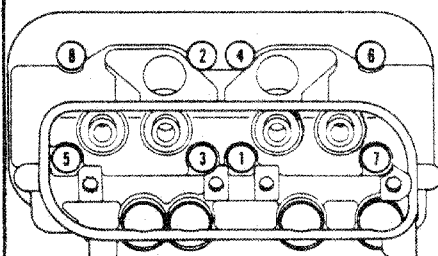


Engine Cylinder Head Valve Drive

Quick Data

Air-cooled



cylinder head tightening sequence:
tighten slightly; then tighten to
30 Nm/22 ft lb

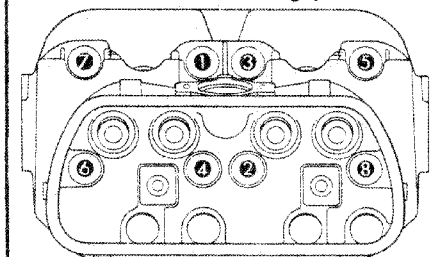
Valve clearances

not adjustable: hydraulic valve lifters

Tightening Torques

Cylinder head	30 Nm (22 ft lb)
Exhaust manifold	20 Nm (15 ft lb)
Intake manifold	15 Nm (11 ft lb)
Rocker arm	15 Nm (11 ft lb)

Water-cooled — Digi-jet



cylinder head tightening sequence:
coat surface of cap nuts with D 3
sealing compound and torque in
sequence to 10 Nm (7 ft lb)
then tighten to 45 NM (33 ft lb)

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Air-cooled

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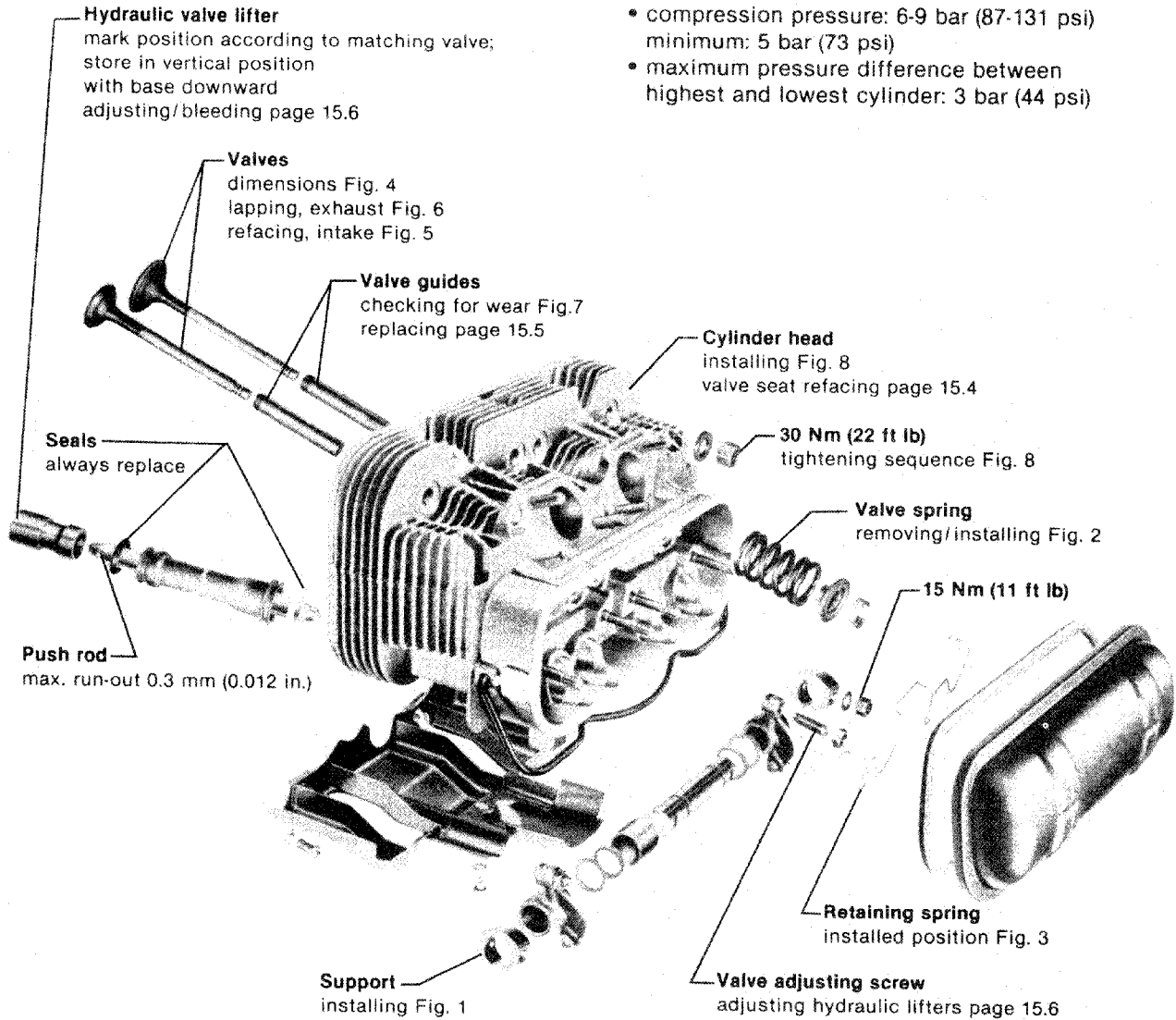
15 Engine-Cylinder Head, Valve Drive

Compression, checking

WARNING

On vehicles with electronic ignition, disconnect terminal 4 on ignition coil and connect to ground before performing compression test

- compression pressure: 6-9 bar (87-131 psi)
minimum: 5 bar (73 psi)
- maximum pressure difference between highest and lowest cylinder: 3 bar (44 psi)



15-429

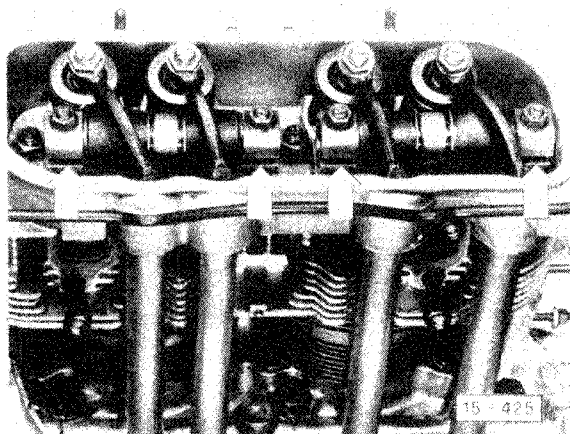


Fig. 1 Rocker arm shaft supports, installing

- slot downward (arrows)
- chamfer outward

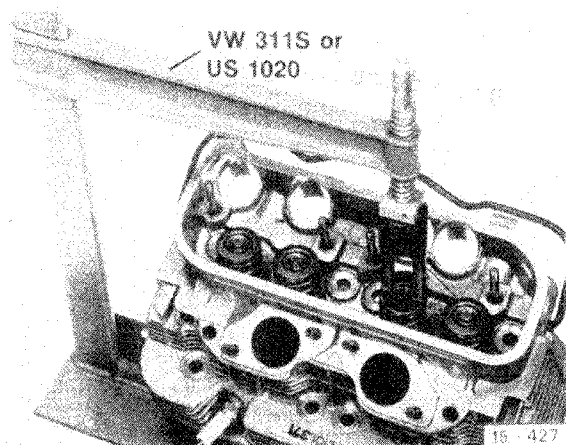


Fig. 2 Valve spring, removing/installing

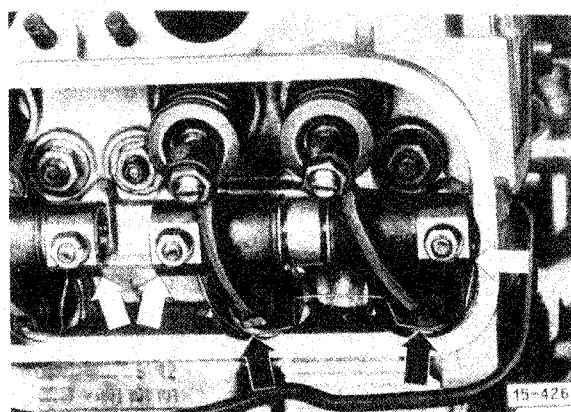


Fig. 3 Retaining spring for pushrod tube, installed position (arrows)

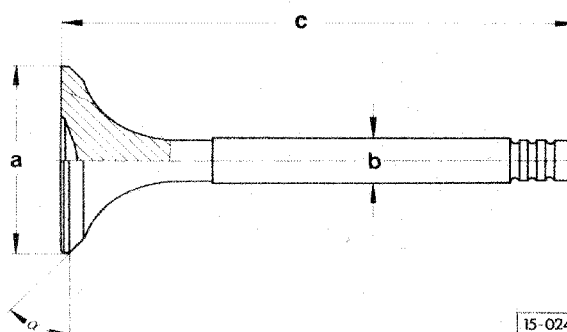


Fig. 4 Valves, dimensions

Intake valve

- $a = 39.3 \text{ mm (1.547 in.)}$ diameter
- $b = 7.95 \text{ mm (0.313 in.)}$ diameter
- $c = 115.4 \text{ mm (4.540 in.)}$ length
- $\alpha = 29^\circ 30'$

Exhaust valve

- $a = 33.0 \text{ mm (1.299 in.)}$ diameter
- $b = 8.92 \text{ mm (0.351 in.)}$ diameter
- $c = 115.4 \text{ mm (4.540 in.)}$ length
- $\alpha = 45^\circ$

CAUTION

Do not rework **exhaust valves** by machine; lap by hand only

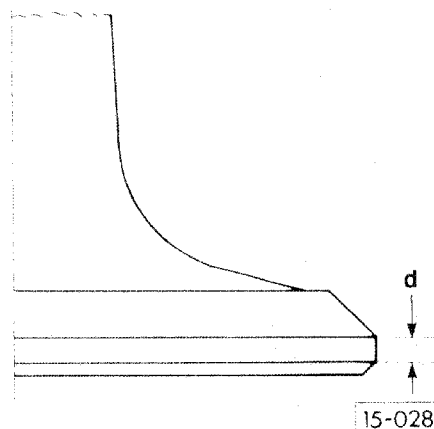


Fig. 5 Intake valves, refacing

- check stem diameter
- grind seat angle to $29^\circ 30'$
 - valve margin d must not be less than $0.5 \text{ mm (0.020 in.)}$

15 Engine-Cylinder Head, Valve Drive

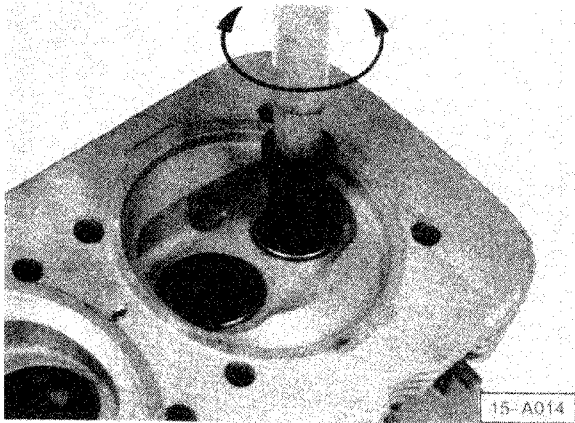


Fig. 6 Exhaust valves, lapping
— lift and turn frequently

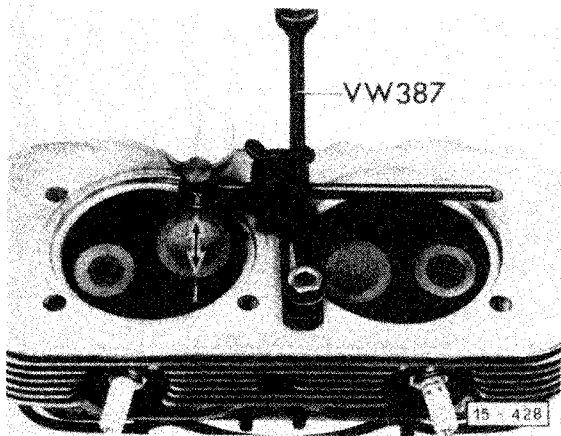


Fig. 7 Valve guide checking for wear

- remove carbon
- insert new valve into valve guide
 - valve stem must be flush with valve guide end
- rock valve back and forth against dial indicator (arrow)
 - max. 1.2 mm (0.047 in.)

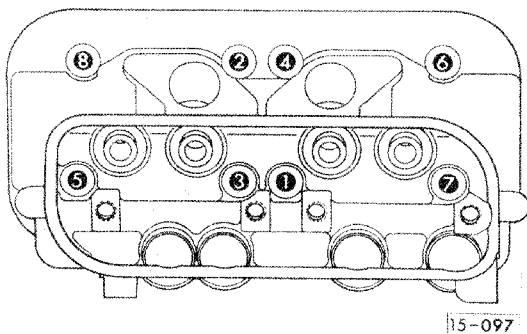
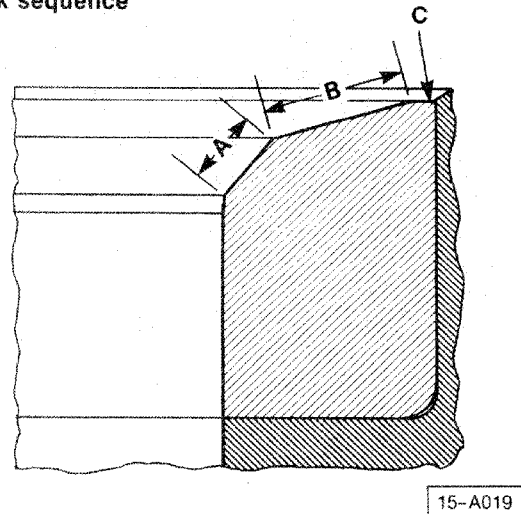


Fig. 8 Cylinder head, installing

- tighten nuts lightly by hand
- torque in numbered sequence to 30 Nm (22 ft lb)

Valve seats, refacing

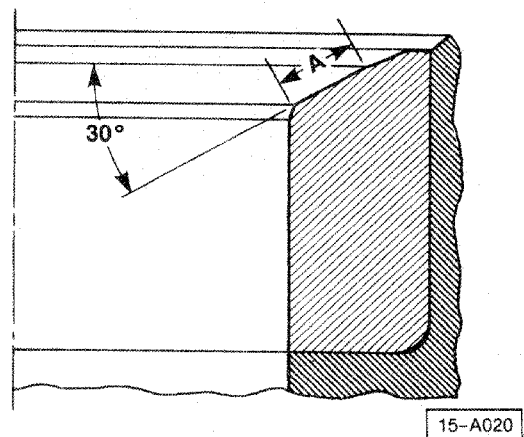
Work sequence



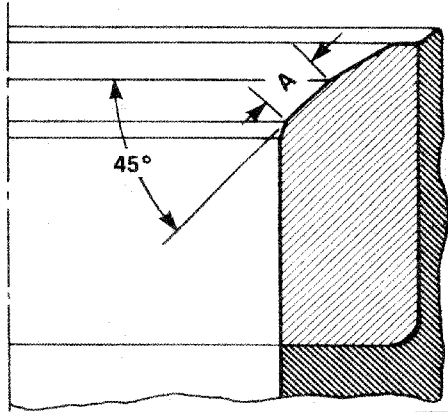
CAUTION

Damaged or burnt seats can be refaced if:

- permissible width of seat **A** is maintained
- 15° chamfer **B** does not exceed outer diameter of valve seat insert in cylinder head at **C**

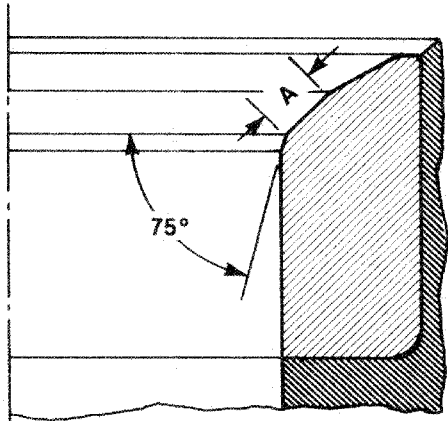


- reface **intake** valve seats **A** to 30° angle
 - stop cutting as soon as complete seat is cleaned



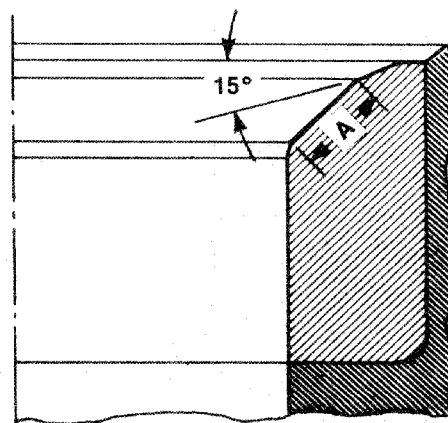
15-A021

- reface **exhaust** valve seats **A** to 45° angle
 - stop cutting as soon as complete seat is cleaned



15-A022

- lightly chamfer edges of intake and exhaust valve seats **A** with 75° cutter



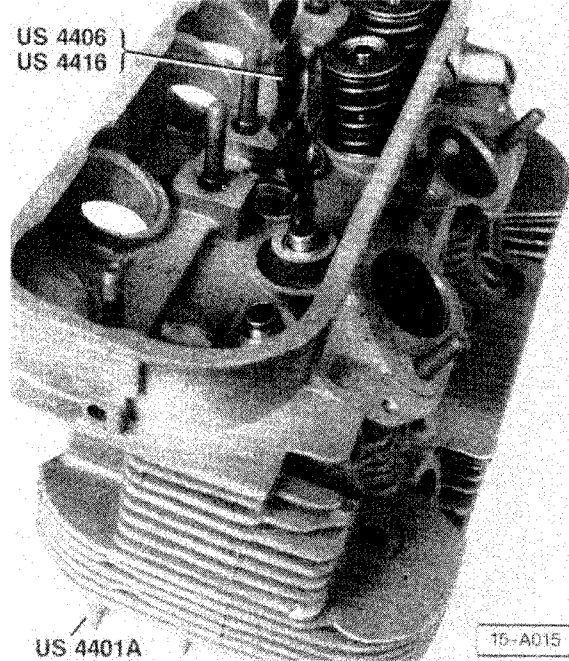
15-A023

- using 15° cutter, narrow **intake** valve seat widths **A** to 1.8–2.2 mm (0.070–0.086 in.)
- using 15° cutter, narrow **exhaust** valve seat widths **A** to 2.0–2.5 mm (0.078–0.098 in.)

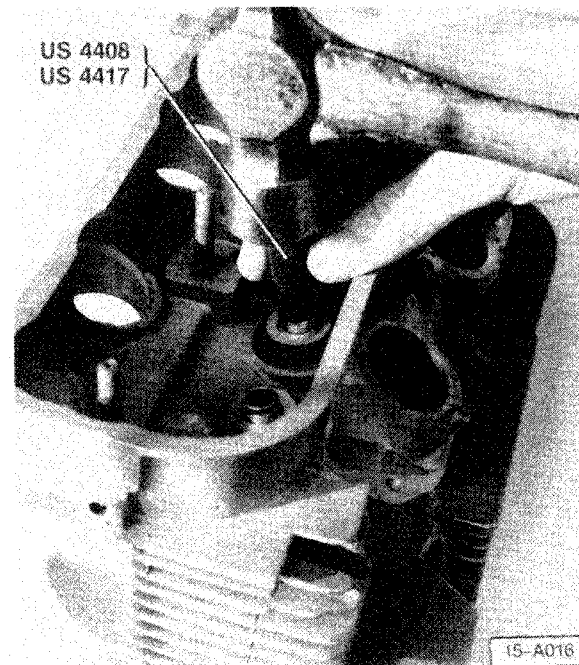
Valve guides, replacing

Work sequence

- clean cylinder head
- check for cracks in head and in valve seats

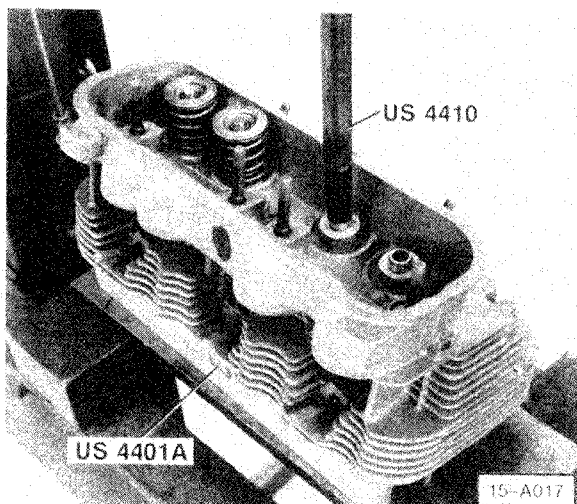


- mount head on US 4401A
- drill guides with shouldered drill to depth of 40–50 mm (1.575–1.968 in.)



- drive out remaining part of guide
- go to next page

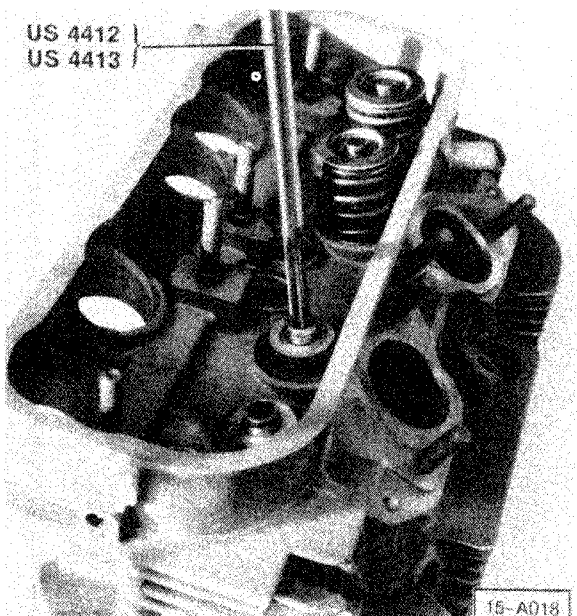
15 Engine-Cylinder Head, Valve Drive



— coat new guide with engine oil and press in

CAUTION

Do not use more than 2 tons of pressure



— ream guides to size
• use cutting oil

CAUTION

After valve guides have been replaced, valve seats must be refaced

Hydraulic valve lifters, adjusting

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, sudden acceleration, high temperatures or high engine speed

CAUTION

If metal particles are found in oil pan, remove, disassemble, clean and reinstall all valve lifters from position removed

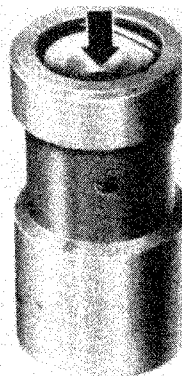
If rocker shafts have been removed, following standard adjustment is necessary

Work sequence

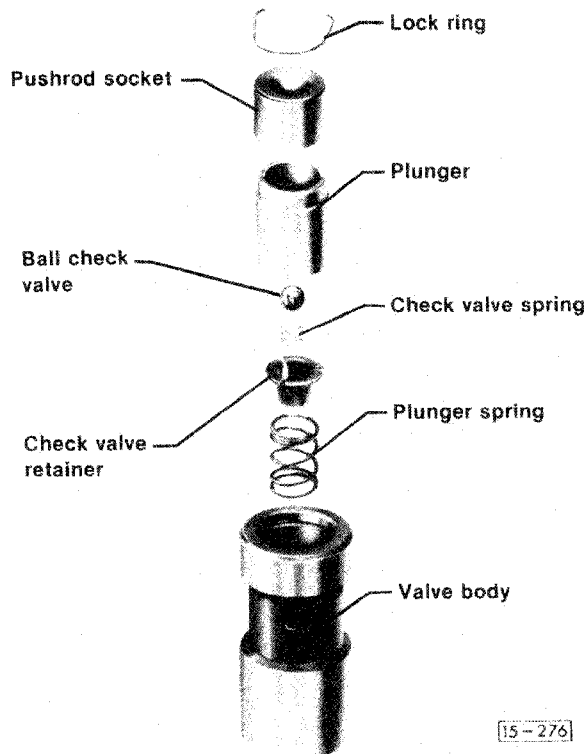
- set adjusting screws in rocker arms so that ball shaped end is flush with surface of arm
- turn crankshaft until cylinder No. 1 is at TDC (mark on rotor in line with mark on distributor housing)
- turn adjusting screws so they just touch valve stems
- turn adjusting screws 2 turns clockwise and tighten locknuts
- rotate crankshaft 180° and adjust next cylinder
- repeat until all cylinders are adjusted

Hydraulic valve lifters, bleeding

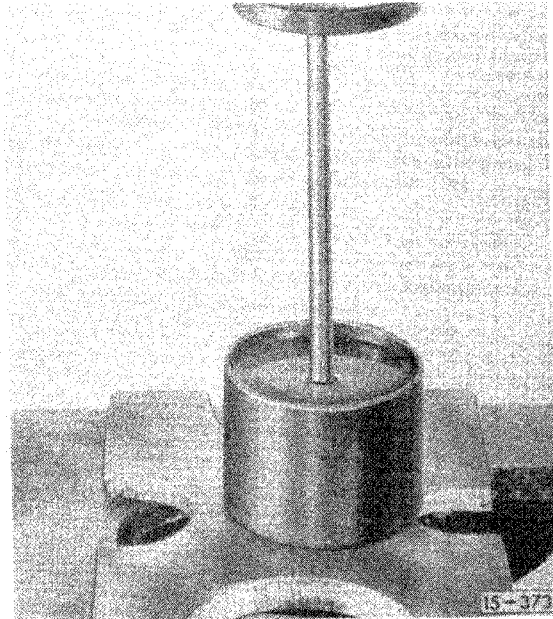
Work sequence



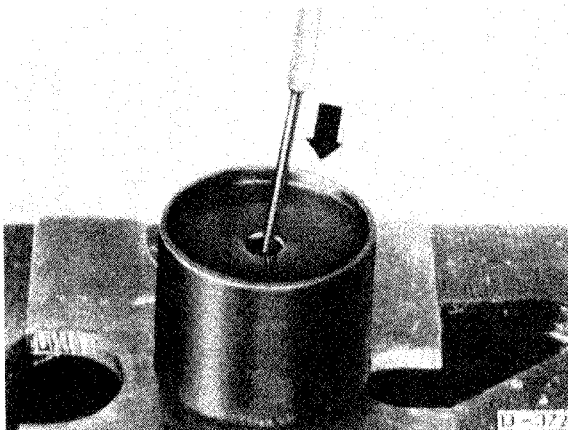
- before installing, check that valve lifter is bled correctly
 - check by applying firm thumb pressure on push rod socket in direction of arrow. Resistance should be felt
- if **NO**, bleed lifter as follows:



- fill tin can with engine oil
- cut an old Type 1 pushrod in half
- remove lock ring, pushrod socket, plunger, ball check valve with spring and plunger spring from body
- place valve lifter body in tin can
 - body must be completely covered by oil
- insert plunger spring, check valve retainer, check valve spring, ball check valve and plunger into valve body



- insert pushrod socket
- place valve lifter (leave in can of oil) in
- press and force down slowly with Type 1 pushrod until lock ring can be installed
- install lock ring

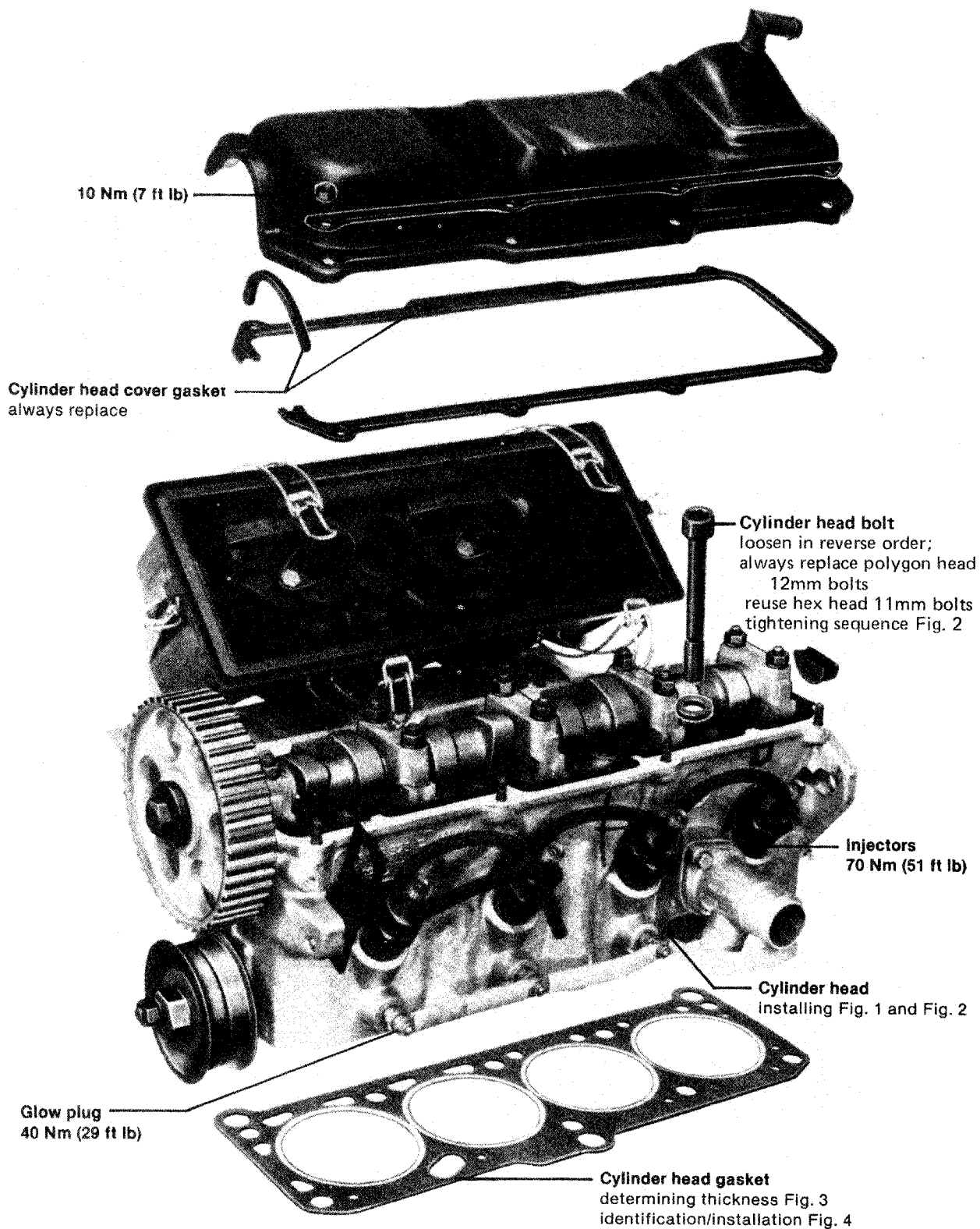


- open valve with scriber (arrow), so that oil can flow out of lower part of plunger

15 Engine-Cylinder Head, Valve Drive

CAUTION

Diesel cylinder heads **cannot** be resurfaced



15-448

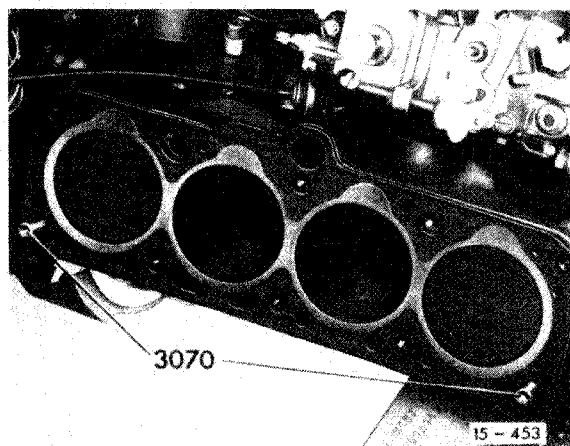
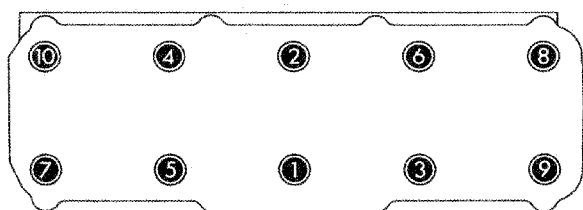


Fig. 1 Cylinder head, installing

- install guide pins from tool set 3070 as shown
- install head gasket
- install head and insert other 8 head bolts and tighten by hand
- remove guide pins with tool and install other 2 head bolts and tighten by hand
- tighten head bolts, see Fig. 2



02-098

Fig. 2 Cylinder head bolts, tightening sequence

- with engine cold, torque cylinder head bolts in sequence in following steps:
step 1 to 40 Nm (30 ft lb)
step 2 to 60 Nm (44 ft lb)
step 3 to 75 Nm (55 ft lb)
- after step 3, turn bolts in sequence with breaker bar ½ turn (180°) further (two ¼ turns are O.K.)
- run engine until it reaches normal operating temperature (engine oil temperature 50°C/122°F or when radiator fan starts running)
- stop engine and retighten head bolts in sequence ¼ turn (90°) further with breaker bar without first loosening them
- after about 1000 miles (with engine either cold or warm) retighten cylinder head bolts with breaker bar, turning bolts in sequence ¼ turn (90°) without loosening them and without interruption

Note

Head can be removed and installed with engine in car.

Removing and installing drive belt—see Repair Group 13.

Before working on head, remove injectors and glow plugs.

Every time head is removed, cylinder head bolts must be torqued, and again after about 1000 miles as described above

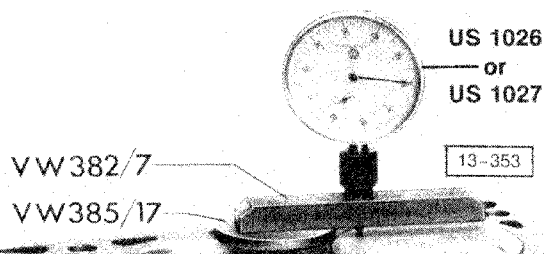


Fig. 3 Cylinder head gasket, determining thickness

- piston height must be measured when installing new pistons or short block and head gasket selected
- measure piston height and select gasket from following table

Piston height mm (in.)	Identification (notches in gasket)	Part No.
0.63-0.82 (0.025-0.032)	1	068 103 383 L
0.83-0.92 (0.033-0.036)	2	068 103 383 M
0.93-1.02 (0.037-0.040)	3	068 103 383 N

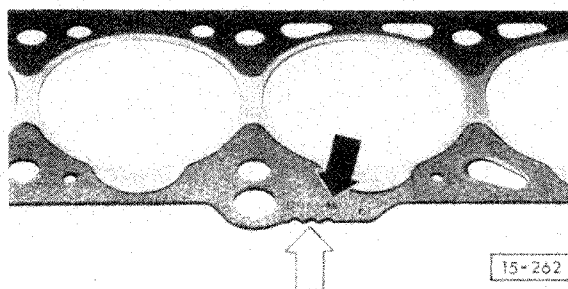


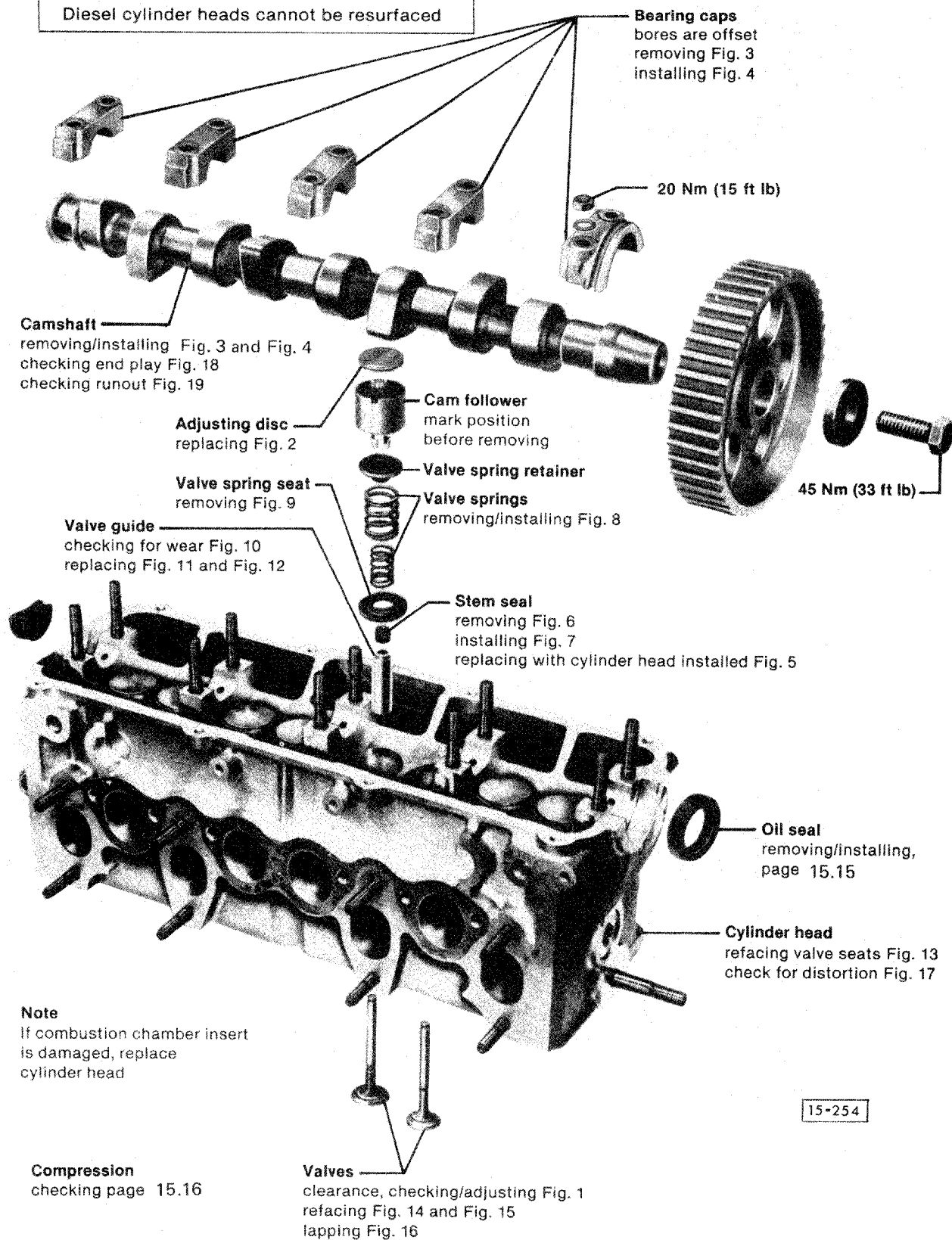
Fig. 4 Cylinder head gasket, identification/installation

- identified by Part No. and notches (arrows)
- always select gasket thickness according to piston height above top of cylinder block
- marking **OBEN** on gasket must face cylinder head

15 Engine-Cylinder Head, Valve Drive

CAUTION

Diesel cylinder heads cannot be resurfaced



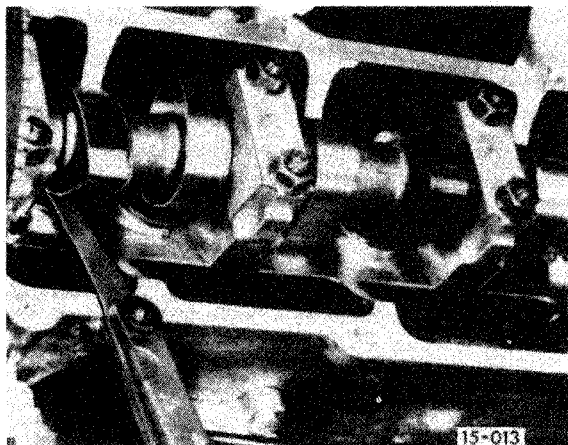


Fig. 1 Valve clearance, checking/adjusting

Warm

- warm up engine. Cylinder head moderately warm. Coolant temperature above 35°C (95°F)
- turn camshaft by pushing vehicle in 4th gear. Cam lobes of valve to be adjusted should point upward
- check that valve clearances are:
 - Intake: 0.20–0.30 mm (0.008–0.012 in.)
 - Exhaust: 0.40–0.50 mm (0.016–0.020 in.)

CAUTION

Do not turn camshaft by mounting bolt. This will stretch drive belt

- if measured valve clearance is larger than given tolerance, remove existing adjusting disc and insert thicker disc to specification (see Fig. 2)
- if measured valve clearance is smaller than given tolerance, remove existing disc and insert thinner disc to specification (see Fig. 2)

Example	Intake	Exhaust
specified clearance	0.20–0.30 mm (0.008–0.012 in.)	0.40–0.50 mm (0.016–0.020 in.)
measured clearance	0.35 mm (0.014 in.)	0.35 mm (0.014 in.)
insert disc that is	0.10 mm (0.004 in.) thicker	0.10 mm (0.004 in.) thinner

Cold

- with engine cold, check that valve clearances are:
 - Intake: 0.15–0.25 mm (0.006–0.010 in.)
 - Exhaust 0.35–0.45 mm (0.014–0.018 in.)

Note

After cylinder head repairs, valve clearance must be checked and if necessary adjusted after 1000 miles. Adjust to mid-point of range

Valve adjusting discs

Thick-ness	Part Number	Thick-ness	Part Number
3.00	056 109 555	3.65	056 109 568
3.05	056 109 556	3.70	056 109 569
3.10	056 109 557	3.75	056 109 570
3.15	056 109 558	3.80	056 109 571
3.20	056 109 559	3.85	056 109 572
3.25	056 109 560	3.90	056 109 573
3.30	056 109 561	3.95	056 109 574
3.35	056 109 562	4.00	056 109 575
3.40	056 109 563	4.05	056 109 576
3.45	056 109 564	4.10	056 109 577
3.50	056 109 565	4.15	056 109 578
3.55	056 109 566	4.20	056 109 579
3.60	056 109 567	4.25	056 109 580

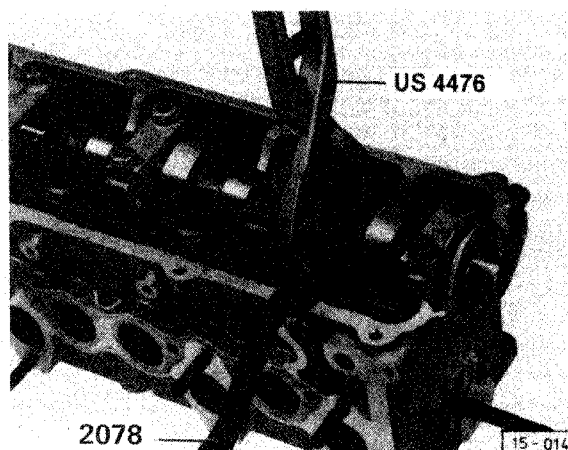


Fig. 2 Valve adjusting disc, removing/installing

CAUTION

When adjusting valves, pistons **must not** be at TDC. Turn crankshaft about 1/4 turn past TDC so that valves do not contact pistons when cam followers are pressed down

- press cam follower down with 2078
- remove valve adjusting disc with US 4476

Note

Thickness of valve adjusting disc etched on underside. When installing be sure that markings face downward (toward cam follower). Discs can be reused if not worn or damaged. Use tray 10-212 for storing discs

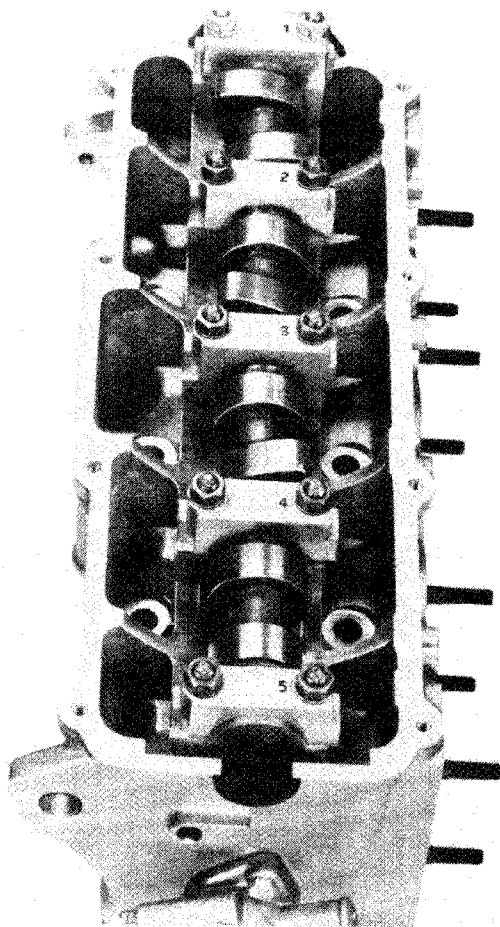


Fig. 3 Camshaft bearing caps, removing

- remove bearing caps 5, 1 and 3
- diagonally loosen bearing caps 2 and 4

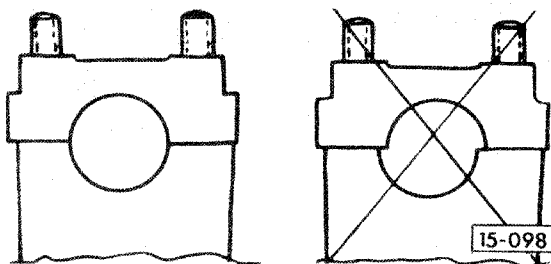


Fig. 4 Camshaft bearing caps, installing

- lubricate bearing surfaces and camshaft journals
- install caps in proper order—observe off center bearing position; numbers on bearing caps are not always on same side
- lightly tighten bearing caps 2 and 4 diagonally
- install caps 5, 1 and 3
- tighten all camshaft bearing cap nuts to 20 Nm (14 ft lb)

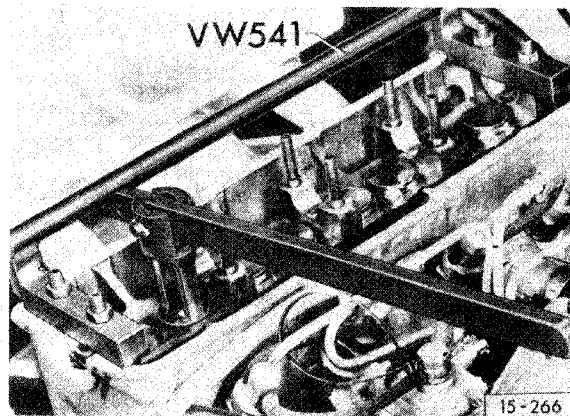


Fig. 5 Valve stem seal, removing (with cylinder head installed)

- remove camshaft, adjusting discs and followers
- turn crankshaft until piston of cylinder concerned is at TDC
- remove valve springs with VW 541
- replace valve stem seal

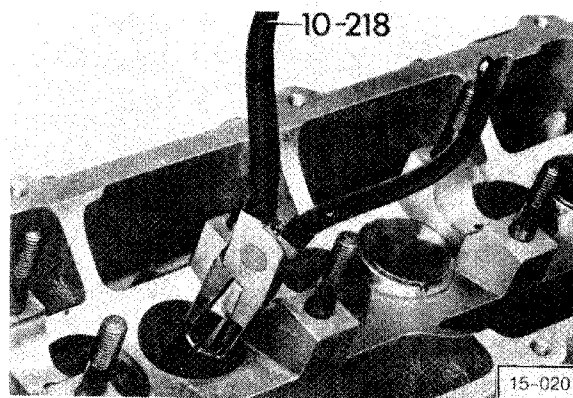


Fig. 6 Valve stem seal, removing

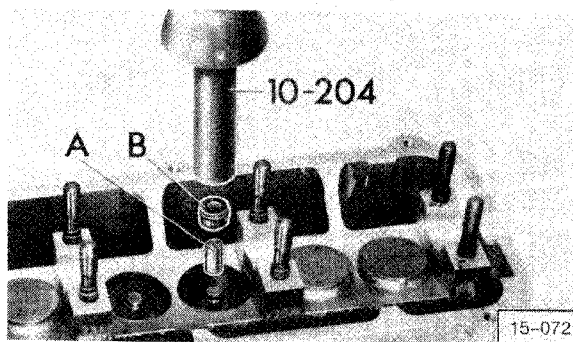


Fig. 7 Valve stem seal, installing

- slide plastic sleeve **A** onto valve stem
- lubricate valve stem seal **B**
- push seal carefully onto valve guide using plastic seal protector, otherwise seal will be damaged and engine will use too much oil

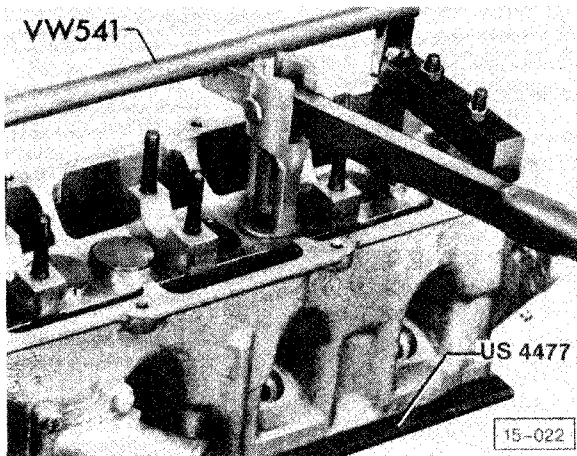


Fig. 8 Valve springs, removing/installing

—first install US 4477 under cylinder head

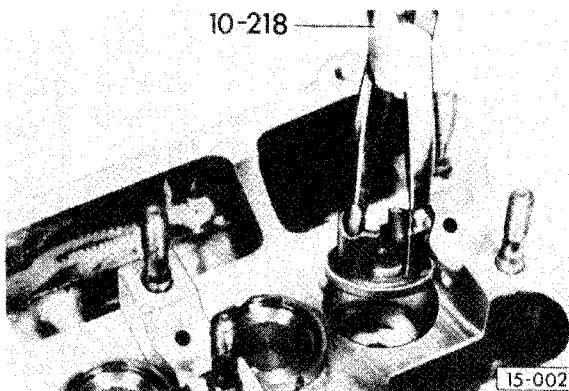


Fig. 9 Valve spring seat, removing

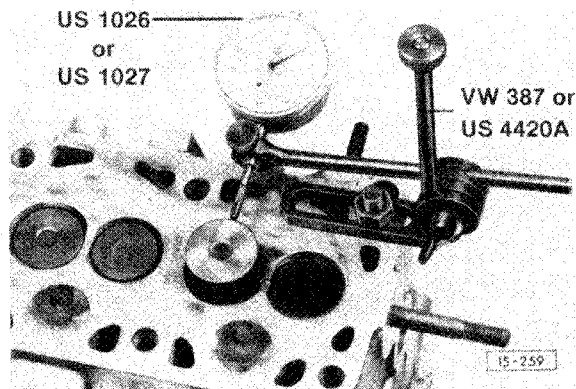


Fig. 10 Valve guide, checking for wear

- remove carbon
- insert **new** valve into valve guide
- valve stem end must be flush with valve guide end
- rock valve back and forth against dial indicator. Dial indicator reading shows valve guide wear
- dial indicator reading = max. 1.3 mm (0.051 in.)

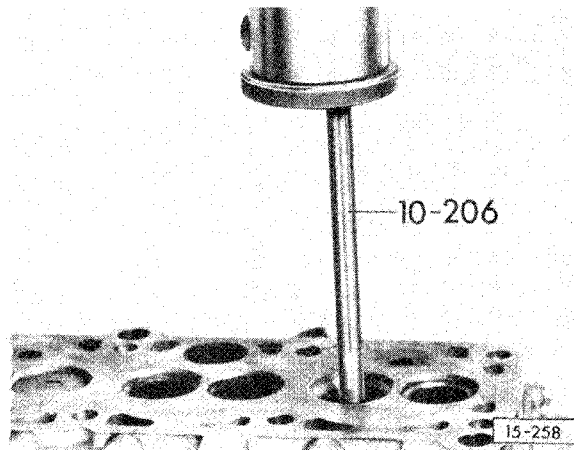


Fig. 11 Valve guide, replacing

- first check cylinder head for cracks or excessively worn seats
- 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

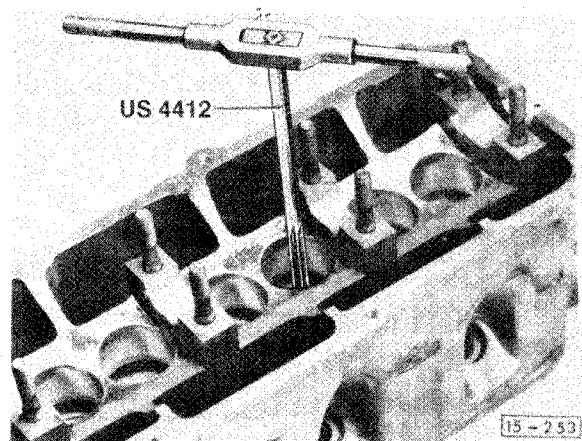


Fig. 12 Valve guides, replacing

- ream guide by hand using proper cutting lubricant

15 Engine-Cylinder Head, Valve Drive

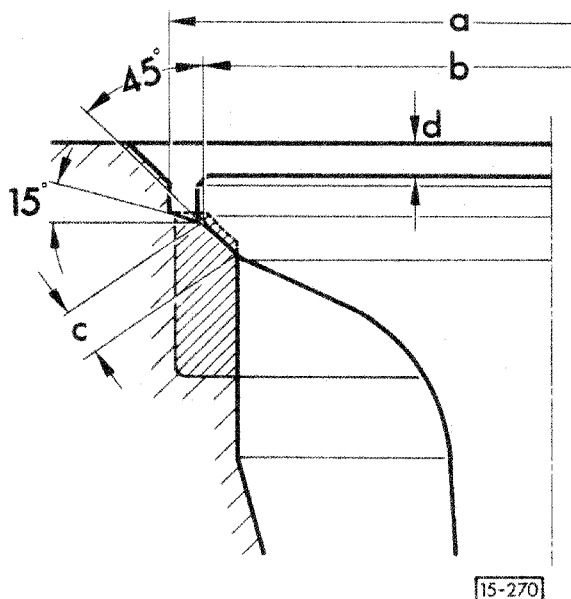


Fig. 13 Valve seats, refacing

- seat refacing pilot must be properly installed
- Valve seat angle = 45°
- Correction angle = 15°
- Dimension **d** must not be more than 1.5 mm (0.059 in.)

Intake

a = 35.2 mm (1.384 in.)
b = 32.8 mm (1.290 in.)
c = 2.0 mm (0.078 in.)

Exhaust

33.2 mm (1.306 in.)
30.4 mm (1.196 in.)
2.4 mm (0.096 in.)

Note

Valve seats which are worn or burned can be refaced provided that correction angle and seat width are maintained. Otherwise, cylinder head must be replaced

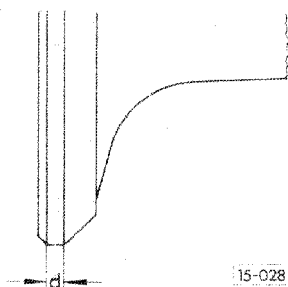


Fig. 14 Intake/Exhaust valves, refacing

- valve margin **d** must not be less than 0.5 mm (0.019 in.)

CAUTION

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

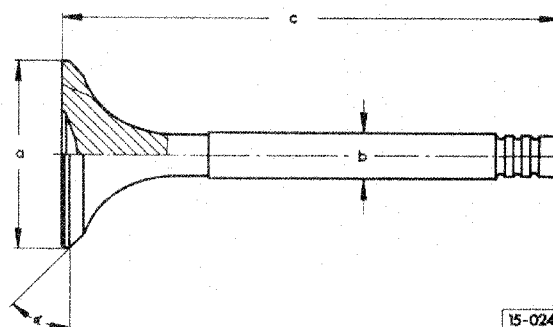


Fig. 15 Intake/Exhaust valves, refacing

Intake

a = 34.00 mm (1.338 in.)
b = 7.97 mm (0.314 in.)
c = 104.8 mm (4.125 in.)
 $\alpha = 45^\circ$

Exhaust

31.00 mm (1.220 in.)
7.95 mm (0.313 in.)
104.6 mm (4.117 in.)
 45°

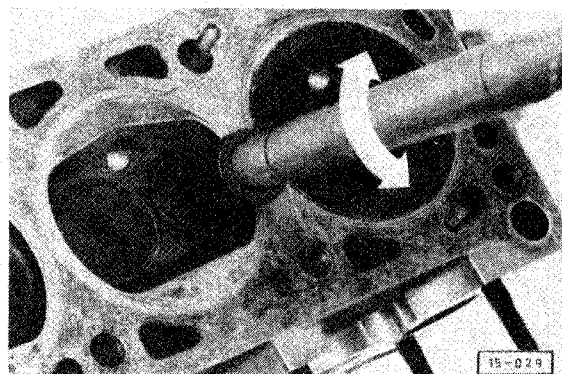


Fig. 16 Valves, lapping

—lift and turn regularly

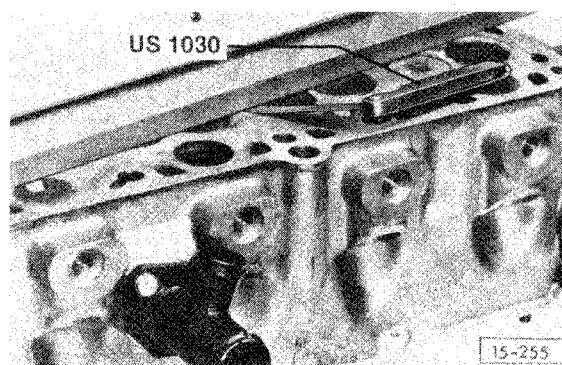


Fig. 17 Cylinder head distortion, checking

- max. 0.1 mm (0.004 in.)
- Diesel cylinder heads cannot be resurfaced

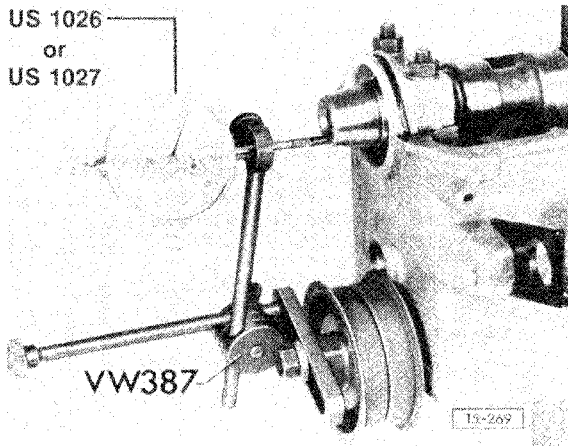


Fig. 18 Camshaft end play, checking

- measure with cam followers removed and caps 1 and 5 installed and torqued
- check that end play is not more than 0.15 mm (0.006 in.)

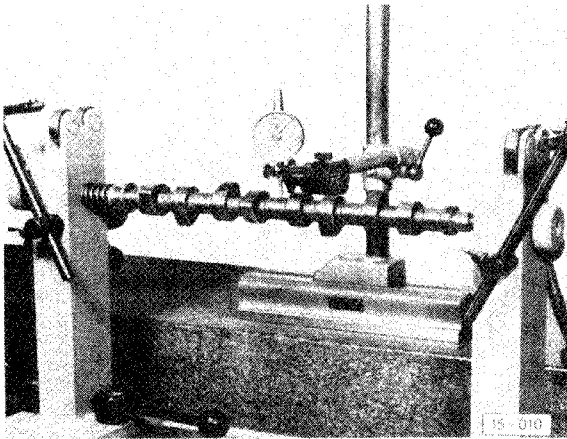


Fig. 19 Camshaft runout, checking

- max. 0.01 mm (0.0004 in.)

Camshaft oil seal, removing/installing

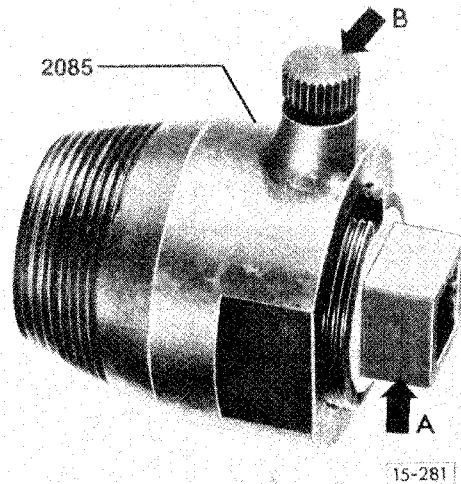
Note

Puller 2002 may also be used

Work sequence

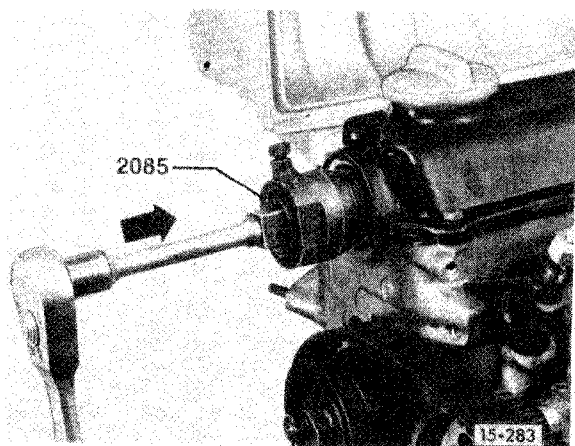
Removing

- set engine at TDC for cylinder No. 1
- remove drive belt cover and drive belt
- loosen camshaft sprocket bolt 1/2 turn and tap sprocket with rubber hammer
- remove bolt and sprocket



- unscrew inner part (arrow A) of oil seal extractor 2085 2 turns (approx. 3mm/1/8 in.) out of outer part
- lock in position with knurled screw (arrow B)
- to guide extractor, screw sprocket bolt into camshaft until it projects about 15 mm (5/8 in.)
- lubricate threads on tapered end of seal extractor

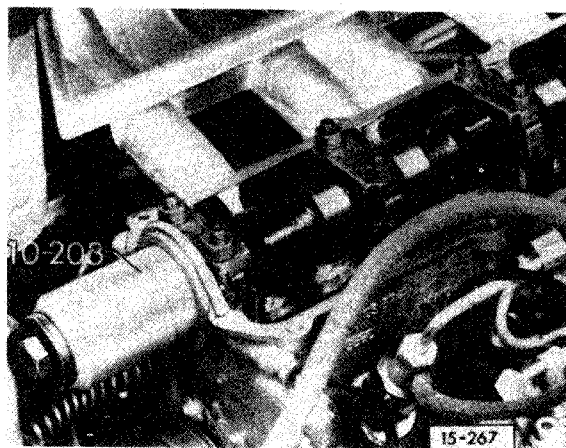
15 Engine-Cylinder Head, Valve Drive



- position seal extractor and screw it into oil seal as far as possible by pushing firmly in direction of arrow
- loosen knurled screw and turn inner part in against camshaft until oil seal is pulled out
- clamp extractor in vise and remove oil seal with pliers

Installing

- coat seal lips and outer edge of seal with oil



- press seal in flush

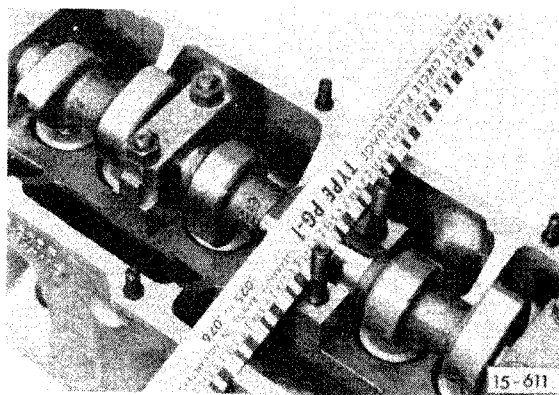
Camshaft radial clearance, checking

Work sequence

- 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 (14 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.

- after completing repairs, check and adjust valve clearances

15 Engine-Cylinder Head, Valve Drive

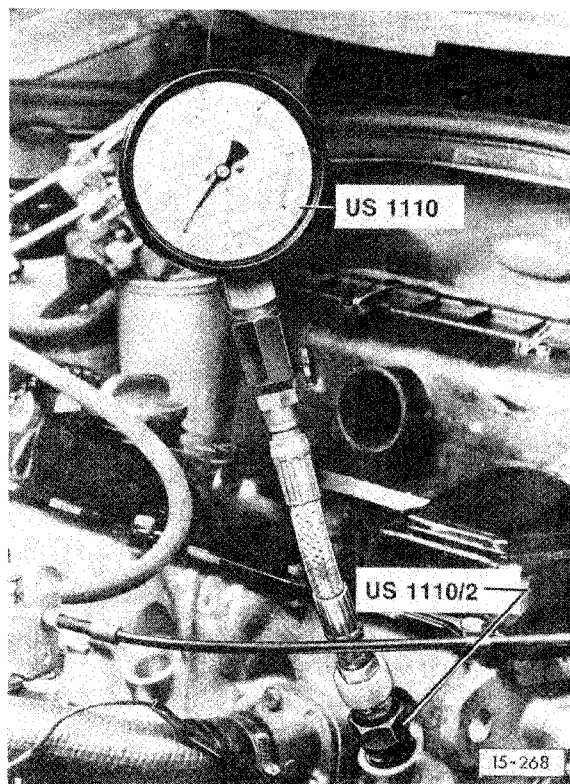
Compression (Diesel), checking

Work sequence

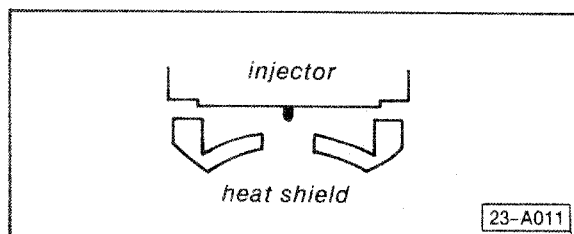
CAUTION

To avoid damage, keep injection parts clean when removing, installing, disassembling and assembling

- engine oil temp 30°C (86°F)
- disconnect wire from fuel shutoff solenoid on injection pump and insulate
- clean all injector pipe fittings
- remove injector pipes with tool 3035
- disconnect fuel return hoses
- remove injectors using US 2775 or equivalent
- remove heat shields
- place old heat shield in cylinder to be checked



- screw in adaptor and compression tester
- set parking brake and place transmission in neutral
- operate starter
 - 28–34 bar (406–493 psi)
 - maximum pressure differential between highest and lowest cylinder, 5 bar (73 psi)
- repeat for other three cylinders



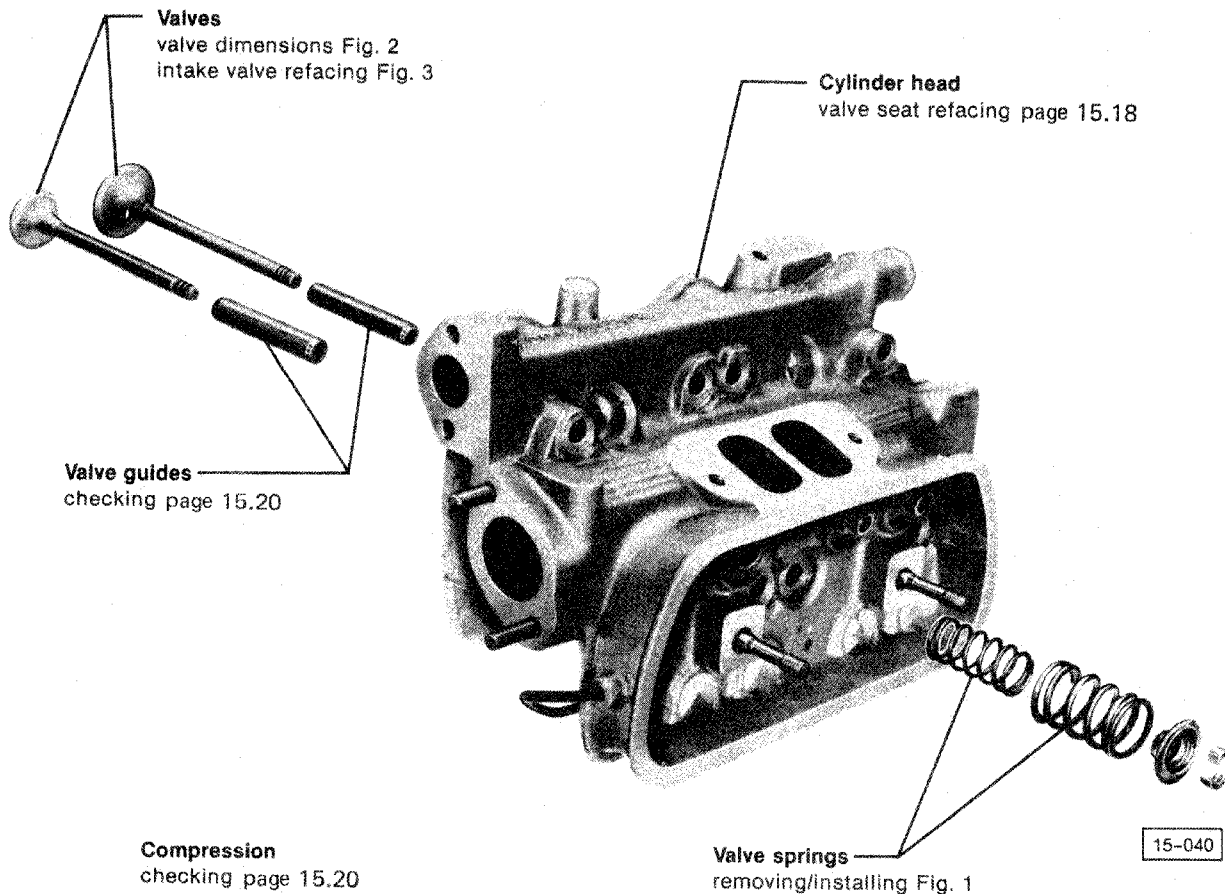
- install new heat shields as shown
- reinstall injectors and tighten to 70 Nm (51 ft lb)
- reconnect fuel return hoses
- reinstall injector pipes and tighten to 25 Nm (18 ft lb)
- reconnect wire to fuel shutoff solenoid on injection pump
- start engine and accelerate a few times to clear air bubbles

Note

Cylinder heads with cracks between valve seats or between a valve seat and spark plug thread can be used again without reducing service life provided that cracks are small and not more than 0.5 mm (0.019 in.) wide or that only first coil of plug thread is cracked

Note

Cylinder head can be removed and installed with engine installed



15 Engine-Cylinder Head, Valve Drive

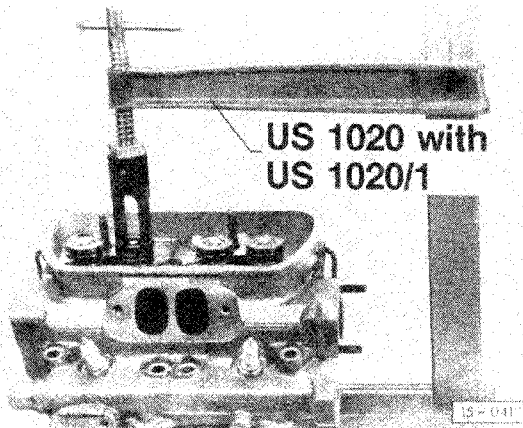


Fig. 1 Valve springs, removing/installing

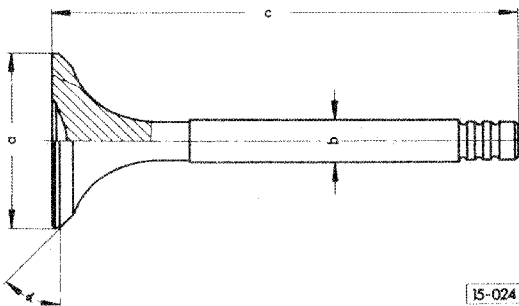


Fig. 2 Valve, dimensions

Intake valve

a = 40.0 mm (1.575 in.) diameter
b = 7.96–7.97 mm (0.313–0.314 in.) dia.
c = 122.5 mm (4.823 in.) length
 $\alpha = 45^\circ$

Exhaust valve

a = 34 mm (1.339 in.) diameter
b = 8.91–8.92 mm (0.3508–.3512 in.) dia.
c = 122.5 mm (4.823 in.) length
 $\alpha = 45^\circ$

CAUTION

Do not rework **exhaust valves** by machine, lap by hand only

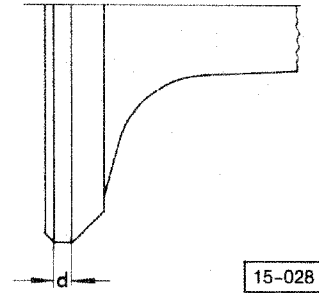
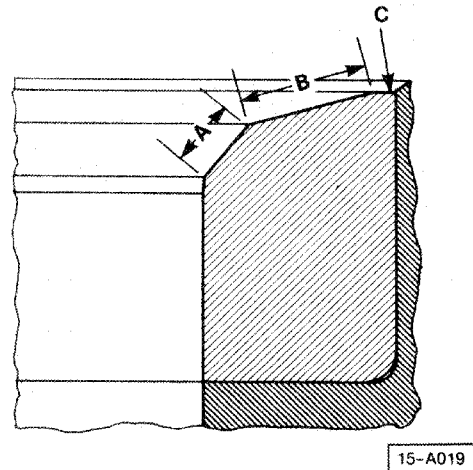


Fig. 3 Intake valves, refacing

- valve margin **d** must not be less than 0.5 mm (0.020 in.)

Valve seats, refacing

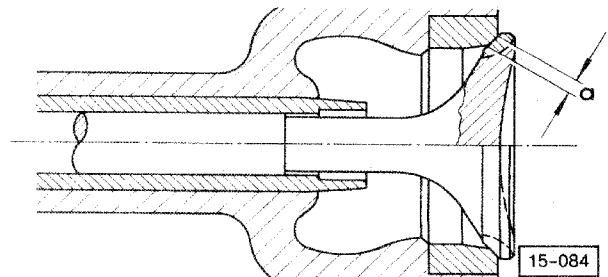
Work sequence



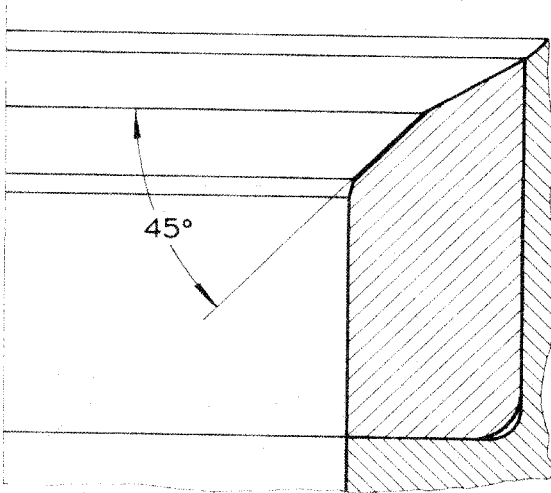
CAUTION

Damaged or burnt seats can be refaced if:

- permissible width of seat **A** is maintained
- 15° chamfer **B** does not exceed outer diameter of valve seat insert in cylinder head at **C**

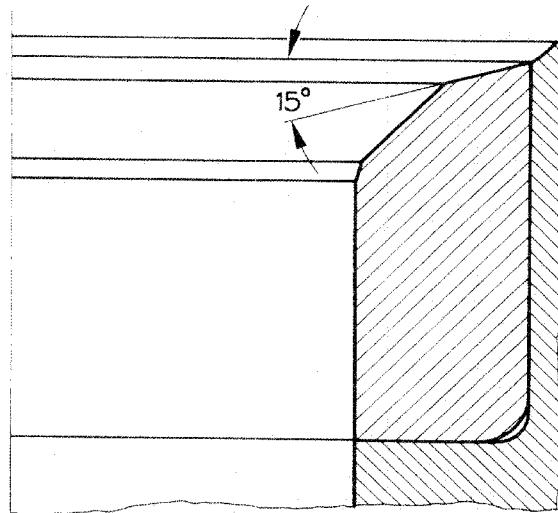


— seat width **a** = 1.4–2.5 mm (0.055–0.098 in.)



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- reface valve seats to 45° angle
- stop cutting as soon as complete seat is cleaned



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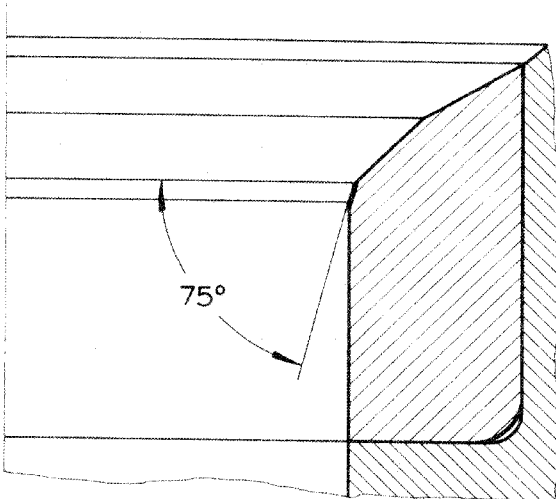
- reface surface to 15° angle
- chamfer upper edge of valve seat until correct seat width is obtained

Note

When new valves are installed in properly reworked seats, it may not be necessary to lap in valves

CAUTION

After lapping valve, remove all traces of grinding paste



15-086

- reface surface to 75° angle
- slightly chamfer lower edge of valve seat

15 Engine-Cylinder Head, Valve Drive

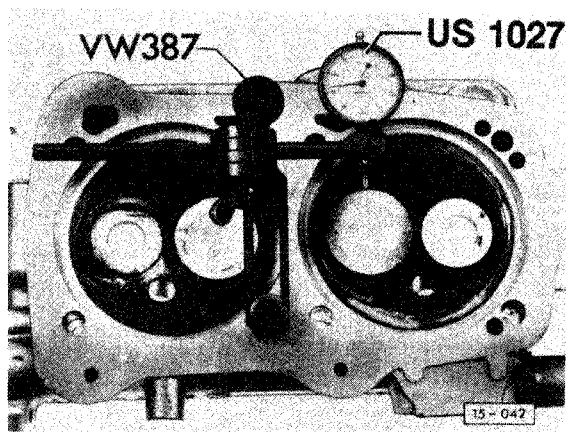
Valve guides, checking

Note

When repairing engines with leaking valves it is not sufficient to rework or replace valve seats and valves.

It is also necessary to check valve guides for wear.

This is particularly important on engines which have considerable mileage.



- remove carbon
- insert new valve into valve guide
 - valve stem must be flush with valve guide end
- rock valve back and forth against dial indicator (arrow)
 - max. 1.2 mm (0.047 in.)

Compression, checking

- engine oil temperature minimum 30 °C (86 °F)
- throttle valve open fully (accelerator pedal in full throttle position)

- remove all spark plugs
- disconnect coil wire at ignition distributor and connect to ground with clamp



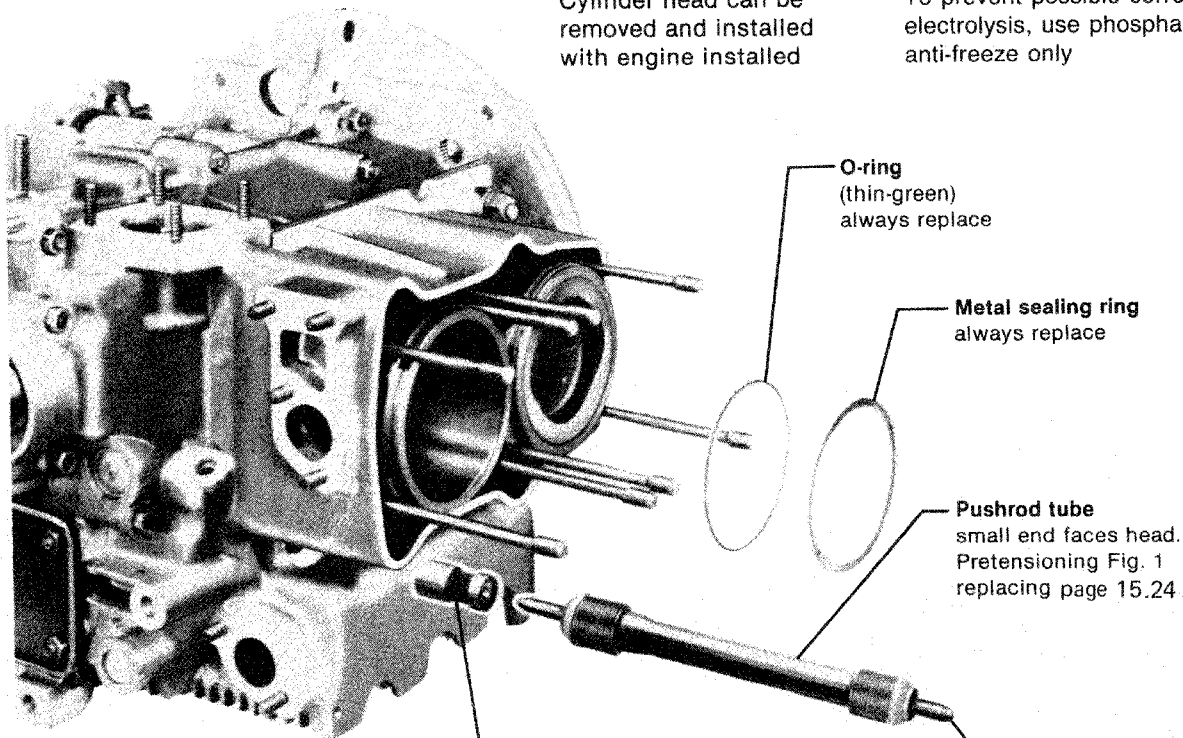
- check compression with tool US 1120
- operate starter until tester no longer indicates a rise in pressure
 - compression pressure: 10–13 bar (145–189 psi)
 - minimum: 8 bar (116 psi)
 - maximum pressure difference between highest and lowest cylinders: 3 bar (44 psi)

Note

Cylinder head can be removed and installed with engine installed

Note

To prevent possible corrosion through electrolysis, use phosphate free anti-freeze only



O-ring
(thin-green)
always replace

Metal sealing ring
always replace

Pushrod tube
small end faces head.
Pretensioning Fig. 1
replacing page 15.24

Hydraulic valve lifter
do not interchange.
adjusting, page 15.22
bleeding, page 15.23

Pushrod
max. run-out 0.3 mm
(0.012 in.).
guide pushrod carefully
into seat of hydraulic valve
lifter

Cap nut
45 Nm (33 ft lb)
drain coolant before
removing nuts;
de-grease and coat
surface with
AMV 188 100 02

Adjusting screw
adjusting hydraulic valve
lifters, page 15.22

Support
slot faces upward

Gasket
always replace.
Apply thin bead of sealing compound
D 000 400 to gasket surface facing
cylinder head

Sealing ring
always replace

Coolant drain plug

Cylinder head
before removing, drain coolant.
Smooth damaged painted surfaces
at gasket contact area with fine
sandpaper and clean with solvent
before installing.
sealing Fig. 2
installing Fig. 3

25 Nm (18 ft lb)

Gasket
always replace

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15 Engine-Cylinder Head, Valve Drive

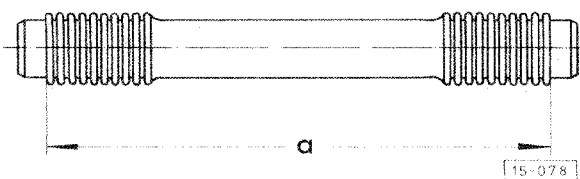


Fig. 1 Pushrod tube, pretensioning

- pretension tube to correct length
 - a = approx. 194 mm (7.638 in.)
- when installing, seam faces upward and small end to cylinder head
- always replace sealing rings
 - pushrod tubes can be replaced with engine installed

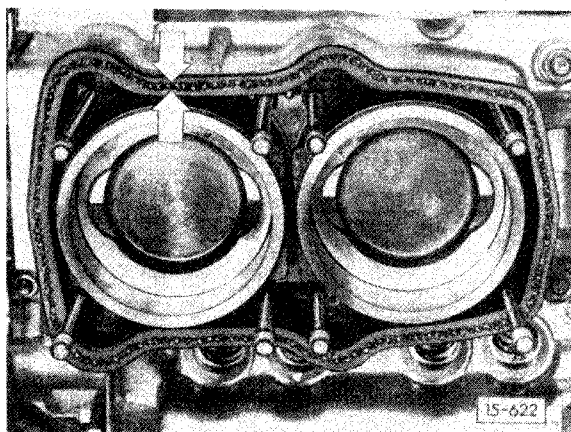


Fig. 2 Cylinder head, sealing

- sand smooth any damaged sealing substance on cylinder head with 400 grit sandpaper
- clean cylinder head sealing surface with solvent to remove dirt and grease
- install new water jacket gasket on crankcase
- apply 1 to 2 mm bead of sealing compound D 000 400 in the center of the new water jacket gasket (arrows)

CAUTION

DO NOT USE TOO MUCH SEALANT.
Excessive sealant could plug cylinder head coolant passages

Note

Cylinder head must be installed within 45 minutes of the sealant application

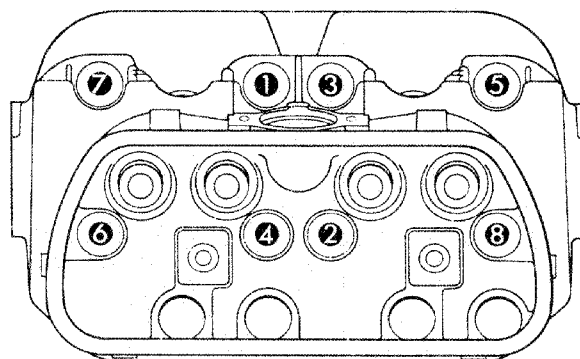


Fig. 3 Cylinder head, installing

- tighten cylinder head at stud 1 with cap nut just enough so that all remaining 7 cap nuts can be installed
- coat surface of cap nuts with AMV 188 000 02 sealing compound and torque (1st stage) in sequence to 10 Nm (7 ft lb)

Note

Be sure that pushrod tubes are properly seated

- tighten cap nuts to final torque 45 Nm (33 ft lb)

Hydraulic valve lifters, adjusting

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, sudden acceleration, high temperatures or high engine speed

CAUTION

If metal particles are found in oil pan, remove, disassemble, clean and reinstall all valve lifters from position removed

Guide pushrod carefully into socket of hydraulic valve lifter

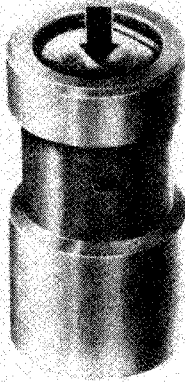
If rocker shafts have been removed, the following adjustment is necessary

Work sequence

- backout adjusting screws in rocker arms so that ball shaped end is flush with surface of arm
- turn crankshaft until cylinder No. 1 is at TDC (mark on rotor in line with mark on distributor housing)
- turn adjusting screws in so they just touch valve stems
- turn adjusting screws 2 turns clockwise and tighten locknuts
- rotate crankshaft 180° and adjust next cylinder
- repeat until all cylinders are adjusted

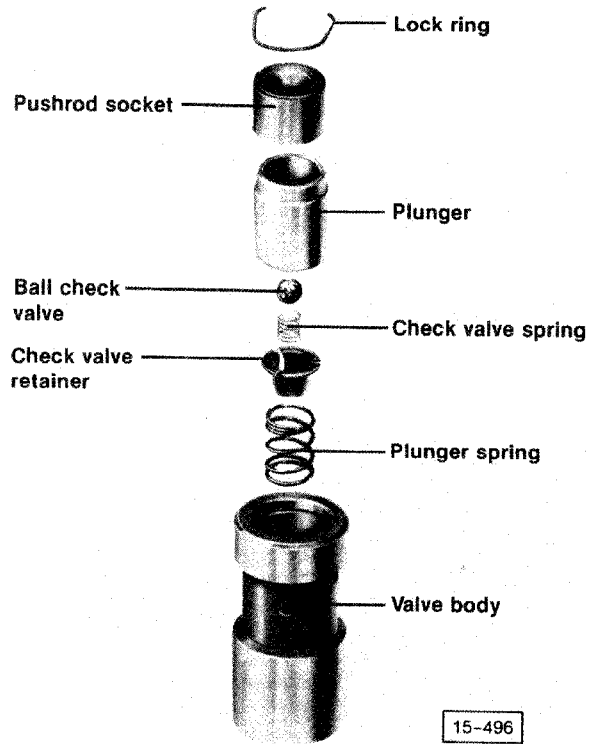
Hydraulic valve lifters, bleeding

Work sequence

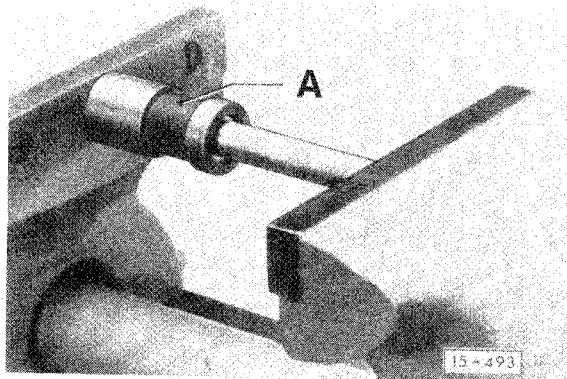


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- before installing, check that valve lifter is bled correctly
 - check by applying firm thumb pressure on push rod socket in direction of arrow. Lifter should not move.
- if **NO**, bleed lifter as follows:



- pry out lock ring
- remove pushrod socket, plunger, ball check valve with spring, check valve retainer and plunger spring from body
- fill valve lifter body with oil up to bleed hole
- insert plunger spring
- install plunger with ball check valve, spring and valve retainer and push downward; at same time, open ball check valve with scribe



- insert pushrod in socket and slowly press together with valve guide or sawed-off pushrod in vise (bore a must face upward) or in press until lock ring can be installed
- install lock ring

15 Engine-Cylinder Head, Valve Drive

Pushrod tubes, replacing

Note

Pushrod tubes supplied as replacement parts can be installed as follows with engine installed

Work sequence

- remove valve cover
- remove rocker arm shaft and pull pushrod out
- remove lower cover plate
- remove defective tube with pliers or screwdriver



- squeeze new pushrod tube together and insert with new sealing rings as shown (arrow) (tube seam faces upward, small end to head)
- insert pushrod and install rocker arm shaft

CAUTION

Guide pushrod carefully into seat of hydraulic valve lifter.
If pushrod rests on edge of valve lifter basic setting will be incorrect and valve lifter will be damaged when engine is started

- adjust hydraulic valve lifters, see page 15.22

Gasoline additive

"Autobahn Gasoline Additive" has been tested by Volkswagen, and found to be effective in reducing carbon deposits that result from fuel and lubricating oil residue. The additive works best with unleaded gasoline, but also works with leaded fuel.

"Autobahn Gasoline Additive" is supplied by Volkswagen of America under Part No. ZVW 246 001.

Note

Read product label for additional information. Read all cautions and warnings.

Caution

Do not exceed this recommendation:

Oil change interval	Max. Treatments between oil changes
Miles	
5,000	2
7,500	4

Excessive carbon deposits reduce engine performance by:

- idle hunting (idle speed goes up and down)
- poor hot or cold starting (starter cranking takes longer)
- engine run-on (dieseling)
- pinging during full-throttle acceleration

To help clean out carbon deposits and minimize future carbon build-up:

- make sure that ignition and fuel systems are adjusted to specifications
- add one (1) 20 oz. bottle "Autobahn Gasoline Additive" to fuel tank. Fill tank completely. Do not refill until the gauge reads "1/4"
- use only gasoline with a detergent additive package. Information about fuel composition is available from any gas station or from the station's fuel supplier.

CAUTION

Part numbers are for reference only. Always consult your Parts Department for latest information.