

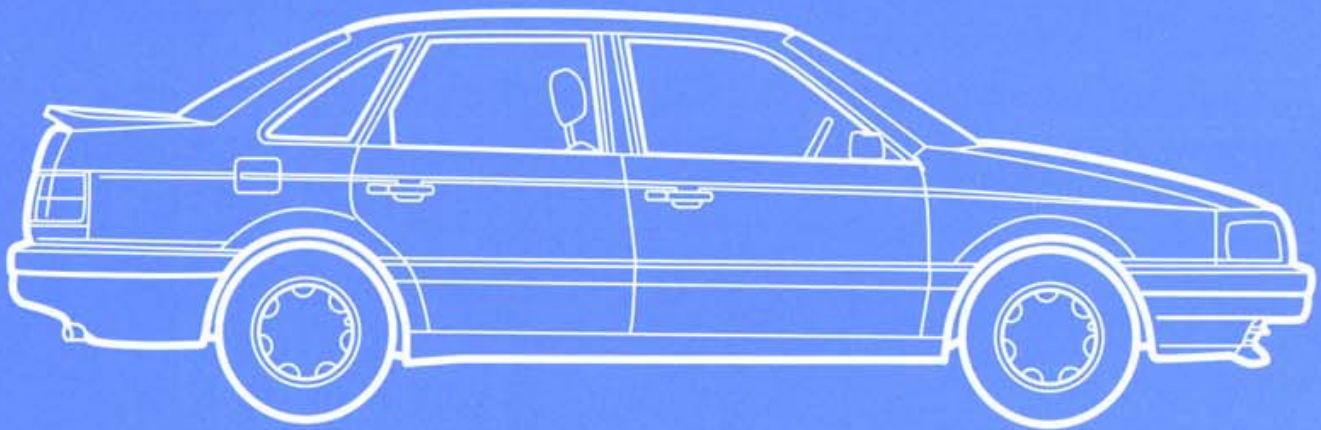


# Volkswagen Passat

## Official Factory Repair Manual

1990, 1991, 1992, 1993, 1994

4-cylinder (16V, G60, and diesel), 6-cylinder (VR6)  
including wagon and Syncro



**Bentley Publishers**

### Contents:

Version 96.01

#### General, Engine

- 2.0L 16V 4-cylinder (code 9A)
- 2.8L VR6 (code AAA)
- 1.9L Diesel (Canada) (code AAZ)
- 1.8L 4-cylinder G60 (code PG)
- Engine Electrical

#### Fuel Supply, Turbocharger, Fuel Injection, Exhaust, Ignition

- 2.0L 16V 4-cylinder (CIS-E Motronic)
- 2.8L VR6 (Motronic)
- 1.9L Diesel (Canada)
- 1.8L 4-cylinder G60 Syncro (Canada) (Digifant)

#### Transmission

- Manual Transmission 02A
- Manual Transmission 02C Syncro (Canada)
- Automatic Transmission 096

#### Suspension, Brakes, Wheels, Steering

- Suspension-Wheels-Brakes-Steering
- Suspension-Wheels-Brakes-Steering Syncro (Canada)

#### Body

- Body Exterior
- Body Interior

#### Heater & Air Conditioning

- Heater-Air Conditioner (R12)
- Air Conditioner (R-134a)

#### Electrical Equipment

- Radio-Wipers-Lights-Switches-Wiring

#### Troubleshooting

- Using VAG Diagnostic Testers

#### Wiring Diagrams

**Volkswagen B3 Passat**  
**General-Engine 4 CYL.**  
**15 Engine - Cylinder Heads/Valve Drive (Page GR-15)**

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- [bearing cover, installing](#)
- [identification](#)
- [O-ring, replacing](#)
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**Compression**

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**Valve stem seals**

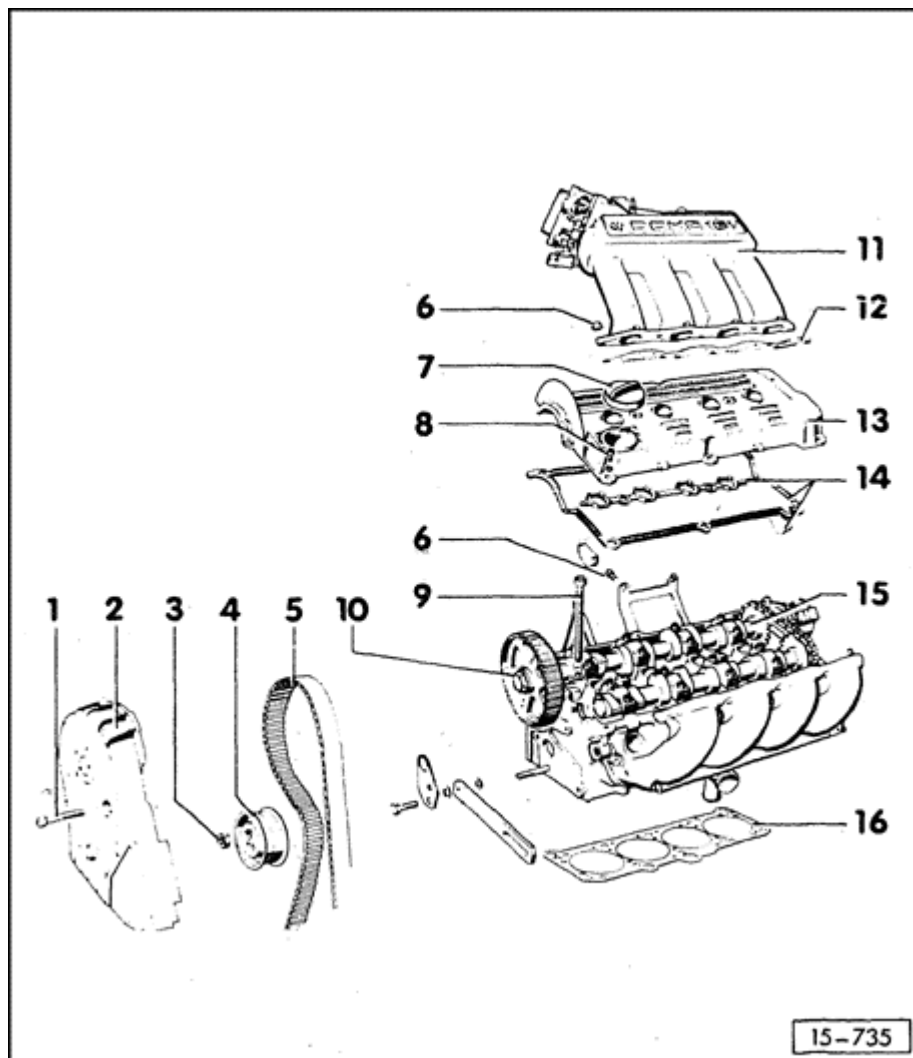
- [replacing](#)

**Valve train**

- [component layout](#)

**Volkswagen B3 Passat**  
**General-Engine 4 CYL.**  
**Cylinder head, removing and installing (Page 15-1)**

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Compression checking, ⇒ [page 15-6](#)

**Note**

- When installing a replacement, cylinder head assembly, oil the surfaces where the cam lobe and lifter contact each other.
- Remove the plastic valve protector (supplied) just before positioning the cylinder head
- After replacing the cylinder head, fill the engine with new coolant.

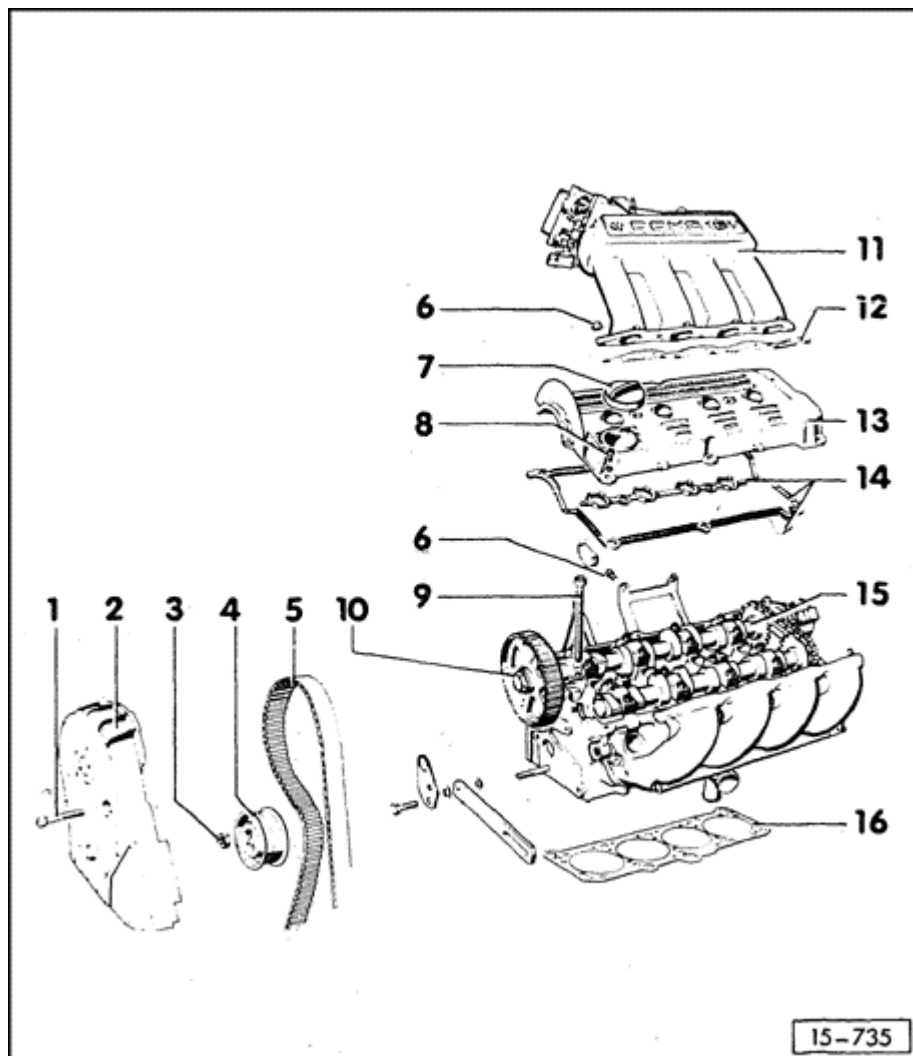
**1 - 6 Nm (53 in. lb)**

**2 - Belt guard, upper section**

**3 - 45 Nm (33 ft lb)**

**Volkswagen B3 Passat**  
**General-Engine 4 CYL.**  
**Cylinder head, removing and installing (Page 15-2)**

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**4 - Drive belt tensioner**

**5 - Drive belt**

- ♦ check for wear
- ♦ do not bend
- ♦ removing, installing and tensioning, ⇒ [Repair Group 13](#)

**6 - 20 Nm (15 ft lb)**

**7 - Cylinder head cover**

- ♦ replace seal if damaged

**8 - 10 Nm (7 ft lb)**

**9 - Cylinder head bolt**

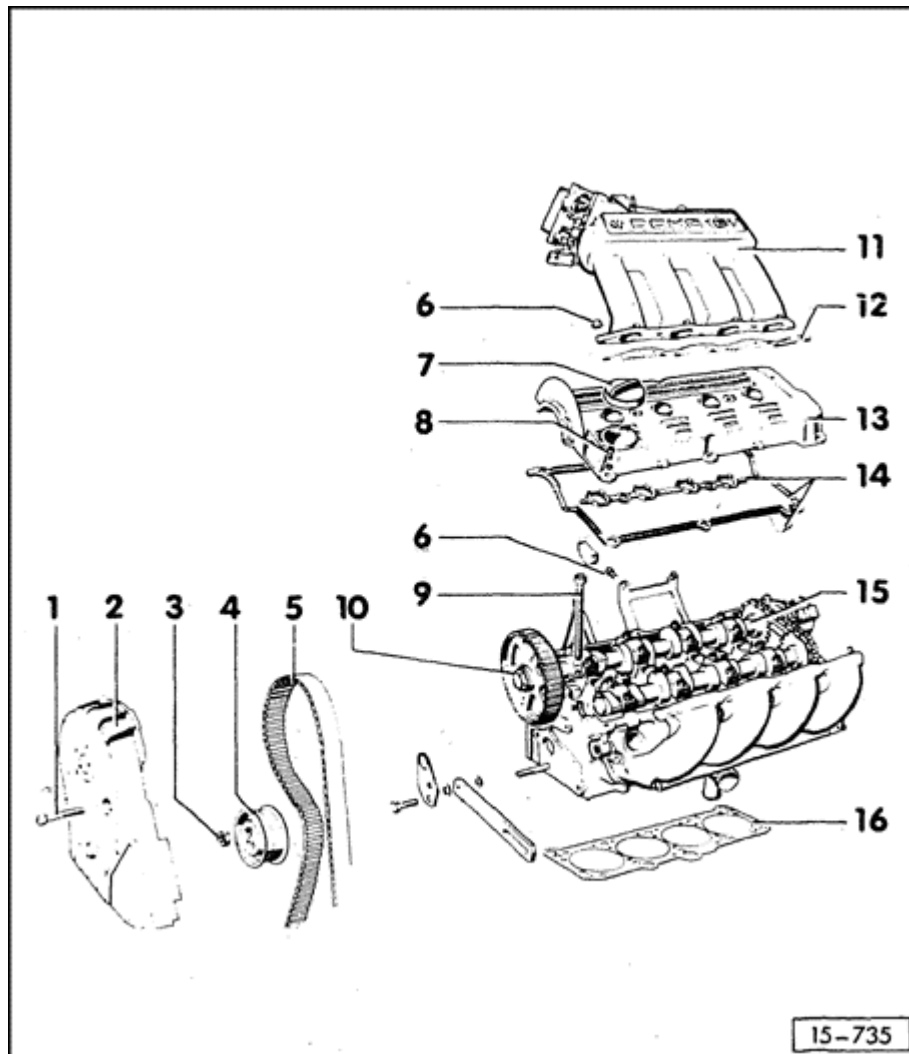
- ♦ note sequence when loosening or tightening, ⇒ [page 15-5](#)

**10 - Camshaft sprocket**

- ♦ note alignment position when installing, ⇒ [Repair Group 13](#)

**Volkswagen B3 Passat**  
**General-Engine 4 CYL.**  
**Cylinder head, removing and installing (Page 15-3)**

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**11 - Intake manifold, upper section**

**12 - Gasket**

- ♦ replace

**13 - Cylinder head cover**

**14 - Gasket/seal for cylinder head cover**

- ♦ replace if damaged

**15 - Cylinder head**

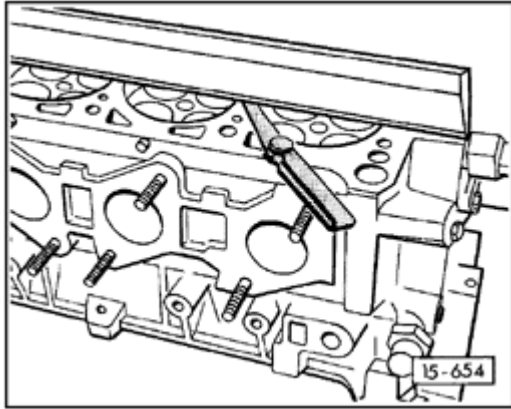
- ♦ check for distortion, ⇒ [Fig. 1](#)
- ♦ installing ⇒ [page 15-5](#)
- ♦ after replacing, fill the system with new coolant

**16 - Cylinder head gasket**

- ♦ replace
- ♦ after replacing, fill the system with new coolant

**Volkswagen B3 Passat**  
**General-Engine 4 CYL.**  
**Cylinder head, distortion, checking (Page 15-4)**

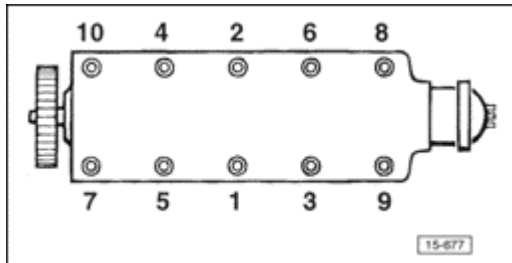
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**Fig. 1 Cylinder head distortion, checking**  
Maximum permissible deviation from flat: 0.05 mm

**Volkswagen B3 Passat**  
**General-Engine 4 CYL.**  
**Cylinder head, installing (Page 15-5)**

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- Engine cold
- Pistons not at TDC
  - install and position cylinder head gasket
  - position cylinder head (note the centering pin in the cylinder block)
  - install the cylinder head bolts finger tight
  - Tighten cylinder head in four stages in the sequence shown
  - 1. Pre-tighten using torque wrench
    - Stage I** = 40 Nm (30 ft lb)
    - Stage II** = 60 Nm (44 ft lb)
  - 2. Using a normal wrench, continue turning:
    - Stage III** = 1/4 turn
    - Stage IV** = 1/4 additional turn

**Loosening**

- Loosen the cylinder head in the reverse order, retorquing the cylinder head after running is not necessary

**Volkswagen B3 Passat**  
**General-Engine 4 CYL.**  
**Compression, checking (Page 15-6)**

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- Engine oil temperature 30° C (86° F) minimum
- Disconnect Hall sensor harness connector at ignition distributor
- Install compression measuring tool US 1120 per manufacturers instructions
- Open throttle to wide open position
- While watching tester, operate starter until no further increase in pressure is noted

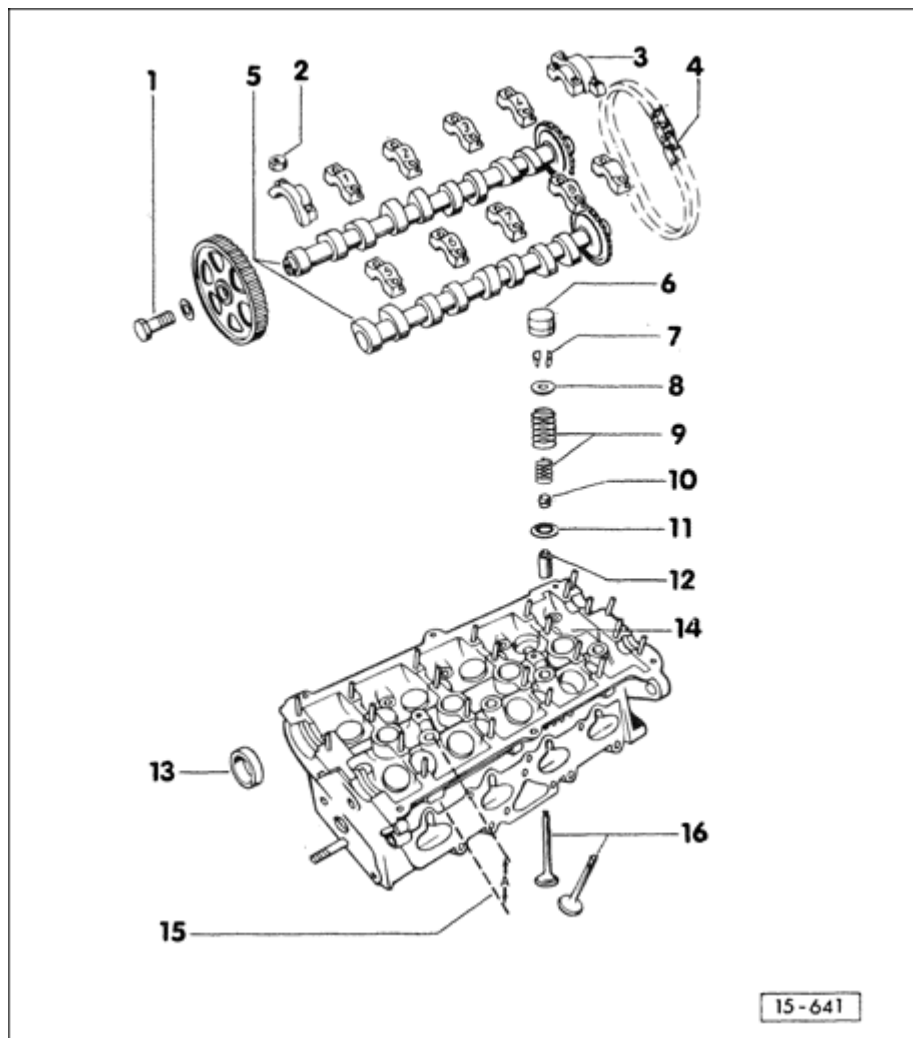
New: 10 to 13 bar

Wear limit: 7.5 bar

Permissible variation between cylinders: 3 bar

**Volkswagen B3 Passat**  
**General-Engine 4 CYL.**  
**Valve train, component layout (Page 15-7)**

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**Note**

*Cylinder heads having fine cracks between the valve seats and the spark plug threads can be reinstalled without reducing engine service life provided that the cracks are not greater than 0.5 mm wide or if only the first thread of the spark plug hole is cracked.*

**1 - 65 Nm (48 ft lb)**

**2 - 15 Nm (11 ft lb)**

**3 - Bearing cap**

♦ installing ⇒ [Fig. 2](#)

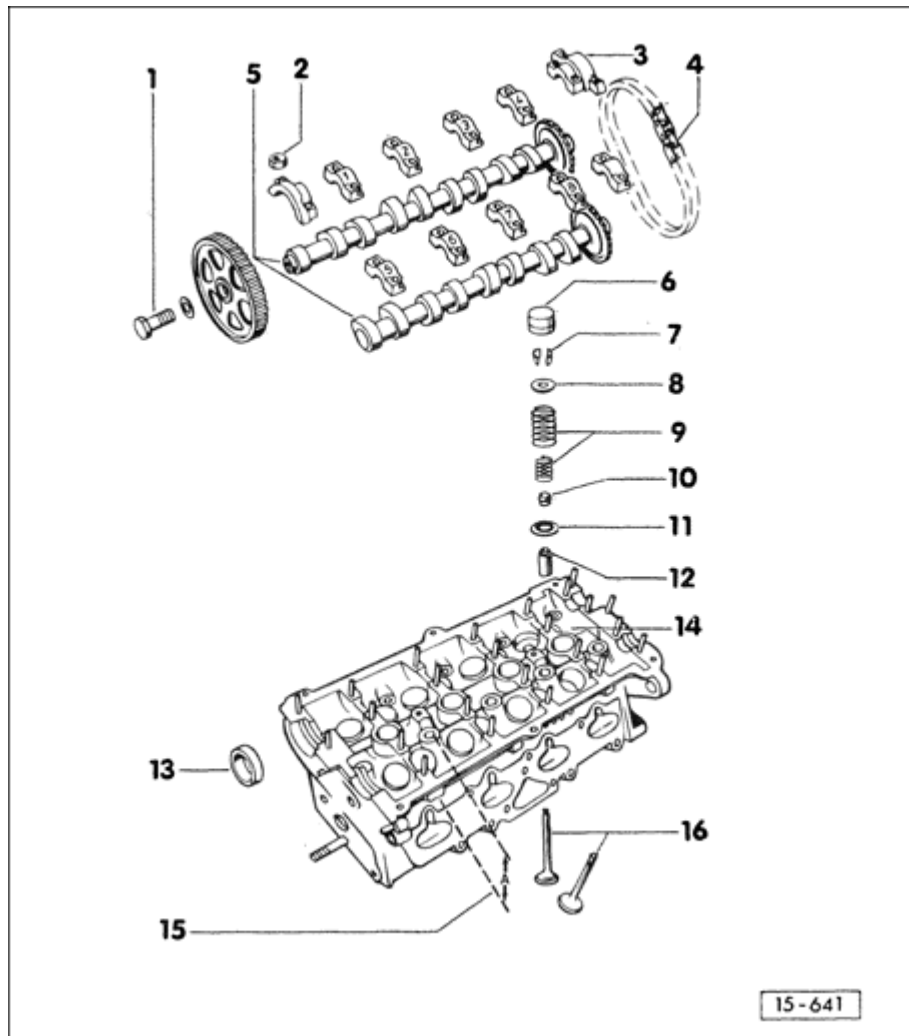
♦ installation sequence, ⇒ [page 15-21](#)

**4 - Drive chain**

♦ before removing, mark running direction using felt tip pen

**Volkswagen B3 Passat**  
**General-Engine 4 CYL.**  
**Valve train, component layout (Page 15-8)**

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**5 - Camshafts**

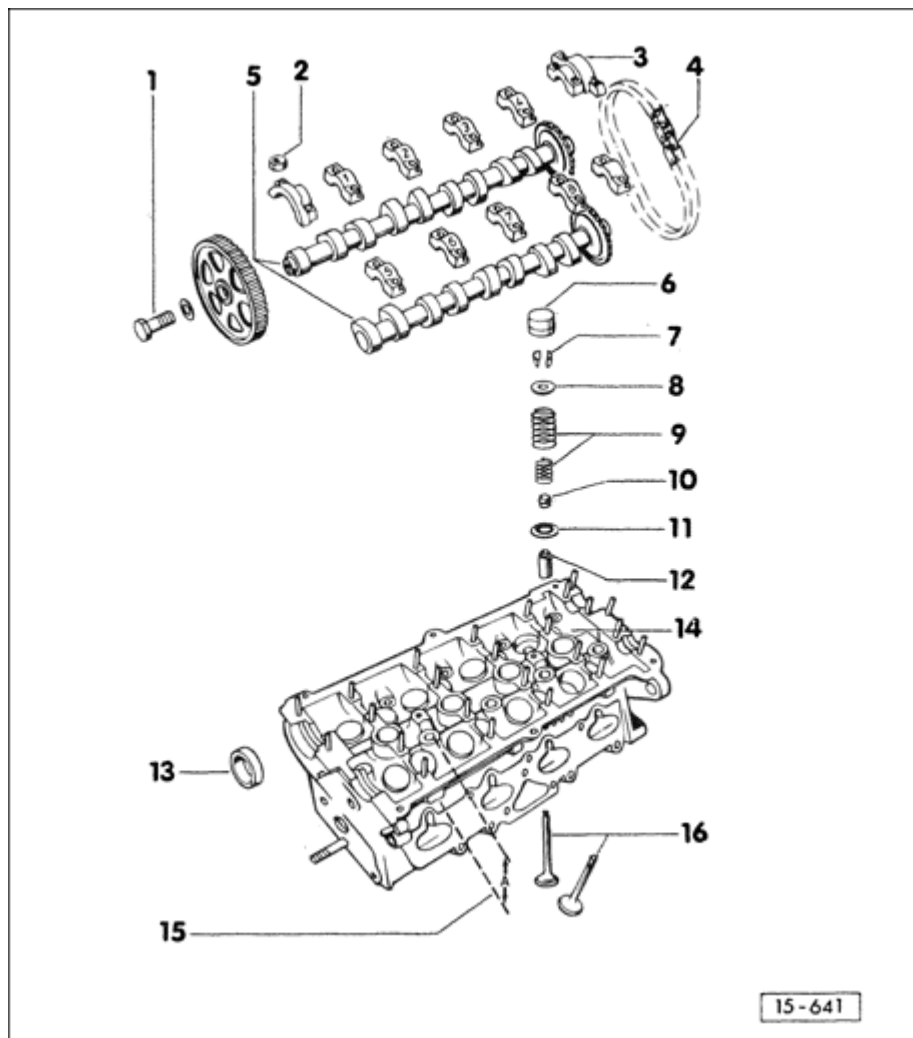
- ◆ axial play, checking ⇒ [Fig. 1](#)
- ◆ removing and installing, ⇒ [page 15-20](#)
- ◆ radial play checking, use Plastigage:  
wear limit:0.01 mm
- ◆ identification and valve timing specs, ⇒ [page 15-13](#)

**6 - Hydraulic lifter**

- ◆ do not interchange
- ◆ valve play checking ⇒ [page 15-19](#)
- ◆ place in inverted position after removing
- ◆ before installing, check axial play, ⇒ [Fig. 1](#)
- ◆ oil contacting surfaces

**Volkswagen B3 Passat**  
**General-Engine 4 CYL.**  
**Valve train, component layout (Page 15-9)**

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**7 - Valve spring keepers**

**8 - Valve spring retainer, upper**

**9 - Valve spring**

- ♦ removing and installing with cyl. head removed: use tool 2037, with head installed: ⇒ [page 15-27](#)

**10 - Valve stem seal**

- ♦ replacing, ⇒ [page 15-26](#)

**11 - Valve spring retainer, lower**

**12 - Valve guide**

- ♦ checking, ⇒ [page 15-23](#)
- ♦ replacing, ⇒ [page 15-24](#)

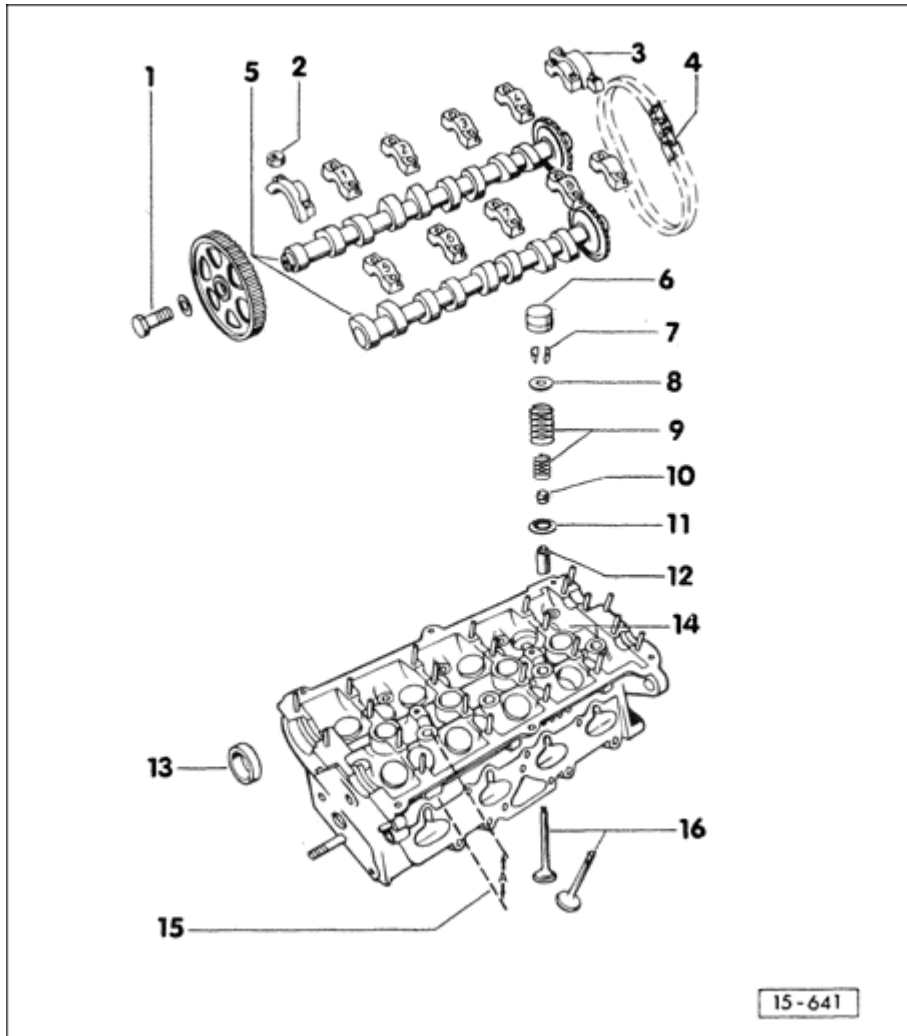
**13 - Oil seal**

- ♦ lightly oil the lip of the seal

♦ replacing, ⇒ [page 15-17](#)

**Volkswagen B3 Passat**  
**General-Engine 4 CYL.**  
**Valve train, component layout (Page 15-10)**

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**14 - Cylinder head**

- ♦ reworking valve seat, ⇒ [page 15-14](#)

**15 - Refacing dimension**

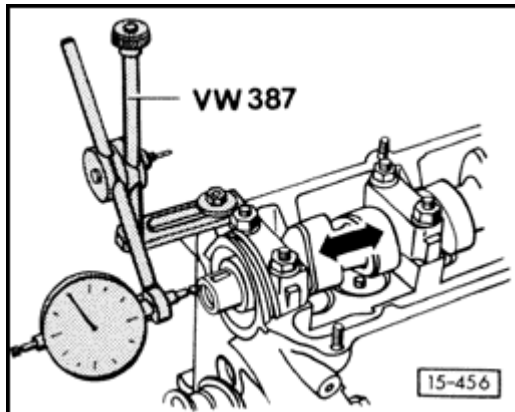
- ♦ measure minimum dimension through bolt hole, minimum dimension: 118.1 mm

**16 - Valves**

- ♦ do not rework, only lapping is permitted
- ♦ valve dimensions: ⇒ [Fig. 3](#)
- ♦ after 11-89, exhaust valves are sodium filled, observe note on [page 15-12](#)

**Volkswagen B3 Passat**  
**General-Engine 4 CYL.**  
**Camshafts, axial play, checking/bearing cover, installing (Page 15-11)**

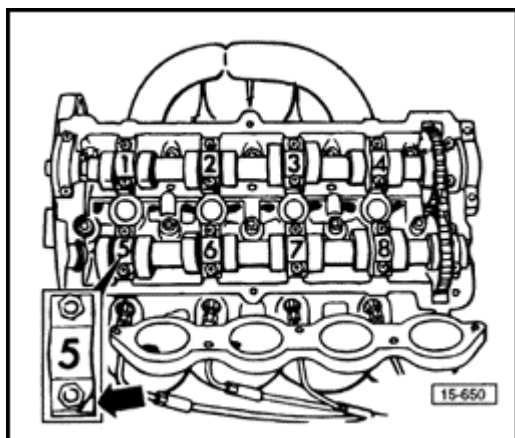
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**Fig. 1 Camshaft axial play, checking**

Wear limit: 0.15 mm maximum

- measure with valve lifters removed and first and last bearing cover installed

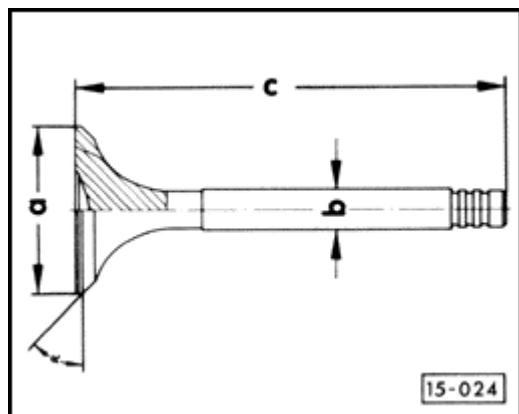


**Fig. 2 Camshaft bearing cover, installed position**

The opening on the bearing covers must point toward the intake side of the cylinder head

**Volkswagen B3 Passat  
General-Engine 4 CYL.  
Valve, dimensions (Page 15-12)**

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**Fig. 3 Valve dimensions**

**Note**

*Do not reface the valves, only lapping is permissible.*

Dimension	Intake Valve	Exhaust Valve
diameter "a"	32.0 mm	28.0 mm
diameter "b"	6.97 mm	6.94 mm
length "c"	95.5 mm	98.2 mm
angle "α"	45°	45°

**CAUTION!**

***Exhaust valves are filled with sodium and should not be scrapped without first observing certain precautions:***

- Cut the valves in the center of the stem using a steel saw.
- Do not allow the valve or the sodium content to come in contact with water while sawing!
- Once valves have been cut in this manner, drop them ten at a time into a bucket filled with water. Stand back because a chemical reaction will occur. The valves can afterward be treated as common metal scrap.

**Volkswagen B3 Passat**  
**General-Engine 4 CYL.**  
**Camshaft identification/valve timing specifications (Page 15-13)**

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Intake camshaft: **027 101 M or 027 101 N**

Exhaust camshaft: **027 102 H or 027 102 J**

Intake opens after TDC: **1°**

Intake closes after BDC: **21°**

Exhaust opens before BDC: **43°**

Exhaust closes before TDC: **3°**

**Volkswagen B3 Passat**  
**General-Engine 4 CYL.**  
**Valve seats, general, refacing (Page 15-14)**

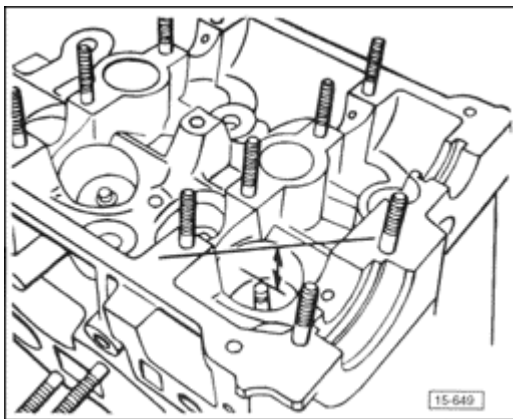
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**Note**

*When repairing engines with leaky valves, it is not sufficient to merely replace the valves and machine the seats. The valve guides must also be checked for wear, a condition that increases with higher mileage.*

*Only rework the valve faces enough to achieve a suitable contact. Calculate the maximum permissible refacing dimension before refacing.*

*If the refacing dimension is exceeded, proper function of the hydraulic lifter will not be assured and the cylinder head will have to be replaced.*



- Insert valve into guide and push firmly into seat
- If the valve is replaced in the course of repairs, use a new valve for measuring.
- Measure the distance between the end of the valve (stem) and the machined upper edge of the cylinder head

**Volkswagen B3 Passat**  
**General-Engine 4 CYL.**  
**Valve seats, general, refacing (Page 15-15)**

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- The maximum permissible refacing dimension If the refacing dimension is exceeded, proper lifter function will not be assured and the cylinder head will have to be replaced.
- Minimum dimension:
  - Intake valve 34.4 mm
  - Exhaust valve 34.7 mm

The measured distance minus the minimum dimension will yield the maximum permissible refacing dimension

Example

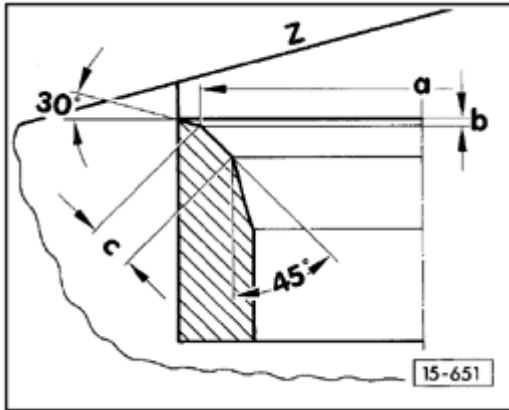
Measured distance	35.1 mm
minus minimum dimension	- 34.4 mm
<hr/>	
maximum permissible refacing dimension	= 0.7 mm

## Volkswagen B3 Passat

### General-Engine 4 CYL.

Valve seats, Exhaust valve seat, refacing/Intake valve seat, refacing (Page 15-16)

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**a** = diameter 31.2 mm

**b** = maximum permissible refacing dimension

**c** = 1.5 to 1.8 mm

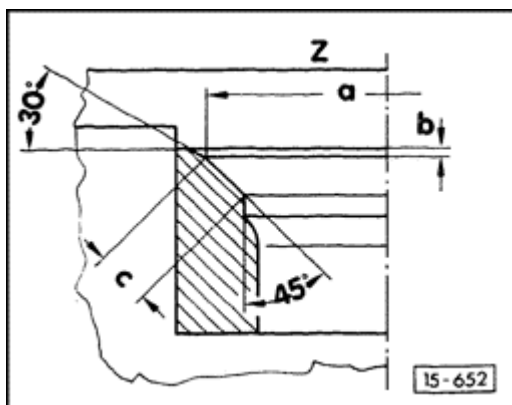
- If necessary, rework valve seat using a 75° cutter

**z** = cylinder head lower edge

45° = valve seat angle

30° = upper correcting angle

### Exhaust valve seat, refacing



**a** = 27.6 mm

**b** = maximum permissible refacing dimension

**c** = approx. 1.8 mm

**Z** = cylinder head lower edge

45° = valve seat angle

30° = upper correcting angle

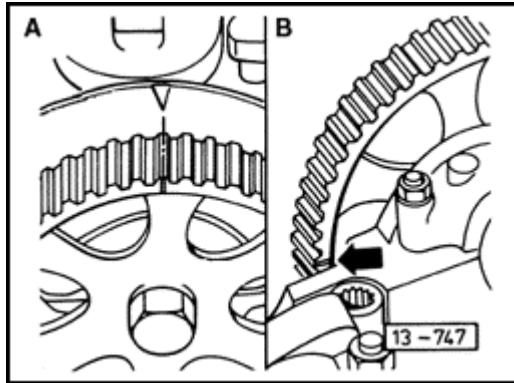
### Note

*Exhaust valve seats have a notch. When refacing; ensure that the radius of the notch is*

*not disturbed.*

**Volkswagen B3 Passat**  
**General-Engine 4 CYL.**  
**Camshafts, O-ring, replacing (Page 15-17)**

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**Note**

*The exhaust valve cavity in the cylinder head has a reduced diameter taper near the valve seat. Great care must be exercised when lapping or machining the exhaust valve seat to avoid disturbing this reduced area.*

- Remove the belt guard upper section
- Loosen the camshaft drive sprocket bolt using tool 3036

**With valve cover installed**

- Rotate crankshaft to TDC position for cylinder 1, the marking on the camshaft sprocket must align with the arrow on the valve cover (view -A-)

**With valve cover removed**

- Rotate crankshaft to TDC position for cylinder 1, the marking on the camshaft sprocket must align with the machined edge of the cylinder head (view -B-)
- Loosen the belt tensioner and remove the drive belt

**Volkswagen B3 Passat**  
**General-Engine 4 CYL.**  
**Camshafts, O-ring, replacing (Page 15-18)**

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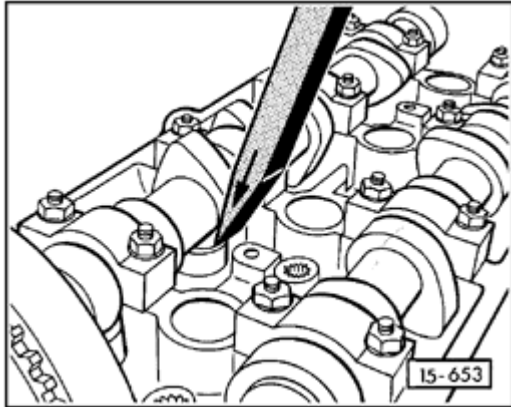
- Remove the camshaft sprocket
- Thread the camshaft mounting bolt (with washer) into the camshaft until it bottoms
- Unscrew inner part of tool 2085 from outer tool two turns and secure using knurled bolt
- Lubricate threaded end of puller and insert into seal (with force) as far as possible
- Loosen the knurled bolt and turn the inner portion of the tool against the camshaft until the O-ring is removed

**Installing**

- Lightly oil the sealing lip of the O-ring
- Position the sealing lip using the tool sleeve and press in to place using tool 10-203 and bolt 10-302/1 up to the stop
- Install the drive belt and adjust camshaft timing, ⇒ [Repair Group 13](#)

**Volkswagen B3 Passat**  
**General-Engine 4 CYL.**  
**Hydraulic valve lifters, checking (Page 15-19)**

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- ◆ *Hydraulic lifters must be replaced as an assembly, they cannot be repaired or adjusted.*
- ◆ *Intermittent valve noise during warmup is normal.*
  - Start engine and let idle until radiator cooling fan comes on at least once, then increase engine speed to 2500 rpm and maintain for two minutes

If the lifters are still noisy, determine which ones are defective as follows:

- Remove the intake manifold and cylinder head cover
- Turn crankshaft clockwise until lobes of lifter to be checked are pointing straight up
- Push down on lifter using a wood or plastic wedge; if the lifter can be pushed down more than 0.1 mm, replace the lifter

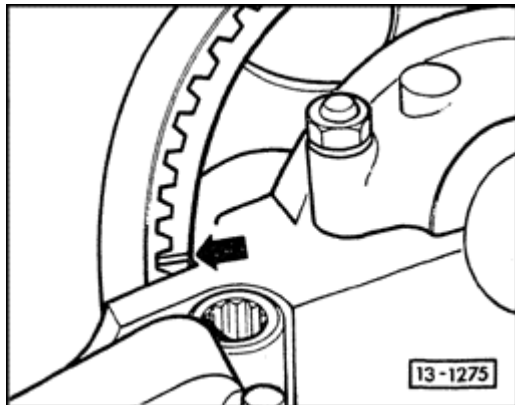
**CAUTION!**

***After installing new lifter(s), do not start the engine for at least 30 minutes to allow the lifter to bleed down. Otherwise the valves could hit the piston***

**Volkswagen B3 Passat  
General-Engine 4 CYL.  
Camshafts, removing and installing (Page 15-20)**

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**Removing**

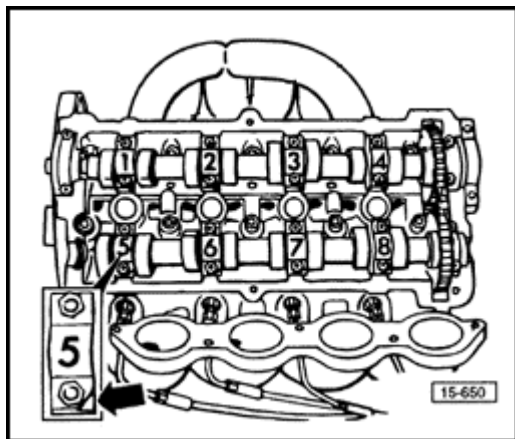


- Remove the upper belt guard, intake manifold and cylinder head cover
- Loosen the camshaft sprocket bolt using tool 3036
- Position the camshaft sprocket by turning the crankshaft to TDC for cylinder 1. The marking on the camshaft must align with the edge of the cylinder head (arrow)
- Loosen the belt tensioner and remove the drivebelt
- Remove the camshaft sprocket
- Remove the ignition distributor
- Mark the running direction of the drive chain for the intake valve camshaft using a felt tip pen, before removing

**Volkswagen B3 Passat  
General-Engine 4 CYL.  
Camshafts, removing and installing (Page 15-21)**

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**Intake camshaft**

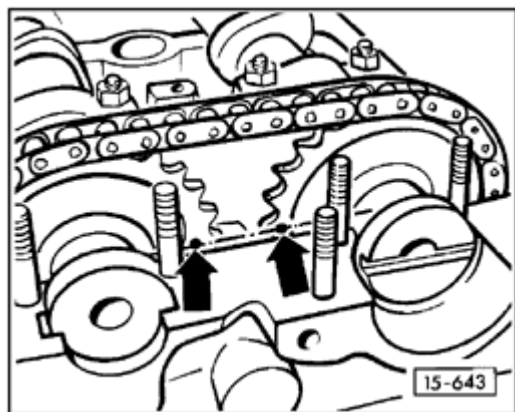


- Remove bearing caps 5 and 7 and the last bearing cap
- Loosen bearing caps 6 and 8 diagonally and alternately

**Exhaust camshaft**

- Remove bearing caps 5 and 7 and the last bearing cap
- Loosen bearing caps 2 and 4 alternately and diagonally

**Installing**



- Oil the contact surfaces between the cam lobes and the lifters
- Install the camshafts and drive chain such that the sprocket markings line up with the arrows
- Ensure that drive chain is installed in proper running direction
- When installing the bearing caps, ensure that the openings in the caps point toward the intake manifold, ⇒ illustration 15-650 (above)

**Volkswagen B3 Passat**  
**General-Engine 4 CYL.**  
**Camshafts, removing and installing (Page 15-22)**

---

**Intake camshaft**

- Tighten bearing caps 6 and 8 alternately and diagonally with 15 Nm (11 ft lb)
- Install remaining bearing caps with 15 Nm (11 ft lb)

**Exhaust camshaft**

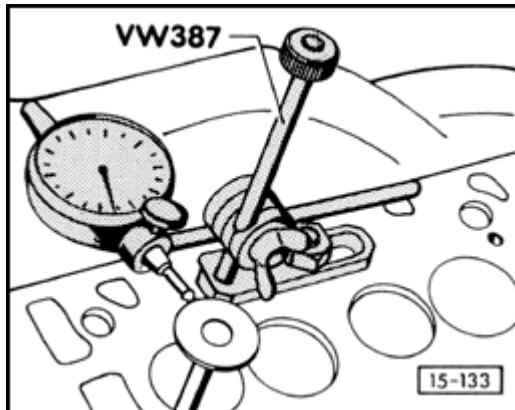
- Tighten bearing caps 2 and 4 alternately and diagonally using 15 Nm (11 ft lb)
- Install remaining bearing caps and tighten with 15 Nm (11 ft lb)
- Install camshaft sprockets and tighten to 65 Nm (48 ft lb) using tool 3036
- Install drive belt and adjust cam timing, ⇒ [Repair Group 13](#)

**CAUTION!**

***After installing lifters, do not start engine for at least 30 minutes. Lifters must be allowed to bleed down or valves could hit the pistons.***

**Volkswagen B3 Passat  
General-Engine 4 CYL.  
Valve guides, checking (Page 15-23)**

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- Insert new valve into guide, end of valve stem must be flush with guide

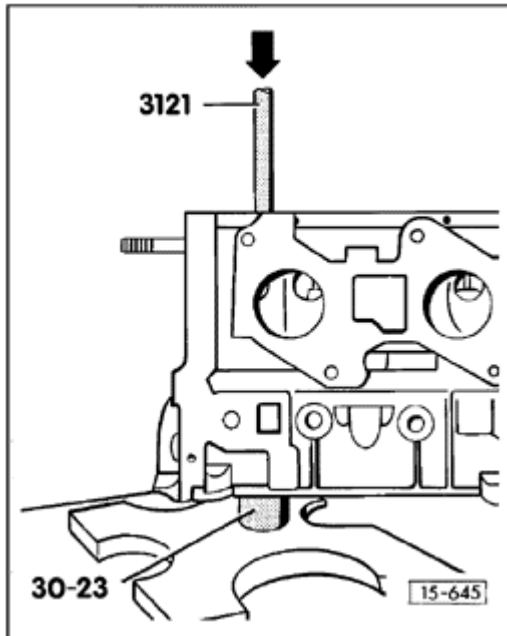
**CAUTION!**

***Due to differences in stem diameters, only insert intake valves into intake guides and exhaust valves into exhaust guides.***

- Using a dial indicator, compare measured play with the following wear limit specifications: 0  
Intake valve guide: = 1.0 mm  
Exhaust valve guide: = 1.3 mm

**Volkswagen B3 Passat**  
**General-Engine 4 CYL.**  
**Valve guides, replacing (Page 15-24)**

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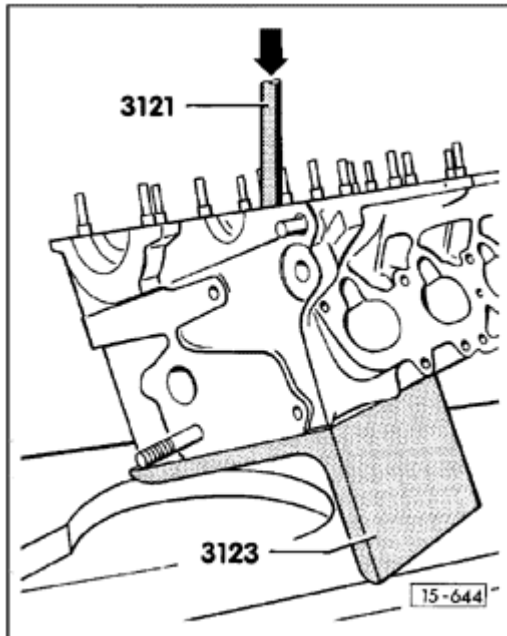


Cylinder heads in which the valve seat surface can no longer be refaced or cylinder heads that have been refaced down to the minimum resurfacing dimension cannot have any additional repairs or resurfacing.

- Press out worn valve guides from the combustion chamber side using support sleeve 30-23

**Volkswagen B3 Passat**  
**General-Engine 4 CYL.**  
**Valve guides, replacing (Page 15-25)**

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- Coat the new guides with oil and press into the cylinder head from the camshaft side using tool 3121 and support piece 3123

***CAUTION!***

***Press in guide up to the shoulder, after the shoulder contacts the cylinder head do not exceed 2000 psi of force or the shoulder will break off.***

- Size the inside guide diameter using hand reamer 3120 while liberally applying a cutting/cooling oil
- Reface the valve seat, ⇒ [page 15-14](#)

**Volkswagen B3 Passat  
General-Engine 4 CYL.  
Valve stem seals, replacing (Page 15-26)**

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**With cylinder head installed**

- Remove camshafts, ⇒ [page 15-20](#)
- Remove the hydraulic lifters, lay in a clean protected area with the contact surfaces downward
- Remove the spark plugs
- Locate the piston for the cylinder being worked on to the BDC position
- Install pressure hose adaptor VW 653/3 in the spark plug hole for that cylinder and apply a pressure of at least 87 psi
- Position assembly tool 2036 and adjust the bearing to stud height
- Remove the valve springs using lever tool VW 541/1A and pressure piece VW 541/5

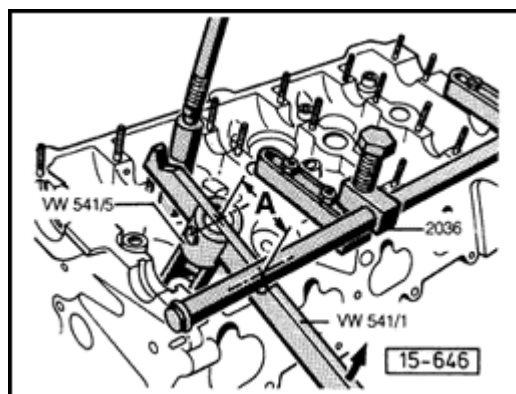
**Note**

*If the valve keepers are hard to remove, tap lightly on the top of the valve assembly with a hammer.*

**Volkswagen B3 Passat  
General-Engine 4 CYL.  
Valve stem seals, replacing (Page 15-27)**

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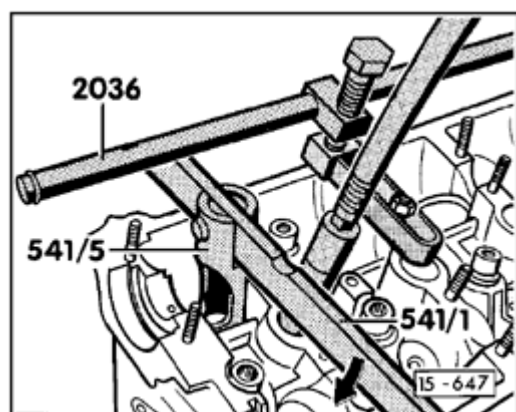
**Intake side**



**Note**

*To prevent the lever from sliding off the support tool, place the lever notch at a distance of "a" = 50 mm.*

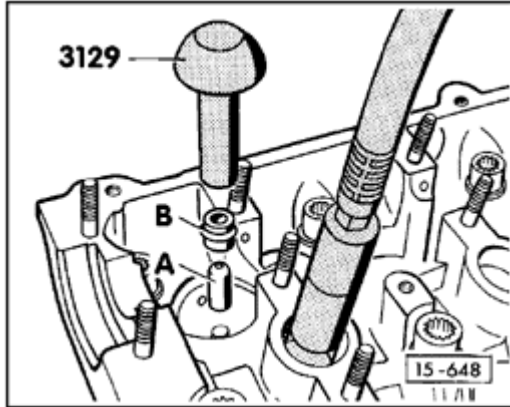
**Exhaust side**



- Remove the valve stem seal using tool 3047A (not shown)

**Volkswagen B3 Passat**  
**General-Engine 4 CYL.**  
**Valve stem seals, replacing (Page 15-28)**

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- To prevent damage to the new seals during installation, install plastic adaptor sleeve -A- over the top of the valve guide
- Lubricate the new seal -B-, insert into tool 3129 and carefully slide over adaptor -A- onto the valve guide