

- | | |
|-------------------------|----------------------|
| 1. Right crankcase half | 8. Seal (2) |
| 2. Pin (2) | 9. Retainer (2) |
| 3. O-ring (2) | 10. O-ring (2) |
| 4. Plate | 11. Screw (2) |
| 5. Screw | 12. Push rod (2) |
| 6. Tappet lifter (2) | 13. Washer (2) |
| 7. Push rod cover (2) | 14. Washer |
| | 15. Locating pin (2) |

Figure 3-10. Middle Valve Train Components
(Quantities per Engine Cylinder)

CLEANING, INSPECTION AND REPAIR

1. Bead blast or scrape carbon from head, top of cylinder and valve ports. Be careful to avoid scratching or nicking cylinder head and cylinder joint faces. Blow off loosened carbon or dirt with compressed air.
2. Soak cylinder head in an aluminum-compatible cleaner/solvent to loosen carbon deposits.
3. Wash all parts in non-flammable solvent, followed by a thorough washing with hot, soapy water. Blow out oil passages in head. Be sure they are free of sludge and carbon particles. Remove loosened carbon from valve head and stem using a wire wheel. Never use a file or other hardened tool which could scratch or nick valve. Polish valve stem with very fine emery cloth or steel wool.
4. Check each rocker arm, at pad end and push rod end, for uneven wear or pitting. Replace rocker arm if either condition exists.

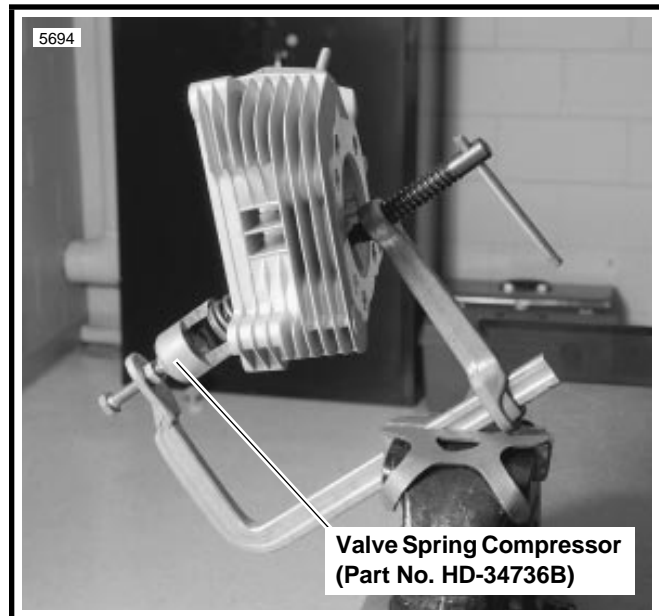


Figure 3-11. Compressing Valve Springs



Figure 3-12. Measuring Rocker Arm Shaft Diameter
(Rocker Cover Position)

5. See [Figure 3-12](#) and [Figure 3-13](#). Measure rocker arm shaft diameter at the positions where shaft fits in lower rocker arm cover and where rocker arm bushings ride. Record the measurements.
6. See [Figure 3-14](#) and [Figure 3-15](#). Measure rocker arm shaft bore diameter in lower rocker cover and rocker arm bushing inner diameter. Record the measurements.
7. Check the clearances and measurements obtained in Steps 5 and 6 against the [SERVICE WEAR LIMITS](#). Repair or replace parts exceeding the [SERVICE WEAR LIMITS](#).
8. Assemble rocker arms and rocker arm shafts into lower rocker cover.



Figure 3-13. Measuring Rocker Arm Shaft Diameter (Rocker Arm Bushing Position)



Figure 3-15. Measuring Rocker Arm Bushing Inner Diameter

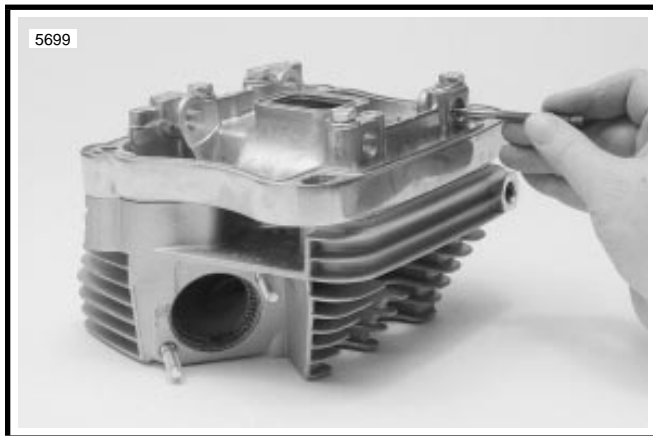


Figure 3-14. Measuring Rocker Arm Shaft Bore Diameter in Lower Rocker Cover

9. Check end play of rocker arm with feeler gauge.
10. Replace rocker arm or lower cover or both if end play exceeds 0.025 in. (0.63 mm).
11. Valve heads should have a seating surface width of 0.040-0.062 in. (1.02-1.57 mm), and should be free of pit marks and burn spots. The color of carbon on exhaust valves should be black or dark brown. White or light buff carbon indicates excessive heat and burning.
12. Valve seats are also subject to wear, pitting, and burning. They should be resurfaced whenever valves are refinished.
13. Clean valve guides by lightly honing with [VALVE GUIDE HONE \(Part No. HD-34723\)](#).
14. Scrub guides with [VALVE GUIDE BRUSH \(Part No. HD-34751\)](#) and hot soapy water. Measure valve stem outer

diameter and valve guide inner diameter. Check measurements against [SERVICE WEAR LIMITS](#).

15. Inspect spark plug threads for damage. If threads in head are damaged, a special plug type insert can be installed using a 12 mm spark plug repair kit.
16. Inspect valve springs for broken or discolored coils.
17. See [Figure 3-16](#). Check free length and compression force of each spring. Compare with [SPECIFICATIONS](#). If spring length is shorter than specification, or if spring compression force is below specification, replace spring.
18. Examine push rods, particularly the ball ends. Replace any rods that are bent, worn, discolored, or broken.
19. See [Figure 3-17](#). Check head gasket surface on head for flatness. Machine or replace any head which exceeds [SERVICE WEAR LIMIT](#) of 0.006 in. (0.15 mm).

Rocker Arms and Bushings

1. See [Figure 3-18](#). To replace worn bushings, press or drive them from the rocker arm. If bushing is difficult to remove, turn a 9/16-18 tap into bushing. From opposite side of rocker arm, press out bushing and tap.
2. Press replacement bushing into rocker arm, flush with arm end, and split portion of bushing towards top of arm.
3. Using remaining old bushing as a pilot, line ream new bushing with [ROCKER ARM BUSHING REAMER \(Part No. HD-94804-57\)](#).
4. Repeat for other end of rocker arm.

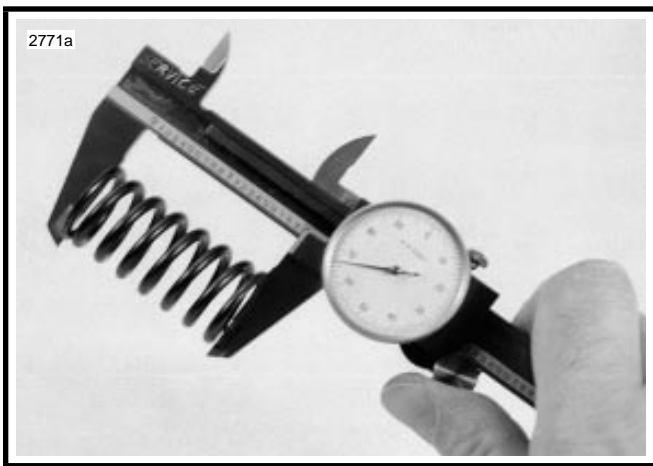


Figure 3-16. Checking Spring Free Length

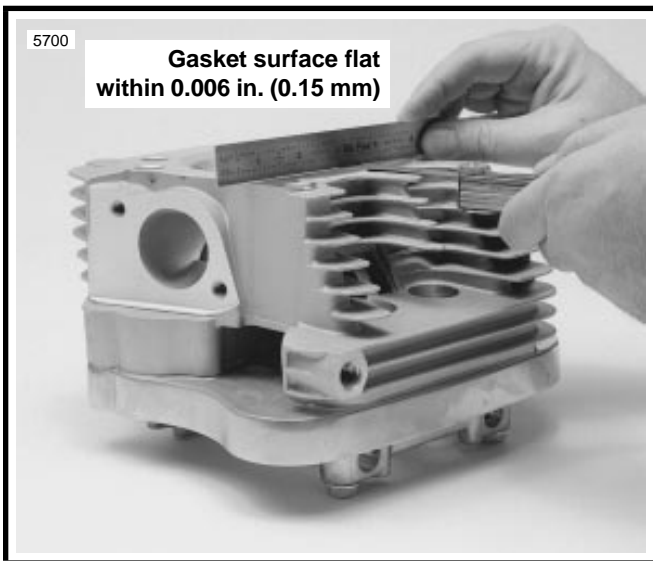


Figure 3-17. Checking Gasket Surface

Replacing Valve Guides

Valve guide replacement, if necessary, must be done before valve seat is ground. It is the valve stem hole in valve guide that determines seat grinding location. Valve stem-to-valve guide clearances are listed in [Table 3-3](#). If valve stems and/or guides are worn beyond service wear limits, install **new** parts.

Table 3-3. Valve Stem Clearances and Service Wear Limits

| VALVE | CLEARANCE | SERVICE WEAR LIMIT |
|---------|-------------------|--------------------|
| Exhaust | 0.0015-0.0033 in. | 0.0040 in. |
| Intake | 0.008-0.0026 in. | 0.0035 in. |

1. To remove shoulderless guides, press or tap guides toward combustion chamber using [DRIVER HANDLE AND REMOVER \(Part No. HD-34740\)](#).
2. Clean and measure valve guide bore in head.

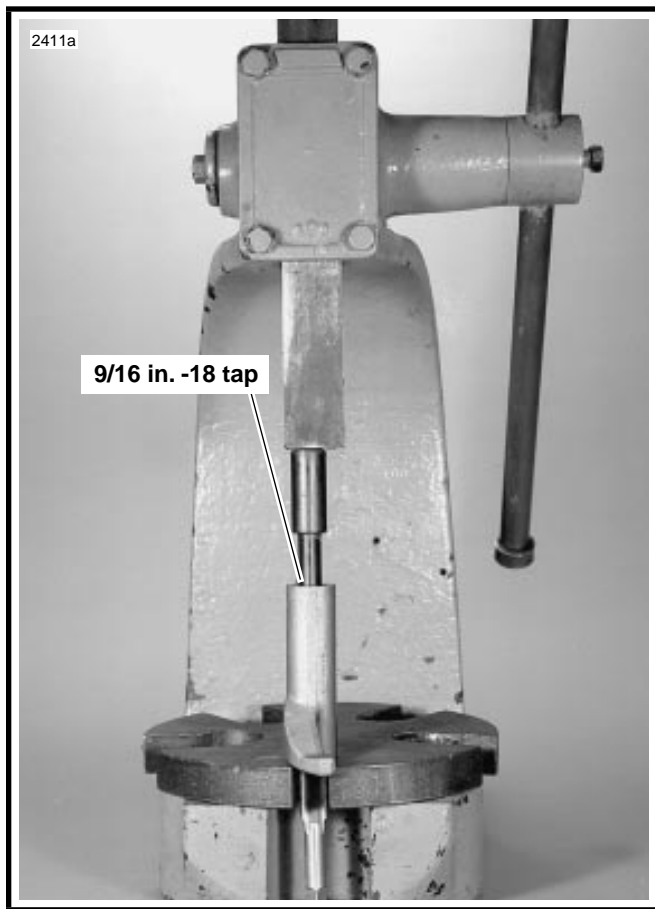


Figure 3-18. Removing Rocker Arm Bushing

3. Measure outer diameter of a new standard valve guide. The guide diameter should be 0.0020-0.0033 in. (0.051-0.084 mm). larger than bore in head. If it is not, select one of the following oversizes: +0.001 in., +0.002 in., or +0.003 in. (+0.025, +0.05 +0.08 mm) (intake and exhaust).
4. See [Figure 3-19](#). Install shoulderless guides using [VALVE GUIDE INSTALLATION TOOL \(Part No. HD-34731\)](#) and [DRIVER HANDLE \(Part No. HD-34740\)](#). Press or drive guide until the tool touches the machined surface surrounding the guide. At this point, the correct guide height has been reached.
5. Ream guides to final size or within 0.0010 in. (0.025 mm) of final size using [VALVE GUIDE REAMER \(Steel, Part No. HD-39932 or Carbide, Part No. HD-39932-CAR\)](#). Use [REAMER LUBRICANT \(Part No. HD-39964\)](#) or liberal amounts of suitable cutting oil to prevent reamer chatter.
6. See [Figure 3-20](#). Apply the proper surface finish to the valve guide bores using the [VALVE GUIDE HONE \(Part No. HD-34723\)](#). Lubricate hone with honing oil. Driving hone with an electric drill, work for a crosshatch pattern with an angle of approximately 60°.

NOTE

The hone is not intended to remove material.

7. Thoroughly clean valve guide bores using [VALVE GUIDE BRUSH \(Part No. HD-34751\)](#) and hot soapy water.

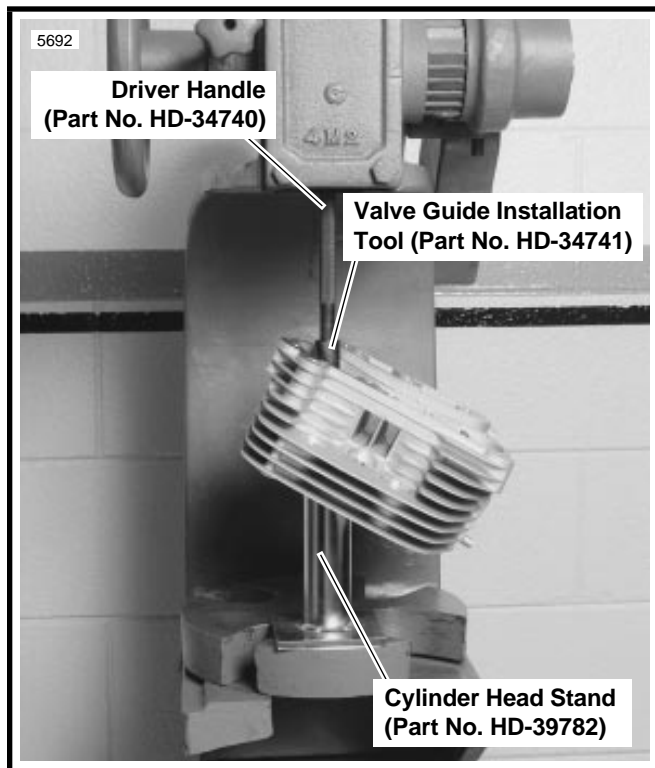


Figure 3-19. Installing Shoulderless Valve Guide

Grinding Valve Faces and Seats

After installing valve guides, valve seats must be refaced to make them concentric with guides.

Valve face angle is 45° for both intake and exhaust valves. If a valve refacing grinder is used, it must be adjusted exactly to this angle. It is important to remove no more metal than is necessary to clean up and true valve face. Install a **new** valve if grinding leaves the valve edge (the margin) with a width of less than 1/32 in. (0.8 mm). A valve with too thin a margin does not seat normally, burns easily, may cause pre-ignition and can also lead to valve cracking. Valves that do not clean up quickly are probably warped or too deeply pitted to be reused. Replace the valve if end of valve stem shows uneven wear. After valves have been ground, handle with care to prevent damage to the ground faces.

The valve seats may be refinished with cutters or grinders. Cut seats to a 46° angle or grind seats to a 45° angle. Valve seat tools and fixtures are available commercially. Seat each valve in the same position from which it was removed.

The correct 3-angle valve seat angles are shown in [Figure 3-21](#). Use a [NEWAY VALVE SEAT CUTTER](#) (Part No. 444-HDF; part of [NEWAY VALVE SEAT CUTTER SET, Part No. HD-35758](#)) to cut the seats. Always grind valves before cutting seats.

1. Cut 46° (or grind 45°) valve seat angle first. Use cutting oil to avoid chatter marks. Cut or grind only enough to clean up the seat.

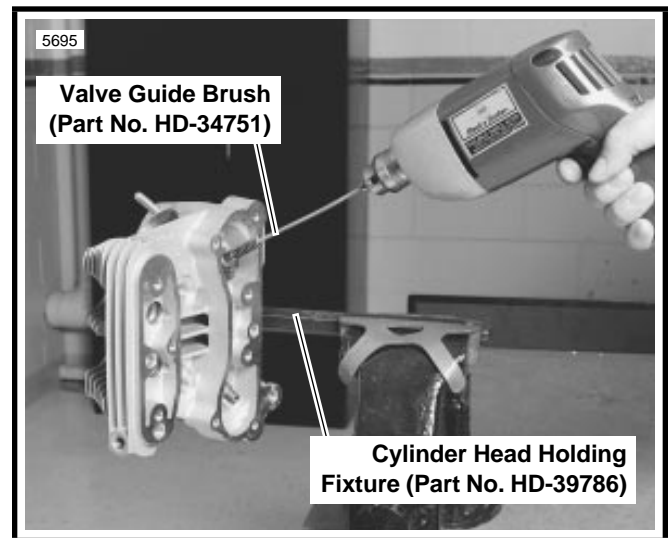


Figure 3-20. Honing Valve Guides

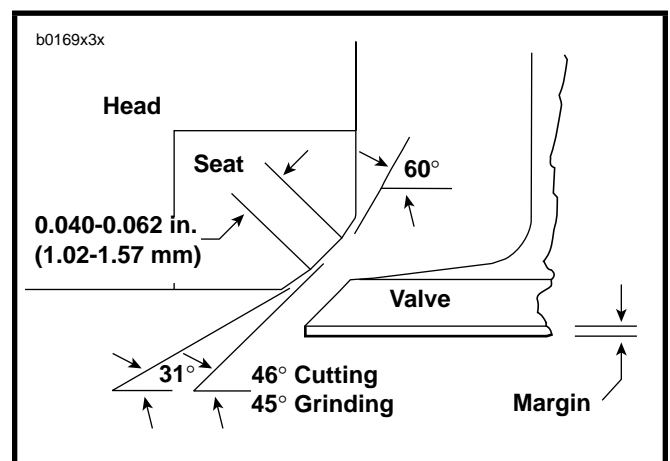


Figure 3-21. Valve Seat Angles

2. Apply a small amount of lapping compound to the valve face. Rotate valve against seat using [VALVE LAPPING TOOL](#) (Part No. HD-96550-36A).
3. See [Figure 3-21](#). Check the contact pattern on valve face. It should be 0.040-0.062 in. (1.02-1.57 mm) wide, and its center should be positioned 2/3 of the way toward the outside edge of face.
4. If valve seat pattern is too close to the stem side of valve face, cut 60° angle in order to raise seat. If pattern is too close to the edge of valve face, cut 31° angle in order to lower seat.
5. After cutting either or both 31° or 60° angles to position seat, final cut 46° (or grind 45°) seat angle to obtain proper 0.040-0.062 in. (1.02-1.57 mm) width.
6. Recheck valve seat width and location with lapping compound as described in Step 2.
7. To achieve a smooth even finish, place a piece of 280 grit emery paper under the cutter head and rotate cutter.

CAUTION

Do not grind valve to shorten. Grinding will remove the case hardening and expose the stem's mild steel core resulting in rapid end wear.

8. See [Figure 3-22](#). Wipe valve seats and valve faces clean. Measure valve stem protrusion. If valve stem protrudes more than 2.034 in. (51.66 mm), replace valve seat or cylinder head. If valve stem protrusion is within the acceptable range, valves and seats are ready for lapping.

Replacing Valve Seats

Replacing a valve seat is a complex operation requiring special equipment. If the seat is loose or is not fully seated in the head, then seat movement will prevent the proper transfer of heat from the valve. The seat surface must be flush with (or below) the head surface. See [SPECIFICATIONS](#) for valve seat-to-cylinder head fit.

To remove the old seat, lay a bead of weld material around the inside diameter of the seat. This will shrink the seat outside diameter and provide a surface for driving the seat out the port side.

Lapping Valve Faces and Seats

NOTE

If valve faces and seats have been smoothly and accurately refaced, very little lapping will be required to complete the seating operation.

1. See [Figure 3-23](#). Apply a light coat of fine lapping compound to valve face. Insert valve in guide. Position one rubber cup end of [VALVE LAPPING TOOL \(Part No. HD-96550-36A\)](#) onto head of valve. Holding lapping tool as shown, apply only very light pressure against valve head, and rotate lapping tool and valve alternately clockwise and counterclockwise a few times.
2. Lift valve and rotate it about 1/3 of a turn clockwise. Repeat lapping procedure in Step 1.
3. Repeat Step 2. Then, remove valve.
4. Wash valve face and seat; dry with a **new**, clean cloth or towel.
5. If inspection shows an unbroken lapped finish of uniform width around both valve and seat, valve is well seated. If lapped finish is not complete, further lapping (or grinding and lapping) is necessary.



Figure 3-22. Measuring Valve Stem Protrusion

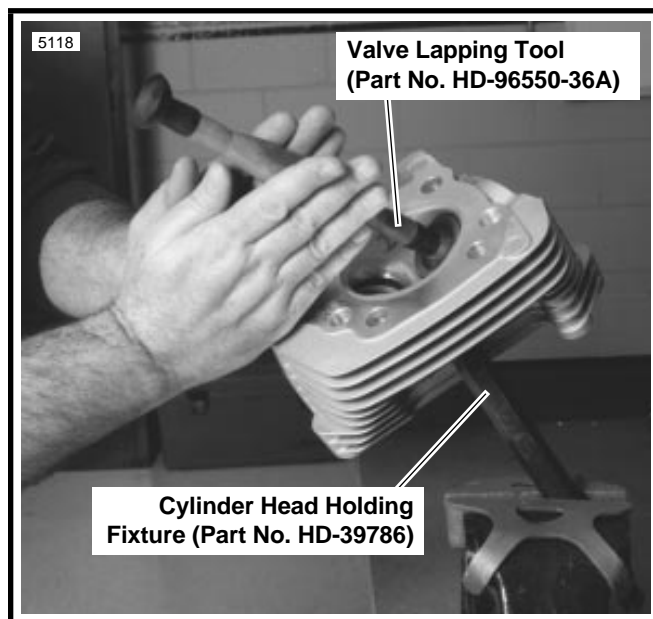


Figure 3-23. Lapping Valves