CYLINDER HEAD/VALVES

GENERAL

- When disassembling, mark and store the disassembled parts to ensure that they are reinstalled in their original locations.
- Clean all disassembled parts with cleaning solvent and dry them by blowing them off with compressed air before inspection.
- Camshaft and rocker arm lubricating oil is fed through oil passages in the cylinder head. Clean the oil passages before assembling cylinder head.

TROUBLESHOOTING

- Engine top-end problems usually affect engine performance. These can be diagnosed by a compression test or by tracing engine noises to the top-end with a sounding rod or stethoscope.
- If the performance is poor at low speeds, check for white smoke in the crankcase breather hose. If the hose is smoky, check for a seized piston ring.

Compression too low, hard starting or poor performance at low speed

- Valves:
  – Incorrect valve adjustment
  – Burned or bent valve
  – Incorrect valve timing
  – Broken valve spring
  – Uneven valve seating
  – Valve stuck open
  – Weak valve spring
- Cylinder head:
  – Leaking or damaged cylinder head gasket
  – Warped or cracked cylinder head
  – Loose spark plug
- Worn cylinder
- Worn piston or piston rings

Compression too high, overheating or knocking

- Excessive carbon build-up on piston head or on combustion chamber
- Decompressor system malfunction

Excessive smoke

- Worn valve stem or valve guide
- Damaged stem seal
- Worn cylinder
- Worn piston or piston rings

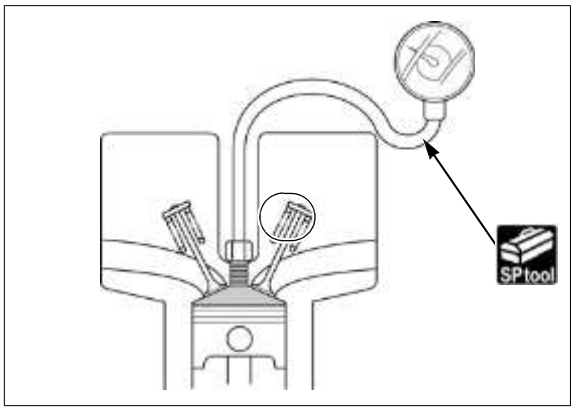
Excessive noise

- Incorrect valve adjustment
- Sticking valve or broken valve stem
- Excessively worn valve seat
- Worn or damaged camshaft
- Worn or damaged cam chain
- Worn cam sprocket teeth
- Worn rocker arm and/or shaft
- Worn or damaged cam chain tensioner
- Worn cylinder
- Worn piston or piston rings

Rough idle

- Low cylinder compression

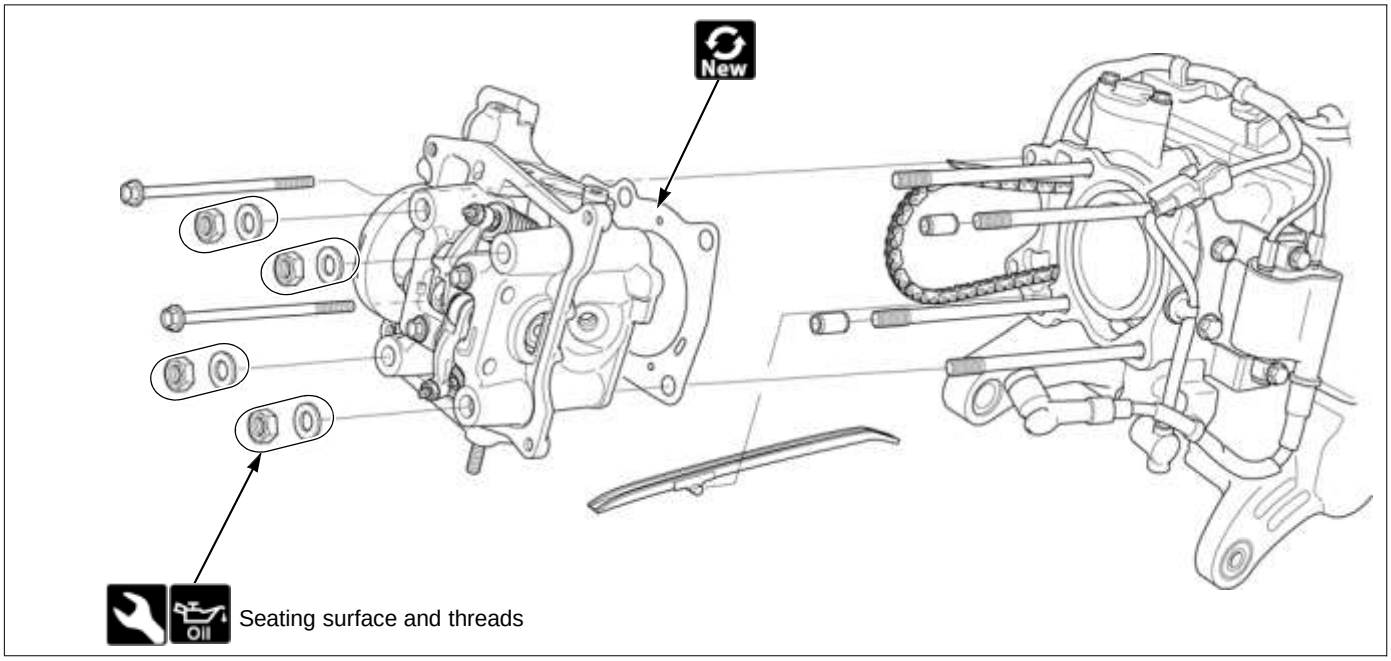
CYLINDER COMPRESSION TEST



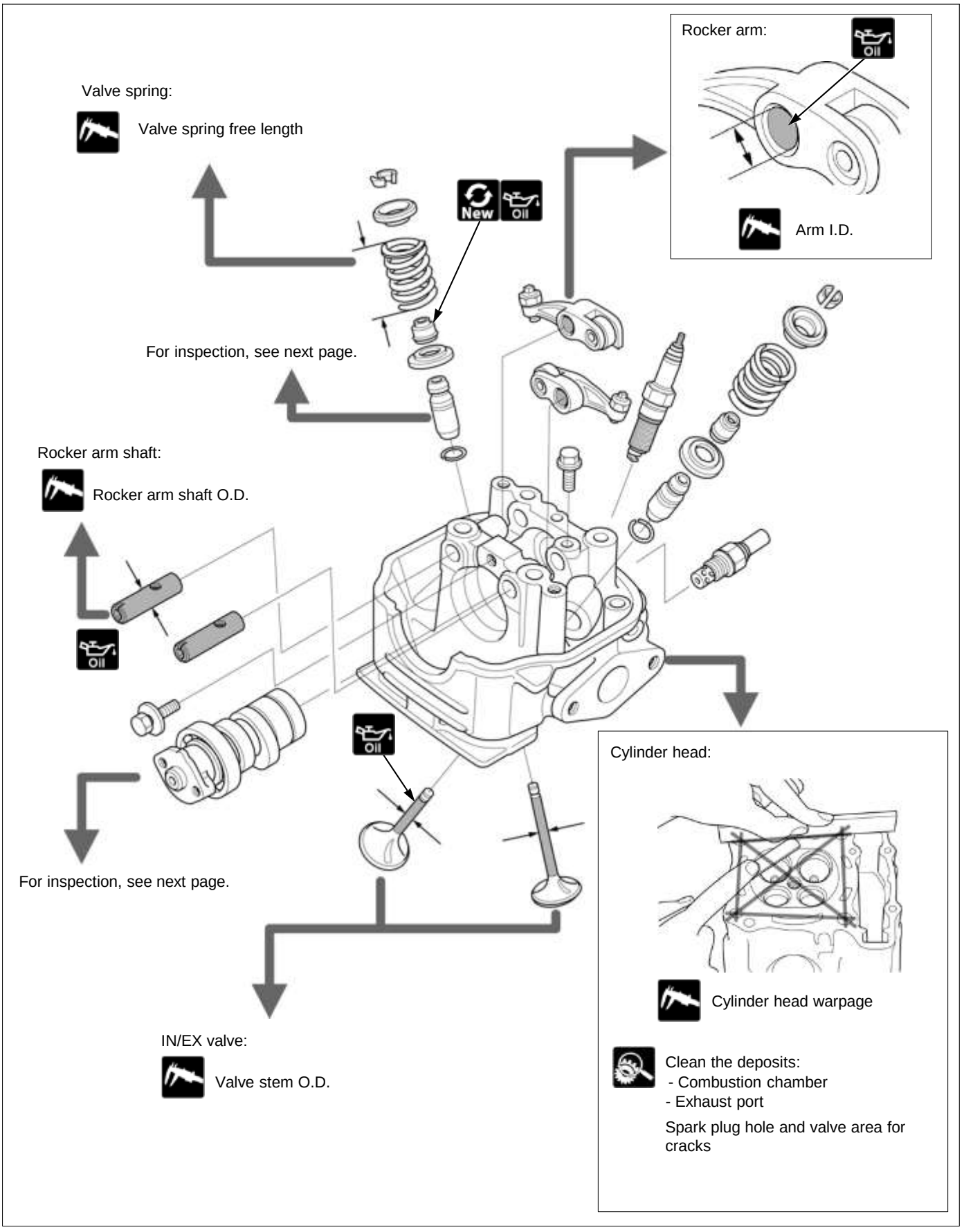
- Warm up the engine.
- Stop the engine.
- Spark plug cap
- Spark plug
- Compression gauge (into the spark plug hole)
- Open the throttle all the way and crank the engine with the starter until the gauge reading stops rising.
  – To avoid discharging the battery, do not operate the starter for more than 7 seconds.
- The maximum reading is usually reached within 4 – 7 seconds.
  – If compression is high, it indicates that carbon deposits have accumulated on the combustion chamber and/or the piston crown.
  – If compression is low, pour 3 – 5 cm^3 of clean engine oil into the cylinder through the spark plug hole and recheck the compression.
- If the compression increases from the previous value, check the cylinder, piston and piston rings.
  – Leaking cylinder head gasket
  – Worn piston ring
  – Worn cylinder and piston
- If compression is the same as the previous value, check the valves for leakage.

CYLINDER HEAD

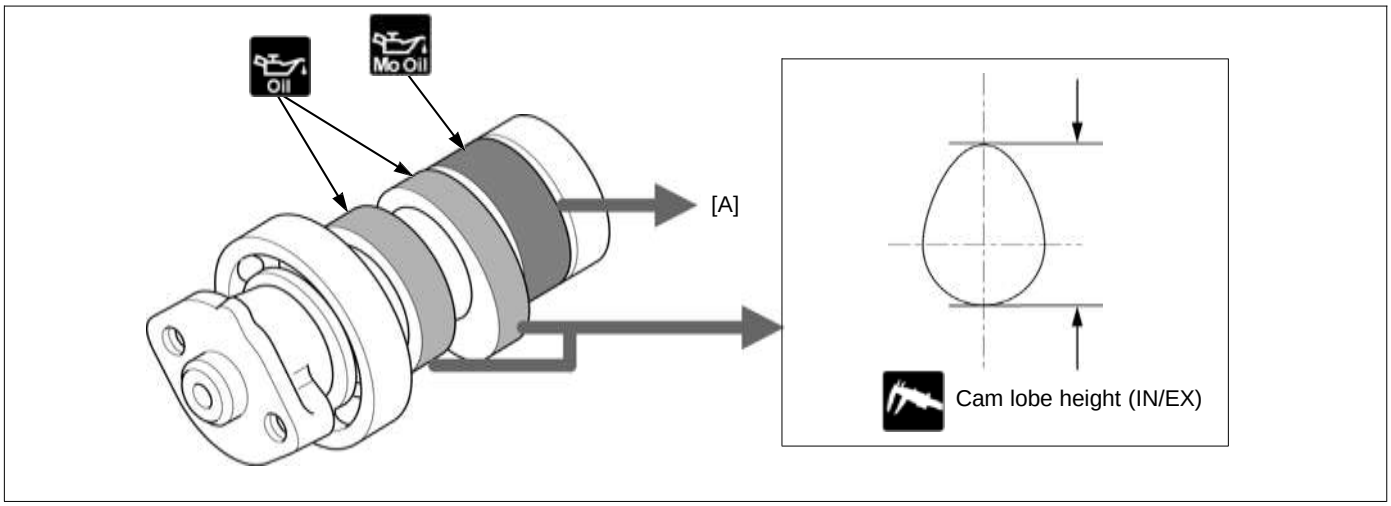
REMOVAL/INSTALLATION



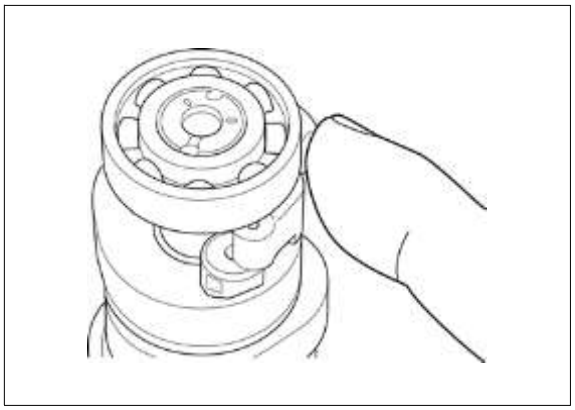
DISASSEMBLY/ASSEMBLY/INSPECTION



Camshaft:

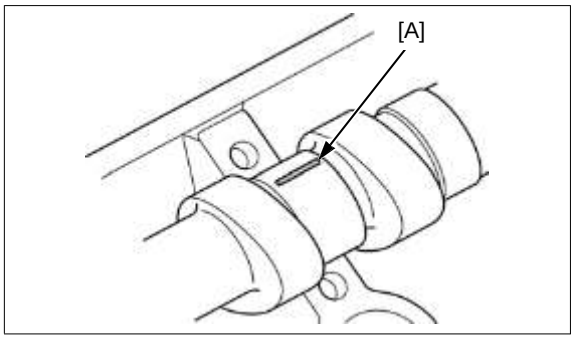


[A] Decompressor System:

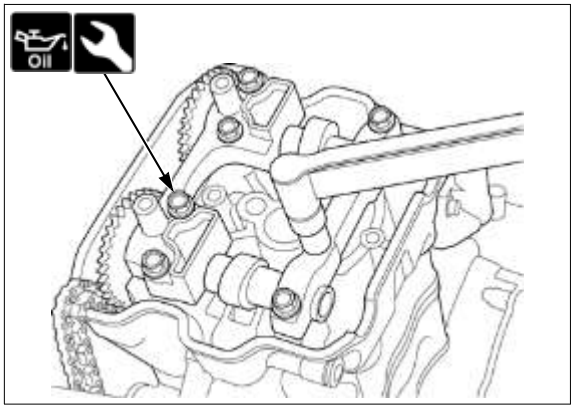


- Turn the decompressor with your finger.
  Make sure that the decompressor operates smoothly and that the weight returns back in position.

CAMSHAFT OIL CLEARANCE INSPECTION



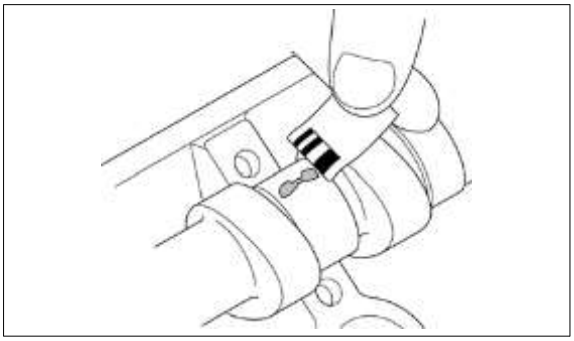
- Do not rotate the camshaft when using plastigauge.
- Journals of the camshaft
- Cylinder head and camshaft holders
- Lay a strip of plastigauge [A] lengthwise on top of each camshaft journal.



- Camshaft holder mounting bolt threads and seating surface
- All camshaft holder mounting bolts

NOTE:

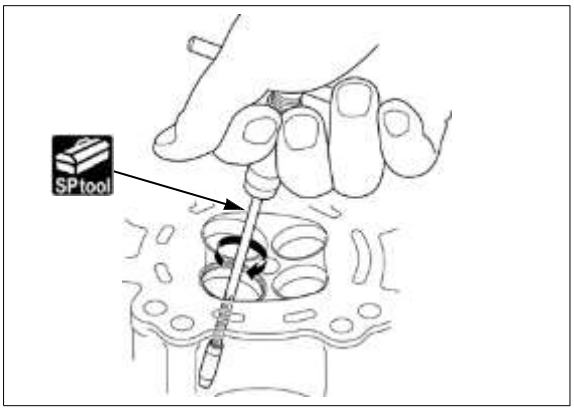
- From inside to outside, tighten the bolts in a crisscross pattern in several steps.
- Failure to tighten the camshaft holder in a crisscross pattern might cause a camshaft or camshaft holder to break.



- Camshaft holders

- Width of each plastigauge
  – The widest thickness determines the oil clearance.
- When the service limits are exceeded, replace the camshaft and recheck the oil clearance.
  – Replace the cylinder head and camshaft holders as a set if the clearance still exceeds the service limit.
- After inspection, remove the plastigauge and clean the camshaft surface.

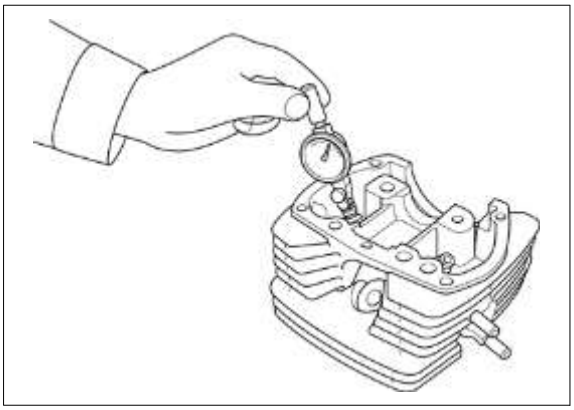
VALVE GUIDE INSPECTION



- Ream the valve guide to remove any carbon build-up before measuring the guide I.D.
- Insert the reamer from the combustion chamber side of the cylinder head and always rotate the reamer clockwise.

NOTE:

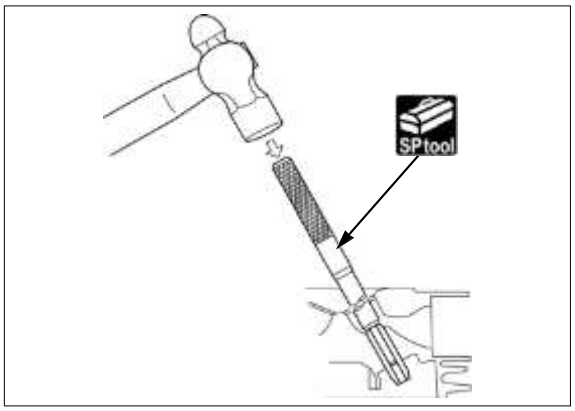
- Use cutting oil on the reamer during this operation.
- Take care not to tilt or lean the reamer in the guide while reaming. Otherwise, the valves may be installed slanted, causing oil leakage from the stem seal and improper valve seat contact. This may prevent valve seat refacing.
- Insert the reamer from the combustion chamber side of the head and always rotate the reamer clockwise.
- Always rotate the reamer clockwise, never counterclockwise when inserting, removing and reaming



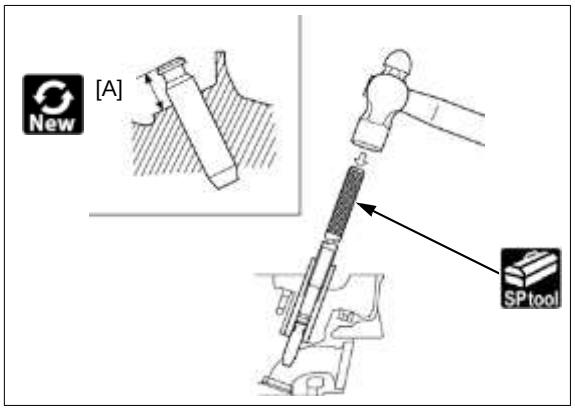
- Each valve guide I.D. (record it)
  – Inspect and reface the valve seats whenever the valve guides are replaced.
- Subtract each valve stem O.D. from the corresponding guide I.D. to obtain the stem-to-guide clearance.
  – If the stem-to-guide clearance exceeds the service limit, determine if a new guide with standard dimensions would bring the clearance within tolerance.
  – If so, replace any guides as necessary and ream to fit.
  – If the stem-to-guide clearance exceeds the service limit with a new guide, also replace the valve.

VALVE GUIDE REPLACEMENT

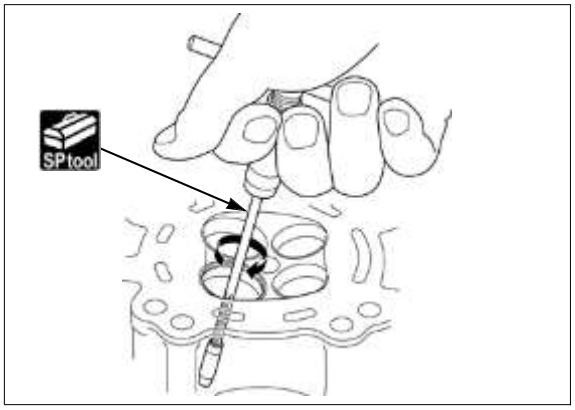
- Refinish the valve seats whenever the valve guides are replaced to prevent uneven seating.
- Chill new valve guides in a freezer section of refrigerator for about an hour.
- Heat the cylinder head to 130 – 140°C (266 – 284°F) with a hot plate or oven. Do not heat the cylinder head beyond 150°C (302°F). Use temperature indicator sticks, available from welding supply stores, to be sure the cylinder head is heated to the proper temperature.
  – To avoid burns, wear insulated gloves when handling the heated cylinder head.
  – Do not use a torch to heat the cylinder head; it may cause warping.



- Support the cylinder.
- Drive out the valve guides from the combustion chamber side of the cylinder head.



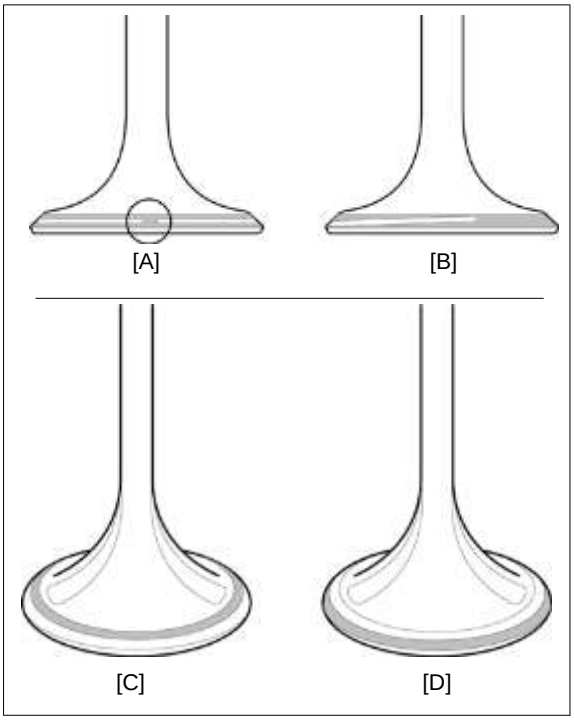
- While the cylinder head is still heated, take off a new valve guides from the freezer.
- Adjust the valve guide driver to the valve guide height and drive in the valve guide from the camshaft side.
- [A] Valve guide height
- Let the cylinder head cool to room temperature.



- Ream a new valve guides.
- Use cutting oil on the reamer during this operation.
- Take care not to tilt or lean the reamer in the guide while reaming. Otherwise, the valves may be installed slanted, causing oil leakage from the stem seal and improper valve seat contact. This may prevent valve seat refacing
- Insert the reamer from the combustion chamber side of the head and always rotate the reamer clockwise.
- After replacement, remove the any metal particles of the cylinder head.

VALVE SEAT INSPECTION

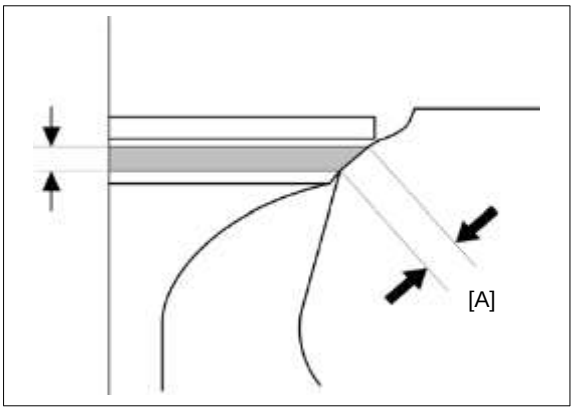
- Clean the intake and exhaust valves for carbon deposits.
- Apply thin coat of Prussian Blue to each valve face.
- Tap the valve against the valve seat several times using a hand lapping tool without rotating valve to make a clear pattern.



- Clean the valve.

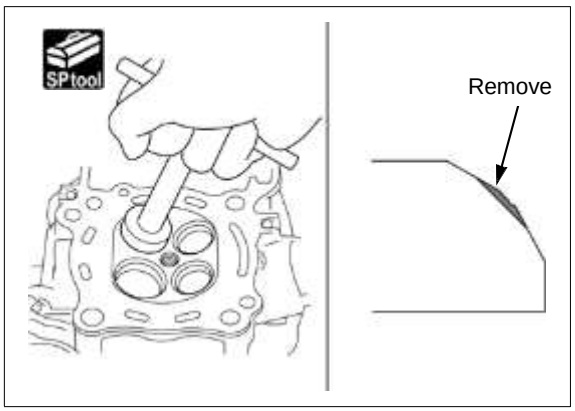
Valve seat face
- [A] Damaged face
  – Replace the valve and reface the valve seat.
- [B] Uneven seat width
  – Replace the valve and reface the valve seat.
- The valve cannot be ground. If the valve face is burned or badly worn or if it contacts the seat unevenly, replace the valve.

Contact area
- [C] Too high
  – Reface the valve seat.
- [D] Uneven seat width:
  – Reface the valve seat.



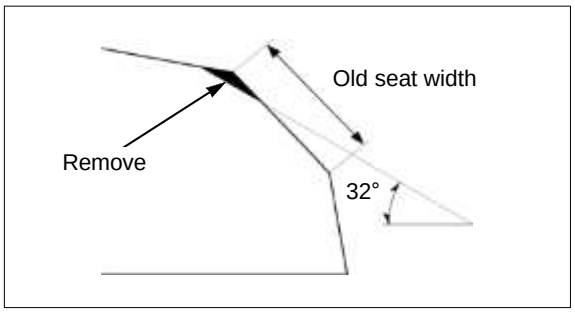
- [A] Valve seat width
- The valve seat contact should be within the specified width and even all around the circumference.
  – If the valve seat width is not within specification, reface the valve seat.

VALVE SEAT REFACING

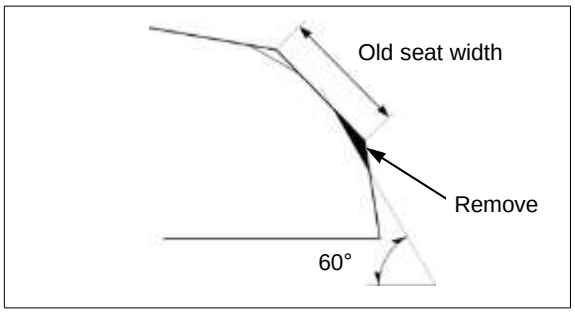


NOTE:

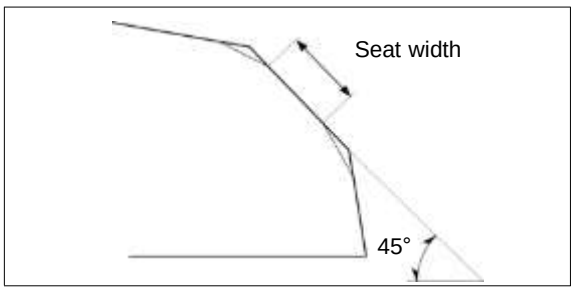
- Follow the refacing manufacturer's operating instructions.
- Reface the valve seat whenever the valve guide has been replaced.
- Be careful not to grind the seat more than necessary.
- Use a 45° cutter, remove any roughness or irregularities from the seat.
  – Reface the valve seat with a 45° cutter when a valve guide is replaced.



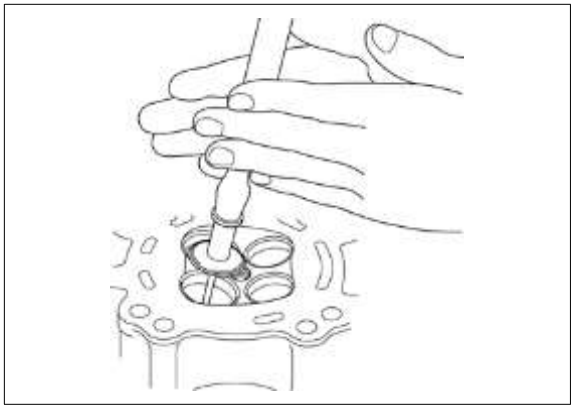
- Using 32° cutter, remove the top 1/4 of the existing valve seat material.



- Using 60° cutter, remove the bottom 1/4 of the old seat.
- Remove the cutter and inspect the area you have just removed.

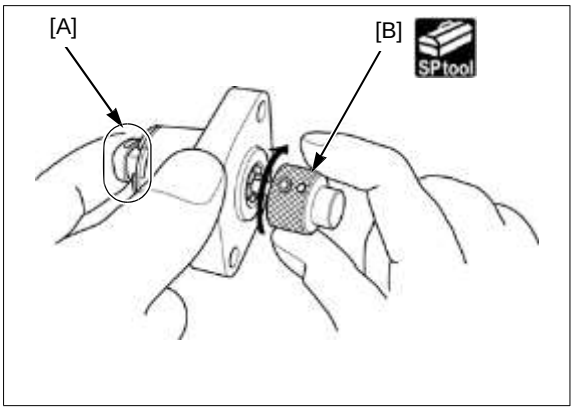


- Using a 45° cutter, cut the seat to proper width.
- Make sure that all pitting and irregularities are removed.
- Refinish if necessary.



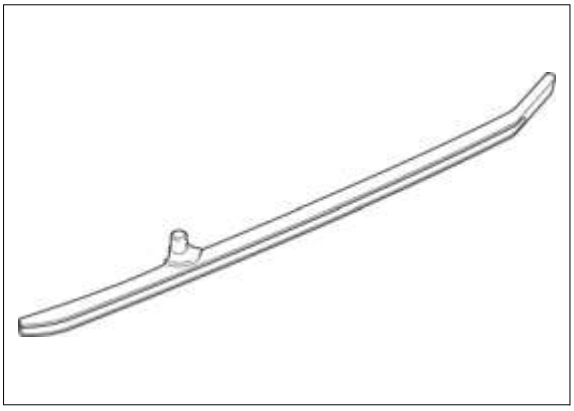
- After cutting the seat, apply lapping compound to the valve face and lap the valve using light pressure.
  – Excessive lapping pressure may deform or damage the seat.
  – Change the angle of lapping tool frequently to prevent uneven seat wear.
  – Lapping compound can cause damage if it enters between the valve stem and guide.
- After lapping, wash any residual compound off the cylinder head and valve.
- Seat contact after lapping.

CAM CHAIN TENSIONER LIFTER INSPECTION



- The tensioner shaft [A] should not go into the body when it is pushed.
- When it is turned clockwise with the tensioner stopper [B], the tensioner shaft should be pulled into the body. The shaft should protrude from the body as soon as the tensioner stopper is released.

CAM CHAIN GUIDE INSPECTION



- Sliding area of the cam chain guide for excessive wear or damage