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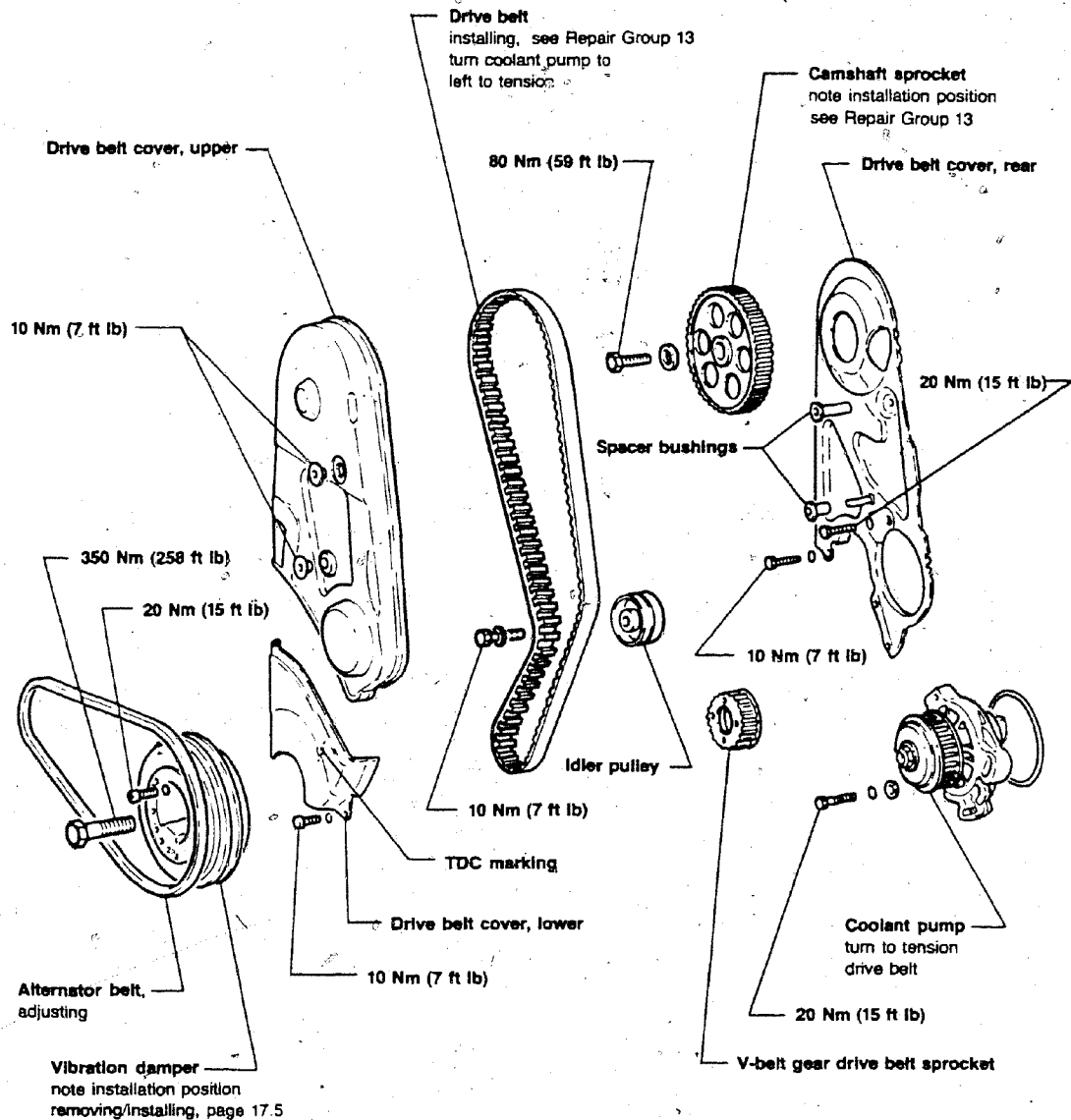
THIS FRAME INTENTIONALLY LEFT

BLANK

Engine – Cylinder Head, Valve Drive

Note

Always replace seals and gaskets.

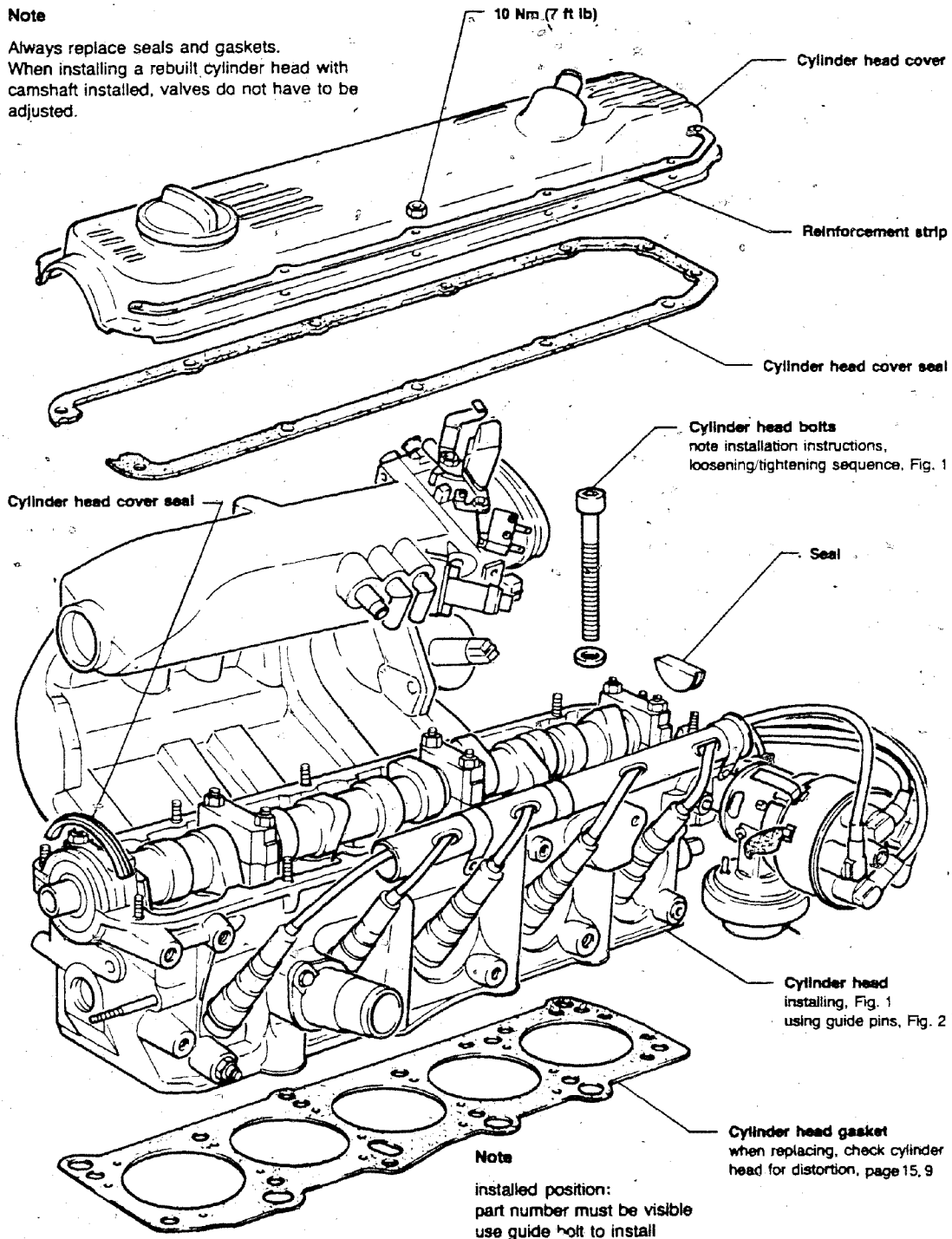


13-481

Engine – Cylinder Head, Valve Drive

Note

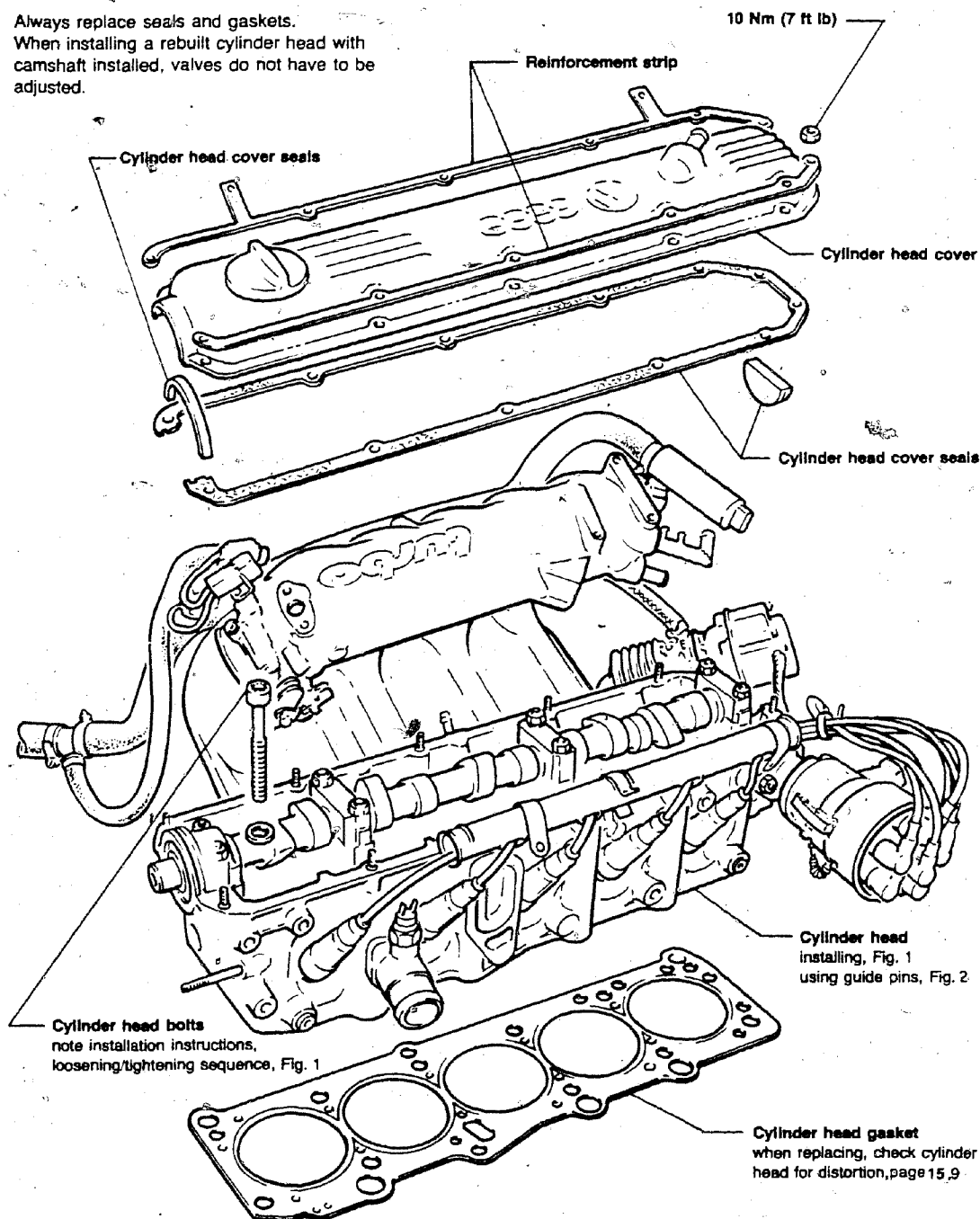
Always replace seals and gaskets.
When installing a rebuilt cylinder head with camshaft installed, valves do not have to be adjusted.



Engine – Cylinder Head, Valve Drive

Note

Always replace seals and gaskets.
When installing a rebuilt cylinder head with camshaft installed, valves do not have to be adjusted.



15-538

Engine – Cylinder Head, Valve Drive

Compression, checking

Engine code MC	New	8.5-12 bar (123-144 psi)
	Wear limit	6.5 bar (92 psi)
Engine code NF	New	11-16 bar (160-172 psi)
	Wear limit	9 bar (131 psi)

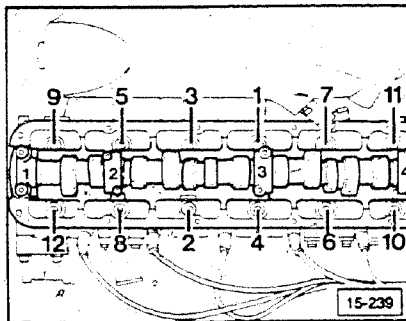
When checking compression, remove spark plugs, disconnect high tension wire No. 4 (center) at ignition distributor cap and connect to ground with clamp; open throttle. Oil temperature above 30°C (86°F).

Note

Maximum pressure difference between highest and lowest cylinder: 3 bar (44 psi).

Note

Before installing cylinder head, turn crankshaft so that pistons are about equal below TDC.

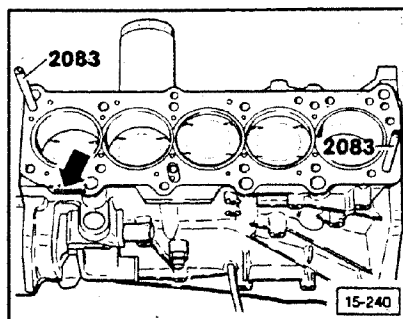


► Fig. 1 Cylinder head bolts, removing/installing

- tighten bolts in 3 step sequence:
 - step 1 = 40 Nm (29 ft lb)
 - step 2 = 60 Nm (44 ft lb)
 - step 3 = 1/2 turn (180°) further without stopping (two 90° turns are OK)

CAUTION

It is not necessary to retorque cylinder head bolts 1000 miles after repairs.



► Fig. 2 Cylinder head gasket, installing

- install dry (no sealing compound)
- use guide pins
 - part number on gasket points toward cylinder head (arrow)

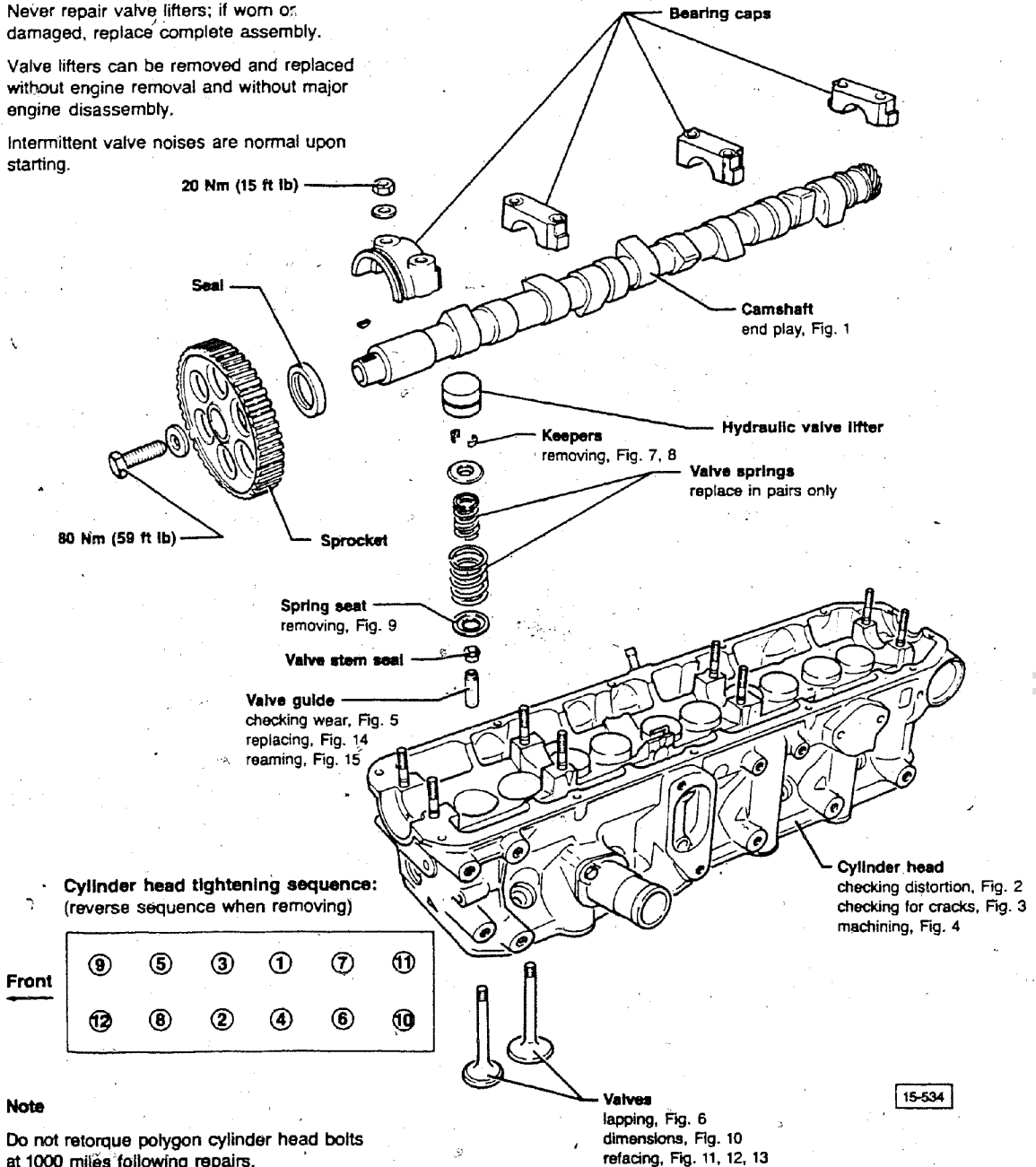
Engine – Cylinder Head, Valve Drive

Note

Never repair valve lifters; if worn or damaged, replace complete assembly.

Valve lifters can be removed and replaced without engine removal and without major engine disassembly.

Intermittent valve noises are normal upon starting.

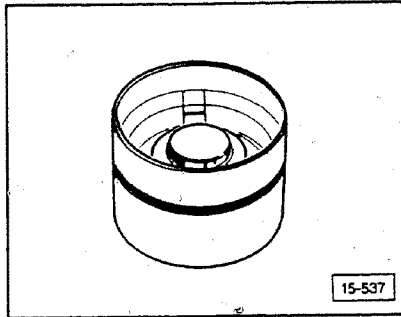


Note

Do not retorque polygon cylinder head bolts at 1000 miles following repairs.

Polygon cylinder head bolts can be reused after making repairs and do not have to be replaced.

Engine – Cylinder Head, Valve Drive



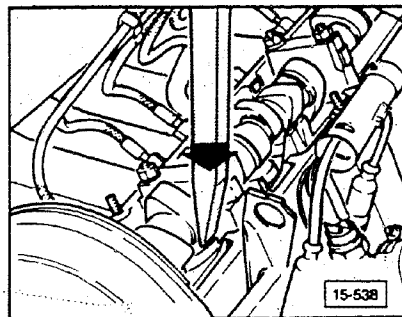
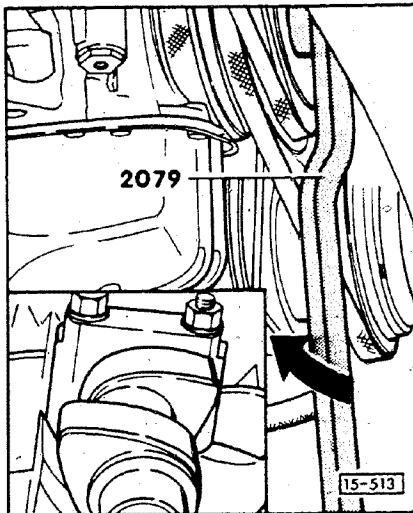
Hydraulic valve lifter, storing

- remove valve lifter and turn upside down for storage (**as shown**)

Hydraulic valve lifter, checking

Hydraulic valve lifters are not adjustable. Noisy lifters may be replaced after the following checks:

- run engine until radiator fan comes on at least once
- bring engine speed to approximately 2500 RPM for 2 minutes
 - if valve lifter is still noisy, replace
- remove valve cover
- turn crankshaft pulley bolt clockwise until cam lobes of cylinder to be checked point up



- push lifter down with suitable wood stick against valve lifter as shown
- if valve lifter can be pushed down more than 0.1 mm (0.004 in.), replace lifter

CAUTION

Hydraulic valve lifters are stored upside down.

After replacing lifters **DO NOT** start engine for approximately 30 minutes to allow lifters to bleed down.

Engine – Cylinder Head, Valve Drive

Camshaft radial clearance, checking

- remove camshaft sprocket
- remove camshaft and cam followers (mark followers)
- remove oil seal
- clean camshaft bearing caps, seats and journals
- place camshaft on cylinder head so cam lobes do not touch valve spring retainers or valves
- lay Plastigage® across journal.
Install bearing caps in correct position and tighten to 20 Nm (15 ft lb)

CAUTION

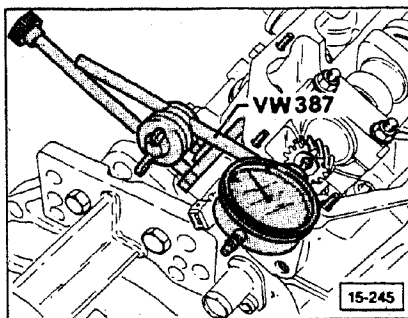
Do not rotate camshaft.

- remove bearing caps
- compare width of Plastigage® with measuring scale
 - wear limit – 0.1 mm (0.004 in.)

Note

If this limit is exceeded, check the radial clearance again with a new camshaft.

If the clearance with a new camshaft also exceeds the wear limit, the cylinder head must be replaced.



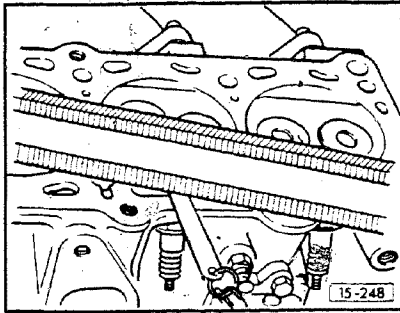
► Fig. 1 Camshaft end play, checking

- maximum 0.15 mm (0.006 in.)

Note

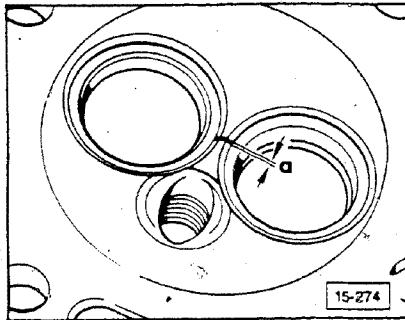
Remove valve lifters (camshaft must be free of tension).

Engine – Cylinder Head, Valve Drive



► Fig. 2 Cylinder head, checking for distortion

- maximum 0.1 mm (0.004 in.)



► Fig. 3 Cylinder head, checking for cracks

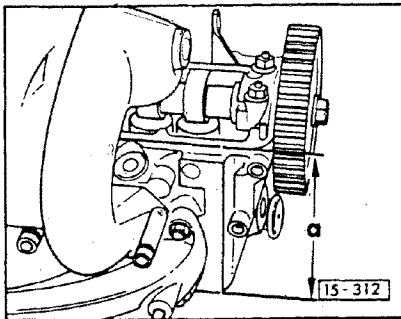
When repairing cylinder heads, small cracks in head between valve seats or valve seats and spark plug threads (where applicable) are permissible.

Cylinder heads showing such cracks can be reused without reducing engine service life or performance, providing cracks are small.

Cracks may not be larger than

a = 0.5 mm (0.019 in.)

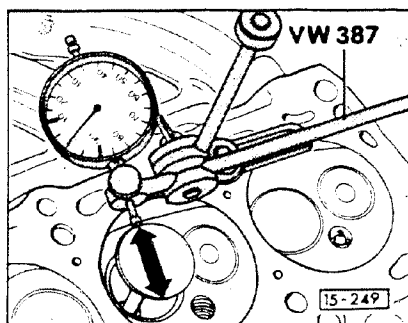
Cracks in spark plug threads (where applicable) may not be longer than through first coil of threads.



► Fig. 4 Cylinder head, machining

- a = minimum 132.75 mm (5.226 in.)

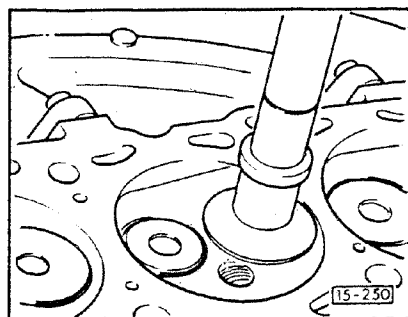
Engine – Cylinder Head, Valve Drive



► Fig. 5 Valve guide, checking for wear

- use VW 387 or US 4420A
- remove carbon
- insert new valve into valve guide
- valve stem end must be flush with valve guide end
- rock valve back and forth (arrow) against dial indicator. Dial indicator reading shows valve guide wear

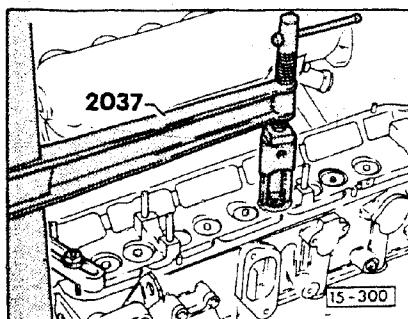
Dial indicator reading, maximum	Intake valve	Exhaust valve
	1.0 mm (0.039 in.)	1.3 mm (0.051 in.)



► Fig. 6 Valves, lapping

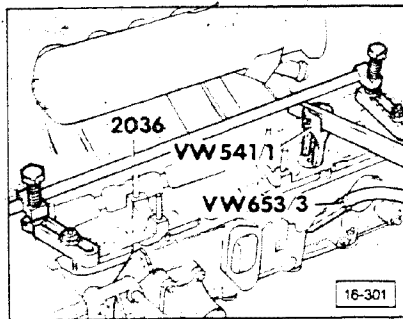
CAUTION

After lapping valve remove all traces of paste.



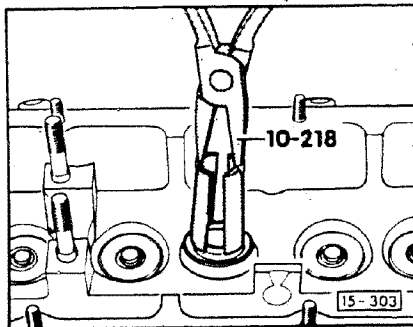
► Fig. 7 Valve keepers, removing (cylinder head removed)

Engine – Cylinder Head, Valve Drive



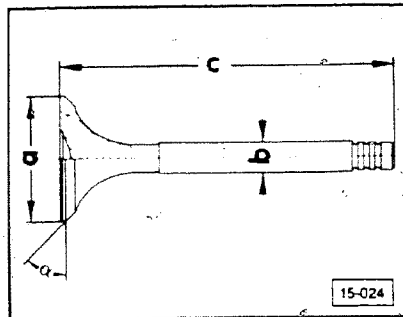
► Fig. 8 Valve keepers, removing
(cylinder head installed)

- remove spark plug
- turn crankshaft until piston of cylinder concerned is in **BDC** position
- install pressure hose **VW 653/3** or equivalent in the spark plug hole and apply continual pressure of at least 6.0 bar (87 psi)



► Fig. 9 Valve spring seat, removing

- remove with **10-218** (as shown)



► Fig. 10 Valve dimensions

Engine code MC, CIS Turbo

	Intake	Exhaust
a	38.0 mm (1.495 in.)	33.0 mm (1.299 in.)
b	8.0 mm (.314 in.)	8.0 mm (.313 in.)
c	91.0 mm (3.582 in.)	90.8 mm (3.575 in.)
α	45°	45°

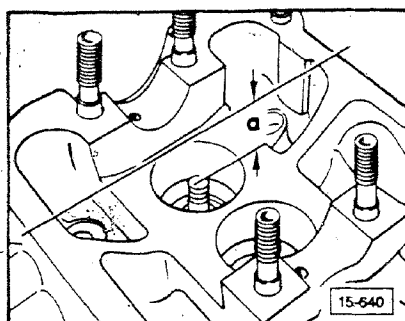
Engine code NF, CIS-E III

	Intake	Exhaust
a	40.0 mm (1.575 in.)	33.0 mm (1.299 in.)
b	8.0 mm (.314 in.)	8.0 mm (.313 in.)
c	91.0 mm (3.582 in.)	90.8 mm (3.575 in.)
α	45°	45°

CAUTION

Do not reface exhaust valves on a machine. Lap in by hand only.

Engine – Cylinder Head, Valve Drive



Valve seats, refacing

Calculating the maximum permissible refacing dimension

- insert valve and hold firmly against valve seat
- measure distance **a** between end of valve stem and upper edge of cylinder head
- calculate refacing dimension **b** (see following illustrations) using the measure distance **a** (above) and

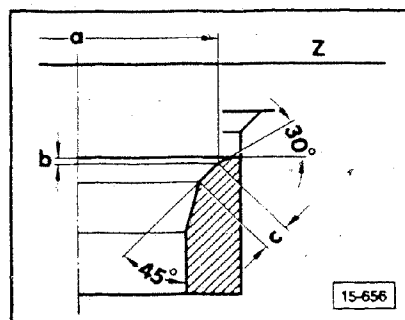
Minimum dimension

intake valve = 33.8 mm
exhaust valve = 34.1 mm

measure distance **a**
– minimum dimension
= maximum permissible refacing
dimension **b**

Note

If the measured distance **a** is smaller than the minimum dimension, the hydraulic valve lifter will not work and the cylinder head must be replaced.



► Fig. 11 Intake valve seats, refacing

Engine code MC, CIS Turbo

a = 37.2 mm (1.466 in.) diameter

Engine Code NF, CIS-E III

a = 39.5 mm (1.555 in.)

b = 9.2 mm (0.362 in.)

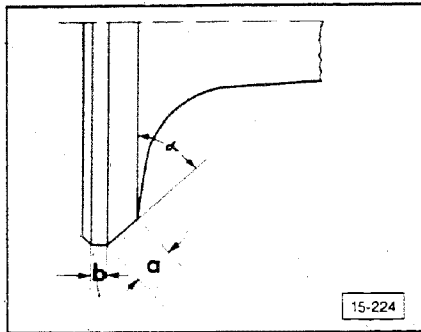
c = 2.0 mm (0.079 in.)

Z = cylinder head surface

30° = correction angle

45° = valve seat angle

Engine – Cylinder Head, Valve Drive

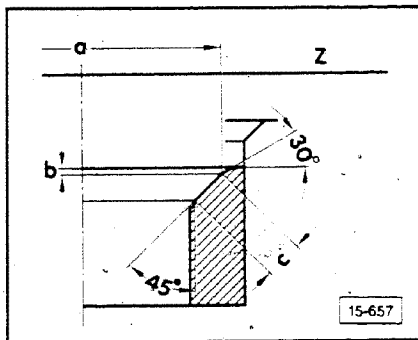


► Fig. 12 Intake valve, refacing

- α = 45°
 a = max 3.5 mm (approximately 9/64 in.)
 b = min 0.5 mm (approximately 1/32 in.)

CAUTION

DO NOT reface exhaust valves on a machine. Lap in by hand only.

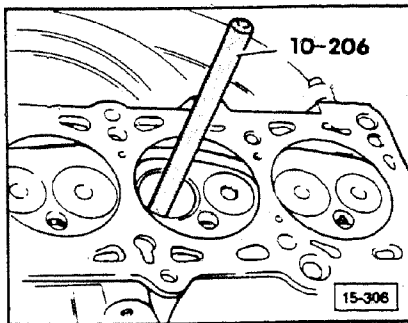


► Fig. 13 Exhaust valve seats, refacing

- a = 32.4 mm (1.108 in.) Z = cylinder head surface
 b = 9.6 mm (0.378 in.) 30° = correction angle
 c = 2.4 mm (0.094 in.) 45° = valve seat angle

Note

Replace cylinder head if valve seats can no longer be reworked.

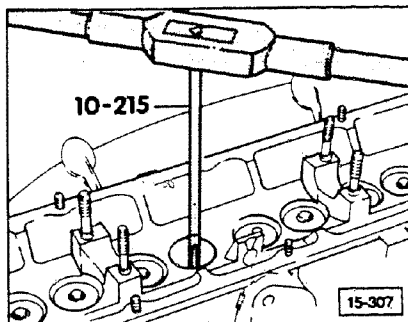


► Fig. 14 Valve guides, replacing

- press worn guides out from combustion chamber side
- coat new guides with oil and press into cold cylinder head from camshaft side. Press guides in as far as they will go

CAUTION

Once guide shoulder is seated do not use more than 1 ton pressure or guide shoulder may break.



► Fig. 15 Valve guides, reaming

- ream guides by hand using proper cutting lubricant
- machine valve seats

Engine – Cylinder Head, Valve Drive

Exhaust valves, discarding

Before discarding exhaust valves read this warning:

WARNING

Exhaust valves are sodium filled. Before discarding these valves neutralize the sodium to avoid possible injury to people in the recycling chain.

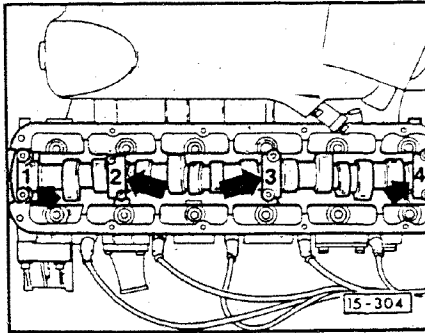
Before discarding observe the following:

- always wear protective goggles or glasses
- note that sodium reacts violently with water
- when cutting valves, valves must not come into contact with water
- use grinding equipment which does not use water or other liquids for lubrication and/or cooling
- to neutralize sodium, drop cut-off valve stems into a bucket of water and move quickly away from water bucket
- do not drop more than 10 valve stems at a time into water bucket

Discarding procedure

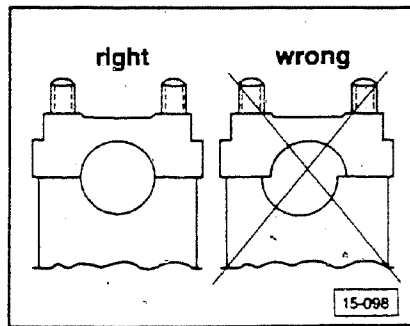
- use grinding stone or grinding disc to cut valve stem off near head of valve
- drop cut-off valve stems into bucket of water (sodium will now react with water!)
- once reaction has stopped (water stops bubbling) scrap valve stems
- water is biodegradeable and may be discarded accordingly

Engine – Cylinder Head, Valve Drive



Camshaft bearing caps, removing

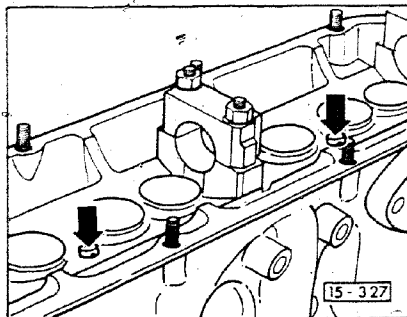
- diagonally loosen bearing caps 2 and 4 and remove
- diagonally loosen bearing caps 1 and 3 and remove



Camshaft bearing caps, installing

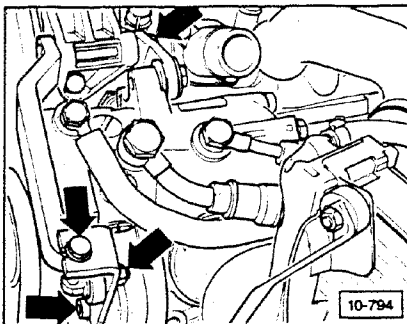
- lubricate bearing surfaces and camshaft journals
- install caps in proper order — observe off center bearing position
- first lightly tighten nuts of bearing caps 2 and 4 diagonally
- then tighten all nuts to 20 Nm (15 ft lb)

Engine – Cylinder Head, Valve Drive



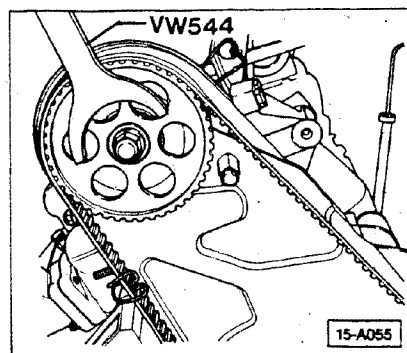
Oil spray jet, positioning

- spray direction (**arrows**) 90° to camshaft

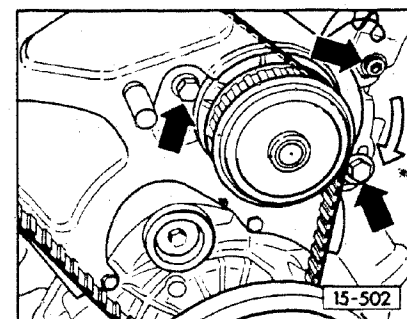


Camshaft oil seal, removing

- remove V-belt for power steering pump by loosening nuts (**arrows**)
- remove power steering pump
 - leave pressure hose connected and lay pump aside
- remove upper drive belt cover
- set crankshaft to **TDC** on cylinder 1



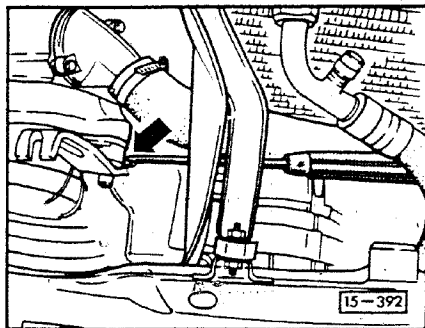
- loosen camshaft sprocket bolt



Engine removed

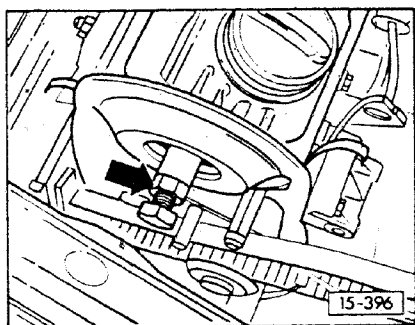
- loosen waterpump and turn clockwise to loosen drive belt (**arrows**)

Engine – Cylinder Head, Valve Drive

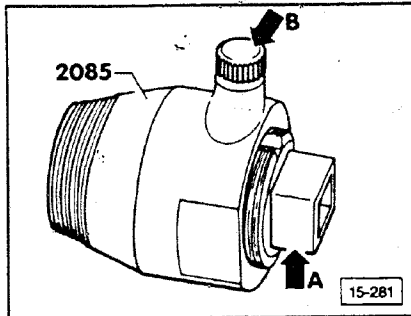


Engine installed

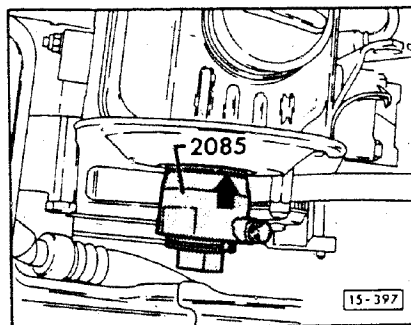
- remove upper radiator cover
- loosen waterpump and turn clockwise to loosen drive belt
 - insert screwdriver through hole in radiator side cover
- remove drive belt
- remove camshaft sprocket and woodruff key



- turn bolt for camshaft sprocket 3 turns into camshaft and tighten with lock nut (arrow)

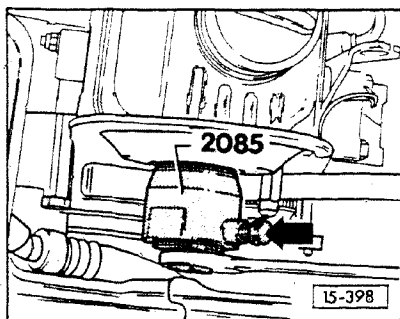


- unscrew inner part (arrow A) 3 to 4 turns
- lock in position with screw (arrow B)



- coat threaded end of puller with oil
- set puller into oil seal and turn clockwise while pushing toward cylinder head as far as it will go (arrow)

Engine – Cylinder Head, Valve Drive

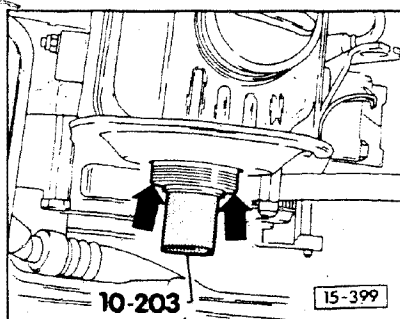


- loosen knurled screw (arrow)
- turn inner part of puller against camshaft until oil seal is pulled out
- clamp oil seal puller in vise and remove seal with pliers

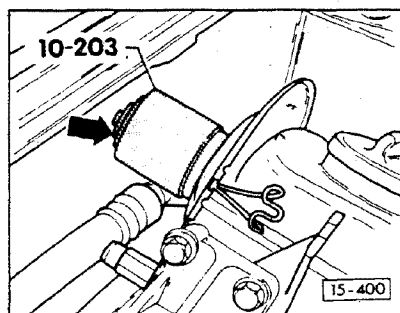
Note

Before installing drive belt, check timing marks.

Camshaft oil seal, installing



- coat seal seat and seal lips lightly with oil
- push seal over sleeve (arrows)

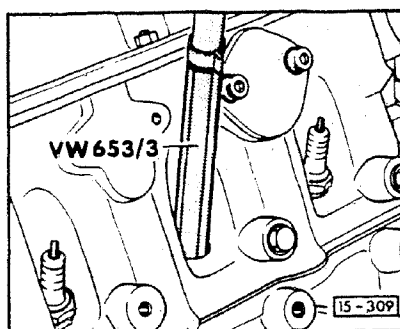


- press oil seal into cylinder head until flush with chamfered edge

Note

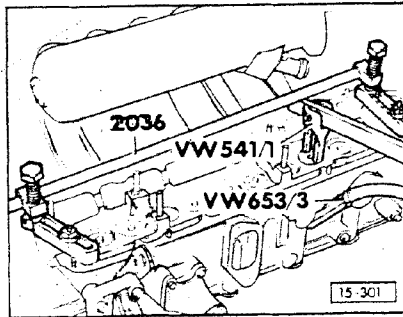
Do not press oil seal any farther, otherwise oil return hole will be blocked.

Valve stem seal, replacing (with cylinder head installed)



- remove camshaft and cam followers
- remove spark plug
- turn crankshaft until piston of cylinder concerned is in **BDC** position
- install pressure hose **VW 653/3** or equivalent into spark plug hole and apply continual pressure of at least 6.0 bar (87 psi)

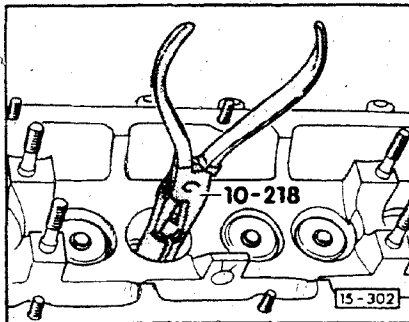
Engine – Cylinder Head, Valve Drive



- remove valve springs with VW 541/1 and 2036

Note

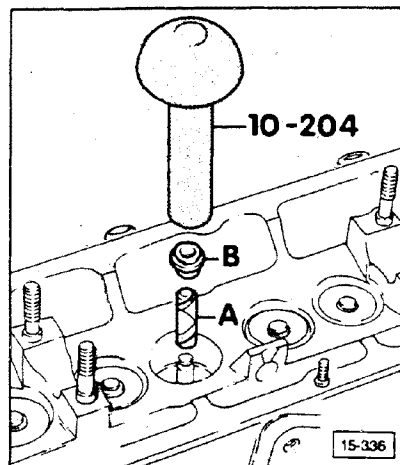
Tight valve keepers can be loosened by tapping lightly on tool lever.



- remove valve stem seal

CAUTION

Do not install seal without using plastic seal protector, otherwise seal will be damaged.



- slide plastic seal protector A onto valve stem
- lubricate valve stem seal B
- push seal carefully onto valve guide with 10-204

Engine-Cylinder Head, Valve Drive

Fuel Quality and Carbon Deposits

Research by Audi and other manufacturers has shown that the performance of gasoline engines today is directly related to the type and quality of fuel used.

Fuel without the proper additives can cause carbon deposits to form on intake valves and fuel injectors.

These carbon deposits can cause reduced engine power, unstable idle and hesitation during acceleration after starting a cold engine.

The extent of carbon build-up varies depending on the type of fuel, type of driving and operating conditions.

Intake valves

Moderate to heavy deposits, grades 4-10, (refer to current campaign circular for further description of deposit grading system) can be removed by using the "Kent-Moore Carbon Blaster."

Light deposits (grades 1-3) on intake valves can be removed as follows:

- add one 591 ml. (20 fl. oz.) bottle of "Autobahn Gasoline Additive", P/N: ZVW 246 001 to fuel tank.
- fill fuel tank completely. Best results are achieved with extended freeway style driving. Do not refill fuel tank until fuel gauge reads 1/4 full.

CAUTION

Do not exceed the following recommendations when using the 591 ml. (20 fl. oz.) bottle of "Autobahn Gasoline Additive":

Normal vehicle oil change interval	Maximum gas additive treatments between oil changes
8000 km (5000 mi.)	2
12000 km (7500 mi.)	4

Fuel injectors

Injectors can be cleaned by using the fuel injection system cleaning kit, US G16 (see current service literature for instructions outlining use of US G16 kit).

NOTE

After cleaning injectors, the idle speed (idle valve adjustment) and CO content should be checked and adjusted if necessary.

Prevention

Carbon deposit build-up on intake valves and injectors can be prevented through the use of gasolines containing the proper deposit control additives. U.S. suppliers such as Shell, Exxon, Chevron and Amoco, among others, advertise and sell gasoline which contains these additives. When in doubt, owners should consult with their local service station or oil company about available gasolines with additives that will keep intake valves and injectors clean.

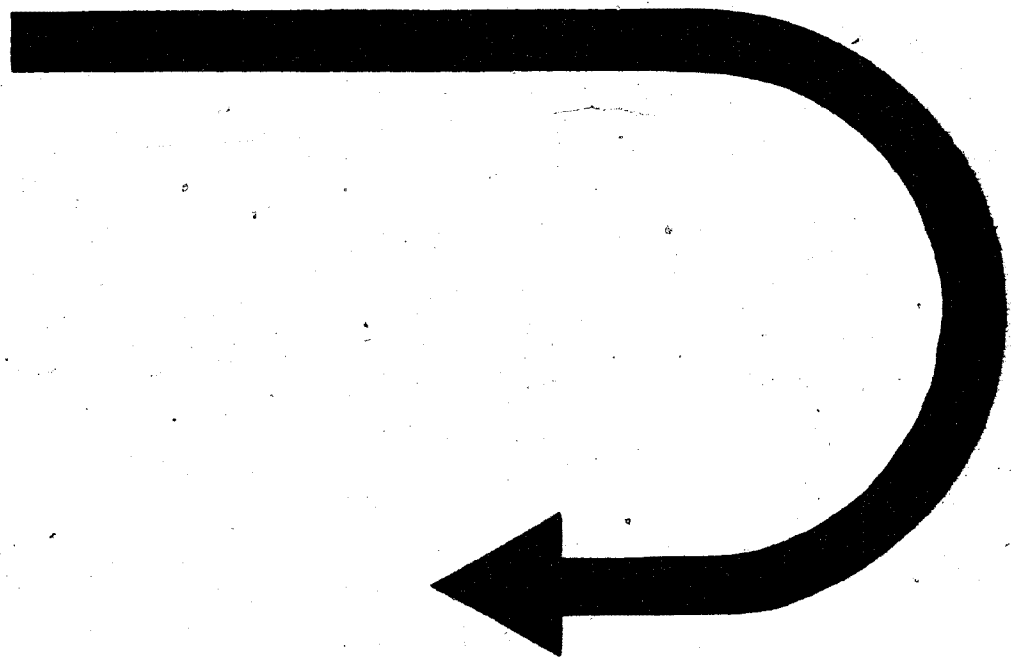
In areas where gasoline containing deposit control additives is unavailable, the specially formulated 192 ml. (6.5 fl. oz.) bottle of "Autobahn Additive" should be used as follows:

- add one 192 ml. (6.5 fl. oz.) bottle of "Autobahn Gasoline Additive", P/N: ZVW 246 003 to fuel tank before every fill up.
- for best results, do not refill fuel tank until the fuel gauge reads 1/4 full.

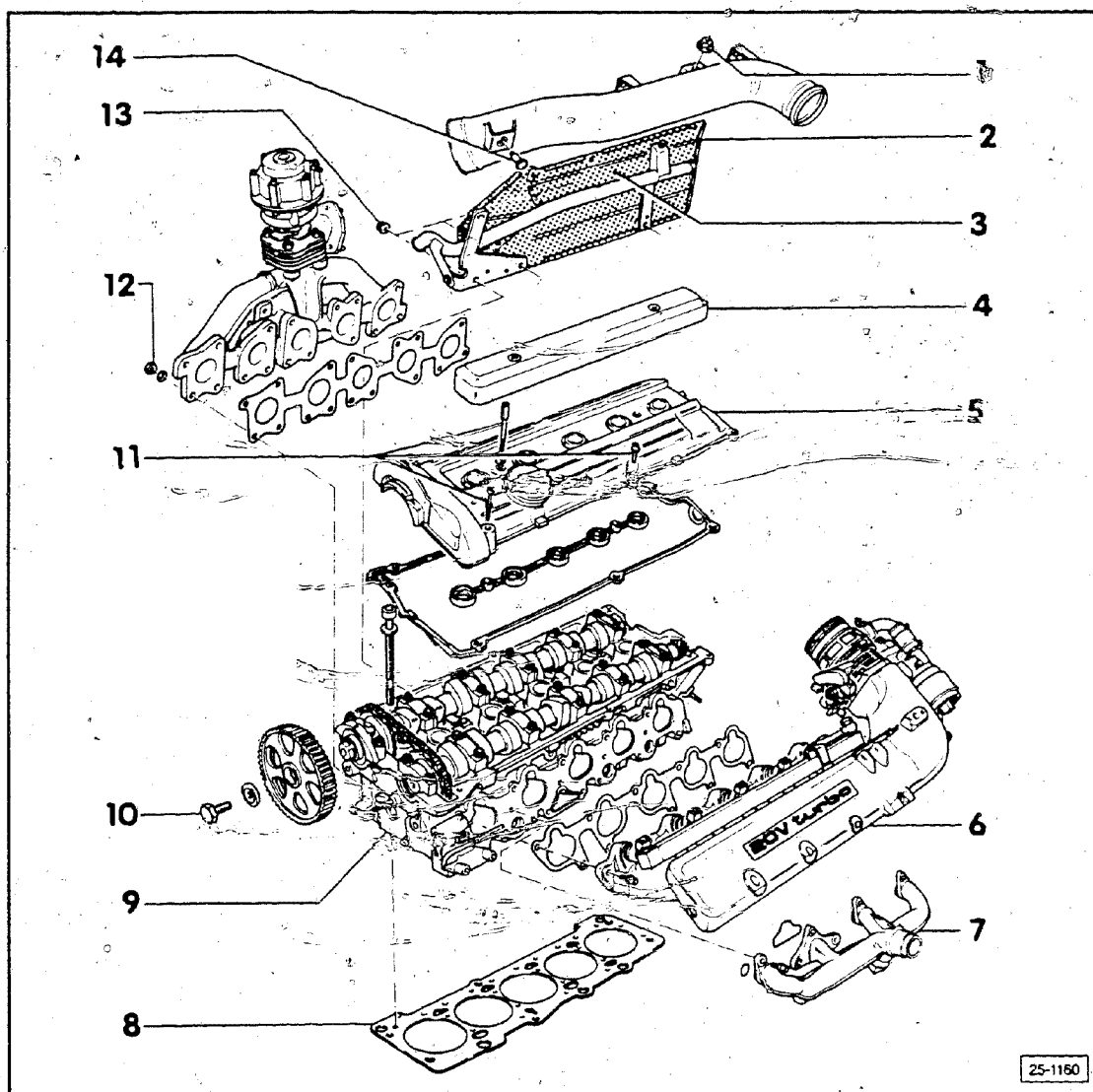
CAUTION

Part numbers are for reference only. Always check with your Parts Department for latest parts information.

CONTINUED IN THE
BEGINNING OF NEXT ROW



Engine – Cylinder Head, Valve Drive



Note

Always replace seals and gaskets. Cylinder head can be removed with engine installed.

When installing replacement head, oil contact surface between hydraulic lifter and camshaft.

CAUTION

After replacing lifters **DO NOT** start engine for approximately 30 minutes to allow lifters to bleed down.

- 1 — 22 Nm (16 ft lb)
- 2 — Heat shield
- 3 — Crankcase breather pipe
- 4 — Ignition wire cover
- 5 — Cylinder head cover
remove throttle valve housing first
- 6 — Intake manifold — 22 Nm (16 ft lb)
remove/install with tool V.A.G. 1669 or equivalent
- 7 — Coolant manifold — 10 Nm (7 ft lb)

Engine – Cylinder Head, Valve Drive

8 — Cylinder head gasket

- install over locating pin in cylinder block
- word "OBEN" or part number must face cylinder head
- replace gasket

9 — Cylinder head

- installing, see page 15.23
- checking for distortion

10 — 67 Nm (50 ft lb)

11 — 10 Nm (7 ft lb)

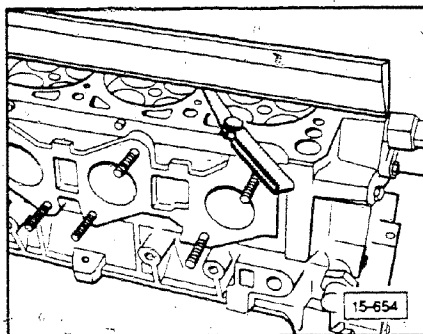
12 — 25 Nm (18 ft lb)

13 — 22 Nm (16 ft lb)

14 — 22 Nm (16 ft lb)

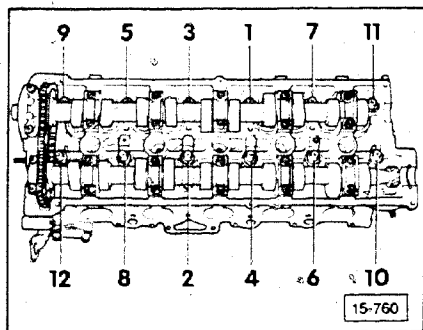
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Engine – Cylinder Head, Valve Drive



Cylinder head distortion, checking

- maximum 0.1 mm (0.004 in.)



Cylinder head, installing

Note

Before installing cylinder head, ensure that crankshaft and cylinder head are set to TDC.

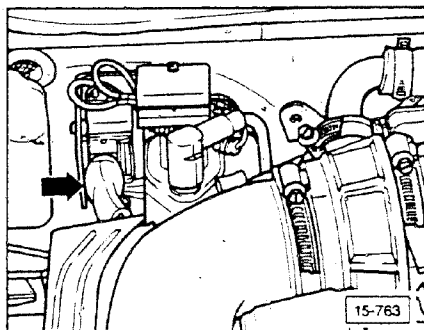
- install dry (no sealing compound)
- use guide pins
- word "OBEN" or part number on gasket points toward cylinder head
 - watch hole pattern
- tighten cylinder head bolts in 3 step numerical sequence:
 - step 1 = 40 Nm (29 ft lb)
 - step 2 = 60 Nm (44 ft lb)
 - step 3 = 1/2 turn (180°) further without stopping. (Two 90° turns are OK)

Note

It is not necessary to retighten bolts after first inspection service or repairs.

Engine – Cylinder Head, Valve Drive

Compression, checking



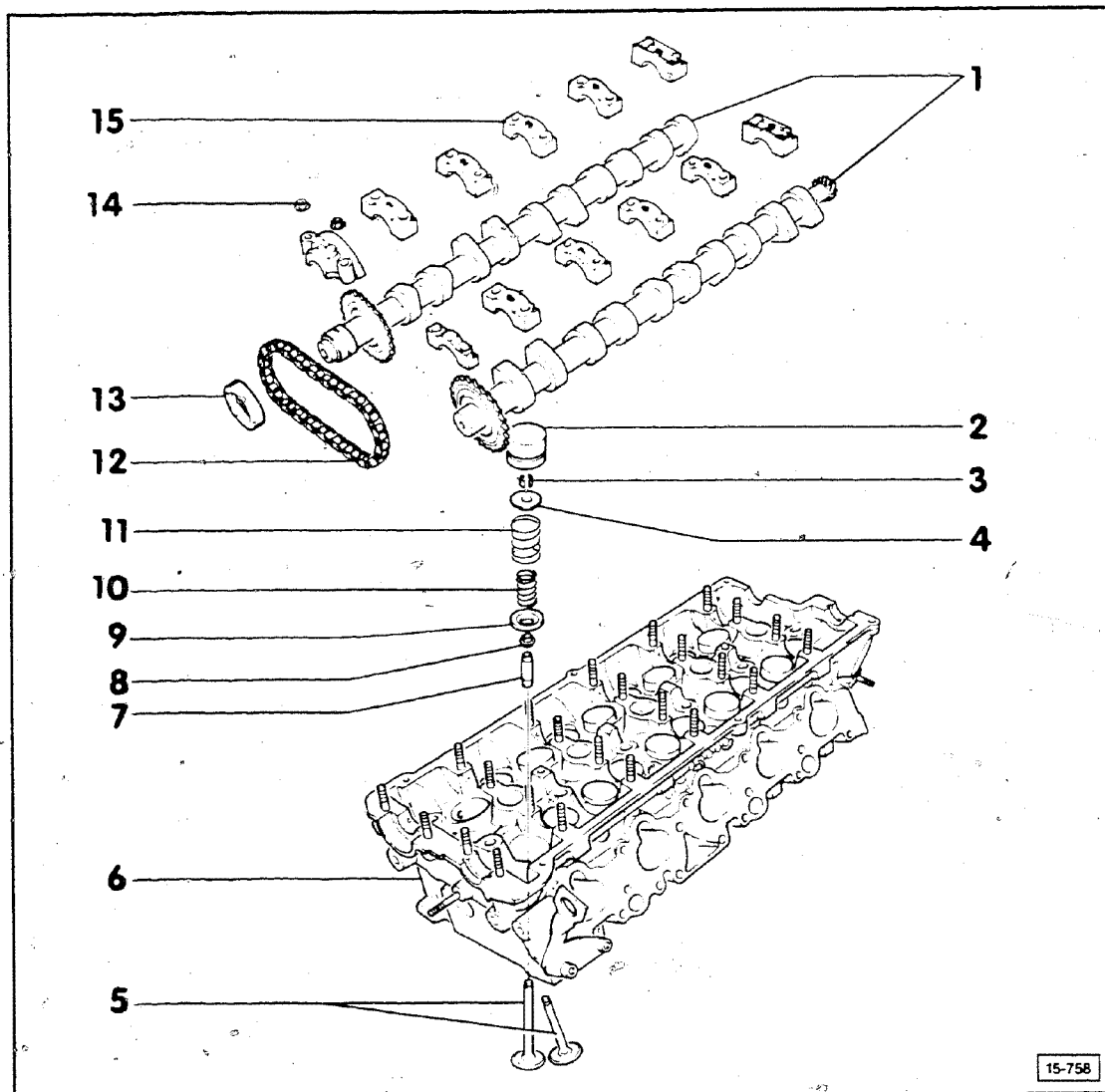
- remove spark plugs
- disconnect high tension lead (**arrow**), and connect to ground with clamp
- open throttle
- oil temperature must be above 30°C (86°F)

Engine code 3B	New	9-13 bar (131-189 psi)
	Wear Limit	7 bar (102 psi)

Note

Maximum pressure difference between highest and lowest cylinder: 3 bar (44 psi).

Engine – Cylinder Head, Valve Drive



Note

When repairing cylinder heads, small cracks in head between valve seats or valve seats and spark plug threads are permissible.

Cylinder heads showing such cracks can be reused without reducing engine service life or performance, providing cracks are small.

Cracks may not be larger than 0.5 mm (0.019 in.) or cracks in spark plug threads may not be longer than through first coil of threads.

1 — Camshafts

- checking side clearance, page 15.27
- check radial clearance with Plastigage: wear limit: 0.2 mm (0.08 in.)
- maximum runout 0.4 mm (0.002 in.)

2 — Hydraulic valve lifters

- must be reinstalled in original location
- check camshaft side clearance before installing
- oil contact surface before installing

3 — Valve keepers

- removing, page 15.18

4 — Upper valve spring seat

Engine code 3B — 20V Turbo

Camshaft, assembly

15.25

Engine – Cylinder Head, Valve Drive

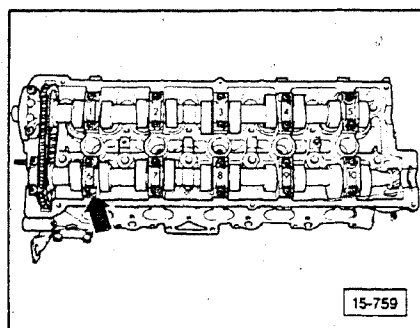
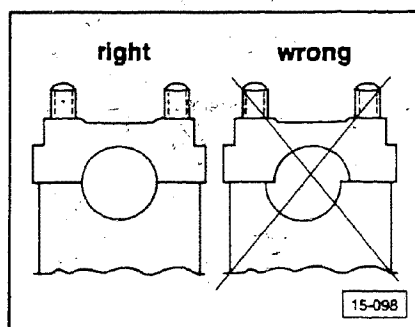
- 5 — **Valves**
 - exhaust valves, discarding, page 15.30
 - dimensions, page 15.28
 - grind only, do not machine
- 6 — **Cylinder head**
 - minimum dimension for machining: 118.1 mm (4.6 in.)
 - measured through a cylinder head bolt hole
- 7 — **Valve guide**
 - checking/replacing, page 15.35
- 8 — **Valve stem seal**
 - replacing, with cylinder head removed, page 15.37
- 9 — **Lower valve spring seat**
 - remove/install with tool 3047A
- 10 — **Inner valve spring**
 - remove/install with VW 541
- 11 — **Outer valve spring**
 - remove/install with VW 541
- 12 — **Drive chain**
- 13 — **Seal**
 - removing/installing, page 15.33
- 14 — **15 Nm (11 ft lb)**
- 15 — **Bearing cap**
 - installation position
 - installation sequence, page 15.27

Engine — Cylinder Head, Valve Drive

Camshaft bearing caps

Installation position

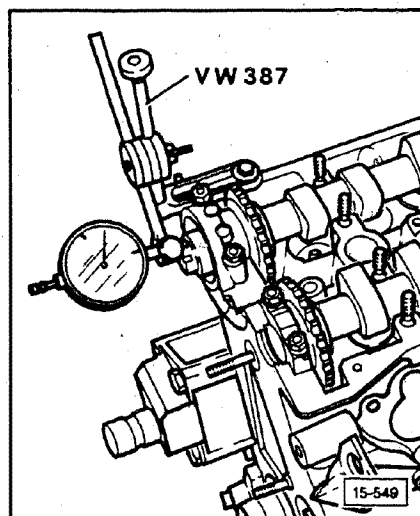
- place bearing caps into position to determine correct installation position (as shown)
- the notch (arrow) on bearing caps must point toward the intake side of the cylinder head



Camshaft, checking

Side clearance

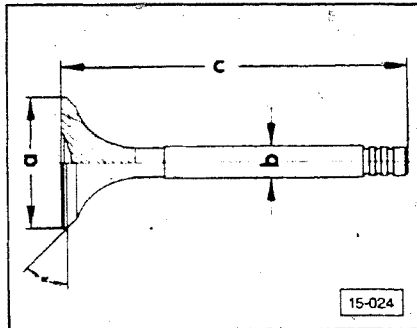
- measure with hydraulic valve lifters, chain and bearing caps 1 and 5 or 6 and 10 installed
 - wear limit: 0.2 mm (0.008 in.)



Engine – Cylinder Head, Valve Drive

Valve dimensions

Engine code 3B



	Intake	Exhaust
a	32.00 mm (1.25 in.)	28.00 mm (1.09 in.)
b	6.97 mm (0.27 in.)	6.94 mm (0.27 in.)
c	95.50 mm (2.82 in.)	98.20 (3.83 in.)
α	45°	45°

Valve seats, refacing

Calculating maximum permissible refacing dimension

- insert valve and hold firmly against valve seat
- measure distance **a** between end of valve stem and upper edge of cylinder head (as shown)
- calculate refacing dimension **b** (see Fig. 15-651, 15-657 following) using the measured distance **a** and

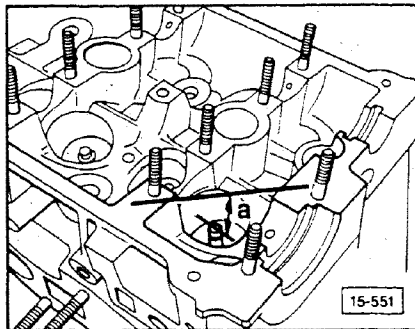
Minimum dimension

Intake valve = 36.0 mm
Exhaust valve = 36.3 mm

measure distance **a**
– minimum dimension
= maximum permissible refacing dimension **b**

Note

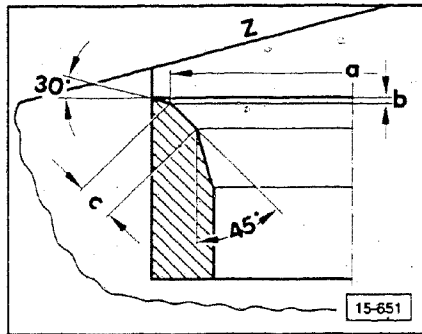
If the measured distance **a** is smaller than the minimum dimension, the hydraulic valve lifter will not work and the cylinder head must be replaced.



Engine – Cylinder Head, Valve Drive

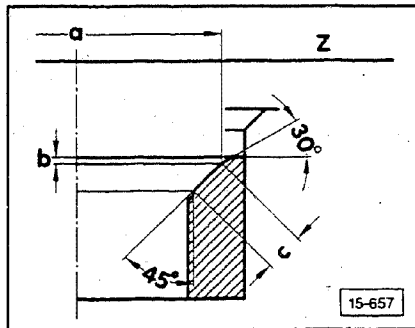
CAUTION

Do not reface valves on a machine. Lap in by hand only.



Intake valve seat

- a = 31.2 mm (1.23 in.)
- b = maximum permissible refacing dimension (as calculated)
- c = 1.5-1.8 mm (0.06-0.07 in.)
 - cut seat ring with 75° correction cutter, if necessary
- z = cylinder head lower edge
- 30 = upper correction angle
- 45 = valve seat angle



Exhaust valve seat

- a = 27.6 mm (1.09 in.)
- b = maximum permissible refacing dimension, (as calculated)
- c = approximately 1.8 mm (approximately 0.07 in.)
- z = cylinder head lower edge
- 30 = upper correction angle
- 45 = valve seat angle

Engine – Cylinder Head, Valve Drive

Exhaust valve, discarding

Before discarding exhaust valves read this warning:

WARNING

Exhaust valves are sodium filled. Before discarding these valves neutralize the sodium to avoid possible injury to people in the recycling chain.

Before discarding observe the following:

- always wear protective goggles or glasses
- note that sodium reacts violently with water
- when cutting valves, valves must not come into contact with water
- use grinding equipment which does not use water or other liquids for lubrication and/or cooling
- to neutralize sodium, drop cut-off valve stems into a bucket of water and move quickly away from water bucket
- do not drop more than 10 valve stems at a time into water bucket

Discarding procedure

- use grinding stone or grinding disc to cut valve stem off near head of valve
- drop cut-off valve stems into bucket of water (sodium will now react with water!)
- once reaction has stopped (water stops bubbling) scrap valve stems
- water is biodegradeable and may be discarded accordingly

Engine – Cylinder Head, Valve Drive

Hydraulic valve lifters, checking

CAUTION

Hydraulic valve lifters are stored upside down.

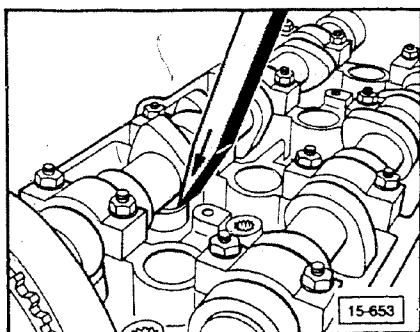
After replacing lifters do not start engine for approximately 30 minutes to allow lifters to bleed down.

Note

Hydraulic valve lifters are not adjustable.

Noisy lifters may be replaced after the following checks:

- run engine until radiator fan comes on at least once
- bring engine speed to approximately 2500 RPM for 2 minutes
 - if valve lifter is still noisy, replace
- remove cylinder head cover
- turn crankshaft pulley bolt clockwise until cam lobes of cylinder to be checked point up
- push lifter down with suitable wood stick against valve lifter as shown
 - if valve lifter can be pushed down more than 0.1 mm (0.004 in.), replace lifter

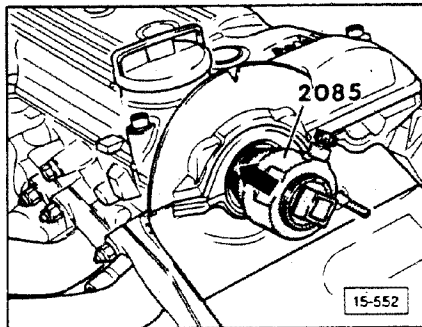
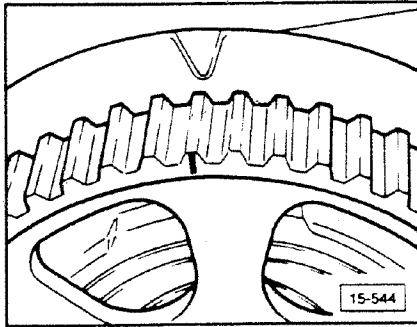


Engine – Cylinder Head, Valve Drive

Camshaft oil seal, removing/installing

Removing

- remove upper drive belt cover
- set crankshaft to **TDC** on cylinder 1
- loosen drive belt and remove
- remove camshaft sprocket
- screw bolt with washer for camshaft sprocket into camshaft as far as it will go



- unscrew inner part of oil seal extractor **2085** 2 turns (approximately 3.0 mm (1/8 in.))
- lock in position with knurled screw on **2085**
- coat threaded end of puller with oil
- set puller into oil seal and turn clockwise while pushing toward cylinder head as far as it will go (**arrow**)
- loosen knurled screw
- turn inner part of puller against camshaft until oil seal is pulled out
- clamp oil seal puller in vise and remove seal with pliers

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Engine – Cylinder Head, Valve Drive

Installing

- coat seal seat and seal lips lightly with oil
- push seal over sleeve
- press oil seal into cylinder head until flush with thrust sleeve 10-203

CAUTION

Do not press oil seal any further, otherwise oil return hole will be blocked.

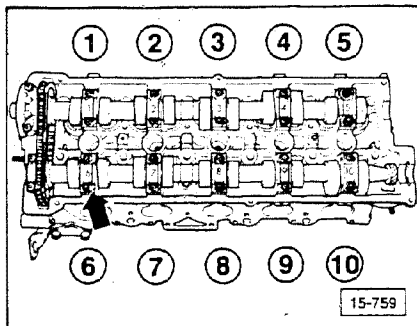
Camshafts, removing/installing

Removing

- remove upper drive belt cover
- remove intake manifold
- remove cylinder head cover
- turn crankshaft to cylinder 1 at TDC
- slacken and remove drive belt
- remove camshaft sprocket

Exhaust camshaft

- remove bearing cap in front of drive chain, and caps 2, 4
- loosen bearing caps 1, 3, and 5 alternately and diagonally



Engine – Cylinder Head, Valve Drive

Intake camshaft

- remove bearing cap in front of drive chain, and caps 7, 9
- loosen bearing caps 6, 8 and 10 alternately and diagonally

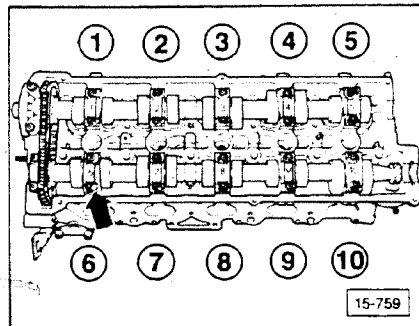
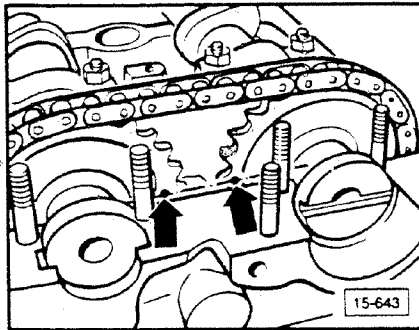
Installing

CAUTION

When installing bearing caps, ensure the notch on bearing cap faces toward the intake side of cylinder head.

The distributor must be removed before installing camshaft, see Repair Group 28.

- install camshaft with chain so markings on chain sprockets match (arrows)



Intake camshaft

- tighten bearing caps 6, 8 and 10 alternately and diagonally
 - tightening torque 15 Nm (11 ft lb)
- install remaining bearing caps
 - tightening torque 15 Nm (11 ft lb)

Exhaust camshaft

- tighten bearing caps 1, 3, and 5 alternately and diagonally
 - tightening torque 15 Nm (11 ft lb)
- install remaining bearing caps
 - tightening torque 15 Nm (11 ft lb)
- install camshaft sprocket and tighten
 - tightening torque 67 Nm (50 ft lb)

Engine – Cylinder Head, Valve Drive

- install drive belt
- adjust valve timing, see Repair Group 13

CAUTION

After replacing lifters, do not start engine for approximately 30 minutes, otherwise valves may hit pistons.

Lifters must bleed down to proper adjustment.

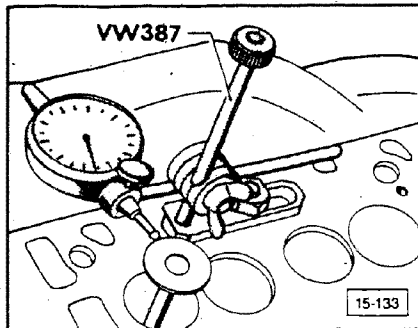
Valve guides, checking

- remove any combustion residue with suitable cleaner
- use tool **VW 387**
- insert new valve into guide
 - end of valve stem must be flush with valve guide end

Note

Use intake or exhaust valves in their respective guides only.

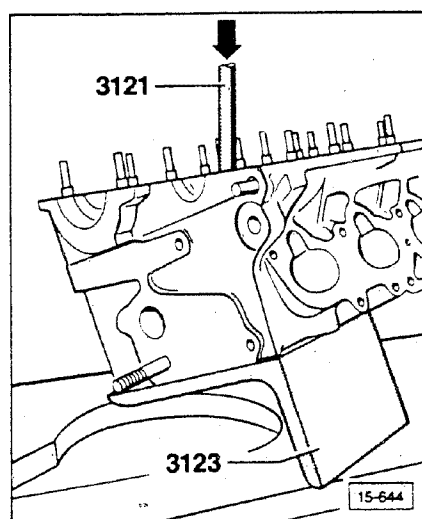
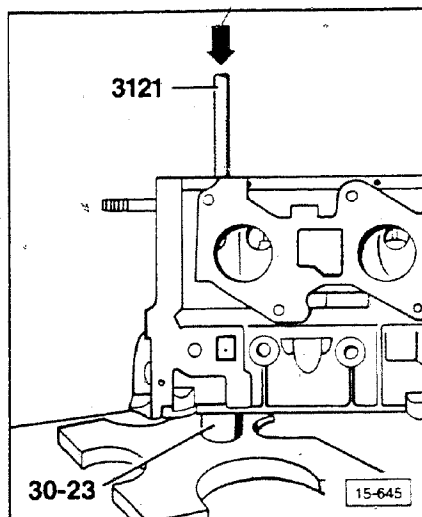
- rock valve back and forth against dial indicator. Dial indicator shows valve guide wear



Dial indicator reading, maximum	Intake valve	Exhaust valve
	1.0 mm (0.039 in.)	1.3 mm (0.051 in.)

Engine – Cylinder Head, Valve Drive

Valves guides, removing/installing



Removing

- insert tool 3121 into valve guide from combustion chamber side
- push out worn valve guide from combustion chamber side using sleeve 30-23 as support

Installing

- coat new guide with oil and using tool 3121 press guide into (cold) cylinder head (from camshaft side) up to shoulder of guide
 - use sleeve 3123 as support

CAUTION

Once guide shoulder is seated do **NOT** apply more than 1 ton of pressure or shoulder of guide may break.

- ream valve guides to size using tool 3120 and machining oil
- machine valve seats

CAUTION

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

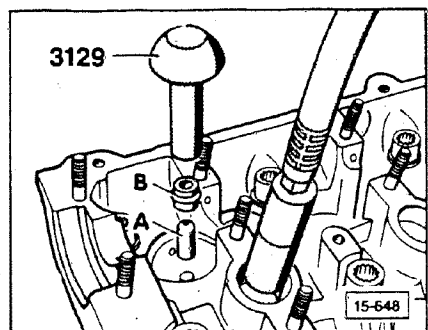
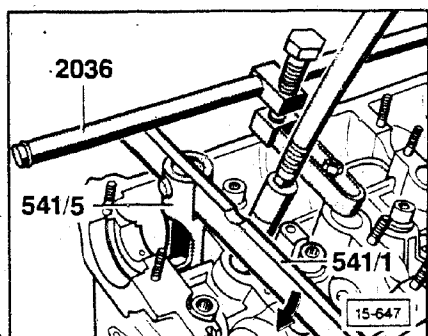
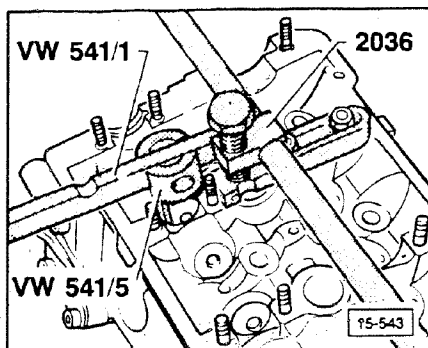
If the refacing dimension is exceeded, proper function of the hydraulic lifter will not be assured and the cylinder head will have to be replaced.

Engine – Cylinder Head, Valve Drive

Valve stem seals, removing/installing

(with cylinder head installed)

- remove camshaft and valve lifters
- remove spark plugs
- rotate crankshaft until piston of cylinder to be repaired is at position **BDC**
- install pressure hose **VW 653/3** (or equivalent) into spark plug hole and apply continual pressure of at least 6 bar (87 psi)



Intake side

- install tool **2036** and adjust to height of stud
- remove valve springs using tool **541/1** in combination with spacer **541/5**

Exhaust side

Tight valve keepers can be loosened by tapping lightly on tool lever in direction of arrow, as shown.

- remove valve stem seals using tool **3047.A**
- slide plastic seal protector **A** onto valve stem
- lubricate valve stem seal **B**
- carefully push seal onto valve guide using tool **3129**

CAUTION

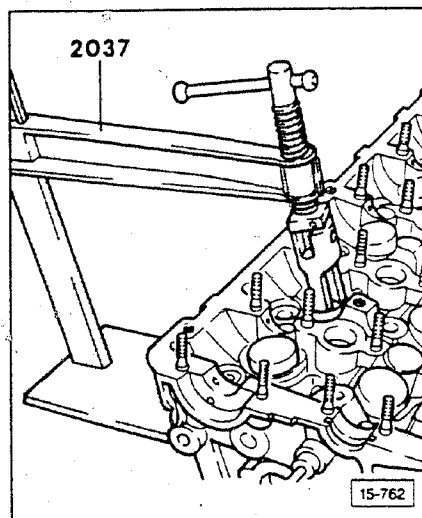
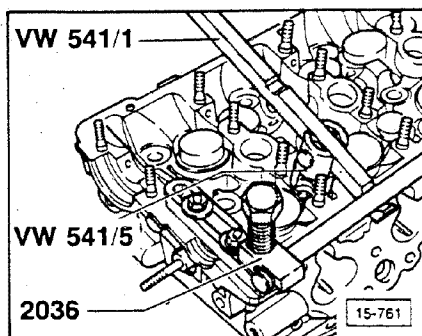
Do **NOT** install seal without using plastic seal protector, otherwise seal will be damaged.

Engine – Cylinder Head, Valve Drive

Valve stem seals, replacing

(with cylinder head removed)

- remove camshaft and valve lifters
- remove spark plugs
- rotate crankshaft until piston of cylinder to be repaired is at Bottom Dead-Center position
- install pressure hose **VW 653/3** (or equivalent) into spark plug hole and apply continual pressure of at least 6 bar (87 psi)
- install tool **2036** and adjust bearing to height of stud
- remove valve springs using tool **541/1** in combination with spacer **541/5**



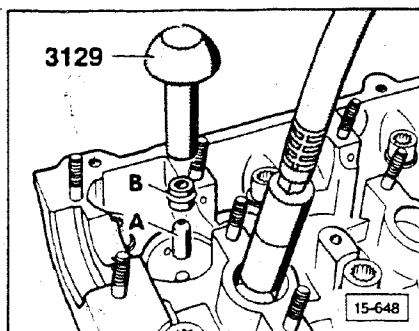
Intake side

Tight valve keepers can be loosened by tapping lightly on tool lever.

Exhaust side

- remove valve springs using **2037**

Engine – Cylinder Head, Valve Drive



- remove valve stem seals using tool 3047 A
- slide plastic seal protector A onto valve stem
- lubricate valve stem seal B
- carefully push seal onto valve guide using tool 3129

CAUTION

Do **NOT** install seal without using plastic seal protector, otherwise seal will be damaged.

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