

Technical data

Engine identification

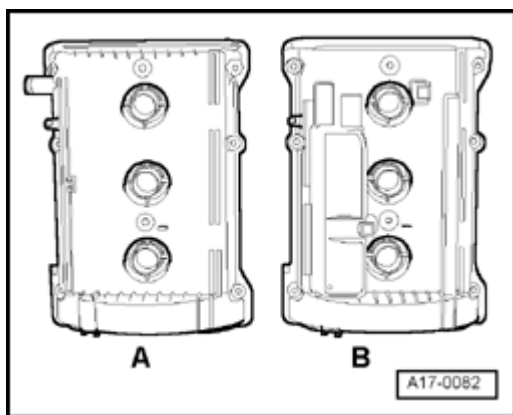
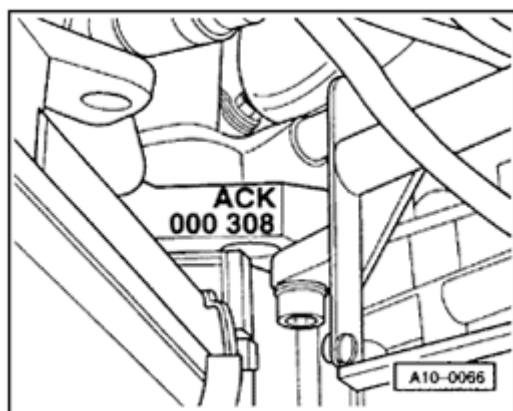
- A** The engine code and serial number are located on the flat surface of the cylinder block in front of the right cylinder head.

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

Identifying engine with modified oil pump (engine code AHA)

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

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



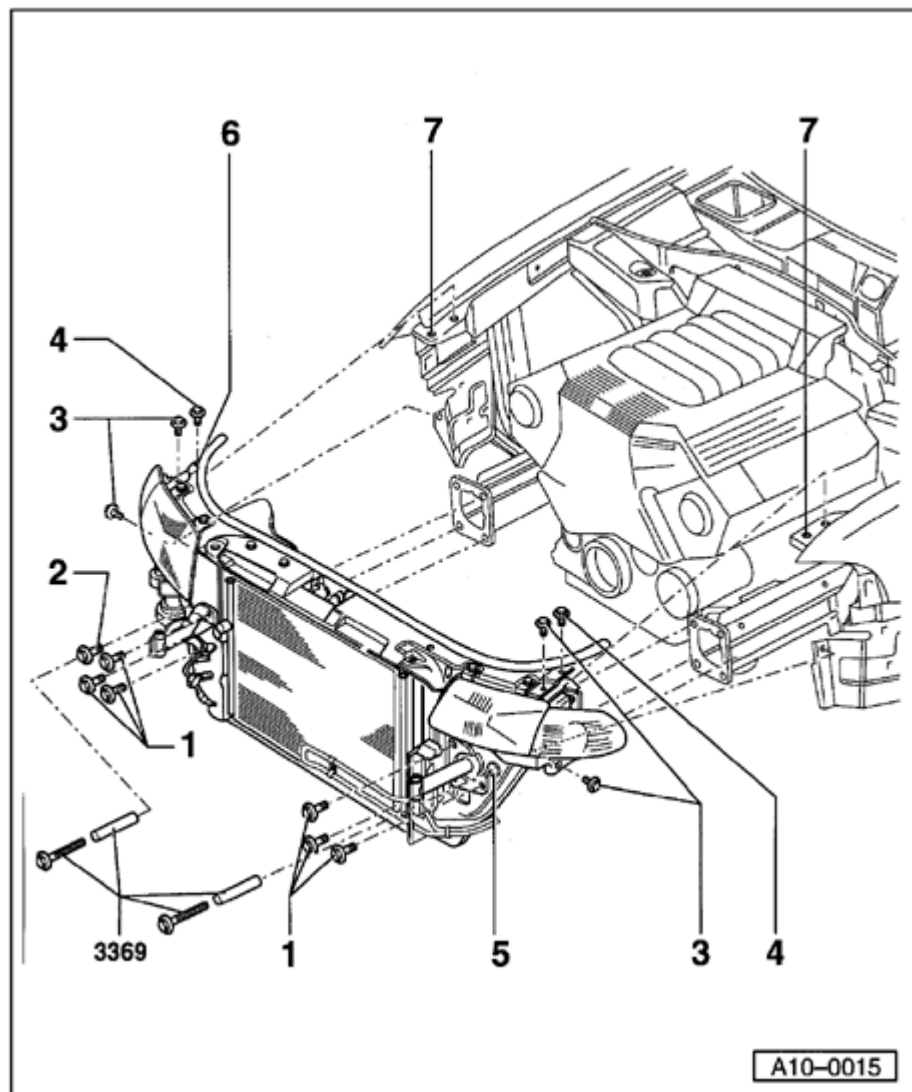
Engine specifications

Engine code		AHA	ATQ
Manufactured		02/97 ➤	
Displacement	liters (cm3)	2771	2771
Output	kw @ RPM	142/6000	142/6000
	HP @ RPM	190/6000	193/6000
Torque	Nm @ RPM	280/3200	280/3200
	Ft lb @ RPM	207/3200	207/3200
Bore diameter	mm (in.)	82.5 (3.25)	82.5 (3.25)
Stroke	mm (in.)	86.4 (3.40)	86.4 (3.40)
Compression ratio		10.6:1	9.9:1
RON	minimum	98 unleaded 1)	
Fuel injection and ignition system		Bosch Motronic	
Knock sensor control		Yes	Yes
On Board Diagnostic (OBD)		Yes	Yes
Oxygen sensor control		Yes	Yes
1) In emergencies, fuel with a RON of 95 may be used. Engine performance will be diminished.			

00-3

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

13-1



Engine, disassembling and assembling

Lock carrier, moving into service position

Special tools and equipment

3369 support tool

1 - Bolts

◆ 45 Nm (33 ft lb)

2 - Bolts

◆ 45 Nm (33 ft lb)

3 - Bolts

◆ 10 Nm (7 ft lb)

4 - Bolts

◆ 10 Nm (7 ft lb)

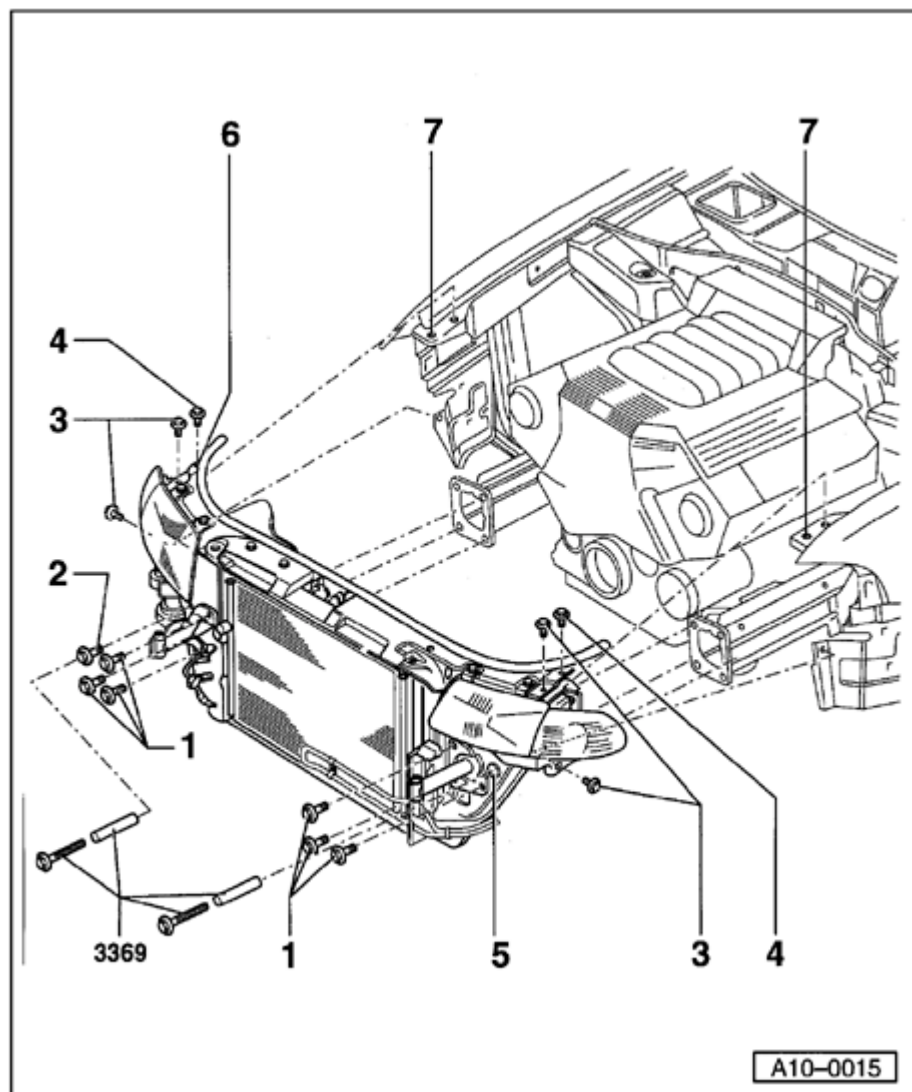
5 - Bore

◆ For 3369 support tool

6 - Lock carrier bore

7 - Fender bore

13-2

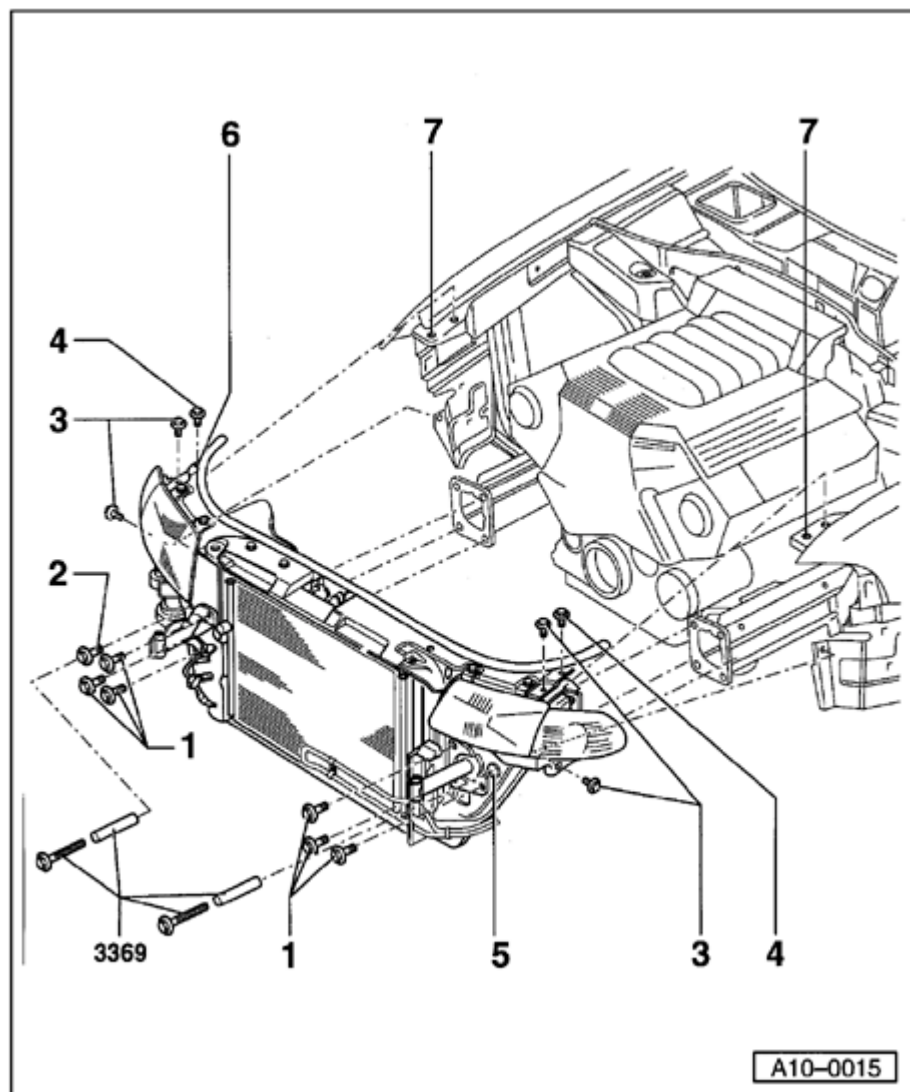


- Remove front bumper.

⇒ [Repair Manual, Body Exterior, Repair Group 63](#)

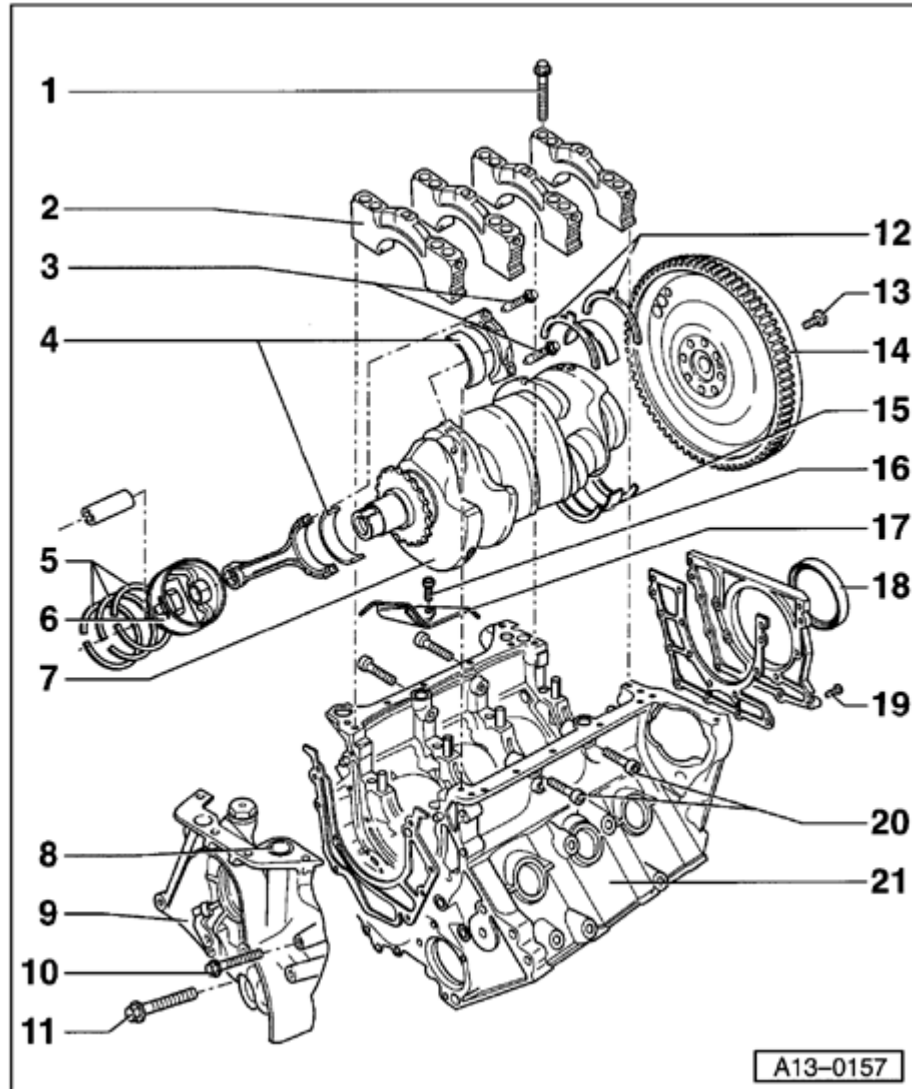
- Remove 3 quick-release screws on front of noise insulation panel.
- Unbolt air guide between lock carrier and air cleaner at lock carrier.
- If installed, remove retaining clamps for wiring harness on left side of radiator frame.
- Remove bolt -2- and install 3369 support tool.
- Install 3369 support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

13-3



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

⇒ [Repair Manual, Body Exterior, Repair Group 63](#)



Cylinder block, crankshaft and flywheel, servicing

Notes:

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

1 - Main bearing cap bolts

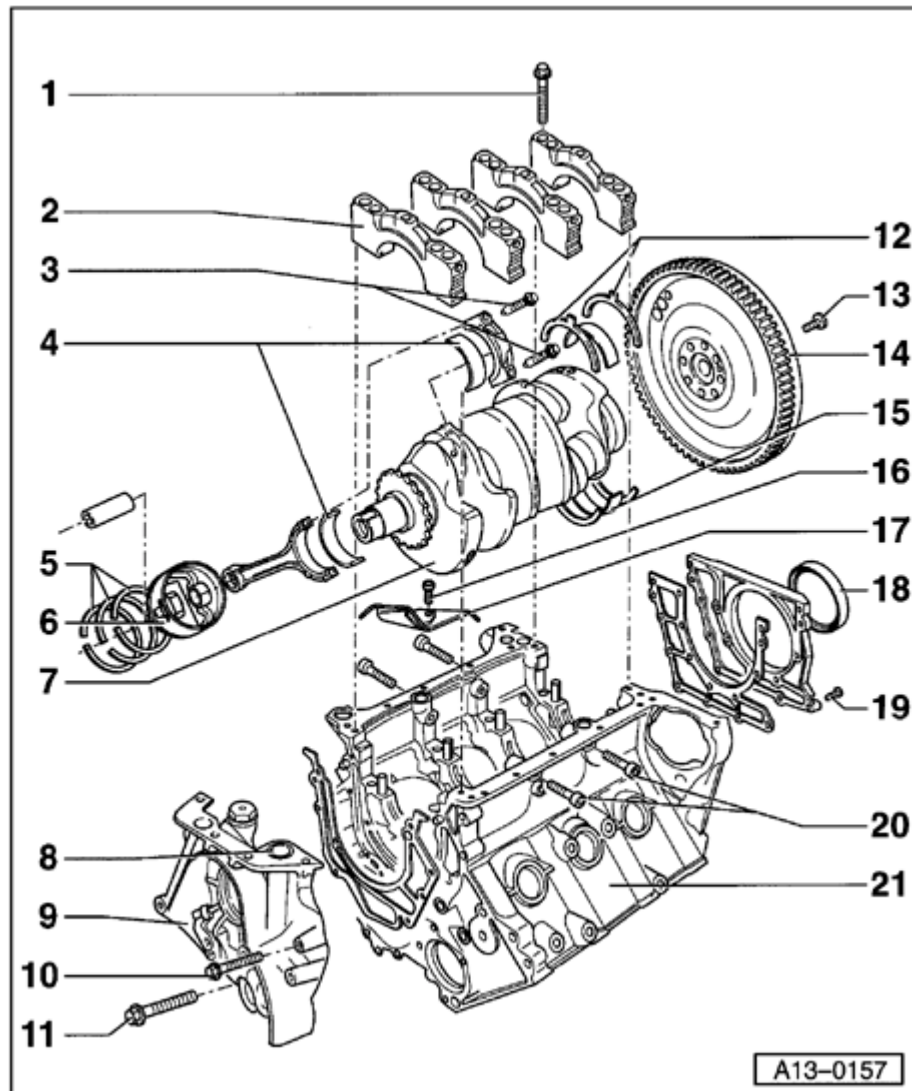
- ◆ Always replace
- ◆ 60 Nm (44 ft lb) + additional 180° (1/2 turn)

2 - Main bearing caps

- ◆ Always replace bolts
- ◆ Marking -1- on oil pump side
- ◆ Checking bearing clearance ⇒ [page 13-25](#)

3 - Connecting rod bearing bolts

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



4 - Connecting rod bearings

- ◆ Do not interchange used bearing shells
- ◆ Connecting rods, connecting rod bearings
⇒ [page 13-33](#)

5 - Piston rings

- ◆ Checking ⇒ [page 13-29](#)

6 - Pistons

- ◆ Checking ⇒ [page 13-29](#)

7 - Crankshaft

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

8 - Oil passage with seal

- ◆ Always replace seal

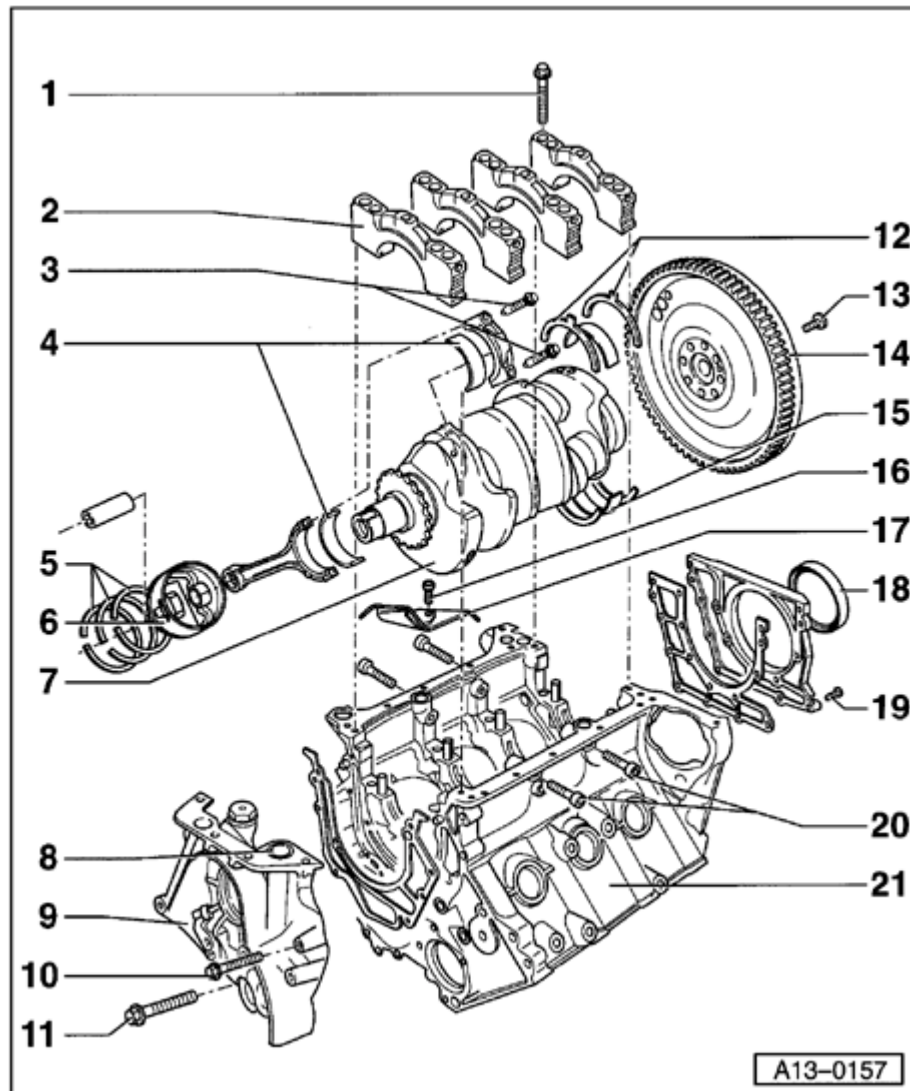
9 - Sealing flange, front

10 - Bolt

- ◆ 10 Nm (7 ft lb)

11 - Collar bolt

◆ 30 Nm (22 ft lb)

**12 - Thrust washer**

- ◆ Measuring crankshaft axial clearance ⇒ [page 13-25](#)
- ◆ Only on 4th crankshaft bearing

13 - Special bolt (12-sided)

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

14 - Dual-mass flywheel or driveplate

- ◆ Removing and installing ⇒ [page 13-22](#)
- ◆ Needle bearing, removing and installing ⇒ [page 13-21](#)

15 - Crankshaft bearing

- ◆ Axial and radial clearance, checking ⇒ [page 13-25](#)

16 - Bolt

- ◆ 10 Nm (7 ft lb)

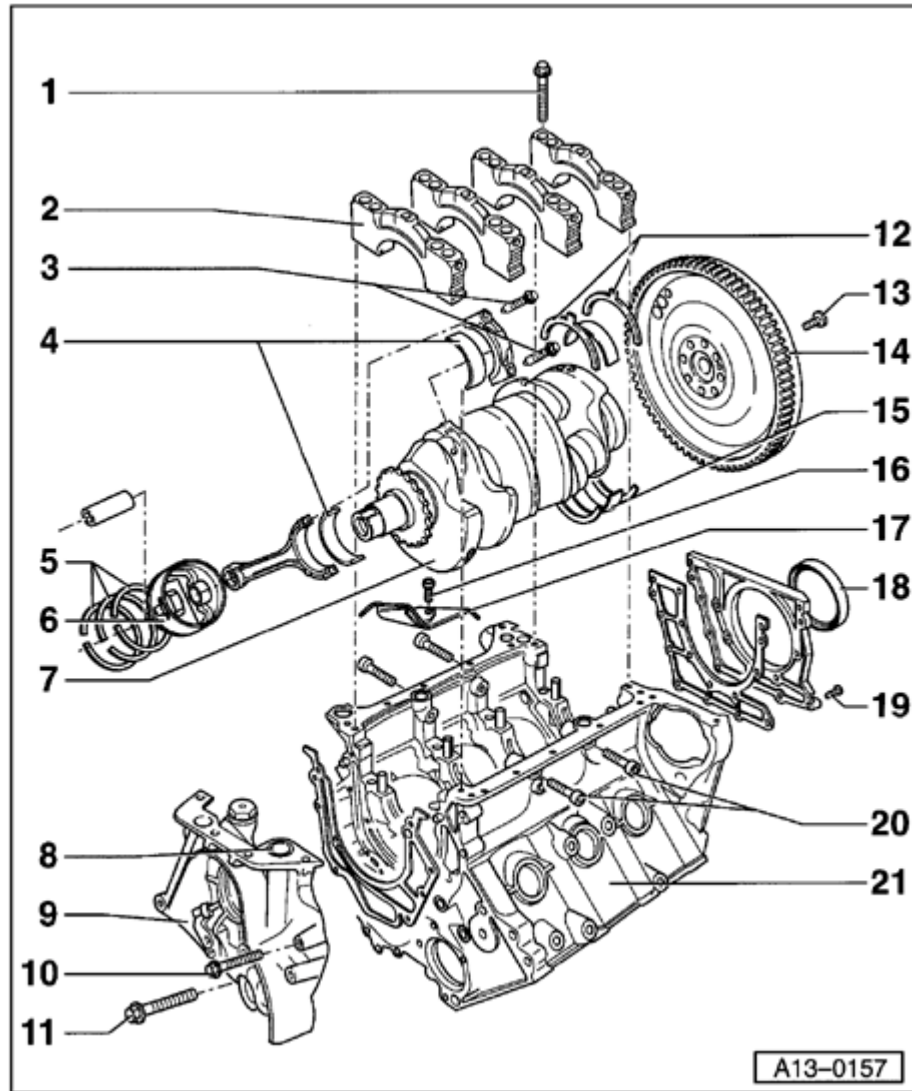
17 - Oil jet

- ◆ To cool pistons

18 - Seal for rear flange

◆ Replacing ⇒ [page 13-18](#)

13-7

**19 - Bolt**

- ◆ 10 Nm (7 ft lb)

20 - Bolt

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

21 - Cylinder block

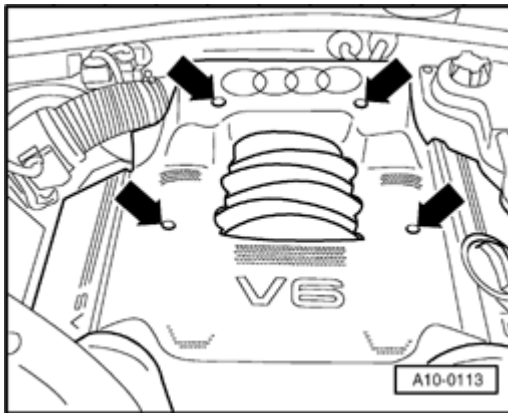
Ribbed belt, removing and installing

- Lock carrier in service position ⇒ [page 13-1](#)

CAUTION!

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

Removing

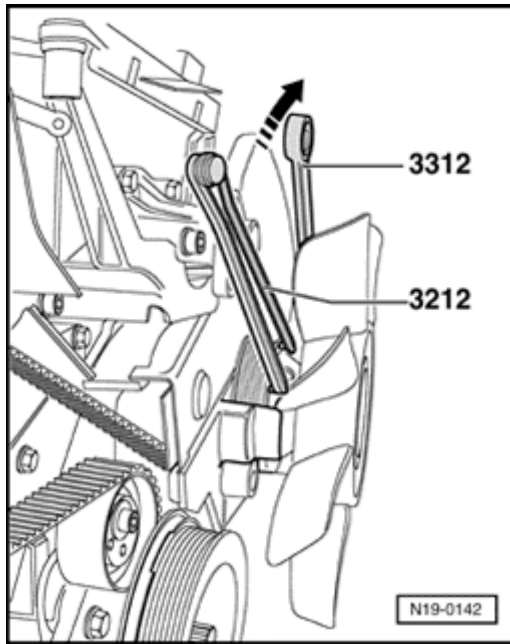


- Remove engine cover (arrows).



- Remove noise insulation panel (arrows).

13-9

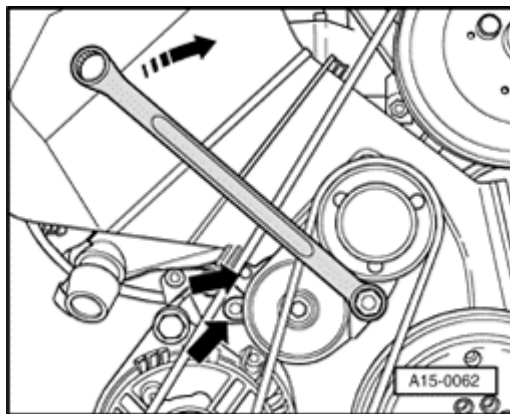


A

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

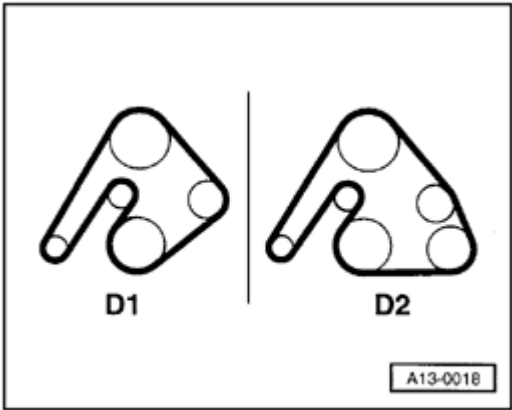
Note:

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



A

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



Installing



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

Note:

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

Routing of ribbed belt:

- D1 - without air conditioning
- D2 - with air conditioning
- Remove 3204 drift.
- Install engine cover.

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

Vibration damper, removing and installing

- Lock carrier in service position ⇒ [page 13-1](#)

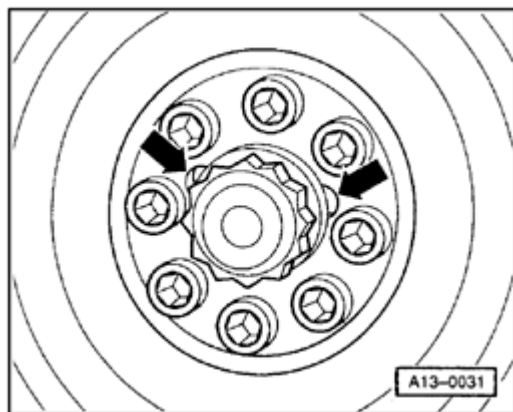
Ribbed belt, removing and installing ⇒ [page 13-8](#).

Note:

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

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

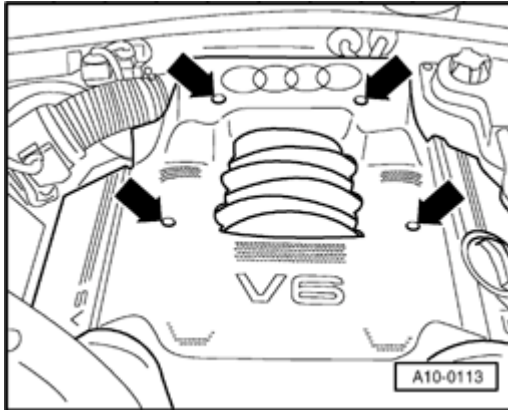
Tightening torque (vibration damper to crankshaft): 20 Nm (15 ft lb)



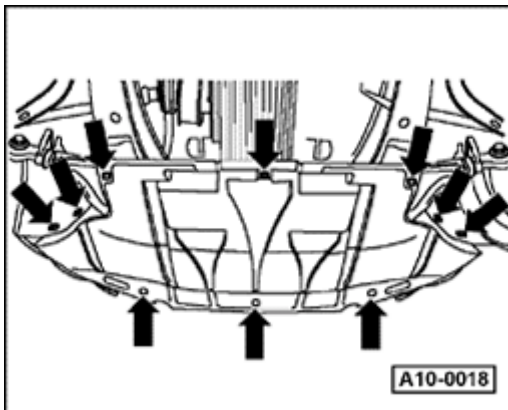
A

Toothed belt, removing and installing

Removing

**A**

- Remove engine cover.

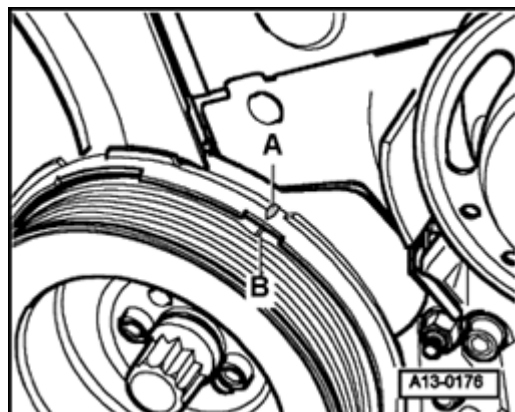
**A**

- Remove noise insulation panel (arrows).
 - Lock carrier in service position ⇒ [page 13-1](#)

Ribbed belt, removing and installing ⇒ [page 13-8](#) .

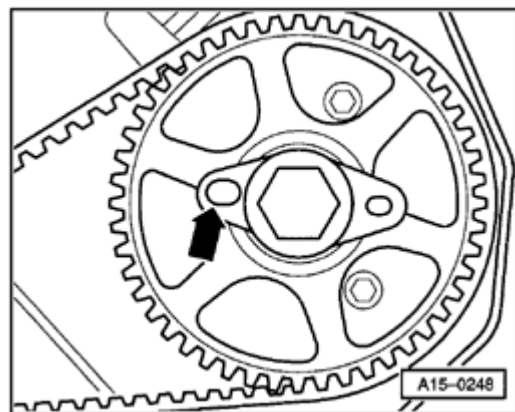
- Unclip toothed belt guard on both sides and remove.

13-13



A

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



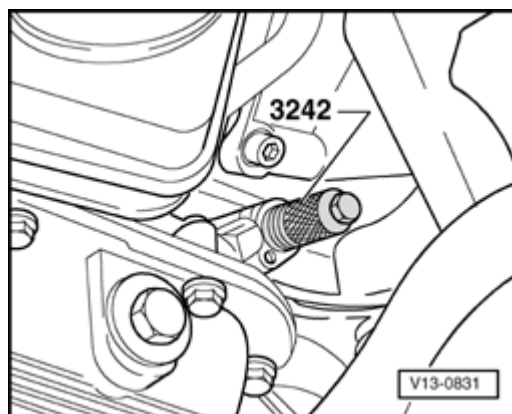
A

- Check position of camshafts. Large holes (arrow) of securing plates on camshaft sprockets must face toward inside and align.
If not, turn crankshaft one revolution further.
- Remove sealing plug from left-side of cylinder block.
- Top Dead Center (TDC) mark on crankshaft must be visible or be felt behind bore of removed sealing plug.

WARNING!

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

13-14



A

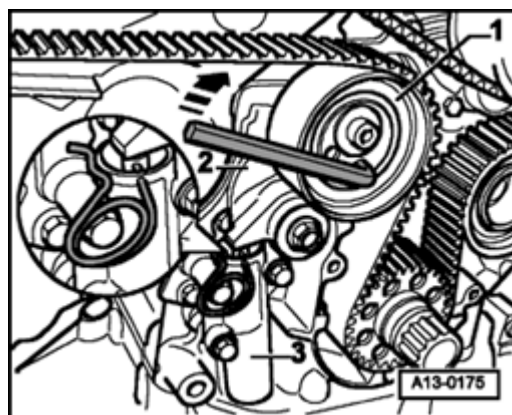
- Install 3242 crankshaft holder into sealing plug opening.
- Remove tensioner for ribbed belt.
- Remove center and right toothed belt guards.

CAUTION!

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

Notes:

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

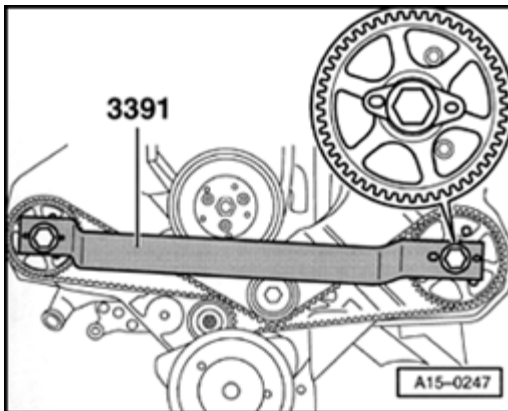
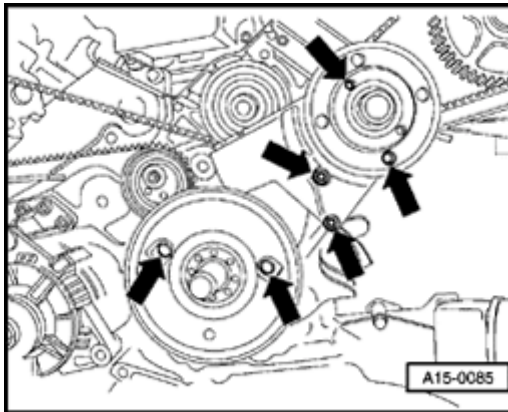


A

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

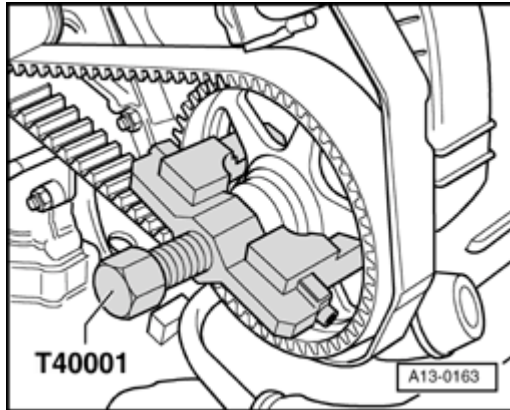
- Insert pin and release tension.
- Remove vibration damper ⇒ [page 13-11](#) .
- ✦ - Remove idler wheel for ribbed belt (arrows).
- Remove toothed belt.

Installing



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

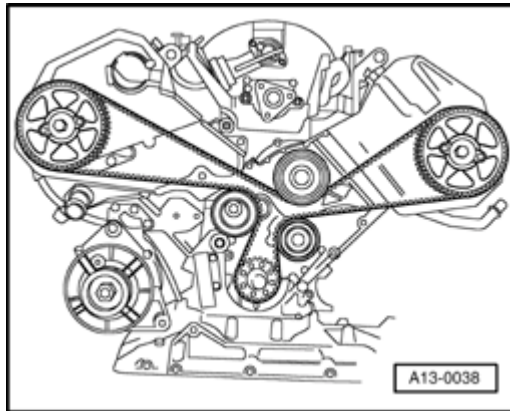
13-16



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

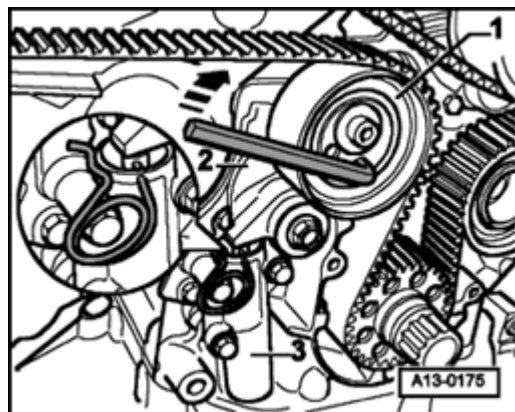
Note:

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



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

13-17



A

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

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

- 1) Always replace the center bolt.
- 2) Two turns of 90° are permissible.

Crankshaft seal, replacing

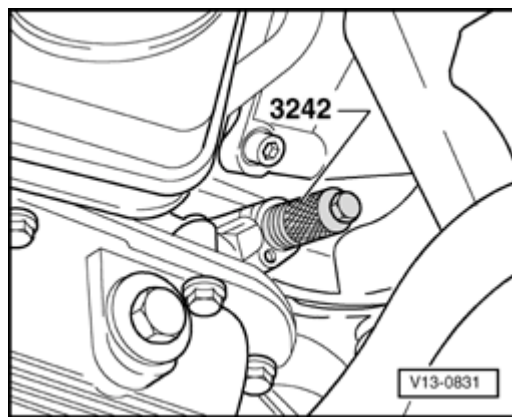
Toothed belt side

- Lock carrier in service position ⇒ [page 13-1](#)

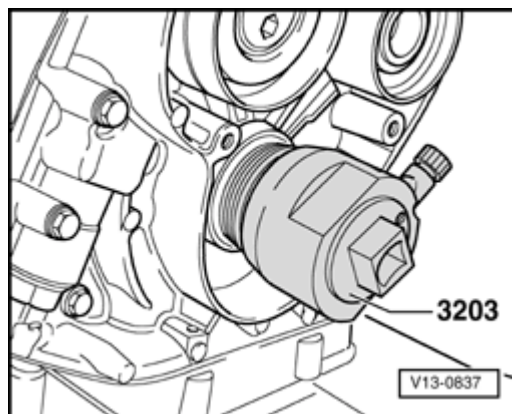
Ribbed belt, removing and installing ⇒ [page 13-8](#) .

Toothed belt, removing and installing ⇒ [page 13-12](#) .

- Remove sealing plug from left-side of cylinder block.
- Turn crankshaft to TDC for cylinder 3. The TDC mark on crankshaft must be visible or felt behind bore for sealing plug.
- Install 3242 crankshaft holder in bore to secure crankshaft.



- Remove crankshaft/toothed belt gear.
- Unscrew inner part of 3203 seal puller two turns (approx. 3 mm) and secure using knurled bolt.

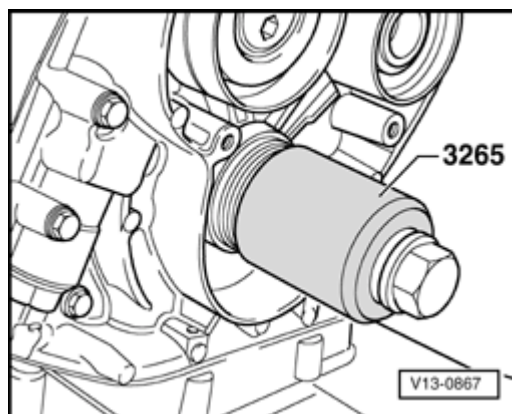


A

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

Installing

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



A

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

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

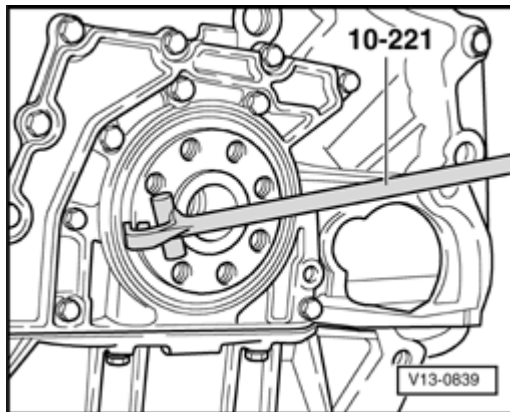
Dual-mass flywheel

Notes:

- ◆ Only replace oil seal with sealing flange.
- ◆ Drain coolant before removing sealing flange ⇒ [page 19-11](#).

If sealing flange is not available, proceed as follows:

- Remove clutch and dual-mass flywheel or driveplate.
- ▲
- Pry out seal using 10-221 extractor.
 - Clean running and sealing surfaces.
 - Push seal onto crankshaft using assembly aid.



Notes:

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

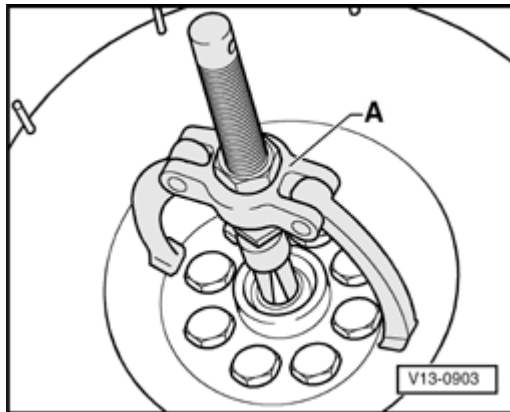


▲

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

13-21

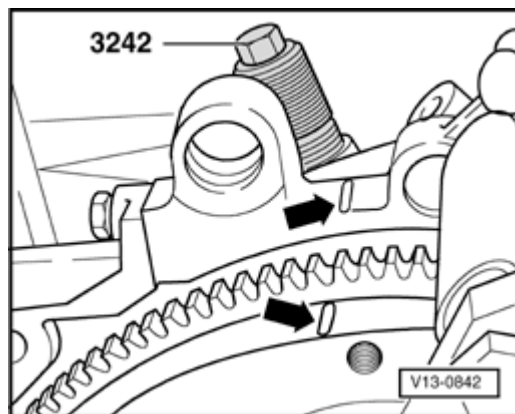
Dual-mass flywheel pilot needle bearing, removing and installing

**A**

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

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

Dual-mass flywheel

**A**

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

Note:

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

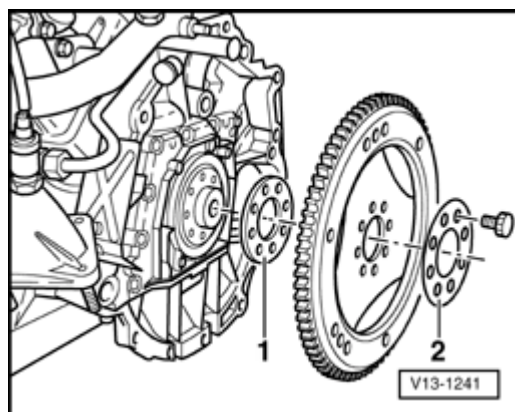
Component	Tightening torque
Dual-mass flywheel to crankshaft	60 Nm (44 ft lb) + 180°
Clutch to dual-mass flywheel	20 Nm (15 ft lb)

Note:

Always replace dual-mass flywheel mounting bolts.

Driveplate

- Hold crankshaft in position using 3242 crankshaft holder ⇒ [page 13-12](#) .
- Mark hole pattern of driveplate, shim -1- and washer -2- to crankshaft.
- Mark positions of shim -1- and washer -2- (behind driveplate).
- Install driveplate with washer -2- (Part No. 035 105 303 A) and shim -1- 3.0 mm (Part No. 054 105 301) or 4.0 mm (Part No. 054 105 202).



CAUTION!

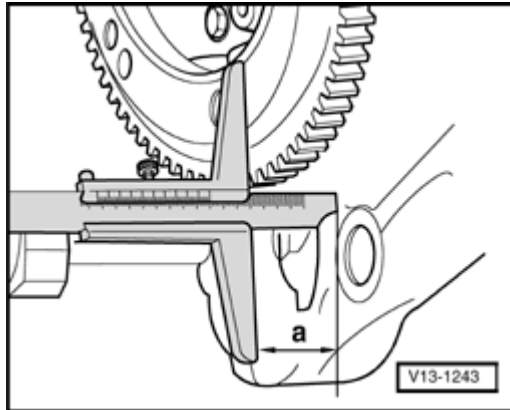
Part numbers are listed here for reference only. Always check with your Parts department for the latest information.

Notes:

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

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

13-24

**A**

- Measure distance -a- at three places and calculate average.
Distance -a-: approx. 12.3 mm.
- If necessary, install different shim.

Note:

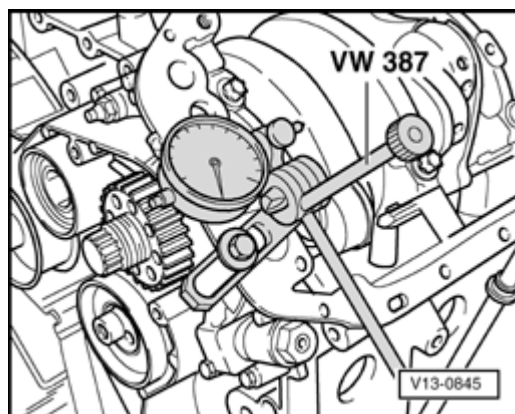
Before installing the engine, make sure the engine to transmission centering sleeves are installed in the engine flange.

Crankshaft axial and radial clearance, measuring

Axial clearance

CAUTION!

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

**A**

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

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

Radial clearance

- Measure radial clearance using Plastigage®.
- Read clearance.

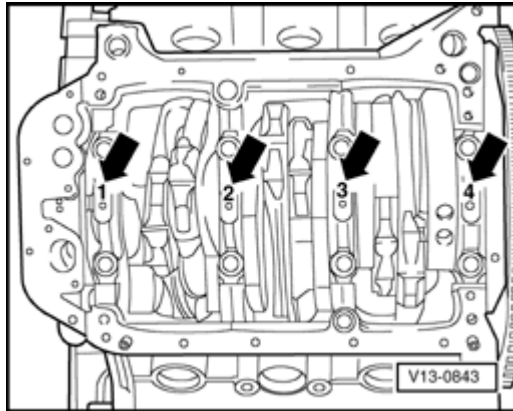
Clearance when new	Wear limit
0.018-0.045 mm (0.0007-0.0018 in.)	0.10 mm (0.0039 in.)

CAUTION!

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

13-27

Crankshaft bearing cap, installing



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

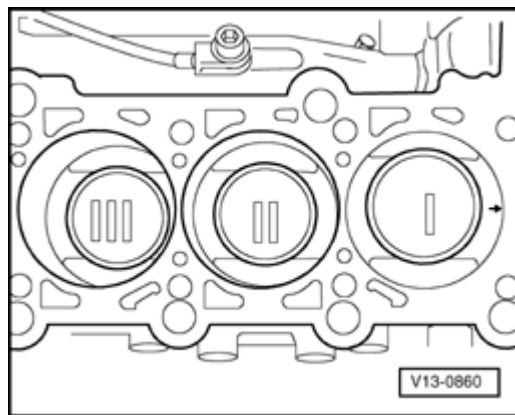
Crankshaft dimensions

Engine codes AHA, ATQ

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

Pistons and piston rings

Pistons

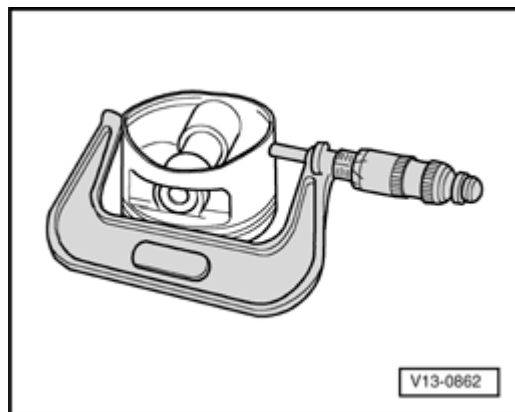


- Installation position: arrow on piston crown must point in driving direction.
- Mark cylinder number on piston crown using waterproof felt pen.

CAUTION!

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

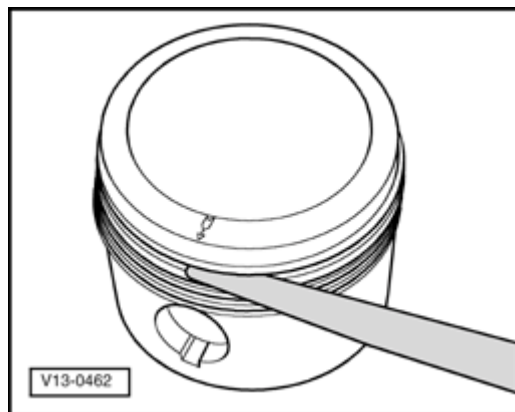
Checking piston diameter



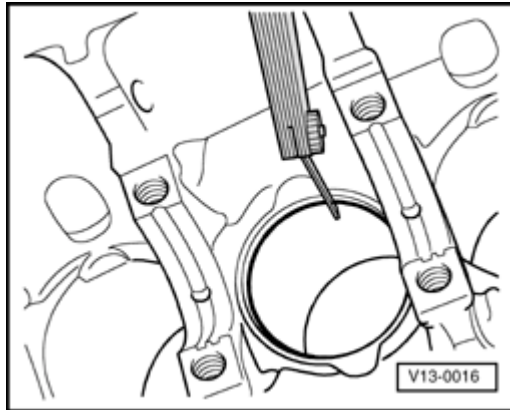
- - Measure pistons approx. 10 mm (3/8 in.) from bottom edge at right angle (90°) to piston pin.
- Deviation from nominal size: 0.04 mm (0.0016 in.).

Piston and cylinder bore dimensions

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

**Checking piston ring side clearance**

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

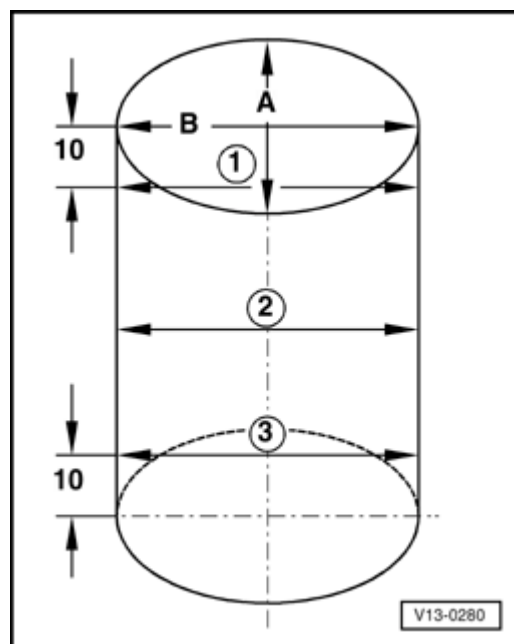


⚡ Checking piston ring end gap

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

Engine codes AHA, ATQ

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



Cylinder bore, checking

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

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

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

Piston and cylinder bore dimensions

Engine codes AHA, ATQ

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

Note:

Replacement pistons are only available in the basic dimension.

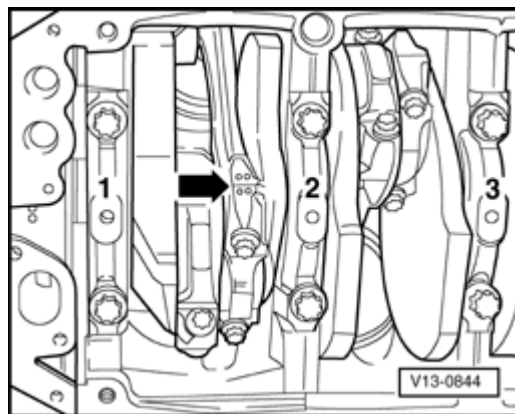
CAUTION!

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

Connecting rod and connecting rod bearings, checking clearance

Notes:

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



A

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

Checking radial clearance

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

CAUTION!

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

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

13-34

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

- Always replace connecting rod bolts.

Valve gear, servicing

WARNING!

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

CAUTION!

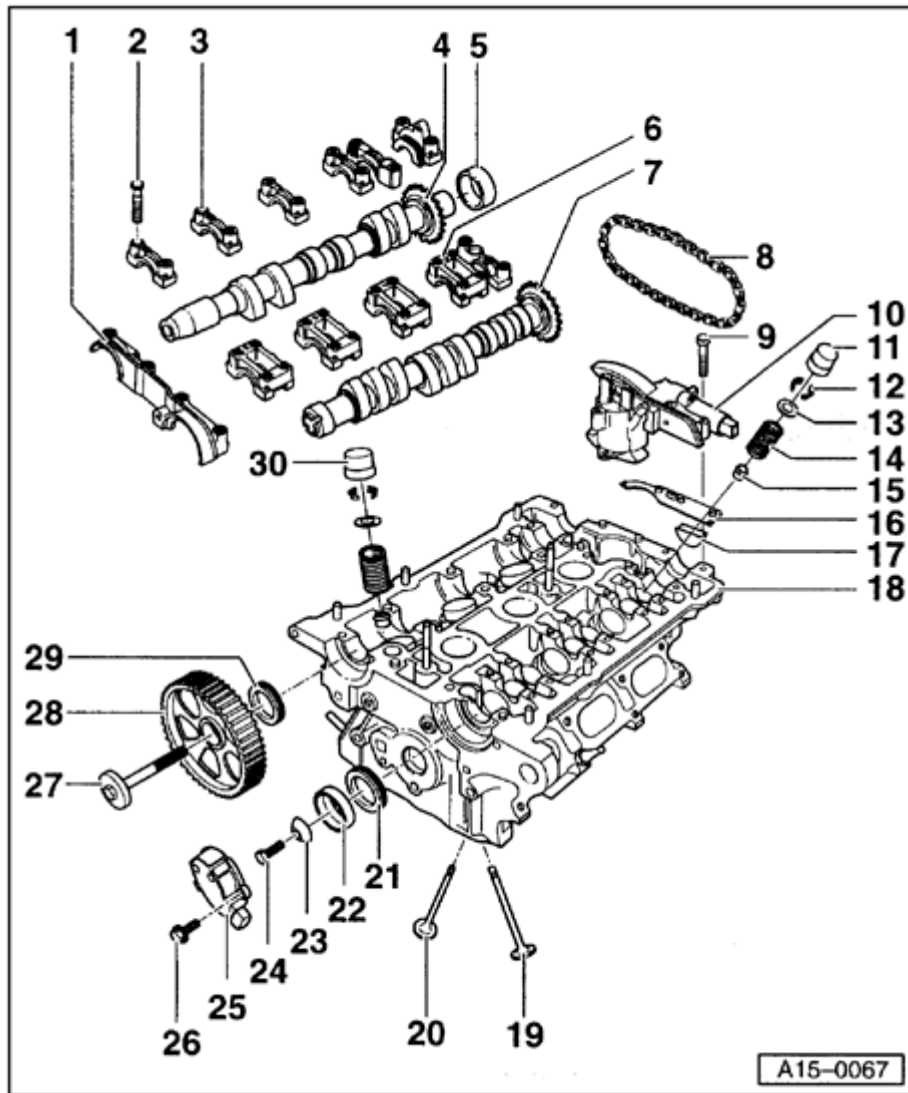
After installing new hydraulic valve lifters the engine must not be started for about 30 minutes (otherwise the valves will strike the pistons). Turn the crankshaft two complete revolutions by hand before starting.

Notes:

- ◆ *Cylinder heads with small cracks between the valve seats that are less than 0.3 mm (0.012 in.) wide and/or between one valve seat and only the first four threads of the spark plug thread, can continue to be used without reduced service life.*
- ◆ *Carefully apply a small amount of sealant D 454 300 A2 at the four end points of the sealing surfaces on the cylinder head using a small screwdriver ⇒ [page 15-13](#) .*

CAUTION!

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



Cylinder head without oil lines to camshaft bearings

1 - Double bearing cap

- ◆ Lightly coat with sealant 454 300 02 A2 before installing ⇒ [page 15-36](#)

2 - Bolt

- ◆ 10 Nm (7ft lb)

3 - Exhaust camshaft bearing cap

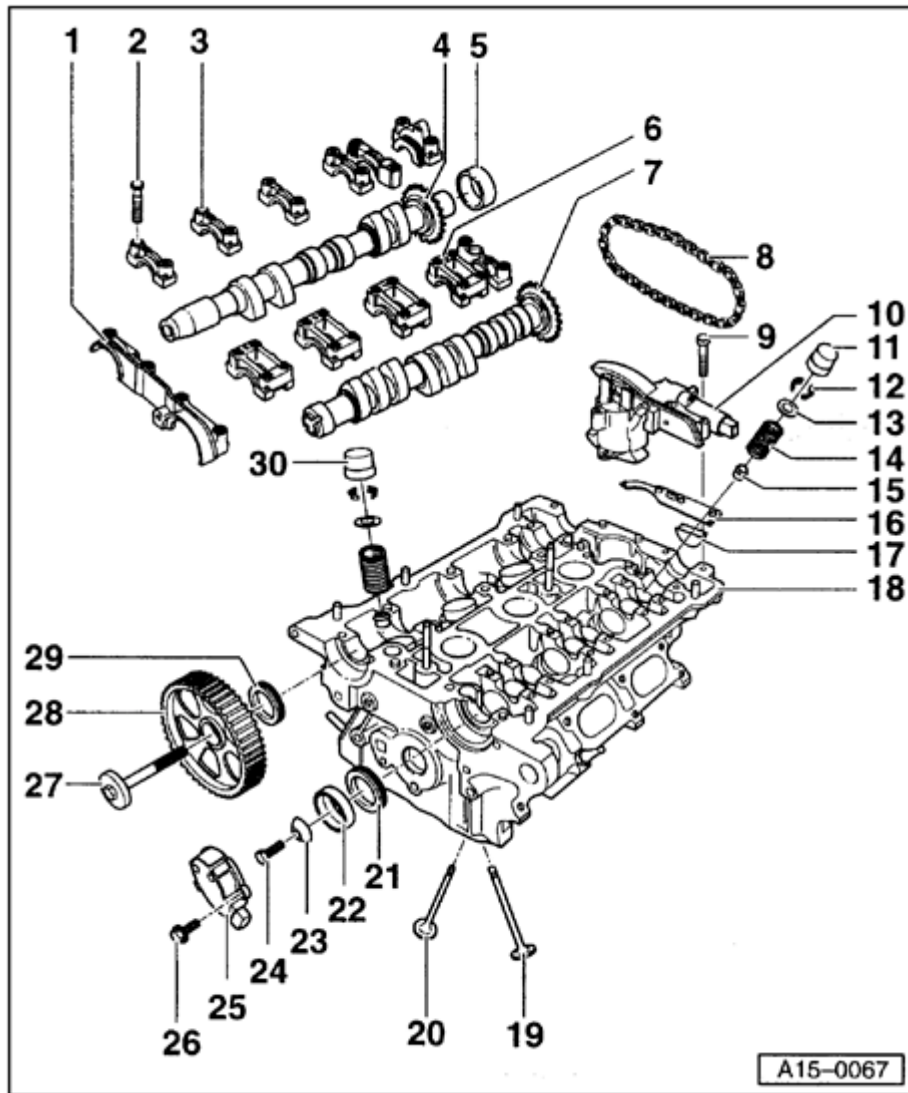
- ◆ Watch guide sleeve
- ◆ Note installation position and numbering ⇒ [page 15-36](#)
- ◆ Lightly coat last bearing cap (after chain) with D454 300 A2 sealant before installing

4 - Exhaust camshaft

- ◆ Checking axial clearance ⇒ [page 15-42](#)
- ◆ Removing and installing ⇒ [page 15-31](#)

Check radial clearance using Plastigage® (hydraulic valve lifters removed):

- ◆ Wear limit: 0.1 mm (0.004 in.)
- ◆ Max. run-out: 0.01 mm (0.0004 in.)



5 - Cap

- ◆ Always replace

6 - Intake camshaft bearing cap

- ◆ Note installation position and numbering ⇒ [page 15-36](#)

7 - Intake camshaft

- ◆ Checking axial clearance ⇒ [page 15-42](#)
- ◆ Removing and installing ⇒ [page 15-31](#)

Check radial clearance using Plastigage® (hydraulic valve lifters removed):

- ◆ Wear limit: 0.1 mm (0.004 in.)
- ◆ Max. run-out: 0.01 mm (0.0004 in.)

8 - Drive chain

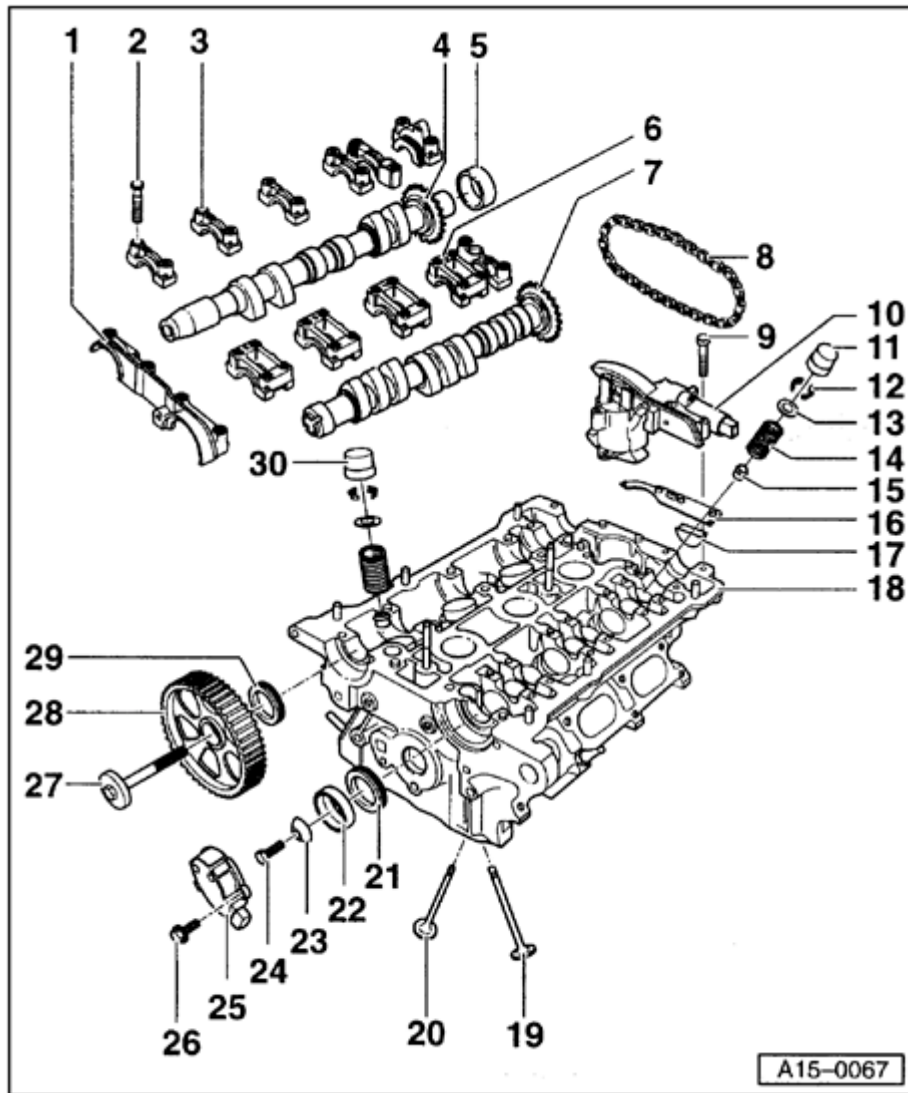
- ◆ Installing ⇒ [page 15-36](#)

9 - Bolt

- ◆ 10 Nm (7ft lb)

10 - Mechanical camshaft adjuster

- ◆ With valve -1- for camshaft adjustment - N205-
- ◆ Secure using 3366 bracket tensioner before removing ⇒ [page 15-31](#)

**11 - Hydraulic valve lifter (intake)**

◆ Notes ⇒ [page 15-45](#)

12 - Valve keepers**13 - Valve spring retainer****14 - Valve spring****15 - Valve stem oil seal**

◆ Replacing with cylinder head installed ⇒ [page 15-47](#)

16 - Rubber/metal seal

◆ Always replace

17 - Seal

◆ Always replace

18 - Cylinder head

◆ Removing and installing ⇒ [page 15-18](#)

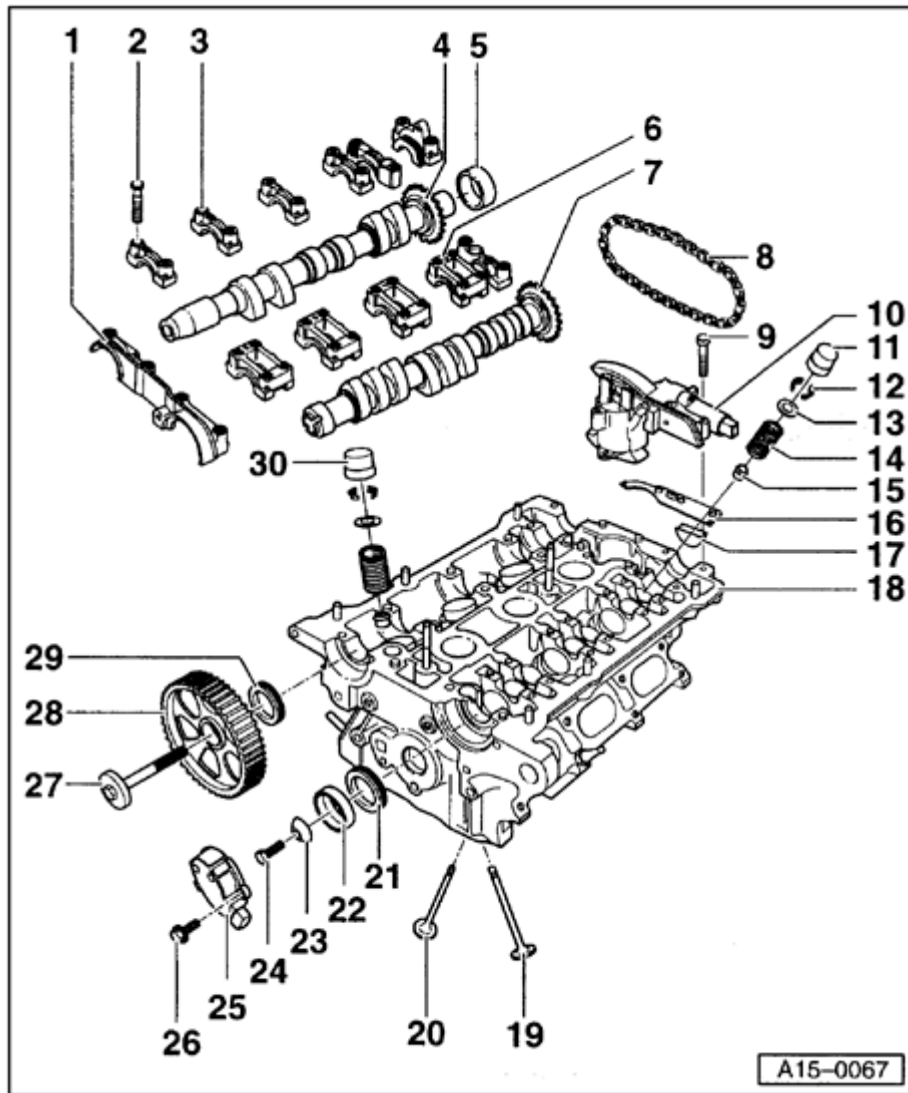
◆ Checking for distortion ⇒ [page 15-27](#)

◆ Resurfacing ⇒ [page 15-28](#)

19 - Exhaust valve**20 - Intake valve****21 - Oil seal**

◆ Camshaft Position (CMP) sensor side

◆ Replacing ⇒ [page 15-14](#)



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

- ◆ Note position (notch on camshaft)

23 - Washer

- ◆ Conical

24 - Bolt

- ◆ 25 Nm (18 ft lb)

25 - Camshaft Position (CMP) sensor -G40-

26 - Bolt

- ◆ 10 Nm (7 ft lb)

27 - Bolt

- ◆ 55 Nm (41 ft lb)

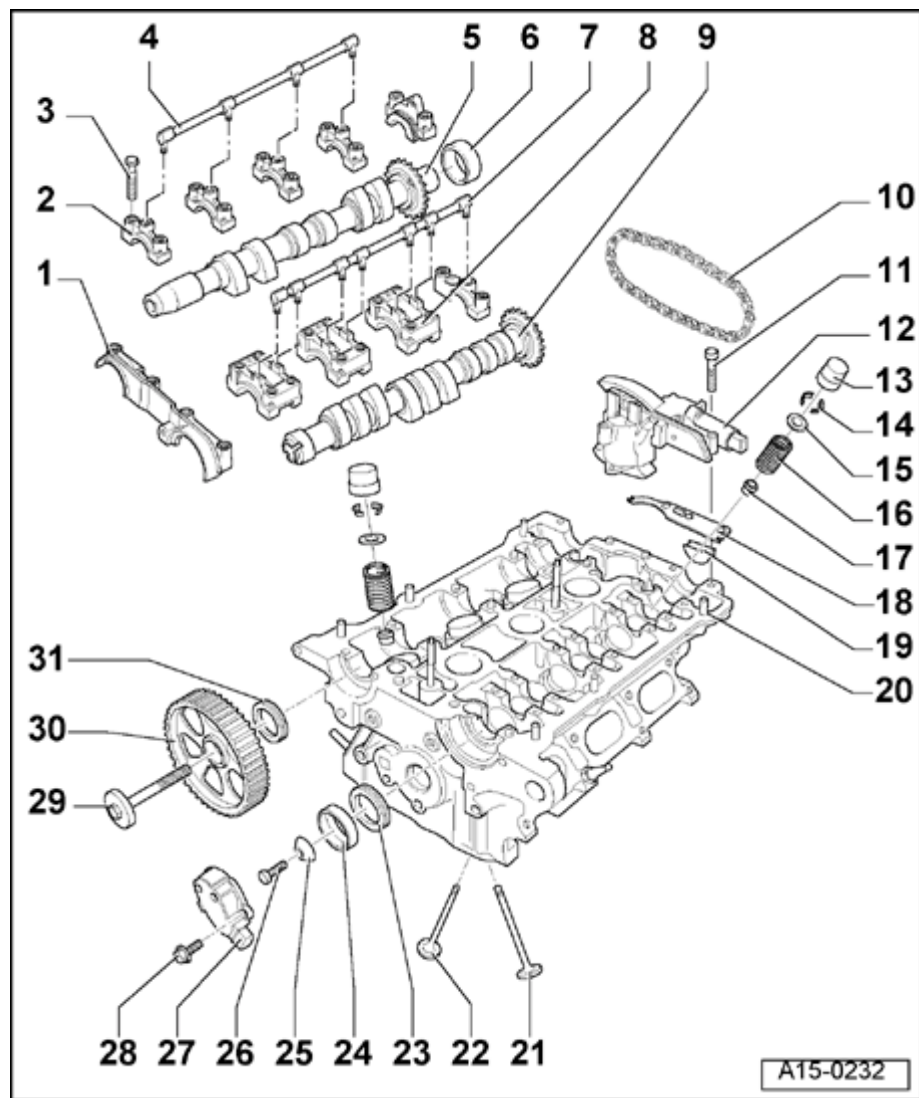
28 - Camshaft sprocket

29 - Oil seal

- ◆ Toothed belt side
- ◆ Replacing ⇒ [page 15-14](#)

30 - Hydraulic valve lifter

- ◆ Notes ⇒ [page 15-45](#)
- ◆ Removing and installing with cylinder head installed ⇒ [page 15-31](#)



Cylinder head with oil lines to camshaft bearings

1 - Double bearing cap

- ◆ Lightly coat with 454 300 02 A2 sealant before installing ⇒ [page 15-17](#)

2 - Exhaust camshaft bearing cap

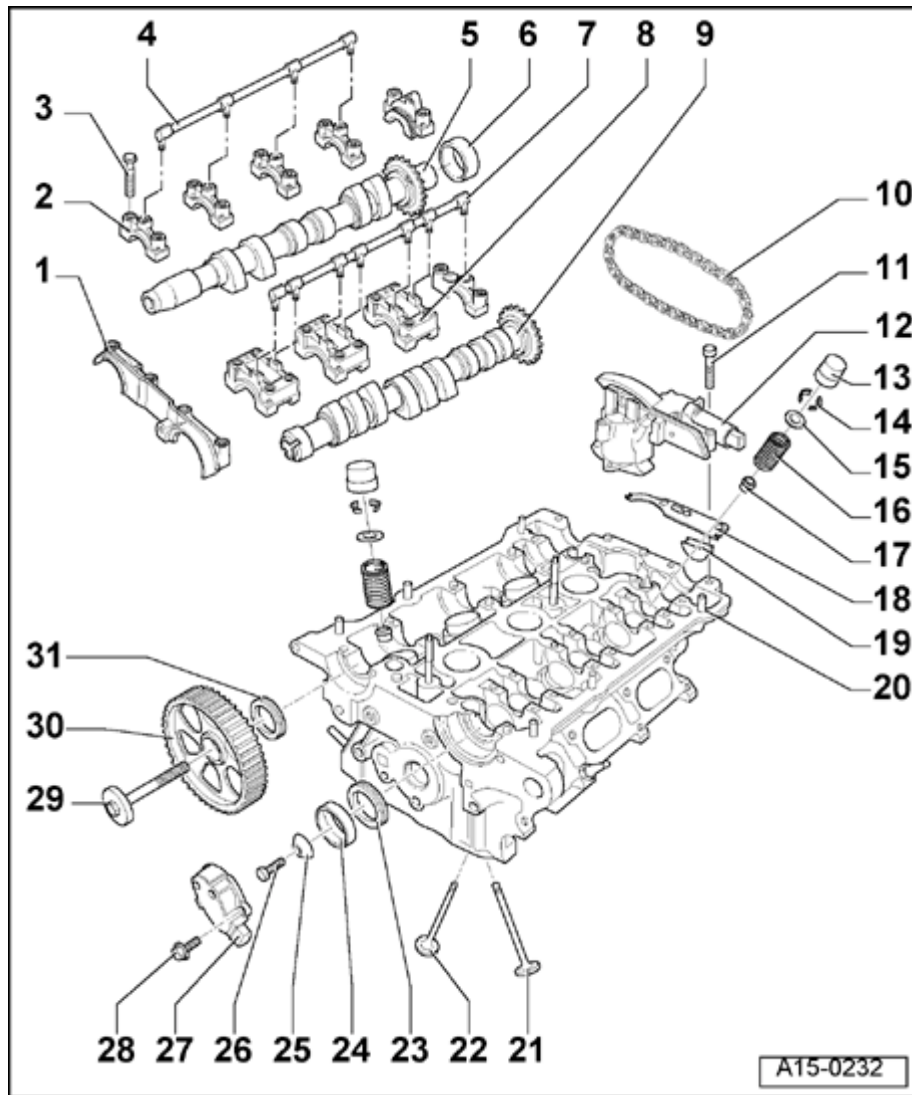
- ◆ With oil line connector
- ◆ Watch guide sleeve
- ◆ Note installation position and numbering ⇒ [page 15-31](#)
- ◆ Lightly coat last bearing cap (after chain) with D454 300 A2 sealant before installing

3 - Bolt

- ◆ 10 Nm (7 ft lb)

4 - Oil line

- ◆ Exhaust side
- ◆ From VIN 8D-W-005 001
- ◆ For bearing cap lubrication
- ◆ Note installed position ⇒ [Fig. 4](#)



5 - Exhaust camshaft

- ◆ Checking axial clearance ⇒ [page 15-42](#)
- ◆ Removing and installing ⇒ [page 15-31](#)

Check radial clearance using Plastigage® (hydraulic valve lifters removed):

- ◆ Wear limit: 0.1 mm (0.004 in.)
- ◆ Max. run-out: 0.01 mm (0.0004 in.)

6 - Cap

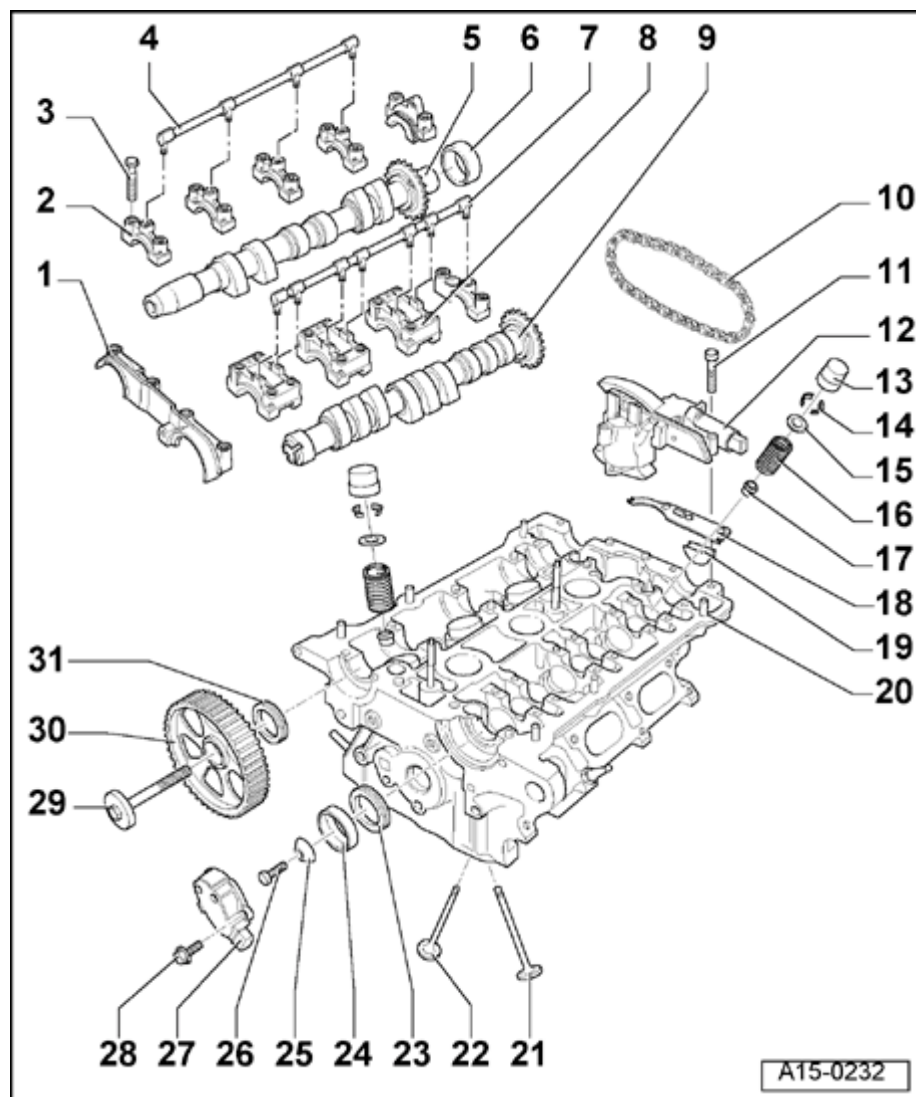
- ◆ Always replace

7 - Oil line

- ◆ Intake side
- ◆ From VIN 8D-W-005 001
- ◆ Note installed position ⇒ [Fig. 3](#)
- ◆ For bearing cap lubrication

8 - Intake camshaft bearing cap

- ◆ With oil line connector
- ◆ Note installation position and numbering ⇒ [page 15-36](#)



9 - Intake camshaft

- ◆ Checking axial clearance ⇒ [page 15-42](#)
- ◆ Removing and installing ⇒ [page 15-31](#)

Check radial clearance using Plastigage® (hydraulic valve lifters removed):

- ◆ Wear limit: 0.1 mm (0.004 in.)
- ◆ Max. run-out: 0.01 mm (0.0004 in.)

10 - Drive chain

- ◆ Installing ⇒ [page 15-36](#)

11 - Bolt

- ◆ 10 Nm (7ft lb)

12 - Mechanical camshaft adjuster

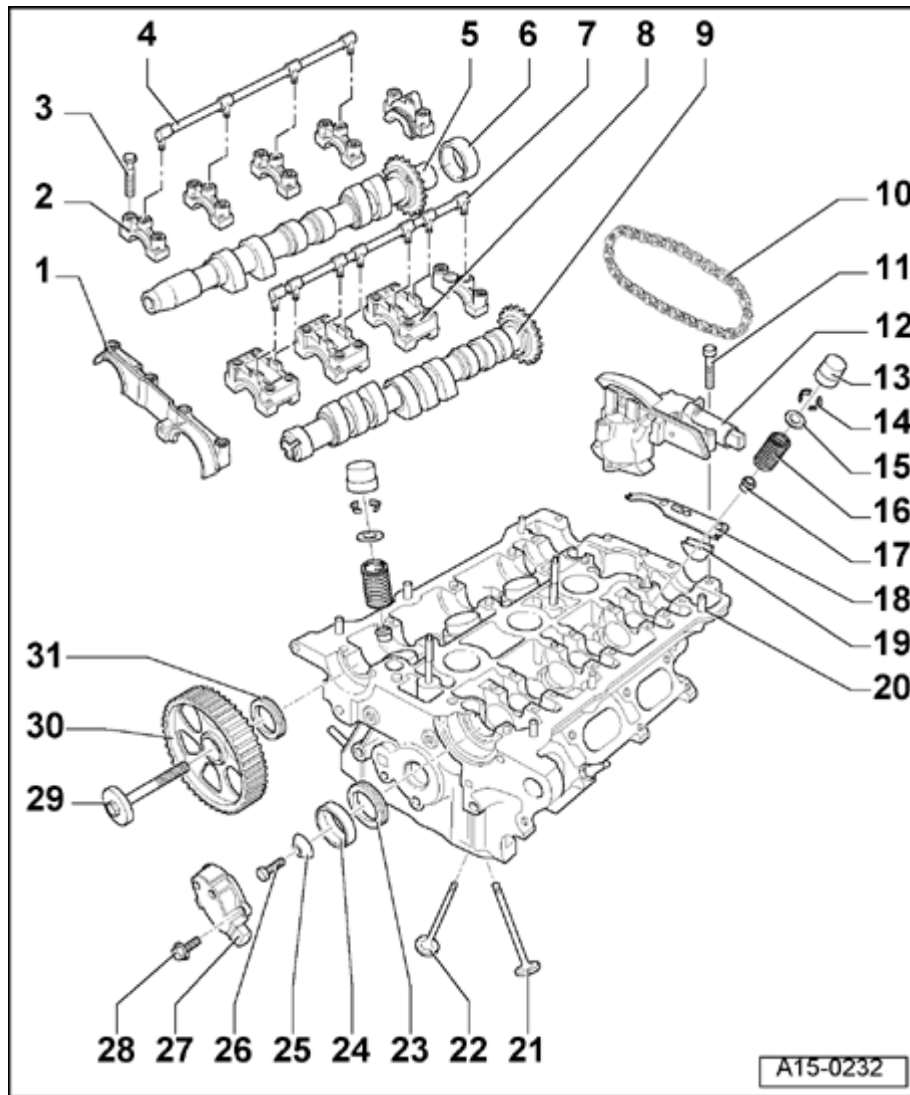
- ◆ With valve -1- for camshaft adjustment - N205-
- ◆ Secure using 3366 bracket tensioner before removing ⇒ [page 15-31](#)

13 - Hydraulic valve lifter (intake)

- ◆ Refer to notes ⇒ [page 15-45](#)
- ◆ Removing and installing with cylinder head installed ⇒ [page 15-31](#)

14 - Valve keepers

15-10

**15 - Valve spring retainer****16 - Valve spring****17 - Valve stem oil seal**

- ◆ Replacing with cylinder head installed ⇒ [page 15-47](#)

18 - Rubber/metal seal

- ◆ Always replace

19 - Seal

- ◆ Always replace

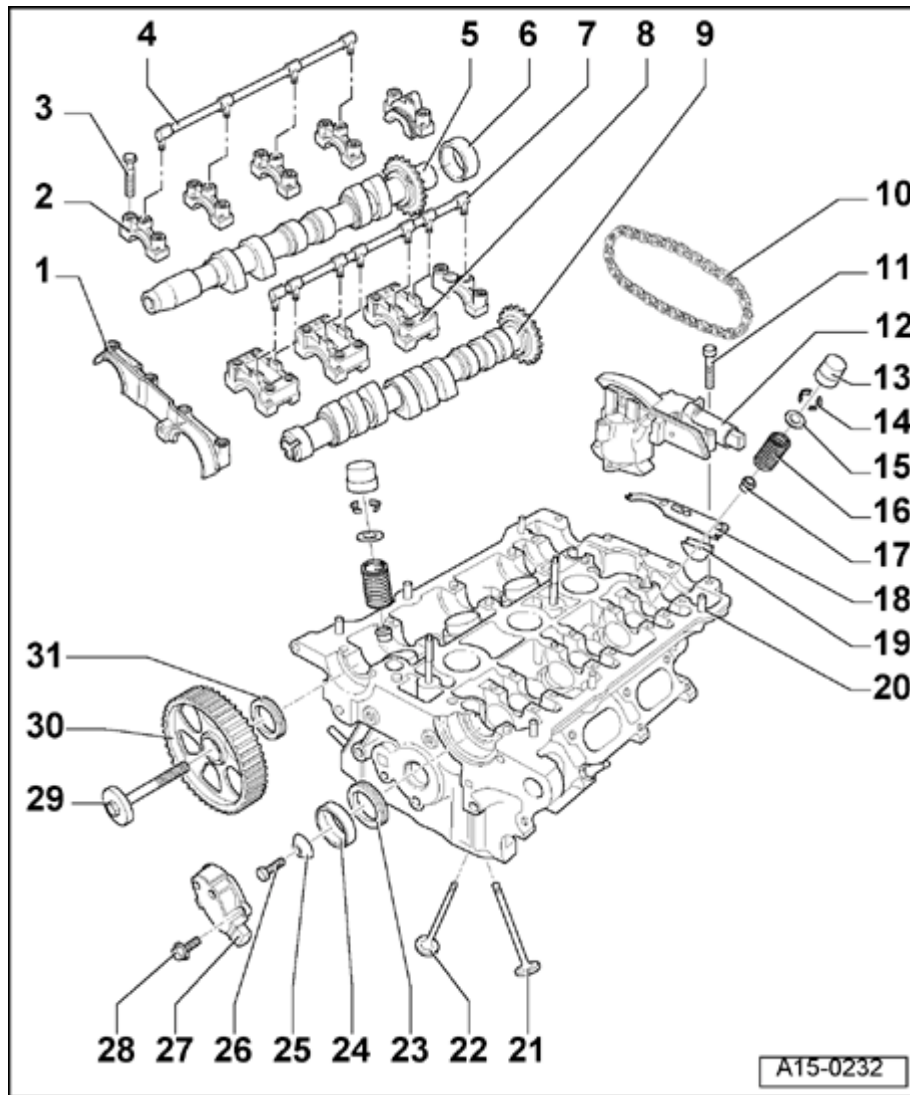
20 - Cylinder head

- ◆ Removing and installing ⇒ [page 15-18](#)
- ◆ Checking for distortion ⇒ [page 15-27](#)
- ◆ Resurfacing ⇒ [page 15-28](#)

21 - Exhaust valve**22 - Intake valve****23 - Oil seal**

- ◆ Camshaft Position (CMP) sensor side
- ◆ Replacing ⇒ [page 15-14](#)

15-11



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

- ◆ Note position (notch on camshaft)

25 - Washer

- ◆ Conical

26 - Bolt

- ◆ 25 Nm (18 ft lb)

27 - Camshaft Position (CMP) sensor -G40-

28 - Bolt

- ◆ 10 Nm (7 ft lb)

29 - Bolt

- ◆ 55 Nm (41 ft lb)

30 - Camshaft sprocket

31 - Oil seal

- ◆ Toothed gear side
- ◆ Replacing ⇒ [page 15-14](#)

Cylinder head with oil lines on the camshaft bearings

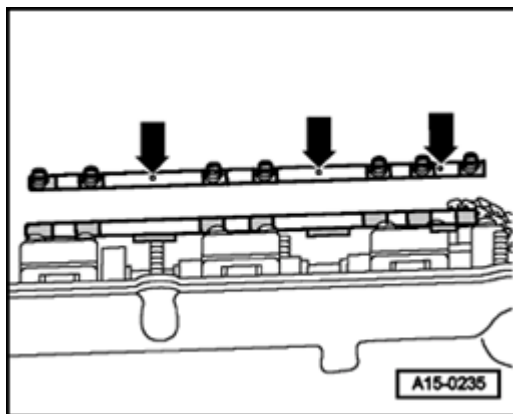


Fig. 3 Installation position of intake camshaft oil line

If connectors are misaligned, oil line bores are exposed (arrows).

- To install correctly, turn oil line 180° and slide connectors over bores.

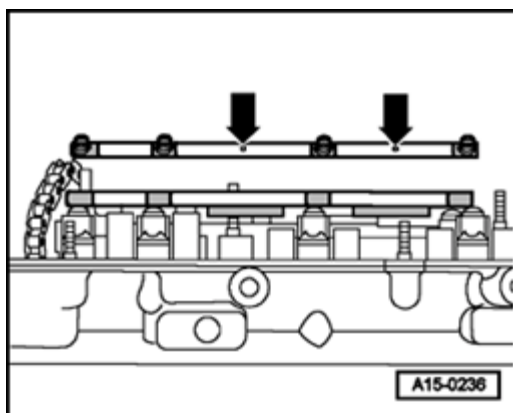


Fig. 4 Installation position of exhaust camshaft oil line

If connectors are misaligned, oil line bores are exposed (arrows).

- To install correctly, turn oil line 180° and slide connectors over bores.

CAUTION!

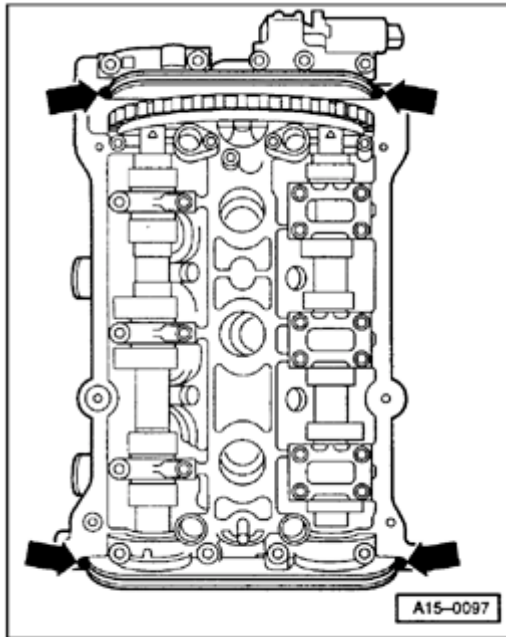
If the oil lines are incorrectly installed, the camshaft bearings will not be lubricated and the cylinder head will have to be replaced.

All models**Sealing contact surfaces between bearing cap and cylinder head**

- Carefully apply small amount of sealant D 454 300 A2 at four end points of sealing surfaces on cylinder head (arrows) using small screwdriver.

CAUTION!

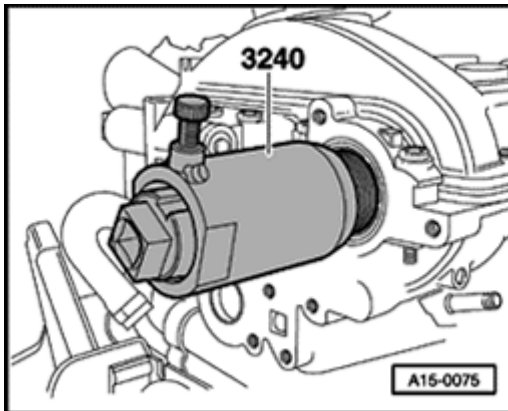
Part numbers are listed here for reference only. Always check with your Parts department for the latest information.



Cylinder head oil seals, replacing

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

- Rotate engine to Top Dead Center (TDC).
- Remove toothed belt ⇒ [page 13-12](#) .
- Remove rear toothed belt guard.

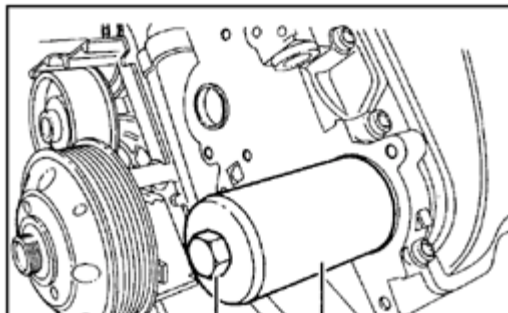
**A**

- Remove seal using 3240 seal extractor.
- Clean contact surface and sealing surface.

Note:

Do not apply oil to sealing lip or outer circumference of seal.

- Install 3241/2 pull sleeve from 3241/1 press sleeve onto camshaft.

**A**

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

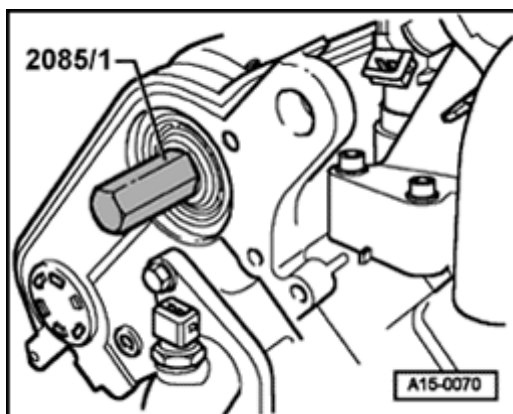
Oil seal on Camshaft Position (CMP) sensor (left and right cylinder head)

- Unbolt Camshaft Position (CMP) sensor.

Tightening torque: 10 Nm (7 ft lb)

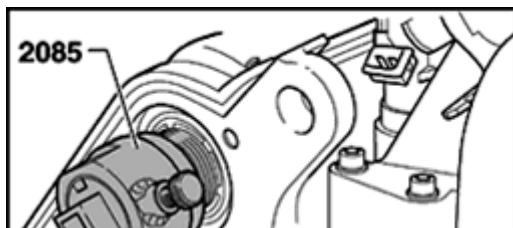
- Unbolt shutter wheel for Camshaft Position (CMP) sensor and carefully pry out using screwdriver.

Tightening torque: 20 Nm (15 ft lb)



A

- Screw in bolt from 2085/1 adapter.



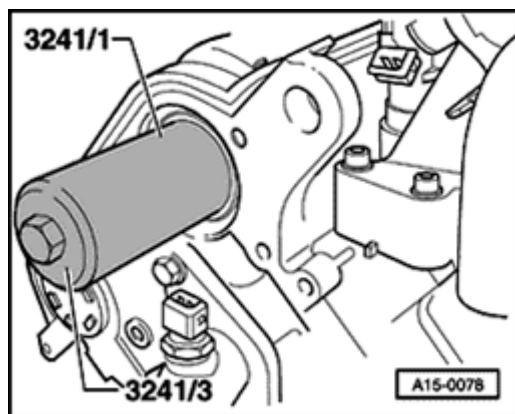
A

- Remove seal using 2085 seal puller and bolt from 2085/1.
- Clean contact surface and sealing surface.

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

- Install pull sleeve from 3241 seal installer onto camshaft.

15-16



A

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

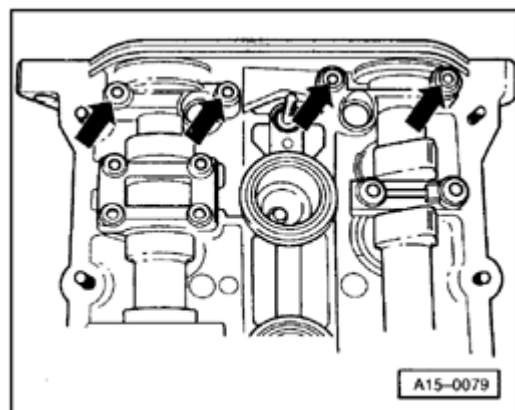
Rear sealing flange (left cylinder head)

The sealing flange and rear oil seal on the left cylinder head must be replaced together as follows:

- Unbolt engine coolant expansion tank from bracket.
- Remove crankshaft ventilation line from cylinder head cover.
- Unbolt Camshaft Position (CMP) sensor.

Tightening torque: 10 Nm (7 ft lb)

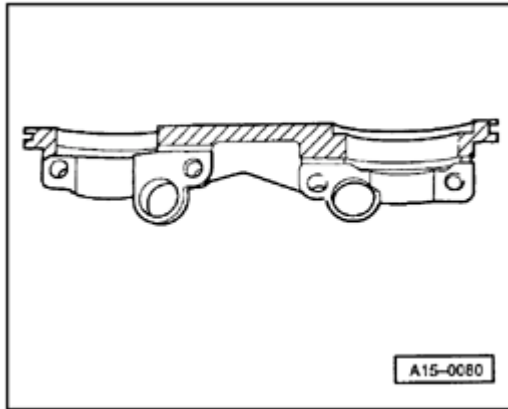
- Unbolt shutter wheel for Camshaft Position (CMP) sensor G40 and carefully pry out using screwdriver.
- Remove cylinder head cover.



A

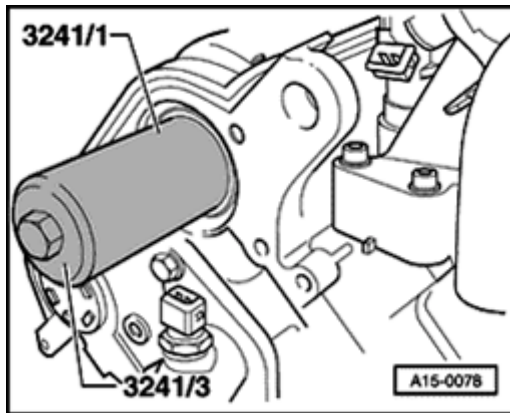
- Remove double bearing cap (arrows).
- Remove seal and sealing flange.
- Clean running and sealing surfaces as well as contact surface of double bearing cap.

15-17



A

- Apply thin coat of sealant 454 300 A2 to hatched areas on double bearing cap, install and tighten to 10 Nm (7 ft lb).
- Install pull sleeve from 3241 seal installer onto camshaft.



A

- Press seal flush using 3241/1 press sleeve and 3241/3 bolt.
- Carefully drive in sealing flange to stop using 3202 retractor and plastic hammer.

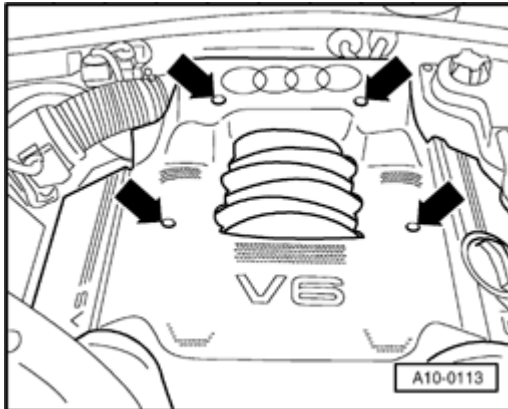
Cylinder head, removing and installing

Note:

The following instructions apply to the left cylinder head.

Removing

- Lock carrier in service position ⇒ [page 13-1](#).
- Remove ribbed belt ⇒ [page 13-8](#).
- Remove toothed belt ⇒ [page 13-12](#).
- A** - Remove engine cover (arrows).

**A**

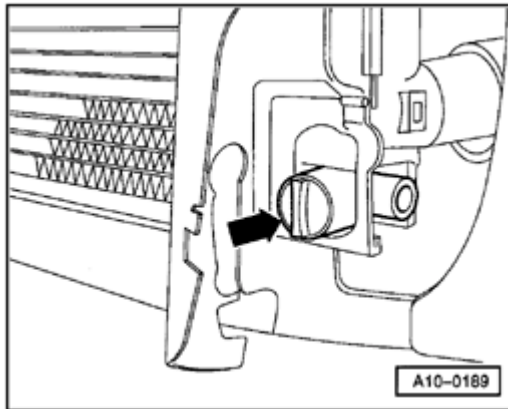
- Remove noise insulation panel (arrows).
- Unbolt left and right-side front exhaust pipes from exhaust manifold.

- Unbolt exhaust system from transmission bracket.

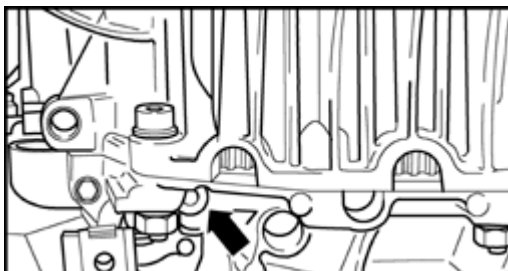
- Place VAG1306 drip tray beneath engine.
- Open engine coolant expansion tank cap.

WARNING!

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



- With bumper removed, open coolant drain plug (arrow) on lower left of radiator by turning it counterclockwise. If necessary, attach accessory hose to connection.
- With bumper installed, pull off retaining clamp for lower right radiator hose (from radiator to engine) and disconnect radiator hose from radiator.

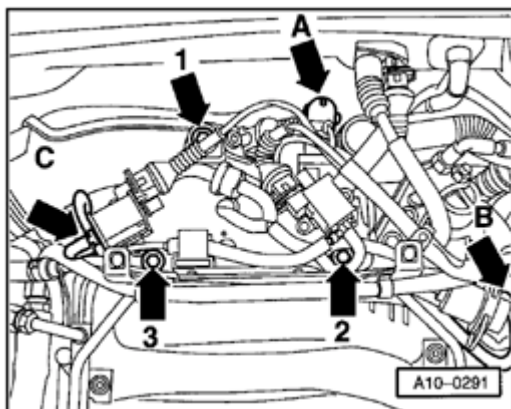


- Using 3247 hex ball socket, open coolant drain plug on engine (arrow) as well.
- Unbolt engine coolant expansion tank from bracket and lay aside (remove if necessary).
- Disconnect crankshaft housing ventilation line from cylinder head

cover.

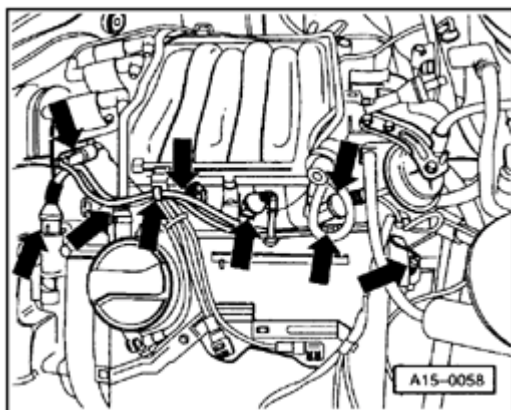
- Remove intake air duct between Mass Air Flow (MAF) sensor and intake air elbow.

15-20



A

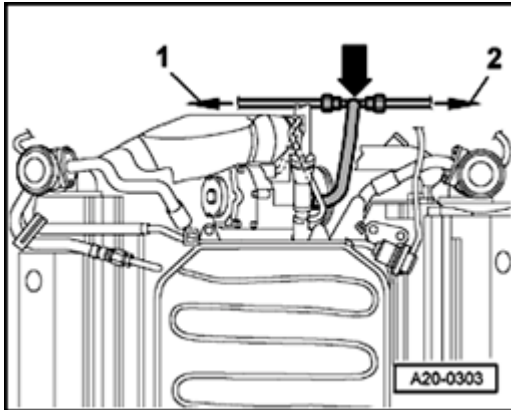
- Disconnect blue harness connector on Intake Manifold Tuning (IMT) valve.
- Disconnect black harness connector for intake air temperature sensor on resonator.
- Cut tie wraps and move wiring to side.
- Disconnect vacuum line at cruise control vacuum diaphragm and at vacuum booster.
- Unbolt cruise control vacuum diaphragm and unhook cruise control vacuum diaphragm linkage at throttle body.
- Disconnect harness connector on throttle body and vacuum lines on fuel pressure regulator.



A

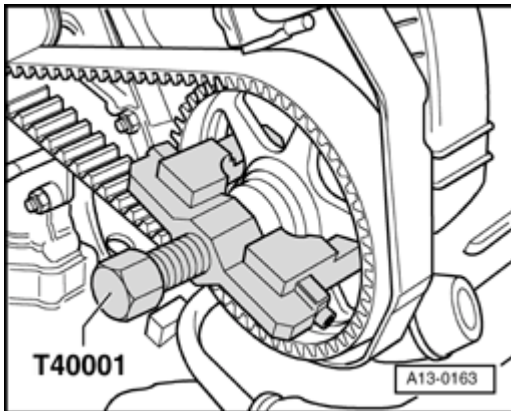
- Disconnect harness connectors from camshaft adjustment valve and from fuel injectors (arrows).
- Disconnect harness connectors from Engine Coolant Temperature (ECT) sensor and Camshaft Position (CMP) sensor (arrows).
- Cut tie wraps on valve cover.
- Unclip wiring retainer on fuel rail and disconnect crankshaft housing ventilation lines from left and right-side valve covers. Move hoses and wiring clear (to rear).

15-21



A

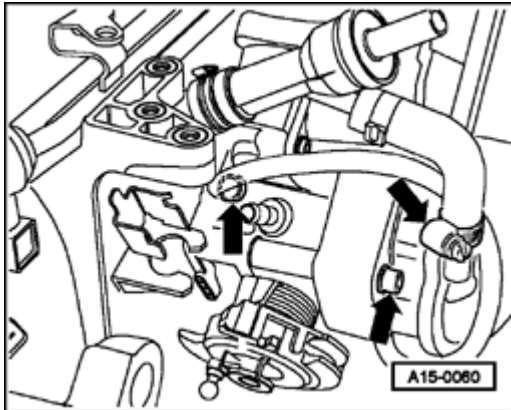
- Disconnect harness connector for tank diagnostic system in engine compartment at arrow.
- Remove 4 bolts for fuel rail on intake manifold.
- Unclip fuel supply and return lines from retainer.
- Move fuel rail together with fuel injectors aside. Cover fuel injectors with clean cloth.
- Install 3391 camshaft locator bar onto camshaft locking plates.
- Loosen both bolts for camshafts and back out bolts approx. 5 turns.
- Remove 3391 camshaft locator bar.



A

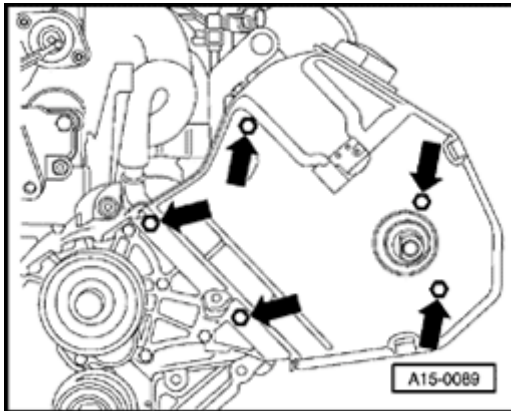
- Remove camshaft gear using T40001 special tool.
- Disconnect left-side spark plug connectors.
- Unbolt bracket for ignition coils (4 bolts) and move to right side together with ignition coils.
- Unhook accelerator pedal cable and pull up out of retaining bracket.

15-22



A

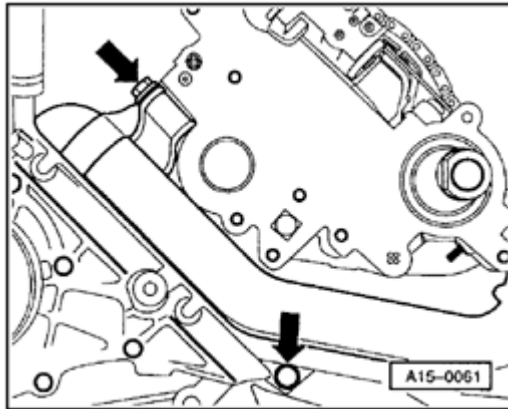
- Disconnect vacuum line at throttle body and line between vacuum booster and intake air elbow (arrows).
- Remove intake air elbow.
- Remove intake manifold.
- Disconnect heated oxygen sensor harness connector at left-side of heater core and set aside.



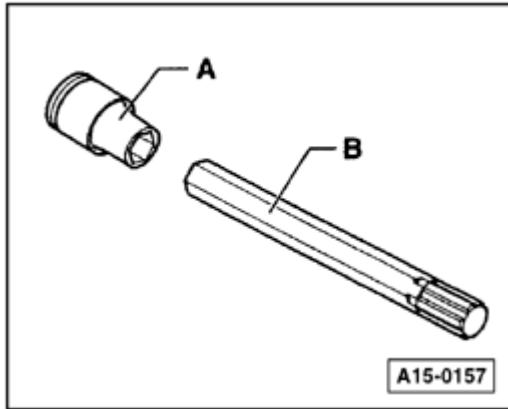
A

- Remove left-rear toothed belt guard (arrows).
- Unbolt coolant hose at rear of cylinder head.

15-23

**A**

- Unbolt coolant hose at front of cylinder head (arrows).
- Using 3452 polydrive special tool, loosen cylinder head bolts in reverse order of tightening sequence and remove.
- Carefully lift off cylinder head.

**A**

- When removing and installing, use 3452 polydrive together with normal commercial 10 mm socket.

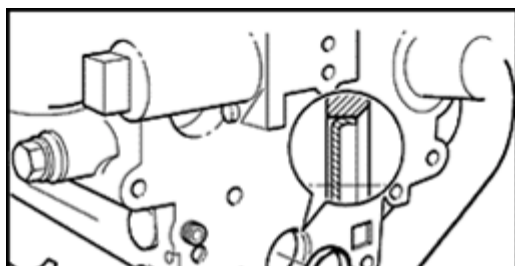
Installing

Notes:

- ◆ *Bolt holes in engine block for cylinder head bolts must be free of oil and coolant.*
- ◆ *Always replace cylinder head bolts.*
- ◆ *Vacuum line connections ⇒ page 10-23*

When installing a new cylinder head:

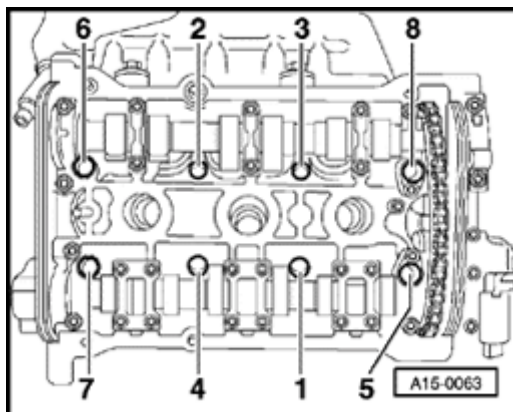
- Install centering pin for intake manifold.
- Replacement cylinder head may be used to replace left or right cylinder head. Install sealing cap at appropriate front end of replacement cylinder head.
- Coat lip of sealing cap with sealant AMV 188 001 02.
- Using VW295 needle bearing drift press in sealing cap until lip of cap seals with chamfer end of cylinder head.
- Before installing cylinder head, set crankshaft and camshafts to TDC for cylinder 3.



A

- Install cylinder head gasket onto guide sleeves. Marking "oben" or Part No. must face toward cylinder head.
- Install cylinder head, install cylinder head bolts and tighten hand-tight.

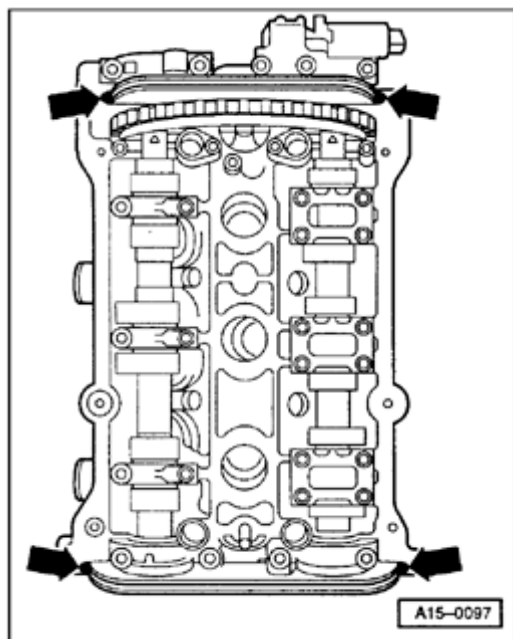
15-25



- Tighten cylinder head bolts in two stages in sequence shown, as follows:

- ◆ Stage 1: 60 Nm (44 ft lb)
- ◆ Stage 2: additional 1/2 turn (180°) using rigid wrench (in two 1/4 turns (90°) if necessary).

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



Sealing contact surfaces between bearing cap and cylinder head.

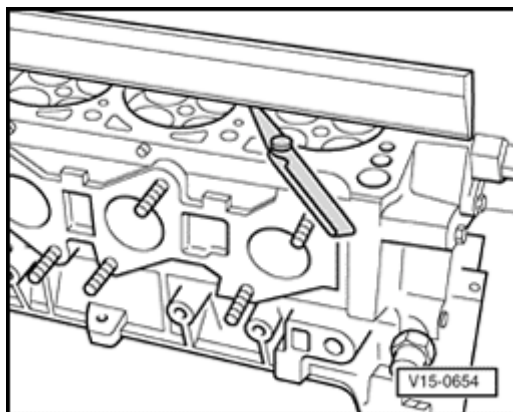
- Carefully apply small amount of sealant D 454 300 A2 at four end points of sealing surfaces on cylinder head using small screwdriver.

Tightening torques

Component		Tightening torque
Bolts	M6	10 Nm (7 ft lb)
Bolts	M8	20 Nm (15 ft lb)
Camshaft bearing cap and camshaft adjuster		10 Nm (7 ft lb)
Exhaust manifold to cylinder head		25 Nm (18 ft lb)
Front exhaust pipe to exhaust manifold		25 Nm (18 ft lb)
Heated Oxygen Sensor (HO2S)		50 Nm (37 ft lb)
Spark plugs		25 Nm (18 ft lb)
Toothed belt sprocket to camshaft		55 Nm (41 ft lb)
Intake manifold to cylinder head		10 Nm (7 ft lb)
Cylinder head cover		10 Nm (7 ft lb)

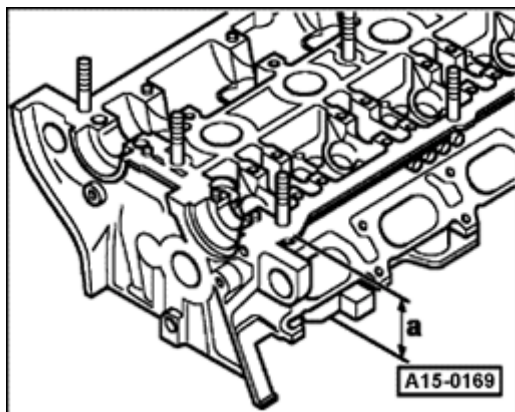
15-27

Cylinder head, checking for distortion



- Measure at several points using straight-edge.
Maximum permissible distortion: 0.1 mm (0.004 in.)

Cylinder head, resurfacing



Resurfacing of the cylinder head is only permissible up to minimum dimension -a-.

Dimension -a-: 139.25 mm (5.4823 in.).

Compression, checking

Test conditions

- Engine oil temperature at least 30 ° C
- Battery fully charged
- Disconnect harness connectors from all 6 fuel injectors.
- Disconnect 5-pin harness connector from power output stage of ignition coils.
- Open throttle fully.
- Use VAG1381 or VAG1763 compression tester to check compression.
- Operate starter until no further pressure increases are indicated by VAG1381 or VAG1763 compression tester.

Compression pressure

New	Wear limit	Max. permissible difference between cylinders

9-14 bar (131-203 psi)	7.5 bar (109 psi)	3 bar (44 psi)
------------------------------	----------------------	----------------

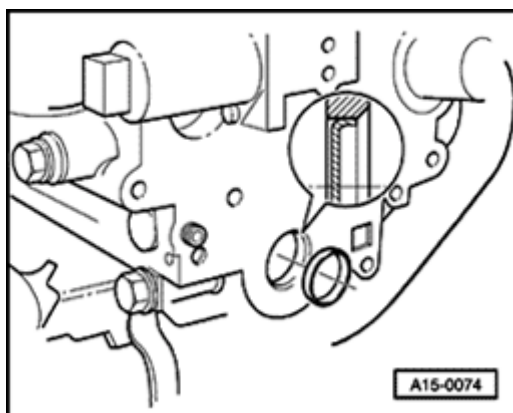
Sealing cap (core plug) in cylinder head, installing

Cylinder heads supplied as replacement parts can be used on either the left or right-sides of the engine. A sealing cap (core plug) must be installed in the front end of the cylinder head in each case.

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

CAUTION!

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

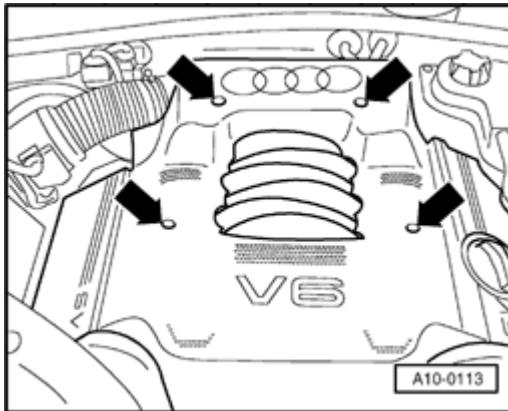


A

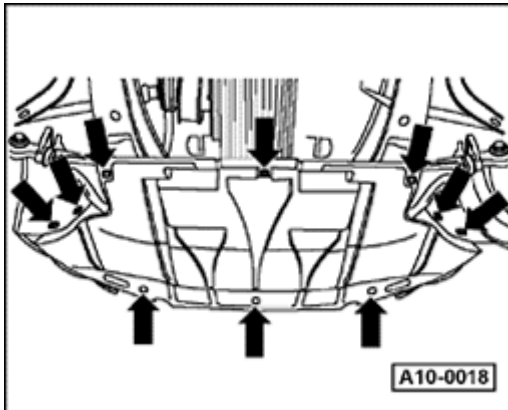
- Using VW295 needle bearing drift, drive in sealing cap (core plug) until outside rim is flush with end of chamfer in cylinder head (see inset).

Camshafts and camshaft adjusters, removing and installing

Removing



- Remove engine cover (arrows).
 - Cylinder head installed
 - Lock carrier in service position ⇒ [page 13-1](#)
- Remove ribbed belt ⇒ [page 13-8](#) .
- Remove toothed belt ⇒ [page 13-12](#) .

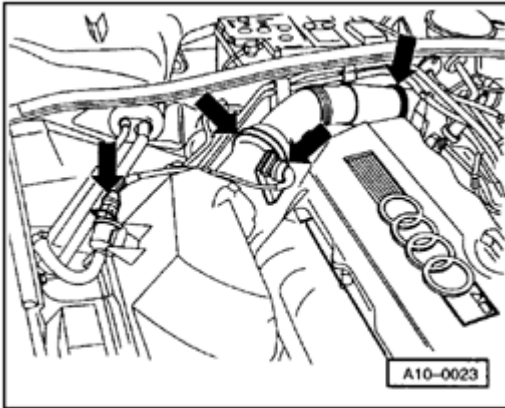


- Remove noise insulation panel (arrows).

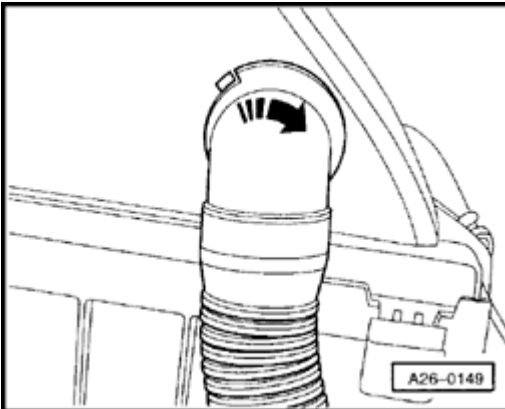
Left-side cylinder head

- Unbolt engine coolant expansion tank from bracket and lay aside.
- Remove crankshaft housing ventilation line from valve cover.

Right-side cylinder head

**A**

- Remove intake air duct between Mass Air Flow (MAF) sensor and intake air elbow.
- Disconnect EVAP canister purge regulator valve and remove valve from retainer.
- Disconnect harness connector for mass air flow sensor.

**A**

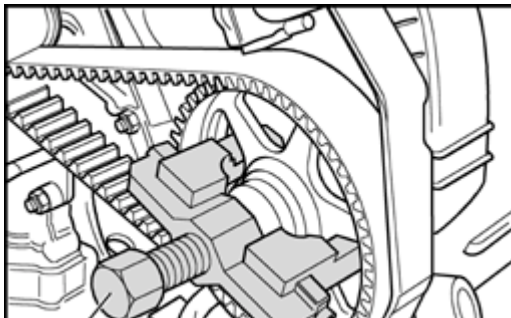
- Turn connection pipe for secondary air injection pump on air cleaner 45° in clockwise direction and pull forward off air cleaner.
- Unbolt air cleaner and remove.

All models

- Remove Camshaft Position (CMP) sensor housing and shutter wheel.
- Unbolt shutter wheel for Camshaft Position (CMP) sensor -G40- and carefully pry out using screwdriver.

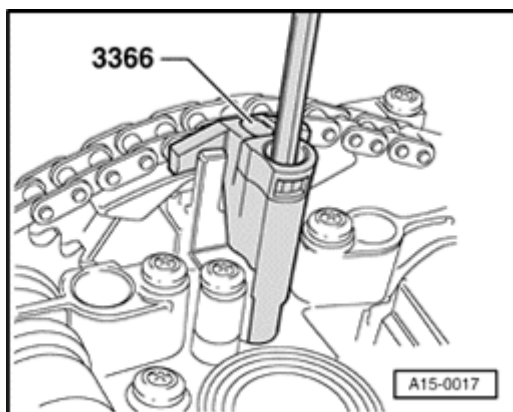
Tightening torque: 20Nm (15 ft lb)

- Remove cylinder head cover.
 - Install 3391 camshaft locator bar into camshaft locking plates.
 - Loosen both bolts for camshafts and back out bolts approx. 5 turns.
 - Remove 3391 camshaft locator bar.
 - Remove both camshaft sprockets using T40001 special tool.
 - Using screwdriver, carefully lift out oil lines for camshaft bearing lubrication from camshaft bearings.
- When lifting out oil lines, be careful not to damage positioning clips.



4

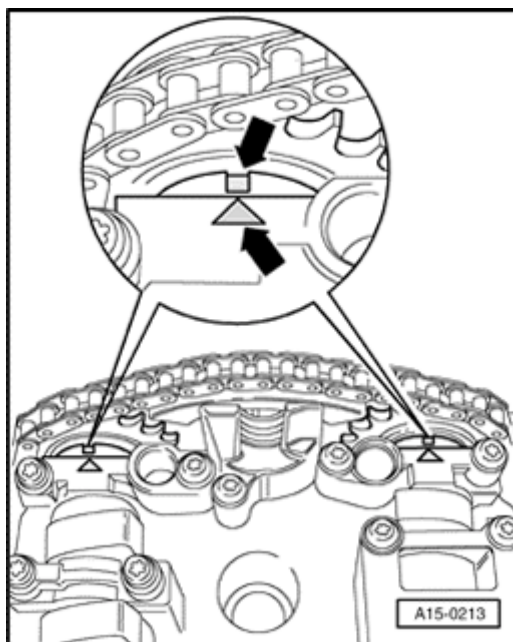
15-34



- Secure camshaft adjuster with 3366 bracket tensioner.

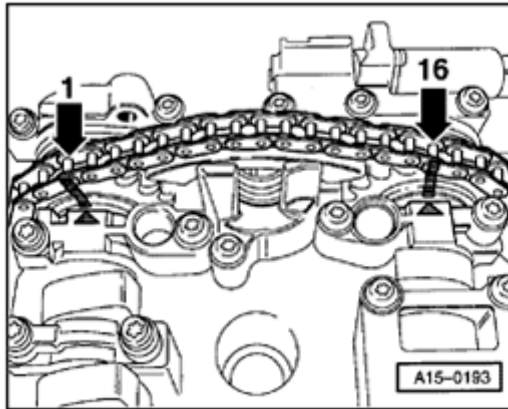
Note:

If the bracket tensioner is tightened too far, the camshaft adjuster may be damaged.



- Verify that camshafts are at TDC.
Both camshaft markings must align with arrows on bearing caps.
- Clean camshaft drive chain and camshaft chain gears opposite both arrows on bearing caps. Mark installed position with paint.

15-35

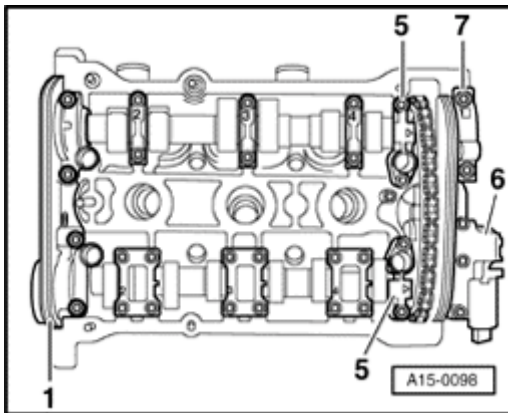


- ⚠ The distance between the two arrows/paint marks is equivalent to 16 drive chain rollers.

The notch on the exhaust camshaft is slightly offset inward toward chain roller -1-.

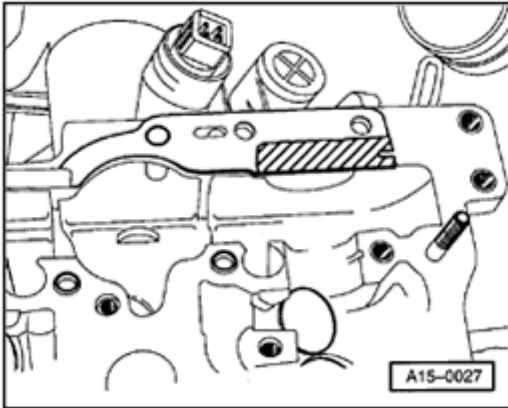
Note:

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

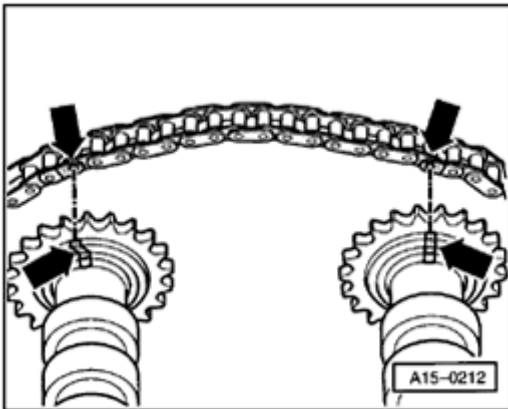


- ⚠
- Remove camshaft adjuster retaining bolts.
 - Remove bearing caps -1-, -3-, -5- and -7- and lay on a clean surface in correct order.
 - Alternating in diagonal sequence, loosen bearing caps -2- and -4- of intake and exhaust camshafts and remove.
 - Remove both camshafts together with camshaft adjuster.

Installing

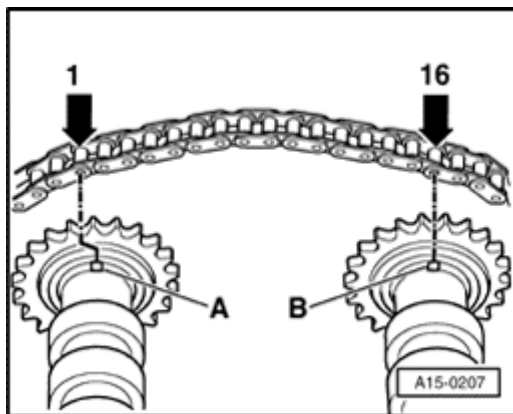
**A**

- Replace rubber/metal camshaft adjuster gasket and spread thin layer of sealant D 454 300 A2 on hatched surface.
- Install drive chain on camshaft chain gear as follows:

**A**

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

15-37



- A** If a new drive chain is installed, distance between notches -A- and -B- on camshafts must equal the distance between 16 drive chain rollers. Illustration shows where first and sixteenth drive chain rollers must be installed on chain gears.

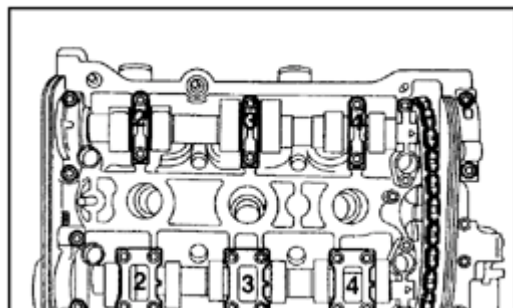
Note:

Notch -A- is slightly offset inward toward drive chain roller -1-.

- Slide in camshaft adjuster between drive chain (second technician required).
- Install camshafts with drive chain and camshaft adjuster into cylinder head.
- Oil camshaft journal surface.

Notes:

- ◆ *Alignment bushings for bearing caps and camshaft adjuster must be installed in cylinder head.*
- ◆ *When installing bearing caps, verify marking on cap is readable from intake side of cylinder head.*
- Tighten camshaft adjuster (pay attention to alignment bushings).

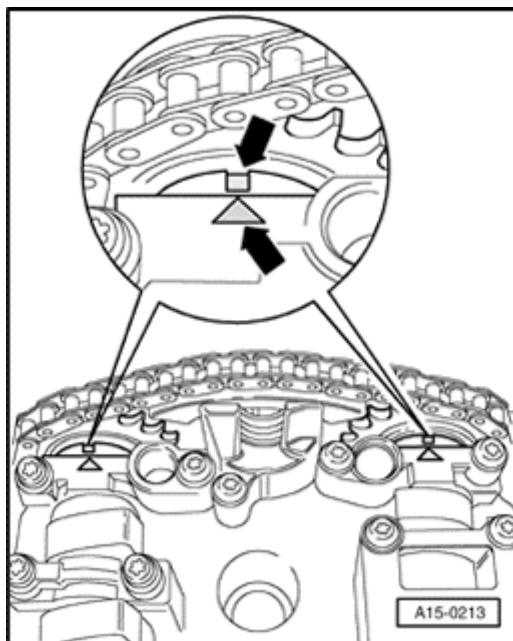


- A**
- Tighten bearing caps -2- and -4- in alternating diagonal sequence (pay attention to alignment bushings).
 - Install both bearing caps on chain sprockets of intake and exhaust camshafts.

- Verify correct position of both camshafts.



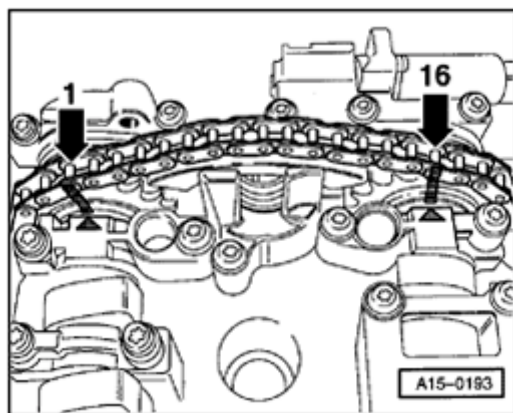
Both camshaft markings must align with arrows on bearing caps (arrows).



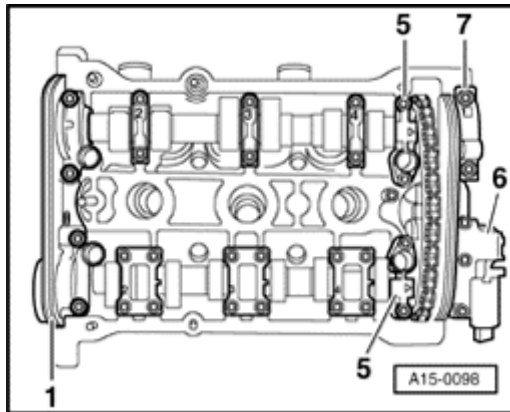
The distance between the two arrows/paint markings is equivalent to 16 drive chain rollers.

Note:

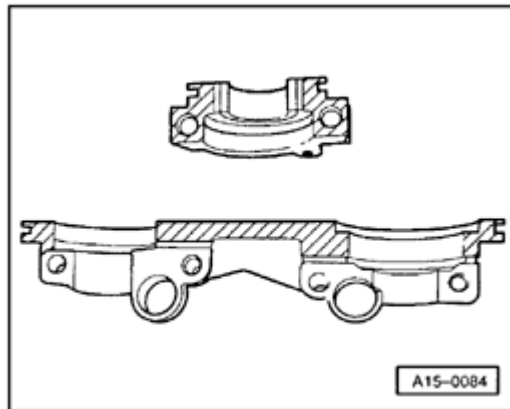
The notch on exhaust camshaft is slightly offset inward toward drive chain roller -1-.



15-39



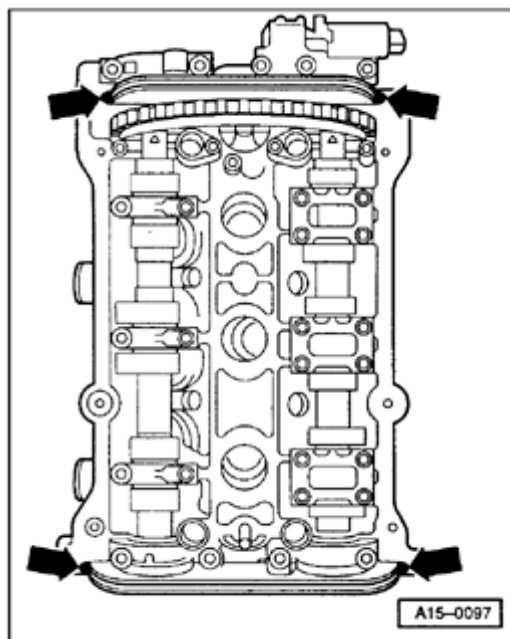
- Lightly coat hatched surface of double bearing cap -1- and bearing cap -7-...



- ...with sealant D 454 300 A2 and install bearing cap (pay attention to alignment bushings).
- Install the other bearing caps (pay attention to alignment bushings).
- Replace oil lines for camshaft bearing lubrication and install.
- Replace oil seal for intake and exhaust camshafts ⇒ [page 15-14](#) .
- Remove 3366 bracket tensioner.

CAUTION!

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



Sealing contact surfaces between bearing cap and cylinder head.

- Carefully apply a small amount of sealant D 454 300 A2 at four end points of sealing surfaces on cylinder head (arrows) using small screw driver.
- Install cylinder head cover.
- Install toothed belt ⇒ [page 13-15](#) .
- Remove ribbed belt ⇒ [page 13-8](#) .

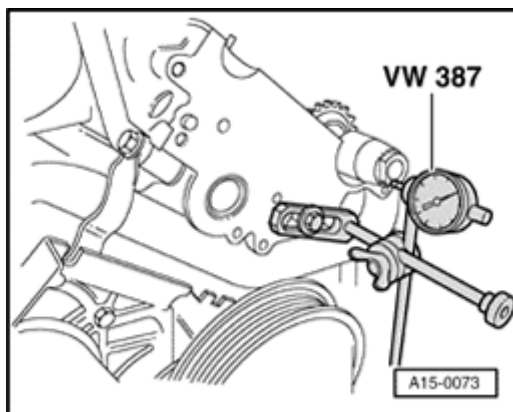
15-41

Tightening torques

Component		Tightening torque
Bolts	M6	10 Nm (7 ft lb)
	M8	20 Nm (15 ft lb)
Except for the following:		
Bearing cap to cylinder head		10 Nm (7 ft lb)
Camshaft adjuster to cylinder head		10 Nm (7 ft lb)
Shutter wheel for Camshaft Position (CMP) sensor -G40- to camshaft		25 Nm (18 ft lb)
Housing for Camshaft Position (CMP) sensor -G40- to cylinder head		10 Nm (7 ft lb)
Camshaft gear to camshaft		55 Nm (41 ft lb)
Camshaft bearing cap and camshaft adjuster		10 Nm (7 ft lb)
Cylinder head cover		10 Nm (7 ft lb)

Camshaft axial play, checking

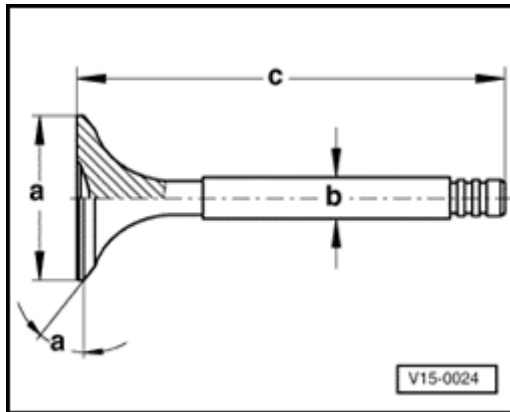
- Remove camshafts ⇒ [page 15-31](#) .
- Remove hydraulic valve lifters.
- Install camshafts without chain into cylinder head and tighten with bearing caps 2 and 4.



4

- Secure VW387 dial indicator holder with dial indicator to cylinder head.
- Press camshaft by hand against dial indicator.
- Set dial indicator to zero.
- Press crankshaft away from dial indicator.
- Read clearance.

New	Wear limit
0.05-0.15 mm (0.0020-0.0059 in.)	0.20 mm (0.0079 in.)



Valve dimensions

WARNING!

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

Dimension	Intake valve	Exhaust valve
Diameter -a-	26.8 - 27.0 mm (1.055 - 1.063 in.)	29.8 - 30.0 mm (1.173 - 1.181 in.)
Diameter -b-	5.96 - 5.97 mm (.2346 - .2350 in.)	5.94 - 5.95 mm (.2338 - .2342 in.)
Length -c-	104.84 - 105.34 mm (4.1275 - 4.1472 in.)	103.64 - 104.14 mm (4.0803 - 4.0999 in.)
Angle -a-	45°	45°

WARNING!

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

Hydraulic valve lifters, checking

CAUTION!

After installing new hydraulic valve lifters the engine must not be started for about 30 minutes. The hydraulic valve lifters must settle (otherwise valves will strike pistons). Then turn crankshaft two full revolutions by hand before starting.

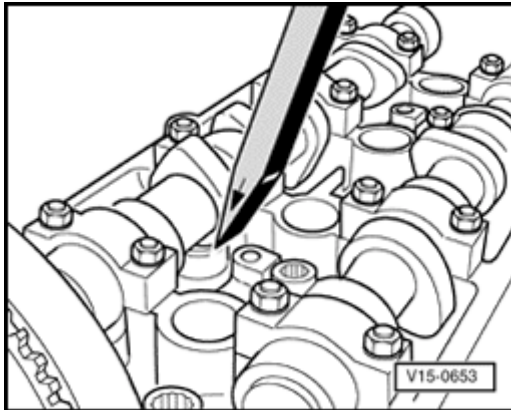
Notes:

- ◆ *Only replace hydraulic valve lifters in complete sets. Hydraulic valve lifters cannot be adjusted or repaired.*
- ◆ *Irregular valve noise when starting engine is normal.*
- Start engine and let run until coolant temperature reaches at least 80 ° C.
- Increase RPM to 2500 for about 2 minutes. If necessary, test drive vehicle.

If hydraulic valve lifters are still loud, locate faulty valve lifter as follows:

- Remove cylinder head cover.

- Rotate crankshaft clockwise by turning mounting bolt for toothed belt sprocket until lobes on camshaft of hydraulic valve lifters to be checked are pointing upward.
- Measure clearance between cam and valve lifter.

**A**

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

Note:

If irregular valve noise occurs repeatedly during short journeys and disappears after extended driving, the oil check valves must be replaced ⇒ [page 17-9](#).

Valve stem oil seals, replacing

- Cylinder head installed
- Lock carrier in service position ⇒ [page 13-1](#)
- Remove ribbed belt ⇒ [page 13-8](#) .
- Remove toothed belt ⇒ [page 13-12](#) .
- Remove camshafts ⇒ [page 15-31](#) .
- Remove valve lifters (do not interchange) and lay aside with contact surface facing down.
- Remove spark plugs.
- Move piston for individual cylinder to Bottom Dead Center (BDC) position.

Note:

Lightly tap valve lever to loosen stuck valve keepers.

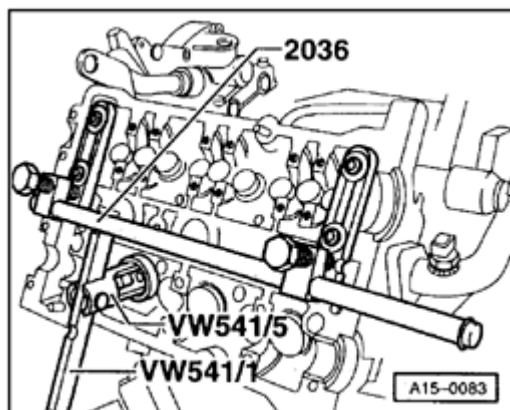
Exhaust side

Note:

Before attaching the adjustable rod, remove the two studs in the center of the cylinder head and the three upper studs (intake side) for mounting the cylinder head cover.

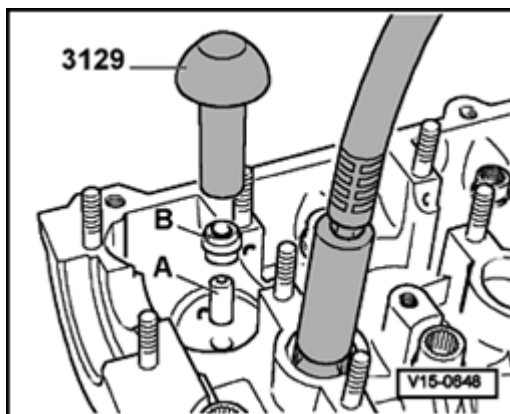
- Install VW653/3 pressure hose together with seal hand tight into spark plug hole of relevant cylinder and apply constant pressure (at least 6 bar).

15-48



A

- Attach 2036 adjustable rod (as shown in figure) using M6 x 40 bolts with large washers.
- Remove valve spring using VW541/1 lever and VW541/5 valve spring tensioner.
- Remove valve spring and valve spring plate.
- Remove valve stem oil seal using 3047A slide hammer.



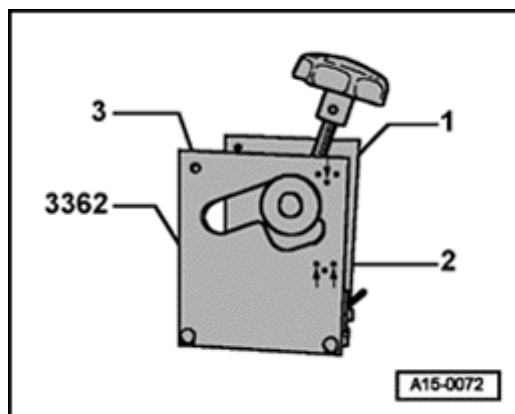
A

- Place plastic sleeve -A- on valve stem to prevent damage to new valve stem oil seals.
- Lightly lubricate sealing lip with oil.
- Insert valve stem oil seal -B- (without oiling outside of seal) into 3129 seal driver and carefully slide onto valve guide.
- When installing new valve, lightly oil valve stem before installing.

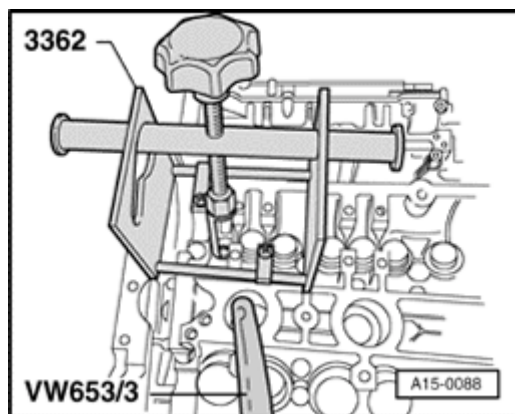
Intake side

Note:

The intake valves are installed in the cylinder head at different angles.

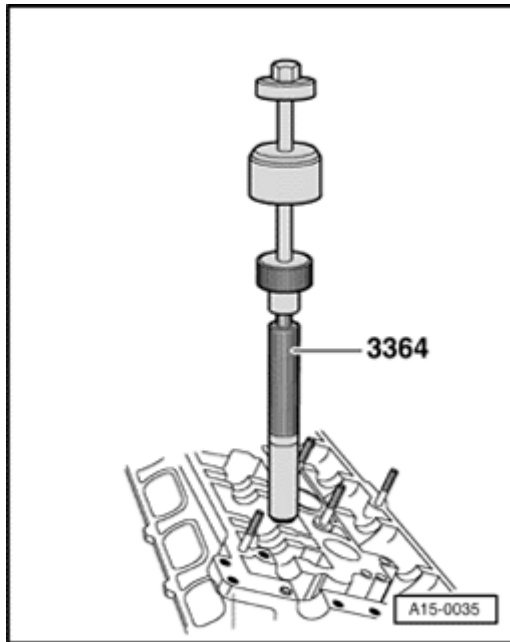


- 3362 valve spring tool can be used in two different positions:
- 1 - Upper position for center valve
 - 2 - Lower position for two outer valves
 - 3 - Threaded holes on each side to take M6 x 25 bolts for mounting valve spring tool to cylinder head.



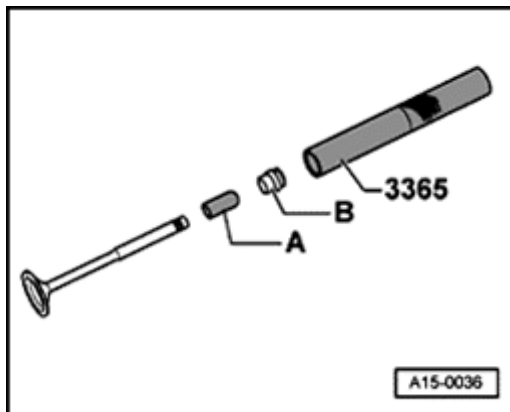
-
- Attach 3362 valve spring tool to cylinder head using two bolts supplied (as shown in figure).
 - Screw VW653/3 pressure hose together with seal hand tight into spark plug hole of relevant cylinder and apply constant pressure (at least 6 bar).
 - Set position of valve spring tool for relevant valve and remove valve spring using threaded spindle.

15-50



A

- Remove valve stem oil seal using 3364 valve seat tool.



A

- Place plastic sleeve -A- on valve stem to prevent damage to new valve stem oil seals.
- Lightly lubricate sealing lip with oil.
- Insert valve stem oil seal -B- (without oiling outside of seal) into 3365 seal driver and carefully slide onto valve guide.
- When installing new valve, lightly oil valve stem before installing.

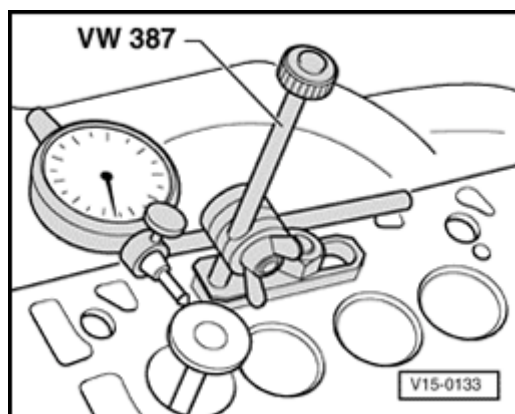
Valves, refacing

WARNING!

- ♦ *Valves must not be refaced by cutting or grinding.*
- ♦ *Only hand lapping is permitted.*
- ♦ *Observe the WARNING regarding proper disposal of sodium-filled exhaust valves ⇒ [page 15-44](#) .*

Valve guides, checking

When servicing engines or cylinder heads with leaking valves, refacing or replacing valve seats and valves is not sufficient. Valve guides must be checked for wear. This is especially important for engines with high mileage.



4

- Insert valve into guide.

Valve shaft edge must seal with guide. Due to differences in valve stem diameter, make sure only intake valves are used to check intake guides, and only exhaust valves are used to check exhaust guides.

- Measure axial play.

Wear limit

Intake valve guide	Exhaust valve guide
0.8 mm (0.031 in.)	0.8 mm (0.031 in.)

- If wear limit is exceeded, replace cylinder head.

Valve seats, refacing

Notes:

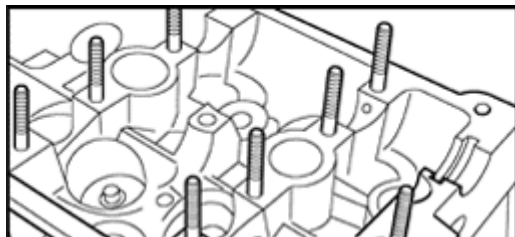
- ◆ *Only reface valve seats enough until a perfect contact pattern is obtained.*
- ◆ *Before refacing, calculate the maximum refacing dimension.*
- ◆ *If refaced dimension is exceeded, hydraulic valve lifter function is no longer guaranteed and cylinder head must be replaced.*

Calculating maximum allowable refacing dimension

- Insert valve and press firmly against valve seat.

Note:

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



- Measure distance between end of valve stem and top surface of cylinder head (four-valve head shown).
- Calculate maximum allowable refacing dimension using distance measured and minimum dimension.

15-54

Minimum dimensions		
Outer intake valve	Center intake valve	Exhaust valve
32.2 mm (1.268 in.)	33.2 mm (1.307 in.)	33.0 mm (1.299 in.)

The measured distance minus the minimum dimension equals the maximum permissible refacing dimension.

Example	
Outer intake valve	
Measured distance	33.0 mm (1.299 in.)
Minimum dimension	- 32.2 mm (1.268 in.)
Maximum permissible refacing dimension	= 0.8 mm (0.031 in.)

Note:

If the measured distance is less than the minimum dimension, repeat the measurement with new valves, or replace the cylinder head.

Lubrication system components, removing and installing

WARNING!

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

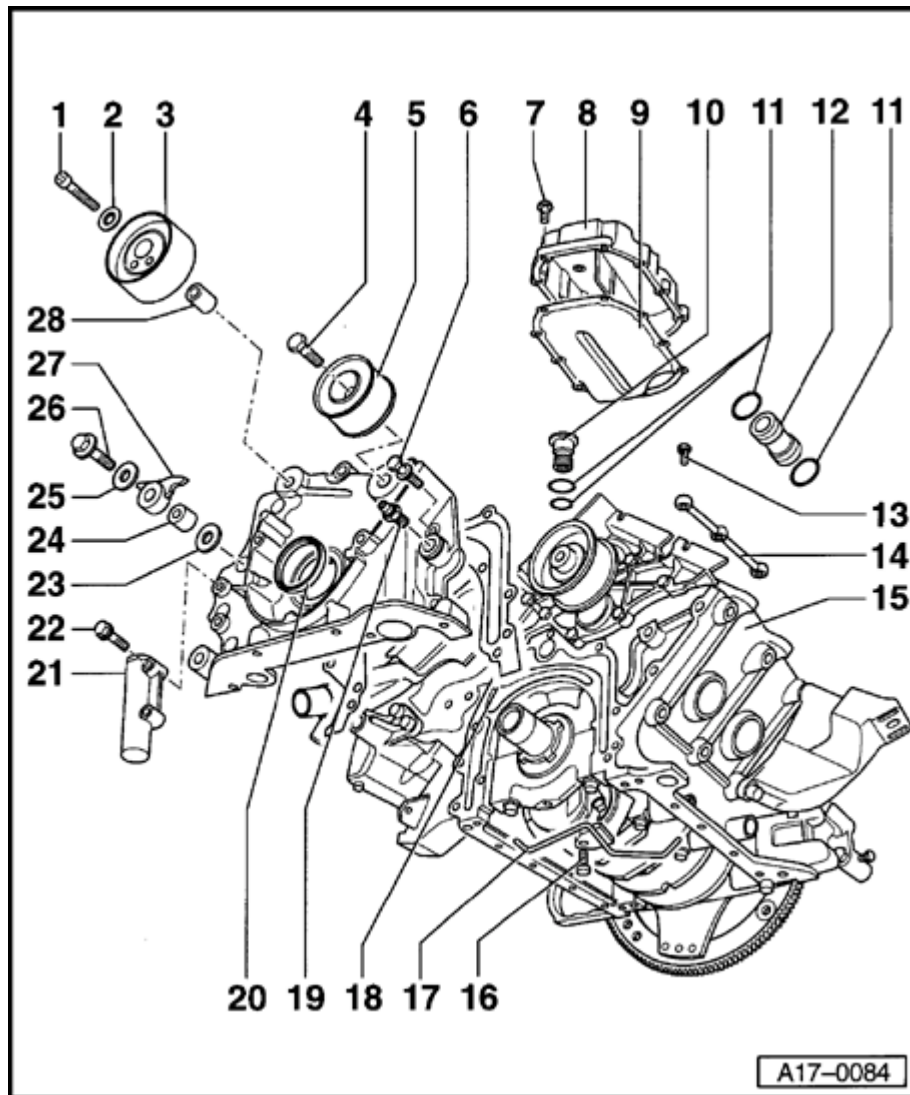
CAUTION!

- ♦ *If large quantities of metal particles or other deposits (caused, i.e. by partial seizure of the crankshaft or connecting rod bearings) are found in engine oil, thoroughly clean oil passages and replace oil cooler to prevent damage from re-occurring.*
- ♦ *Do not overfill with oil past the MAX mark on the oil dipstick. Damage to the Three Way Catalytic Converter (TWC) could result.*

Checking oil level ⇒ [page 17-32](#) .

Notes:

- ◆ *Always replace seals and gaskets.*
- ◆ *Viscosity classes and oil specifications ⇒ [page 17-31](#) .*
- ◆ *Checking oil pressure ⇒ [page 17-30](#) .*



Oil pump, cylinder block breather and oil spray jets, removing and installing

Oil pan (upper part) and oil pan (lower part), removing and installing ⇒ [page 17-10](#) .

1 - Bolt

◆ 20 Nm (15 ft lb)

2 - Washer

3 - Tensioner roller

◆ For toothed belt

4 - Bolt

◆ 45 Nm (33 ft lb)

5 - Bolt

◆ 10 Nm (7 ft lb)

◆ For toothed belt

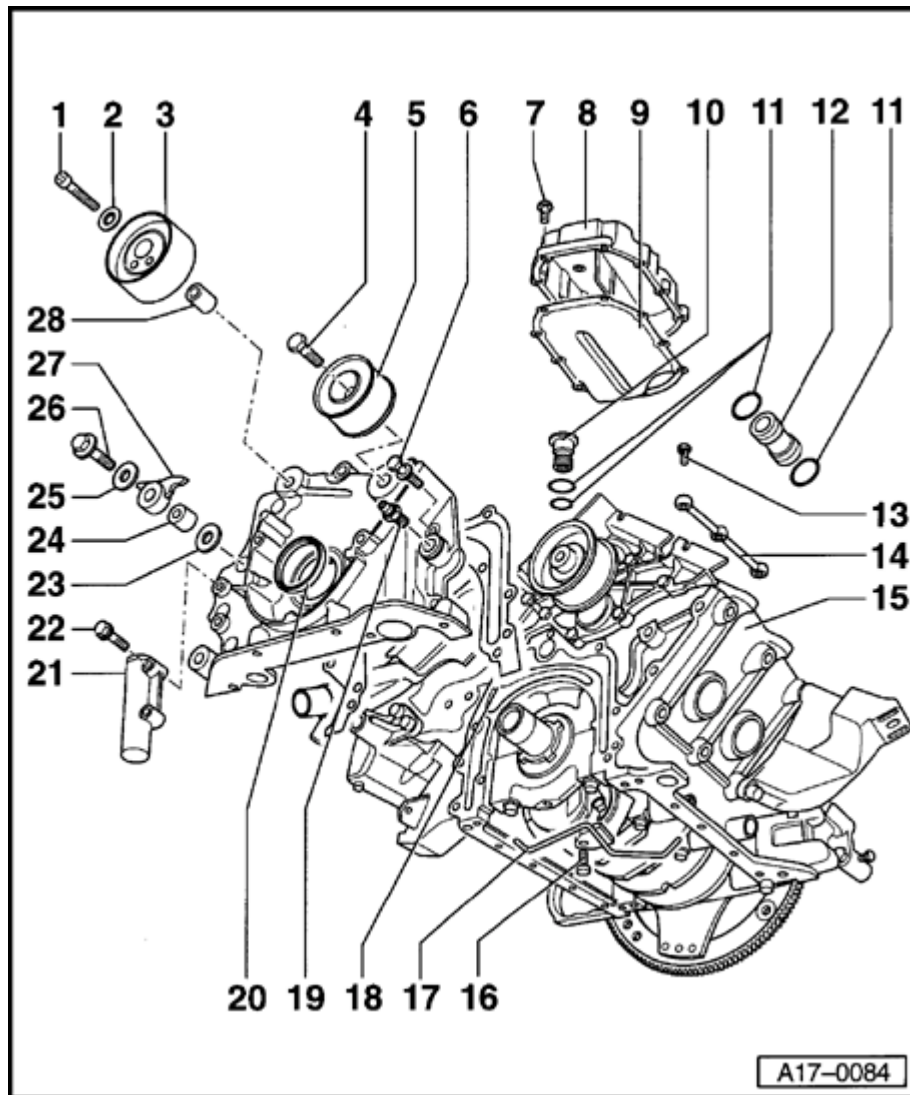
6 - Bolt

◆ 10 Nm (7 ft lb)

7 - Bolt

◆ 10 Nm (7 ft lb)

17-3

**8 - Breather housing****9 - Gasket/breather plate**

◆ Always replace

10 - Oil check valve

◆ 25 Nm (18 ft lb)

11 - Oil seal**12 - Connector****13 - Bolt**

◆ 15 Nm (11 ft lb)

14 - 15 Nm

◆ For oil spray jets for piston cooling

15 - Cylinder block**16 - Bolt**

◆ 10 Nm (7 ft lb)

◆ Use locking fluid D 000 600 A2 when installing

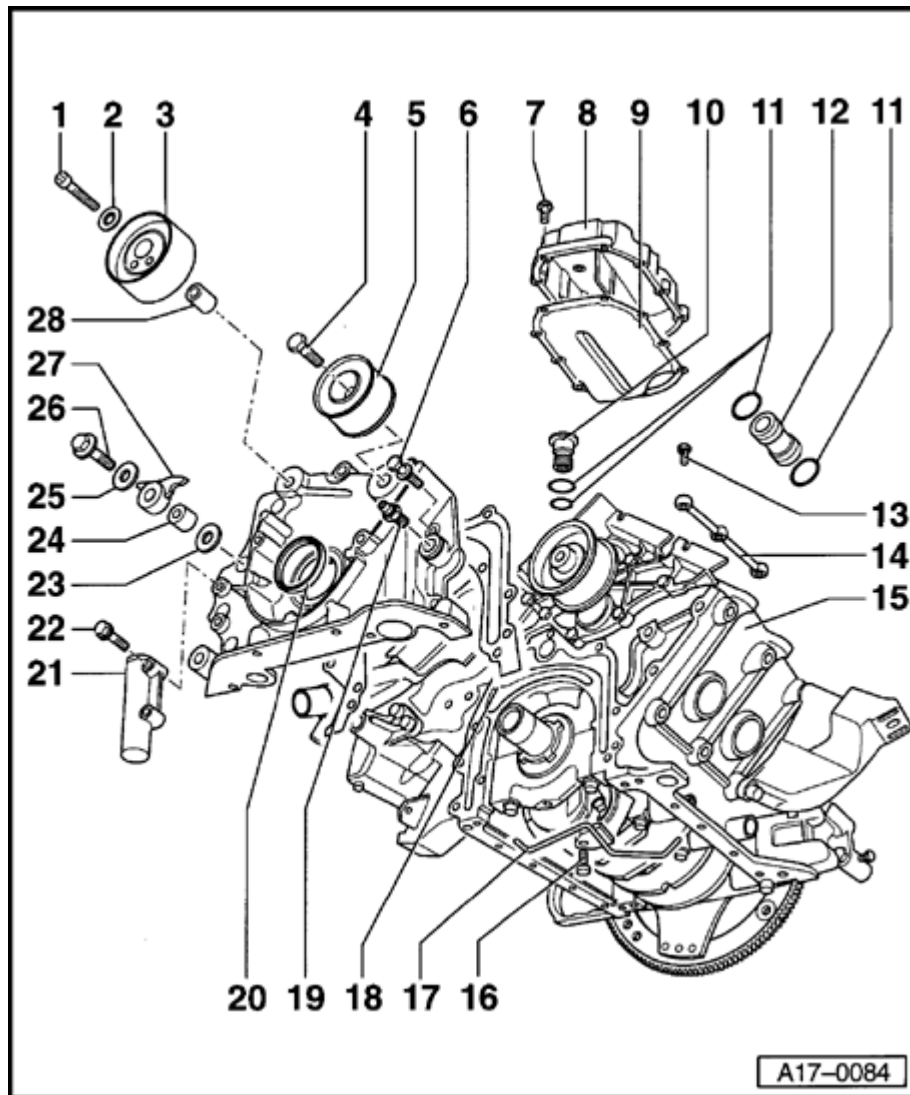
17 - Oil spray jet

◆ For piston cooling

18 - Gasket

◆ Metal gasket

◆ Always replace

**19 - Engine oil temperature sensor -G8-**

- ◆ 10 Nm (7 ft lb)
- ◆ For oil temperature gauge
- ◆ White
- ◆ If seal is leaking, replace seal

20 - Oil seal

- ◆ Replacing ⇒ [page 15-14](#)

21 - Tensioner

- ◆ Compress and secure before removing ⇒ [page 13-12](#)

22 - 10 Nm

- ◆ Use locking fluid D 000 600 A2 when installing

23 - Washer**24 - Bearing bushing**

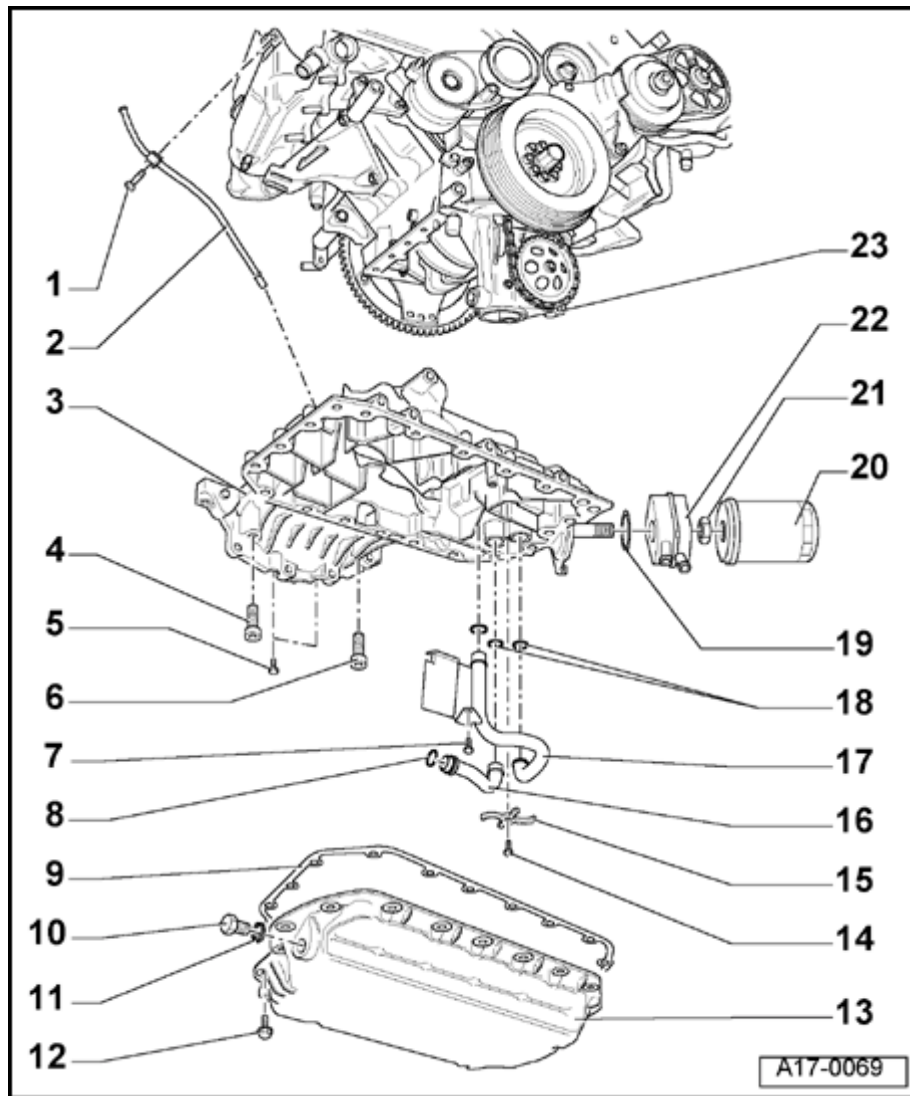
- ◆ For tensioner lever

25 - Washer**26 - Bolt**

- ◆ 25 Nm (18 ft lb)

27 - Tensioning lever**28 - Bearing bushing**

◆ For tensioner roller



Oil pump, oil pan, oil filter, oil cooler, removing and installing

1 - Bolt for dipstick tube

- ◆ 25 Nm (18 ft lb)

2 - Dipstick tube

- ◆ Replace O-ring

3 - Oil pan (upper part)

- ◆ No gasket is installed between engine block and oil pan (upper part)
- ◆ Only use silicon sealant D 454 300 A2

4 - Bolt

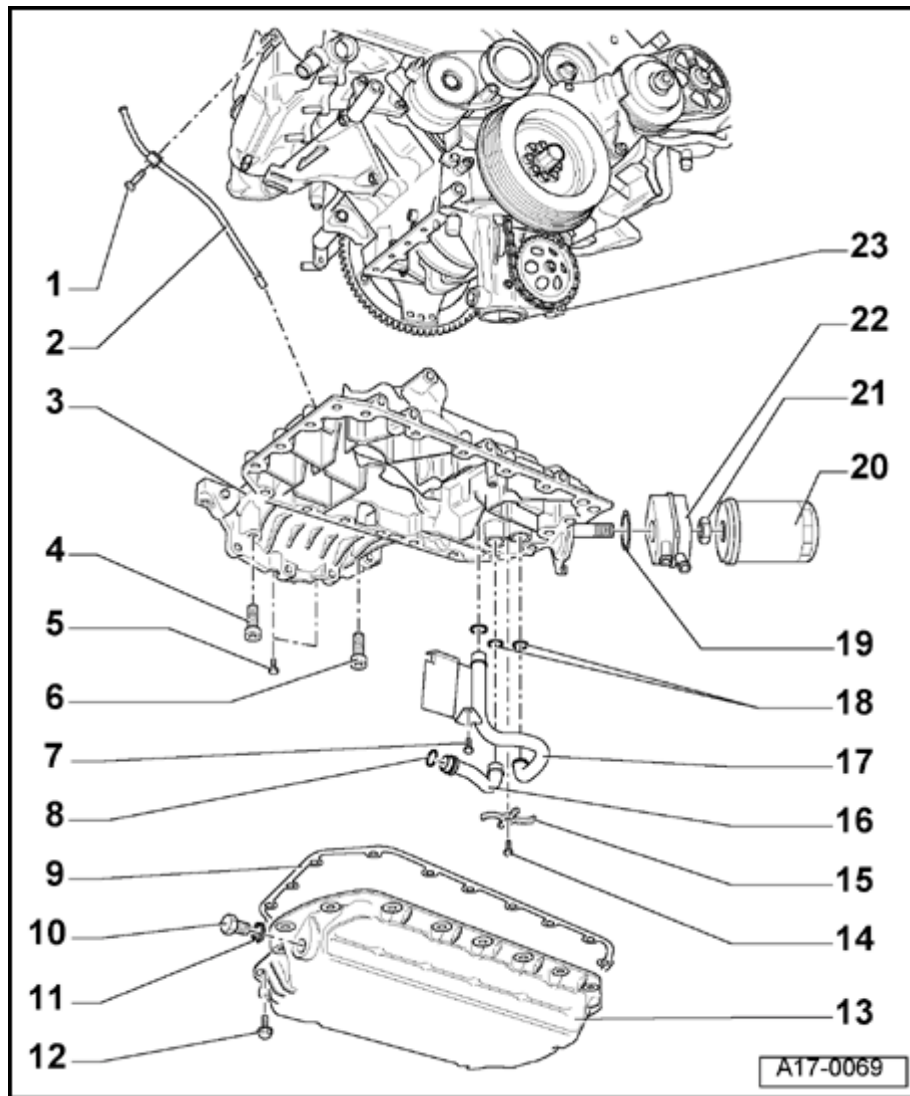
- ◆ M8
- ◆ 20 Nm (15 ft lb)

5 - Bolt

- ◆ M6
- ◆ 15 Nm (11 ft lb)

6 - Bolt

- ◆ M8
- ◆ 20 Nm (15 ft lb)
- ◆ Bolt is next to coolant drain plug

**7 - Bolt**

- ◆ M6
- ◆ 10 Nm (7 ft lb)

8 - O-ring

- ◆ Always replace

9 - Gasket for oil pan (lower part)

- ◆ Sealing surfaces clean and dry

10 - Oil drain plug

- ◆ 30 Nm (22 ft lb)

11 - Gasket for oil drain plug

- ◆ Always replace

12 - Bolt

- ◆ M6
- ◆ 10 Nm (7 ft lb)

13 - Oil pan (lower part)**14 - Bolt**

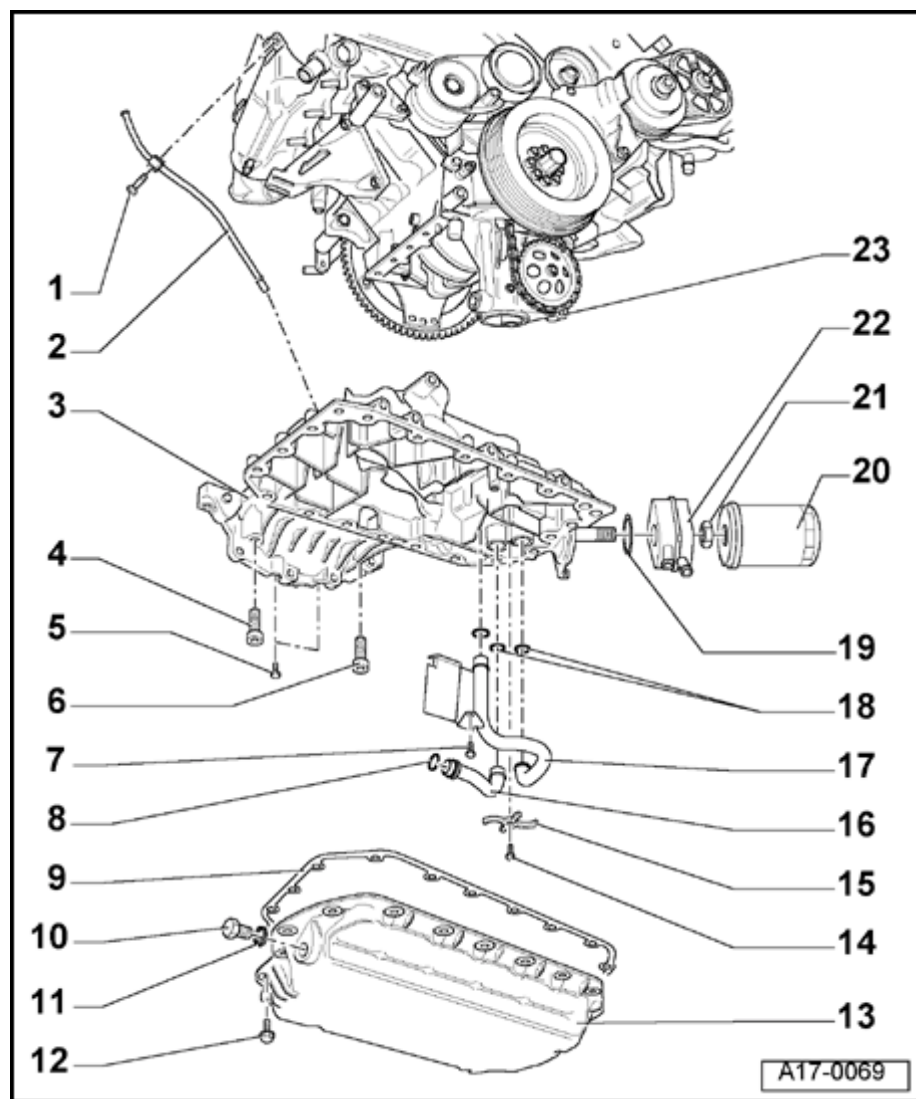
- ◆ M6
- ◆ 10 Nm (7 ft lb)

15 - Bracket for oil lines**16 - Oil supply line**

- ◆ From pump to oil filter

17 - Oil supply line

- ◆ From oil filter to engine oil circulation

**18 - O-ring**

- ◆ Always replace

19 - O-ring

- ◆ Always replace

20 - Oil filter**21 - Hex nut**

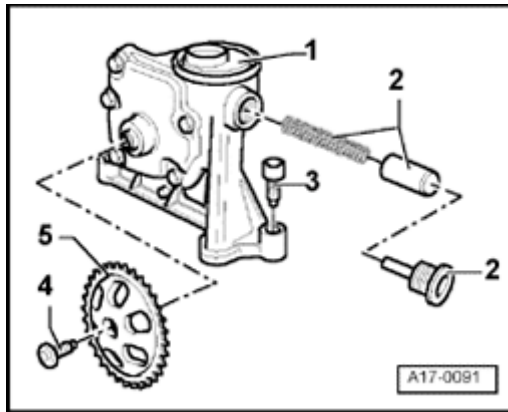
- ◆ 30 Nm (22 ft lb)
- ◆ Threaded pipe for oil cooler and oil filter installed in oil pan (upper part) and tightened to 20 Nm (15 ft lb)

22 - Oil cooler

- ◆ When installing, make sure O-ring is seated correctly

23 - Oil pump

- ◆ Disassembling and assembling ⇒ [Fig. 1](#)
- ◆ Driven by chain from crankshaft
- ◆ Tightening torque (chain sprocket to oil pump): 25 Nm (18 ft lb)
- ◆ Tightening torque (oil pump to engine block): 25 Nm (18 ft lb)



A

Fig. 1 Removing and installing oil pump

1 - Oil pump

Cannot be disassembled (oil pressure release valve is integrated with oil pump)

2 - Pressure regulation valve

Tightening torque: 40 Nm (30 ft lb)

3 - Tightening torque: 20 Nm (15 ft lb)

4 - Tightening torque: 25 Nm (18 ft lb)

5 - Chain sprocket

When installing, make sure shaft fits chain sprocket

Oil check valve, replacing

Note:

If irregular valve noise occurs repeatedly during short periods of driving and disappears after extended periods of driving, the oil check valves must be replaced.

- Remove intake manifold.

Tightening torque: 10 Nm (7 ft lb)

- Remove cover under intake manifold.

Tightening torque: 10 Nm (7 ft lb)

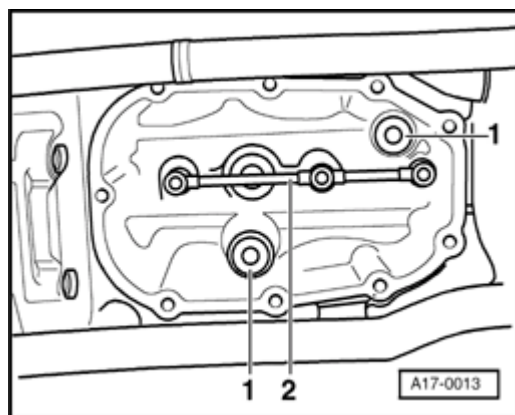
4

- Replace oil check valves -1-.

Tightening torque: 25 Nm (18 ft lb)

Note:

The opening also contains distribution line -2- for supplying jets for piston cooling.



Oil pan (upper part) and oil pan (lower part), removing and installing

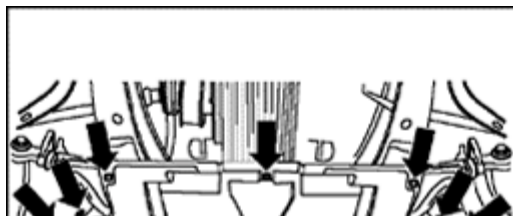
Special tools and equipment

- ◆ Drill with plastic brush attachment
- ◆ Sealant D 454 300 A2
- ◆ Torque wrench 10 Nm - 45 Nm
- Switch ignition off and disconnect battery Ground (GND) strap.

CAUTION!

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

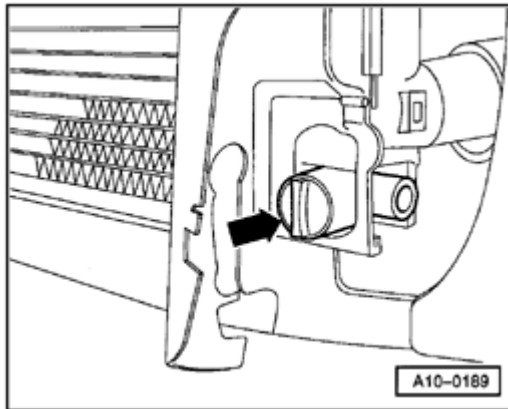
- Withdraw dipstick.
- Unbolt dipstick tube at right-front of cylinder head, pull up and remove.
- ◀ - Remove noise insulation panel (arrows).



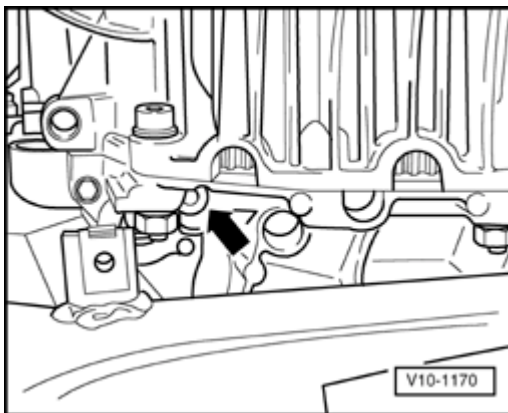
- Lock carrier in service position ⇒ [page 13-1](#)

- Open engine coolant expansion tank cap.

- Place VAG1306 drip tray beneath engine.



- Turn radiator drain plug counterclockwise (arrow). If needed, attach tube to connection flange.



- Open coolant pump bearing housing drain plug as well (arrow).

- Drain engine coolant.

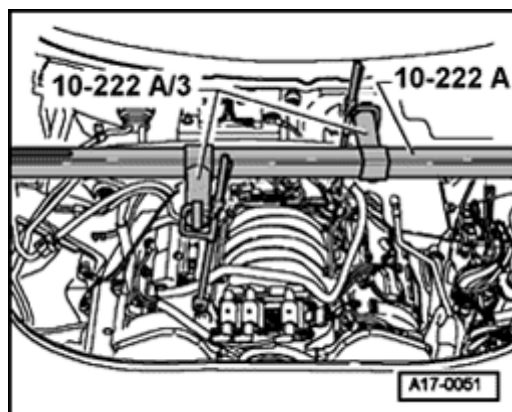
- Drain engine oil.

Collect engine oil in appropriate receptacle.

Vehicles with automatic transmission

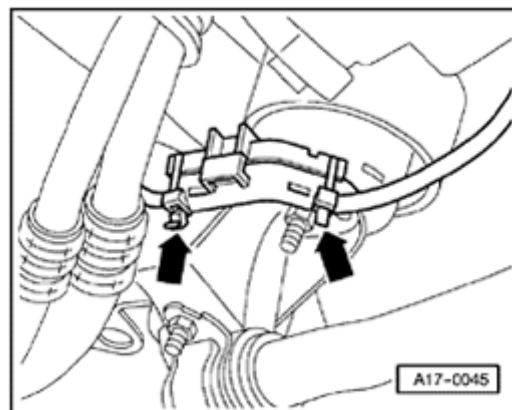
- Unbolt oil cooler line bracket from right-side of oil pan.

17-12



A

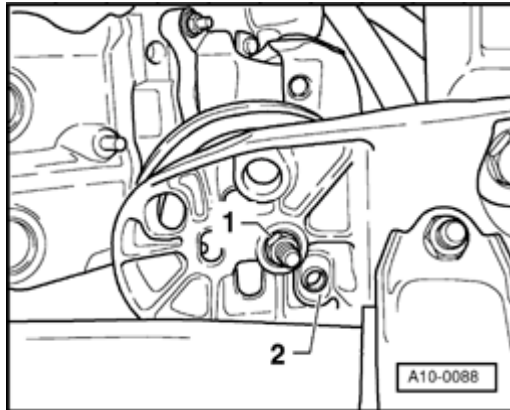
- Set 10-222A engine support bridge together with 10-222A/3 engine support adapter on fender mounting edges.
- Attach 2024A engine sling to mounting eyes at front and rear of engine.
- Using 10-222A engine support bridge spindle, lift up engine as far as possible.



A

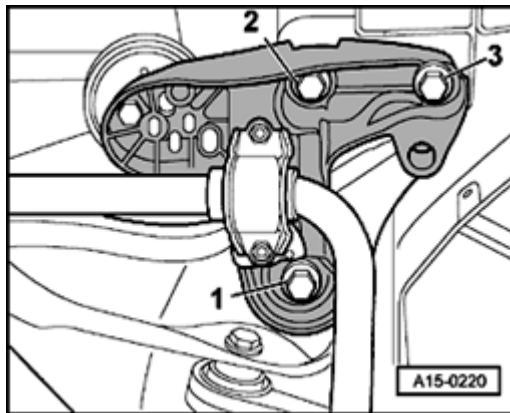
- Cut tie wraps (arrows), open bracket for starter wiring and remove wiring.
- Remove torque support at front of engine.
- Unbolt coolant line at front of engine from oil pan.
- Disconnect harness connector from oil pressure switch on left-side of oil pan.
- Disconnect coolant lines from oil cooler underneath oil filter.

17-13



A

- Remove left and right nuts from lower engine mount -1-.
- Mark installation positions for threaded assembly -1- and guide sleeves -2- on left and right lower engine mounts.



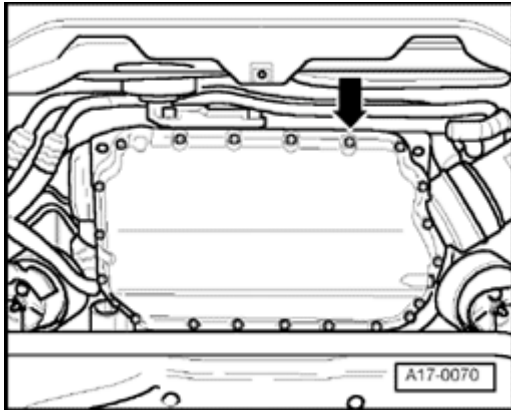
A

- First remove front bolts -2- and -3- from left and right-sides of subframe. Then remove bolts -1-.
- Swing stabilizer down.
- Remove starter.

Note:

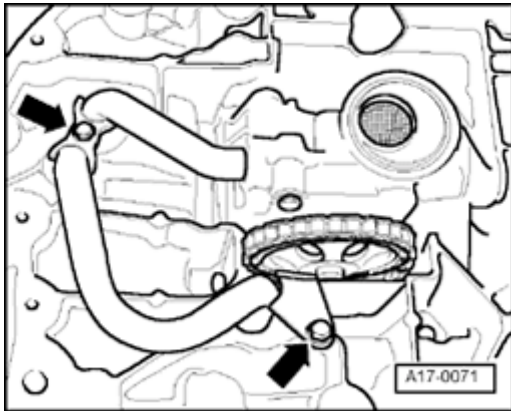
Only loosen or lower subframe at front to avoid changing wheel alignment.

17-14



A

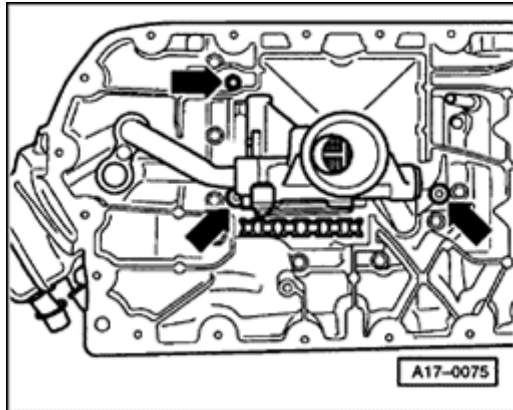
- Remove oil pan (lower part) and oil pan (upper part).



A

- Unbolt both oil supply lines. Pull longer of two lines down and off oil pan (upper part).

17-15



A

- Unbolt oil pump from engine to allow removal of shorter oil supply line (do not remove oil pump).
- Remove bolts between oil pan (upper part) and transmission.
- Unbolt oil pan (upper part) from engine.

Note:

Two M6 and two M8 bolts are installed vertically in rear of oil pan (upper part) in front of connection between engine and transmission.

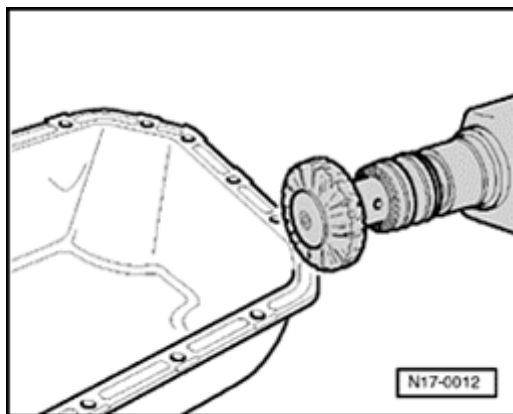
Installing

Installation is the reverse of removal, noting the following:

- Clean sealing surfaces so they are completely free of any oil or grease.

WARNING!

Wear protective glasses.

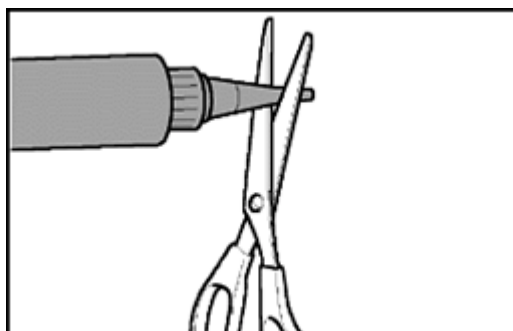


A

- Using rotating plastic brush, remove any remaining sealant from oil pan.

Note:

After applying silicon sealant D 454 300 2, oil pan must be installed within 5 minutes.



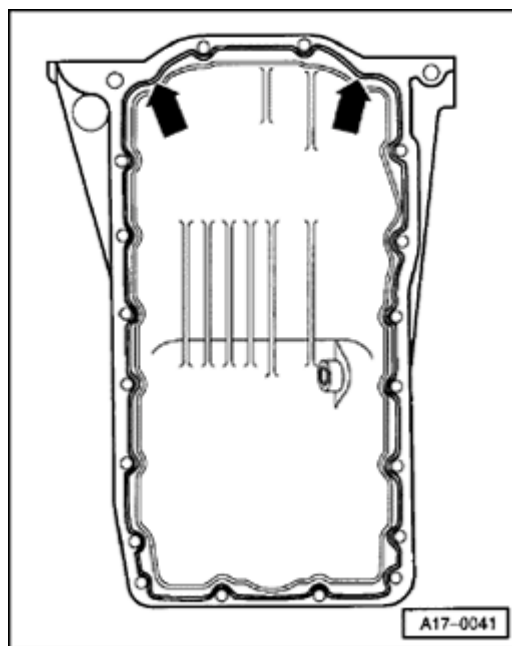
A

- Cut tube jet at front marking (jet diameter approx. 3 mm).
Thickness of sealant: 2-3 mm (0.04-0.12 in.)

Note:

Sealant must not be thicker than 3 mm, otherwise excess sealant may get into the oil pan and clog the oil intake strainer.

17-17



A

- Apply silicon sealant to clean sealing surface as shown in illustration. (The illustration shows placement of sealant on cylinder block.)

Note:

Be especially careful when applying sealant to rear oil seal carrier (arrows in illustration A17-0041).

- Immediately install oil pan and tighten all bolts between oil pan and engine block to 5 Nm (44 in. lb).
- Tighten bolts between oil pan and transmission to 45 Nm (33 ft lb).
- Tighten bolts between oil pan and engine block in 2 stages in diagonal sequence.
Finally sequence tightening torque: 15 Nm (11 ft lb)
- Tighten M10 bolts between oil pan and cylinder block to 45 Nm (33 ft lb).
- Clean both sealing surfaces on oil pan (lower part) so they are free of oil and grease.

Note:

Do not use glue or sealant.

- Install new gasket on oil pan (lower part) and attach to oil pan (upper part) with two bolts diagonal to each other.
- Tighten all bolts hand tight.

17-18

- Starting in center and moving toward outside, tighten bolts to 10 Nm (7 ft lb).
- Install new seal on oil drain plug and tighten to 30 Nm (22 ft lb).

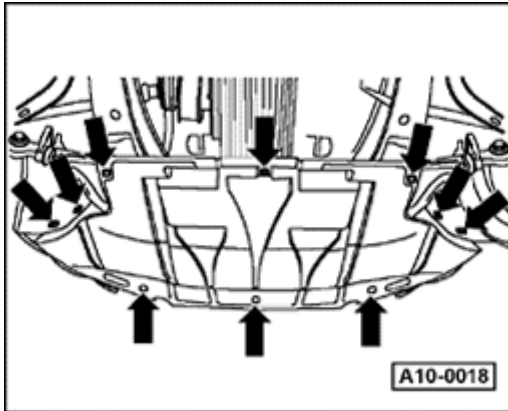
Notes:

- ◆ *When installing oil pan on removed engine, make sure oil pan is aligned with cylinder block on flywheel side.*
- ◆ *After installing oil pan, allow sealant to dry for approx. 30 minutes. Only after allowing sealant to dry may engine oil be added.*
- Install subframe.

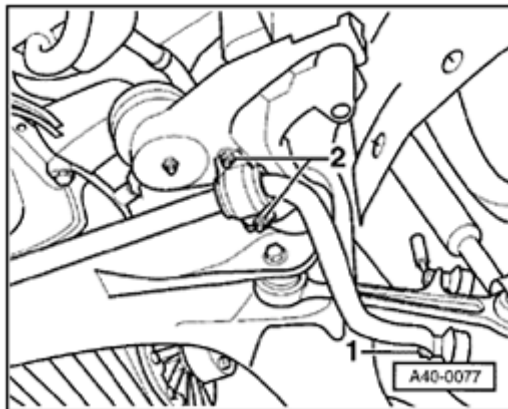
⇒ [Repair Manual, Suspension, Wheels, Steering, Repair Group 40](#)

- Install lock carrier.

Oil pump, removing and installing



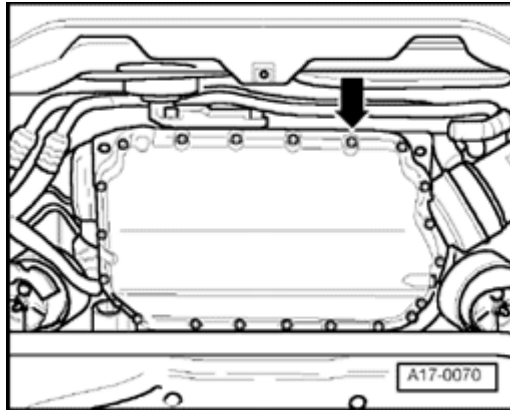
- Remove noise insulation panel (arrows).
- Drain engine oil.
- Collect engine oil in appropriate receptacle.



- Unbolt both stabilizer mounting brackets -2- from subframe.
- Lower stabilizer not more than 10 cm (3.94 in.) and secure using wire.

Vehicles with automatic transmission

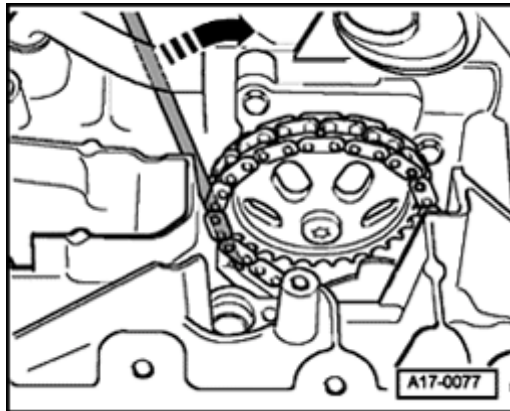
- Unbolt oil cooler line bracket from right-side of oil pan.



A

- Remove oil pan (lower part) ⇒ [page 17-10](#) .

Checking chain tensioner



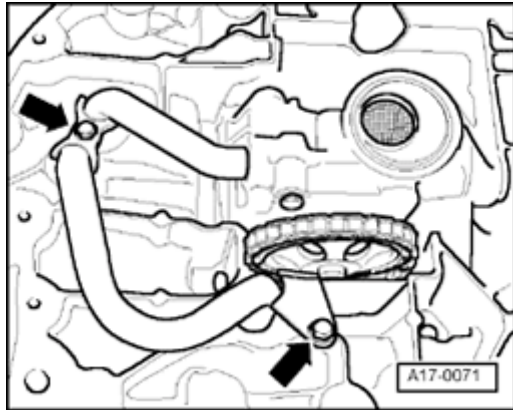
A

- Insert screwdriver between chain and chain tensioner and lift against chain tensioner.

If no spring tension is evident and chain is not under tension, chain tensioner is damaged and must be replaced.

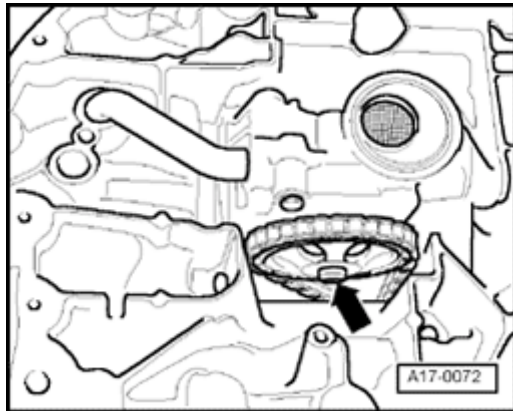
- Before replacing chain tensioner, remove front oil seal carrier ⇒ [page 17-26](#) .

17-21



A

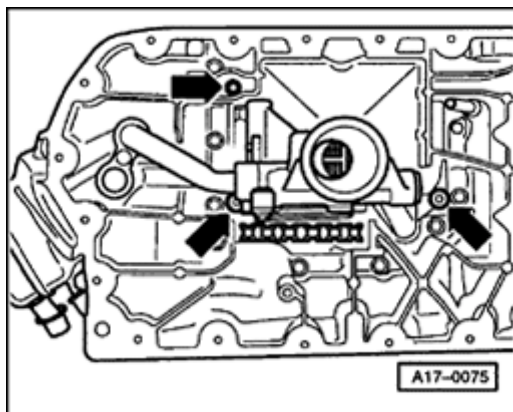
- Unbolt bracket for oil supply lines (arrows) and pull front oil supply line (longer line) down and remove.



A

- Using Torx® T45, unbolt chain sprocket from oil pump and pull off oil pump.

17-22



A

- Remove oil pump together with shorter oil supply line.

Installing

Installation is the reverse of removal, noting the following:

- Before installing oil pump, install short oil supply line together with O-rings into pump and into oil pan (upper part).
- Clean both sealing surfaces on oil pan (lower part) so they are free of oil and grease.

Note:

Do not use glue or sealant.

- Install new gasket on oil pan (lower part) and attach to oil pan (upper part) with two bolts diagonal to each other.
- Tighten all bolts hand tight.
- Starting in the center and moving toward the outside, tighten bolts to 10 Nm (7 ft lb).
- Install new seal on oil drain plug and tighten to 30 Nm (22 ft lb).

17-23

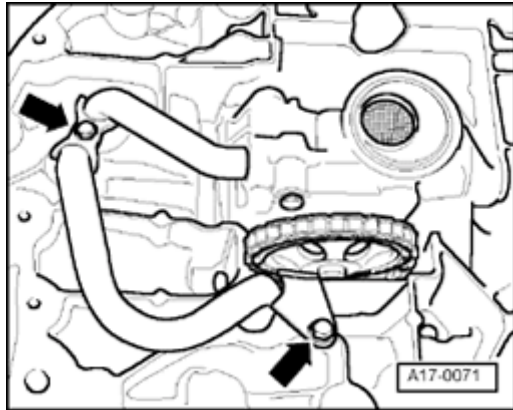
Tightening torques

Component		Tightening torque
Oil pan to cylinder block	M6	10 Nm (7 ft lb)
	M8	20 Nm (15 ft lb)
Oil pan (lower part) to oil pan (upper part)	M6	10 Nm (7 ft lb)
Oil pan to transmission	M8	25 Nm (18 ft lb)
	M10	45 Nm (33 ft lb)
Coolant line to oil pan		10 Nm (7 ft lb)
Oil drain plug in oil pan (lower part)		30 Nm (22 ft lb)

Component		Tightening torque
Dipstick tube to cylinder head	M6	10 Nm (7 ft lb)
	M8	25 Nm (18 ft lb)
Oil pump to engine block		25 Nm (18 ft lb)
Oil supply line for oil pump		10 Nm (7 ft lb)

to oil pan (upper part)		
Oil seal carrier, front	M6	10 Nm (7 ft lb)

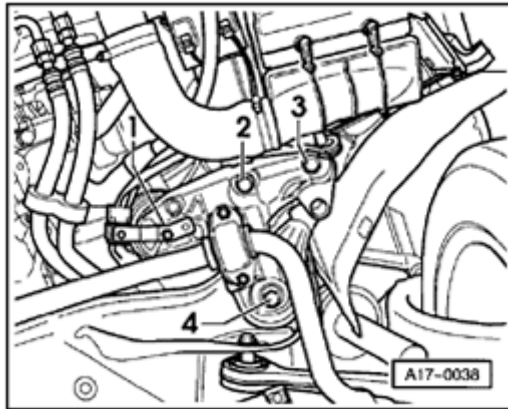
17-24



A

Component		Tightening torque
Collar screw	M8	30 Nm (22 ft lb)
Stabilizer bracket to subframe 1)		25 Nm (18 ft lb)
Coolant drain plug to engine		20 Nm (15 ft lb)
Torque support stop to bracket on engine		25 Nm (18 ft lb)
Engine mount to subframe		25 Nm (18 ft lb)
Torque support to front side of oil pan		25 Nm (18 ft lb)
Engine mount to engine support		25 Nm (18 ft lb)
Chain sprocket to oil pump		25 Nm (18 ft lb)
1) Replace all self-locking nuts after removal.		

17-25



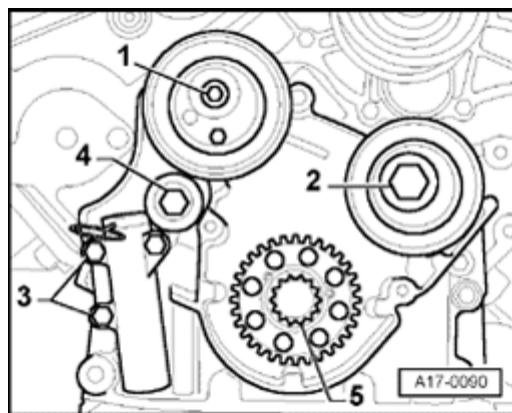
Other tightening torques

Component	Tightening torque
Nut for engine mount -1-	25 Nm (18 ft lb)
Bolts -2- and -3-	60 Nm (44 ft lb)
Combination bolt -4- 2)	110 Nm (81 ft lb) + 90°
2) Replace combination bolt -4- after removing.	

Front oil seal carrier and oil pump chain, removing and installing

Removing

- Remove ribbed belt ⇒ [page 13-8](#) .
- Remove toothed belt ⇒ [page 13-12](#) .
- Remove oil pan (upper part) and oil pan (lower part) ⇒ [page 17-10](#) .



4

- Before removing front oil seal carrier, remove following components:

1 - Toothed belt tensioner roller

Tightening torque: 20 Nm (15 ft lb)

2 - Idler roller

Tightening torque: 45 Nm (33 ft lb)

3 - Toothed belt tensioner

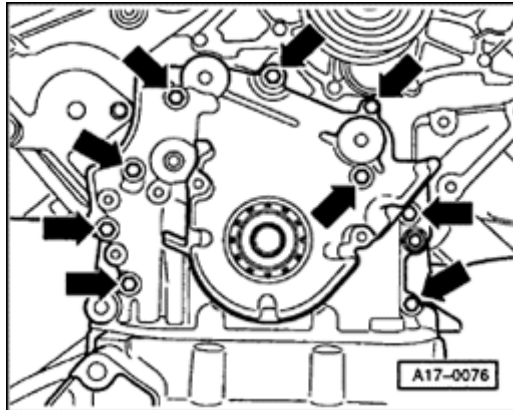
Tightening torque: 20 Nm (15 ft lb)

4 - Toothed belt tensioner lever

Tightening torque: 20 Nm (15 ft lb)

5 - Crankshaft center bolt and toothed belt sprocket

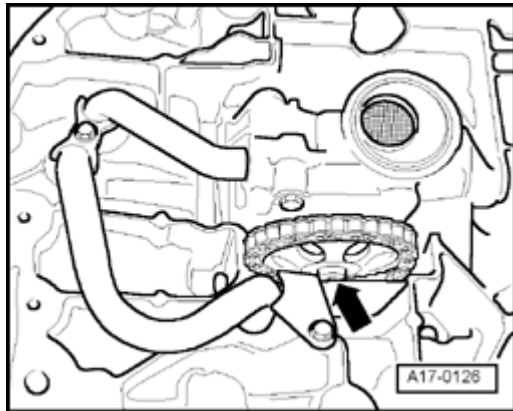
17-27



A

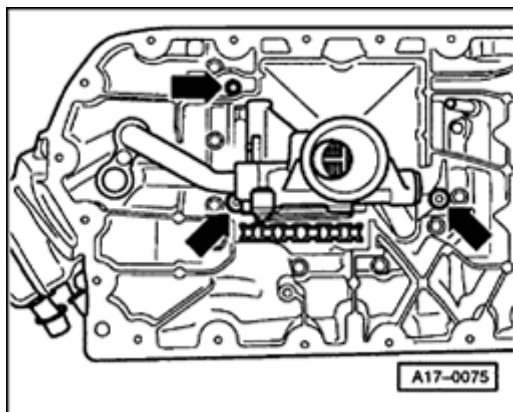
- Remove front oil seal carrier and remove gasket from front oil seal carrier (M6 bolts: 10 Nm, 7 ft lb) (Collar screw M8: 30 Nm 22 ft lb).

Replacing oil pump drive chain



A

- Using Torx® T45, unbolt chain sprocket from oil pump and pull off oil pump.



A

- Remove oil pump together with shorter oil supply line.
- Remove oil pump chain sprocket and remove drive chain from crankshaft ⇒ [page 17-26](#) .

Installing

Installation is the reverse of removal, noting the following:

- Remove any remaining sealant from front oil seal carrier and if necessary, from cylinder block.
- Clean sealing surfaces so they are completely free of any oil or grease.

Note:

Install gasket for front oil seal carrier dry.

- Tighten bolts for oil seal carrier.

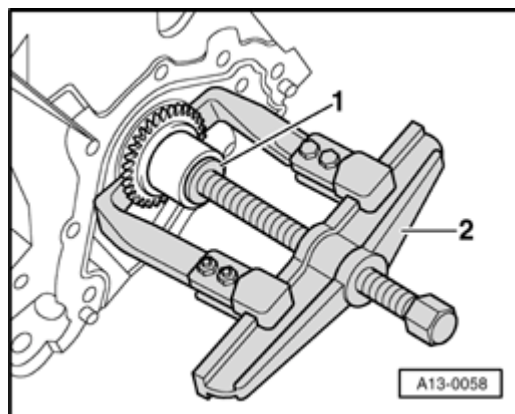
Tightening torque: M6 - 10 Nm (7 ft lb), M8 - 20 Nm (15 ft lb)

Oil pan (upper part) and oil pan (lower part), removing ⇒ [page 17-10](#) .

Oil pump chain sprocket on crankshaft, removing and installing

Removing

Front sealing flange and oil pump chain, removing and installing ⇒ [page 17-26](#) .



- Using puller -2-, remove crankshaft chain sprocket, while protecting crankshaft end with appropriate washer -1-.

Installing

- Warm chain sprocket in 220 ° C (428 ° F) oven for approx. 15 minutes.

WARNING!

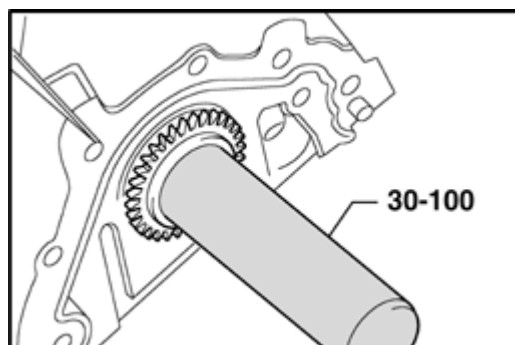
Wear protective gloves.

Note:

Installation position: wider collar of chain sprocket points toward engine.



- Using pliers, install chain sprocket on crankshaft end and slide onto crankshaft to stop using 30-100 press tube. If necessary, carefully tap with plastic hammer.



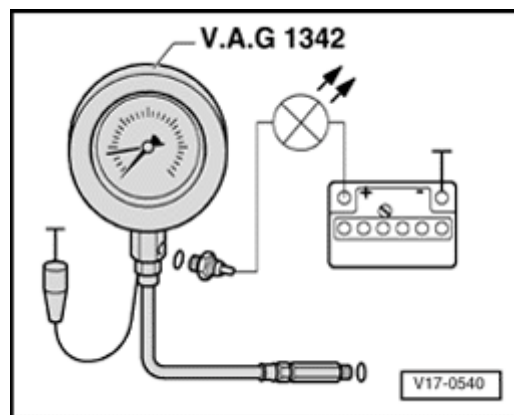
Lubrication system components, checking

Oil pressure and oil pressure switch, checking

Note:

For the functional check and servicing of the optical and acoustic oil pressure warning ⇒ "Electrical Wiring Diagrams, Troubleshooting & Component Locations".

Test sequence



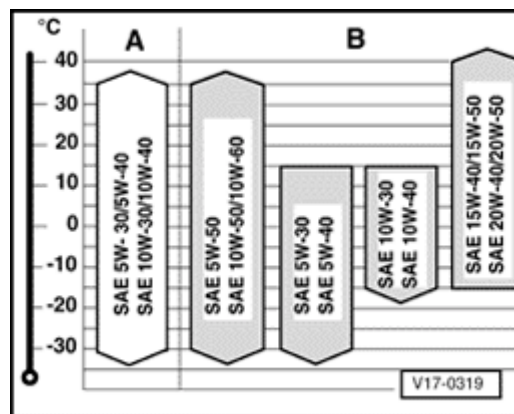
- Remove oil pressure switch -F1- and install in tester.
- Install tester into oil pan in place of oil pressure switch.
- Connect brown wire of tester to Ground (GND).
- Using auxiliary cables from VW1594, connect VAG1527B voltage tester to oil pressure switch and Battery (+).
- Start engine and slowly increase engine speed (RPM).
At 1.2-1.6 bar pressure LED must light up.
- If not, replace oil pressure switch.
- Increase engine speed (RPM) further.
- At 2000 rpm and an oil temperature of 80 ° C, oil pressure must be at least 2.0 bar.

Engine oil

Engine oil capacity (w/filter): 5.7 L (6.0 qt.).

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

Viscosity classes and oil specifications



A

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

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

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

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

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

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

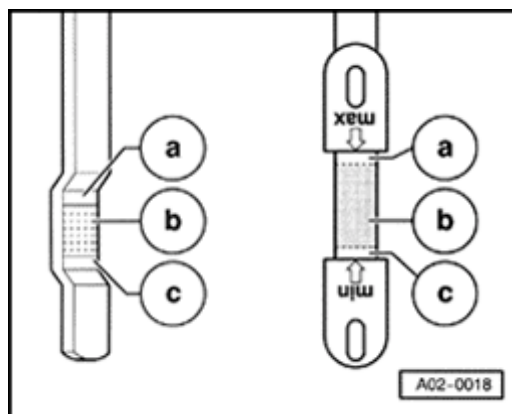
²⁾ These oils may only be used in exceptional cases if no approved engine oil is available.

Mixing oils when topping up is permissible.

Oil level, checking

Test requirements

- Minimum engine oil temperature 60 ° C
 - Vehicle must be standing on level ground when checking oil level
 - After stopping engine, wait a few minutes to allow oil to flow back into oil pan
- Withdraw dipstick, wipe using clean cloth and reinsert fully.
- Withdraw dipstick again and read oil level.



Range of markings on dip stick:

- a - Oil MUST NOT be topped off.
- b - Oil may be topped off. After topping off, oil may reach range -a-.
- c - Oil MUST BE topped off. After topping off, it is sufficient if oil level is somewhere in range -b- (shaded area).

CAUTION!

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

Cooling system components, removing and installing

WARNING!

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

Notes:

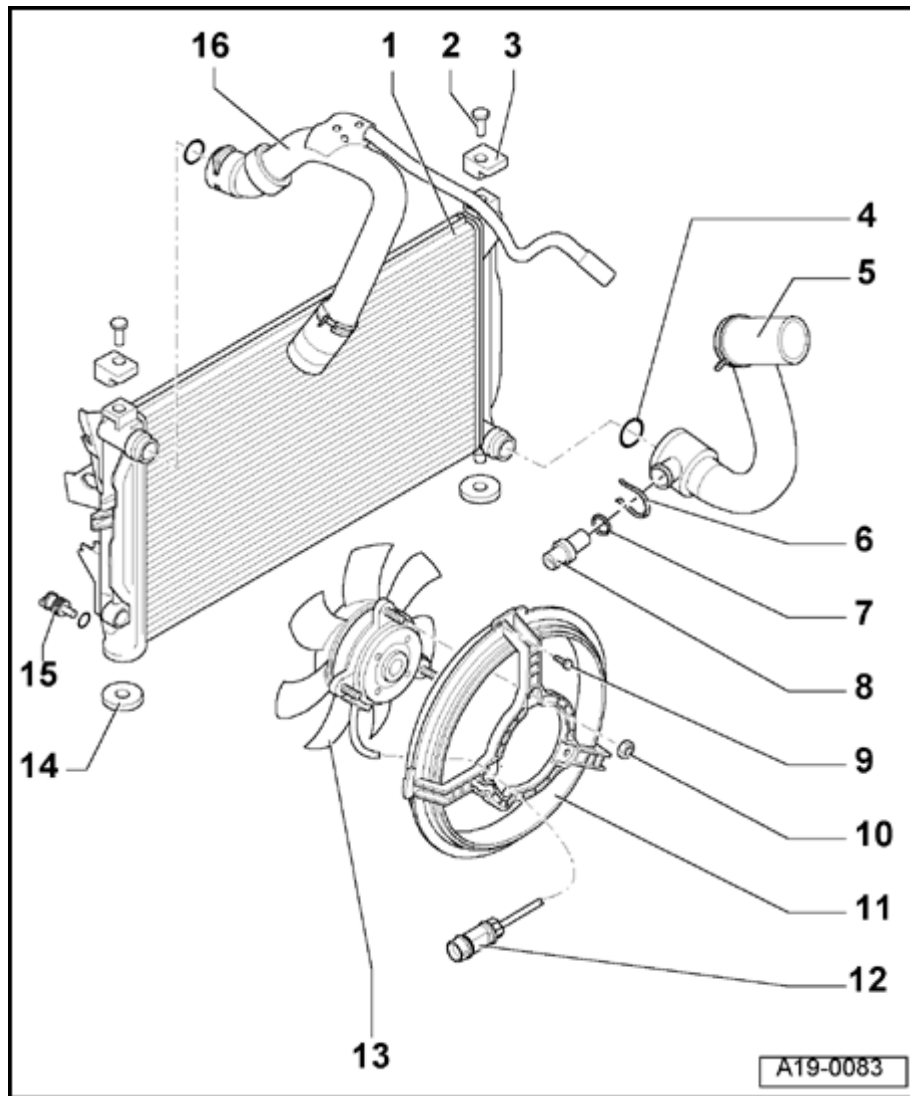
- ◆ *Hoses are secured with spring-type clips. If servicing, only use the same type of spring-type clip.*

⇒ *Parts catalog*

- ◆ *VAG1921 pliers are recommended when installing spring-type clips.*
- ◆ *The O-rings installed at the quick-release connections must be replaced if damaged or leaking.*
- ◆ *Seals and gaskets must always be replaced.*

- ◆ *When installing coolant hoses, make sure they are free of stress and do not come into contact with other components (the arrows which are located on the coolant pipes and coolant hoses must be opposite each other).*

Perform cooling system leakage test using VAG 1274 cooling system tester and 1274/9 adapter.



Cooling system components (on body)

1 - Radiator

- ◆ Removing and installing ⇒ [page 19-17](#)
- ◆ After replacing, completely replace coolant
- ◆ With ATF cooler on vehicles with automatic transmission

2 - Securing clip

3 - Securing rubber

4 - O-ring

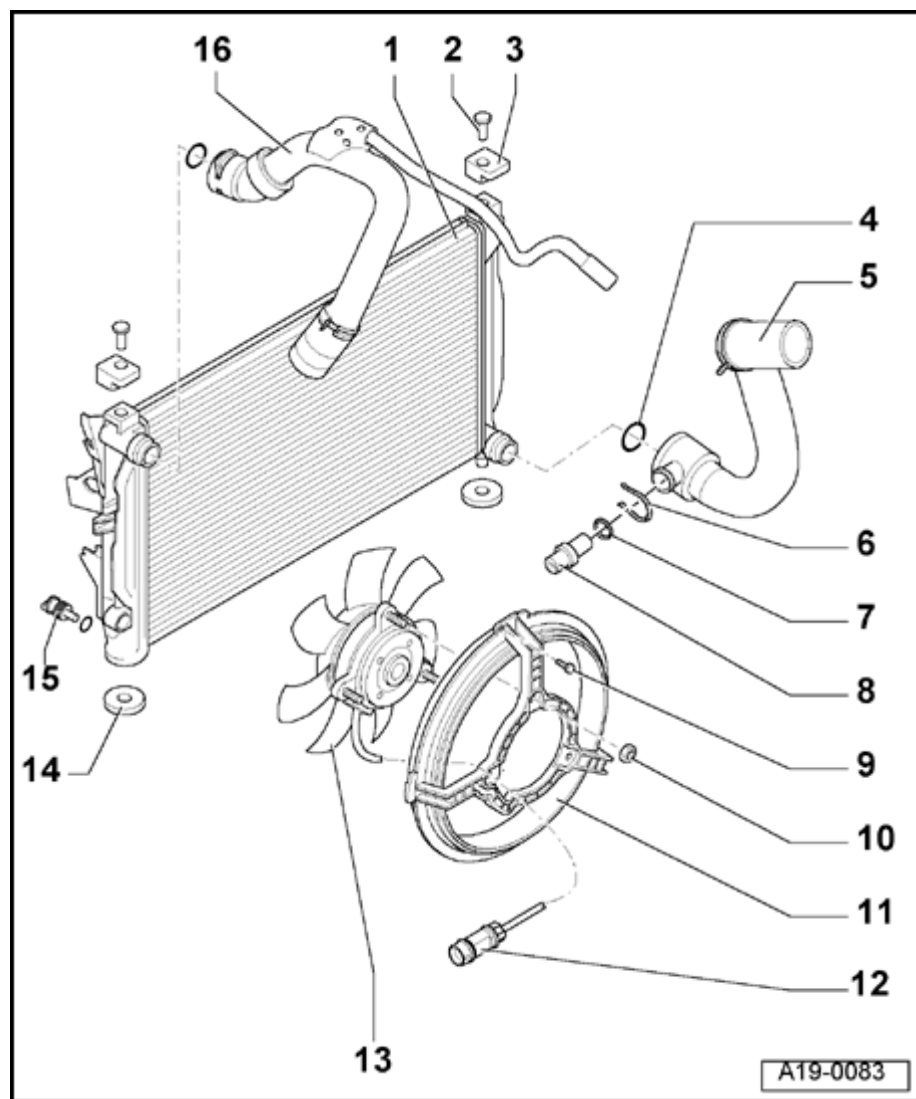
- ◆ Replace if damaged

5 - Lower coolant hose

- ◆ Secured to radiator with retaining clip
- ◆ Make sure hose is securely seated
- ◆ Coolant hose connection diagram ⇒ [page 19-9](#)

6 - Securing clip

- ◆ To secure temperature switch in coolant hose

**7 - O-ring**

- ◆ Replace if damaged

8 - Coolant Fan Control (FC) thermal switch - F18-

- ◆ 35 Nm (26 ft lb)
- ◆ For electric coolant fan

Switching temperatures, stage 1:

- ◆ On: 92-97 °C (198-207 °F)
- ◆ Off: 84-91 °C (183-196 °F)

Switching temperatures, stage 2:

- ◆ On: 99-105 °C (210-221 °F)
- ◆ Off: 91-98 °C (196-208 °F)

9 - Locking bolt**10 - 10 Nm (7 ft lb)****11 - Fan ring**

- ◆ Clipped into air ducting and secured with locking 9 bolt

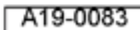
12 - 2-pin harness connector**13 - Coolant fan -V7-**

- ◆ Checking ⇒ [page 19-26](#)

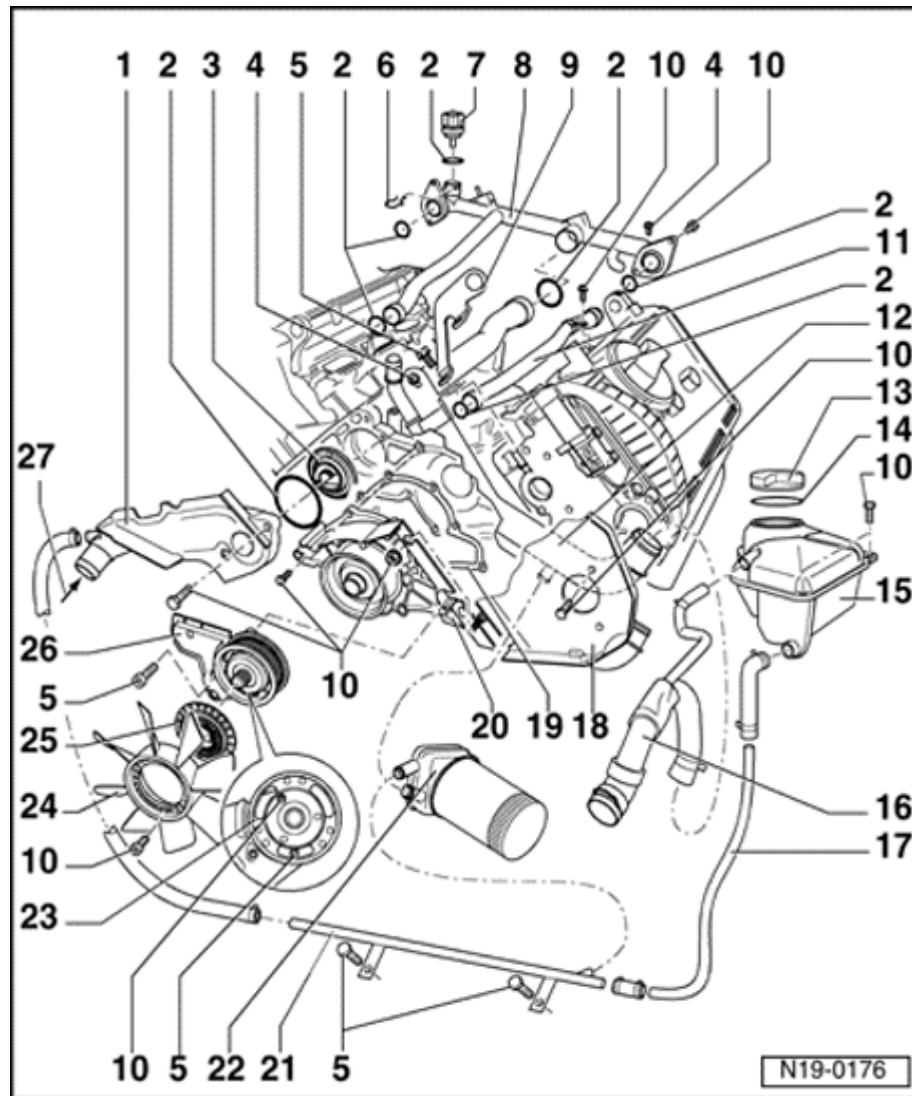
14 - Rubber washer

15 - Coolant drain plug

◆ 10 Nm (7 ft lb)



- ◆ Secured to radiator with retaining clip
- ◆ Make sure hose is securely seated
- ◆ Coolant hose connection diagram ⇒ [page 19-9](#)



Cooling system components (on engine)

1 - Connection

- ◆ For thermostat

2 - O-ring

- ◆ Always replace

3 - Coolant thermostat

- ◆ Removing and installing ⇒ [page 19-23](#)
- ◆ Note installation position ⇒ [page 19-23](#)

Checking:

- ◆ Heat thermostat in water
- ◆ Opening begins at approx. 86° C (187° F)
- ◆ Min. opening: 7 mm (0.28 in.)

4 - Bleeder screw

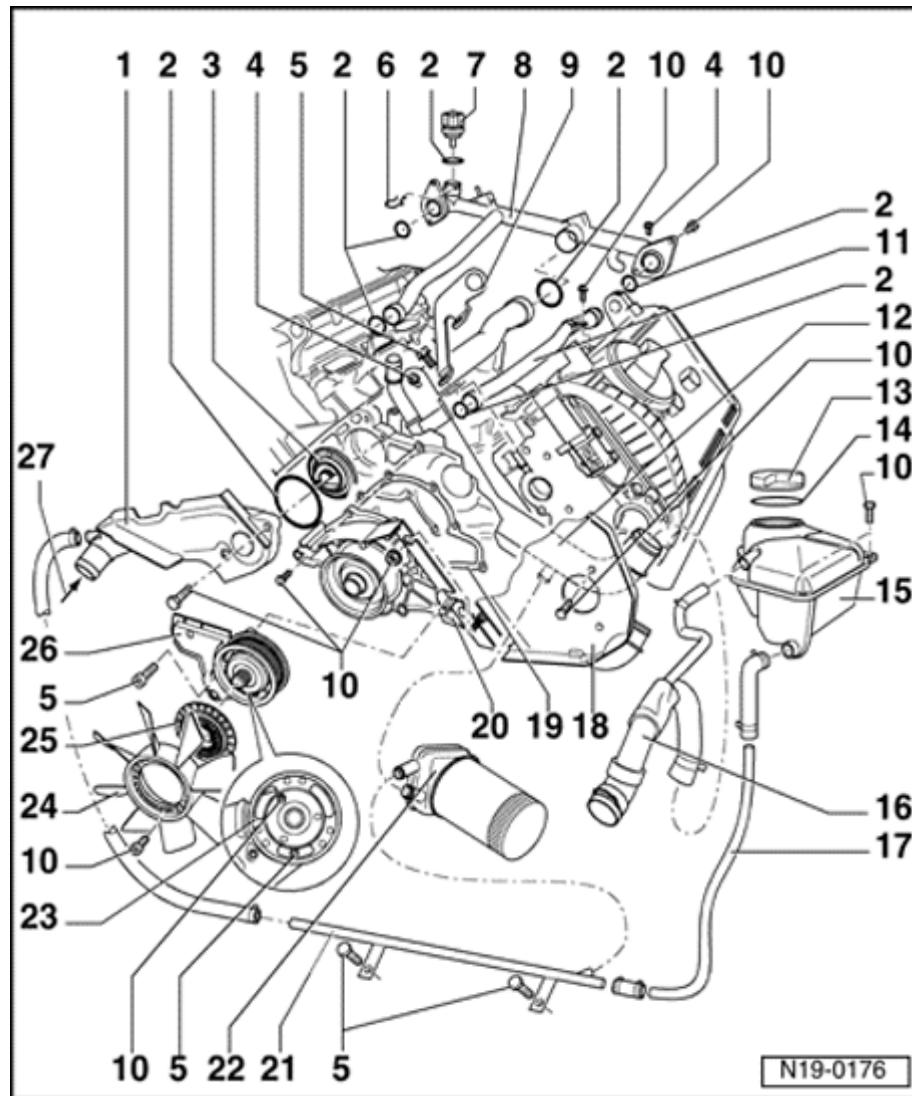
- ◆ 20 Nm (15 ft lb)

5 - Bolt

- ◆ 25 Nm (18 ft lb)

6 - Retaining clip

- ◆ Make sure clip is seated securely



7 - Engine Coolant Temperature (ECT) sensor -G62-

- ◆ For Engine Control Module (ECM)
- ◆ If necessary, release pressure in cooling system before removing
- ◆ Checking ⇒ Repair Manual, 2.8 Liter V6 5V Fuel Injection & Ignition, Repair Group 01

8 - Rear coolant line

- ◆ Coolant hose connection diagram ⇒ [page 19-9](#)

9 - Lifting eye

10 - 10 Nm (7 ft lb)

11 - Coolant line

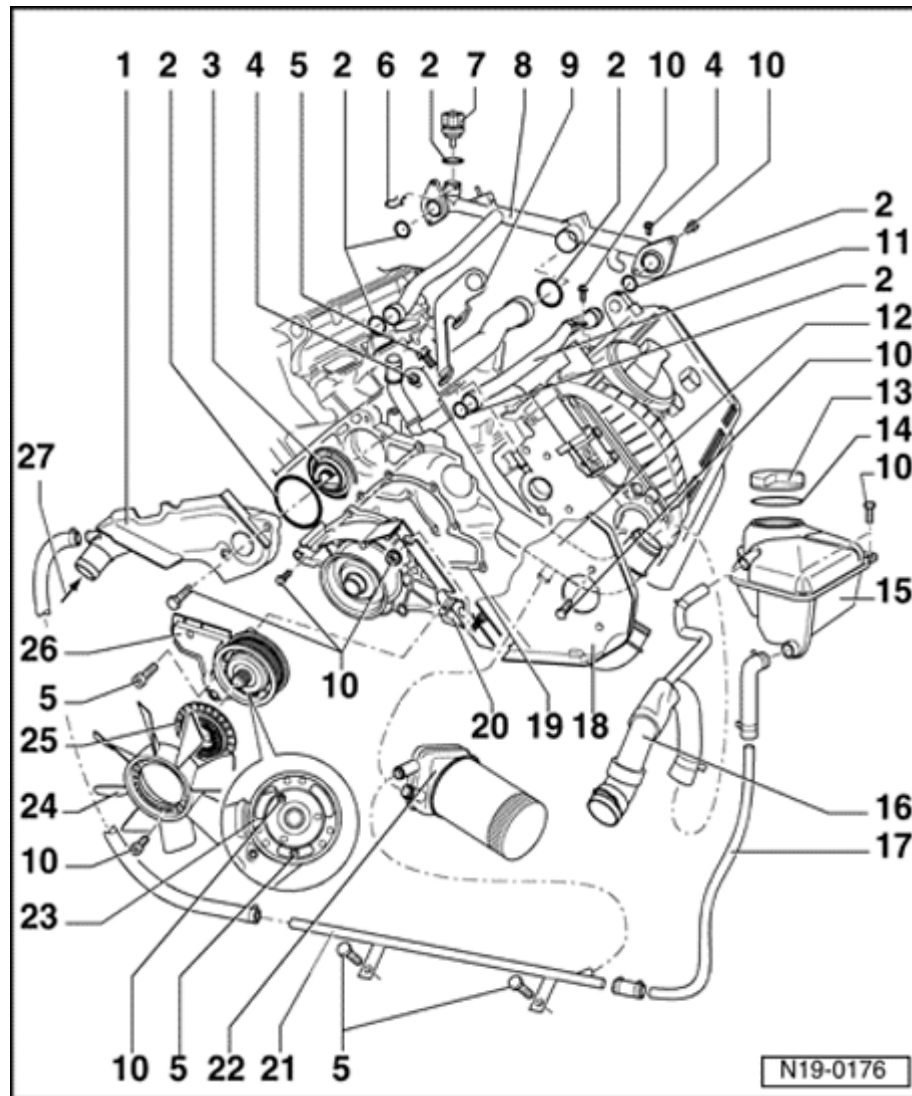
- ◆ Coolant hose connection diagram ⇒ [page 19-9](#)

12 - Front coolant hose

- ◆ Coolant hose connection diagram ⇒ [page 19-9](#)

13 - Sealing cap

- ◆ Check using VAG1274 cooling system tester with VAG1274/8 adapter
- ◆ Test pressure: 1.4-1.6 bar (20-23 psi)

**14 - O-ring**

- ◆ Replace if damaged

15 - Expansion tank

- ◆ Check using VAG1274 cooling system tester with VAG1274/9 adapter

16 - Upper coolant hose

- ◆ Secured to radiator with retaining clip
- ◆ Make sure hose is securely seated
- ◆ Coolant hose connection diagram ⇒ [page 19-9](#)

17 - Coolant line

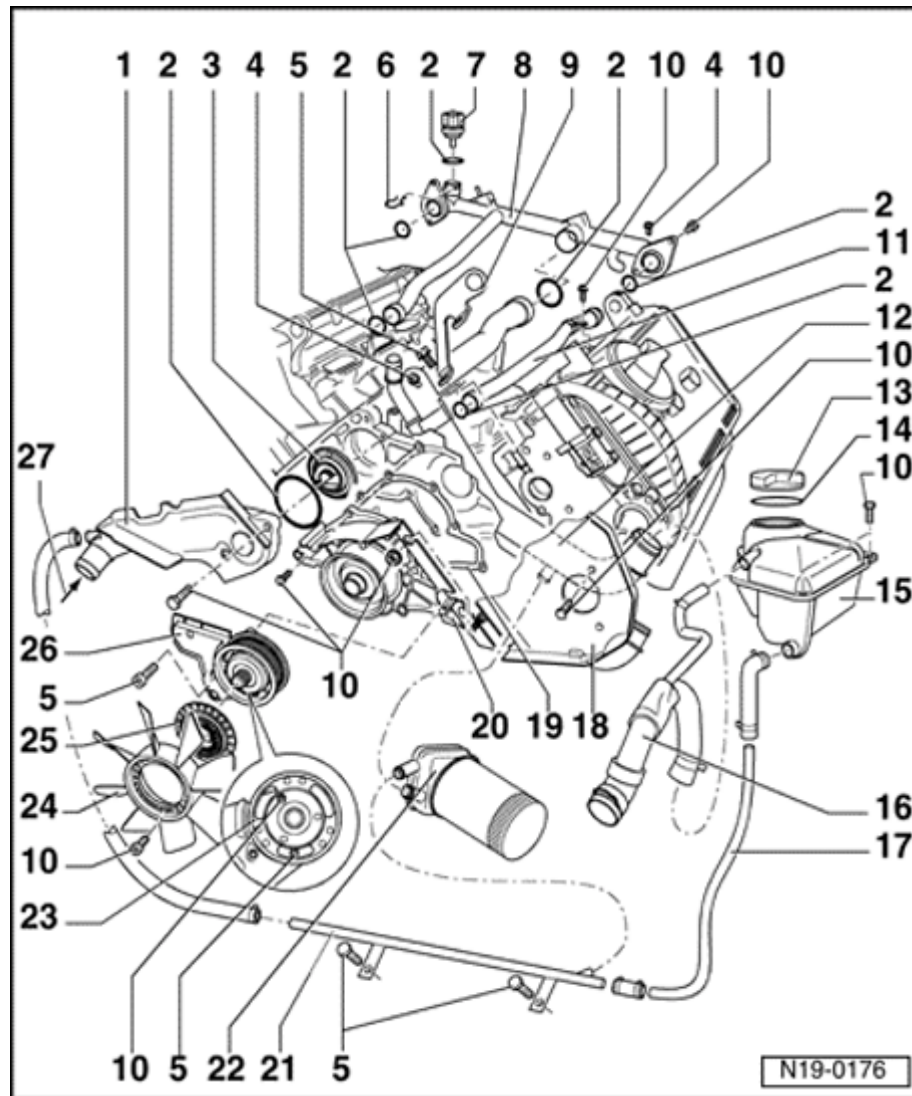
- ◆ Coolant hose connection diagram ⇒ [page 19-9](#)

18 - Rear toothed belt guard**19 - Gasket**

- ◆ Always replace

20 - Coolant pump

- ◆ Check for ease of movement
- ◆ Completely replace if damaged or leaking
- ◆ Removing and installing ⇒ [page 19-20](#)

**21 - Lower coolant line**

- ◆ Coolant hose connection diagram ⇒ [page 19-9](#)

22 - Oil cooler**23 - Belt pulley**

- ◆ For viscous fan

24 - Fan wheel for viscous fan**25 - Viscous fan coupling**

- ◆ Note left-hand thread
- ◆ Tightening torque only valid when using 3312 open end spanner.
- ◆ Tighten to 40 Nm (30 ft lb)
- ◆ Removing and installing ⇒ [page 19-25](#)

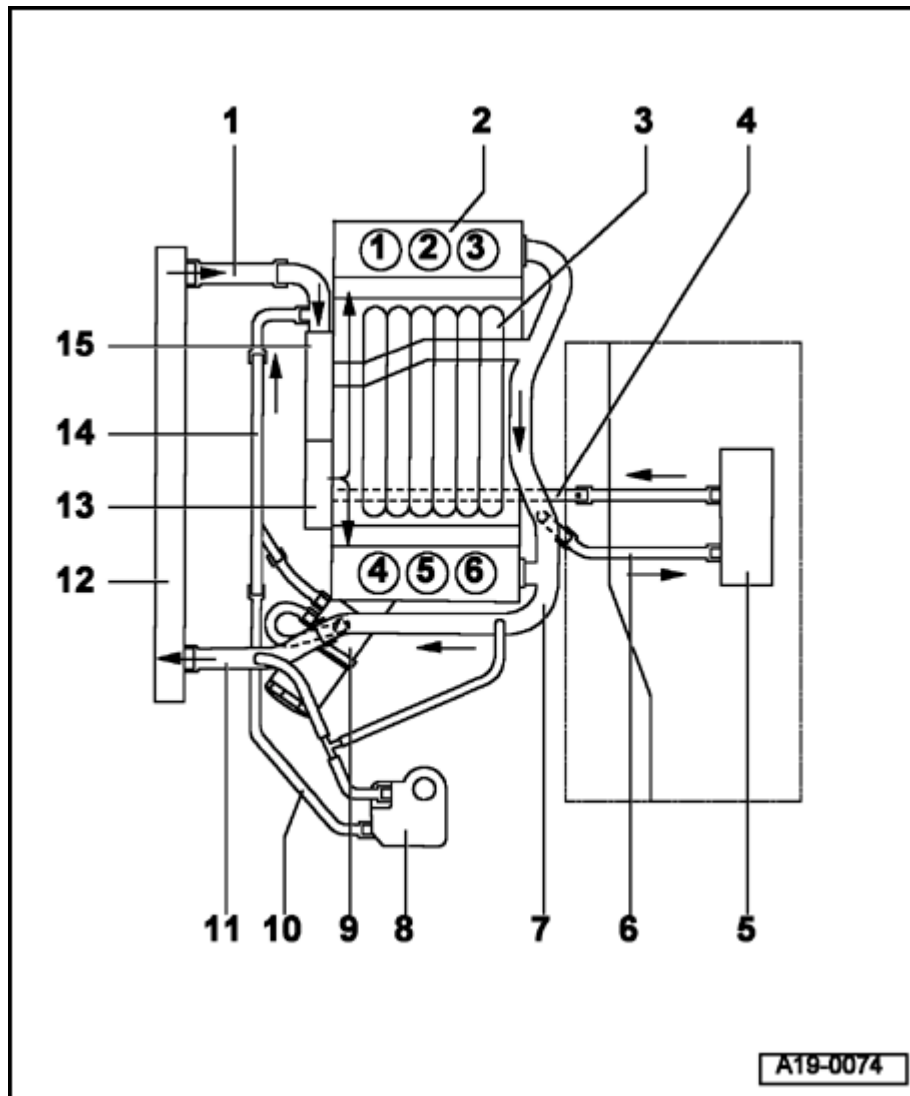
26 - Bracket

- ◆ For viscous fan

27 - From bottom of radiator

- ◆ Coolant hose connection diagram ⇒ [page 19-9](#)

19-9



Coolant hose connection diagram

1 - Lower coolant hose

◆ From radiator to engine

2 - Cylinder head/cylinder block

3 - Intake manifold

4 - Coolant line

◆ From heat exchanger to engine block

5 - Heater core

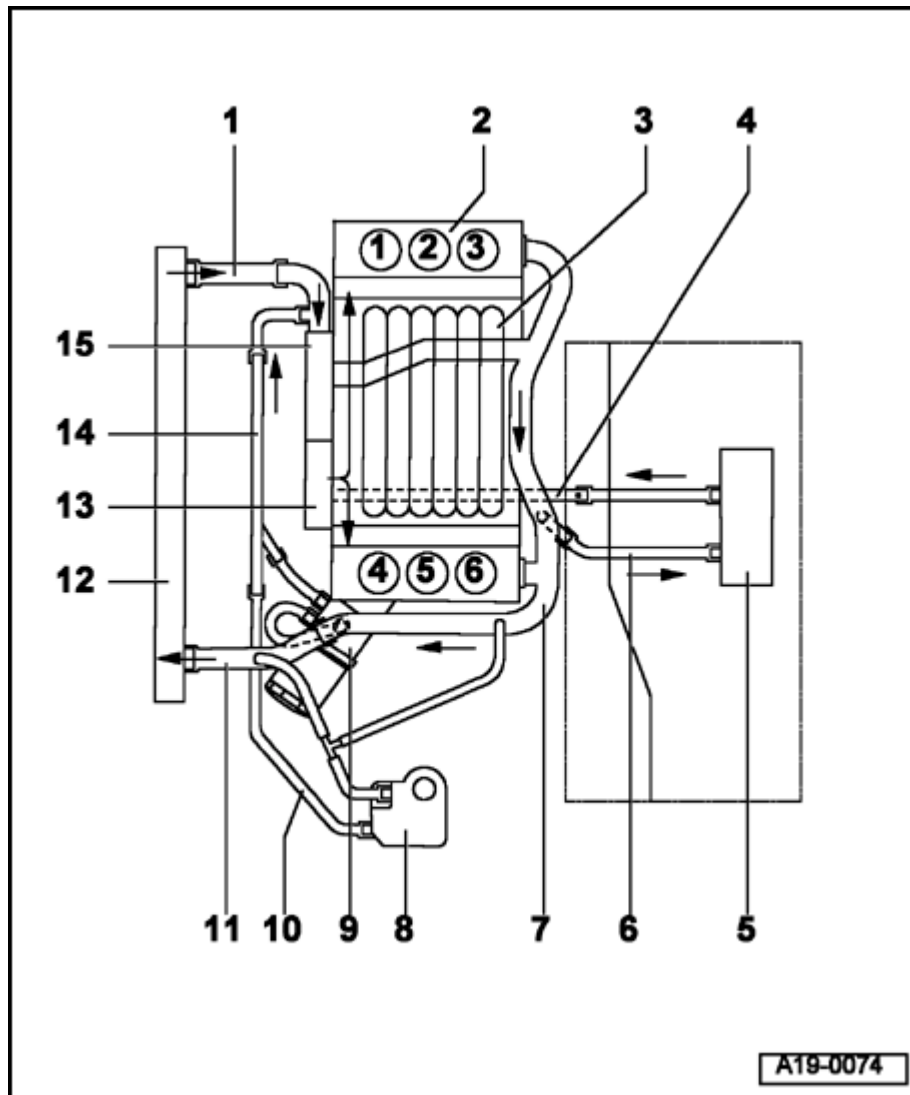
6 - Coolant hose

◆ To heat exchanger

7 - Rear coolant line

8 - Expansion tank

19-10



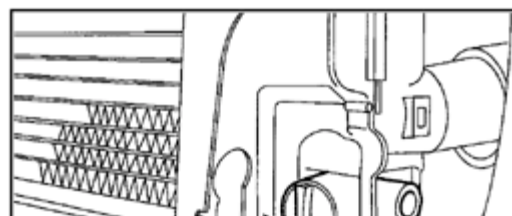
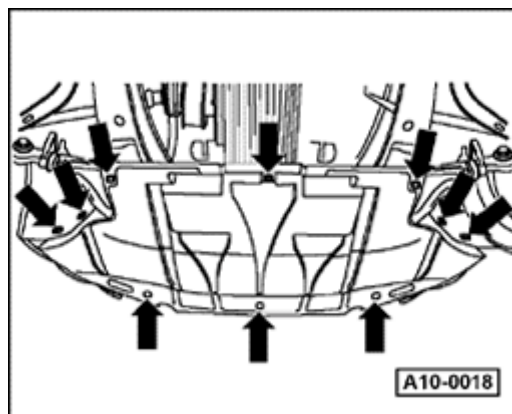
Cooling system, draining and refilling

Draining

WARNING!

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

- Open coolant expansion tank cap.
- Remove noise insulation panel.
- Place VAG1306 drip tray underneath engine.



- With bumper removed, open coolant drain plug (arrow) on lower left of radiator by turning it counterclockwise. If necessary, attach accessory hose to connection.
- With bumper installed, pull off retaining clamp for lower right radiator

hose (from radiator to engine) and disconnect radiator hose from radiator.

CAUTION!

Follow disposal regulations for coolant.



- Drain engine coolant at drain plug (arrow).

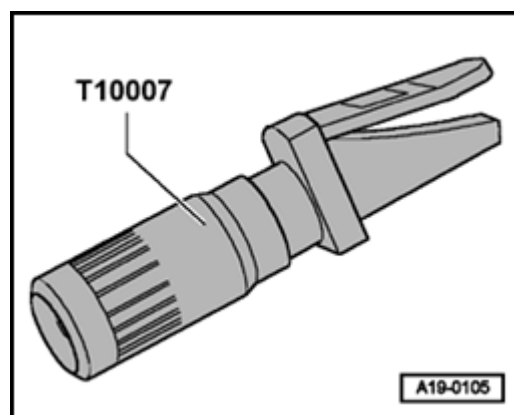
Filling

Notes:

- ◆ Only use coolant additive G12 (according to TL VW 7745 D). G12 is red in color.
- ◆ Do not mix G12 with any other coolant additive!
- ◆ If the fluid in expansion tank is brown, G12 has been mixed with other coolant. In this case, the coolant must be flushed and replaced.
- ◆ "G12" and coolant additives marked in accordance with "TL VW 774 D" prevent frost and corrosion damage, scaling and also raise the boiling point of the coolant. Therefore, the cooling system must be filled year round with frost and corrosion protection additives.
- ◆ A higher boiling point improves engine reliability under heavy load particularly in countries with tropical climates.
- ◆ Frost protection additives protect against frost to about -25°C (about -35°C in arctic climates).
- ◆ The coolant concentration must not be reduced by adding water even in warmer seasons and in warmer countries. The anti-freeze ratio must be at least 40%.

Note (continued from page ⇒ [Page 19-12](#)):

- ◆ *If for climatic reasons greater frost protection is required, the amount of G 12 can be increased, but only up to 60% (frost protection to about -40 ° C), otherwise frost protection and cooling effectiveness will be reduced.*
- ◆ *If the radiator, heat exchanger, cylinder head or cylinder head gasket is replaced, completely replace the engine coolant.*



Test coolant frost protection using T10007 special tool.

Recommended mixture ratios:

Frost protection to	Anti-freeze amount	G 121)	Water 1)
-25 ° C (-13 ° F)	40 %	2.5 l (2.7 qt.)	3.5 l (3.7 qt.)
-35 ° C (-31 ° F)	50 %	3.0 l (3.2 qt.)	3.0 l (3.2 qt.)

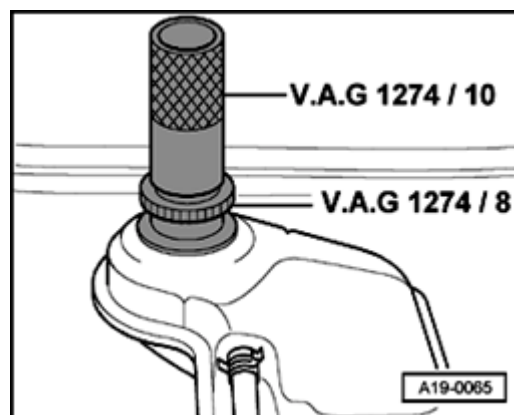
¹⁾ The quantity of coolant can vary depending upon the equipment installed in the vehicle.

19-14

- Replace coolant drain plug O-ring and install coolant drain plug into engine.

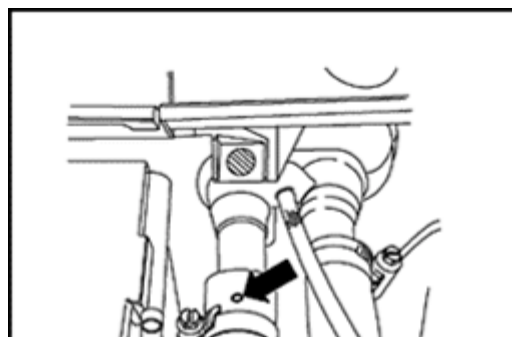
Tightening torque: 20 Nm (15 ft lb).

- Install lower right coolant hose and secure with retaining clip.
- Secure coolant drain valve to radiator.



A

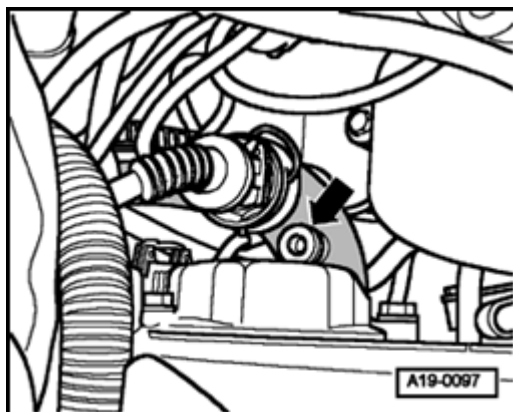
- Screw VAG1274/9 onto expansion tank and insert VAG1274/10 into adapter.



A

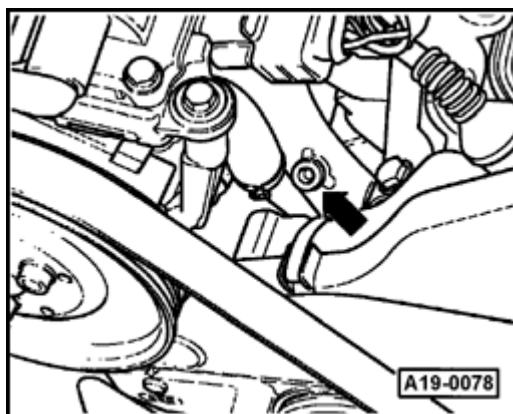
- Loosen clamp on coolant hose on heater core and pull back hose until bleeder hole in coolant hose (arrow) is no longer sealed by connection.
- Top off coolant until it flows out from bleeder hole in coolant hose.
- Push coolant hose onto connection and tighten.

19-15



A

- Loosen bleeder screw on lower coolant line (arrow) under expansion tank (if necessary, unbolt expansion tank).
- Top off coolant until it flows out from bleeder screw.
- Close bleeder screw and tighten to 20 Nm (15 ft lb).



A

- Loosen bleeder screw on front coolant line (arrow) between power steering pump and left-side of cylinder head.
- Top off coolant until it flows out from bleeder hole in coolant line.
- Close bleeder screw and tighten to 20 Nm (15 ft lb).
- Top up coolant to MAX mark.
- Install coolant expansion tank cap.
- Set heater controls to maximum heat position.
- Start engine and let run at idle for approx. 10 minutes.

- Raise engine speed to approx. 2000 rpm for approx. 5 minutes.
- Allow engine to idle until lower coolant hose on radiator is hot.
- Check coolant level and top-off if necessary. When engine is at normal operating temperature, coolant level must be on MAX mark. When engine is cold, coolant level must be between MIN and MAX marks.

WARNING!

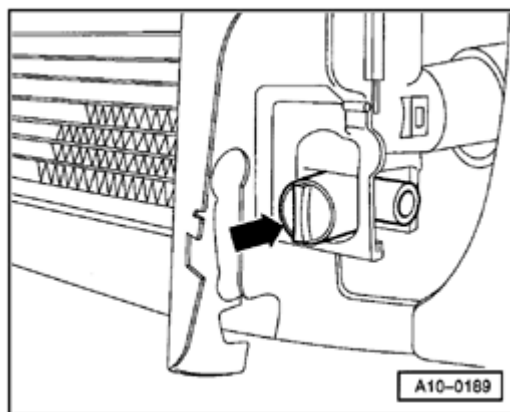
The cooling system is pressurized when the engine is warm. When opening the expansion tank, wear gloves and other appropriate protection, cover the cap with a cloth and open carefully to relieve system pressure slowly.

Radiator, removing and installing

Removing

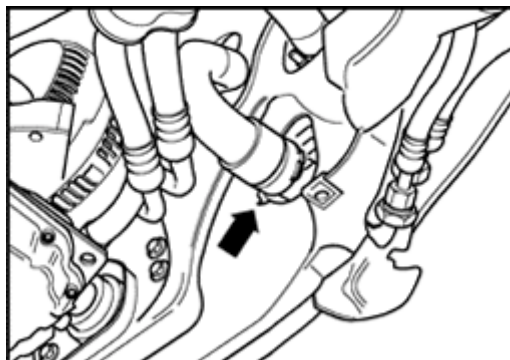
- Remove front bumper.

⇒ [Repair Manual, Body Exterior, Repair Group 63](#)



A

- Drain coolant at drain plug (arrow) ⇒ [page 19-11](#) .



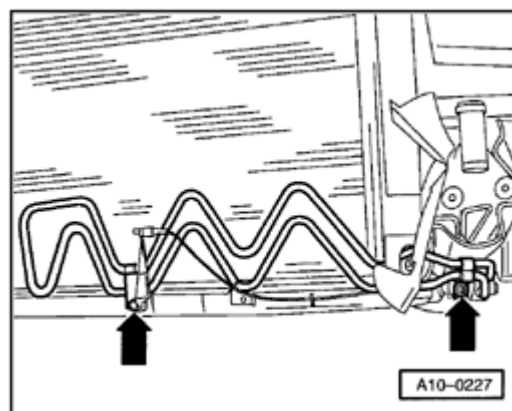
A

- Disconnect coolant hoses at radiator, unhinge clamp from connection flange (arrow).
- Disconnect connector from temperature switch at bottom-left of radiator.

Vehicles with automatic transmission

- Remove ATF lines from radiator.

⇒ [Repair Manual, 5 Spd. Automatic Transmission 01V, Repair Group 37](#)



All models

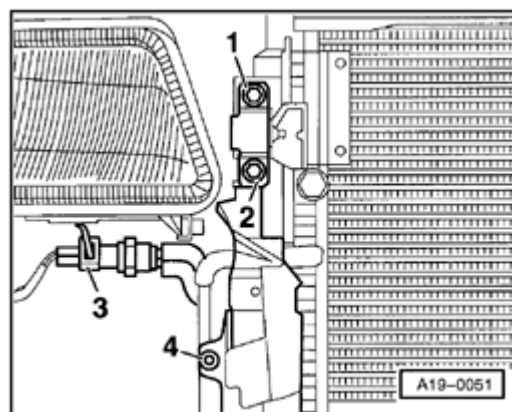


- Unbolt power steering hydraulic oil cooling line (arrows).

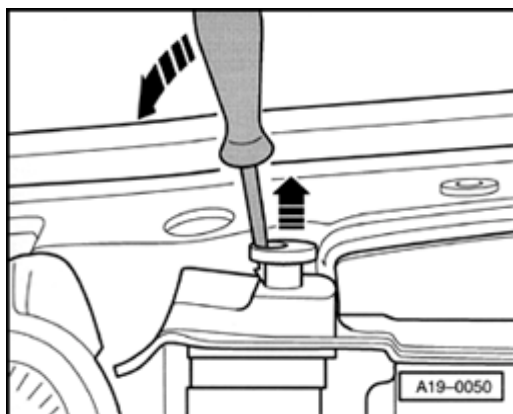
Vehicles with air conditioning

CAUTION!

- ♦ **DO NOT open the air conditioning refrigerant circuit.**
- ♦ **Disconnect A/C refrigerant lines at brackets and support points only.**
- ♦ **Avoid damage from bending. Refrigerant lines kink easily.**



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



All models



- Release both radiator retaining bolts, pull up and remove (arrows).
- Tilt radiator toward front, lift up and remove.

Installing

Installation is the reverse of removal, noting the following:

- Fill up coolant ⇒ [page 19-11](#) .

Vehicles with automatic transmission

- Check ATF level.

⇒ [Repair Manual, 5 Spd. Automatic Transmission 01V, Repair Group 37](#)

Tightening torques

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

Coolant pump, removing and installing

Notes:

- ◆ *Always replace seals and gaskets.*
- ◆ *Cover the toothed belt with a cloth to protect it from coolant before removing the coolant pump.*

Removing

- Remove front bumper.

⇒ [Repair Manual, Body Exterior, Repair Group 63](#)

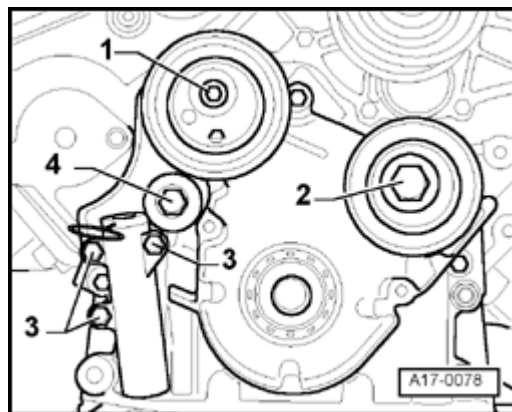
- Move lock carrier into service position.

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

- Remove ribbed belt ⇒ [page 13-8](#) .
- Remove toothed belt ⇒ [page 13-12](#) .

- Drain coolant ⇒ [page 19-11](#) .

19-21



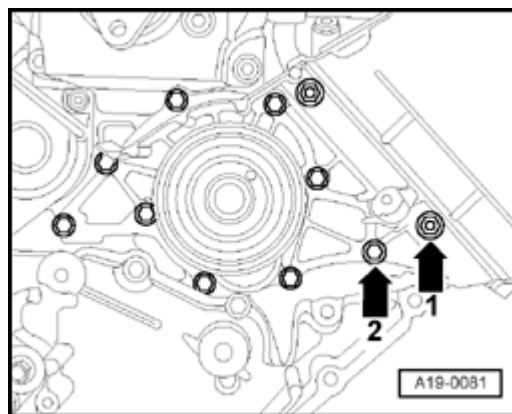
- Remove the following components before removing coolant pump:

1 - Toothed belt tensioner roller

Tightening torque: 20 Nm (15 ft lb)

2 - Idler roller

Tightening torque: 45 Nm (33 ft lb)

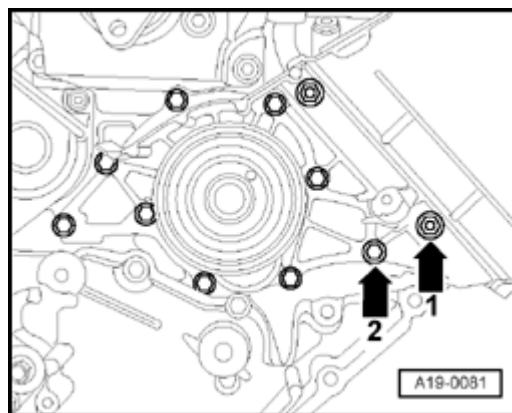


- Remove coolant pump mounting bolts -1- and remove coolant pump - 2-.

Installing

Installation is the reverse of removal, noting the following:

- Remove any remaining sealant from sealing surfaces of coolant pump and cylinder block.
- Clean sealing surfaces so they are completely free of any oil or grease.
- Install new gasket on water pump flange.
- Install coolant pump -2- into cylinder block and tighten all 9 mounting bolts (arrow -2-) to 10 Nm (7 ft lb).
- Install rear toothed belt guard on water pump housing (arrow -1-).
Tightening torque: 10 Nm (7 ft lb).
- Install and tension toothed belt ⇒ [page 13-12](#) .
- Install toothed belt guard.
- Install ribbed belt ⇒ [page 13-8](#) .
- Fill cooling system with coolant ⇒ [page 19-11](#) .



A

Thermostat, removing and installing

Notes:

- ◆ *Always replace seals and gaskets.*
- ◆ *Cover the toothed belt with a cloth to protect it from coolant before removing thermostat.*

Removing

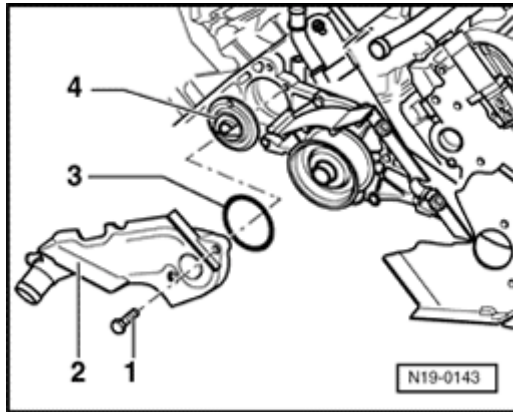
- Drain coolant ⇒ [page 19-11](#) .
- Remove front bumper.

⇒ [Repair Manual, Body Exterior, Repair Group 63](#)

- Lock carrier in service position

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

- Remove ribbed belt ⇒ [page 13-8](#) .



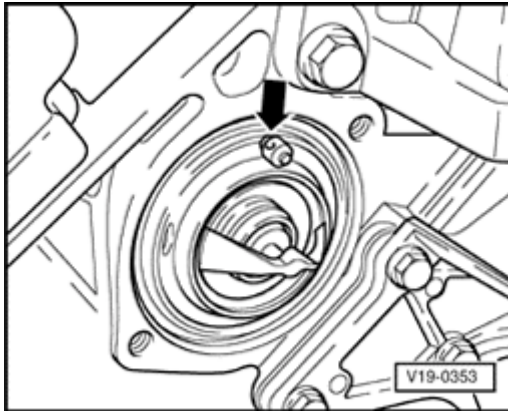
- Remove toothed belt ⇒ [page 13-12](#) .

4

- Remove connection mounting bolts -1- and remove connection -2-.
- Remove thermostat -4-.

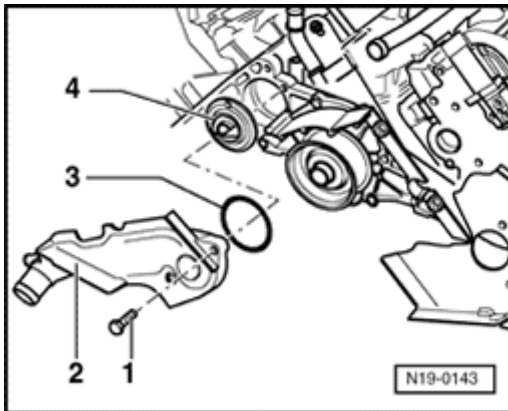
Installing

Installation is the reverse of removal, noting the following:



A

- Bleeder valve for thermostat (arrow) must be at the top.
- Install thermostat -4- into engine block.
- Moisten new O-ring -3- with coolant.



A

- Install connection -2- for thermostat and tighten bolt -1- to 10 Nm (7 ft lb).
- Install and tension toothed belt ⇒ [page 13-12](#) .
- Install ribbed belt ⇒ [page 13-8](#) .
- Fill cooling system with coolant ⇒ [page 19-11](#) .

Viscous fan, removing and installing

Removing

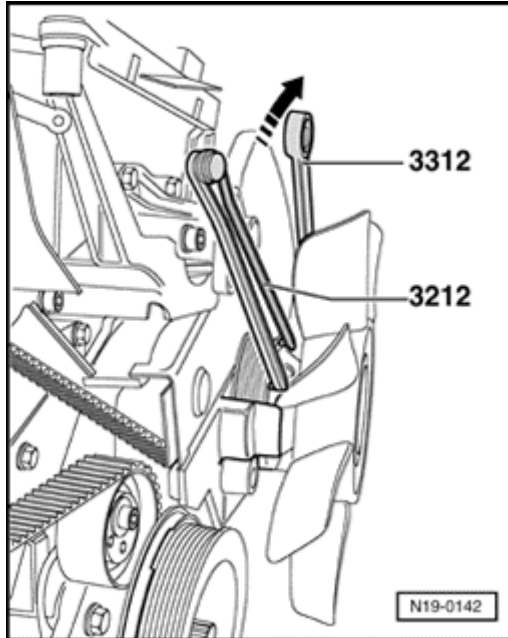
A

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

Installing

Installation is the reverse of removal, noting the following:

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



19-26

Coolant fan, checking

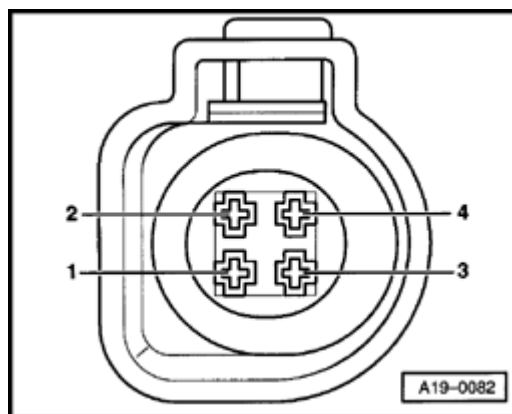
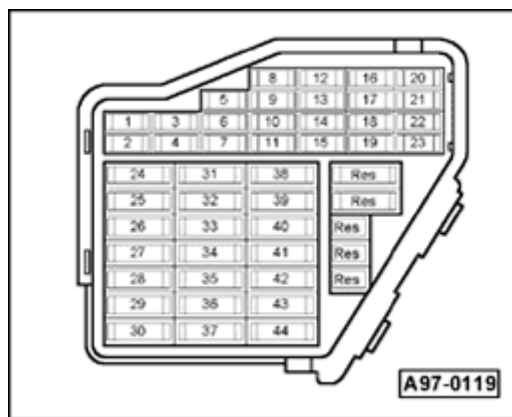
Test requirements



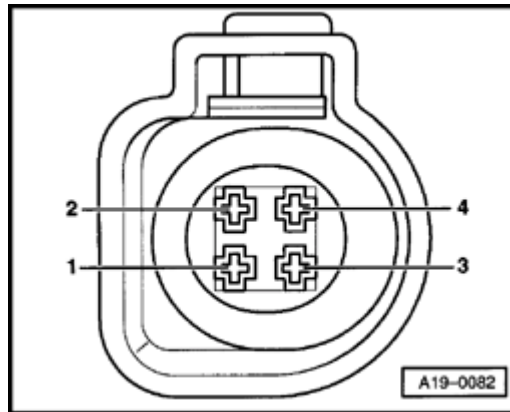
- Fuse No. 34 OK
- Coolant Fan Control (FC) thermal switch -F18- OK

Test procedure

- Disconnect 3-pin harness connector from coolant Fan Control (FC) thermal switch -F18- at bottom left of radiator.
 - Switch ignition on.
 - Bridge terminal -1- and terminal -2- of harness connector using auxiliary cables from VW1594 connector test kit.
- Coolant fan -V7- must run on 1st speed.



19-27



- Bridge terminal -1- and terminal -3- of harness connector using auxiliary cables from VW1594 connector test kit.

Coolant fan -V7- must run on 2nd speed.

If 1st or 2nd fan speed does not run:

- Locate and repair open circuit using wiring diagram:

⇒ *Electrical Wiring Diagrams, Troubleshooting & Component Locations*

If no open circuit can be found:

- Replace coolant fan -V7-.

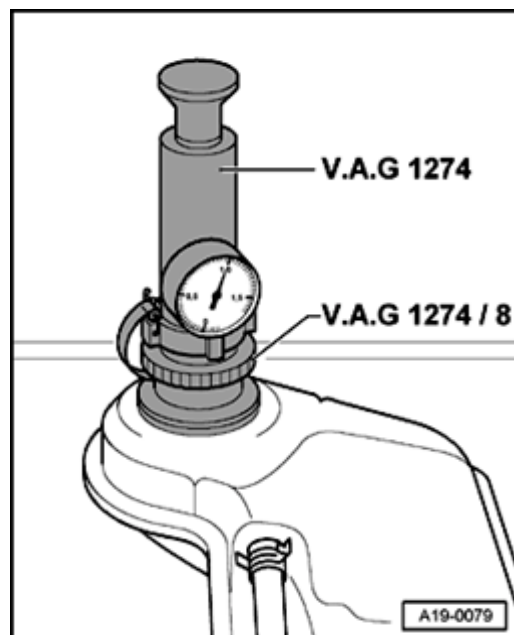
Cooling system, pressure test

- Engine at operating temperature

WARNING!

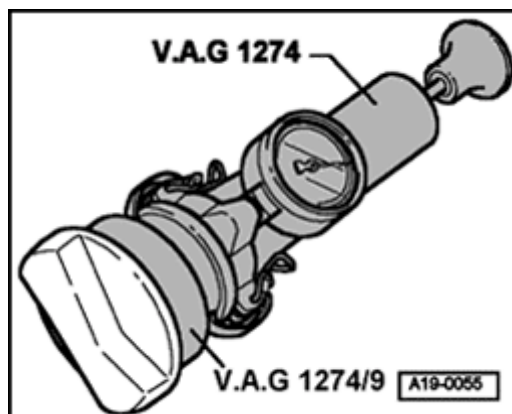
The cooling system is pressurized when the engine is warm. When opening the expansion tank, wear gloves and other appropriate protection, cover the cap with a cloth and open carefully to relieve system pressure slowly.

- Open cap on coolant expansion tank.
- Using VAG1274/8 adapter attach VAG1274 cooling system tester to coolant expansion tank.
- Use tester hand pump to create a pressure of approx. 1.0 bar (14.5 psi).
- If pressure falls, check for leaks and repair.



Pressure relief valve in cap, checking

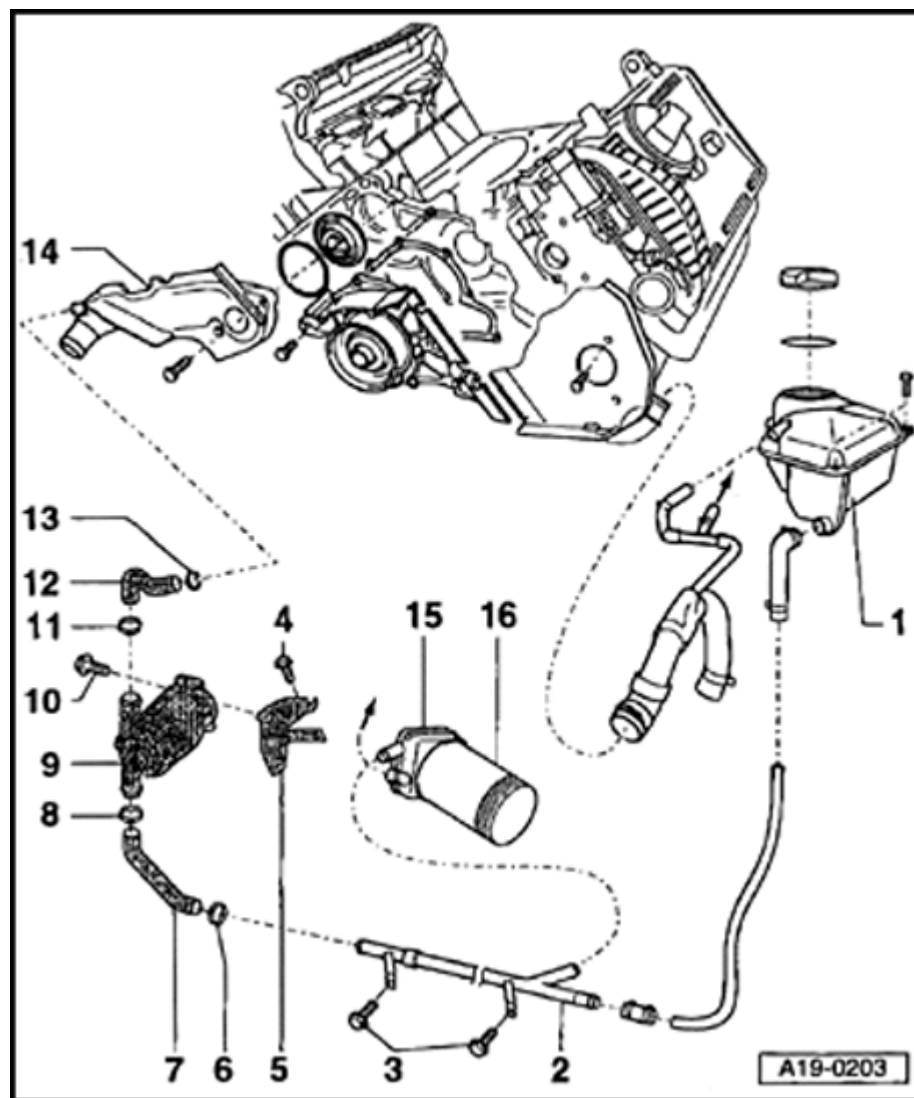
- Attach sealing cap to tester using VAG1274/9 adapter.



4

- Install hand pump and pump.
- Pressure relief valve must open at pressure between 1.4-1.6 bar (20.3-23.2 psi).

19-30



After-run coolant pump

1 - Coolant reservoir

- ◆ Perform coolant system leak test using VAG1274 cooling system tester and VAG1274/9 adapter.

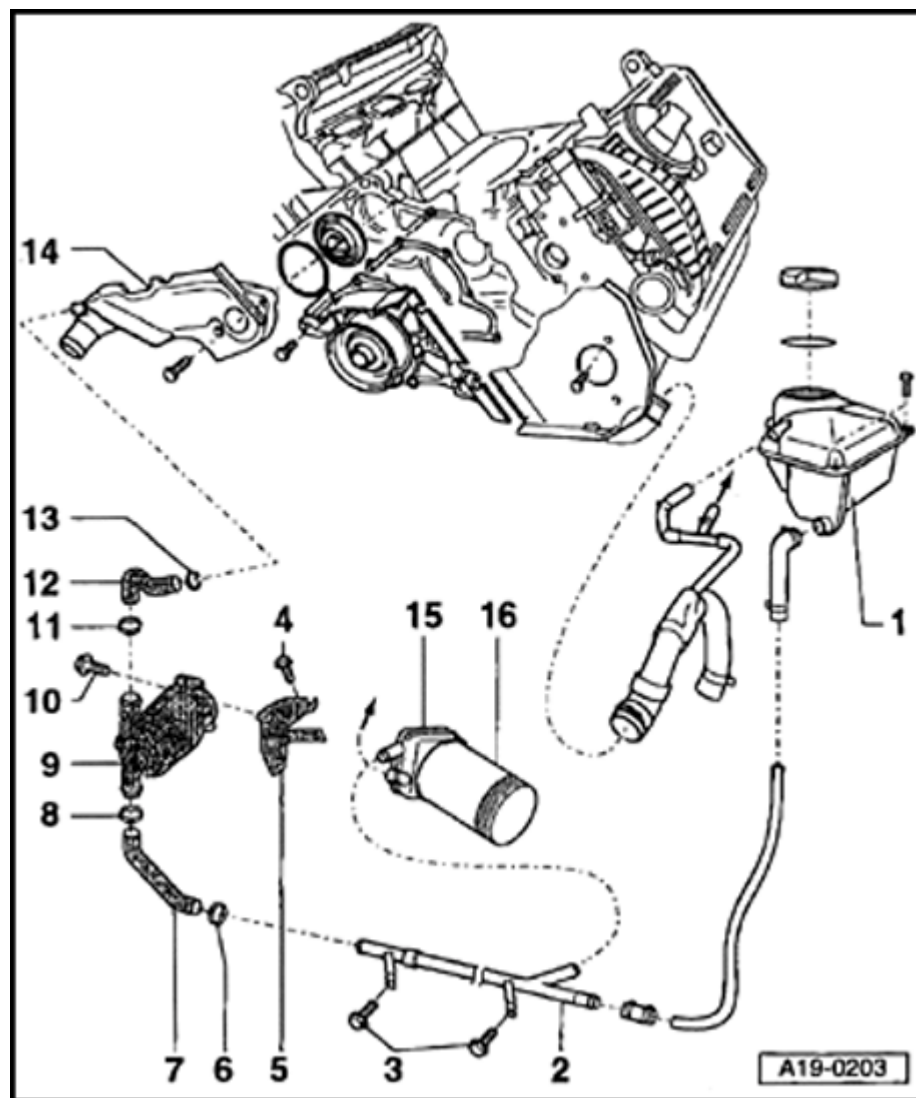
2 - Lower coolant pipe

3 - 25 Nm

4 - 25 Nm

5 - Bracket for after-run coolant pump

19-31



6 - Spring clamp

7 - Coolant hose

8 - Spring clamp

9 - Electrical after-run coolant pump

◆ Checking ⇒ [page 19-32](#)

◆ Removing and installing ⇒ [page 19-34](#)

10 - 10 Nm

11 - Spring clamp

12 - Coolant hose

13 - Spring clamp

14 - Connection

◆ For thermostat

15 - Oil cooler

16 - Oil filter

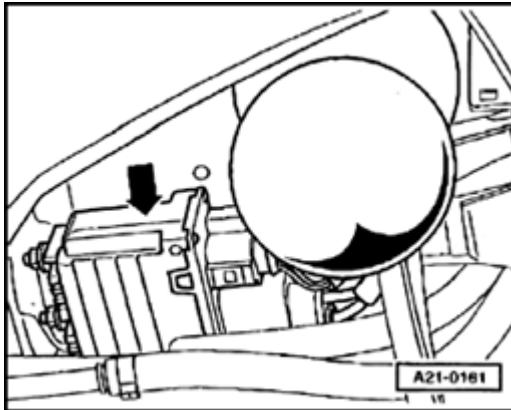
After-run coolant pump, checking

Note:

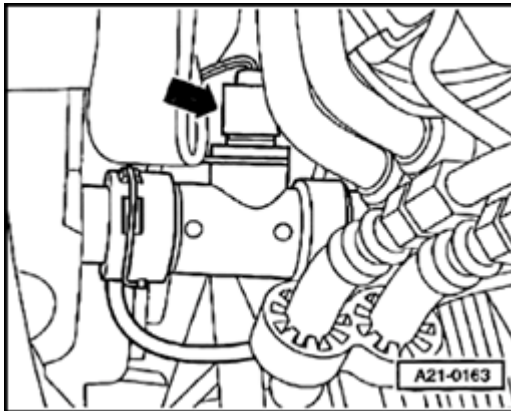
- ◆ *Control modules with an after-run time of 15 seconds after engine is turned off were installed since start of production. As a running change in m.y. 1999, control modules with an after-run time of 3 minutes were installed.*
- ◆ *The coolant after-run pump also continues to run after the engine is started again before the 15 second or 3 minute cycle is completed.*
- ◆ *The coolant after-run pump and the after-run fan are controlled via the same control module.*

After switching off the engine, the after-run pump always runs for 15 seconds or 3 minutes after the engine has been switched off. If during this time the switch-on temperature of 102 ° C (coolant temperature) is reached at the thermostat of the second fan stage, the after-run pump continues to run and the coolant fan continues to run in the after-run stage until the switch-off temperature of 91 ° C of the coolant at thermostat has been reached. The maximum running time of the after-run pump is 10 minutes.

19-33

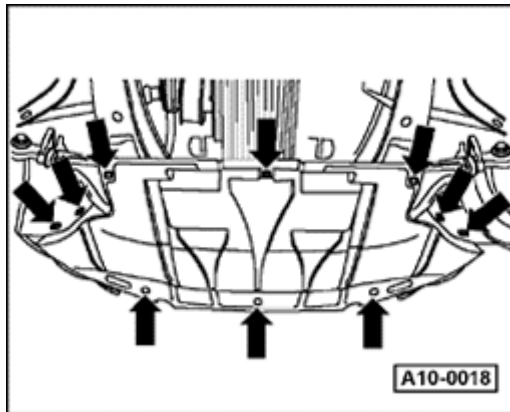


- ▲ The control module for the after-run pump and coolant fan is installed below the longmember (left side)



- ▲ The thermostat is installed in the coolant return hose.

After-run coolant pump, removing and installing



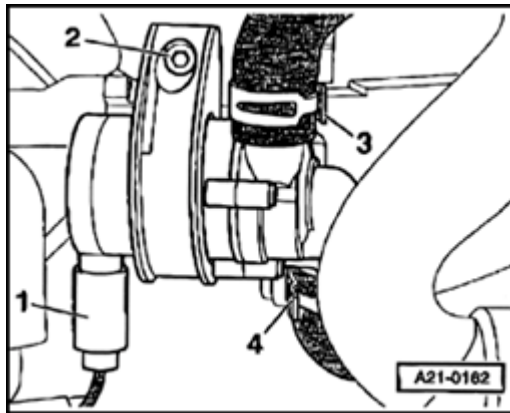
A

- Remove noise insulation panel.

Note:

The electrical coolant pump is located on the right side behind the generator.

- Drain coolant ⇒ [page 19-11](#) .



A

- Disconnect connection -1-.
- Disconnect both hoses -3- and -4- from pump.
- Unbolt pump from bracket -2-.

Exhaust system components, removing and installing

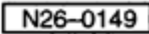
WARNING!

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

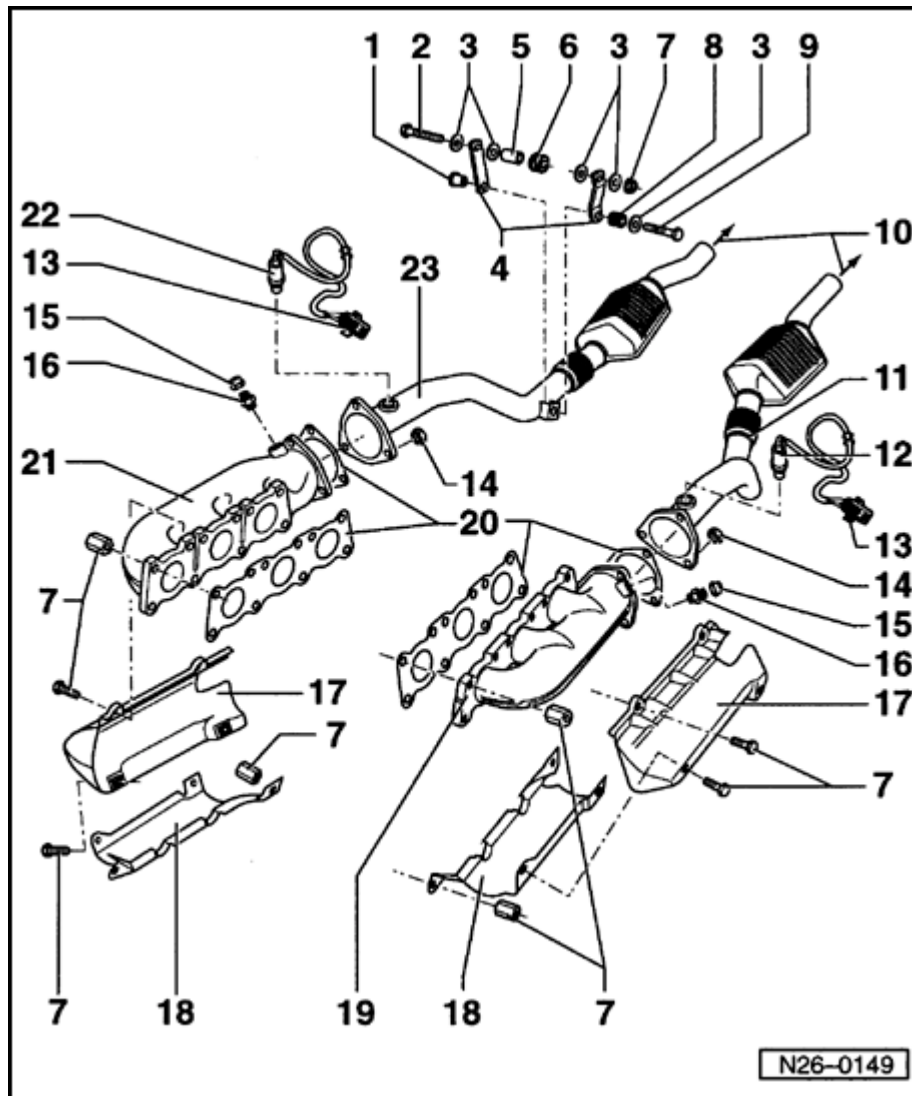
Notes:

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

- ◆ *The flexpipe in left and right exhaust pipes must not be bent more than 10°, otherwise it may be damaged.*



10 - To center muffler



11 - Left-front exhaust pipe with Three Way Catalytic Converter (TWC)

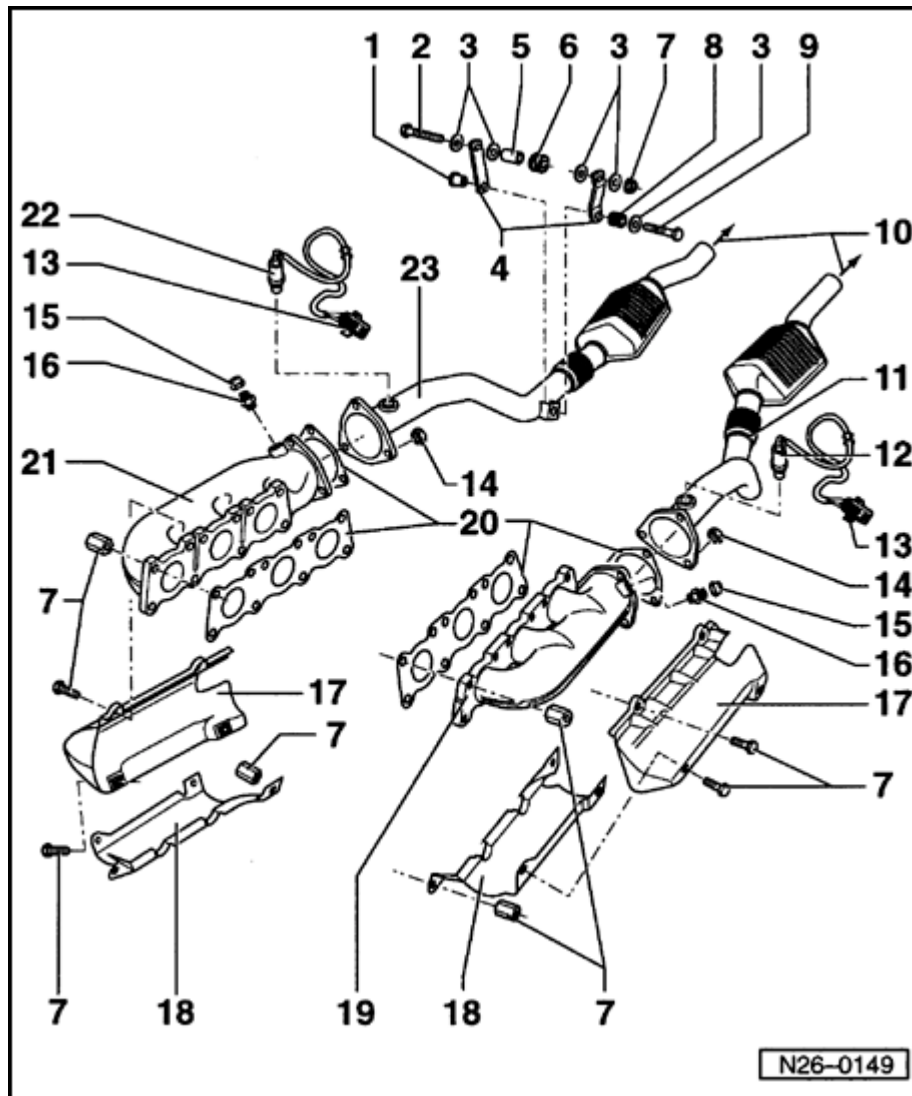
- ◆ The flexpipe in left and right exhaust pipes must not be bent more than 10°, otherwise it may be damaged

12 - Heated Oxygen Sensor (HO2S) 2 -G108-

- ◆ 50 Nm (37 ft lb)
- ◆ Only grease threads using "G5" ("G5" must not get into slots on body of sensor)
- ◆ Checking DTC memory ⇒ Repair Manual, 2.8 Liter V6 5V Fuel Injection & Ignition, Repair Group 01
- ◆ Checking components and heating function ⇒ Repair Manual, 2.8 Liter V6 5V Fuel Injection & Ignition, Repair Group 24

CAUTION!

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

**13 - 4-pin harness connectors**

- ◆ Black
- ◆ Mounted to bulkhead
- ◆ For Heated Oxygen Sensors (HO2S) and for heating function

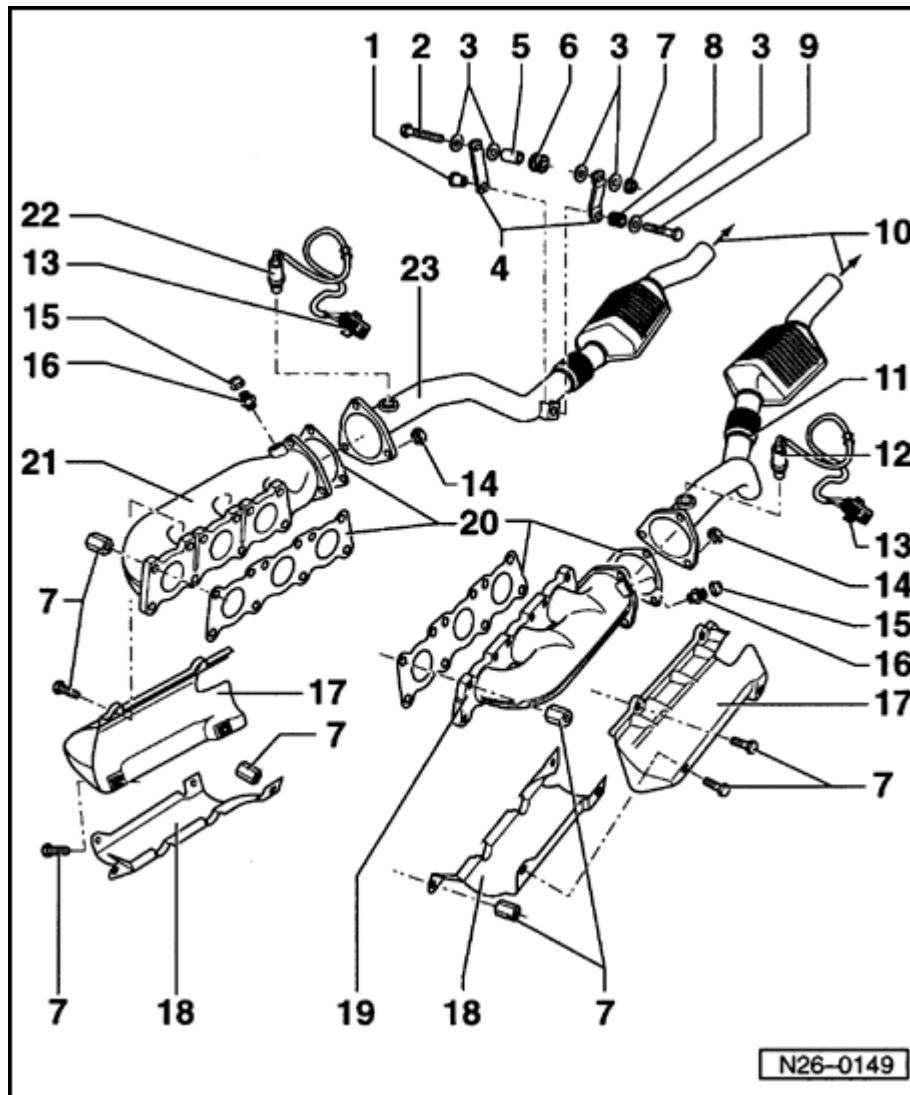
14 - 25 Nm (18 ft lb)**15 - Cover cap**

- ◆ 10 Nm (7 ft lb)

16 - Connection**17 - Upper heat shield****18 - Lower heat shield****19 - Left-side exhaust manifold****20 - Gaskets**

- ◆ Always replace

21 - Right-side exhaust manifold



22 - Heated Oxygen Sensor (HO2S) -G39-

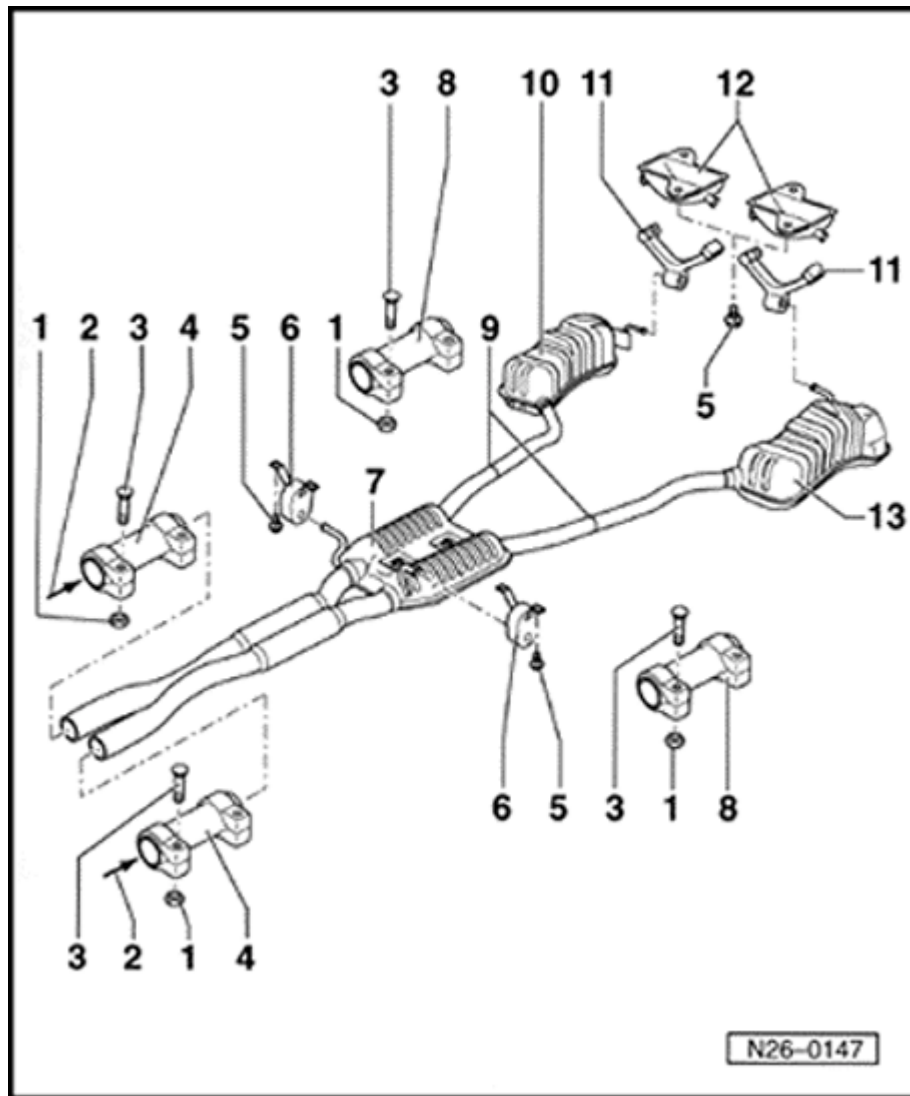
- ◆ 50 Nm (37 ft lb)
- ◆ Only grease threads with "G5" ("G5" must not get into slots on body of sensor)
- ◆ Checking DTC memory ⇒ Repair Manual, 2.8 Liter V6 5V Fuel Injection & Ignition, Repair Group 01
- ◆ Checking components and heating function ⇒ Repair Manual, 2.8 Liter V6 5V Fuel Injection & Ignition, Repair Group 24

CAUTION!

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

23 - Right-front exhaust pipe with Three Way Catalytic Converter (TWC)

- ◆ The flexpipe in left and right exhaust pipes must not be bent more than 10°, otherwise it may be damaged



Mufflers with mounts

Vehicles with all-wheel drive

Vehicles with front-wheel-drive ⇒ [page 26-9](#) .

1 - 40 Nm (30 ft lb)

2 - From Three Way Catalytic Converter (TWC)

3 - Carriage bolts

4 - Double clamp

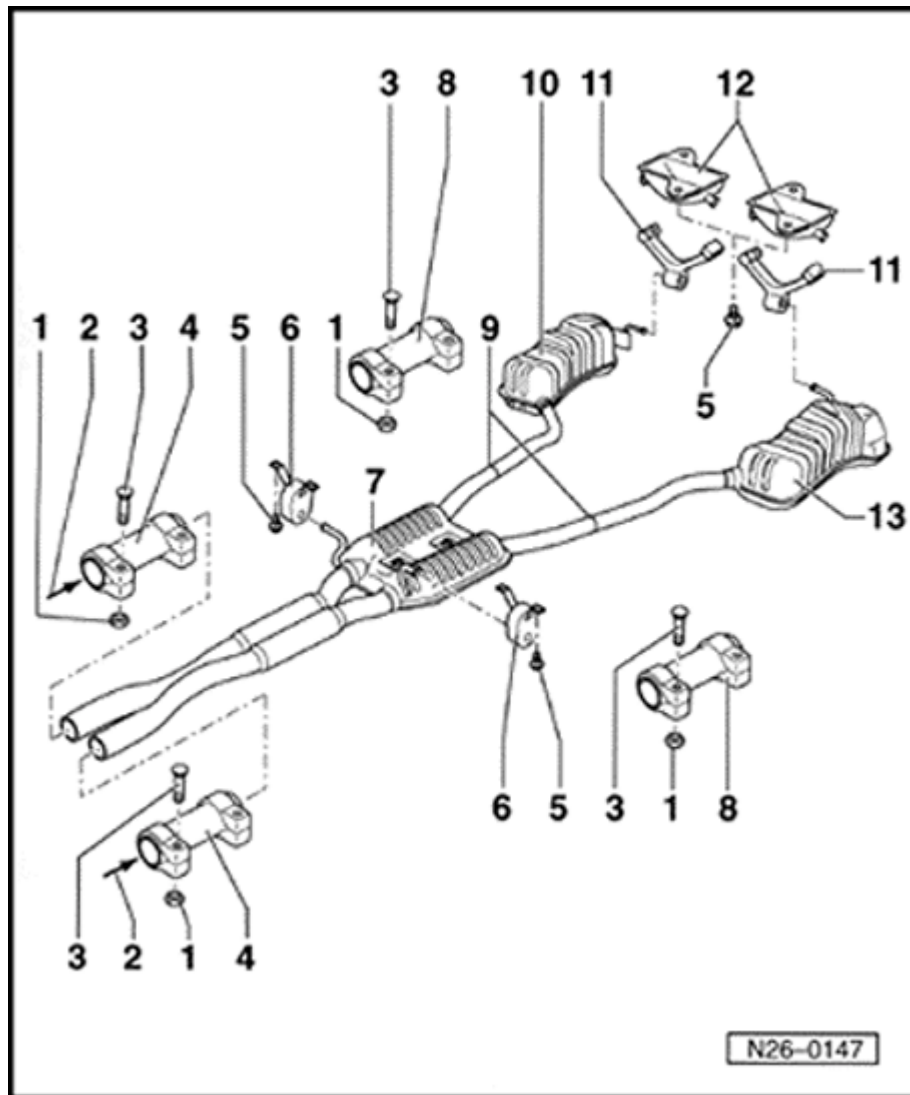
5 - 25 Nm (18 ft lb)

6 - Mounts

◆ With retaining ring

7 - Center muffler

8 - Double clamp (for repair)



9 - Separating points

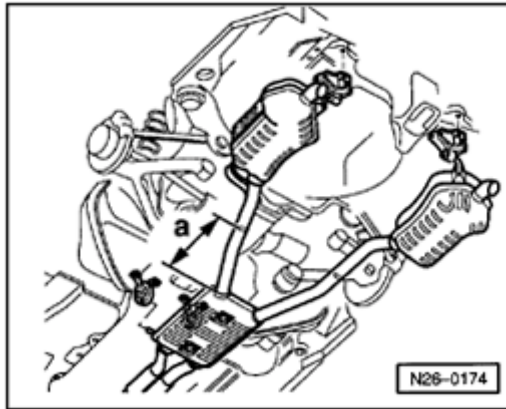
- ◆ At factory, center and rear mufflers are installed as single component. Replacement center and rear mufflers are supplied separately, with double clamp for connecting joint
- ◆ Cutting through at separating point ⇒ [Fig. 1](#)

10 - Right-rear muffler

11 - Mounts

12 - Brackets

13 - Left-rear muffler



A

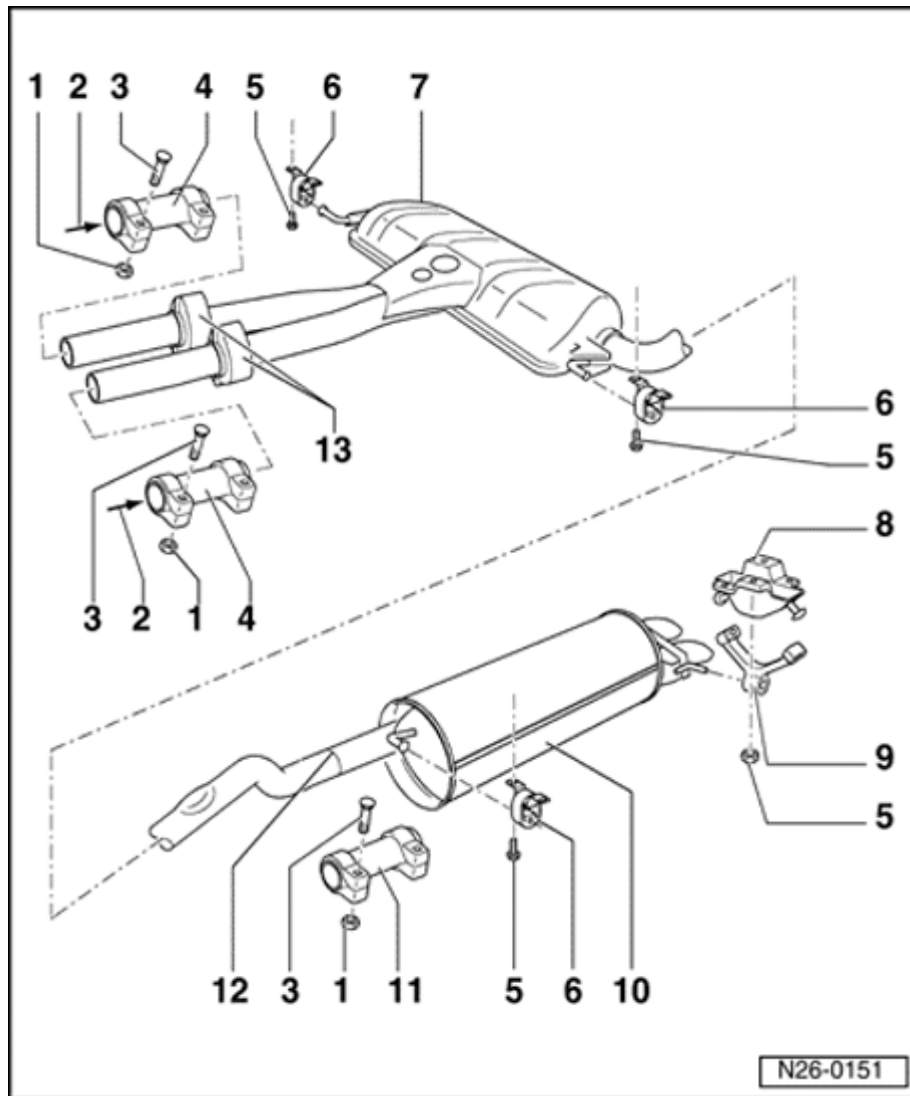
Fig. 1 Separating point between front and rear mufflers

Cutting

- Using VAG1523 body saw, cut through connecting pipe between center muffler and rear muffler at groove.

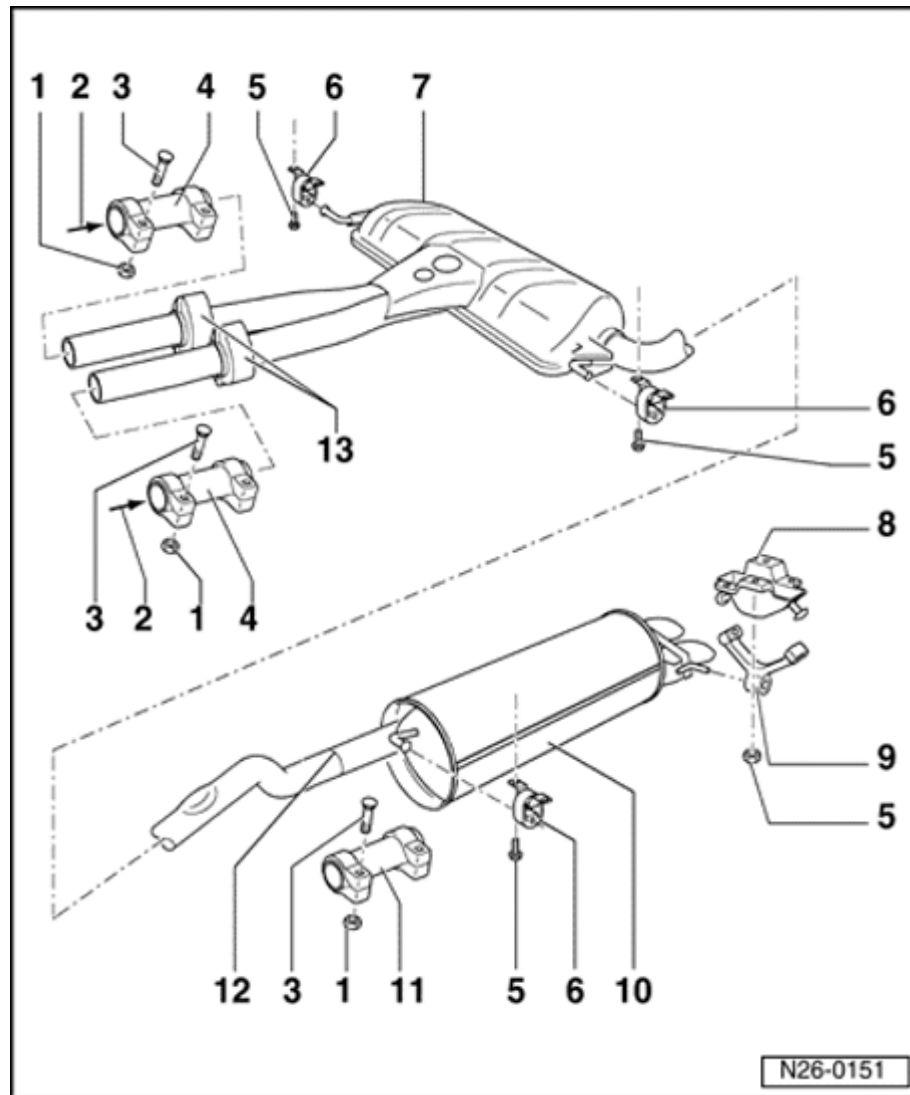
Distance -a-: approx. 244 mm (9-1/2 in.).

26-9

**Vehicles with front wheel drive**

- 1 - 40 Nm (30 ft lb)
- 2 - From Three Way Catalytic Converter (TWC)
- 3 - Carriage bolts
- 4 - Double clamps
- 5 - 25 Nm (18 ft lb)
- 6 - Mounts
 - ◆ With retaining ring
- 7 - Center muffler
- 8 - Bracket
- 9 - Mount
- 10 - Rear muffler
- 11 - Double clamp (for repair)

26-10

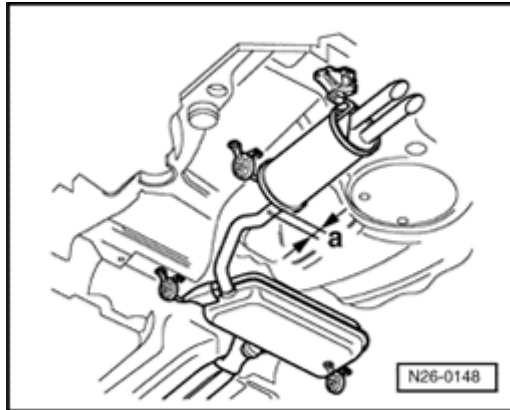


12 - Separating point

- ◆ At factory, center and rear mufflers are installed as single component. Replacement center and rear mufflers are supplied separately, with double clamp for connecting joint
- ◆ Cutting through at separating point ⇒ [Fig. 1](#)

13 - To front mufflers

26-11



A

Fig. 1 Separating point between front and rear mufflers

Cutting

- Using VAG1523 body saw, cut through connecting pipe between center muffler and rear muffler at groove.

Distance -a-: approx. 182 mm (7 in.).

26-12

Secondary Air Injection (AIR) system

- ◆ Check Diagnostic Trouble Code (DTC) memory.

⇒ *Repair Manual, 2.8 Liter V6 5V Fuel Injection & Ignition, Repair Group 01*

- ◆ Initiate output Diagnostic Test Mode (DTM).

⇒ *Repair Manual, 2.8 Liter V6 5V Fuel Injection & Ignition, Repair Group 01*

- ◆ Initiate "Basic Setting" (scan tool function 04).

⇒ *Repair Manual, 2.8 Liter V6 5V Fuel Injection & Ignition, Repair Group 01*

- ◆ Check Secondary Air Injection (AIR) valve.

⇒ *Repair Manual, 2.8 Liter V6 5V Fuel Injection*

& Ignition, Repair Group 01

Notes:

- ◆ *The secondary air injection system injects air behind the exhaust valves during a cold start. Cold start means engine coolant temperature between 8-65° C (46-149° F). The amount of air injected is temperature dependent.*
- ◆ *The need for secondary air is triggered by the Motronic Engine Control Module (ECM) -J220- via the Secondary Air Injection (AIR) Injection pump relay -J299- to the Secondary Air Injection (AIR) solenoid valve -N112- and the two combination valves.*
- ◆ *When "Basic Setting" (scan tool function 04) is initiated, a diagnosis for the secondary air injection system can be carried out. The diagnostics consists of a flow test and a leak test.*

Flow test

During the flow test, the oxygen sensor control is switched off (engine runs rich at that time). At the same time the secondary air injection pump is switched on, injecting fresh air into the exhaust manifold which increases the oxygen content in the exhaust gas. The oxygen sensor now measures a lean mixture. To pass the diagnostic test, the oxygen sensor must measure a lean mixture for a certain time. Passing the test means that the secondary air injection system delivers enough air and the secondary air injection system is OK.

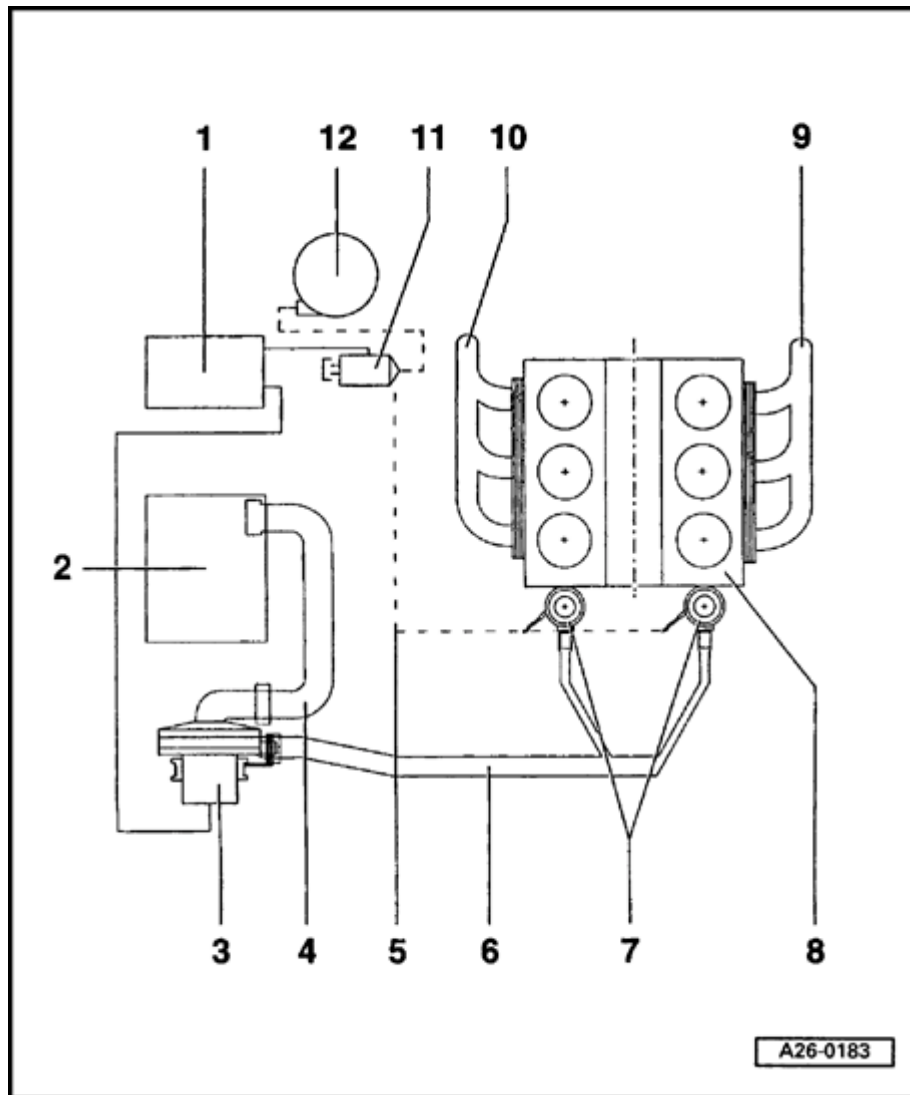
Leak test

- Flow test must check out OK
- Engine at operating temperature

The secondary air injection pump is switched on during idle. Since the combination valves are not triggered by the secondary air injection solenoid valve, they remain closed. When the secondary air injection pump is switched on, the oxygen sensor system is monitored by the ECM. If the system does not leak, fresh air cannot enter the exhaust manifold. If the system is leaking, the oxygen sensor signal will respond to the leaner mixture (caused by the secondary air getting into the exhaust manifold) and cause a noticeable

enrichment. This enrichment is recognized by the ECM.

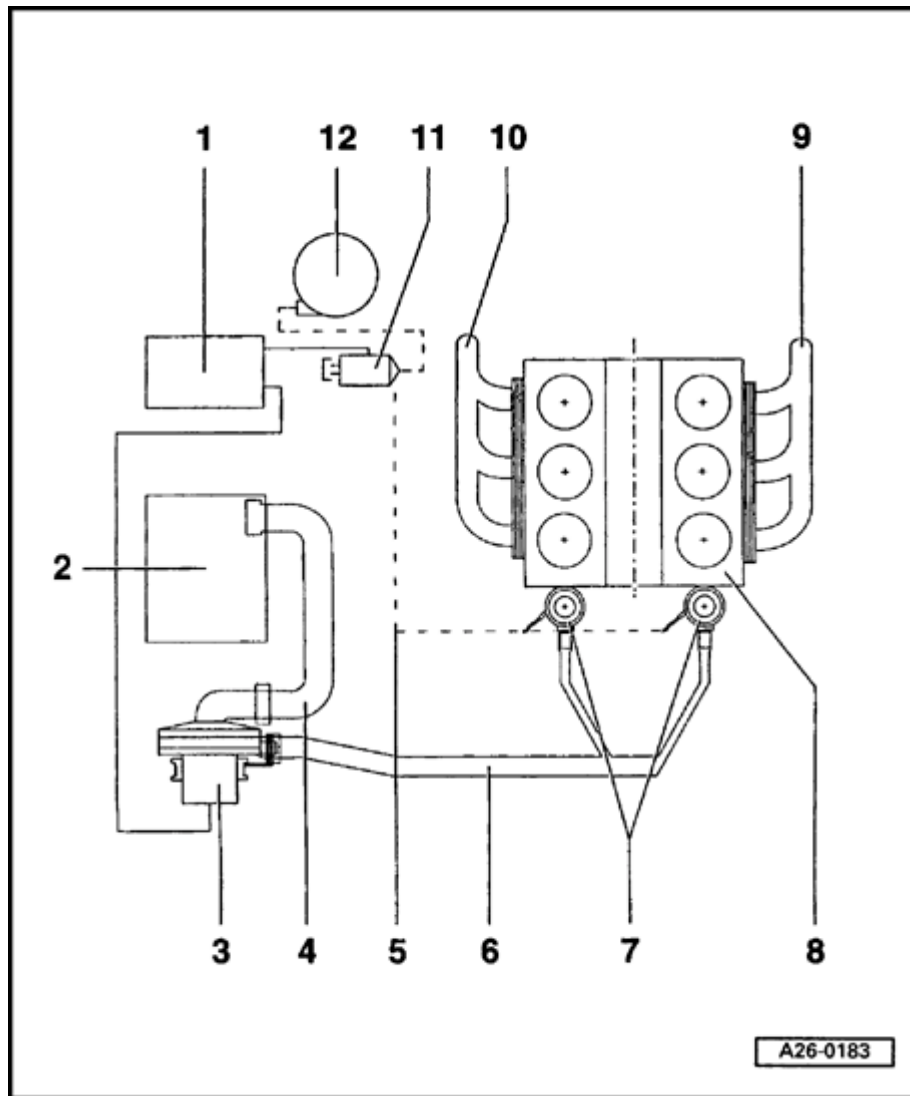
26-14



Secondary Air Injection (AIR) system, overview

- 1 - Motronic Engine Control Module (ECM) - J220-**
- 2 - Air cleaner**
 - ◆ Connection for intake air of Secondary Air Injection (AIR) pump
- 3 - Secondary Air Injection (AIR) pump motor -V101-**
- 4 - Connection**
 - ◆ Between air cleaner and secondary air injection pump
 - ◆ Removing ⇒ [page 26-16](#)
- 5 - Vacuum line**
 - ◆ Control line between Secondary Air Injection (AIR) solenoid valve -N112- and combination valves
- 6 - Connection tube**
 - ◆ From secondary air injection pump to combination valves

26-15

**7 - Combination valves**

- ◆ Located at rear of left and right cylinder heads
- ◆ Removing and installing ⇒ [page 26-16](#)

8 - Engine**9 - Right exhaust manifold****10 - Left exhaust manifold****11 - Secondary Air Injection (AIR) solenoid valve -N112-****12 - Vacuum reservoir**

- ◆ Located in left-front wheelhousing

Secondary Air Injection (AIR) system components, removing and installing

Component locations ⇒ [page 26-14](#) .

Fuel injection and ignition components.

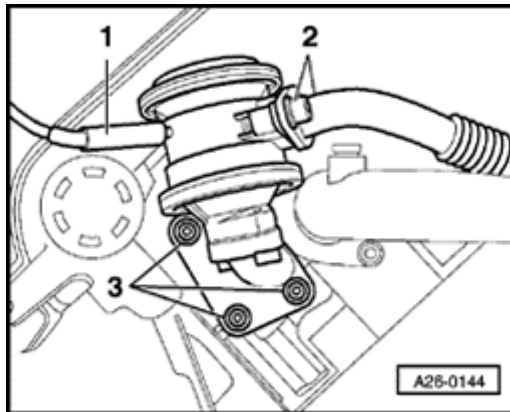
⇒ *Repair Manual, 2.8 Liter V6 5V Fuel Injection & Ignition, Repair Group 24*

Note:

Always replace gaskets and seals.

A - Combination valve, left

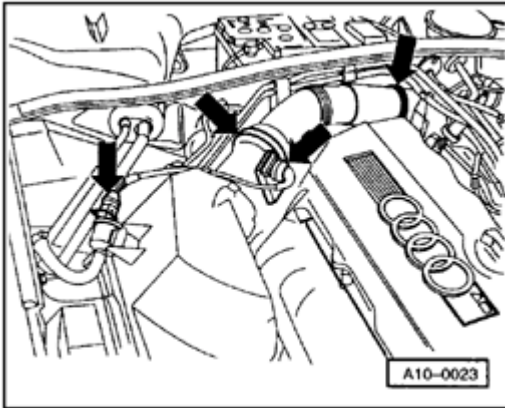
- Remove engine coolant expansion tank from bracket.



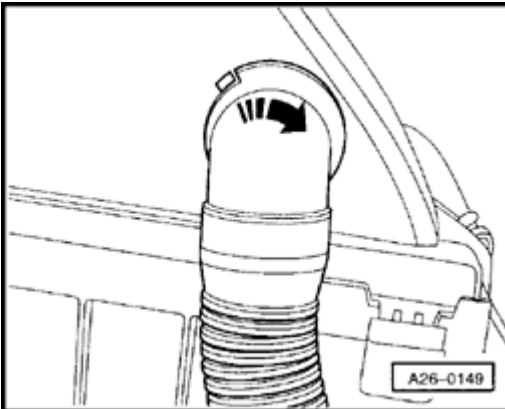
A

- Disconnect vacuum line -1-.
 - Disconnect connection tube -2- from combination valve.
- Tightening torque: 10 Nm (7 ft lb).
- Remove bolts -3- for combination valve from cylinder head and remove valve.
- Tightening torque: 10 Nm (7 ft lb).

26-17

B - Combination valve, right**A**

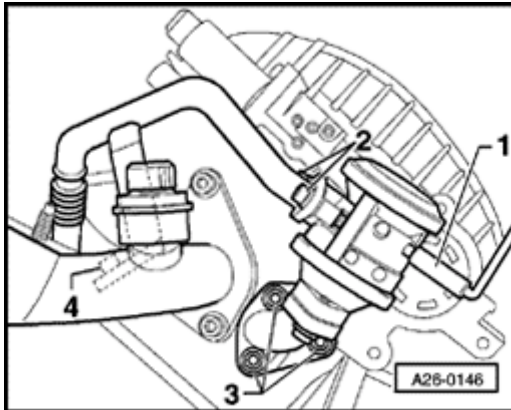
- Remove intake air duct between Mass Air Flow (MAF) sensor and intake air elbow (three -arrows- on right).
- Remove intake air elbow from throttle body connector.
- Disconnect harness connector for Evaporative Emission (EVAP) canister purge regulator valve (left arrow) and pull valve out of bracket.
- Disconnect harness connector at Mass Air Flow (MAF) sensor.

**A**

- Turn connector tube for Secondary Air Injection (AIR) pump 1/4-turn (45°) to right and pull forward off air cleaner.
- Remove air cleaner housing.

Tightening torque: 20 Nm (15 ft lb).

26-18



A

- Remove vacuum line -1-.
- Disconnect connection tube -2- from combination valve.
Tightening torque: 10 Nm (7 ft lb).
- Remove bolts -3- for combination valve from cylinder head and if necessary, remove bracket -4- from cylinder head.
 - ◆ Bolt -3- tightening torque: 10 Nm (7 ft lb).
 - ◆ Bracket -4- tightening torque: 20 Nm (15 ft lb).
- Remove combination valve.

C - Secondary Air Injection (AIR) pump motor

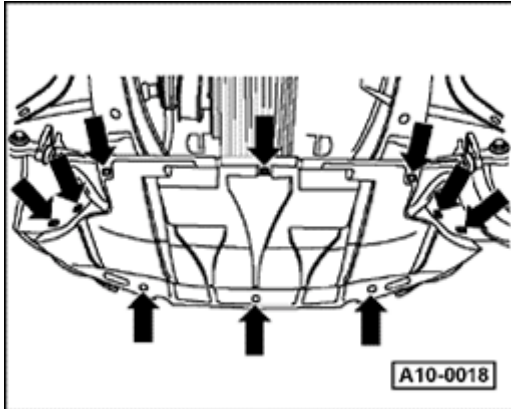
A

- Remove noise insulation panel (arrows).
- Remove front bumper.

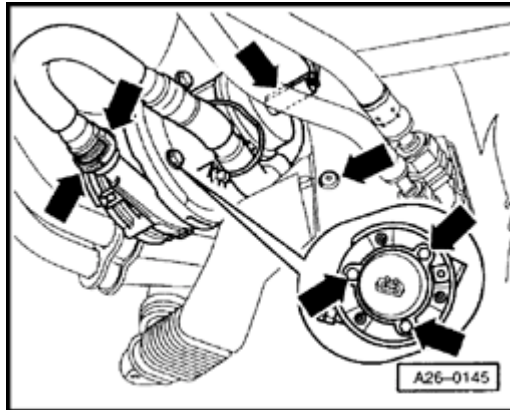
⇒ [Repair Manual, Body Exterior, Repair Group 63](#)

- Move lock carrier into service position.

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

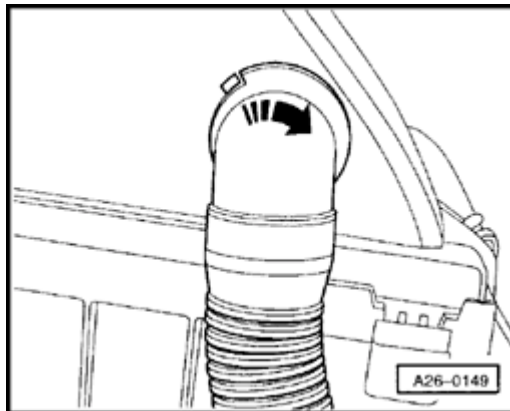


26-19



A

- Remove air duct to generator at front of air shroud.
- Disconnect connection at connector tube to Secondary Air Injection (AIR) pump combination valves (left arrows), pull down to remove and cut tie wraps.
- Remove three bolts on Secondary Air Injection (AIR) pump (lower right arrows) but do not remove nuts.
- Remove pump toward rear from bracket.
- Remove connection line on Secondary Air Injection (AIR) pump to air cleaner.



A

- Turn connector tube for Secondary Air Injection (AIR) pump 45° to right and disconnect.
- Remove air Secondary Air Injection (AIR) pump.

Installing

Installation is the reverse of removal.