

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!

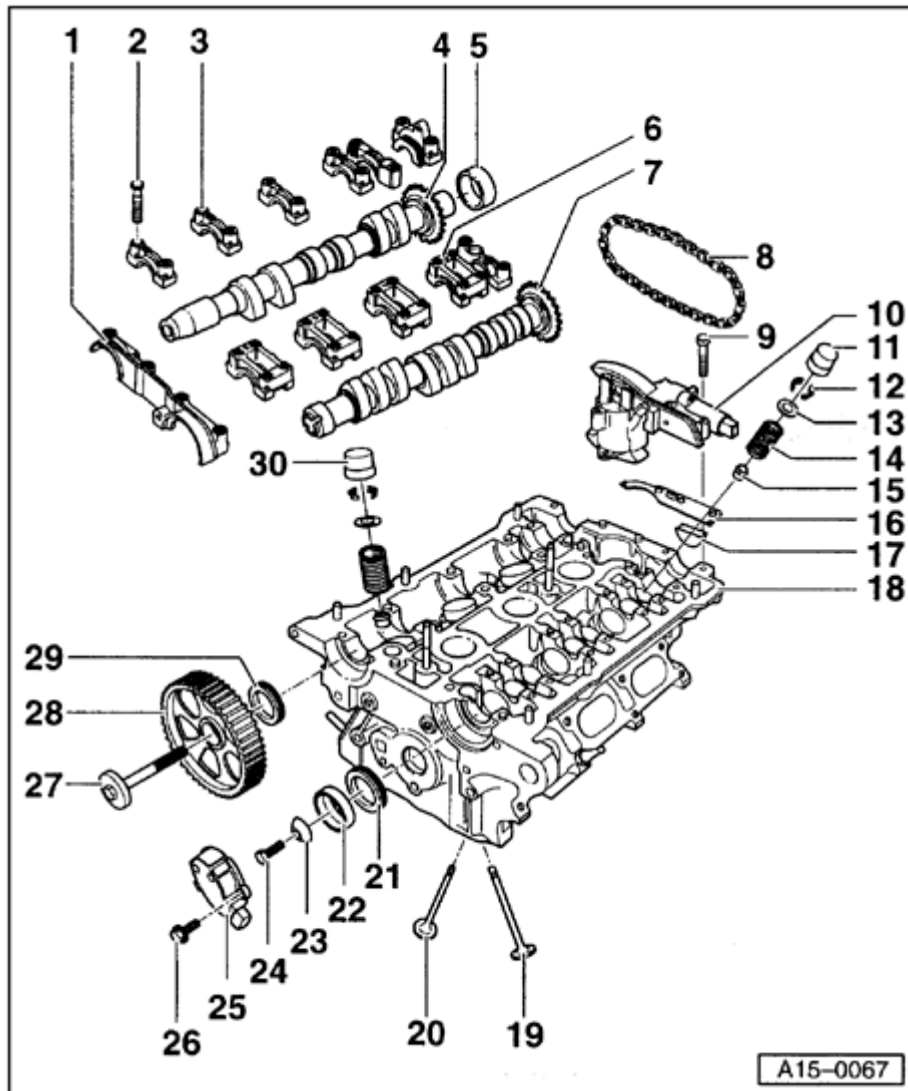
After installing new hydraulic valve lifters the engine must not be started for about 30 minutes (otherwise the valves will strike the pistons). Turn the crankshaft two complete revolutions by hand before starting.

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

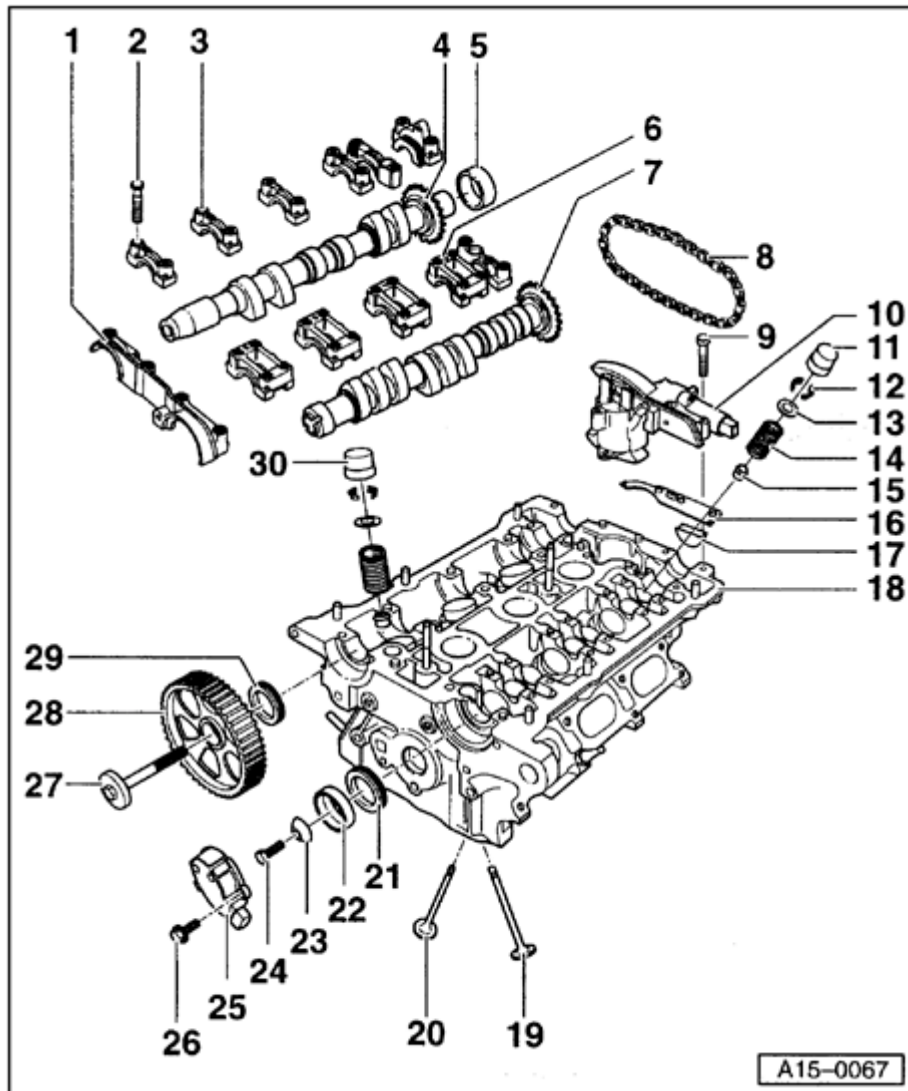
- ◆ Watch guide sleeve
- ◆ Note installation position and numbering ⇒ [page 15-36](#)
- ◆ Lightly coat last bearing cap (after chain) with D454 300 A2 sealant before installing

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

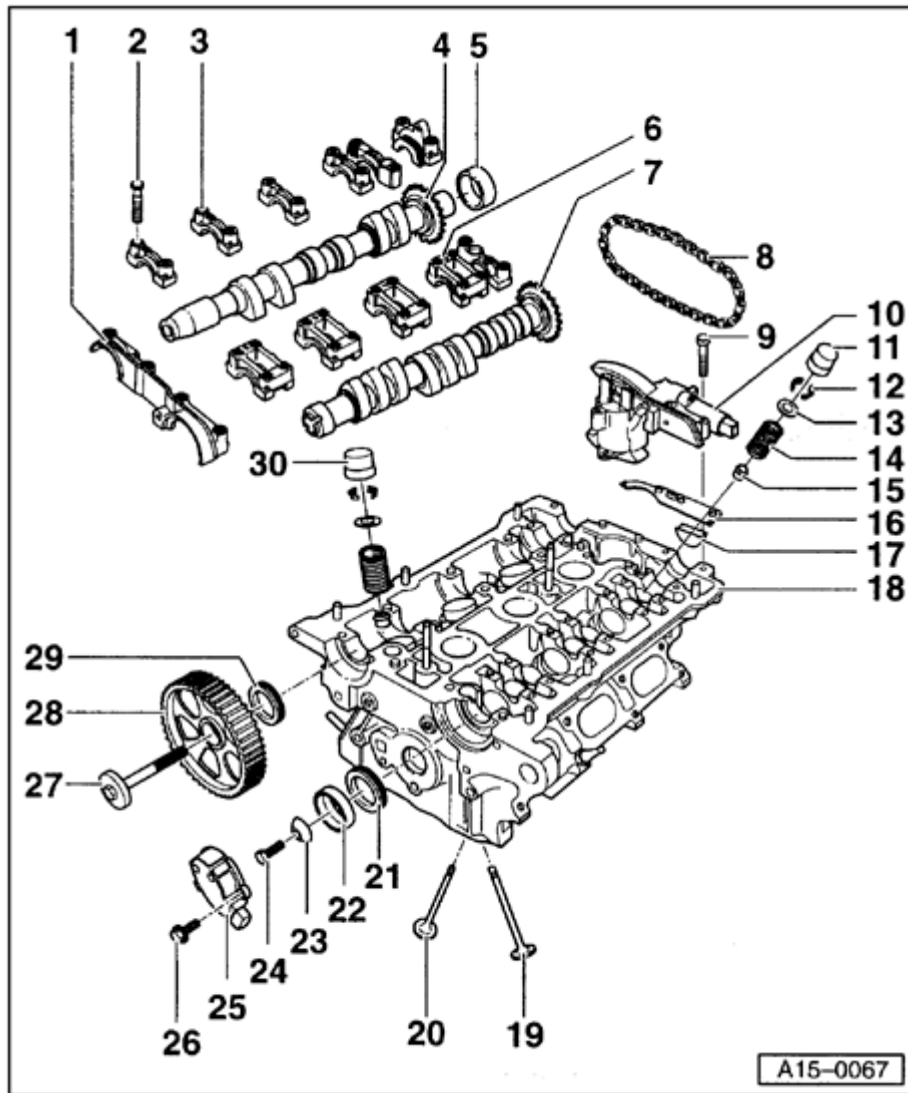
- ◆ Installing ⇒ [page 15-36](#)

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](#)

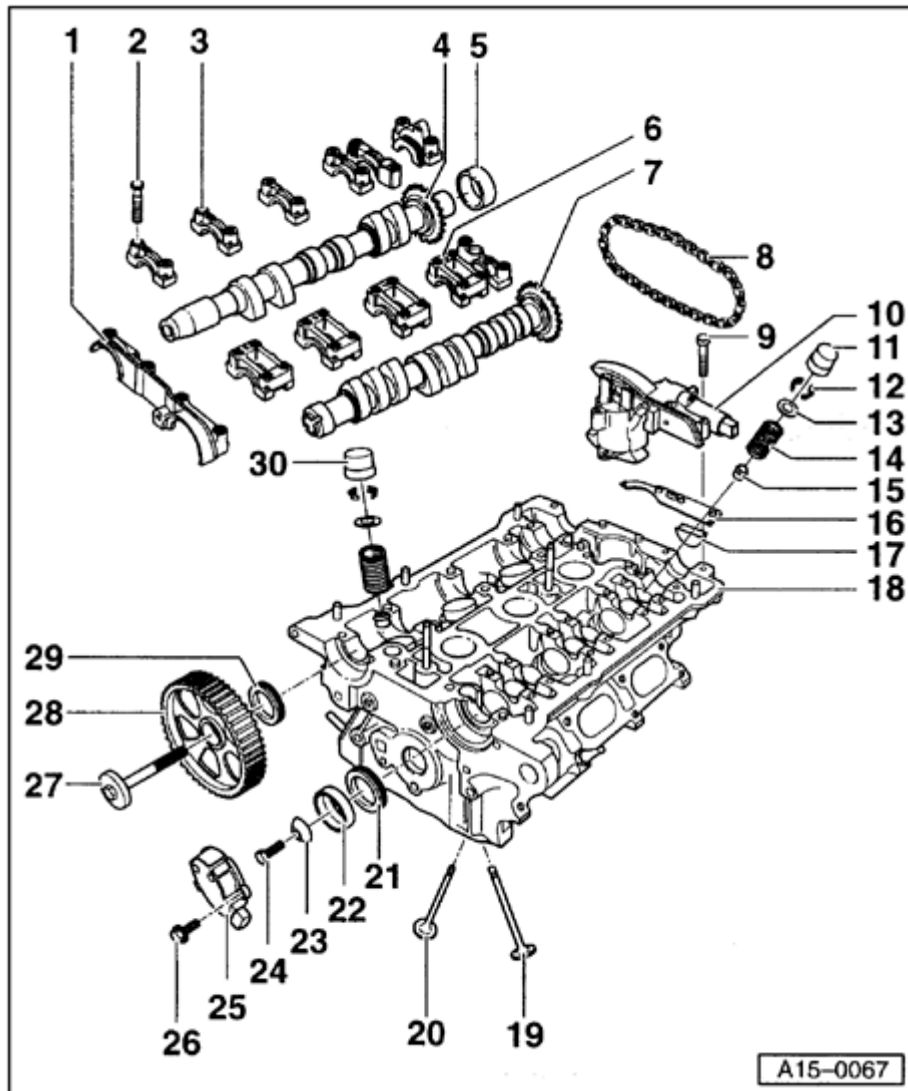
◆ Checking for distortion ⇒ [page 15-27](#)

◆ 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)

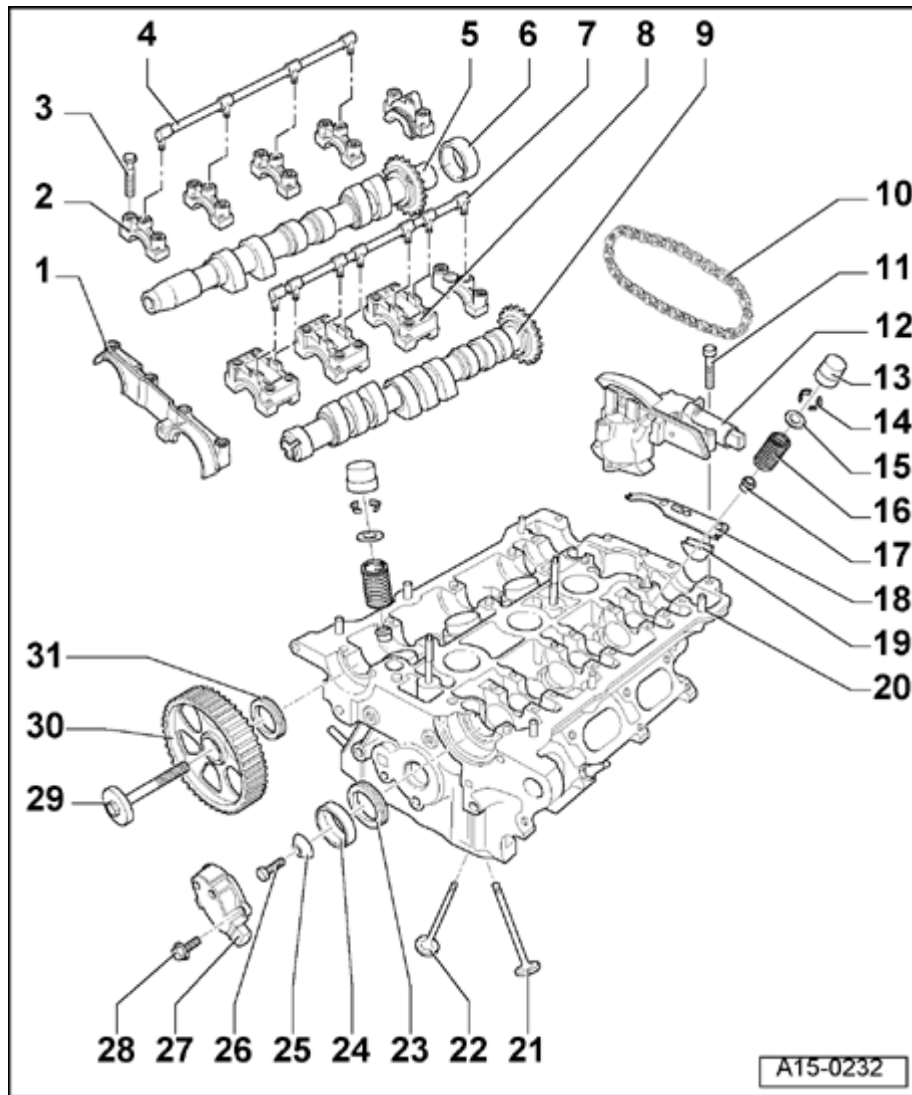
28 - Camshaft sprocket

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

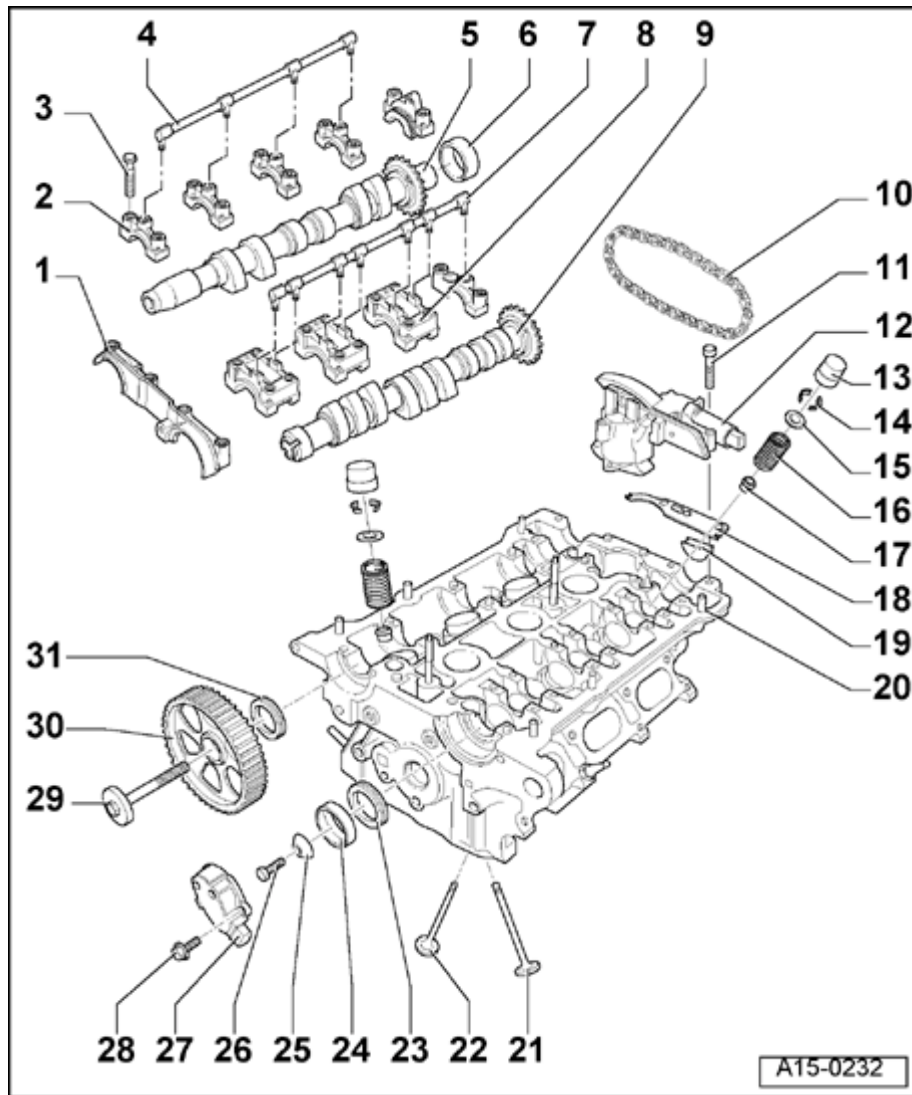
- ◆ With oil line connector
- ◆ Watch guide sleeve
- ◆ Note installation position and numbering ⇒ [page 15-31](#)
- ◆ Lightly coat last bearing cap (after chain) with D454 300 A2 sealant before installing

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

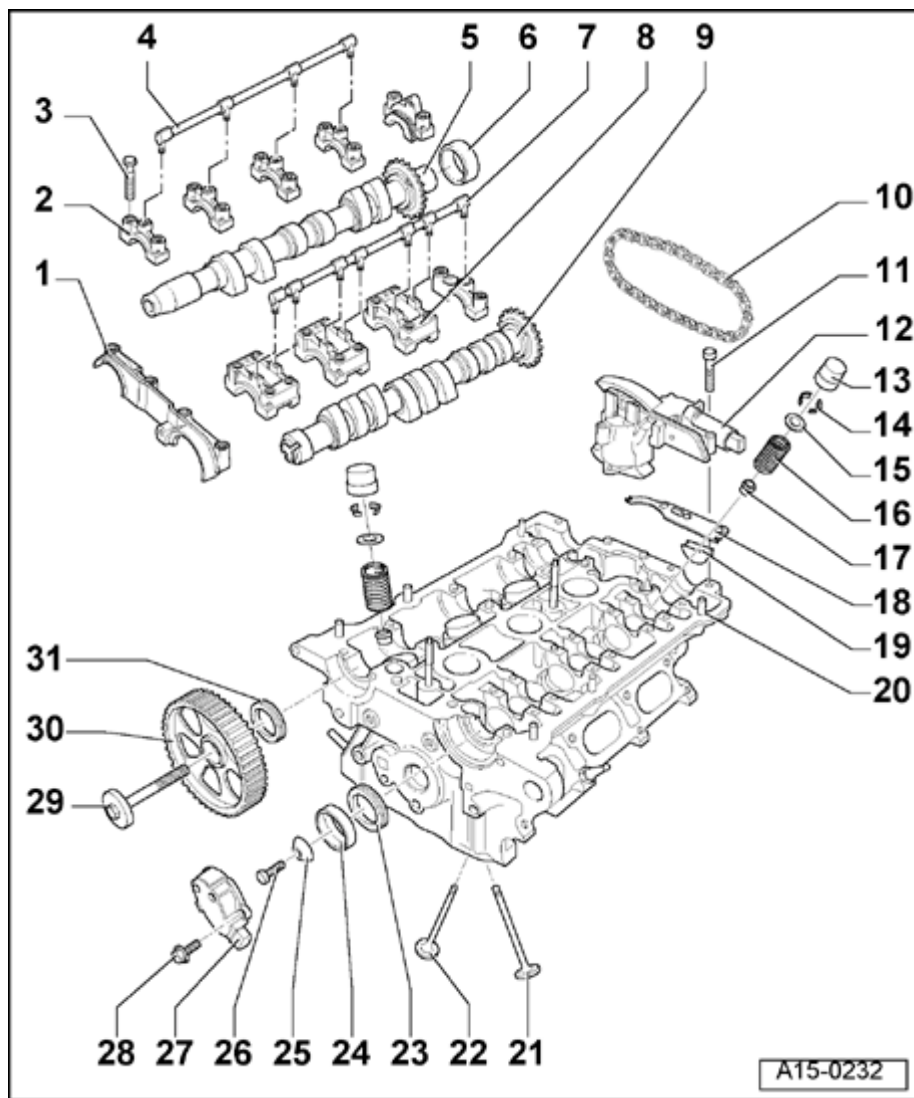
- ◆ Always replace

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-

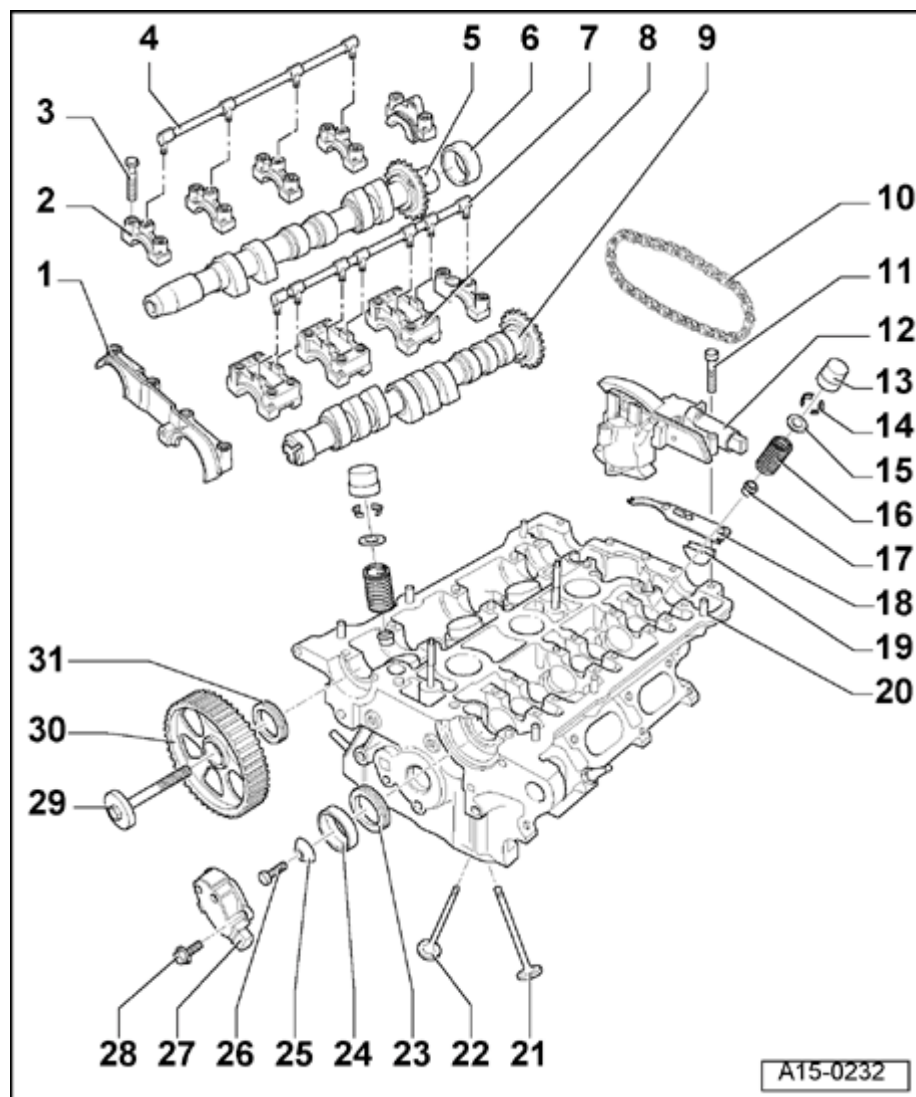
◆ Secure using 3366 bracket tensioner before removing ⇒ [page 15-31](#)

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 - 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

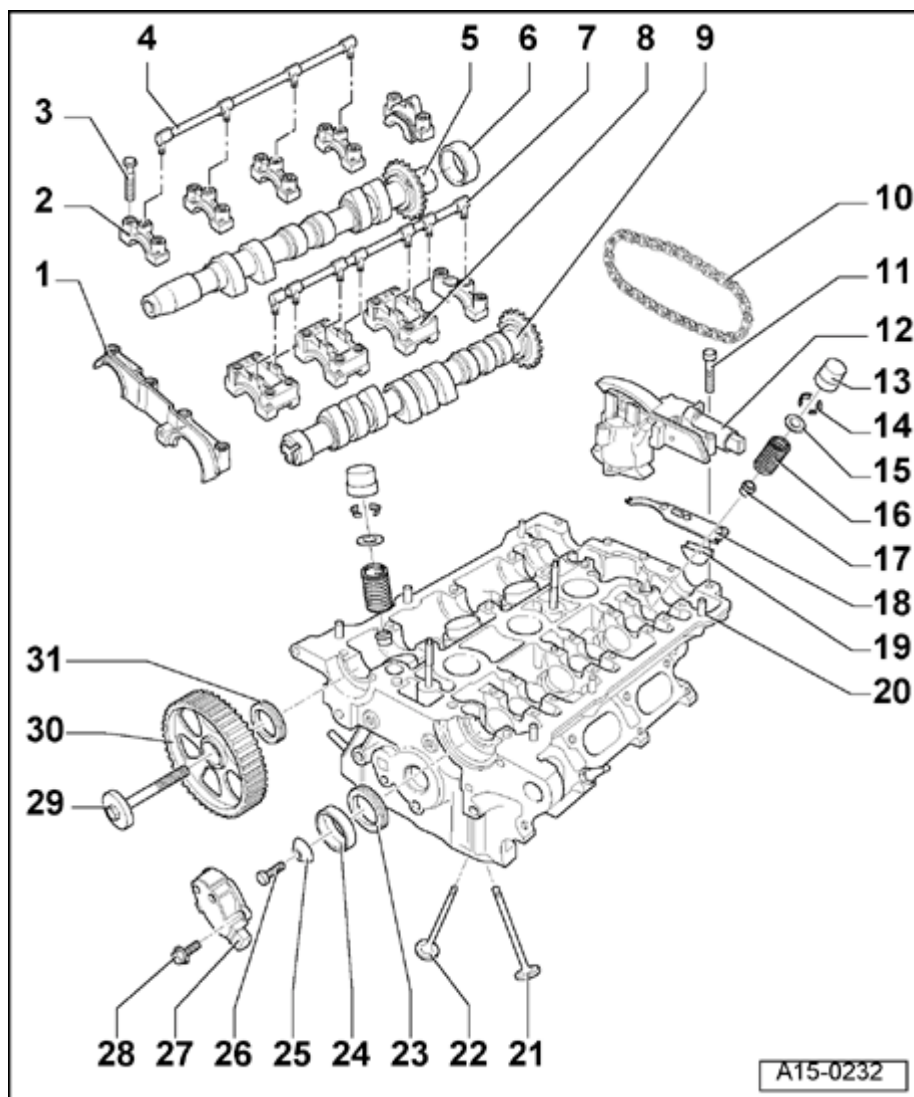
- ◆ Removing and installing ⇒ [page 15-18](#)
- ◆ Checking for distortion ⇒ [page 15-27](#)
- ◆ Resurfacing ⇒ [page 15-28](#)

21 - Exhaust valve

22 - Intake valve

23 - Oil seal

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



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)

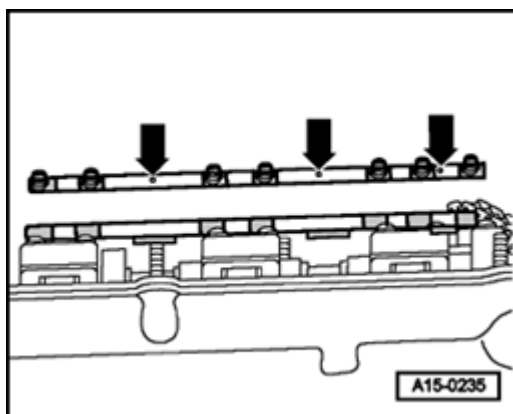
30 - Camshaft sprocket

31 - Oil seal

- ◆ Toothed gear side

- ◆ Replacing ⇒ [page 15-14](#)

Cylinder head with oil lines on the camshaft bearings

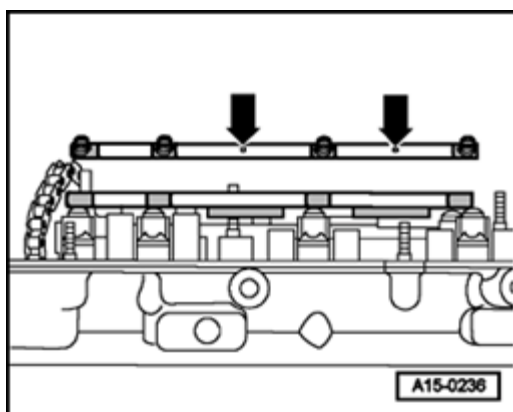


A

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.



A

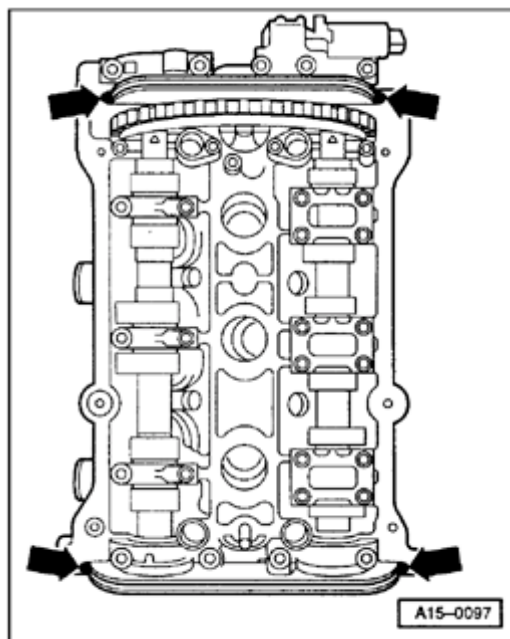
Fig. 4 Installation position of exhaust camshaft oil line

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.

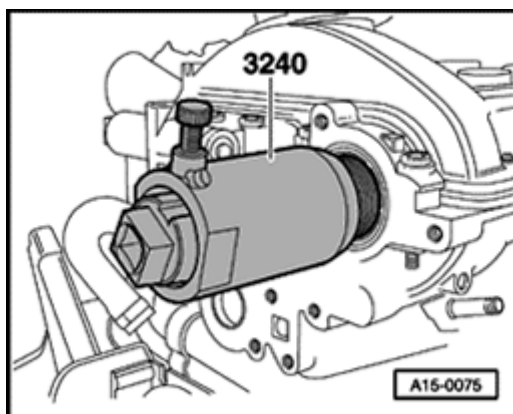
CAUTION!

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.

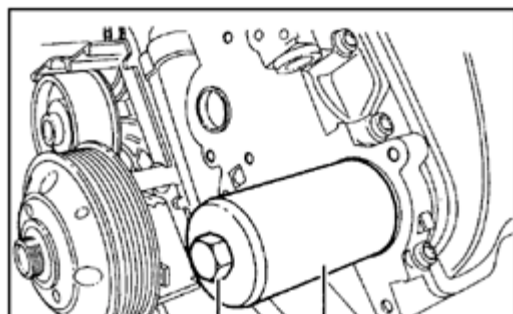


- A** - Remove seal using 3240 seal extractor.
- Clean contact surface and sealing surface.

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.

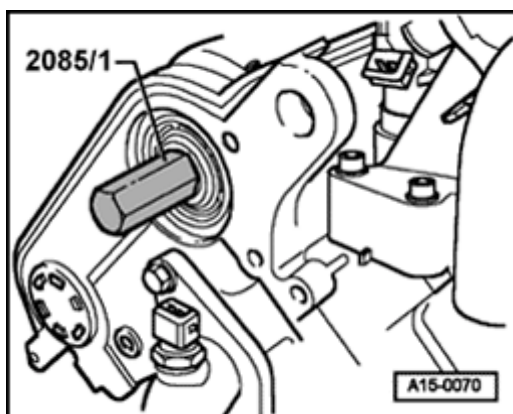
Oil seal on Camshaft Position (CMP) sensor (left and right cylinder head)

- Unbolt Camshaft Position (CMP) sensor.

Tightening torque: 10 Nm (7 ft lb)

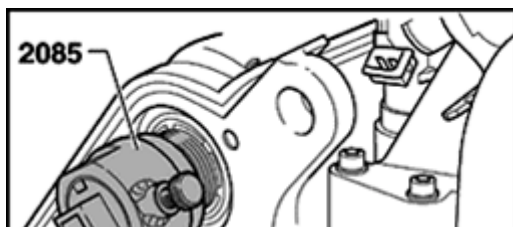
- Unbolt shutter wheel for Camshaft Position (CMP) sensor and carefully pry out using screwdriver.

Tightening torque: 20 Nm (15 ft lb)



A

- Screw in bolt from 2085/1 adapter.

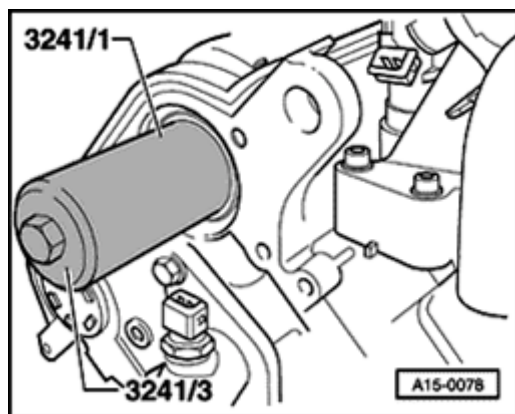


A

- 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.



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

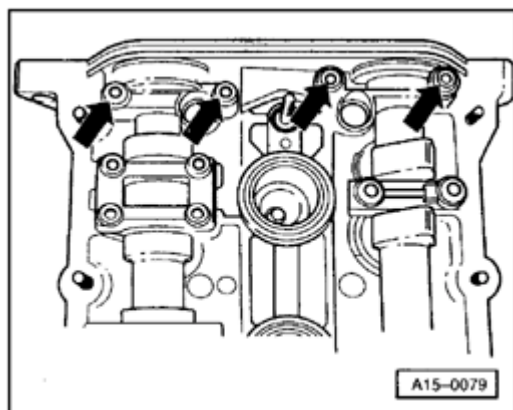
Rear sealing flange (left cylinder head)

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.

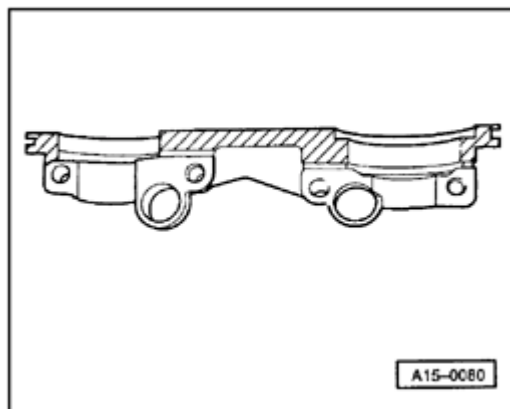
Tightening torque: 10 Nm (7 ft lb)

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



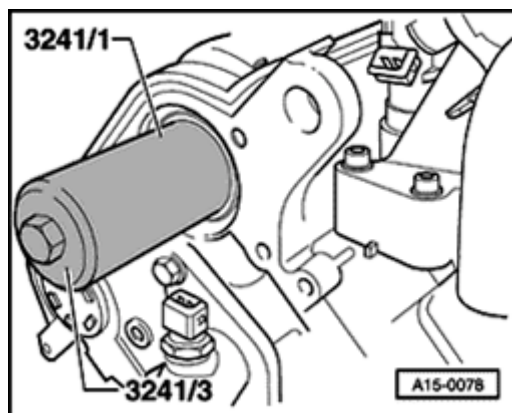
- A
- Remove double bearing cap (arrows).
 - Remove seal and sealing flange.
 - Clean running and sealing surfaces as well as contact surface of double bearing cap.

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.

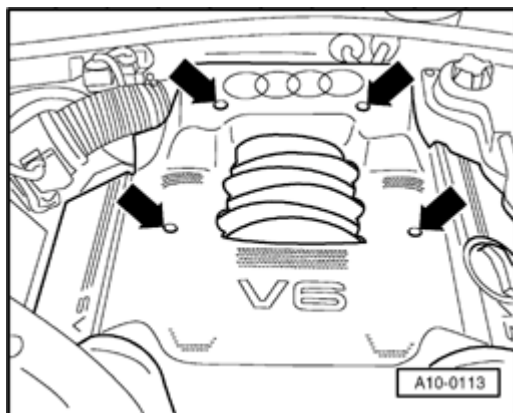
Cylinder head, removing and installing

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).



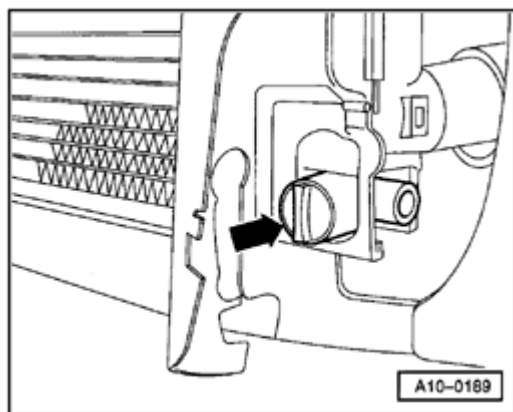
- A** - Remove noise insulation panel (arrows).
- Unbolt left and right-side front exhaust pipes from exhaust manifold.

- Unbolt exhaust system from transmission bracket.

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

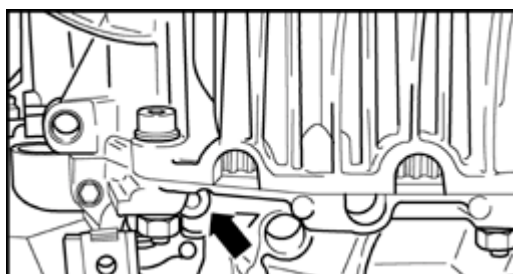
WARNING!

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.



A

- 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.

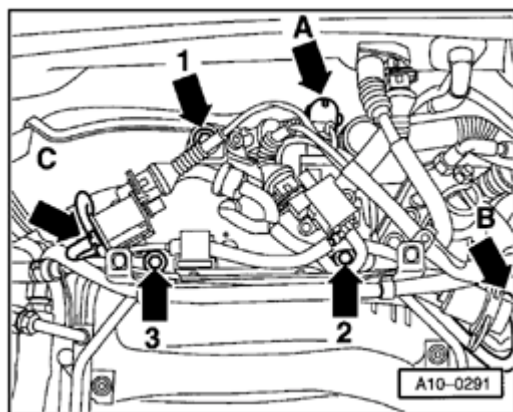


A

- 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

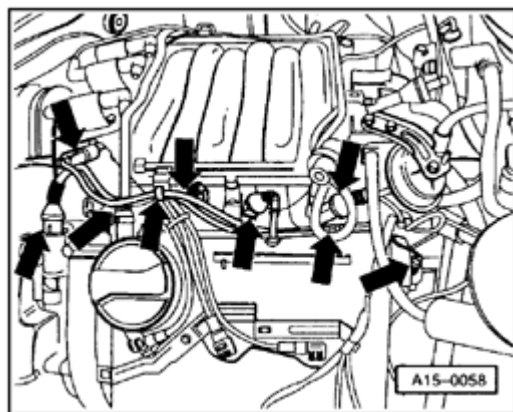
cover.

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



A

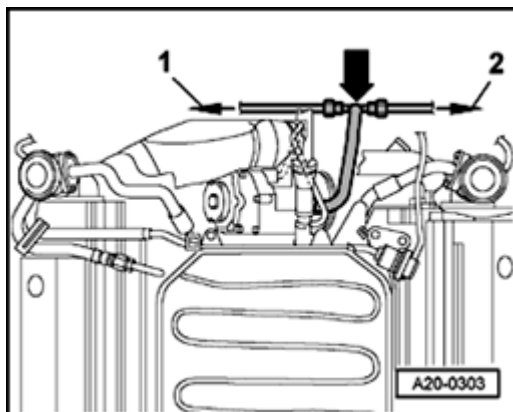
- Disconnect blue harness connector on Intake Manifold Tuning (IMT) valve.
- Disconnect black harness connector for intake air temperature sensor on resonator.
- Cut tie wraps and move wiring to side.
- Disconnect vacuum line at cruise control vacuum diaphragm and at vacuum booster.
- Unbolt cruise control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

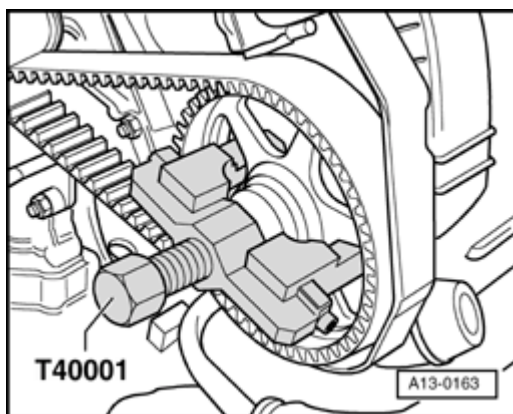
- Disconnect harness connectors from camshaft adjustment valve and from fuel injectors (arrows).
- Disconnect harness connectors from Engine Coolant Temperature (ECT) sensor and Camshaft Position (CMP) sensor (arrows).
- Cut tie wraps on valve cover.
- Unclip wiring retainer on fuel rail and disconnect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

15-21



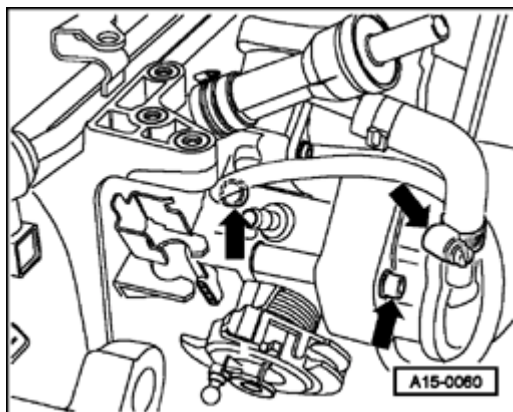
A

- 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.



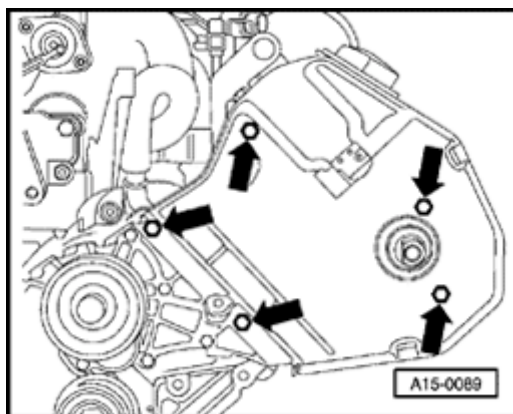
A

- 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.



A

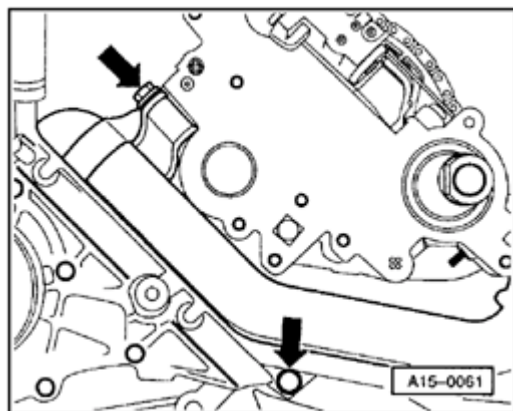
- Disconnect vacuum line at throttle body and line between vacuum booster and intake air elbow (arrows).
- Remove intake air elbow.
- Remove intake manifold.
- Disconnect heated oxygen sensor harness connector at left-side of heater core and set aside.



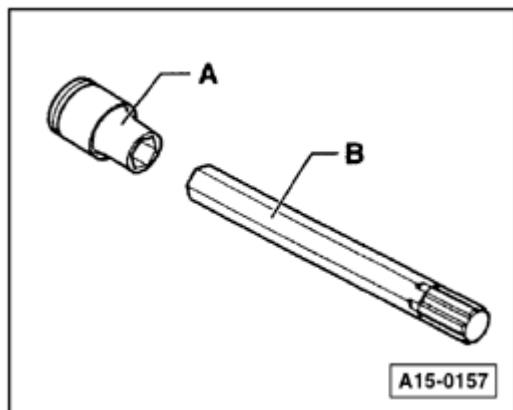
A

- 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.

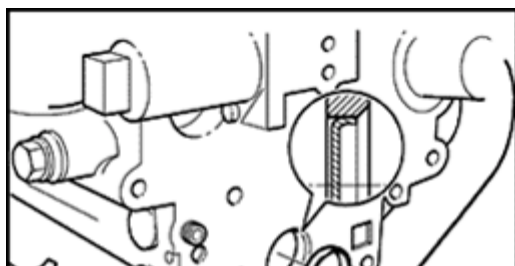
Installing

Notes:

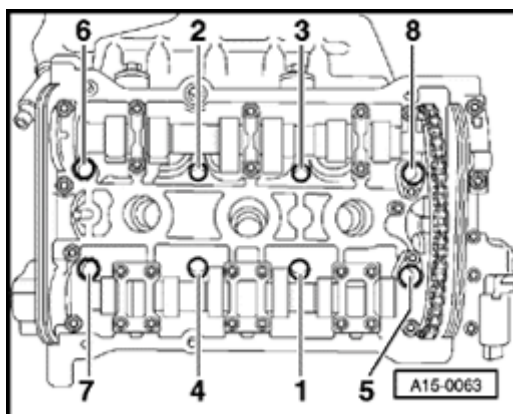
- ◆ *Bolt holes in engine block for cylinder head bolts must be free of oil and coolant.*
- ◆ *Always replace cylinder head bolts.*
- ◆ *Vacuum line connections ⇒ page 10-23*

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.

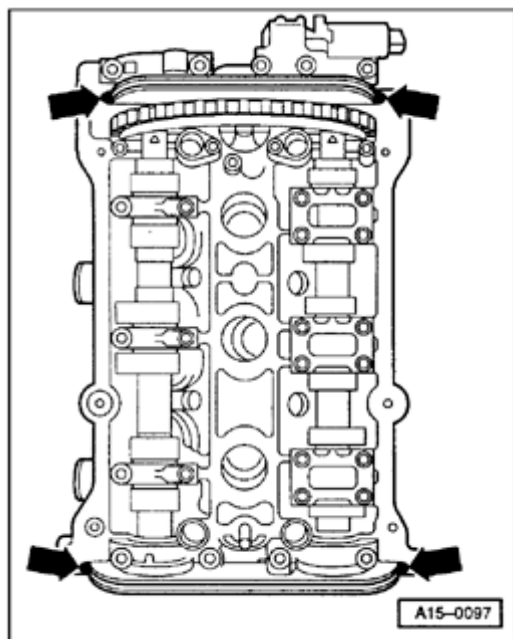


- Install cylinder head gasket onto guide sleeves. Marking "oben" or Part No. must face toward cylinder head.
- Install cylinder head, install cylinder head bolts and tighten hand-tight.



- A
- 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.

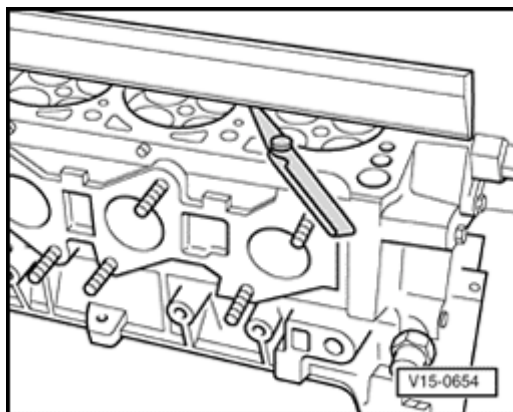


- A
- Sealing contact surfaces between bearing cap and cylinder head.
 - Carefully apply small amount of sealant D 454 300 A2 at four end points of sealing surfaces on cylinder head using small screwdriver.

Tightening torques

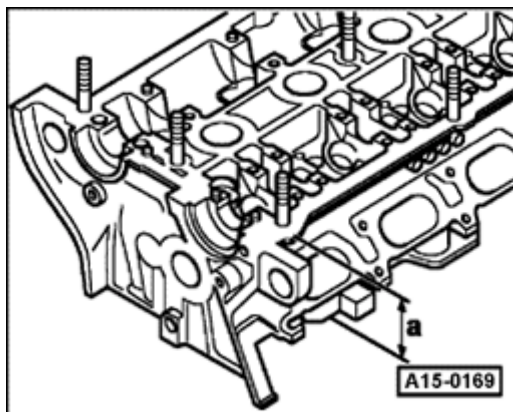
Component	Tightening torque
Bolts M6	10 Nm (7 ft lb)
Bolts M8	20 Nm (15 ft lb)
Camshaft bearing cap and camshaft adjuster	10 Nm (7 ft lb)
Exhaust manifold to cylinder head	25 Nm (18 ft lb)
Front exhaust pipe to exhaust manifold	25 Nm (18 ft lb)
Heated Oxygen Sensor (HO2S)	50 Nm (37 ft lb)
Spark plugs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

Cylinder head, checking for distortion

**A**

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

Cylinder head, resurfacing



- A** 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
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9-14 bar (131-203 psi)	7.5 bar (109 psi)	3 bar (44 psi)
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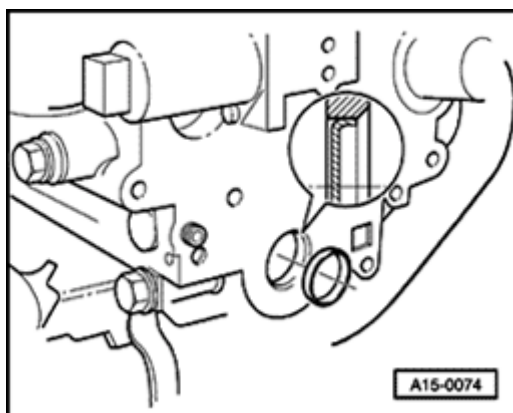
Sealing cap (core plug) in cylinder head, installing

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!

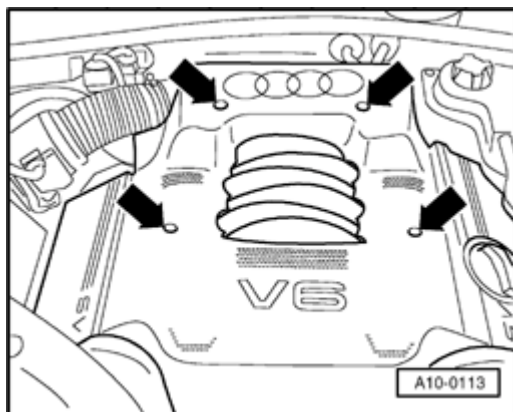
Part numbers are listed here for reference only. Always check with your Parts department for the latest information.

**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).

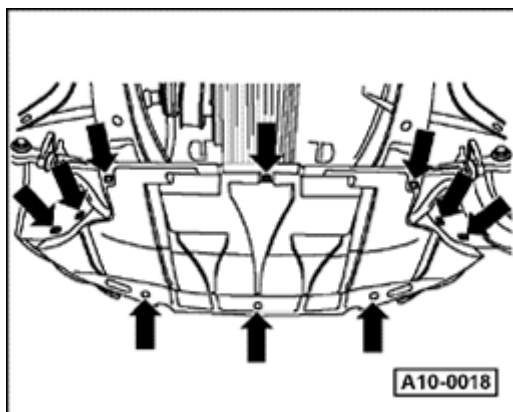
Camshafts and camshaft adjusters, removing and installing

Removing



A

- 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](#) .



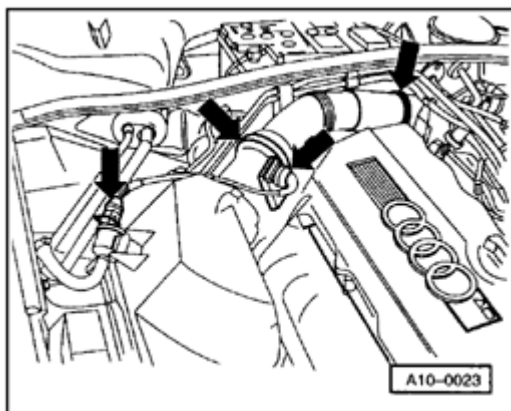
A

- Remove noise insulation panel (arrows).

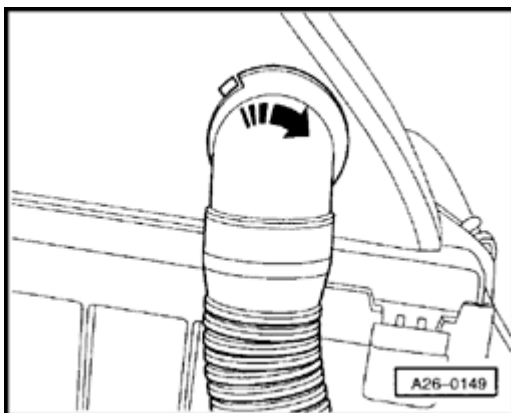
Left-side cylinder head

- 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**

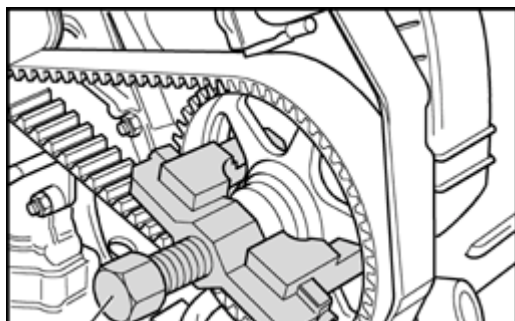
- Turn connection pipe for secondary air injection pump on air cleaner 45° in clockwise direction and pull forward off air cleaner.
- Unbolt air cleaner and remove.

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.

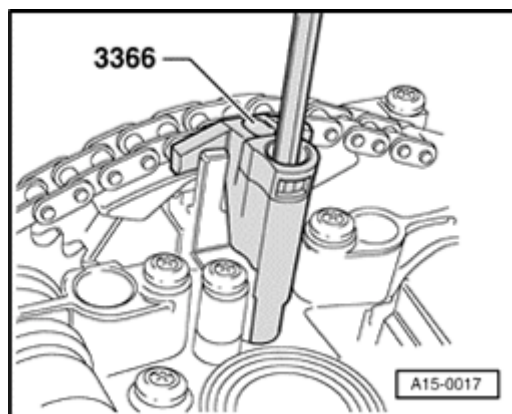
Tightening torque: 20Nm (15 ft lb)

- 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.



A

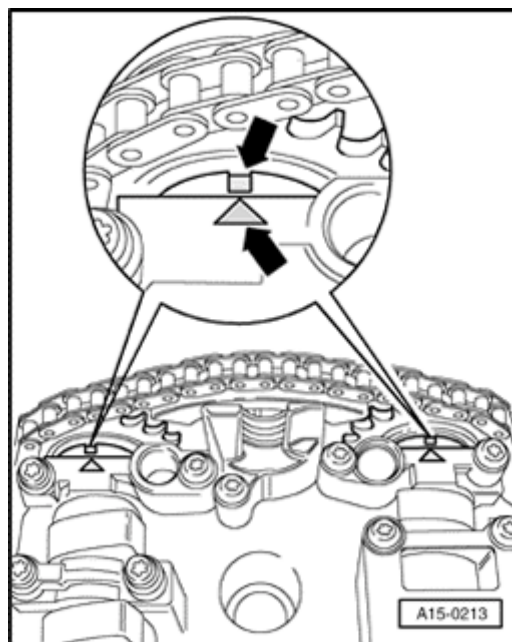
- Remove both camshaft sprockets using T40001 special tool.
 - Using screwdriver, carefully lift out oil lines for camshaft bearing lubrication from camshaft bearings.
- When lifting out oil lines, be careful not to damage positioning clips.



- A** - Secure camshaft adjuster with 3366 bracket tensioner.

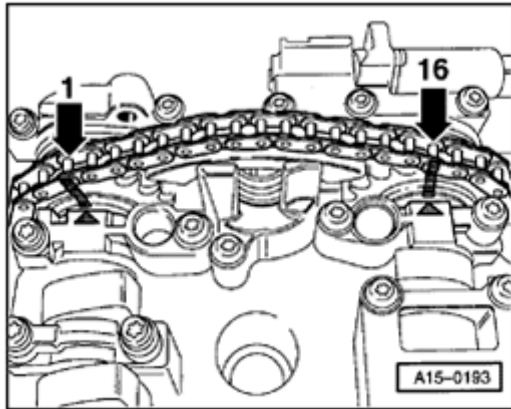
Note:

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



- A** - 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

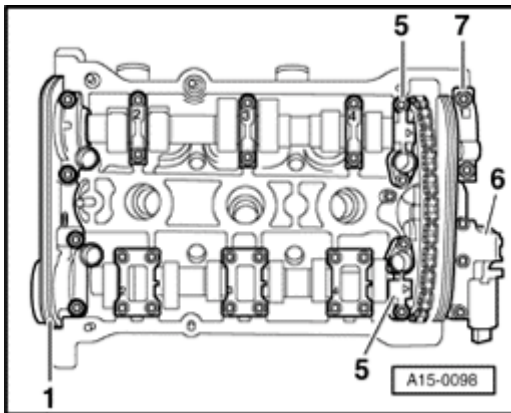


- ▲ The distance between the two arrows/paint marks is equivalent to 16 drive chain rollers.

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

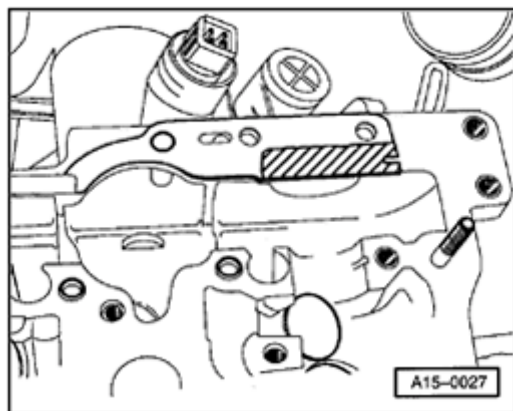
Note:

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

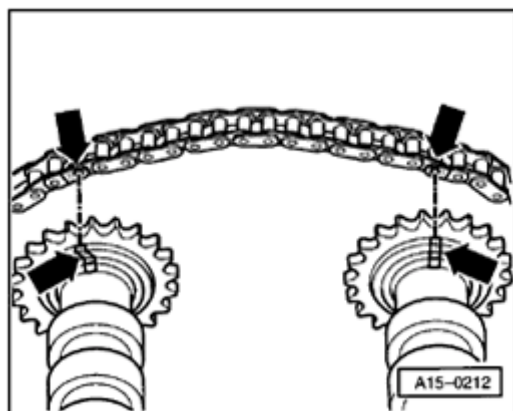


- ▲
- Remove camshaft adjuster retaining bolts.
 - Remove bearing caps -1-, -3-, -5- and -7- and lay on a clean surface in correct order.
 - Alternating in diagonal sequence, loosen bearing caps -2- and -4- of intake and exhaust camshafts and remove.
 - Remove both camshafts together with camshaft adjuster.

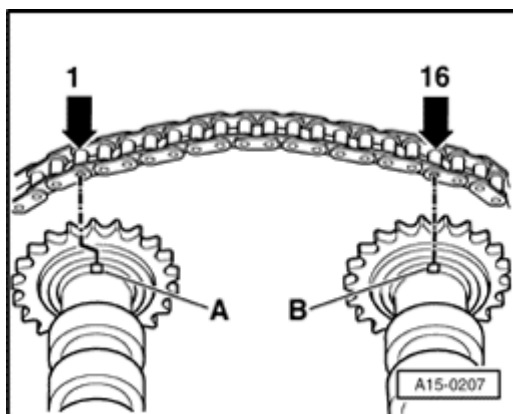
Installing



- 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).



- 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.

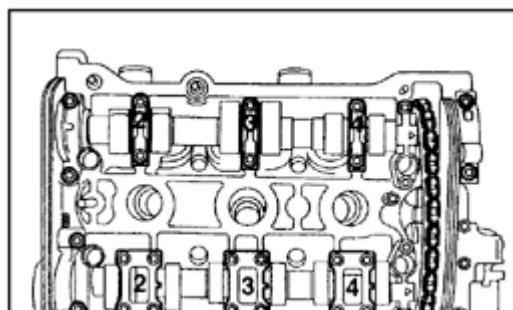
Note:

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.

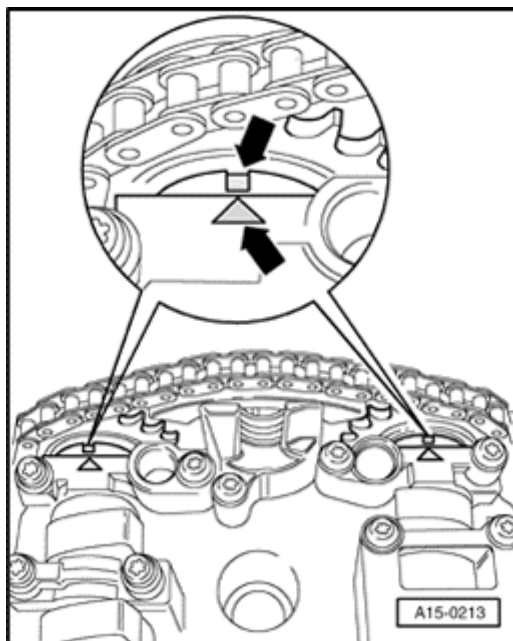
Notes:

- ◆ *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).



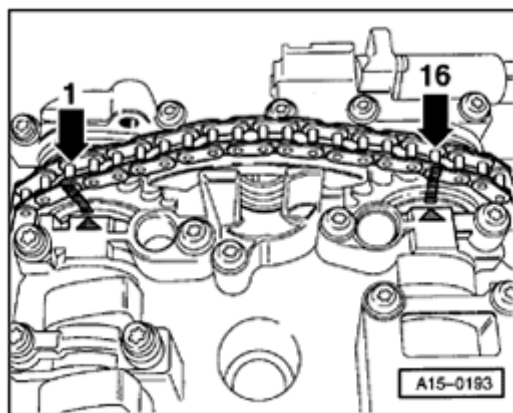
- A**
- Tighten bearing caps -2- and -4- in alternating diagonal sequence (pay attention to alignment bushings).
 - Install both bearing caps on chain sprockets of intake and exhaust camshafts.

- Verify correct position of both camshafts.



A

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

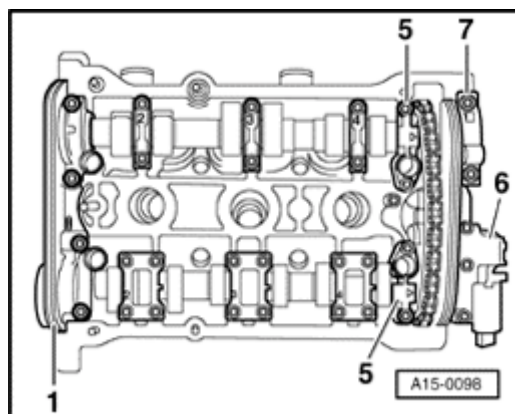


A

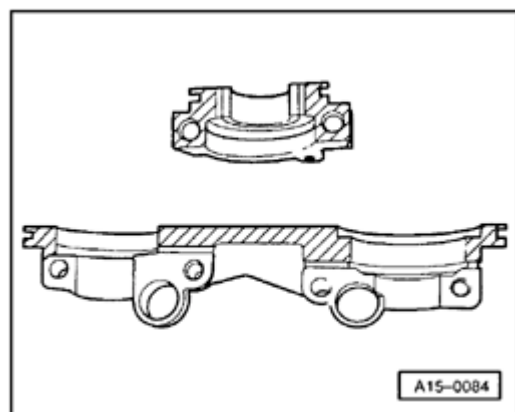
The distance between the two arrows/paint markings is equivalent to 16 drive chain rollers.

Note:

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



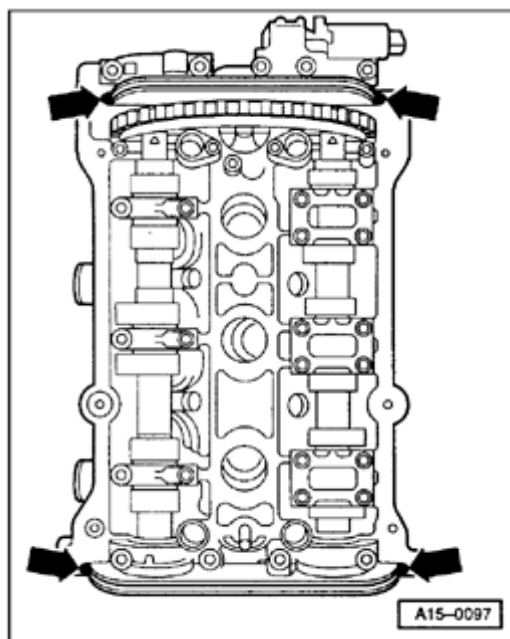
- A
- Lightly coat hatched surface of double bearing cap -1- and bearing cap -7-...



- A
- ...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.

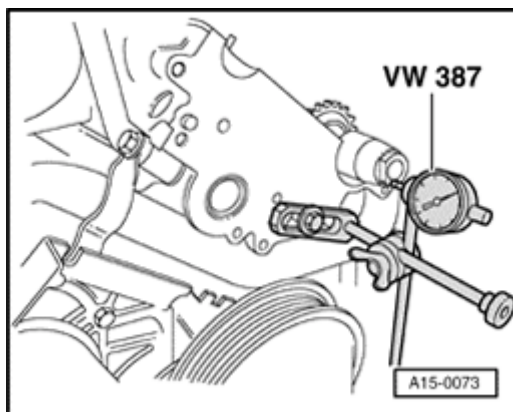
- Carefully apply a small amount of sealant D 454 300 A2 at four end points of sealing surfaces on cylinder head (arrows) using small screw driver.
- Install cylinder head cover.
- Install toothed belt ⇒ [page 13-15](#) .
- Remove ribbed belt ⇒ [page 13-8](#) .

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

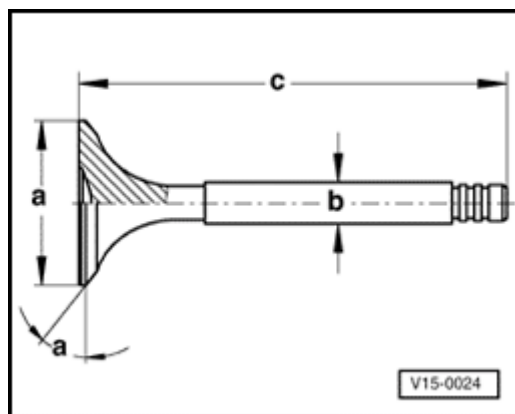
- Remove camshafts ⇒ [page 15-31](#) .
- Remove hydraulic valve lifters.
- Install camshafts without chain into cylinder head and tighten with bearing caps 2 and 4.



A

- 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.)



A 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.

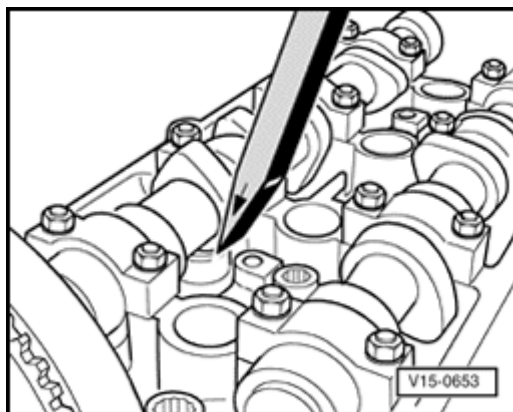
Notes:

- ◆ *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:

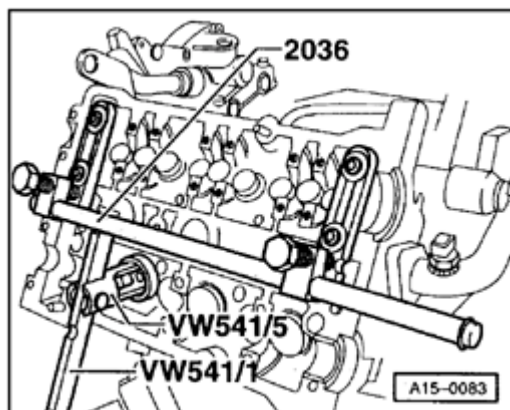
Lightly tap valve lever to loosen stuck valve keepers.

Exhaust side

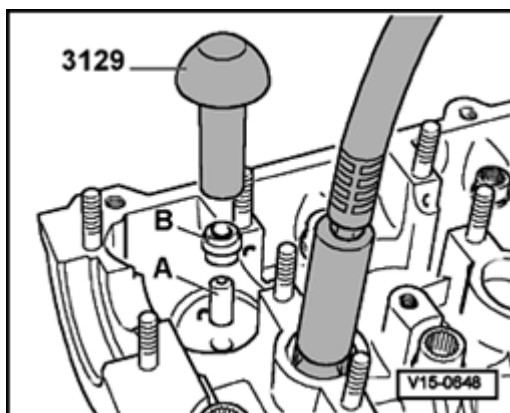
Note:

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).



- 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.

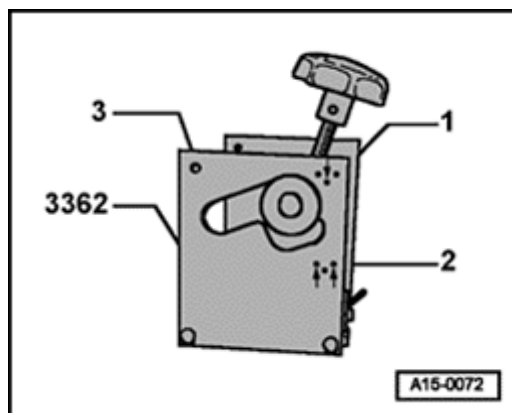


- A**
- Place plastic sleeve -A- on valve stem to prevent damage to new valve stem oil seals.
 - Lightly lubricate sealing lip with oil.
 - Insert valve stem oil seal -B- (without oiling outside of seal) into 3129 seal driver and carefully slide onto valve guide.
 - When installing new valve, lightly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

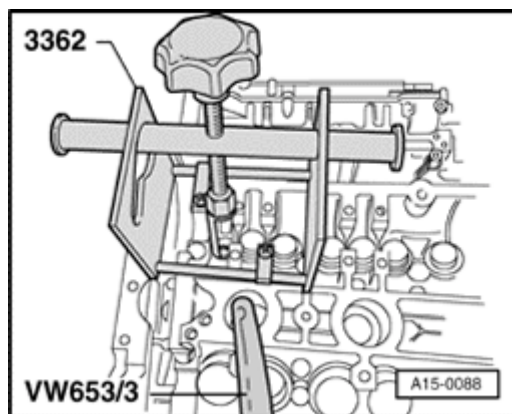
Intake side

Note:

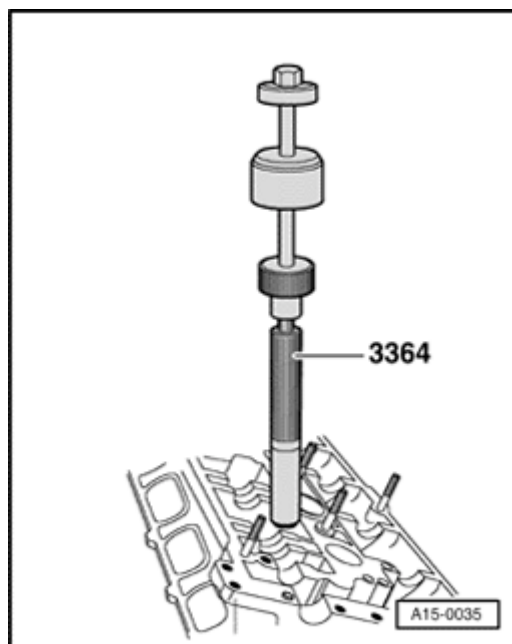
The intake valves are installed in the cylinder head at different angles.



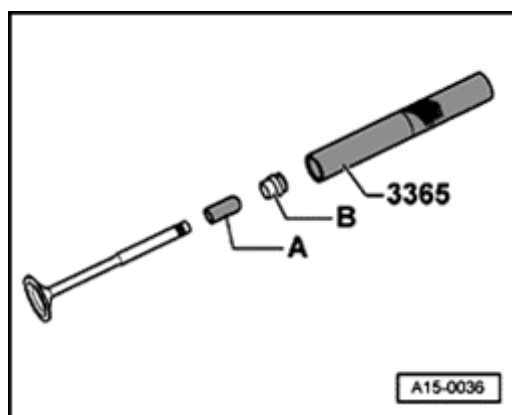
- ▲ 3362 valve spring tool can be used in two different positions:
- 1 - Upper position for center valve
 - 2 - Lower position for two outer valves
 - 3 - Threaded holes on each side to take M6 x 25 bolts for mounting valve spring tool to cylinder head.



- ▲
- 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.



- 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.

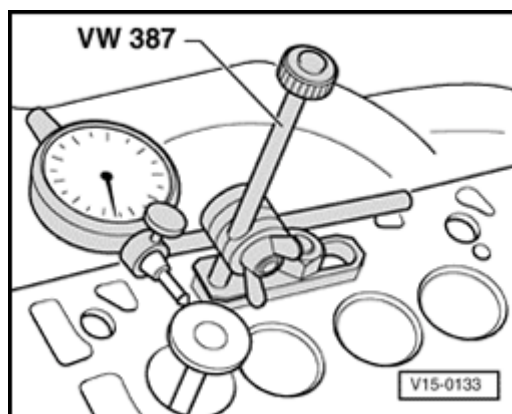
Valves, refacing

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.



A

- 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:

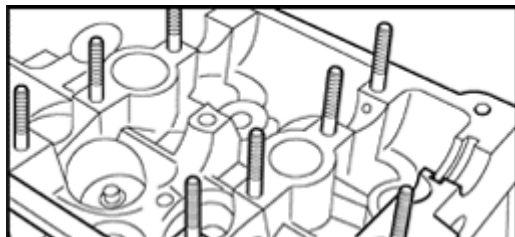
- ◆ *Only reface valve seats enough until a perfect contact pattern is obtained.*
- ◆ *Before refacing, calculate the maximum refacing dimension.*
- ◆ *If refaced dimension is exceeded, hydraulic valve lifter function is no longer guaranteed and cylinder head must be replaced.*

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.



A

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

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

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

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

Note:

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