

Valvetrain, servicing

Note:

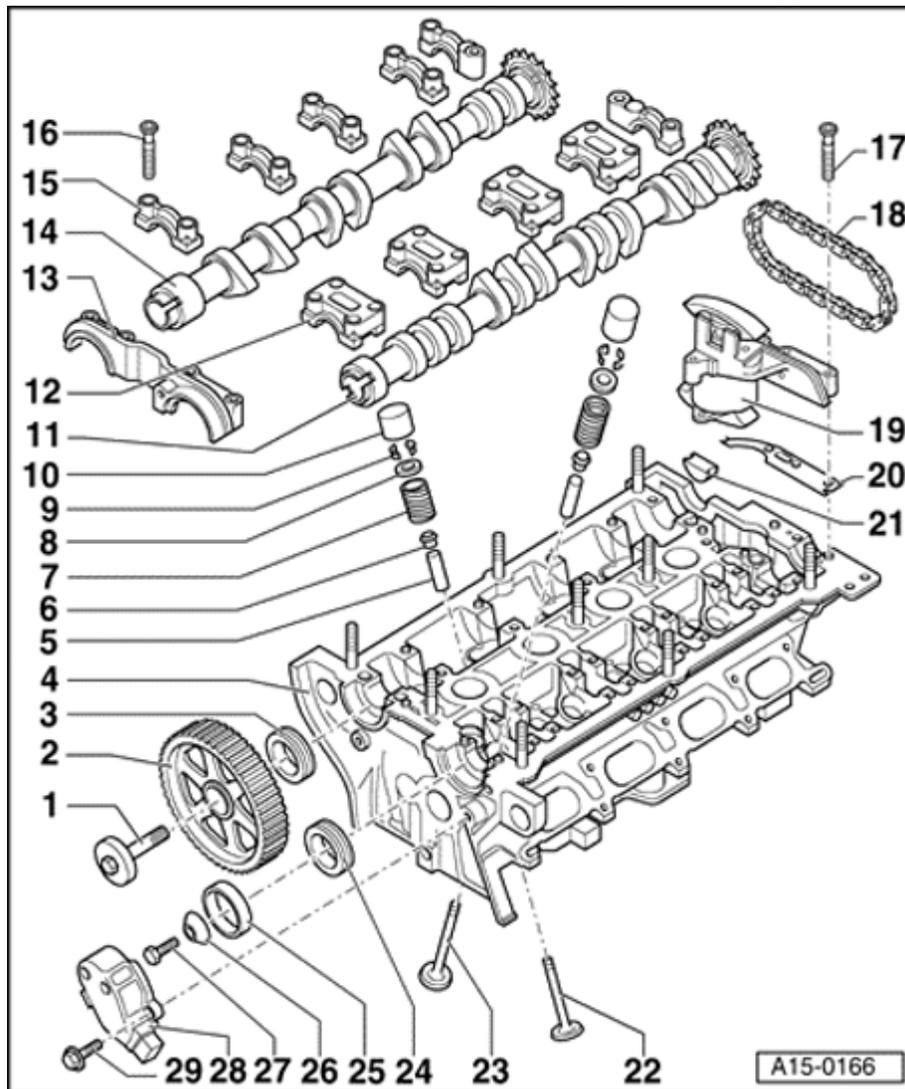
- ◆ *Cylinder heads with small cracks between the valve seats that are less than 0.3 mm (0.012 in.) wide and/or between one valve seat and only the first 4 threads of the spark plug thread, can continue to be used without reduced service life.*

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

CAUTION!

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

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



1 - Bolt

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

2 - Camshaft gear

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

3 - Oil seal

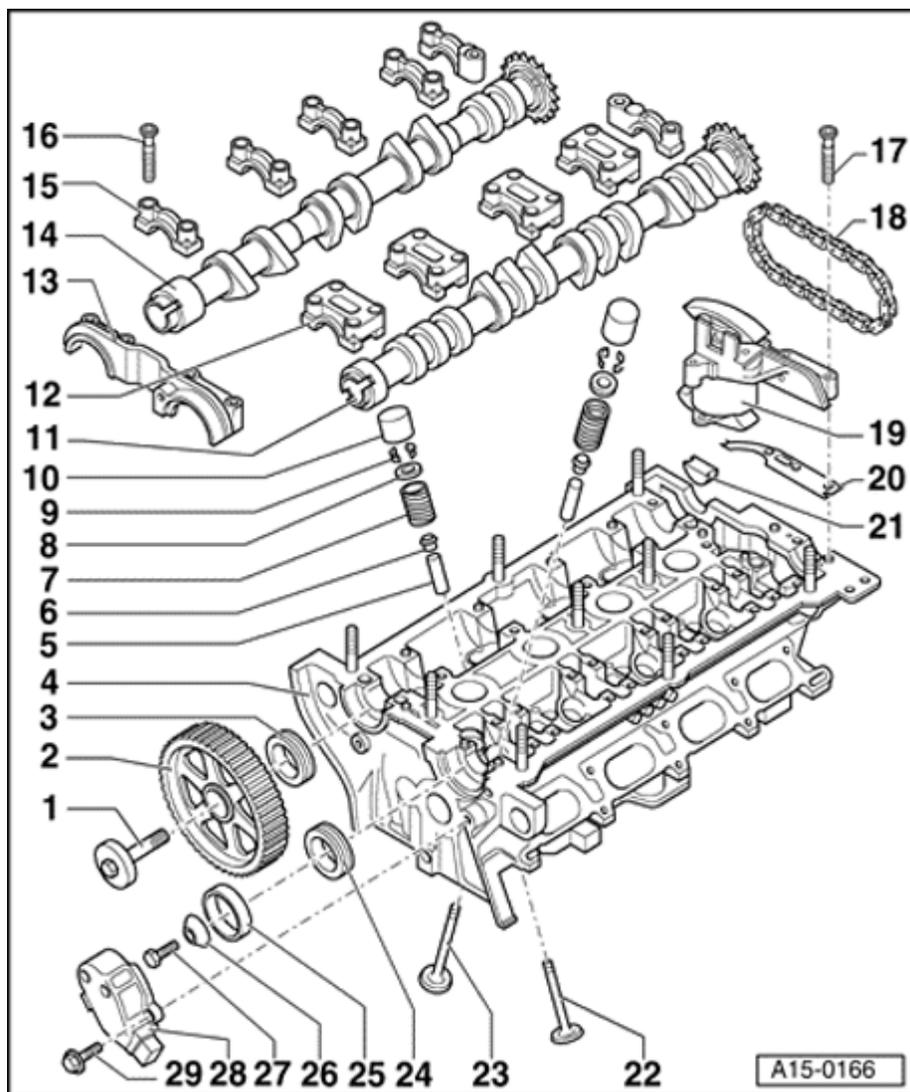
- ◆ For exhaust camshaft
- ◆ Always replace ⇒ [Page 15-42](#)

4 - Cylinder head

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

5 - Valve guide

- ◆ Check ⇒ [Page 15-66](#)
- ◆ Replace ⇒ [Page 15-67](#)



6 - Valve stem oil seal

- ◆ Replace ⇒ [Page 15-62](#)

7 - Valve spring

- ◆ Removing and installing ⇒ [Page 15-62](#)

8 - Valve spring retainer

9 - Valve keeper

10 - Hydraulic valve lifter

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

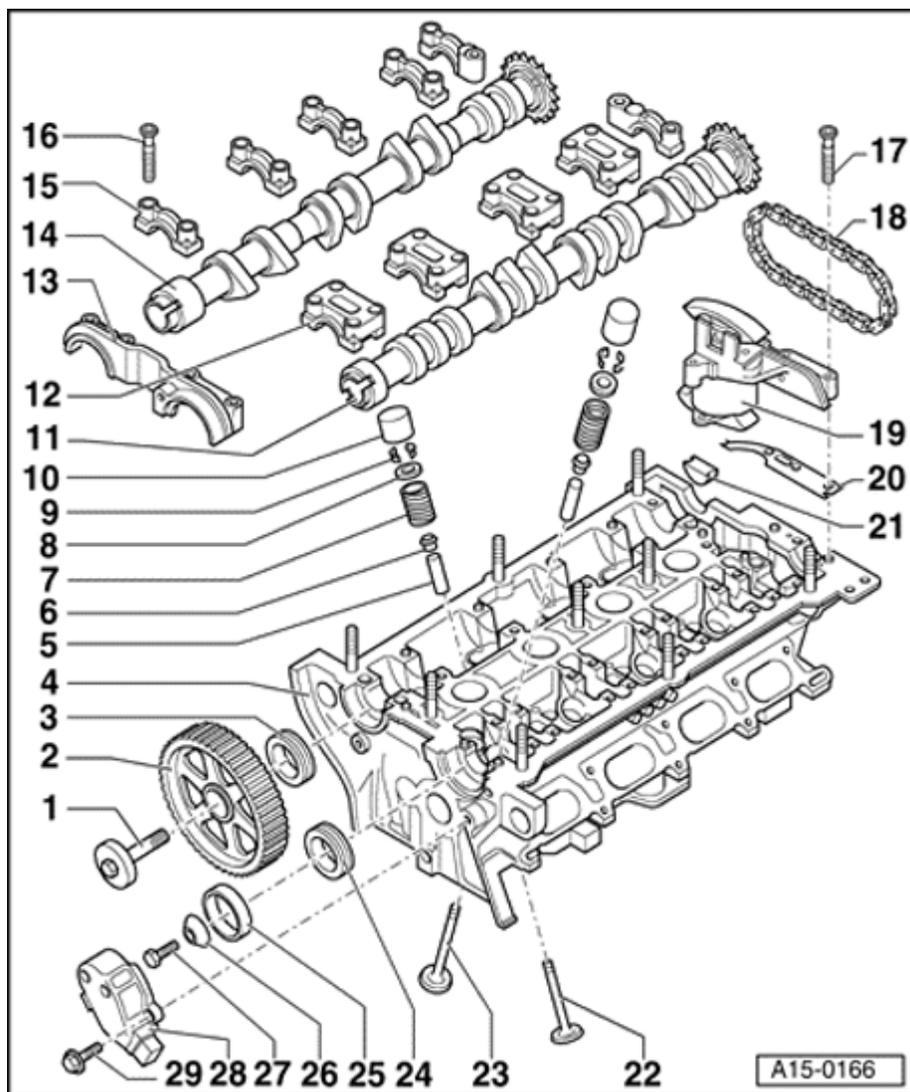
11 - Intake camshaft

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

Wear range: 0.1 mm (0.004 in.)

- ◆ Max. run-out: 0.01 mm (0.0004 in.)
- ◆ Axial play, checking ⇒ [Page 15-41](#)

- ◆ Camshafts, removing and installing ⇒
[Page 15-50](#)



12 - Bearing cap for intake camshaft

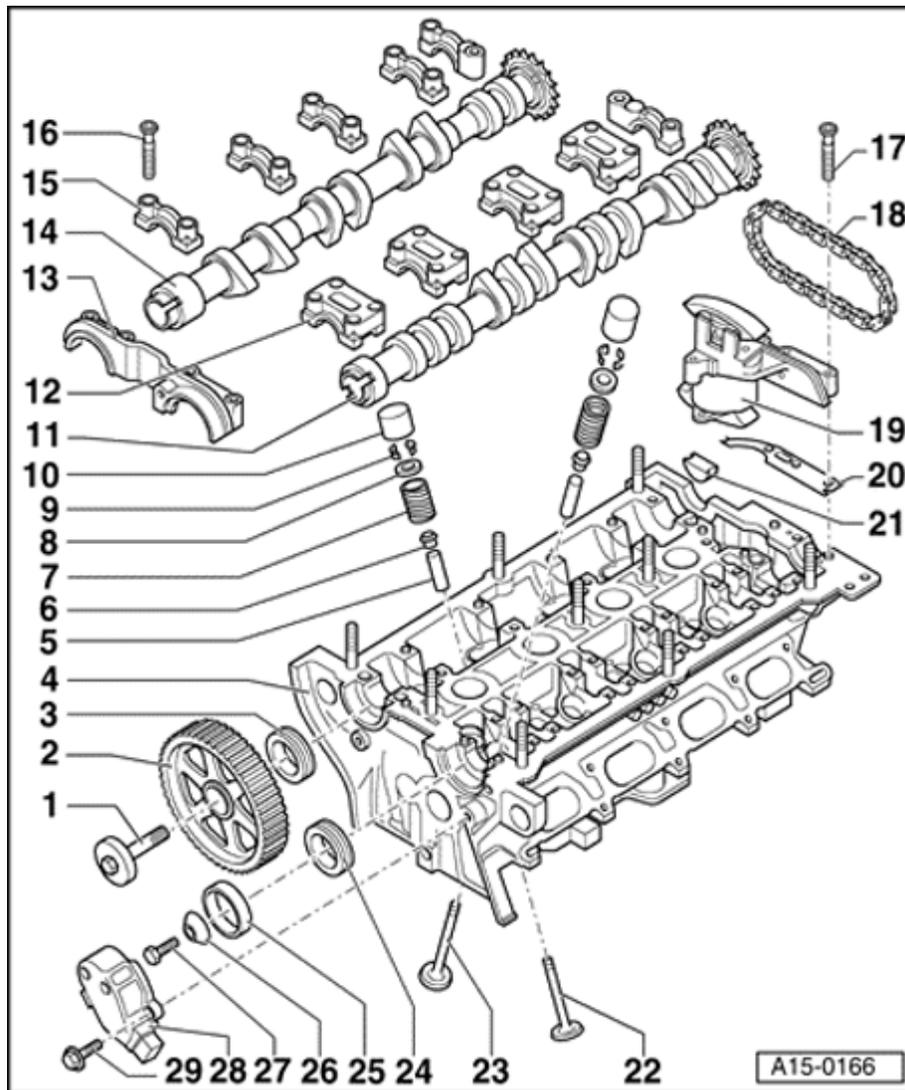
- ◆ Must fit on bushing
- ◆ Bushings must be installed in cylinder head
- ◆ Verify correct installation position
- ◆ Installation sequence ⇒ [Page 15-50](#)

13 - Double bearing cap

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

14 - Exhaust camshaft

- ◆ Using Plastigage[®] check radial play (valve lifters removed)
- Wear range: 0.1 mm (0.004 in.)
- ◆ Max. run-out: 0.01 mm (0.0004 in.)
 - ◆ Axial play, checking ⇒ [Page 15-41](#)
 - ◆ Camshafts, removing and installing ⇒ [Page 15-50](#)



15 - Bearing cap for exhaust camshaft

- ◆ Must fit on bushing
- ◆ Bushings must be installed in cylinder head
- ◆ Verify correct installation position
- ◆ Installation sequence ⇒ [Page 15-50](#)

16 - Bolt

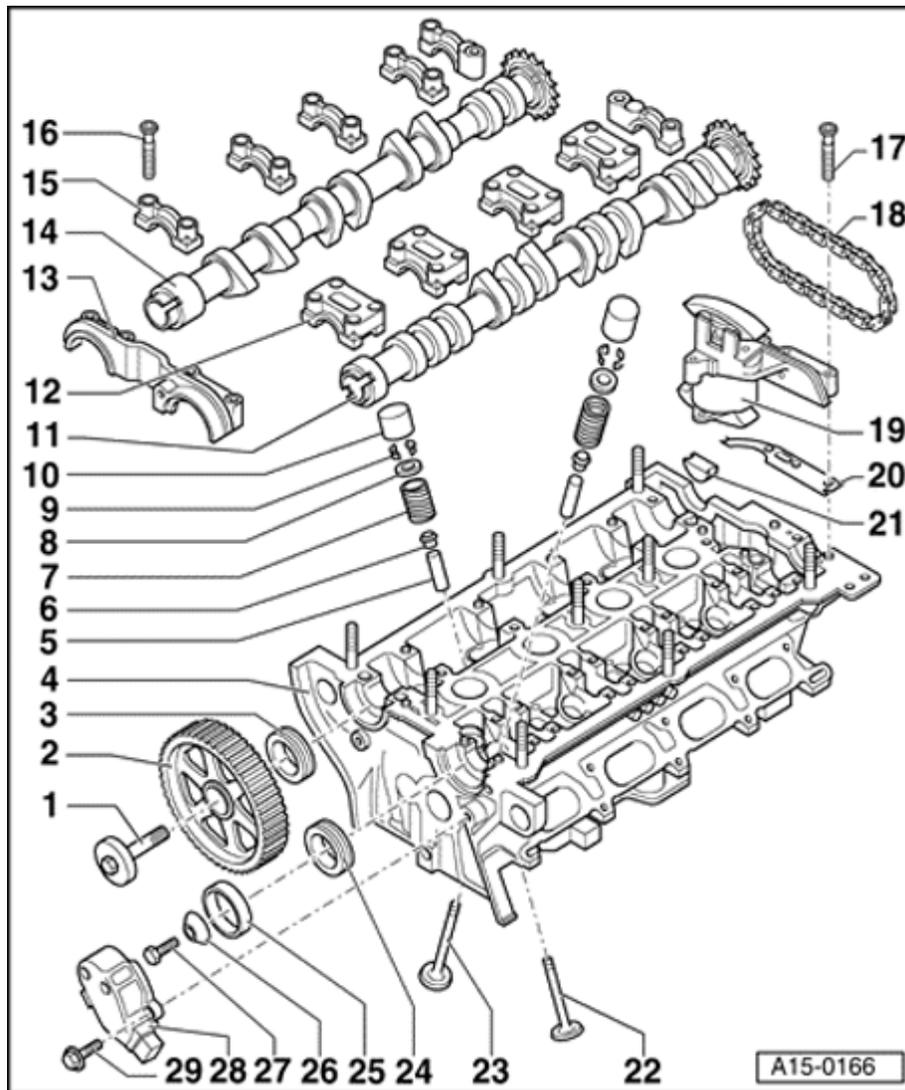
- ◆ 10 Nm (7 ft lb)

17 - Bolt

- ◆ 10 Nm (7 ft lb)

18 - Drive chain

- ◆ Check for wear
- ◆ Before removing, mark installed position ⇒ [Page 15-52](#)
- ◆ Camshafts, removing and installing ⇒ [Page 15-50](#)



19 - Hydraulic chain tensioner

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

20 - Rubber/metal seal

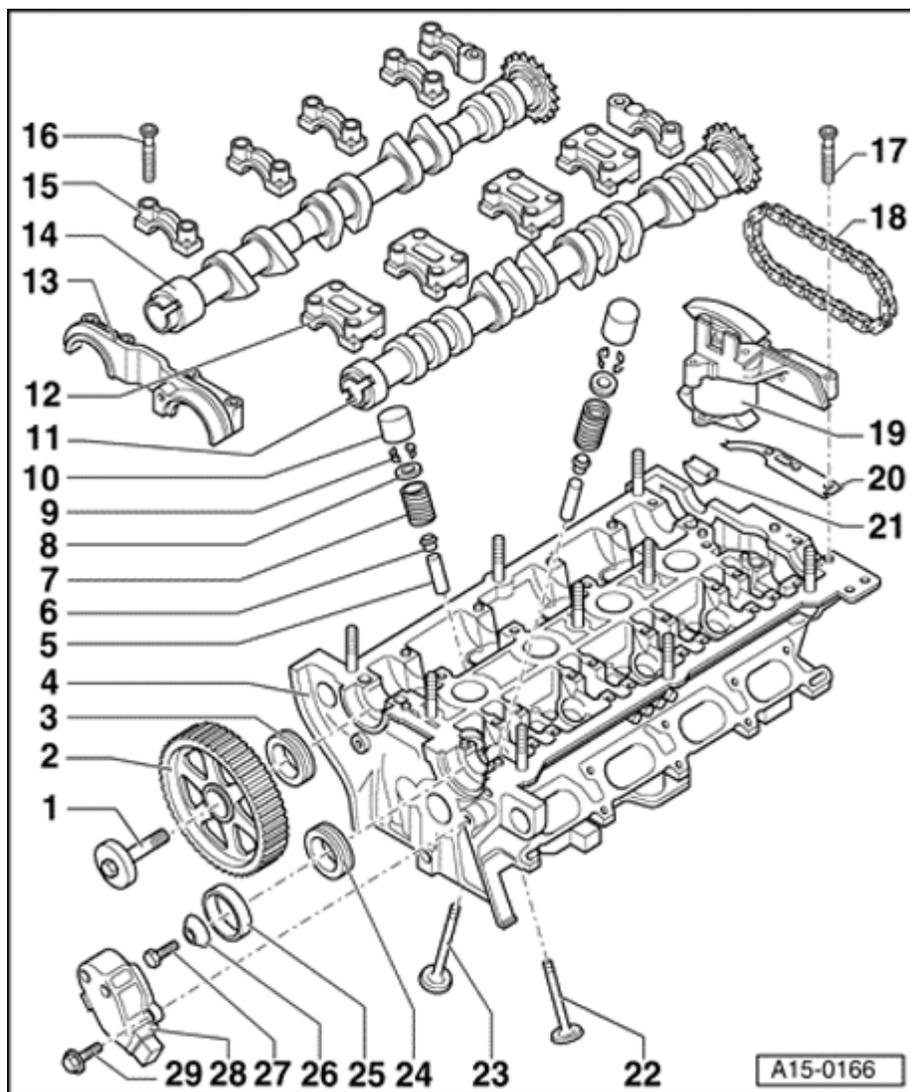
- ◆ Replacing ⇒ [Page 15-53](#)

21 - Gasket

- ◆ Always replace

22 - Exhaust valve

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



23 - Intake valve

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

24 - Oil seal

- ◆ For intake camshaft
- ◆ Replacing ⇒ [Page 15-42](#)

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

- ◆ Note position: insert lug in camshaft notch

26 - Washer

- ◆ Conical
- ◆ Note position

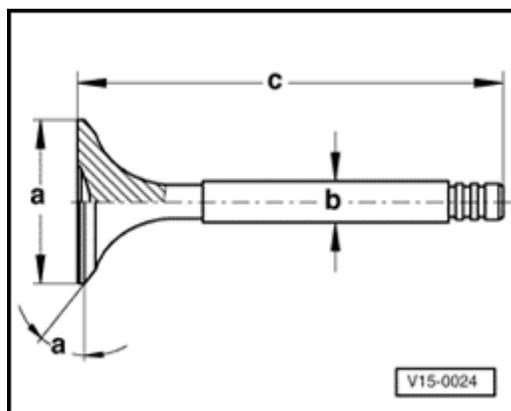
27 - Bolt

- ◆ 25 Nm (18 ft lb)

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

29 - Bolt

- ◆ 10 Nm (7 ft lb)



A

Fig. 1 Valve dimensions

WARNING!

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

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

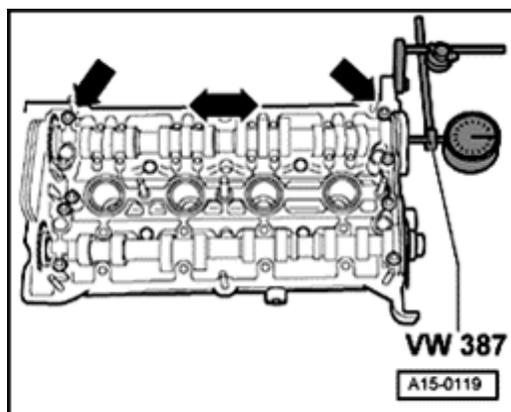
Camshafts axial play, checking

Special tools and equipment

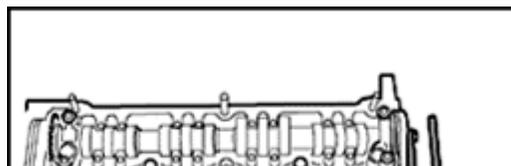
- ◆ VW387 dial gauge holder
- ◆ Dial indicator

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

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



◀ Intake camshaft



◀ Exhaust camshaft

Wear limit for intake and exhaust camshafts:

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

Oil seals for camshafts, replacing

- Cylinder head installed
- Lock carrier in service position ⇒ [Page 13-1](#)

Special tools and equipment

- ◆ 2085 seal puller
- ◆ 3241 seal installer
- ◆ 3036 retainer

Replacing exhaust camshaft oil seal

Removing

- Remove ribbed belt and ribbed belt tensioner ⇒ [Page 13-15](#) .
- Remove engine covers.
- Remove upper toothed belt cover ⇒ [Page 13-29](#) .
- Turn crankshaft at central bolt of toothed belt gear in direction of

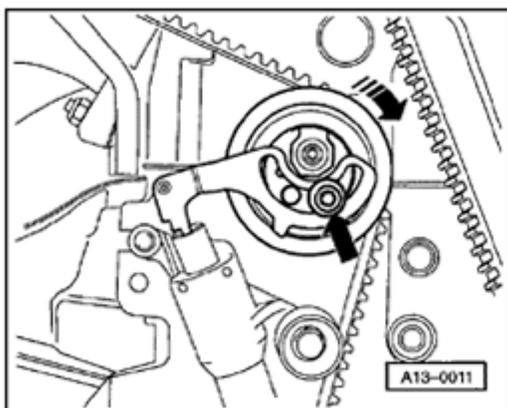


A

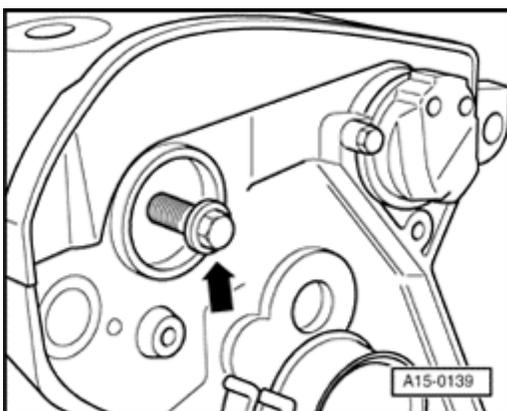
engine rotation to TDC Cyl. 1 marking (arrows).

CAUTION!

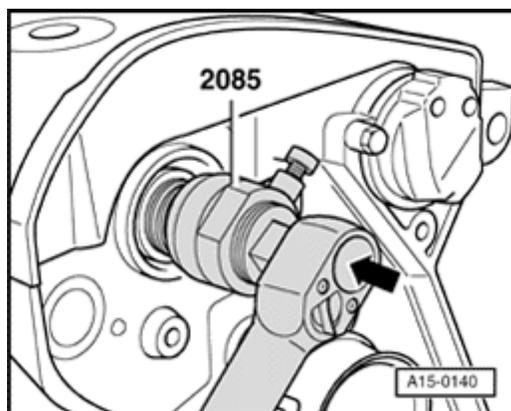
Before removing toothed belt, note direction of rotation with chalk or felt-tip marker. Reversing the direction of rotation of a used belt can destroy the belt.



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



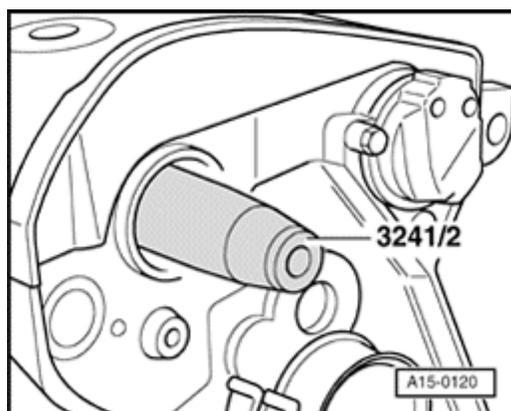
- A**
- Thread camshaft gear retaining bolt (arrow) into camshaft by hand until stop to guide 2085 seal puller.
 - Unthread inner part of 2085 seal puller two turns (approx. 3 mm or 0.12 in.) and secure using knurled bolt.



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

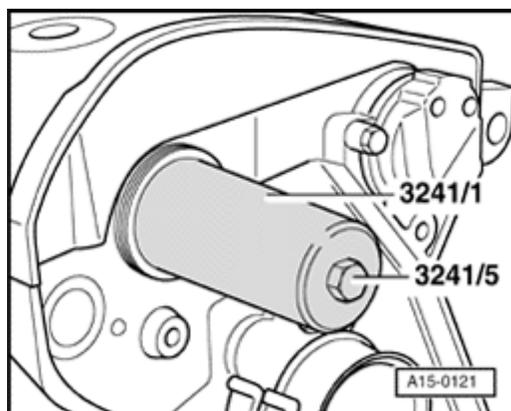
Installing

- Lightly oil lip of oil seal.

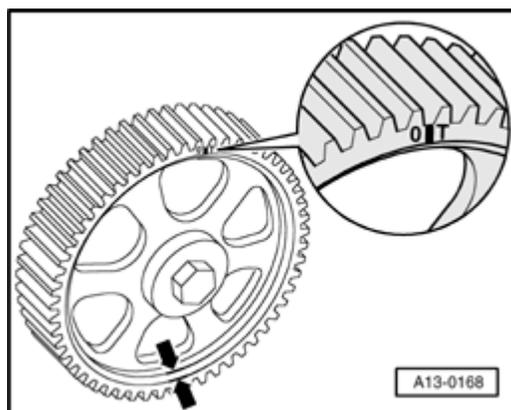


- A**
- Place 3241/2 guide sleeve on end of camshaft.
 - Slide oil seal over guide sleeve.

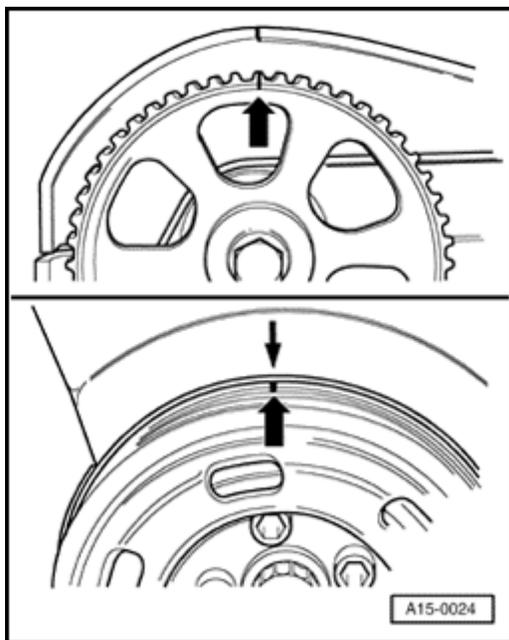
15-45



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



- A**
- Install camshaft gear.
Note position: thin rib of camshaft gear points outward (arrows) and TDC Cyl. 1 marking is visible from the front.
 - Using 3036 retainer, install camshaft gear retaining bolt.



A

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

Note:

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

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

Note:

Follow all procedures for removing and installing toothed belt ⇒ [Page 13-29](#) .

- Install ribbed belt and ribbed belt tensioner ⇒ [Page 13-15](#) .

Note:

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

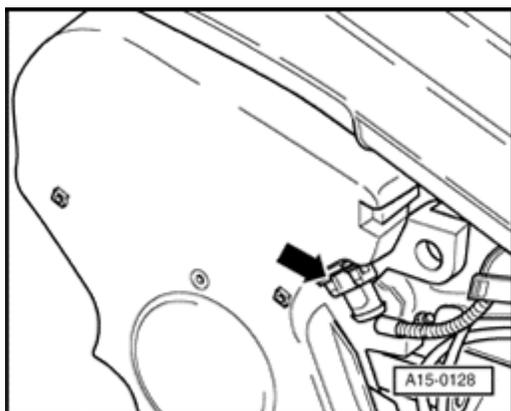
Tightening torques

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

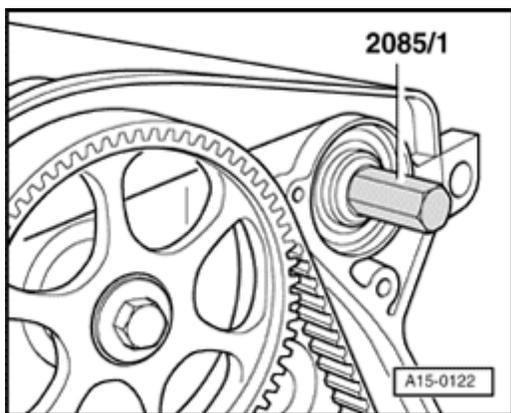
Replacing intake camshaft oil seal

Removing

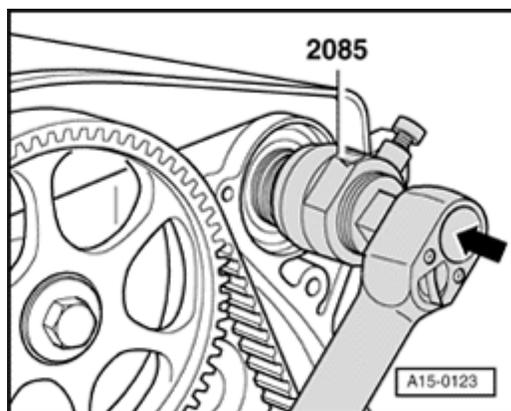
- Remove ribbed belt and ribbed belt tensioner ⇒ [Page 13-15](#) .



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



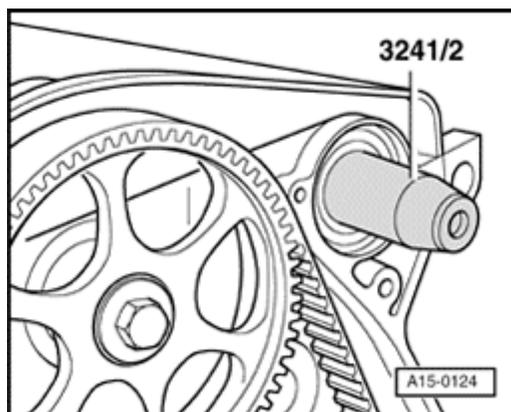
- A** - Insert 2085/1 adapter into camshaft by hand until stop to guide seal puller.
- Unscrew inner part of 2085 seal puller two turns (approx. 3 mm or 0.12 in.) and secure using knurled bolt.



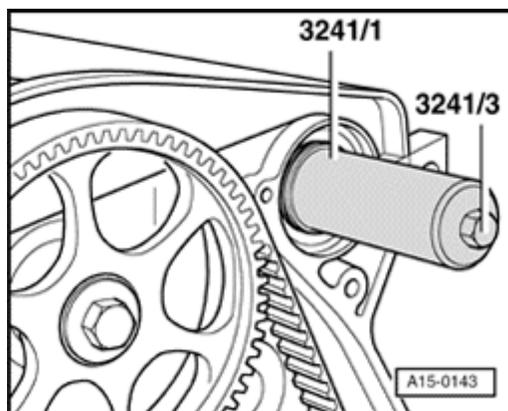
- A**
- Grease threaded head of 2085 seal puller, attach and with forced pressure screw into oil seal as far as possible.
 - Loosen knurled bolt and turn inner part against crankshaft until oil seal is removed.

Installing

- Lightly oil lip of oil seal.



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



A

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

Note:

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

Tightening torques

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

Camshafts and hydraulic chain tensioner, removing and installing

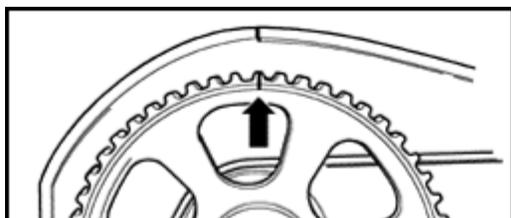
- Cylinder head installed
- Lock carrier in service position ⇒ [Page 13-1](#)

Special tools and equipment

- ◆ 3036 retainer
- ◆ 3366 bracket-tensioner

Removing

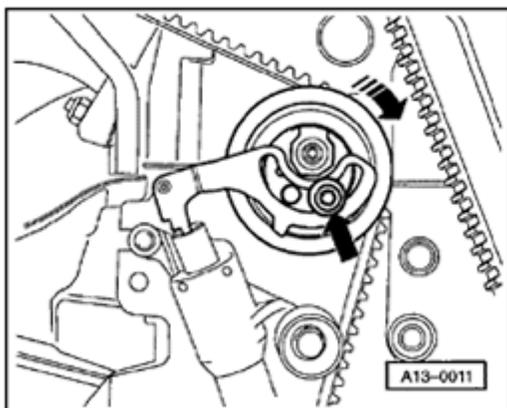
- Remove ribbed belt and ribbed belt tensioner ⇒ [Page 13-15](#) .
- Remove engine covers.
- Remove upper toothed belt cover ⇒ [Page 13-29](#) .
- Turn crankshaft at central bolt of toothed belt gear in direction of engine rotation to TDC Cyl. 1 marking (arrows).
- Remove cylinder head cover ⇒ [Page 15-17](#) .

**A**

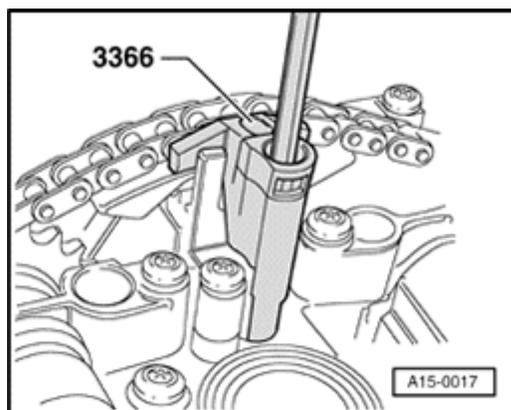
CAUTION!

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

15-51



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

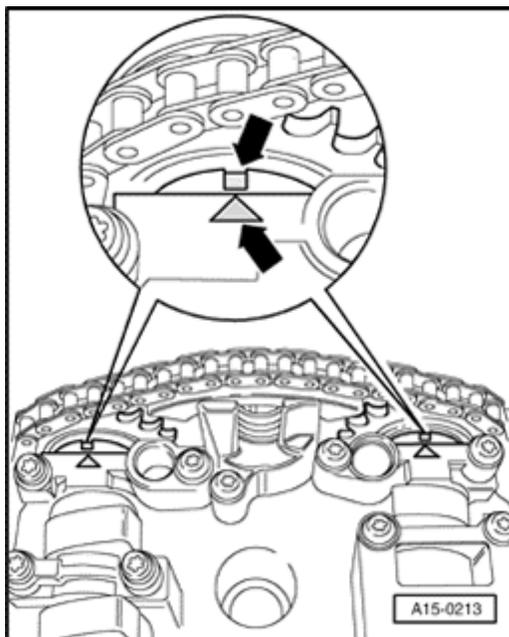


- A**
- Secure hydraulic chain tensioner using 3366 bracket-tensioner.

CAUTION!

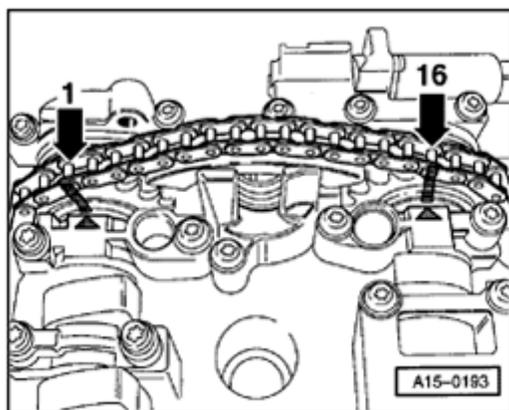
If over-tightened, the chain tensioner will be damaged.

- Verify that camshafts are at TDC Cyl 1.



A

- Both camshaft markings must align with arrows on bearing caps.
- Clean drive chain and camshaft chain gears opposite both arrows on bearing caps. Mark installed position using paint.



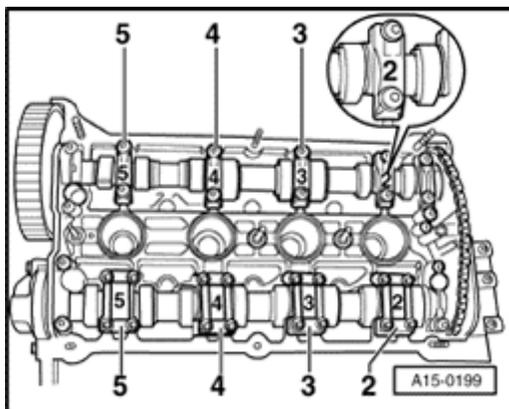
A

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

Note:

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

15-53



A

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

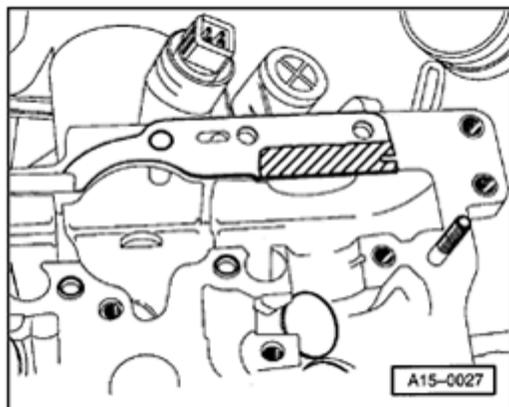
Installing

A

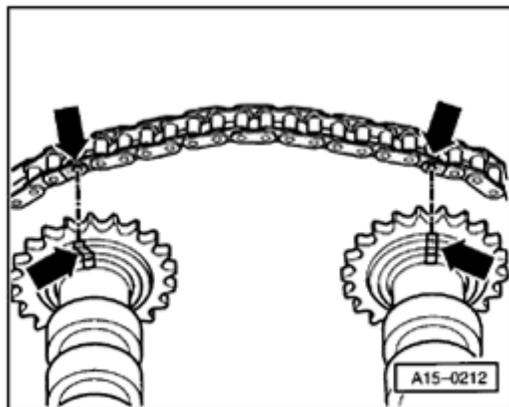
- Replace rubber/metal chain tensioner gasket and spread sealant D 454 300 A2 on hatched surface.

CAUTION!

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

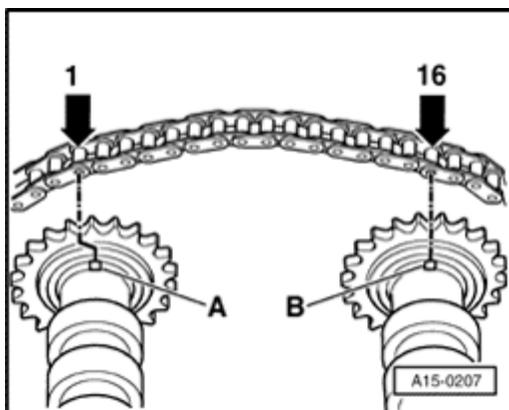


Install drive chain on camshaft chain gear as follows:



A

- When installing 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.
- ◆ Notch -A- is slightly offset inward toward drive chain roller -1-.
- Slide in hydraulic chain tensioner between drive chain.

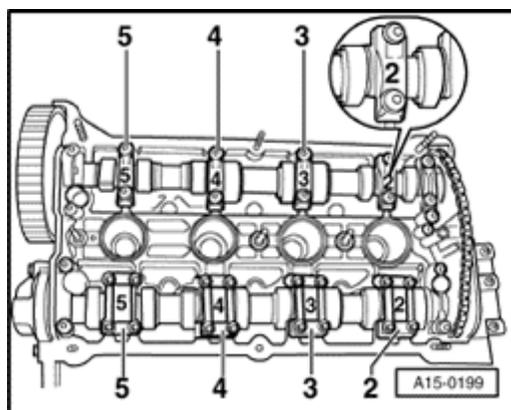
- Install camshafts with drive chain and hydraulic chain tensioner into cylinder head.

- Oil camshaft contact surfaces.

Note:

- ◆ *Alignment bushings for bearing caps and hydraulic chain tensioner must be installed in cylinder head.*
- ◆ *When installing bearing caps, verify marking on cap is readable from intake side of cylinder head.*

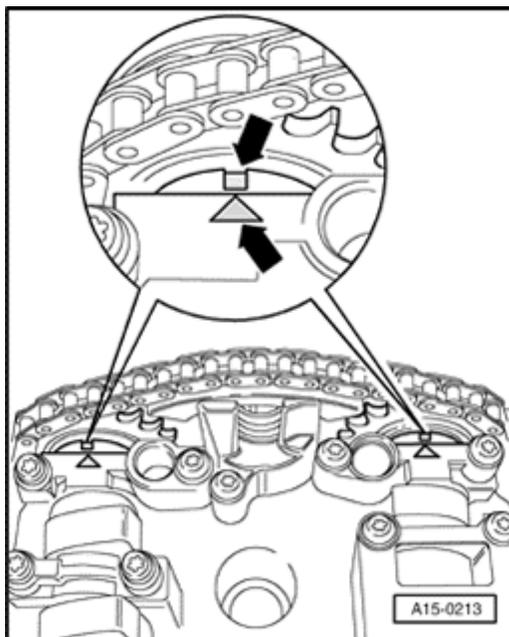
- Tighten hydraulic chain tensioner (pay attention to alignment bushings).



A

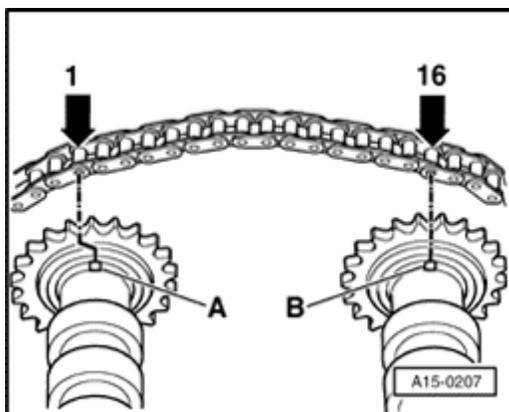
- Tighten bearing caps -2- and -4- of intake and exhaust camshafts in alternating diagonal sequence (pay attention to alignment bushings).
- Install both bearing caps on chain sprockets of intake and exhaust camshafts.

- Verify correct position of both camshafts.



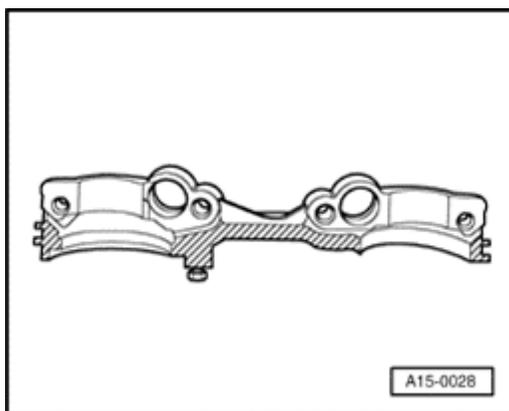
A

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



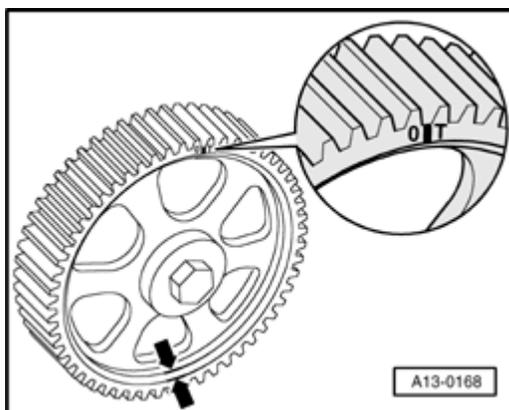
A

- Remove 3366 bracket-tensioner.
- Lightly coat hatched surface of double bearing cap with sealant D 454 300 A2 and install bearing cap (pay attention to alignment bushings).

CAUTION!

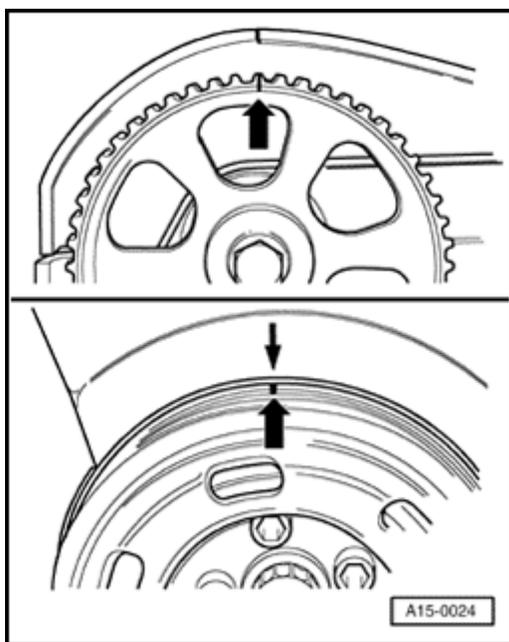
Part numbers are listed here for reference only. Always check with your Parts department for the latest information.

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



A

- Install camshaft gear.
Note position: thin rib of camshaft gear points outward (arrows) and TDC Cyl. 1 marking is visible from the front.
- Using 3036 retainer, install camshaft gear retaining bolt.
- Install Camshaft Position (CMP) sensor -G40- ⇒ [Page 15-38](#) .
- Install cylinder head cover ⇒ [Page 15-18](#) .



A

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

Note:

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

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

Note:

Follow all procedures for removing and installing toothed belt ⇒ [Page 13-29](#) .

CAUTION!

- ♦ ***After installing the camshafts, the engine must not be started for approx. 30 minutes. The hydraulic valve lifters have to settle (otherwise valves will strike the pistons).***
- ♦ ***After installing the valvetrain and lifters, carefully rotate the crankshaft by hand at least 2 full revolutions before starting to be sure that valves do not strike the pistons.***
- Install ribbed belt and ribbed belt tensioner ⇒ [Page 13-15](#) .

Note:

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

Tightening torques

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

Hydraulic valve lifters, checking

Special tools and equipment

- ◆ Feeler gauge
- ◆ Wood or plastic wedge

Note:

- ◆ *Hydraulic valve lifters cannot be serviced.*
- ◆ *Irregular valve noise when starting engine is normal.*
- Start engine and let run until coolant temperature reaches at least 80 ° C (176 ° F).
- Increase RPM to 2500 for about 2 minutes; if necessary test drive vehicle.

Note:

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

If hydraulic valve lifters are still loud, locate faulty

valve lifter as follows:

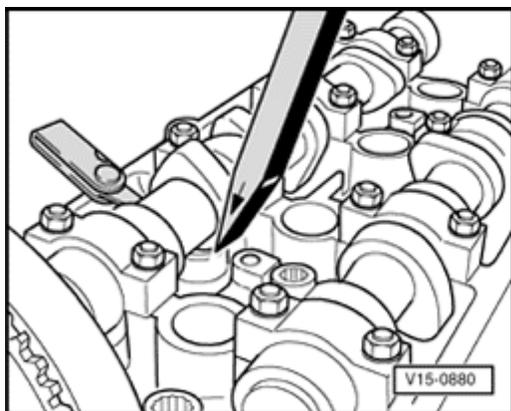
- Remove cylinder head cover ⇒ [Page 15-17](#) .
- Turn crankshaft until cams of valve lifters to be tested point up.

Vehicles with manual transmission

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

Vehicles with automatic transmission

- Remove noise insulation panel and turn central bolt of toothed belt gear for crankshaft in clockwise direction.
- Determine play between cams and valve lifters.



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.

Valve lifter, replacing ⇒ [Page 15-50](#) .

CAUTION!

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

Valve stem oil seals, replacing

- Cylinder head installed

Special tools and equipment

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

Removing

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

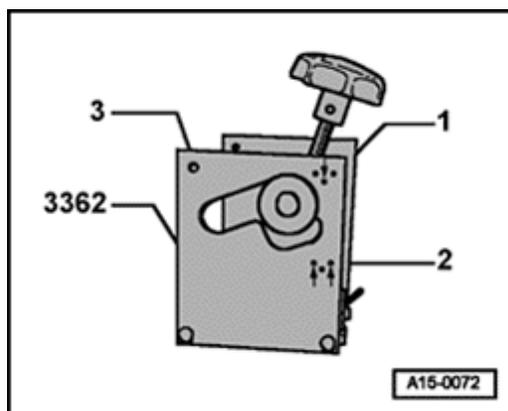
spark plugs.

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

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

Note:

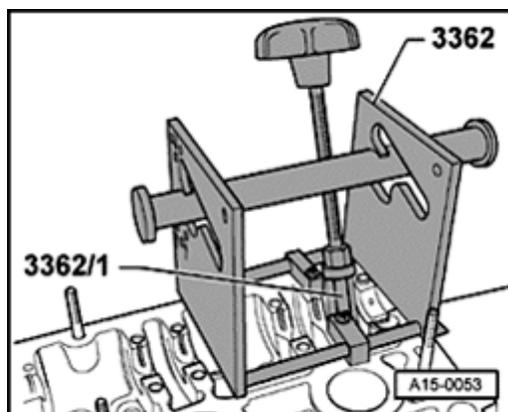
Lightly tap valve spring retainer to loosen stuck valve keepers.



A

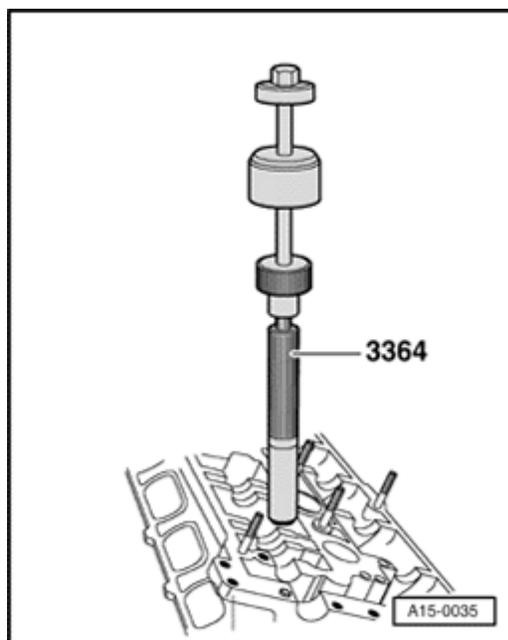
Intake and exhaust valves have different installation angles in cylinder head. 3362 valve spring tool can be used in two different positions:

- 1 - Top position for the center intake valve
- 2 - Lower position for both outer intake valves and both exhaust valves
- 3 - Threaded bores with M6 x 25 retaining bolts on the left and right are used to secure the lower bracket to cylinder head

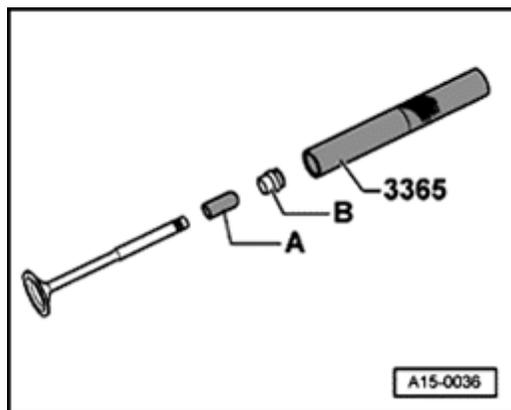


A

- Using retaining bolts bolted into tool, secure 3362 valve spring tool to cylinder head.
- Adjust tool to correct position for corresponding valve.
- Attach pressure hose to compressor.
Minimum pressure: 6 bar (87 psi)
- Using threaded spindle and 3362/1 pressure piece, press valve springs downward and remove.



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



Installing

A

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

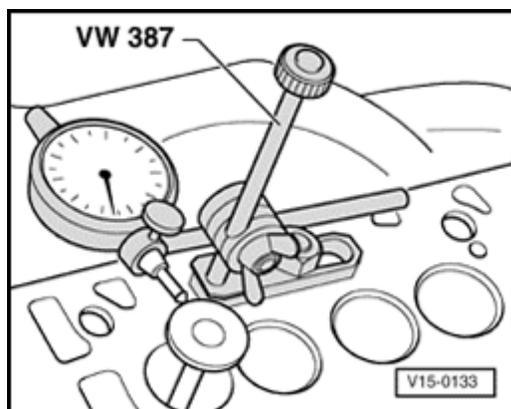
CAUTION!

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

Valve guides, checking

Special tools and equipment

- ◆ VW387 dial gauge holder
- ◆ Dial indicator



A

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

CAUTION!

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

- Measure side play.

Wear limit

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

Note:

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

Valve guides, replacing

Special tools and equipment

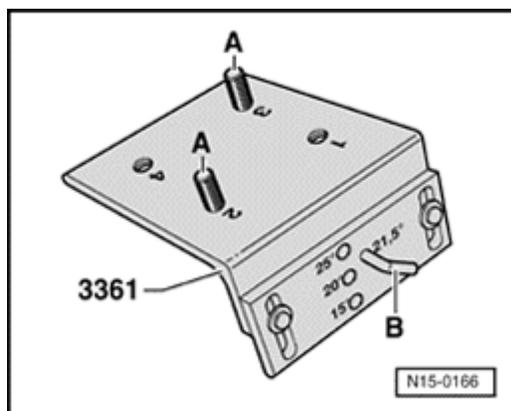
- ◆ VW411 punch
- ◆ 3120 reamer (7mm) and cutting fluid
- ◆ 3360 driver
- ◆ 3361 press-in pad

Removing

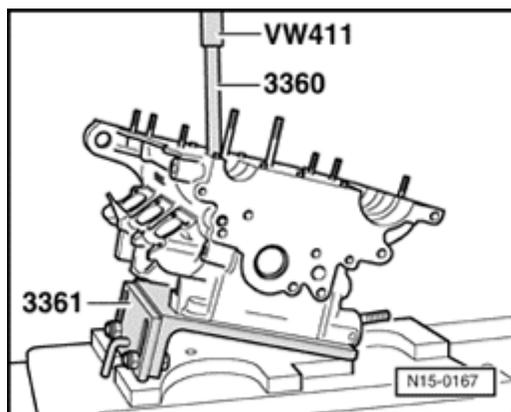
- Clean cylinder head and check.

Note:

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



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



- A**
- Using 3360 driver, press out worn valve guides as follows:
 Valve guide without collar: from camshaft side
 Valve guide with collar (replacement valve guide): from combustion chamber side

Installing

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

Note:

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

- Using 3363 reamer -7 mm, ream valve guide. Use cutting fluid.
- Reface valve seats ⇒ [Page 15-71](#) .
- Replace valve stem oil seals ⇒ [Page 15-62](#) .

WARNING!

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

WARNING!

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

Valve seats, refacing

Note:

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

Special tools and equipment

- ◆ Depth gauge
- ◆ Valve seat refacing tool

Note:

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

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

Determining maximum allowable refacing dimension

- Insert valve and press tightly against valve seat.

Note:

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

- Measure distance between end of valve stem and camshaft center axis (camshaft center axis is located at the level of cylinder head upper edge).
- Determine maximum allowable refaced dimension using distance measured and minimum dimension.

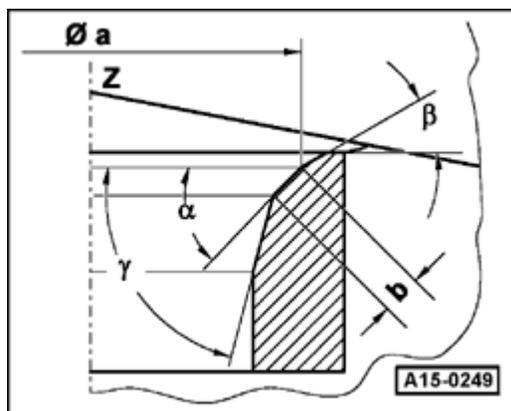
Minimum dimensions		
Outer intake valves	Center intake valve	Exhaust valves
34.0 mm	33.7 mm	34.4 mm
(1.338 in.)	(1.236 in.)	(1.354 in.)

Distance measured minus minimum dimension = maximum allowable refacing dimension.

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

Note:

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



A Valve seats, refacing

Intake valve seat

Diameter -a- = 26.2 mm (1.031 in.)

Dimension -b- = 1.5-1.8 mm (0.059-0.070 in.)

Z = Cylinder head lower edge

Angle -a- = 45° valve seat angle

Angle -b- = 30° upper correction angle

Angle -g- = 60° lower correction angle

Exhaust valve seat

Diameter -a- = 29.0 mm (1.142 in.)

Dimension -b- = approx. 1.8 mm (0.070 in.)

Z = Cylinder head lower edge

Angle -a- = 45° valve seat angle

Angle -b- = 30° upper correction angle

Angle -g- = 60° lower correction angle