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Description

The DT 466 and DT 570 cylinder heads are cast iron and feature four valves per cylinder.

The design of the cylinder head valve train focuses on component commonality between the intake and exhaust sides of the head. Shared parts include: valve bridges, guides, springs, retainer keys, rotators, and valve stem seals. These parts are also compatible between the 466 and 570 engine families.

The valve rotators create positive valve rotation for increased valve face life.

The valve stem seals are one piece design, easy to install, and have a hardened washer for valve spring seating.

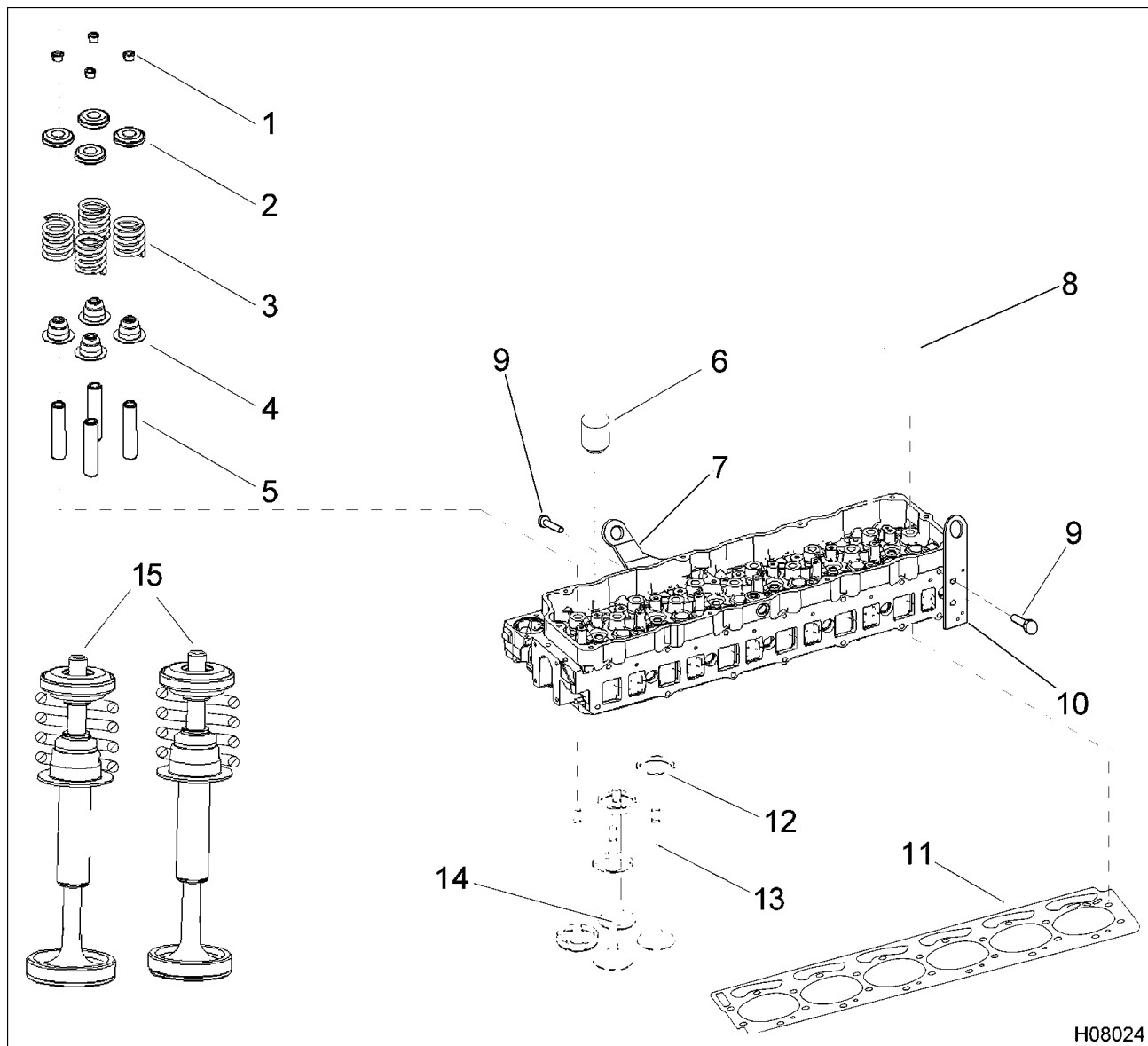
The valve guides and valve seats are replaceable.

The bridge can be installed on the intake or exhaust in either direction, and still allow compression brake operation through the pad on top.

A single roller tappet transfers lifting forces through a push rod, rocker arm, and then onto a valve bridge where both valves are opened and closed simultaneously. This allows for a greater quantity of air to flow through the engine than comparably sized engines using only two valves per cylinder.

Phosphate coating has been carried over from past production to rocker arms for initial break-in and to extend life.

Pressurized oil is fed from the crankcase through the head at cylinder number 6 exhaust lower support. Oil then enters shaft and is distributed to all rocker arms.



H08024

Figure 112 Cylinder head and valve train components

- | | | |
|-------------------------------|-----------------------------|--------------------------|
| 1. Valve spring retainer keys | 6. Fuel injector sleeve | 11. Cylinder head gasket |
| 2. Valve rotators | 7. Front lifting eye | 12. Valve seat insert |
| 3. Valve springs | 8. Cylinder head bolt, (26) | 13. Exhaust valve |
| 4. Valve stem seals | 9. Bolt, M12 x 25 (4) | 14. Intake valve |
| 5. Valve guide inserts | 10. Rear lifting eye | 15. Valve assemblies |

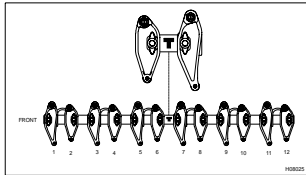


Figure 113 Valve train components

- | | | |
|---|-----------------------------|---|
| 1. Intake rocker arm (6) | 5. Rocker pivots (12) | 11. Roller tappet guide (6) |
| 2. Valve lash adjustment nuts, M10 (12) | 6. Valve bridge (12) | 12. Push rods (12) |
| 3. Exhaust rocker arm (6) | 7. Rocker arm shaft | 13. Valve lash adjuster screw, M10 (12) |
| 4. Rocker shaft clamp assembly (12) | 8. Rocker shaft support (6) | 14. Rocker shaft plug (2) |
| | 9. Lower support washer (6) | |
| | 10. Roller tappets (12) | |

Removal



WARNING: To avoid serious personal injury, possible death, or damage to the engine or vehicle, read all safety instructions in the "Safety Information" section of this manual.



WARNING: To avoid serious personal injury, possible death, or damage to the engine or vehicle, make sure the transmission is in neutral, parking brake is set, and wheels are blocked before doing diagnostic or service procedures on engine or vehicle.

NOTE: For information regarding the removal or installation of adjacent components, refer to the following service procedures located in other sections of this manual:

- VGT turbocharger
- Intake and exhaust manifolds
- EGR system components
- High-pressure oil manifold or Diamond Logic™ Engine Brake (if equipped)
- Fuel filter assembly
- Fuel injector assembly
- Crankcase breather assembly
- Coolant outlet tube assembly
- Water supply housing

Valve Cover

1. If cylinder head is to be removed in chassis, drain coolant to a level below the head gasket joint.
2. Disconnect crankcase ventilation and drain tubing from breather assembly. The breather assembly can remain attached to the valve cover during the valve cover removal (See Crankcase Ventilation System, page 226).

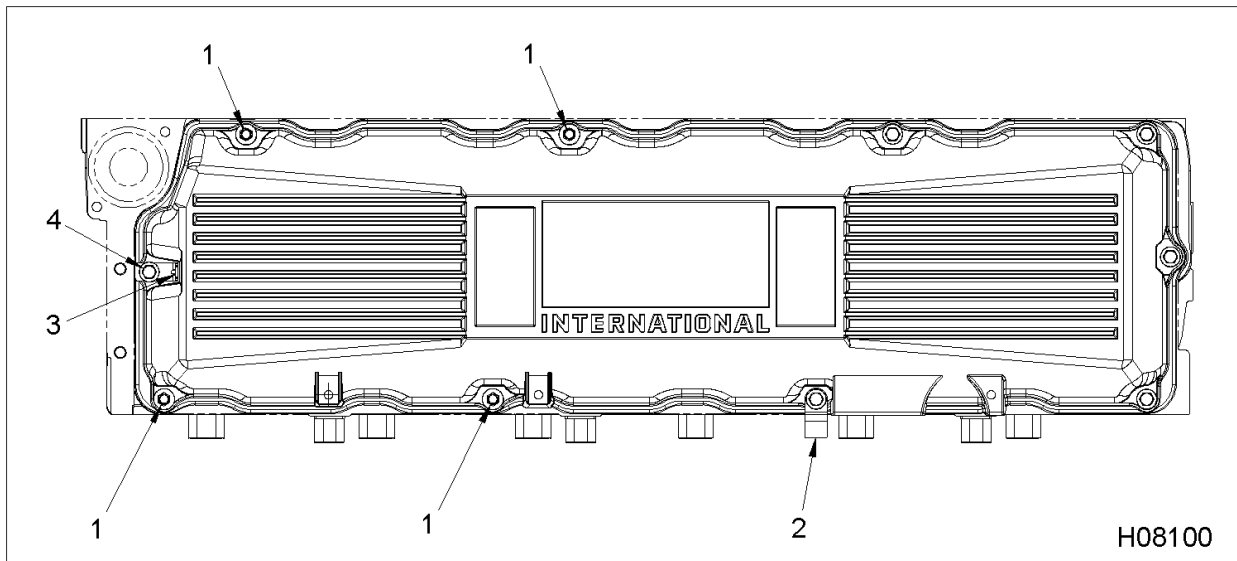


Figure 114 Valve cover assembly detail

- | | | |
|----------------------------------|---|----------------------|
| 1. Bolt / stud, M8 x 80 / 19 (4) | 3. Valve cover harness mounting bracket | 4. Bolt, M8 x 80 (6) |
| 2. Extension bracket | | |

3. Remove four valve cover bolt / studs (M8 x 80 / 19).
4. Remove six valve cover bolts (M8 x 80).
5. Lift valve cover off of cylinder head.
6. Disconnect all electrical and injector connectors at valve cover gasket.
7. Remove valve cover gasket.

NOTE: For fuel injector removal (See Fuel Injector Assemblies, page 318).

Removing Rocker Arm Assembly

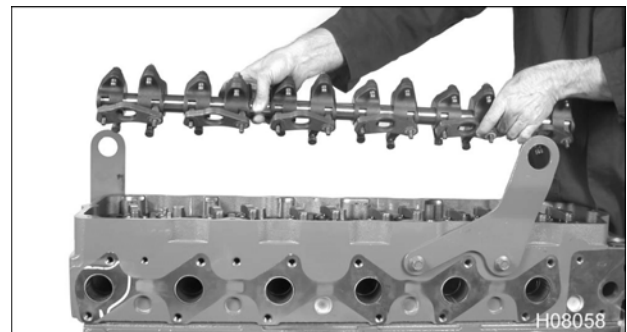


Figure 115 Removing rocker arm assembly

! WARNING: To avoid serious personal injury, possible death, or damage to the engine or vehicle, have an assistant help remove or install the high-pressure oil manifold assembly due to its heavy weight and limited accessibility.

- | | |
|--|---|
| <ol style="list-style-type: none"> 1. Remove 12 bolts (M8 x 90) securing oil rail assembly to cylinder head. 2. Lift assembly up and away from engine. 3. Drain the supply manifold oil rail. | <ol style="list-style-type: none"> 1. Loosen all rocker arm adjusting screws and nuts. This will avoid possible valve train damage during installation. 2. Loosen but do not remove 12 rocker shaft clamp bolts. 3. Lift the rocker arm shaft assembly up and away from the cylinder head and set aside. |
|--|---|

NOTE: There are six nylon washers, one for each rocker shaft support, that are for assembly purposes. Make sure that you have these washers for installing the rocker arm shaft.



Figure 116 Removing the valve bridge

4. If removing valve bridges, mark all valve bridges for installation (original orientation) later on.

Measuring Camshaft Lift

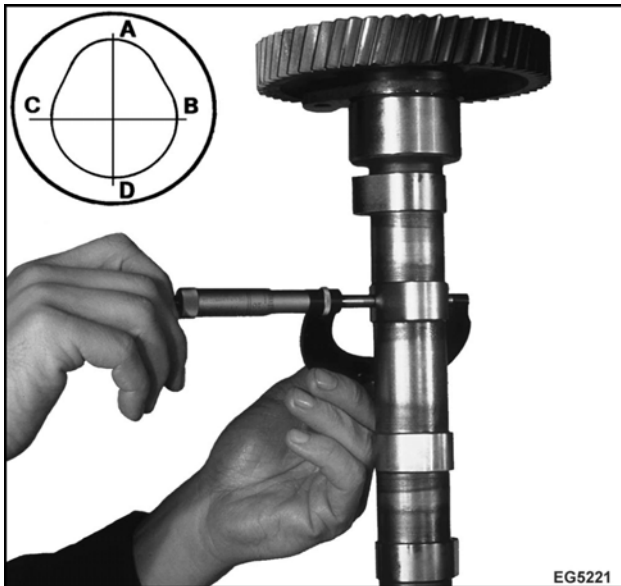


Figure 117 Measuring cam lobes with micrometer

NOTE: If a complete engine overhaul is scheduled, camshaft lobe wear can be determined by measuring lobes (See Checking Camshaft Lobes and Journals, page 235) with a micrometer after the camshaft is removed.

At this stage of disassembly, determine the appropriate stage of camshaft inspection. If this is not a complete engine overhaul, measure camshaft lobe lift now using the following procedure.

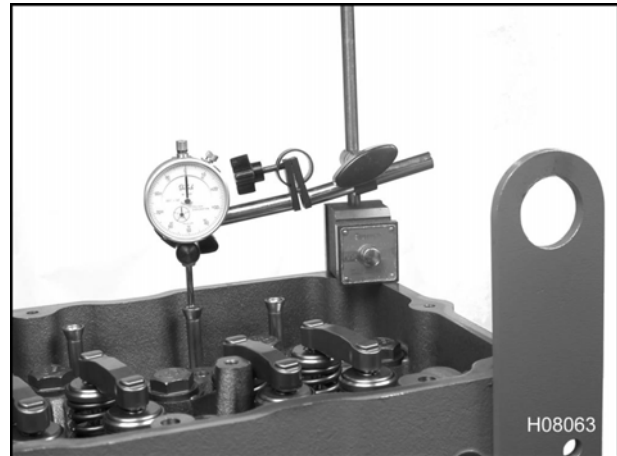


Figure 118 Mounting magnetic base dial indicator

1. Mount a magnetic base dial indicator onto the cylinder head.
2. Place dial indicator tip on top of push rod and rotate engine until push rod is at its lowest point of travel (base circle), then "zero" indicator.

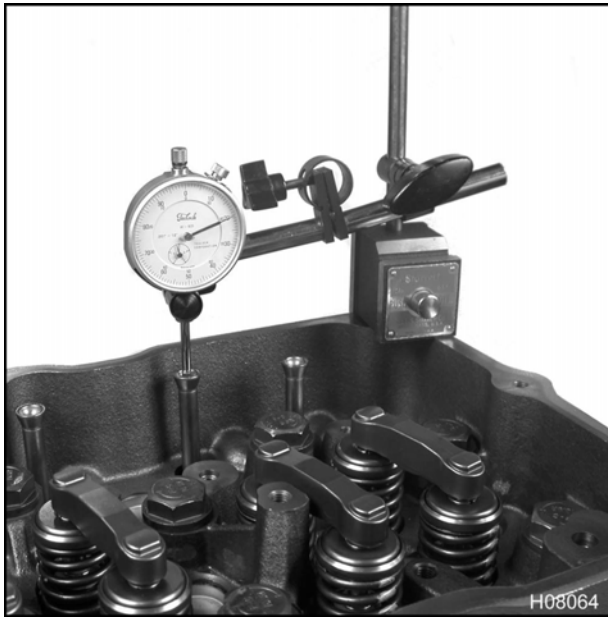


Figure 119 Recording camshaft lobe reading

3. Rotate the crankshaft and bring push rod to its highest point of travel. Record indicator reading.
4. Repeat this procedure for all lobes.
5. For specifications on camshaft lobe (Table 14).

Removing Rocker Arms

NOTE: Mark rocker arms and rocker shaft supports for location to ensure correct placement for later reassembly.

1. Place the rocker arm assembly on a clean flat surface. Mark each rocker arm before removal to aid in assembly of the rocker arm shaft later on.
2. Remove the 12 rocker shaft clamps.

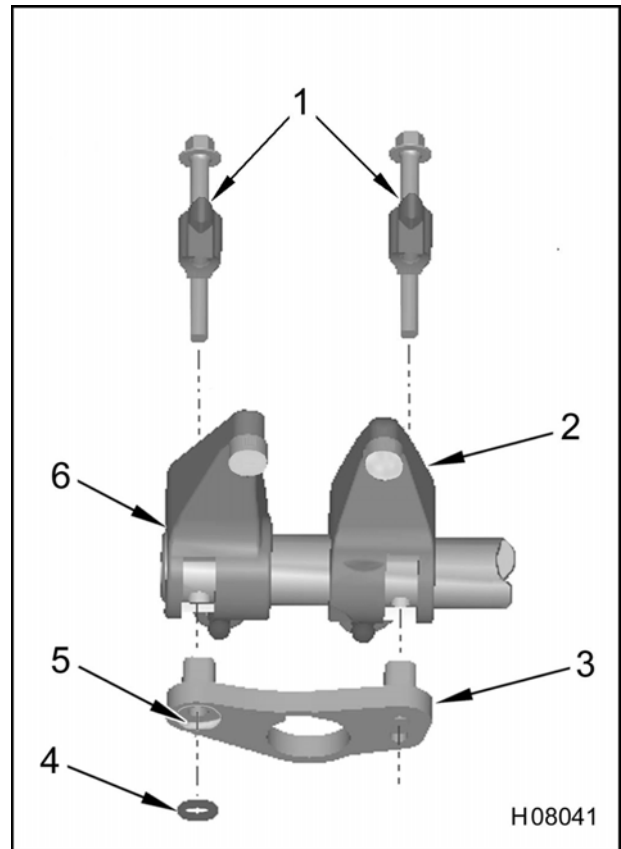


Figure 120 Rocker arm configuration

1. Clamp bolt assembly
2. Exhaust rocker arm
3. Rocker arm shaft support
4. Lower support washer
5. Machined recessed
6. Intake rocker arm

3. Slide rocker arm assembly components off shaft.
4. Tag all pushrods with cylinder number and valve association (intake or exhaust).
5. Remove all pushrods.

Removing Cylinder Head

CAUTION: To avoid engine damage, remove injectors before cylinder head removal (See High-Pressure Oil Manifold Assembly, page 317).

1. Remove 26 cylinder head mounting bolts (M15 x 180).



WARNING: To avoid serious personal injury, possible death, or damage to the engine or vehicle, chain must be equipped with safety hooks. See safety section in front of manual.

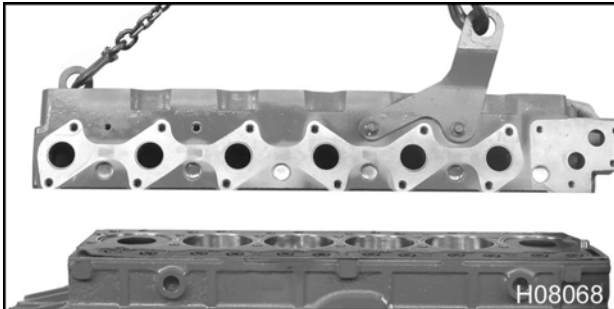


Figure 121 Removing cylinder head from crankcase

2. Attach appropriate hoist and lifting hooks to lifting eyes. Carefully lift the cylinder head from the crankcase.
3. After cylinder head been placed on a workbench surface, remove both lifting eyes and four bolts (M12 x 25) from cylinder head.



Figure 122 Removing cylinder head gasket

NOTE: Place the cylinder head on wood blocks to protect the valves and bottom deck surface.

4. Remove the cylinder head gasket from the crankcase. Discard the gasket.



Figure 123 Removing alignment dowels

5. Remove the alignment dowels from the top of the crankcase, only if damaged.

Hydraulic Lifters

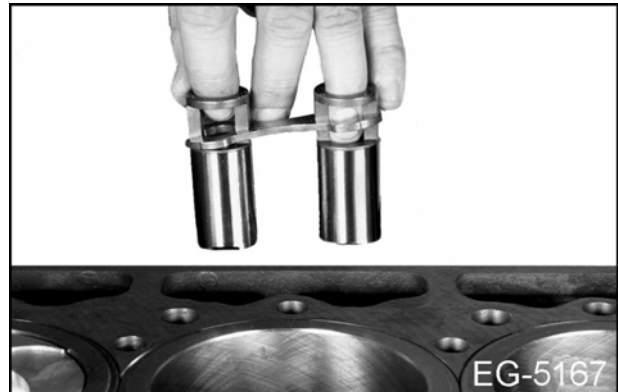


Figure 124 Removing roller tappet and guides

Remove each roller tappet and guide from tappet bore and mark with cylinder number, valve association (intake or exhaust), and roller orientation. Rollers should only be re-installed so they revolve in the same direction as before removal.

Cleaning

Cylinder Head

CAUTION: To avoid engine damage, leave the valves installed within the cylinder head. This protects the valve seats during the cleaning process.

1. Use a rotary wire brush or a sanding block with mineral spirits to remove any deposits and gasket material from the gasket surface of the cylinder head.
2. Use an appropriately sized brush to clean all mounting bolt holes in the cylinder head.

CAUTION: To avoid engine damage, dirty or damaged bolt threads may cause binding and false torque readings.

3. Clean the threads of all cylinder head mounting bolts.
4. Wash rocker arm assemblies, hydraulic lifters, and pushrods in a suitable solvent and dry them thoroughly. Replace any bolts that have damaged threads.

CAUTION: To avoid engine damage, do not use chlorinated solvents on bolts or crankcase tapped holes. Parts should be clean, dry, and free of any chemical residuals other than engine oil.

1. Spin the head bolt thread gauge (Table 18) onto the cylinder head bolt across the entire length of threads.
2. If the thread gauge encounters any resistance on the threads, the bolt is considered stretched beyond limits and therefore cannot be reused.
3. Discard and replace any cylinder head bolt that fails the reusability test with new cylinder head bolts.

Push Rods

1. Thoroughly clean each push rod using a suitable solvent and dry them using filtered compressed air page 3.
2. Inspect each push rod for wear at both ends. Replace as required.

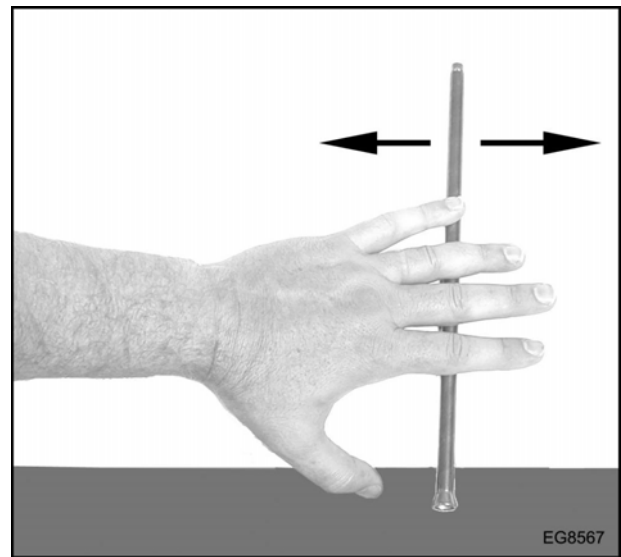


Figure 125 Check push rods for straightness

Inspection

Cylinder Head Bolt Reusability Test

NOTE: A head bolt thread gauge is needed for the successful completion of this procedure.

3. Check all push rods for straightness by rolling on a flat surface with the cup end hanging over the edge of flat surface. Check push rod runout. If specifications are exceeded, replace the push rod. Replace any push rod which are bent.

Rocker Shaft

CAUTION: To avoid engine damage, if it is necessary to replace the rocker shaft, all of the rocker arms must be replaced. Reusing rocker arms on a new shaft will not allow for an adequate break-in period, causing premature failure of the rocker arm assembly.

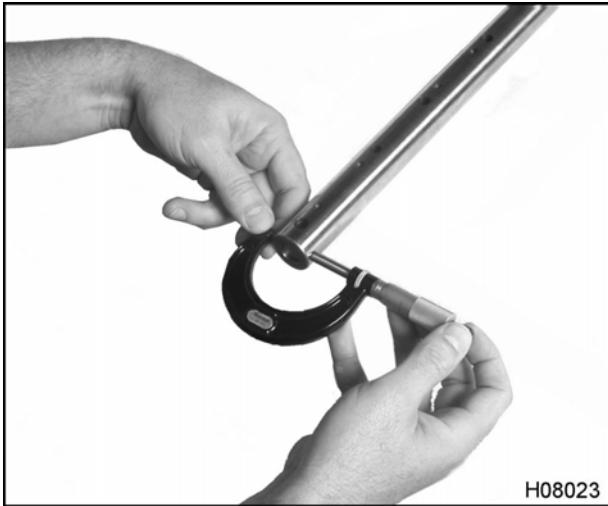


Figure 126 Measuring rocker arm shaft

1. Check the rocker shaft for scoring, pitting and wear. Replace rocker shaft and all of the rocker arms as required.

NOTE: It is normal to see a slight polishing at the rocker arm area.

2. Use an outside micrometer to measure a non-contact area of the rocker shaft. This dimension will be used as a baseline for the shaft diameter.
3. Use an outside micrometer to measure each of the 12 lever contact areas of the rocker shaft. If the difference between the baseline and any of the measurements is greater than 0.03 mm (0.001 in), replace the rocker shaft and all of the rocker arms.
4. To ensure that oil supply holes are open, insert a small wire or another suitable tool.

5. Check the cup plugs at each end of the rocker shaft. Do not disturb the cup plugs unless they are damaged. If replacement is required, pry out the plugs and press in new plugs.

Rocker Arms

1. Inspect arms for scoring, pitting, or signs of excessive wear. If the bore has visible damage, replace the rocker arm. Be sure to inspect the lower half of the rocker arm. The most significant wear will occur at this location. Rocker arms may be reused in their original locations if the phosphate coating is worn off and the shaft was not replaced.

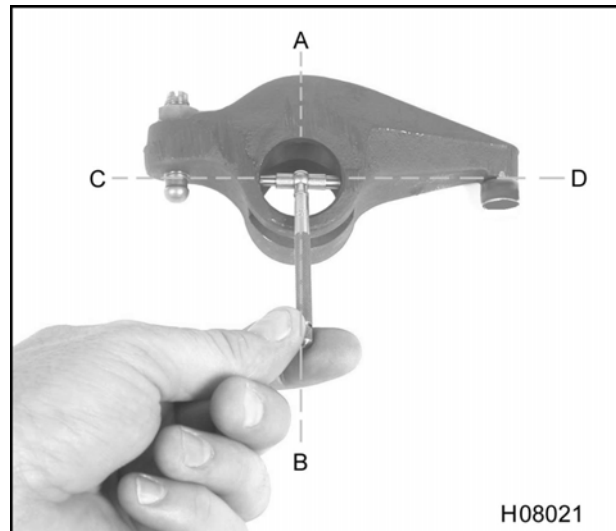


Figure 127 Measuring the rocker arm bore

NOTE: The purpose of the black phosphate coating on the rocker arm is to provide a break-in lubricant between the rocker shaft and rocker arm bore. It is normal to see the black phosphate coatings worn off of the bottom of the lever arm in the shaft and bore contact area. Rocker arms must be labeled and installed in their original locations to maintain the proper wear pattern.

2. Use a telescoping gauge and outside micrometer to measure the rocker arm bore diameter at two locations. Measure the diameter at **A-B** and **C-D**. If the difference between the diameters is greater than or equal to 0.03 mm (0.001 in), replace the rocker arm.

3. Inspect the valve bridge contact pivot on the rocker arm for scoring, pitting, or signs of excessive wear.
4. Inspect the valve lash adjuster for signs of wear. Replace the adjuster screw if excessive wear is found.

Cylinder Head Warpage

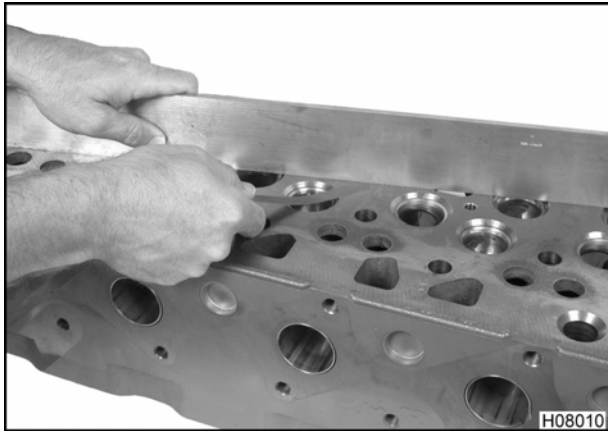


Figure 128 Checking for warpage

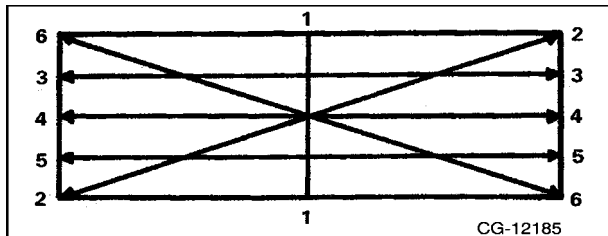


Figure 129 Checking pattern

Use a straightedge and feeler gauge to check the gasket surface of the cylinder head for warpage. Use the checking pattern that is shown. If warpage is present as indicated by a feeler gauge measurements exceeding cylinder head gasket surface flatness specifications, check thickness of cylinder head.

Cylinder Head Thickness

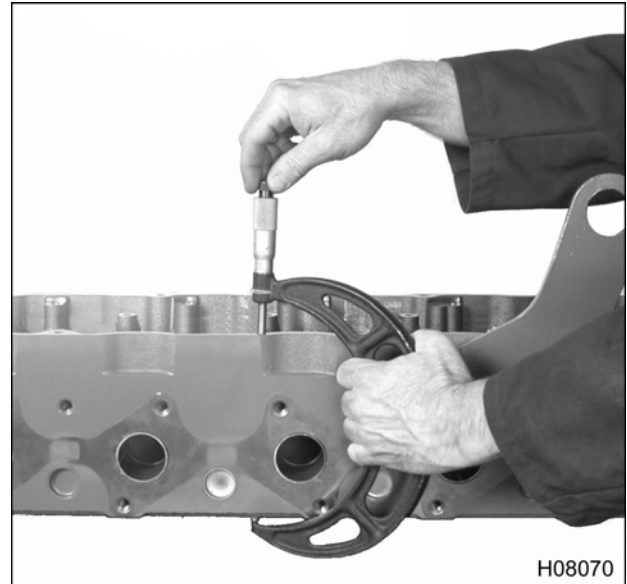


Figure 130 Checking cylinder head thickness

Use a 6-7 inch outside micrometer to measure the thickness of the cylinder head at six locations (four corners and two center points). Cylinder head thickness must equal or exceed the minimum specification after resurfacing. If the minimum specification after resurfacing cannot be met, replace cylinder head.

Valve Seat Leakage

NOTE: This test does not check for the condition of the valve guides or the valve stem-to-valve guide clearance.

1. Position the cylinder head on wood blocks with the gasket surface facing down.
2. Squirt mineral spirits into the intake and exhaust valve ports and wait 5 minutes.
3. Use an inspection mirror to check valve seat area for leakage of the mineral spirits past the valve seats.

NOTE: If leakage occurs, the valves must be reconditioned.

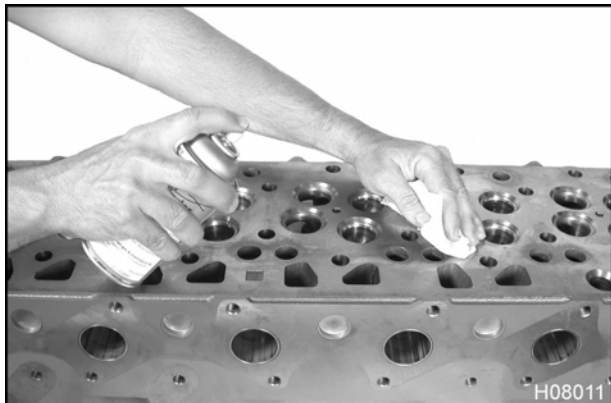
Cylinder Head Cracking

Figure 131 Spraying brake cleaner on cylinder head

NOTE: The cylinder head cracking inspection can be performed with or without valves installed.

1. Spray brake cleaner on the gasket surface of the cylinder head and wipe it dry.

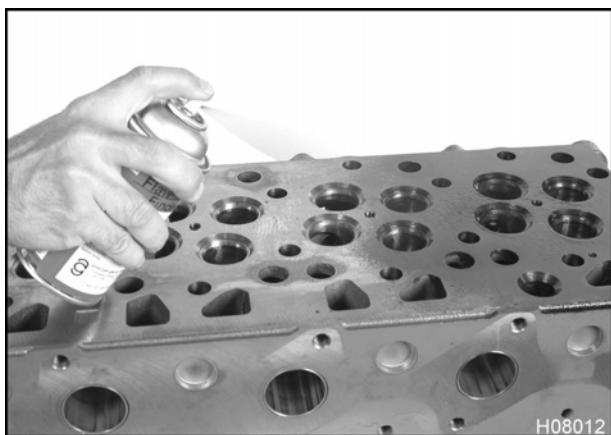


Figure 132 Spraying dye penetrant on cylinder head

2. Spray dye penetrant on the gasket surface of the cylinder head. Leave the dye penetrant on for 1-10 minutes.

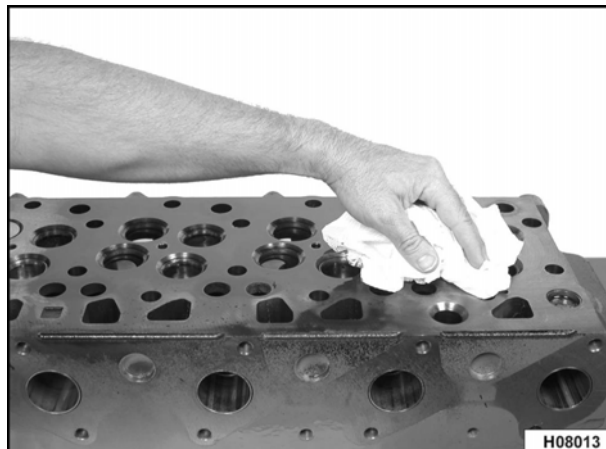


Figure 133 Wiping dye penetrant off cylinder head

3. Wipe off dye penetrant. The dye will remain in any cracks in the cylinder head.



Figure 134 Spraying developer on cylinder head

4. Spray developer on the gasket surface of the cylinder head. Allow the developer to dry for 5-15 minutes.

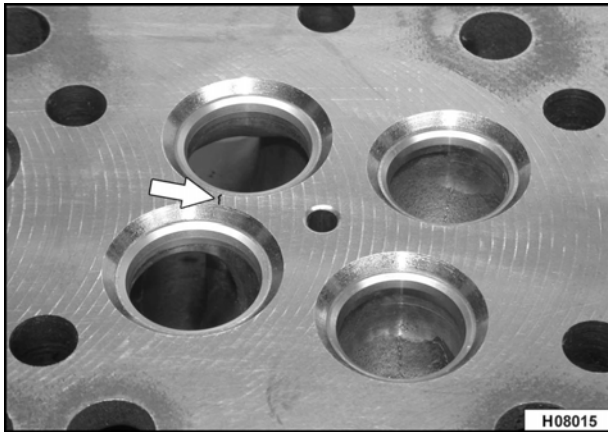


Figure 135 Crack in cylinder head

NOTE: Any cracks will show up as purple lines against the white developer. If any cracks are present, replace the cylinder head.

Pressure Check Cylinder Head

Pressure testing the cylinder head will reveal cracks in ports or sleeve leakage which cannot be observed using dye penetrant. Pressure-test the cylinder head as follows:

1. Install fuel injectors into cylinder head injector bores and secure. Refer to Fuel Injectors (See Fuel Injectors, page 321) for installation procedure.
2. Remove the valves, using a valve spring compressor. See "Reconditioning" in this section for valve removal instructions.
3. Pressure test the cylinder head using the cylinder head pressure test tools (Table 18).

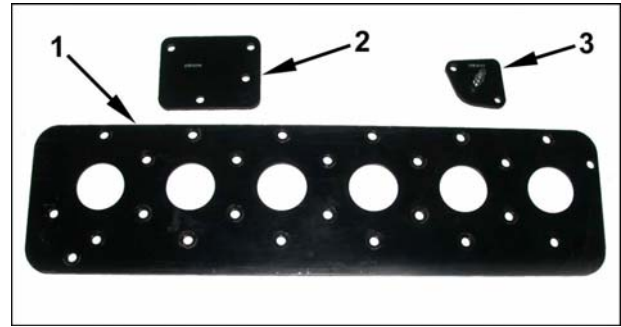


Figure 136 Cylinder head pressure test tools

1. Cylinder head test plate (bolts not shown)
 2. Water supply housing pressure adapter
 3. Thermostat opening pressure adapter- cylinder head
4. Fasten the pressure plate to the cylinder head gasket surface using the 24 mounting bolts and nuts supplied with the kit.
 5. Remove thermostat and install air regulator. Secure to cylinder head with two mounting bolts.
 6. Remove the pipe plug next to the thermostat opening. Fill cylinder head with hot water and reinstall pipe plug
 7. Install a hose fitting to the cylinder head at the removed plug. Apply 124–138 kPa (18–20 psi) air pressure and inspect for leaks at the:
 - Fuel injector nozzle sleeve area
 - Ports
 - Upper deck
 - Lower deck

If leakage is observed at any port or the upper and lower deck, replace the cylinder head.

Reconditioning

Removing Valves from Cylinder Head



WARNING: To avoid serious personal injury, possible death, or damage to the engine or vehicle, wear safety glasses when removing valves or valve spring retainer keys.

1. Install a valve spring compressor tool over the valve, see Cylinder head and valve special service tools (Table 18). Compress the valve spring.

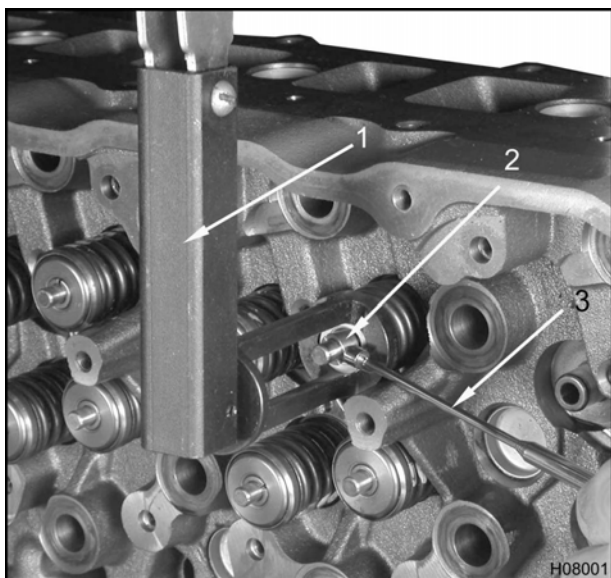


Figure 137 Removing valve spring retainer keys

1. Valve spring compressor tool
 2. Valve spring retainer key
 3. Magnet
2. Use a magnet to remove the valve spring retainer keys.

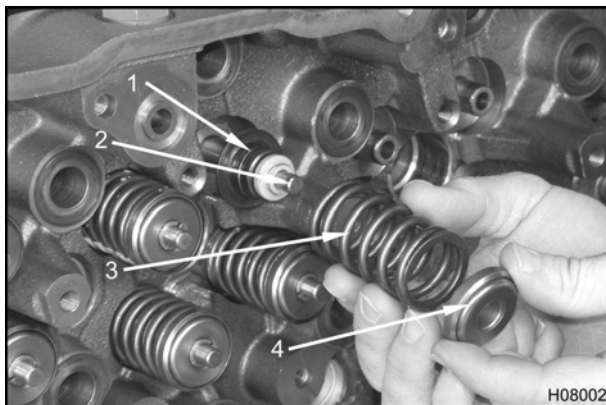


Figure 138 Removing valve rotator, spring, and valve stem seal

1. Valve stem seal
2. Valve stem
3. Valve spring
4. Valve rotator

3. Remove valve spring compression tool, valve rotator, and spring.
4. Remove and discard valve stem seal.
5. Remove valve from the cylinder head.
6. Repeat steps 1-5 for all 24 valve locations.

Inspecting Valve Guides

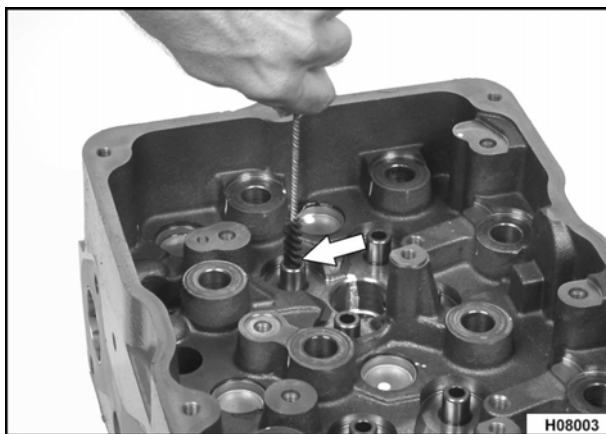


Figure 139 Cleaning valve guides

1. After removing valves, use soap, water, and a nylon brush to clean valve guides.

2. Position an inspection light at the bottom of the valve guide bores. Inspect bores for signs of burning or cracking. Replace any valve guides that are damaged.



Figure 140 Measuring valve guide with ball gauge



Figure 141 Measuring ball gauge with an outside micrometer

3. Use a ball gauge and an outside micrometer to measure the inside diameter of each valve guide.

If inside diameter of valve guide exceeds specifications, replace valve guide.

4. Measure the valve guides within 0.64 mm (0.025 in) of each end and 90 degrees from the crankshaft center line. Record the readings in order to determine the valve-to-guide running clearance later.

Replacing Valve Guides

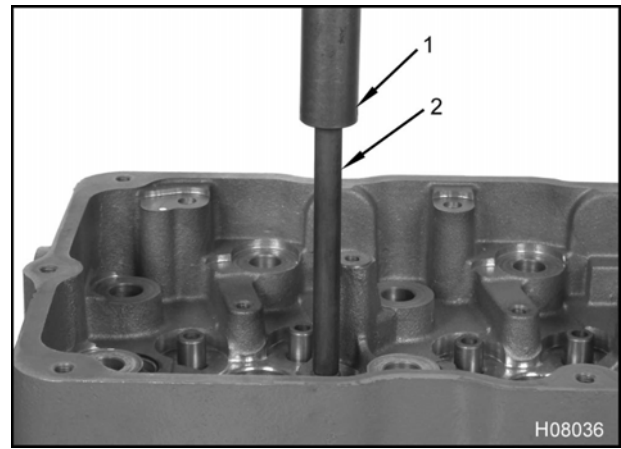


Figure 142 Pressing out valve guide insert

1. Arbor press ram
2. Valve guide removal tool

1. Secure the cylinder head on a press table. Align the valve guide to be replaced with the center of the press ram.
2. Insert the valve guide removal tool into the valve guide from the top side of the cylinder head. Press out the valve guide insert.

CAUTION: To avoid engine damage, do not use a hammer or any other tool to remove or install the valve guide inserts into the cylinder head.

NOTE: Chilling the valve guide inserts first may facilitate installation.

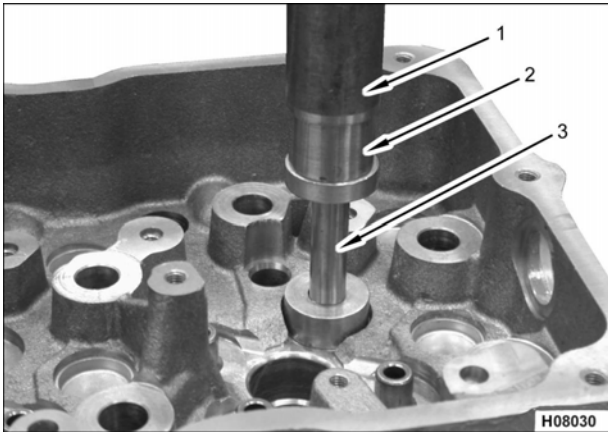


Figure 143 Pressing in the valve guide insert

1. Arbor press ram
 2. Valve guide installation tool
 3. Valve guide insert
3. Lubricate a new valve guide insert with clean engine oil. Use the valve guide installation sleeve to install the valve guide insert until the installation sleeve bottoms out against the cylinder head.

NOTE: Do not ream the inside diameter of the valve guide after installation. Service valve guides are provided in a finish reamed condition.

4. After installing the valve guide insert, debur the valve guide by using the valve guide deburring tool.

Inspecting Valves

1. Remove all carbon deposits from the valve stems and valve heads.
2. Inspect each valve for burn marks, warpage, scuffing and bending. Replace any damaged valves.

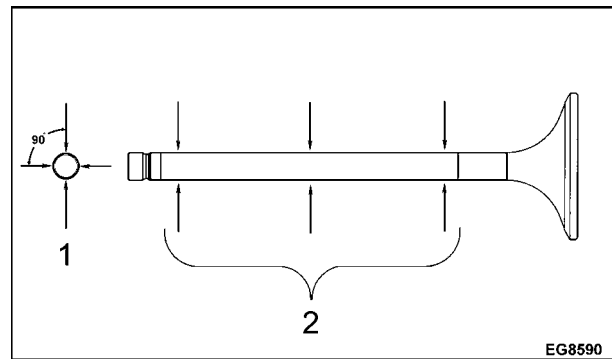


Figure 144 Measuring valve stem diameter

1. Two measurements 90 degrees apart
 2. Valve stem diameter measurement locations
3. To check for wear, use a micrometer to measure the diameter of each valve stem.
4. Measure the valve stem diameter at two locations that are approximately equidistant. At each location, take two measurements that are 90 degrees apart. Average the two measurements at each location and record the readings.
- If the average of measurements at any of the two locations exceed the valve stem diameter specification, replace the valve.
5. Inspect the valve stem tip for scoring, pitting, or signs of excessive wear.
6. Using the valve stem diameter and valve guide inside diameter measurements, recorded earlier (see "Inspecting Valve Guides") determine valve stem-to-guide running clearance. See "Specifications". Replace the valve or valve guides as required.

NOTE: Subtract the average valve stem diameter from the average valve guide inner diameter (determined earlier).

Valve Guide – Valve Stem = Running Clearance.

Refacing Valves

Valve Face

NOTE: If the valves are in serviceable condition, they may be refaced to the specified angles, as required.

CAUTION: To avoid engine damage, maintain the minimum valve face margin across the entire valve face. An insufficient valve face margin will not provide proper heat dissipation, ultimately causing the valve to warp or break.

NOTE: Make sure that there is sufficient coolant in the valve grinding machine reservoir. Turn coolant pump on before grinding.

1. Use the dressing stud attachment on the grinder to dress the cutting stone.

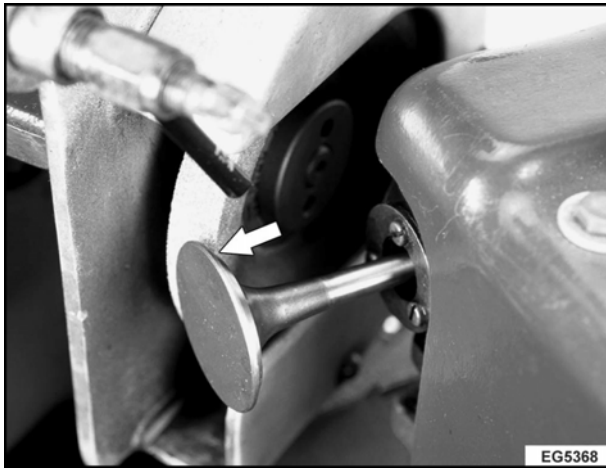


Figure 145 Grinding valve face

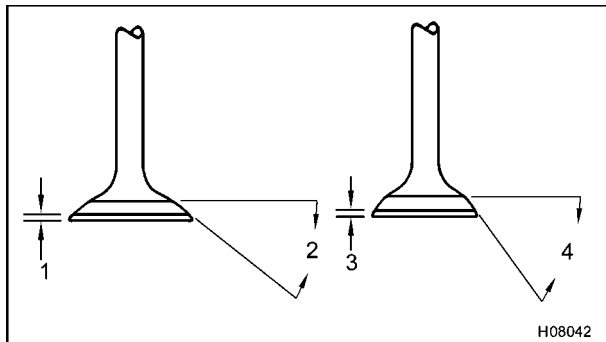


Figure 146 Valve face angles

1. Intake margin
2. Intake valve angle
3. Exhaust margin
4. Exhaust valve angle

NOTE: Intake valves and exhaust valves have different valve face margins.

2. Install valve in the grinder and set the grinder to the specified angle.
3. Turn on coolant and grinder.

NOTE: Removal of too much material may reduce the margin below minimum specifications.

4. Grind the valve face. Only remove the minimum amount of material necessary.

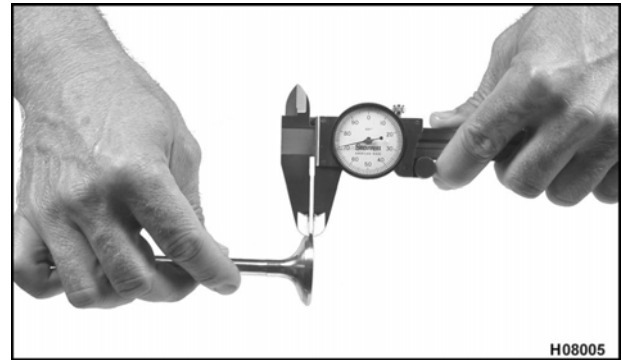


Figure 147 Measuring valve face margin

5. Use a caliper to measure the valve face margin at four locations. If any of the measurements are less than the minimum specification (Table 14), replace valve.

Valve Stem Tip

CAUTION: To avoid engine damage, leave a sufficient amount of material so that the valve bridge does not contact the valve retainer keys or valve rotator during operation. Refacing the tip of the valve stem provides a new wear surface for the valve bridge.

1. Use the dressing stud attachment on the grinder to dress the cutting stone.

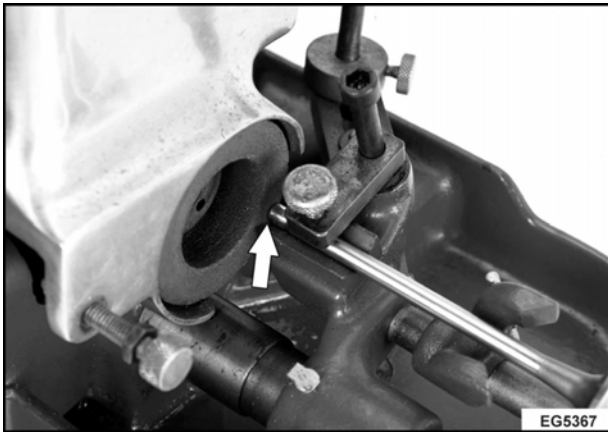


Figure 148 Grinding valve stem

2. Install the valve in the grinder so that the tip of the valve stem is close to the grinding stone.
3. Briefly touch the tip of the valve stem to the grinding stone. Only remove the minimum amount of material that is necessary.

Checking Valve Face-to-Valve Seat Contact

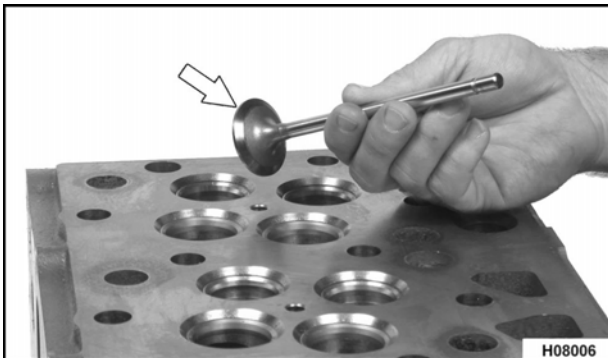


Figure 149 Applying Prussian Blue™ to valve face

1. After refacing a valve, spread a thin film of Prussian Blue™ on the valve face and insert the valve in the valve guide.



Figure 150 Turning valve on valve seat

2. Apply pressure on the center of the valve head while turning the valve 90 degrees on the valve seat.
3. Remove the valve from the cylinder head. Check the impression that was made on the valve seat and valve face. Prussian Blue should appear around the entire contact surface of the valve seat and valve face.
4. Perform this check several times to rule out any errors. If the Prussian Blue™ contact impression is good, proceed to valve installation. If the Prussian Blue™ contact impression is not good, continue with resurfacing valve seats.