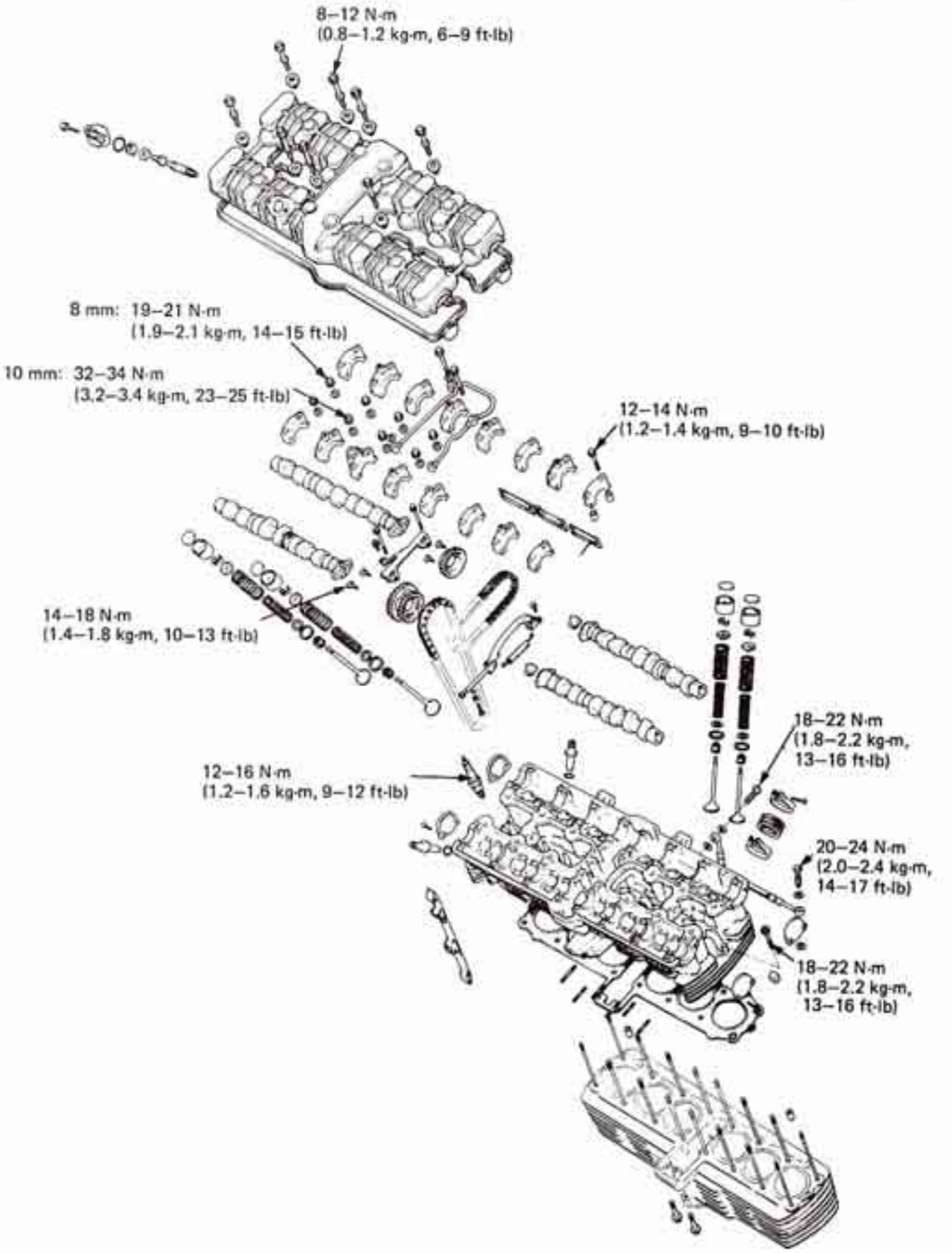


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SERVICE INFORMATION

GENERAL INSTRUCTIONS

- All cylinder head maintenance and inspection can be accomplished with the engine installed.
- Camshaft lubricating oil is fed through the oil hose. Be sure the holes in the oil hose bolt are not clogged.
- During assembly, apply molybdenum disulfide to the camshaft bearings to provide initial lubrication. Pour clean engine oil into the oil pockets in the cylinder head to lubricate the camshafts.
- To remove the cylinder head, the engine should be tilted. The camshafts and valve lifters can be serviced without engine tilting.
- Marks 1 thru 16 on the camshaft holders mean position of holders to be installed; 1 to 8 are for EXHAUST side and 9 to 16 for INTAKE side from left to right respectively. When installing, be sure the mark ⇧ faces forward.

TOOLS

Special

Valve Guide Reamer	07984–2000000
Valve Lifter Hole Protector	07999–4220000

Common

Valve Guide Remover (5.5 mm)	07742–0010100
Valve Spring Compressor	07757–0010000

TORQUE VALUES

Cylinder head cover		8–12 N·m (0.8–1.2 kg-m, 6–9 ft-lb)
Camshaft holder		12–16 N·m (1.2–1.6 kg-m, 9–12 ft-lb)
Cylinder head cap nut	10 mm	33–35 N·m (3.3–3.5 kg-m, 24–25 ft-lb)
	8 mm	19–21 N·m (1.9–2.1 kg-m, 14–15 ft-lb)
Cylinder head 6 mm bolt		19–21 N·m (1.9–2.1 kg-m, 14–15 ft-lb)
Cam sprocket		14–18 N·m (1.4–1.8 kg-m, 10–13 ft-lb)
Spark plug		12–16 N·m (1.2–1.6 kg-m, 9–12 ft-lb)
Oil hose Upper		18–22 N·m (1.8–2.2 kg-m, 13–16 ft-lb)
Lower		20–24 N·m (2.0–2.4 kg-m, 14–17 ft-lb)

SPECIFICATIONS

			STANDARD	SERVICE LIMIT
Compression pressure			1177 ± 98 kPa (12 ± 1 kg/cm², 171 ± 14 psi)	———
Camshaft	Cam height	IN.	37.000–37.160 mm (1.4567–1.4630 in)	36.9 mm (1.45 in)
		EX.	37.500–37.660 mm (1.4763–1.4826 in)	37.4 mm (1.47 in)
	Oil clearance	No. 1 and 9	0.040–0.082 mm (0.0016–0.0032 in)	0.12 mm (0.005 in)
		No. 2 and 10	0.063–0.105 mm (0.0025–0.0041 in)	0.14 mm (0.006 in)
		No. 3 and 11	0.063–0.105 mm (0.0025–0.0041 in)	0.14 mm (0.006 in)
		No. 4 and 12	0.040–0.082 mm (0.0016–0.0032 in)	0.12 mm (0.005 in)
		No. 5 and 13	0.040–0.082 mm (0.0016–0.0032 in)	0.12 mm (0.005 in)
		No. 6 and 14	0.063–0.105 mm (0.0025–0.0041 in)	0.14 mm (0.006 in)
		No. 7 and 15	0.063–0.105 mm (0.0025–0.0041 in)	0.14 mm (0.006 in)
		No. 8 and 16	0.040–0.082 mm (0.0016–0.0032 in)	0.12 mm (0.005 in)
	Run out		———	0.03 mm (0.001 in)

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			STANDARD	SERVICE LIMIT
Valve lifter	Valve lifter O.D.	Mark B	27.982–27.993 mm (1.1017–1.1021 in)	27.98 mm (1.102 in)
		Mark A	27.972–27.982 mm (1.1013–1.1017 in)	27.97 mm (1.101 in)
	Cylinder head I.D.	Mark A	28.000–28.011 mm (1.1024–1.1028 in)	28.02 mm (1.103 in)
		Mark B	28.011–28.021 mm (1.1028–1.1032 in)	28.03 mm (1.104 in)
	Lifter to cylinder head clearance		———	0.07 mm (0.003 in)
Valve spring	Free length	IN. Outer	43.9 mm (1.73 in)	42.5 mm (1.67 in)
		In. Inner	40.7 mm (1.60 in)	39.8 mm (1.57 in)
		Ex. Outer	43.9 mm (1.73 in)	42.5 mm (1.67 in)
		EX. Inner	40.7 mm (1.60 in)	39.8 mm (1.57 in)
	Preload/length	IN. Outer	12.6–14.6 kg/37.5 mm (27.78–32.19 lbs/1.48 in)	12.0 kg/37.5 mm (26.46 lbs/1.48 in)
		IN. Inner	6.39–7.81 kg/34.5 mm (14.087–17.218 lbs/1.36 in)	6.0 kg/34.5 mm (13.23 lbs/1.36 in)
		EX. Outer	12.6–14.6 kg/37.5 mm (27.78–32.19 lbs/1.48 in)	12.0 kg/37.5 mm (26.46 lbs/1.48 in)
		EX. Inner	6.39–7.81 kg/34.5 mm (14.087–17.218 lbs/1.36 in)	6.0 kg/34.5 mm (13.23 lbs/1.36 in)
Valve guide	Valve stem O.D.	IN	5.475–5.490 mm (0.2156–0.2161 in)	5.47 mm (0.215 in)
		EX.	5.455–5.470 mm (0.2148–0.2154 in)	5.45 mm (0.215 in)
	Valve guide I.D.	IN.	5.500–5.512 mm (0.2165–0.2170 in)	5.54 mm (0.218 in)
		EX.	5.500–5.512 mm (0.2165–0.2170 in)	5.54 mm (0.218 in)
	Stem-to-guide clearance	IN.	———	0.07 mm (0.003 in)
		EX.	———	0.09 mm (0.004 in)
	Valve seat width		0.90–1.10 mm (0.035–0.043 in)	1.5 mm (0.06 in)
Cylinder head	Warpage		———	0.10 mm (0.004 in)
Cam chain	Length		169.70–169.92 mm (6.681–6.690 in)	170.7 mm (6.72 in)

TROUBLESHOOTING

Engine top-end problems are usually performance-related and can be diagnosed by a compression test, or are engine noise which can be traced to the top end with a sounding rod or stethoscope.

Low Compression or Uneven Compression

1. Valves
   - Incorrect valve adjustment
   - Burned or bent valves
   - Incorrect valve timing
   - Broken valve spring
2. Cylinder head
   - Leaking or damaged head gasket
   - Warped or cracked cylinder head
3. Cylinder and piston (Refer to Section 7)

Compression Too High

1. Excessive carbon build-up on piston head or combustion chamber

Excessive Noise

1. Incorrect valve adjustment
2. Sticking valve or broken valve spring
3. Damaged or worn camshaft
4. Loose or worn cam chain
5. Worn or damaged cam chain tensioner
6. Worn cam sprocket teeth

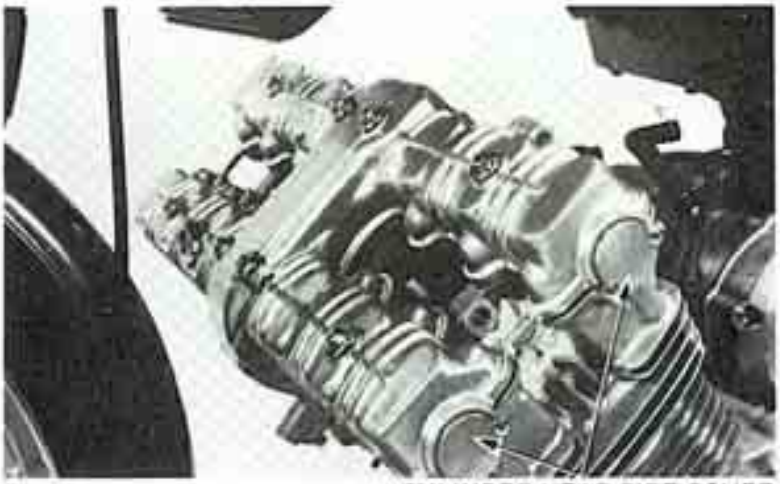
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CAMSHAFT REMOVAL

Remove the left and right leg shields (page 13-18).
Remove the fairing and engine guards (page 13-18).
Disconnect the tachometer cable and remove the tachometer drive gear.
Disconnect the spark plug caps.
Remove the No. 1 and 6 spark plugs.
Remove the front engine hanger brackets.
Remove the cylinder head side covers.

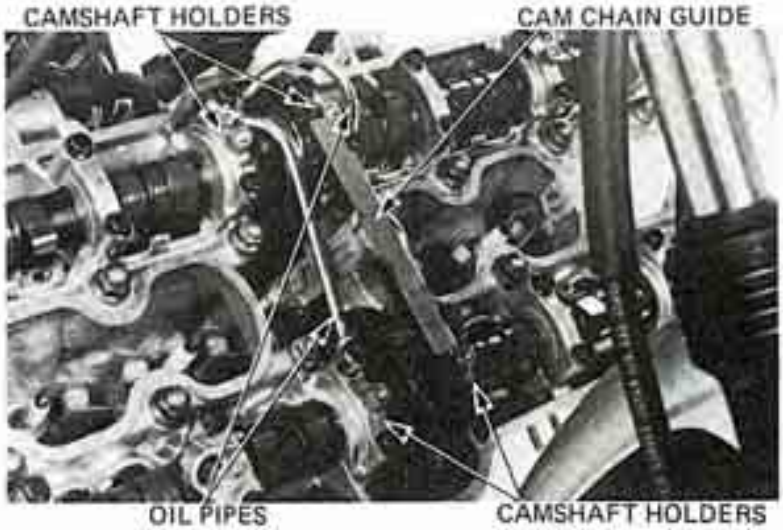
CAUTION

The tachometer driven gear must be removed to prevent No. 4 camshaft holder breakage when the camshafts are rotated. Camshaft holder breakage necessitates cylinder head assembly replacement.

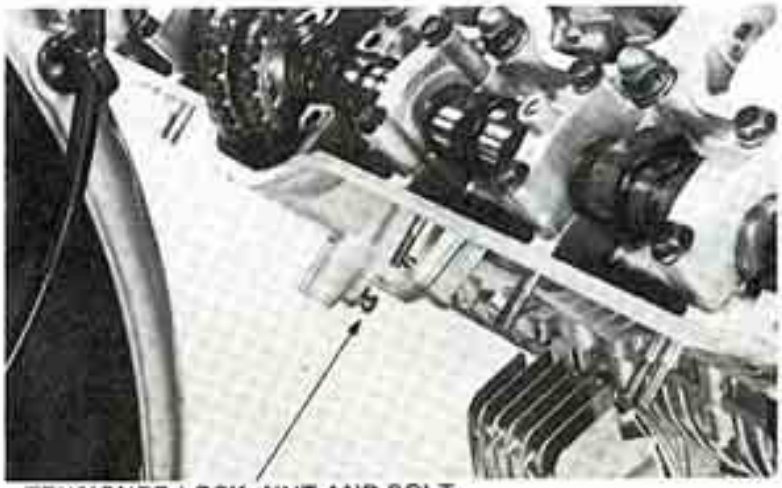


CYLINDER HEAD SIDE COVER

Remove the cylinder head cover bolts and the cylinder head cover.
Remove the oil pool plates.
Remove the oil pipes and cam chain guide.
Remove the No. 4, No. 5, No. 12 and No. 13 camshaft holders.
Remove the dowel pins.



Loosen the front cam chain tensioner lock nut and bolt.



TENSIONER LOCK NUT AND BOLT

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Press the cam chain tensioner down to reduce chain tension.
Tighten the lock bolt and nut.



Loosen the rear cam chain tensioner lock nut.



LOCK NUT

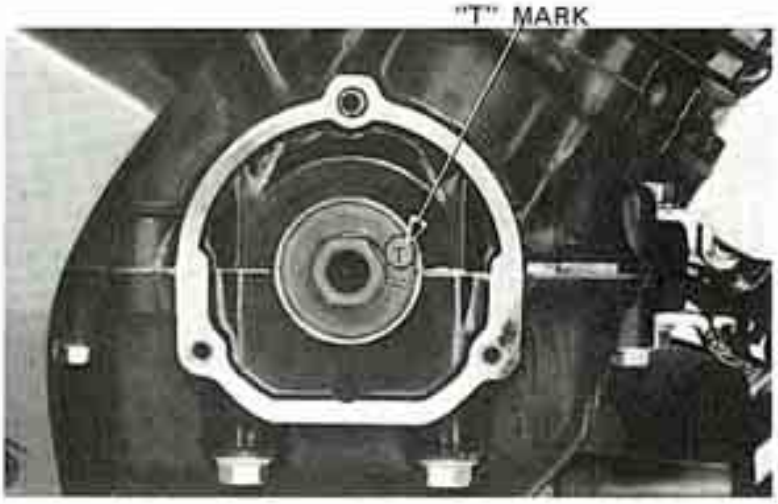
Pull the cam chain tensioner up to reduce chain tension and tighten the bolt and lock nut.



CAM CHAIN TENSIONER

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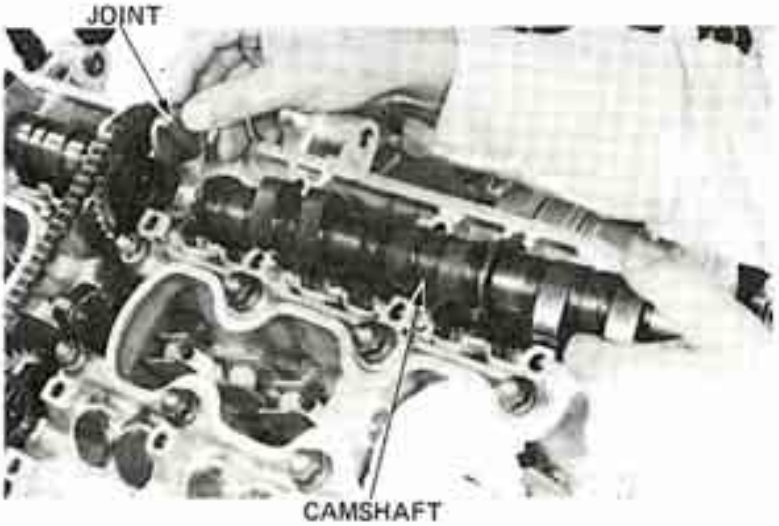
Remove the right crankshaft side cover.
Turn the crankshaft clockwise until the "T" mark on the crankshaft end aligns with the forward crankcase mating surface.



Make sure the No. 1 cylinder intake and exhaust cam lobes face the spark plug.
If they do not, turn the crankshaft 360 degrees clockwise and realign the "T" mark.
Remove the No. 2 and 10 camshaft holders.
Remove the No. 1, 9, 3 and 11 holders.
Remove the dowel pins.



Remove the left camshafts and joints.



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Turn the crankshaft 360 degrees clockwise and realign the "T" mark with the crankcase mating surfaces.
The No. 6 intake and exhaust cam lobes face the spark plug.
Remove the No. 15 camshaft holder.
Then remove the No. 16 and 14 camshaft holders.
Remove the dowel pins.



Remove the right intake camshaft with the cam sprocket.
Loosen the cam sprocket bolt.



Turn the crankshaft clockwise until cam lift is minimal and the other cam sprocket bolt can be removed.
Remove the cam sprocket with the cam chain.

NOTE

Suspend the cam chain with a piece of wire to keep it from falling into the cylinder.

Remove the No. 7 camshaft holder, then remove the No. 8 and 6 camshaft holders.
Remove the right exhaust camshaft.

NOTE

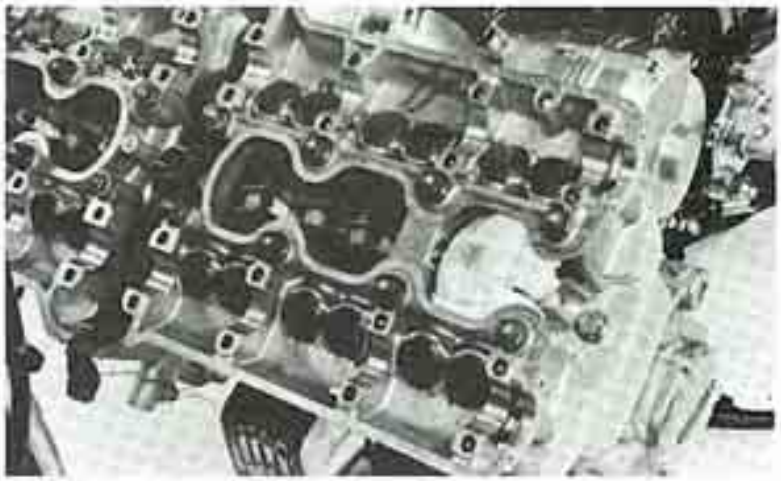
After removing the camshaft, the valve clearance adjusting shims and valve lifters can be removed.



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CAM BEARING SURFACE INSPECTION

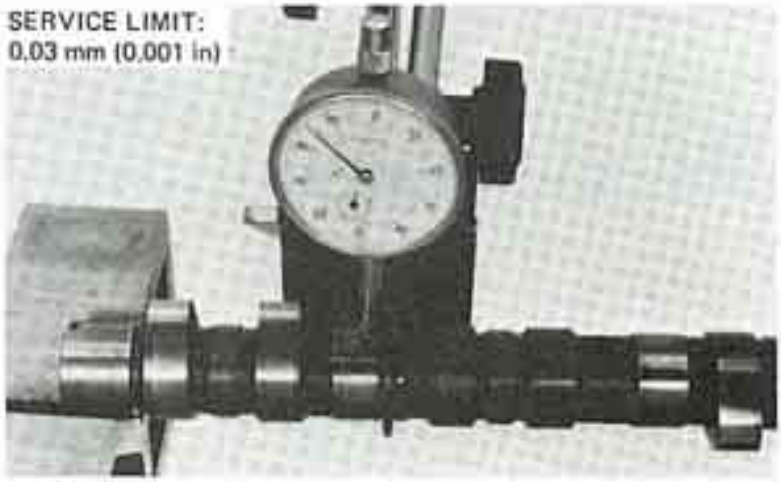
Inspect the cam bearing surfaces for scoring, scratches, or evidence of insufficient lubrication. Inspect the bearing surface of the camshaft holders.



CAMSHAFT RUNOUT

Check the camshaft runout with a dial gauge. Support both ends of the camshaft with V-blocks.

SERVICE LIMIT:
0.03 mm (0.001 in)



CAM LOBE INSPECTION

Measure the height of each cam lobe.
Inspect the cam lobes for wear or damage.

SERVICE LIMTI:
IN: 36.9 mm (1.45 in)
EX: 37.4 mm (1.47 in)

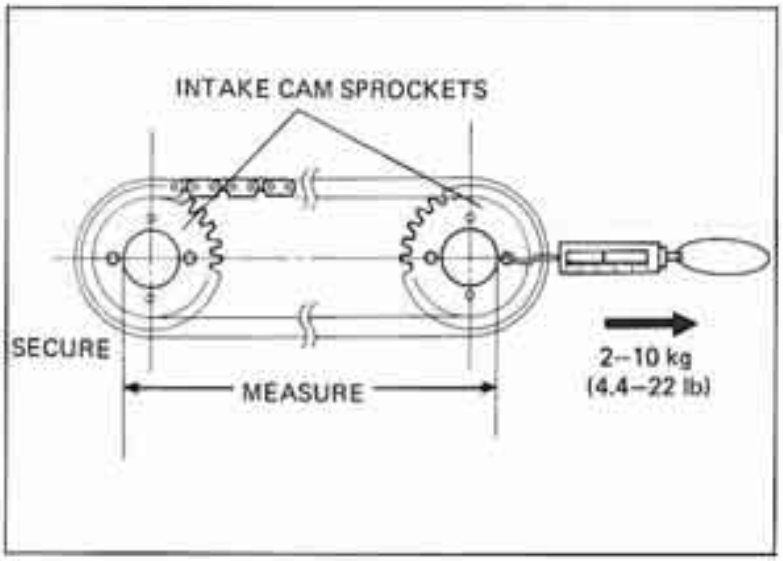


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CAM CHAIN LENGTH MEASUREMENT

Place the cam chain over the intake camshaft sprockets. Secure one sprocket and apply 2–10 kg (4.4–22 lb) of tension with a spring scale. Measure the distance between the points as shown.

SERVICE LIMIT: 170.7 mm (6.72 in)



CAM CHAIN GUIDE INSPECTION

Inspect the cam chain guide for damage or local or excessive wear.

CAMSHAFT OIL CLEARANCE

Remove the adjusting shims and the valve lifters.

NOTE

Mark each part to ensure correct reassembly.

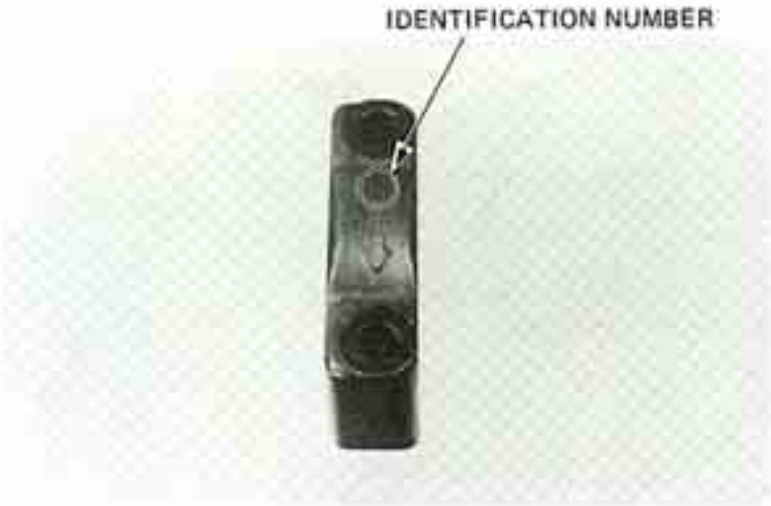


Wipe any oil from the journals.
Lay a strip of plastigauge lengthwise on top of each camshaft journal.



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Determine the camshaft holder identification number before installing.

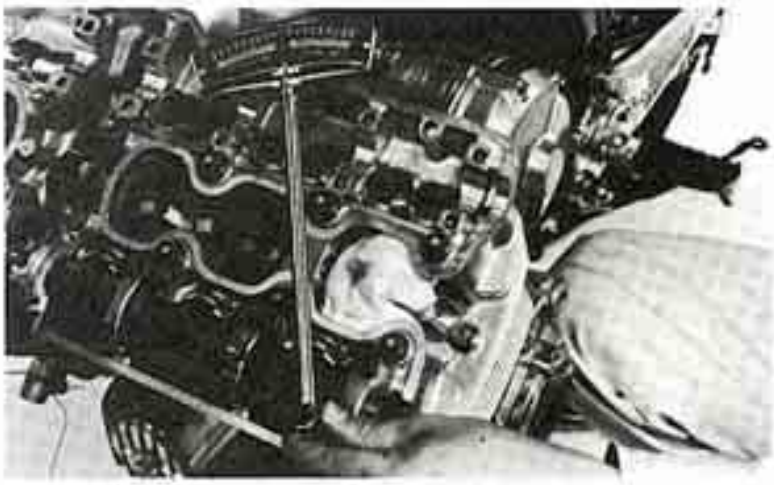


Install the camshaft holders and tighten to the specified torque in a crisscross pattern.

NOTE

Do not rotate the camshaft when using plastigauge.

TORQUE:
12–14 N-m (1.2–1.4 kg-m, 9–10 ft-lb)



Remove the camshaft holders and measure the width of each Plastigauge. The widest thickness determines the oil clearance.

SERVICE LIMITS:
No. 1, 4, 5, 8, 9, 12, 13 and 16:
0.12 mm (0.005 in)
No. 2, 3, 6, 7, 10, 11, 14 and 15:
0.14 mm (0.006 in)

When the service limits are exceeded, replace the camshaft and recheck the oil clearance.
Replace the cylinder head and camshaft holders if the clearance still exceeds service limits.



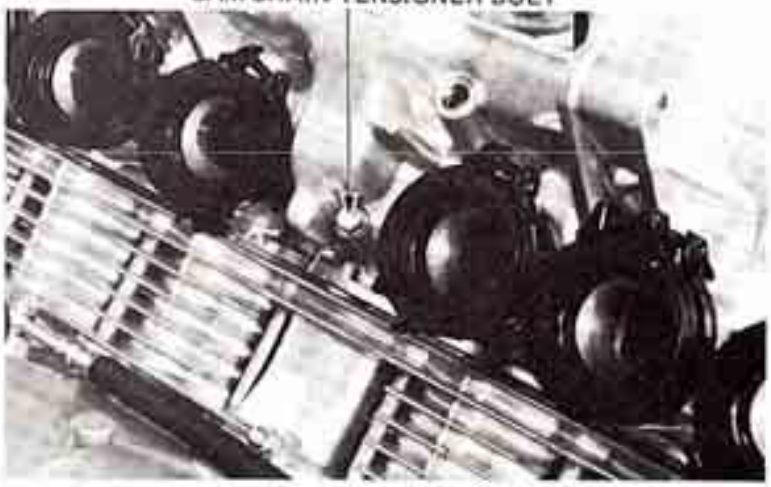
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CYLINDER HEAD REMOVAL

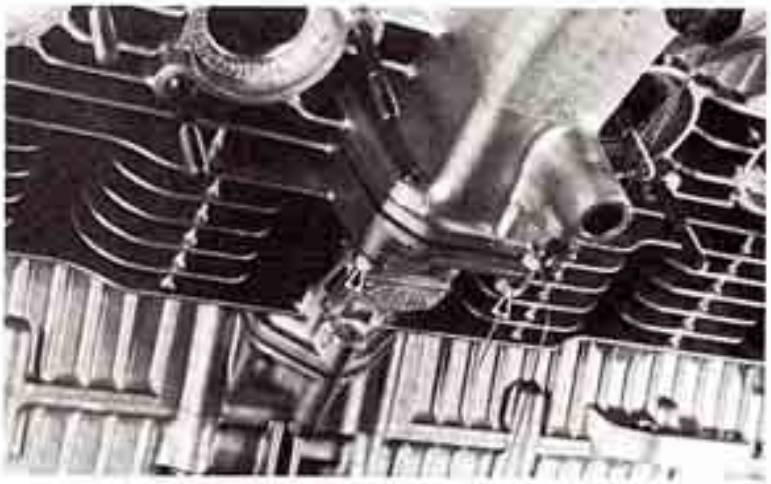
Place the motorcycle on its side stand for 2-3 minutes to allow oil to drain from the cylinder head to the sump.
Then, place the motorcycle on its center stand.
Tilt the engine (Section 5).
Remove the cylinder head cover and remove the camshaft (Page 6-3).
Remove the carburetor and exhaust system.
Remove the oil hose bolt.



Remove the rear cam chain tensioner bolt.



Remove the two cam chain housing bolts.



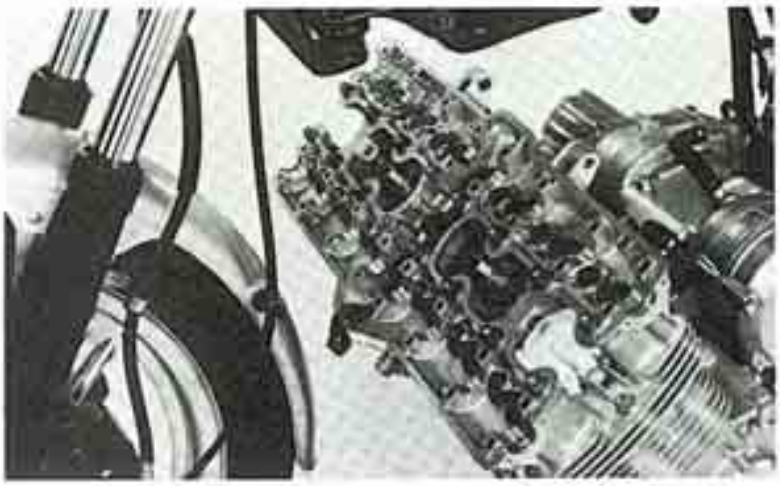
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Remove the 16 cap nuts and two bolts.

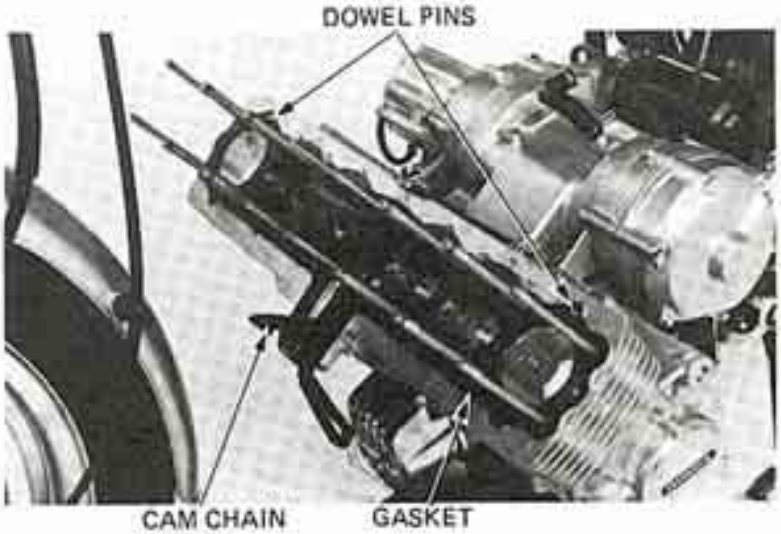
NOTE

Remove the nuts and bolts in 2-3 steps and in a crisscross pattern to prevent warpage.

Remove the cylinder head.



Remove the cylinder head gasket, dowel pins, and cam chain guide.

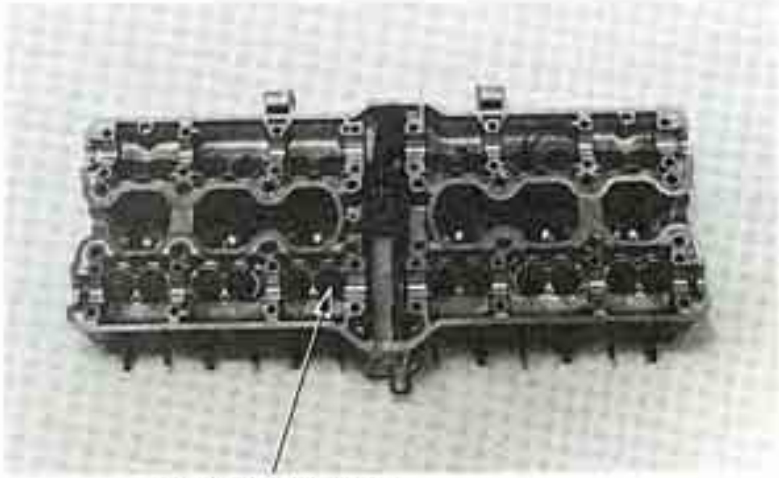


CYLINDER HEAD DISASSEMBLY

Remove the carburetor insulators.
Remove the valve shims.
Remove the valve lifters.

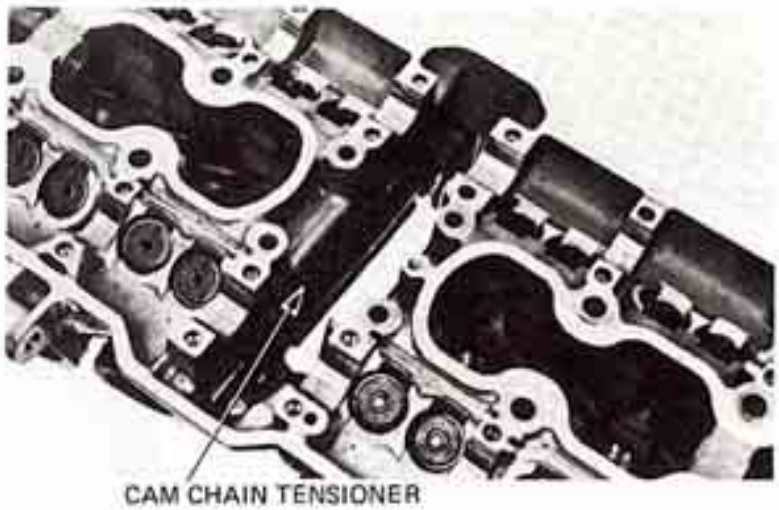
NOTE

Mark all disassembled parts to ensure original assembly.



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Loosen the cam chain tensioner lock nut and bolts.
Remove the bolt in the cylinder head.
Pull the chain tensioner back and remove.



Remove the valve spring keepers, retainers, springs and valves.

CAUTION

To prevent loss of tension, do not compress the valve springs more than necessary to remove the keepers.

NOTE

- Avoid damaging the lifter sliding surface.
- Mark all disassembled parts to ensure original assembly.

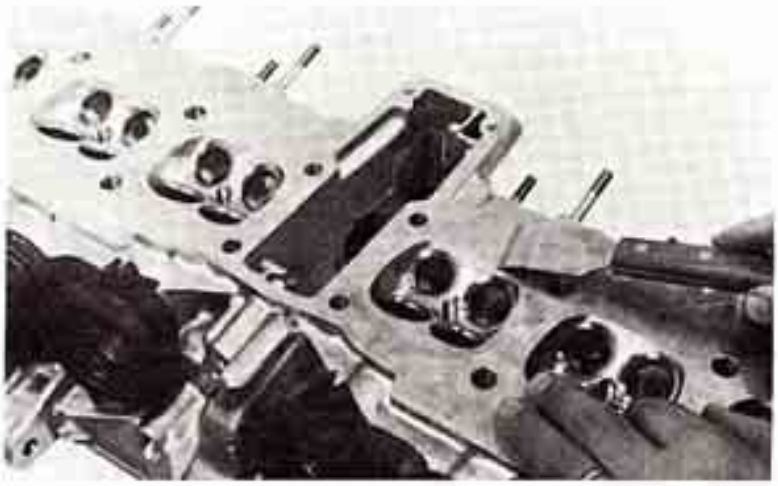
Remove the valve stem seals.



Remove the carbon deposits from the combustion chamber.
Clean off the head gasket surfaces.

NOTE

- Avoid damaging the gasket surfaces.
- Gasket will come off easier if soaked in solvent.



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VALVE LIFTER O.D. MEASUREMENT

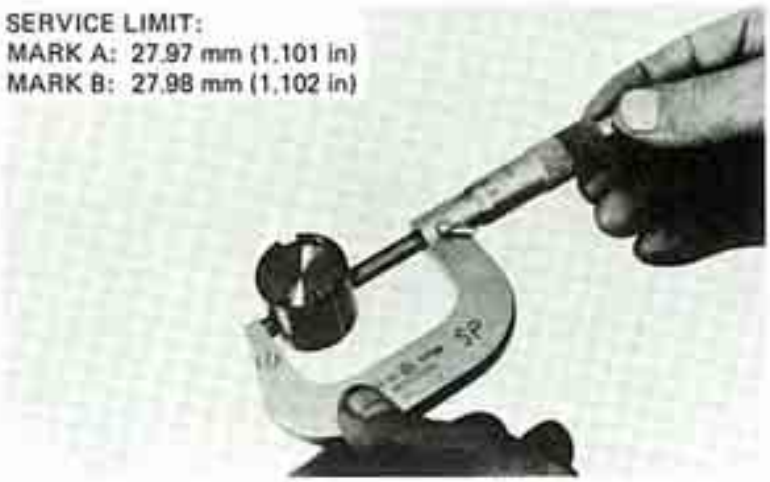
Measure the valve lifter O.D.,

STANDARD:

MARK A: 27.972–27.982 mm (1.1013–1.1017 in)

MARK B: 27.982–27.993 mm (1.1017–1.1021 in)

SERVICE LIMIT:
MARK A: 27.97 mm (1.101 in)
MARK B: 27.98 mm (1.102 in)



CYLINDER HEAD I.D. MEASUREMENT

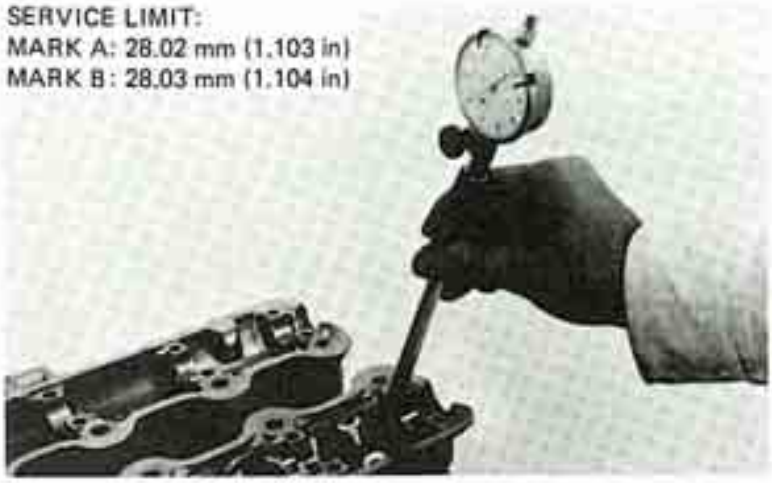
Measure the cylinder head I.D.

STANDARD:

MARK A: 28.000–28.011 mm (1.1024–1.1028 in)

MARK B: 28.011–28.021 mm (1.1028–1.1032 in)

SERVICE LIMIT:
MARK A: 28.02 mm (1.103 in)
MARK B: 28.03 mm (1.104 in)



CYLINDER HEAD INSPECTION

Inspect the sliding surfaces for scoring, scratches, or evidence of insufficient lubrication.

Check the spark plug hole and valve areas for cracks. Check the cylinder head for warpage with a straight edge and a feeler gauge.



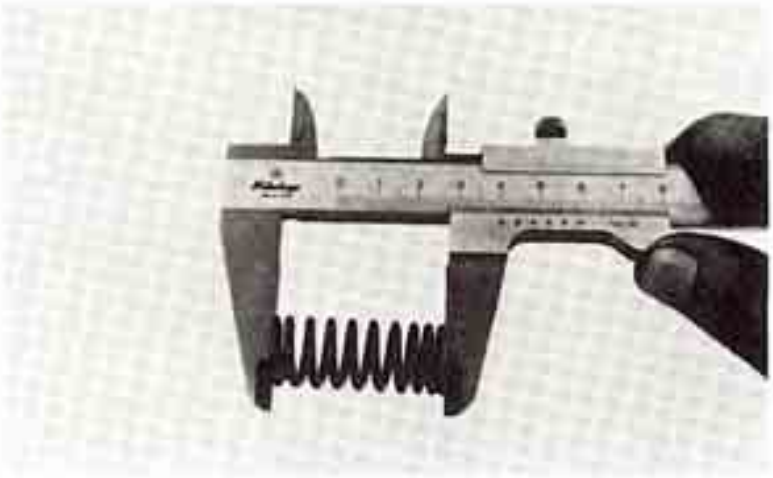
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VALVE SPRING FREE LENGTH INSPECTION

Measure the length of the inner and outer valve springs.

SERVICE LIMITS:

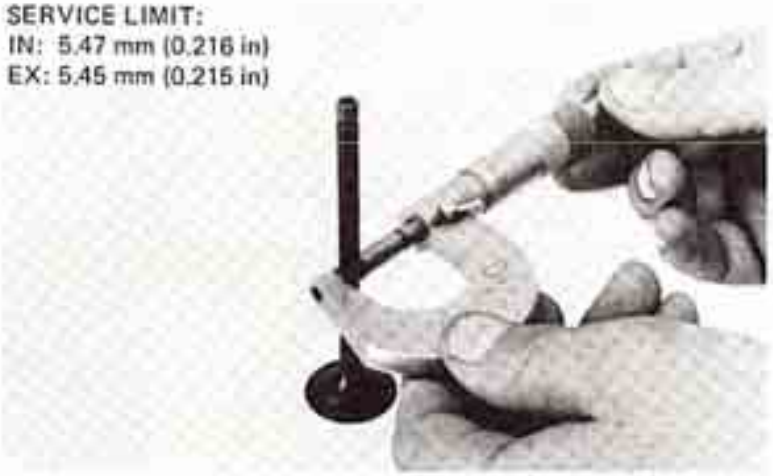
Inner:	**IN.**	**39.8 mm (1.57 in)**
	EX.	**39.8 mm (1.57 in)**
Outer:	**IN.**	**42.5 mm (1.67 in)**
	EX.	**42.5 mm (1.67 in)**



VALVE STEM-TO-GUIDE CLEARANCE

Inspect each valve for bending, burning, scratches or abnormal stem wear.
Check the valve movement in the guide.
Measure and record each valve stem O.D.

SERVICE LIMIT:
IN: 5.47 mm (0.216 in)
EX: 5.45 mm (0.215 in)



NOTE

Ream the guides to remove any carbon build-up before checking clearance.

Measure and record each valve guide I.D. using a ball gauge or inside micrometer.

SERVICE LIMITS:

IN. 5.54 mm (0.215 in)
EX. 5.54 mm (0.215 in)

Subtract each valve stem O.D. from the corresponding guide I.D. to obtain the stem to guide clearance.

SERVICE LIMITS:

IN. 0.07 mm (0.003 in)
EX. 0.09 mm (0.004 in)

VALVE GUIDE REAMER (5.5mm)
07984-2000000



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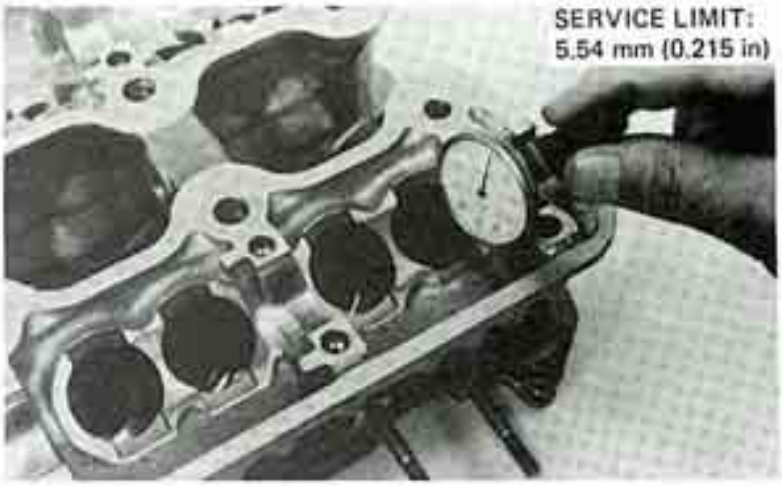
NOTE:

If the stem-to-guide clearance exceeds the service limits, determine if a new guide with standard dimensions would bring the clearance within tolerance. If so, replace any guides as necessary and ream to fit.

If stem-to guide clearance exceeds the service limits with new guide, replace the affected valves and guides.

NOTE

Reface the valve seats whenever the valve guides are replaced.



CAM CHAIN GUIDE AND CAM CHAIN TENSIONER INSPECTION

Inspect the cam chain guide for damage or excessive wear.

Inspect the cam chain tensioner slipper for damage or excessive wear.
Inspect the tension spring for weakness.

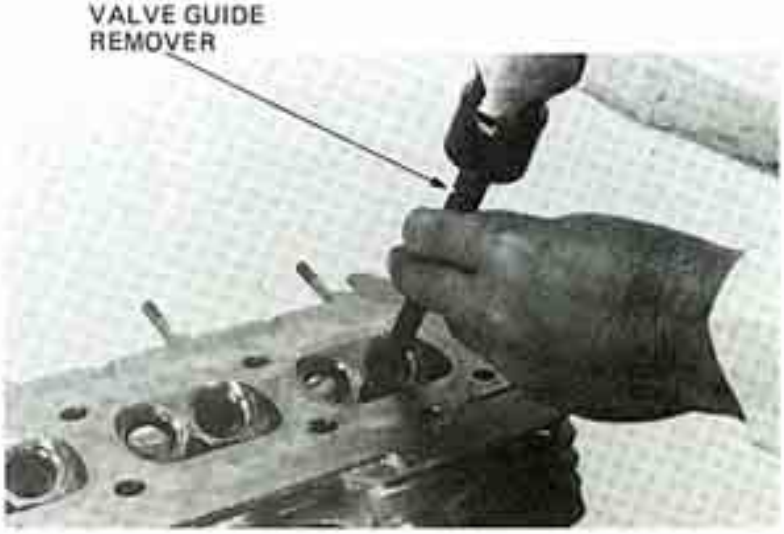


VALVE GUIDE REPLACEMENT

Support the cylinder head and drive out the guide from the valve port.

NOTE

When driving out the valve guide, do not damage the head.



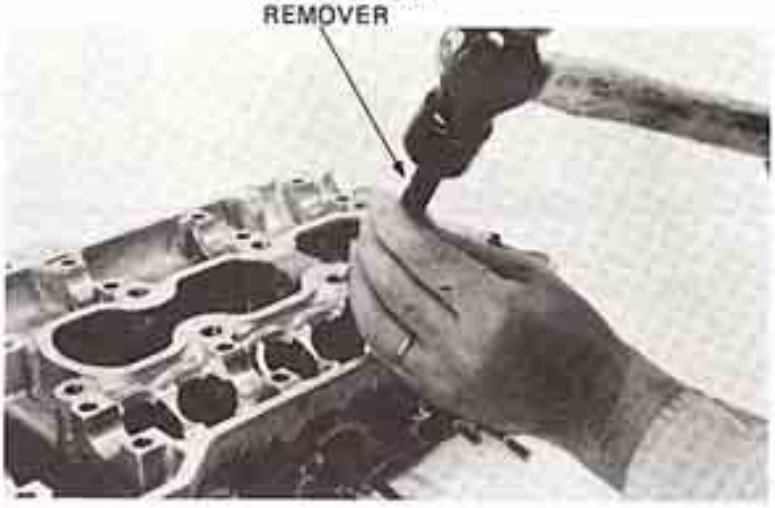
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Install a new oversize valve guide from the top of the head.

NOTE

For best results, heat the cylinder head to 150°C (300°F) before installing new oversize guides.

VALVE GUIDE REMOVER

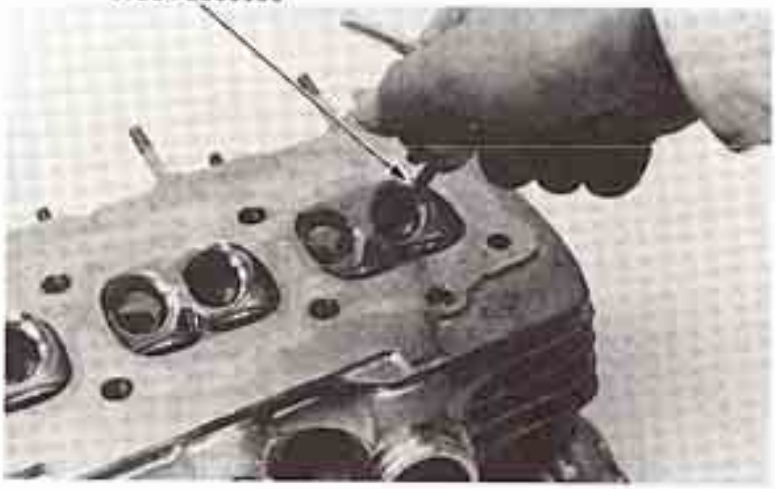


Ream the new valve guide after installation.

NOTE

- Use cutting oil on the reamer during this operation.
- Rotate the reamer when inserting and removing it.

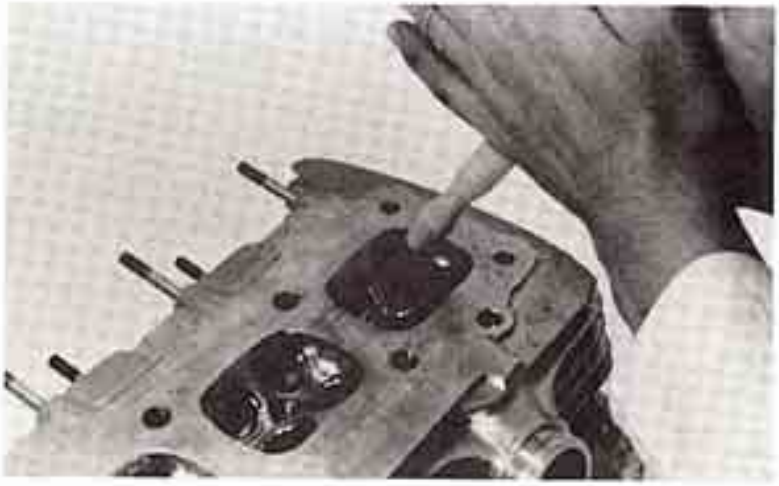
VALVE GUIDE REAMER (5.5 mm)
07984-2000000



Reface the valve seat.
Clean the cylinder head thoroughly to remove any metal particles.

VALVE SEAT INSPECTION/REFACING

Clean all intake and exhaust valves thoroughly to remove carbon deposits.
Apply a light coating of valve lapping compound to each valve face. Lap each valve and seat using a rubber hose or other hand-lapping tool.



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Remove the valve and inspect the face.

CAUTION

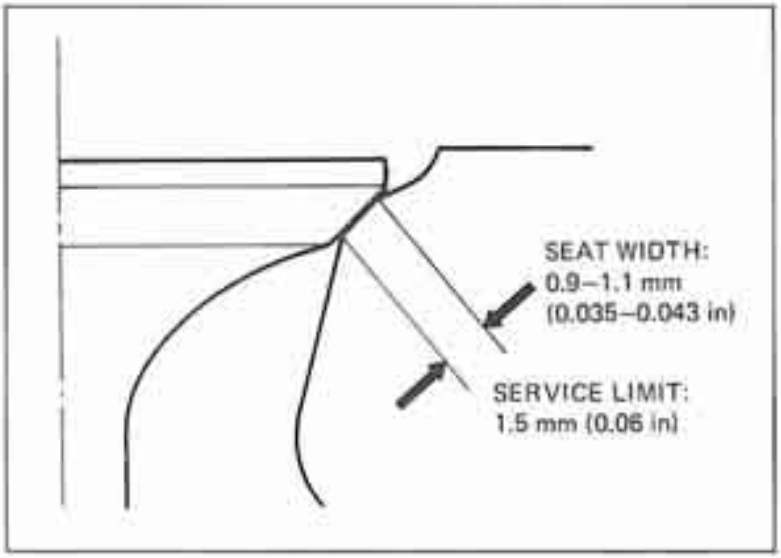
The valves cannot be ground. If the valve face is rough, worn unevenly, or contacts the seat improperly, the valve must be replaced.

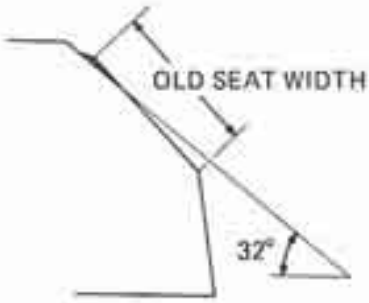
Inspect the valve seat.

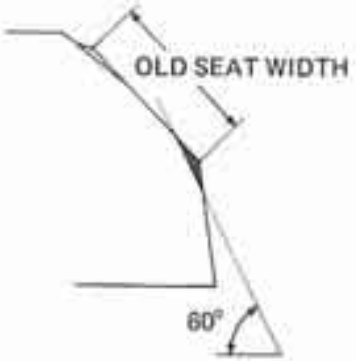
If the seat is too wide, too narrow, or has low spots, the seat must be ground.

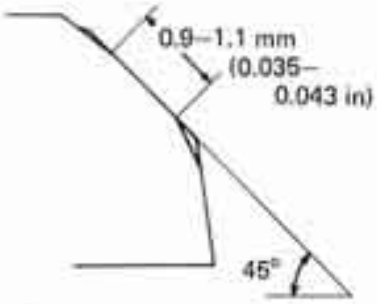
NOTE

Follow the refacer manufacturer's operating instructions.

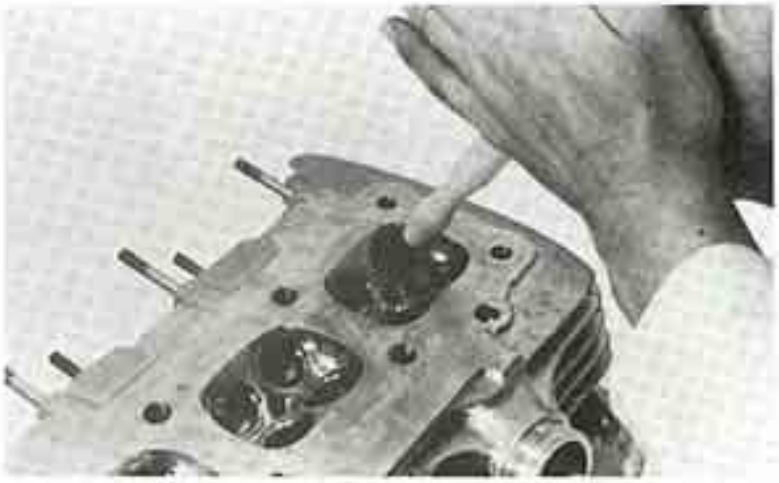








After cutting the seat, apply lapping compound to valve face, and lap the valve using light pressure. After lapping, wash any residual compound off the cylinder head and valve.



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CYLINDER HEAD ASSEMBLY

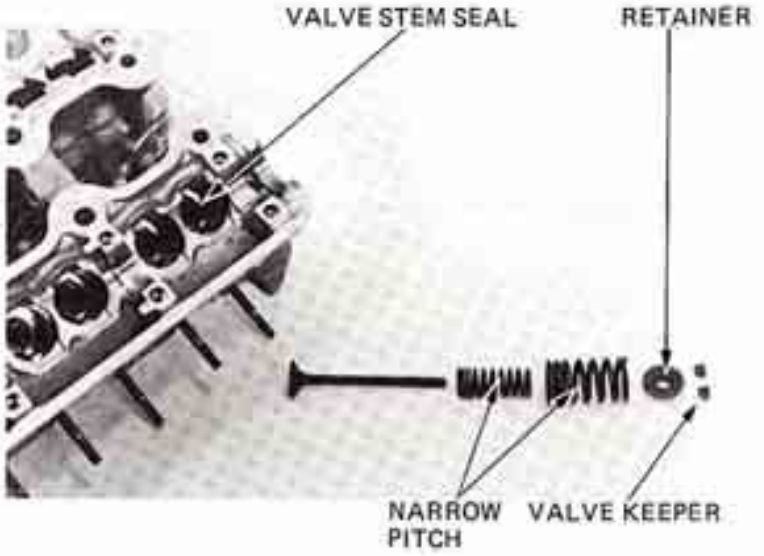
NOTE

Install new valve stem seals when reassembling.

Lubricate each valve stem with molybdenum disulfide grease and insert the valve into the valve guide.

NOTE

To avoid damage to the stem seal, turn the vavle slowly when inserting.



Install the valve springs and retainers.

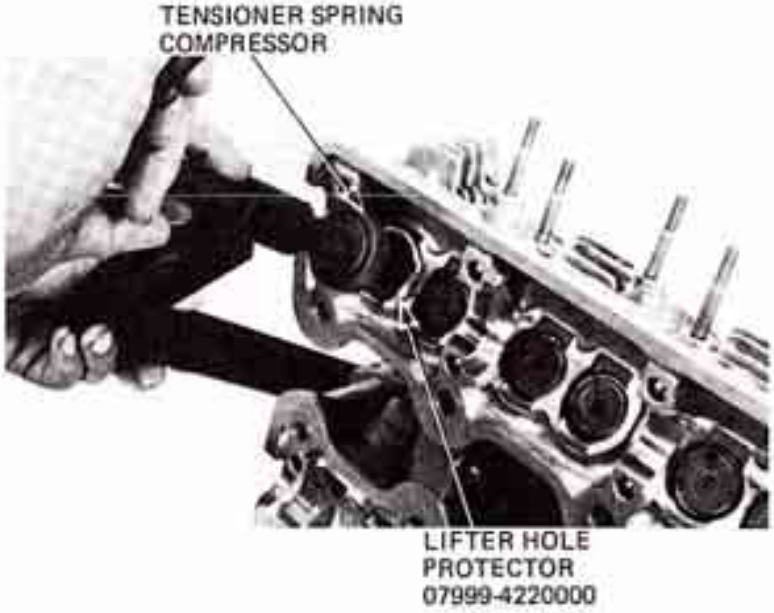
NOTE

Install the valve springs with the tightly wound coils facing the cylinder head.

Install the valve keepers.

CAUTION

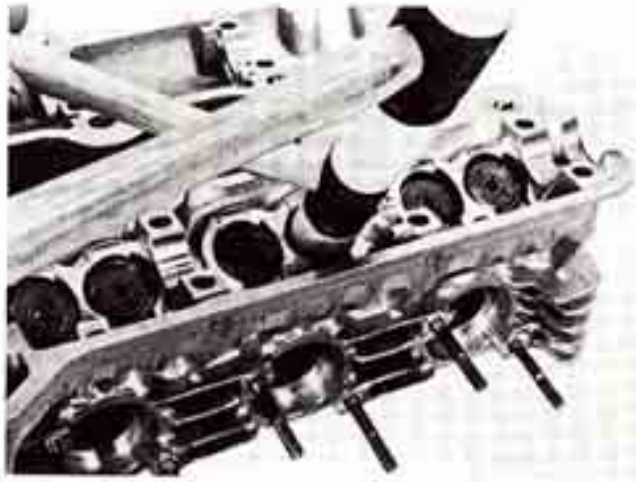
To prevent loss of tension, do not compress the valve spring more than necessary to install the valve keepers.



Tap the valve stems gently with a soft hammer to firmly seat the keepers.

NOTE

Support the cylinder head above the work bench surface to prevent possible valve damage.



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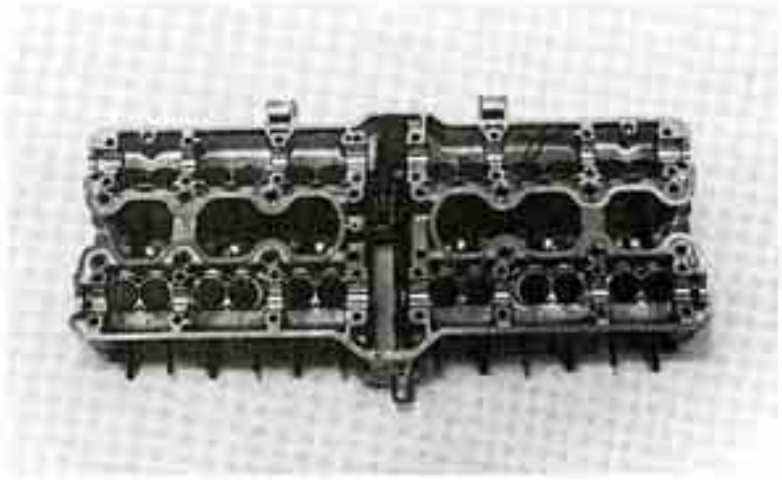
Install the cam chain tensioner.
Push the chain tensioner and tighten the lock nut.



Install the valve lifters and adjustment shims.

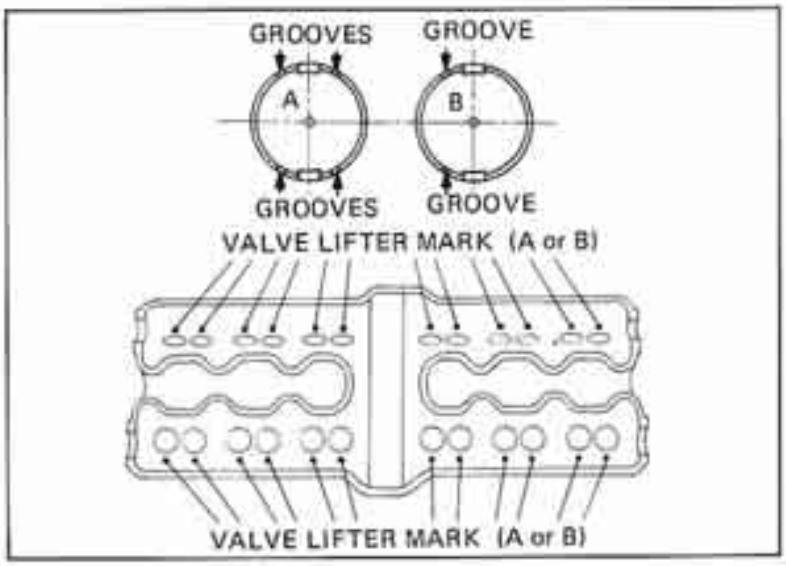
NOTE

Make sure that the valve lifters and shims are in their original position.



NOTE

Valve lifters are available in two sizes.
When installing new valve lifters, use lifters with the letter code that coresponds the code stamped on the cylinder head. Use 'A' with 'A', 'B' with 'B'.

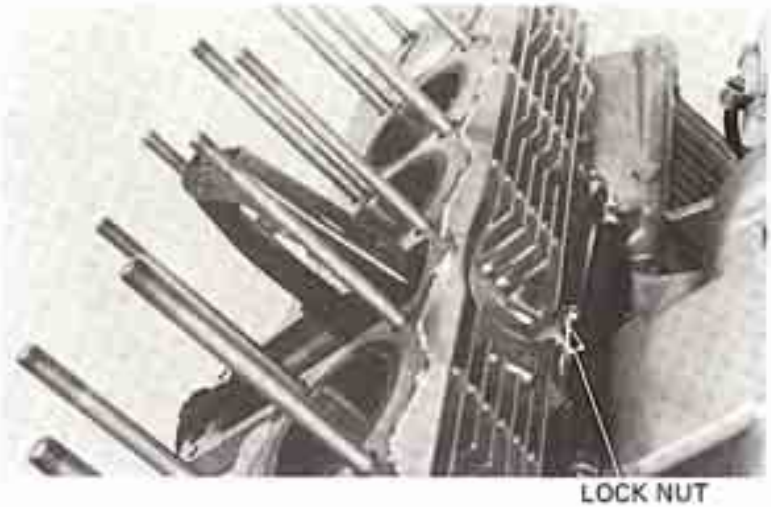


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CYLINDER HEAD INSTALLATION

Clean the cylinder head gasket surfaces of any gasket material.

Loosen the cam chain tensioner lock nut and pull the tensioner up.
Retighten the lock nut.
Install the dowel pins, a new gasket and cam chain guide.



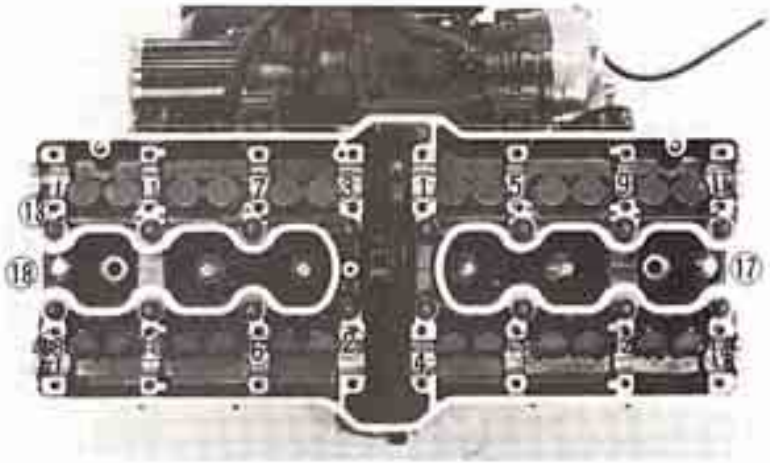
LOCK NUT

Install the cylinder head assembly.
Tighten the cap nuts in the sequence shown.
Tighten the two bolts.
Tighten the two bolts at the cam chain housing.

NOTE

Apply molybdenum disulfide grease to the threads of the cylinder bolts and washers.

TORQUE VALUES:
10 mm cap nut:
32–34 N·m (3.2–3.4 kg-m, 23–25 ft-lb)
8 mm cap nut:
19–21 N·m (1.9–2.1 kg-m, 14–15 ft-lb)
8 mm bolt:
18–22 N·m (1.8–2.2 kg-m, 13–16 ft-lb)



Tighten the cam chain tensioner bolt.
TORQUE:
10–14 N·m (1.0–1.4 kg-m, 7–10 ft-lb)



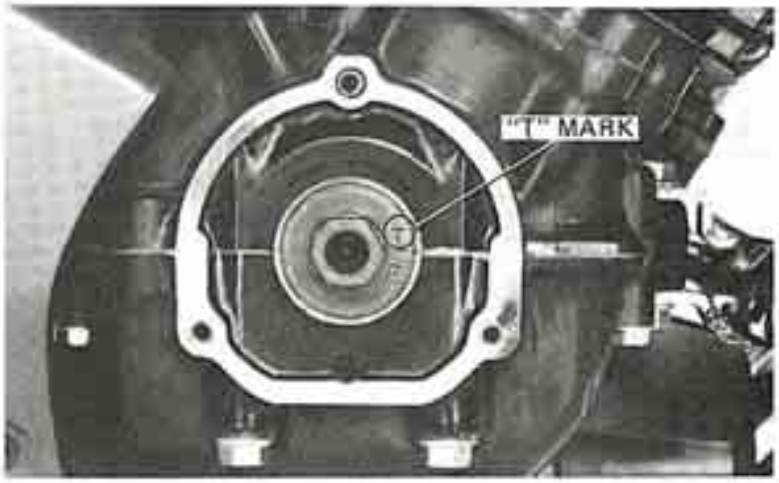
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CAMSHAFT INSTALLATION

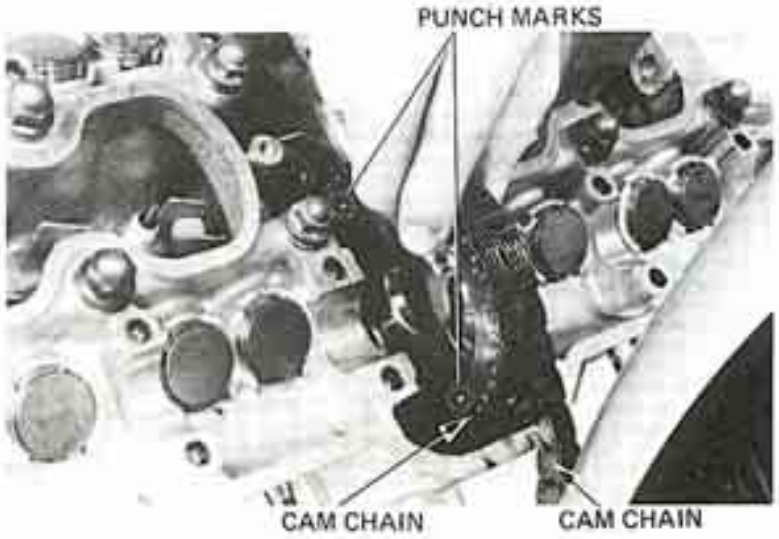
Lubricate the camshaft bearings with molybdenum disulfide grease.



Turn the crankshaft clockwise until the "T" mark is toward the front of the engine and is aligned with the crankcase mating surfaces as shown.



Place the cam chains over the exhaust camshaft sprocket, aligning the sprocket punch marks with the cylinder head surface.
Install the right exhaust camshaft, positioning the cam lobes for the No. 6 cylinder toward the spark plug. Install a camshaft sprocket bolt, but do not tighten yet.



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Loosely install the No. 6 and No. 8 camshaft holders. Install the No. 7 holder, positioning the camshaft so its flange fits into the slot in the No. 7 holder.

NOTE

Install camshaft holders with directional arrows pointing toward the front of the engine.

Tighten the camshaft holder bolts in a crisscross pattern.

TORQUE:
12–16 N·m (1.2–1.6 k·m, 9–12 ft·lb)

Turn the crankshaft clockwise 360° to obtain access for installing the other camshaft sprocket bolt. Install the sprocket bolt and tighten to the specified torque.

TORQUE:
14–18 N·m (1.4–1.8 kg·m, 10–13 ft·lb)

Turn the crankshaft another 360° and tighten the sprocket bolt which was installed earlier.
Adjust the cam chain (page 3-14).

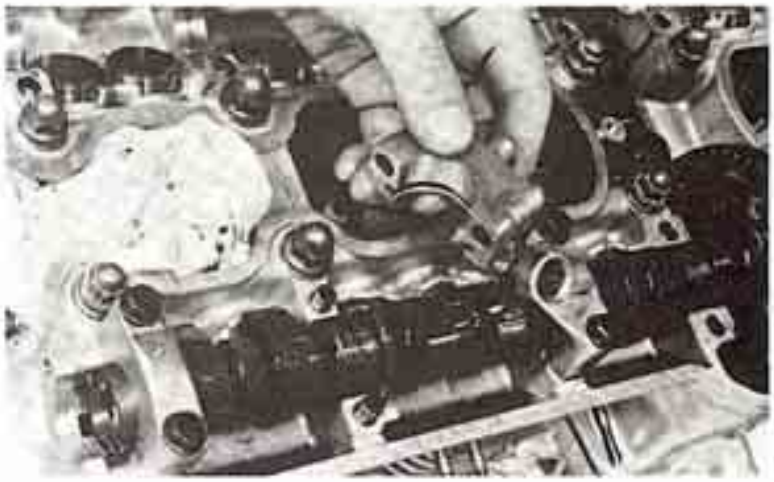
Position the crankshaft so the "T" mark is again aligned with the crankshaft mating surfaces as shown on page 6-21. Recheck the position of the exhaust camshaft sprocket; the punch marks must align with the cylinder head surface. Place the cam chain over the intake camshaft sprocket, aligning the sprocket punch marks with the cylinder head surface.
Install the right intake camshaft, positioning the cam lobes for the No. 6 cylinder toward the spark plugs. Install a camshaft sprocket bolt, but do not tighten yet.

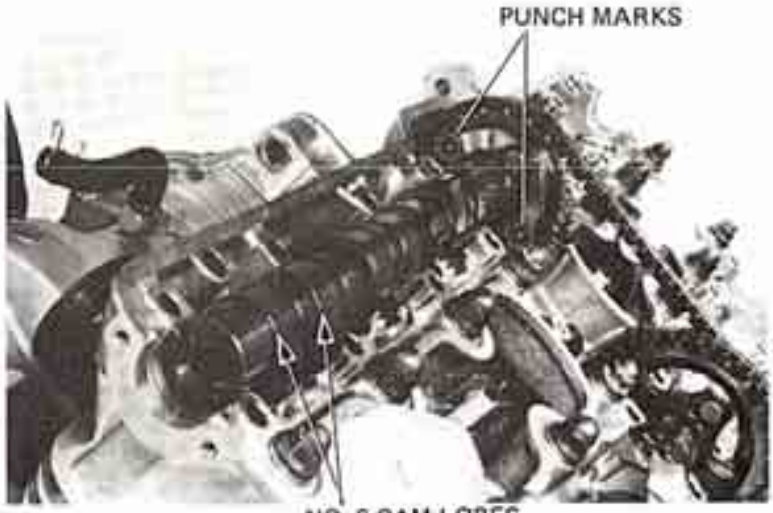
NOTE

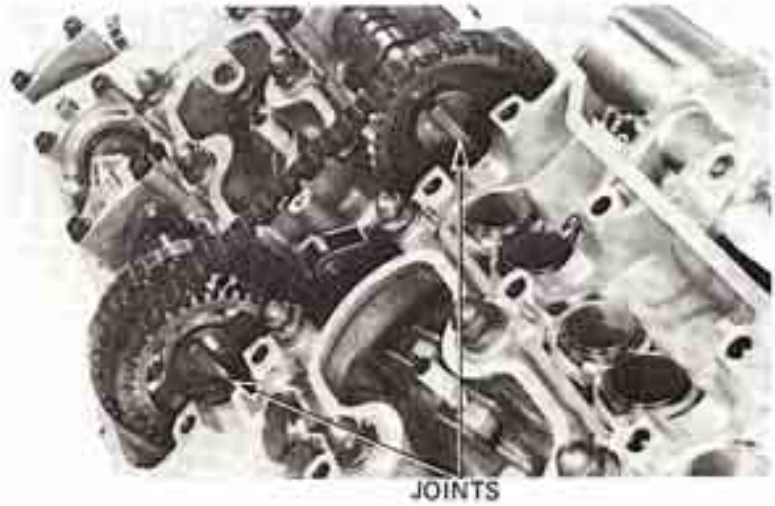
If the sprocket was not removed from the camshaft during disassembly, then reinstall as an assembled set.

Loosely install the No. 14 and No. 16 camshaft holders. Install the No. 15 holder, positioning the camshaft so its flange fits into the slot in the No. 15 holder.
Tighten the camshaft holder bolts, then tighten the camshaft sprocket bolt, following the same procedure described for exhaust camshaft installation.

Turn the crankshaft clockwise 360° until the "T" mark is aligned with the crankcase mating surface. Make sure the cam lobes for the No. 6 cylinder are toward outside.
Install and tighten the camshaft sprocket bolt. Adjust the cam chain tensioner (page 3-14). Recheck the crankshaft and camshaft sprocket alignment.
Insert the camshaft joints into the camshaft ends.







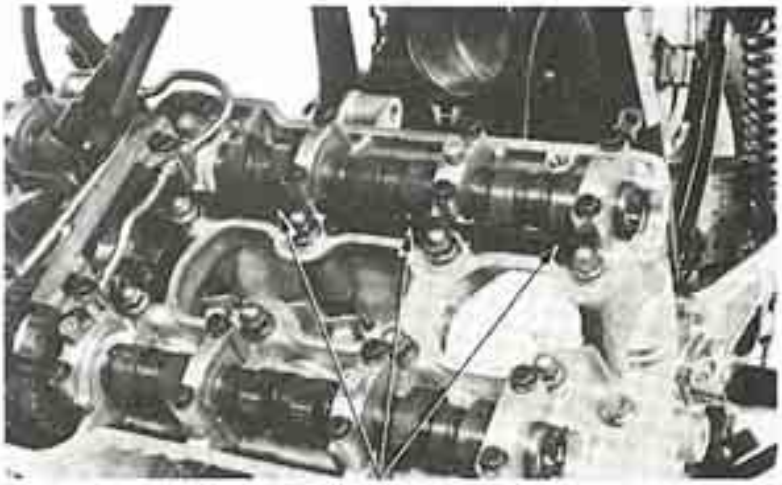
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Connect the left camshafts to the joints with No. 1 cam lobes toward the spark plug.
Install No. 1, No. 3 and No. 9 and 11 holders loosely.
Install the No. 2 and No. 10 holders.
Tighten the bolts to the specified torque in a crisscross pattern.



NO. 1 CAM LOBES
ALSO, NO. 1 EX. CAM LOBES
TOWARD SPARK PLUG.

Install the oil pipes and cam chain guide with the No. 4, 5, 12 and 13 holders.
Tighten in a crisscross pattern to the specified torque.



OIL POOL PLATES

Install the engine.
Fill the oil pockets in the head with oil so that the cam lobes are submerged.

Adjust valve tappet clearance (Section 3).

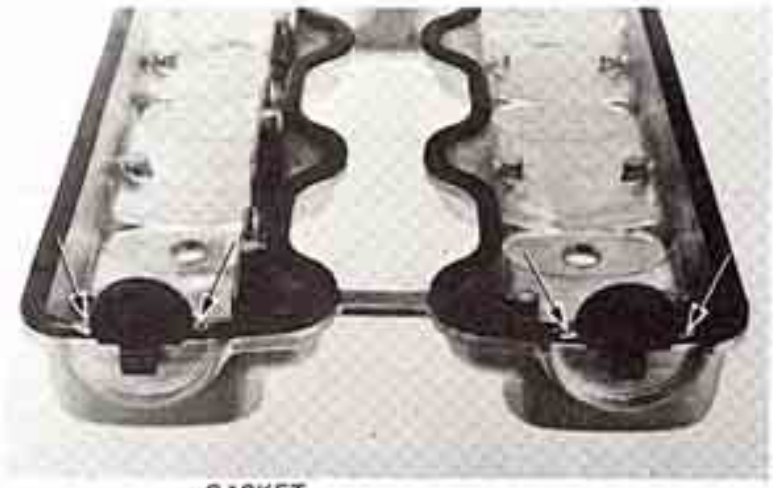


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Inspect the cylinder head cover gasket for damage or deterioration.
Apply a sealant on the cylinder gasket as shown, adjacent to each side cover.

NOTE

Before applying sealant, clean the gasket.



GASKET

Install the cylinder head cover and cylinder head side covers.

Insert the tachometer drive gear.
Install the tachometer gear cover.
Connect the tachometer cable.

TACHOMETER DRIVE GEAR



Install the right crankshaft side cover and gasket with bead printed surface toward the crankcase.
Install a new O-ring on the upper screw only.
Adjust the cam chain (page 3-14).

O-RING



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