

# Chapter Seven

## GM V6 and V8 Engines

A wide range of GM powerplants has been offered for **MerCruiser** installations. Engines include the 229 cid V6, the small block **V8** in displacements up to 350 cid, and the large block V8 (or Mark IV) up to 482 cid.

The Chevrolet-built V6 and V8 engines are very similar in design and construction; there is little difference in the repair and service procedures for these engines. The procedures given in this chapter are typical and apply to all engines, except where specifically noted.

The V6 engine cylinders are numbered from front to rear: 1-3-5 on the port bank and 2-4-6 on the starboard bank. The cylinder firing order is 1-6-5-4-3-2. The **V8** engine cylinders are numbered from front to rear: 1-3-5-7 on the port bank and 2-4-6-8 on the starboard bank. The cylinder firing order is 1-8-4-3-6-5-7-2.

Hydraulic valve lifters and **pushrods** operate the rocker arms and valves. No lash adjustment is necessary in service or during assembly unless some component in the valve train has been replaced.

The cast iron crankshaft is supported by 4 (V6) or 5 (V8) main bearings. Crankshaft rotation is counterclockwise when seen from the drive unit end of the engine.

The chain-driven camshaft is supported by 4 (V-6) or 5 (V-8) bearings and is located above the crankshaft between the 2 cylinder banks. The oil pump is located on the bottom front of the block and is driven by the distributor.

Specifications (**Tables 1-4**) and tightening torques (**Table 5**) are at the end of the chapter.

### ENGINE SERIAL NUMBER

The engine serial number is stamped on a **plate** mounted at the rear of the engine on the flywheel housing (**Figure 1**).

This information identifies the engine and indicates if there are unique parts or if internal changes have been made during the model run. It is important when ordering replacement parts for the engine.

### SPECIAL TOOLS

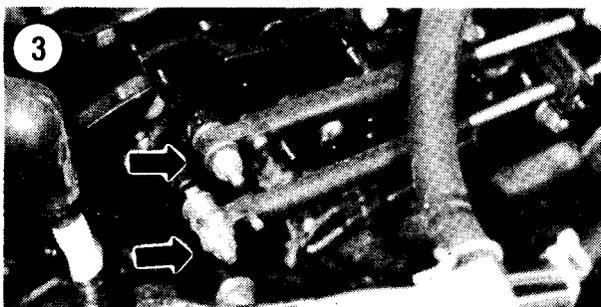
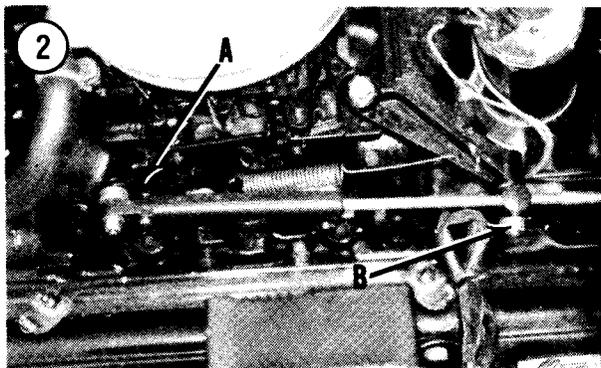
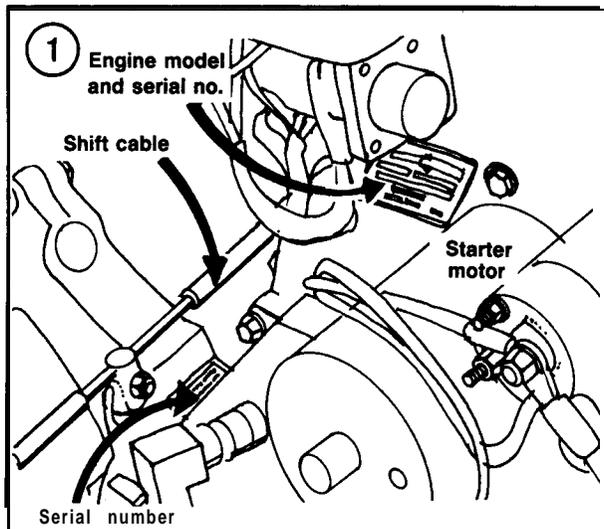
Where special tools are required or recommended for engine overhaul, the tool numbers are provided. Mercury Marine tool part numbers have a "C" prefix. GM tool part numbers have a "J" prefix. While GM tools can sometimes be rented from rental dealers, they can be purchased from Kent-Moore, Inc., 28635 Mound Road, Warren, MI 48089.

### REPLACEMENT PARTS

Various changes are made to automotive engine blocks used for marine applications. Numerous part changes are required due to operation in fresh and salt water. For example, the cylinder head gasket must be corrosion-resistant. Marine engines use head gaskets of copper or stainless steel instead

of the standard steel used in automotive applications. Brass expansion or core plugs must be used instead of the steel plugs found in automotive blocks.

Since marine engines are run at or near maximum rpm most of the time, the use of special valve lifters, springs, pistons, bearings, camshafts and other heavy-duty moving components is necessary for maximum life and performance.



For these reasons, automotive-type parts should not be substituted for marine components. In addition, Mercury recommends that only Quicksilver parts be used. Parts offered by other manufacturers may look alike, but may not be manufactured to Mercury's specifications. Any damage resulting from the use of other than Quicksilver parts is not covered by the Mercury Marine warranty.

## REMOVAL

Some service procedures can be performed with the engine in the boat; others require removal. The boat design and service procedure to be performed will determine whether the engine must be removed. In some installations, it may be necessary to remove the stern drive unit first. See Chapter Fourteen.

### WARNING

*The engine is heavy, awkward to handle and has sharp edges. It may shift or drop suddenly during removal. To prevent serious injury, always observe the following precautions.*

1. Never place any part of your body where a moving or falling engine may trap, cut or crush you.
2. If you must push the engine during removal, use a board or similar tool to keep your hands out of danger.
3. Be sure the hoist is designed to lift engines and has enough load capacity for your engine.
4. Be sure the hoist is securely attached to safe lifting points on the engine.
5. The engine should not be difficult to lift with a proper hoist. If it is, stop lifting, lower the engine back onto its mounts and make sure the engine has been completely separated from the boat.

1. Remove the engine hood cover and all panels that interfere with engine removal. Place to one side out of the way.
2. Disconnect the negative battery cable, then the positive battery cable. As a precaution, remove the battery from the boat.
3. Disconnect the throttle cable at the carburetor (A, Figure 2, typical). If necessary, remove cable from anchor plate (B, Figure 2, typical).
4. Disconnect the engine-to-dash wiring harness.
5. Disconnect the fuel lines at the fuel pump. Plug the fuel lines to prevent leakage.
6. Disconnect the shift cables from the shift plate (Figure 3, typical), then remove the cables from the J-clamp on the exhaust manifold (Figure 4).

7. Disconnect the water inlet hose.
8. Disconnect the exhaust elbow bellows.
9. Disconnect the reverse lock switch wires from the trim pump. Disconnect the trim pump wires (red and black) from the engine or battery.
10. Remove the gray "down" hose from the reverse lock. Remove the black plastic hose from the trim sender. Plug hoses and cap connections.
11. Open the engine drain valve(s) and drain all water from the block.
12. Attach a lifting bracket to the engine lifting eyes. Connect the bracket to an engine hoist and elevate it enough to remove all slack.

#### NOTE

*At this point, there should be no hoses, wires or linkage connecting the engine to the boat or stern drive unit. Recheck this to make sure nothing will hamper engine removal.*

13. Remove the bell housing-to-engine bolts.
14. Remove the engine mount-to-deck mount bolts.
15. If clearance is limited, remove the engine mounting brackets.
16. Slide the engine forward sufficiently to disengage it from the drive-shaft assembly.
17. Remove the engine from the boat with the hoist.

### ENGINE INSTALLATION

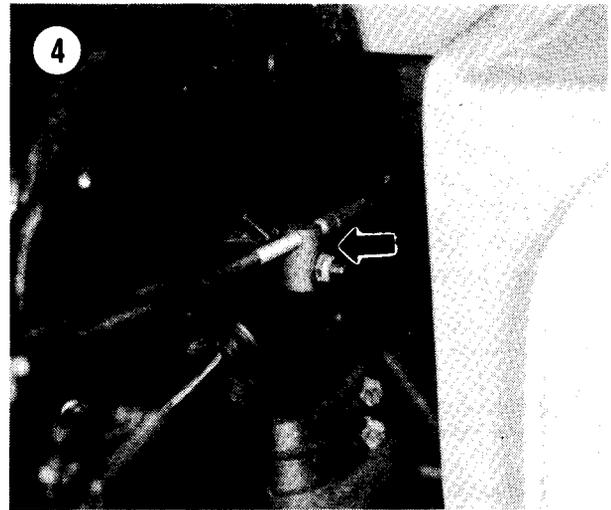
Engine installation is the reverse of removal, plus the following.

1. Fit a double-wound lockwasher and a fiber washer on top of each inner transom plate engine support. See **Figure 5**.
2. Lower engine in place over transom plate and connect exhaust bellows to elbows while lowering. Let rear engine mounts rest on transom plate engine supports but do not remove hoist tension.

#### CAUTION

*Elastic stop nuts should never be used more than twice. It is a good idea to replace such nuts with new ones each time they are removed. Never use worn-out stop nuts or non-locking nuts.*

3. Install one steel washer and spacer on each rear mount bolt. Install bolts downward through engine mounts, washers and brackets. Thread elastic stop nuts on bolts and tighten to specifications (**Table 4**).



4. Use guide bolts to align the engine to the bell housing. It may be necessary to rotate the crankshaft slightly to align the engine coupling splines with the drive shaft. You may also rotate the drive shaft by placing the outdrive in forward gear and rotating the propeller.
5. Coat the engine coupling splines with multi-purpose lubricant.

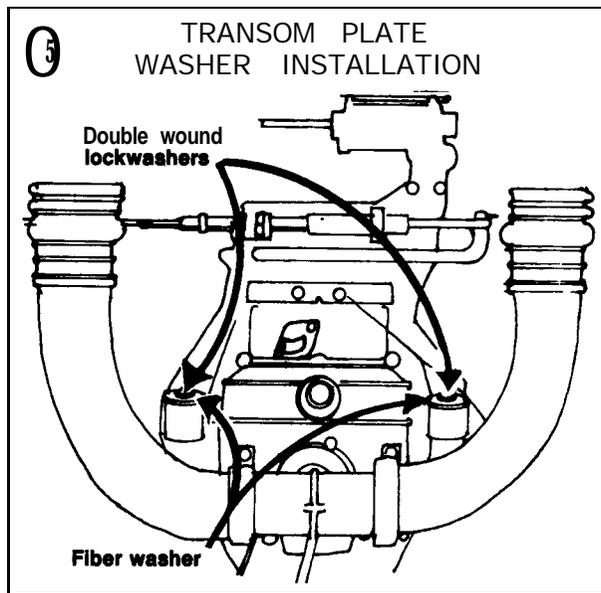
#### CAUTION

*If the alignment tool specified in Step 6 is not available, take the boat to a MerCruiser dealer for proper alignment. Drive shaft/coupling spline misalignment can cause serious damage.*

6. Coat the solid end of alignment tool part No. C-91-57797A3 with multipurpose lubricant and insert it from outside the boat through the U-joint bellows into the gimbal bearing. Index the bearing and drive shaft with the engine coupling splines. If indexing is difficult, raise or lower the engine with the hoist as required to permit indexing with no resistance.
7. Tighten all fasteners to specifications (**Table 4**). Remove the alignment tool.
8. Close all water drain valves.
9. Fill the engine with an oil recommended in Chapter Four.
10. Fill the cooling system, if equipped with a closed system. See Chapter Twelve.
11. Adjust the drive belts. See Chapter Thirteen.

### DISASSEMBLY CHECKLISTS

To use the checklists, remove and inspect each part in the order mentioned. To reassemble, go



through the checklists backwards, installing the parts in order. Each major part is covered under its own heading in this chapter, unless otherwise noted.

#### Decarbonizing or Valve Service

1. Remove the rocker arm cover.
2. Remove the intake and exhaust manifolds.
3. Remove the rocker arm.
4. Remove the cylinder head.
5. Remove and inspect the valves. Inspect valve guides and seats, repairing or replacing as required.
6. Assemble by reversing Steps 1-5.

#### Valve and Ring Service

1. Perform **Decarbonizing or Valve Service**.
2. Remove the oil pan.
3. Remove the pistons with the connecting rods.
4. Remove the piston rings. It is not necessary to separate the pistons from the connecting rods unless a piston, connecting rod or piston pin needs repair or replacement.
5. Assemble by reversing Steps 1-4.

#### General Overhaul

1. Remove the engine from the boat.
2. Remove the flywheel.
3. Remove the engine mount brackets and oil pressure sending unit from the engine.

4. If available, mount the engine on an engine stand. These can be rented from equipment rental dealers. The stand is not absolutely necessary, but it will make the job much easier.
  5. Check the engine for signs of coolant or oil leaks.
  6. Clean the outside of the engine.
  7. Remove the distributor. See Chapter Thirteen.
  8. Remove all hoses and tubes connected to the engine.
  9. Remove the fuel pump. See Chapter Eleven.
  10. Remove the intake and exhaust manifolds.
  11. Remove the thermostat. See Chapter Twelve.
  12. Remove the rocker arm assemblies.
  13. Remove the crankshaft pulley/vibration damper and timing case cover. Remove the timing chain and sprockets or the timing gears.
  14. Remove the camshaft.
  15. Remove the seawater pump, if so equipped. See Chapter Twelve.
  16. Remove the cylinder heads.
  17. Remove the oil pan and oil pump.
  18. Remove the pistons and connecting rods.
  19. Remove the crankshaft.
  20. Inspect the cylinder block.
- 2 1. Assemble by reversing Steps 1- 19.

#### ROCKER ARM COVER

##### Removal/Installation

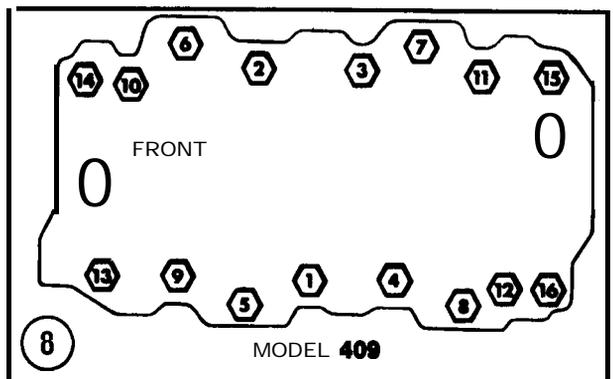
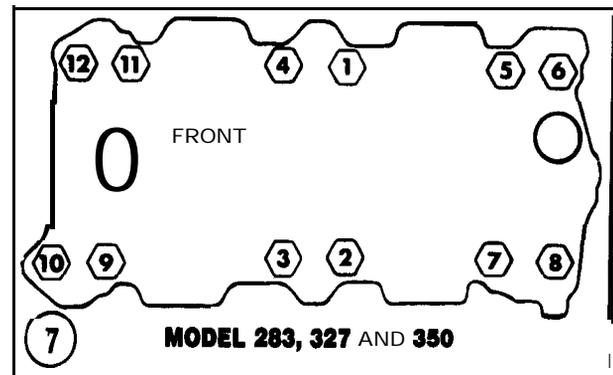
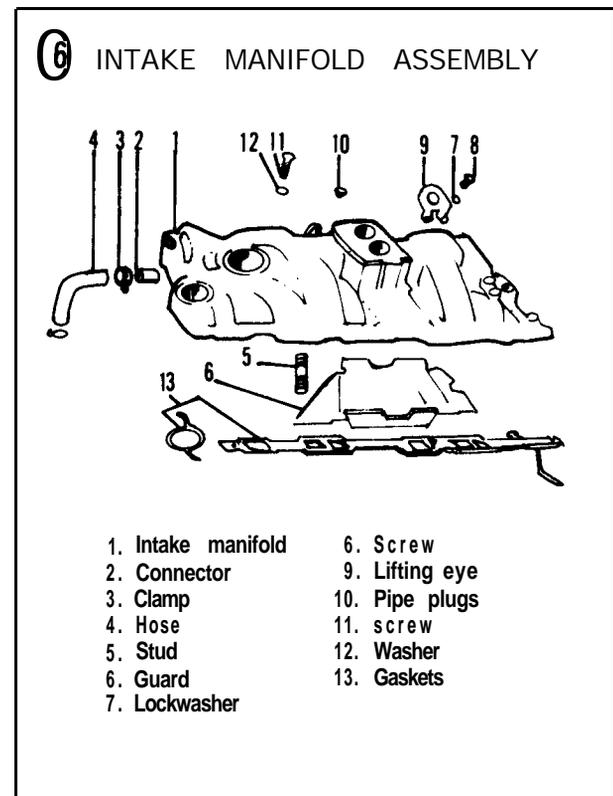
1. Remove the carburetor vent hose from the starboard cover.
2. Disconnect the spark plug cables at the plugs and remove the plug cable retainers from their brackets on the cover.
3. Remove the cover attaching screws.
4. Tap the rocker arm cover with a plastic mallet to break the gasket seal. Remove the rocker arm cover.
5. Clean any gasket residue from the cylinder head and rocker arm cover with degreaser and a putty knife.
6. Coat one side of a new gasket with an oil-resistant sealer and install sealer-side down on the cylinder head.
7. Install the cover on the cylinder head.
8. Install the attaching screws and tighten to specifications (Table 4).
9. Install the spark plug cable retainers on the rocker arm cover brackets. Connect the wires to the appropriate spark plugs.
10. Install the carburetor vent hose in the rocker arm cover.

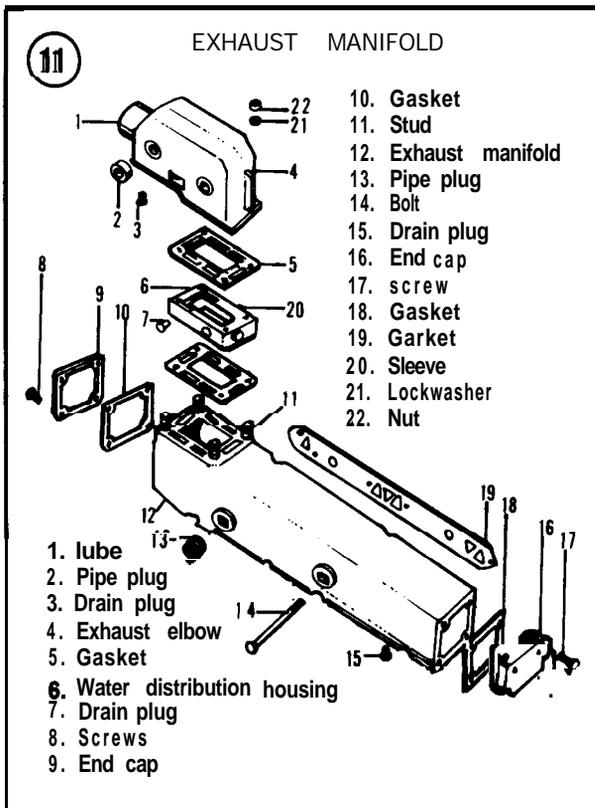
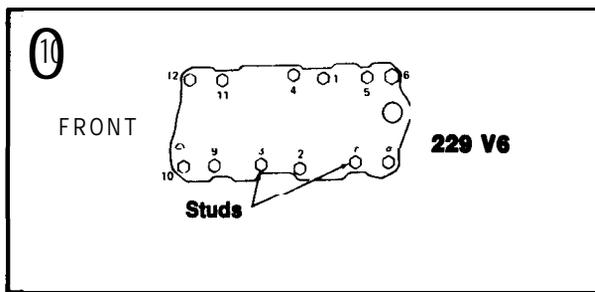
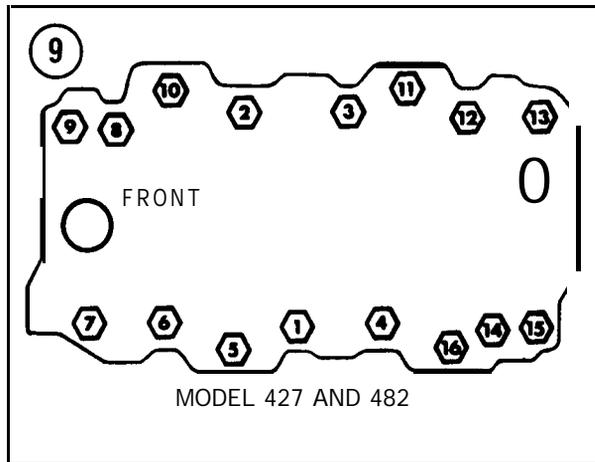
## INTAKE MANIFOLD

### Removal/Installation

Refer to **Figure 6** for this procedure.

1. Disconnect the negative battery cable.
2. Disconnect the crankcase vent hose from the rocker cover. Remove the flame arrestor.
3. Open the cylinder block water drain(s) and allow all water to drain. Disconnect the water hoses at the manifold.
4. Disconnect the throttle cable linkage at the carburetor.
5. Disconnect the temperature sender leads.
6. Disconnect the spark plug cables. Remove the cable retainers from the rocker arm covers.
7. Remove the distributor cap and place cap with plug cables attached to one side out of the way.
8. Disconnect the distributor ground lead and switch box wires.
9. Mark the position of the distributor rotor relative to the intake manifold. Loosen the hold-down clamp and remove the distributor. See Chapter Thirteen.
10. Disconnect the fuel inlet line at the carburetor. Plug the line to prevent leakage.
11. Remove the bolts and stud nuts holding the intake manifold in place.
12. Pry the intake manifold loose and remove it from the engine.
13. Remove and discard the intake manifold gaskets and seals. Discard the attaching bolt sealing washers.
14. Clean all gasket residue from the block, cylinder heads and intake manifold with degreaser and a putty knife.
15. Coat the areas where the gaskets butt together and all water passages with Perfect Seal (part No. C-92-34227).
16. Install new seals on the cylinder block. Install new gaskets on the cylinder heads. Make sure gaskets interlock with seal tabs and holes in gaskets are aligned with holes in cylinder heads.
17. Lower intake manifold into position on cylinder block. Check seal area to make sure seals are in their proper position. If not, remove the manifold, correct the seal positioning and reinstall manifold.
18. Install manifold attaching bolts/nuts. Tighten manifold fasteners to specifications (**Table 4**) in the sequence shown in **Figures 7-10**.
19. Reverse Steps 1-10 to complete installation.





**Inspection**

1. Check manifold for cracks or distortion. Replace as required.
2. Check gasket surfaces for nicks or burrs. Small burrs may be removed with an oilstone.
3. Place a straightedge across the manifold gasket surfaces. If there is any gap between the gasket surface and straightedge, measure it with a feeler gauge. Measure from end to end and corner to corner.
4. The gasket surface should be flat within 0.006 in. per foot of manifold length. If not, replace the manifold.

**EXHAUST MANIFOLDS**

Figure 11 and Figure 12 show the typical exhaust manifold used on MerCruiser models.

**Removal/Installation**

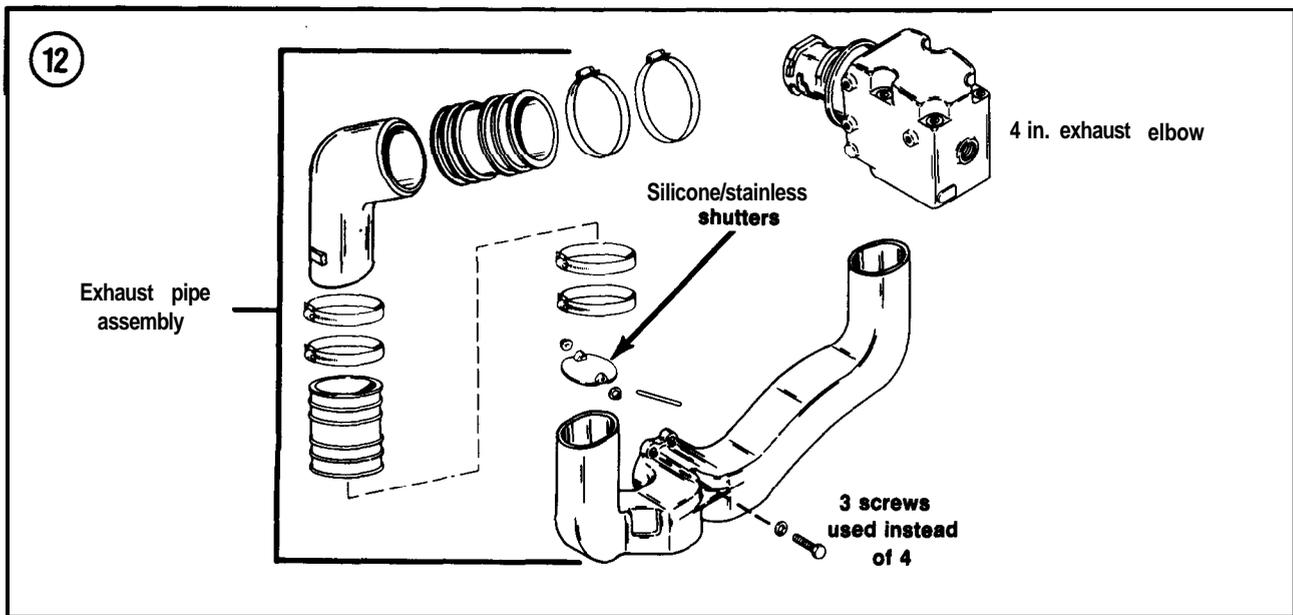
Refer to Figure 11 or Figure 12 for this procedure.

1. Disconnect the negative battery cable.
2. Open the cylinder block water drain(s) and allow all water to drain.
- 3A. **PowerPlus** manifold-Disconnect the exhaust pipe assembly at the manifold and exhaust elbow. Drain any water remaining in the manifold housing and elbow.
- 3B. All others-Remove the exhaust tube and water hoses from the manifold. Drain any water remaining in the manifold housing and elbow.
4. On starboard manifold, disconnect fuel lines from the water-separating fuel filter. Remove fuel filter assembly.

**NOTE**

*Crankcase dipstick tube support bracket is retained by one starboard manifold attaching bolt. Remove support bracket with manifold in Step 5.*

5. Remove manifold attaching nuts or bolts and washers. Remove the manifold.



6. Clean all gasket residue from the cylinder head and manifold mating surfaces with degreaser and a putty knife.

7. Install manifold on cylinder head with a new gasket. Tighten fasteners to specifications (Table 4), working from the center to the ends.

8. Reverse Steps 1-4 to complete installation.

#### Inspection/Cleaning

1. Inspect engine exhaust ports for signs of rust or corrosion. Replace manifold if such signs are found.
2. Check water passage in exhaust elbow for clogging.
3. Check inside of exhaust hose for signs of burning. Replace if burning is noted.
4. Remove pipe plugs in manifold and exhaust elbow. Check for sand, silt or other foreign matter.

### CRANKSHAFT PULLEY AND TORSIONAL DAMPER

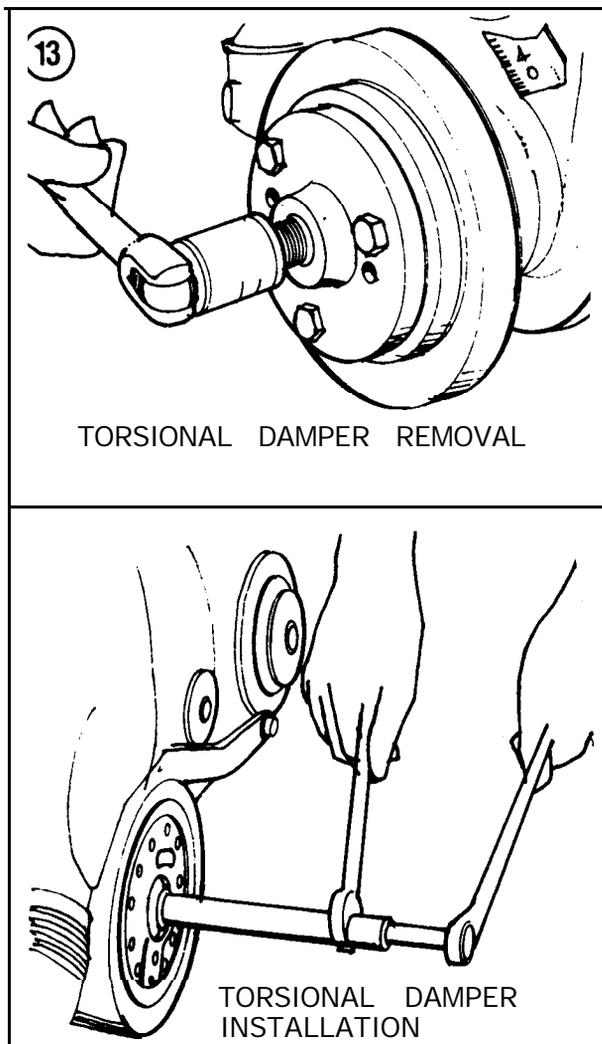
#### Removal/Installation

1. Remove alternator drive belt. See Chapter Thirteen.
2. Remove pulley attaching bolts. Remove pulley.
3. Remove vibration damper retaining bolt.
4. Install puller part No. J-6978 on damper as shown in Figure 13 and remove damper from crankshaft.
5. Coat the front of the crankshaft and the oil seal rubbing surface on the inner hub of the vibration damper with engine oil to prevent damage to the front cover seal.

#### NOTE

*If tool part No. J-21058 is not available for use in Step 6, pull the damper onto the crankshaft with a thick flat washer, a full-threaded 1/2-20x5 in. bolt and a 1/2-20 nut.*

6. Position torsional damper over the key on the crankshaft and install tool part No. J-21058. See Figure 13.
7. Draw vibration damper onto crankshaft and remove tool.
8. Install damper retaining bolt and tighten to specifications (Table 4).
9. Install pulley and tighten attaching bolts to specifications (Table 4).
10. Install and adjust alternator drive belt. See Chapter Thirteen.



## FRONT COVER AND SEAL

### Front Cover Removal/Installation

This procedure can generally be performed without removing the engine from the boat, provided you are careful in cutting the oil pan seal in Step 7.

1. Open the engine drain valve(s) and drain all the water from the block.
2. Drain the crankcase. See Chapter Four.
3. Remove the seawater pump.
4. Remove any accessory brackets attached to the circulating water pump. Remove the pump pulley and drive belt.
5. Remove the crankshaft pulley and torsional damper as described in this chapter.
6. Remove the 2 bolts holding the front of the oil pan to the front cover.

7. Use a sharp **X-acto** knife to cut the oil pan seal flush with the cylinder block face.
8. Remove the front cover bolts. Remove the cover and discard the gasket.
9. Clean the gasket mounting surfaces on the block and cover with degreaser and a putty knife.
10. Lubricate the timing chain or gears with engine oil.
11. Coat the gasket surfaces of the block and front cover with Perfect Seal (part No. C-92-34227) or equivalent and install a new gasket over the dowel pins on the engine block.
12. Use the cut portion of the oil pan seal as a template and cut a matching section from a new seal for use in Step 13.
13. Coat the exposed surface of the oil pan flange with Perfect Seal (part No. C-92-34227) or equivalent and install the seal portion cut in Step 12. Coat the exposed seal surface with Perfect Seal.
14. Position the front cover on the engine block. Work carefully to prevent damage to the oil seal or movement of the gasket and oil pan seal.
15. Apply downward pressure on the cover and install the oil pan attaching screws.
16. Coat the attaching bolt threads with Perfect Seal (part No. C-92-34227) or equivalent. Install the bolts. Tighten cover bolts and oil pan screws to specifications (Table 4).
17. Reverse Steps 1-5 to complete installation.

### Front Cover Seal Replacement

1. Remove front cover as described in this chapter.
2. Place cover on a clean flat workbench surface.
3. Pry the old seal from the cover with a screwdriver.
4. Clean the seal recess in the cover with solvent and blow dry.
5. Position new seal in cover recess with open end of seal facing cover. Support cover at seal area and drive seal into place with tool part No. J-22102.
6. Install front cover as described in this chapter.

## TIMING CHAIN AND SPROCKETS

### NOTE

*The 427 cid and 482 cid engines are equipped with timing gears. See Camshaft Removal in this chapter for timing gear removal procedure.*

### Removal

1. Remove the torsional damper and front cover as described in this chapter.

2. Rotate crankshaft clockwise to align marks on camshaft and crankshaft as shown in **Figure 14**.

*NOTE*

*Camshaft sprocket is a light press fit. If it does not slip off easily in Step 3, tap gently on the lower sprocket edge with a plastic mallet.*

3. Remove camshaft sprocket bolts. Remove camshaft sprocket and timing chain as an assembly.

**Installation**

1. Install the timing chain on the camshaft sprocket. With chain hanging freely, align camshaft sprocket timing mark with crankshaft timing mark. See **Figure 15**.

2. Align the dowel hole in the camshaft sprocket with the dowel on the camshaft and press sprocket on shaft.

*NOTE*

*Do not drive camshaft sprocket into place in Step 3 or you may dislodge the *welch* plug behind the camshaft in the rear of the block.*

3. Install the camshaft sprocket bolts and draw the sprocket onto the camshaft by tightening the bolts. Torque to specifications (**Table 4**).

4. Lubricate timing chain liberally with clean engine oil.

5. Install front cover and torsional damper as described in this chapter.

**ROCKER ARM ASSEMBLIES**

**Removal/Installation**

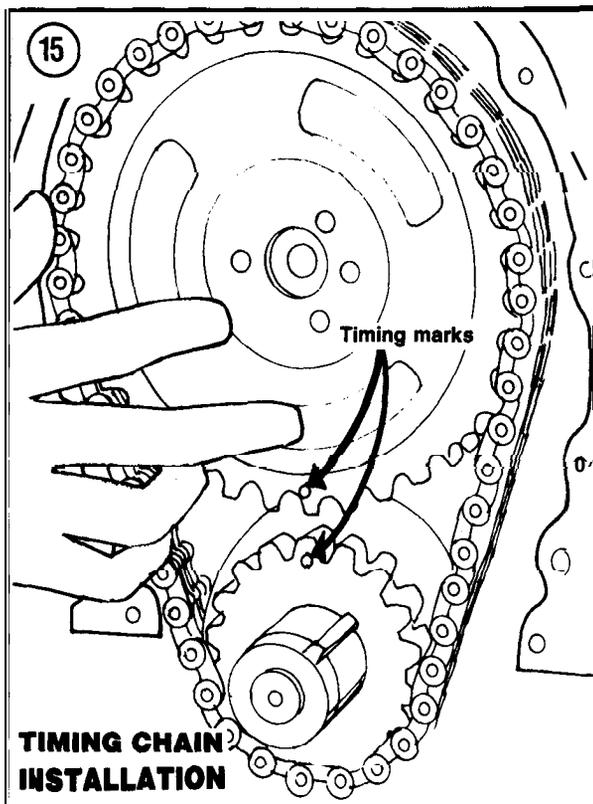
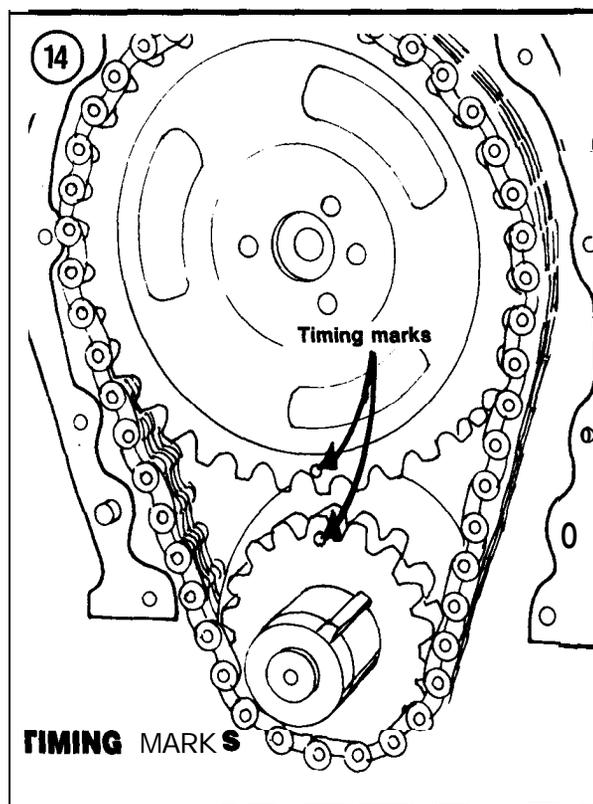
Each rocker arm moves on its own pivot ball. The rocker arm and pivot ball are retained by a nut.

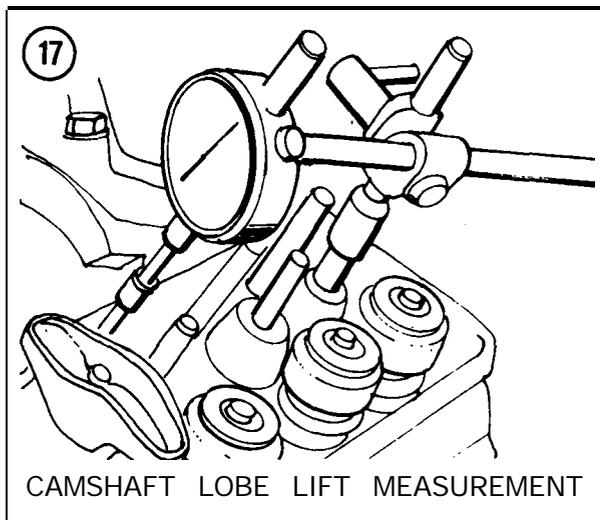
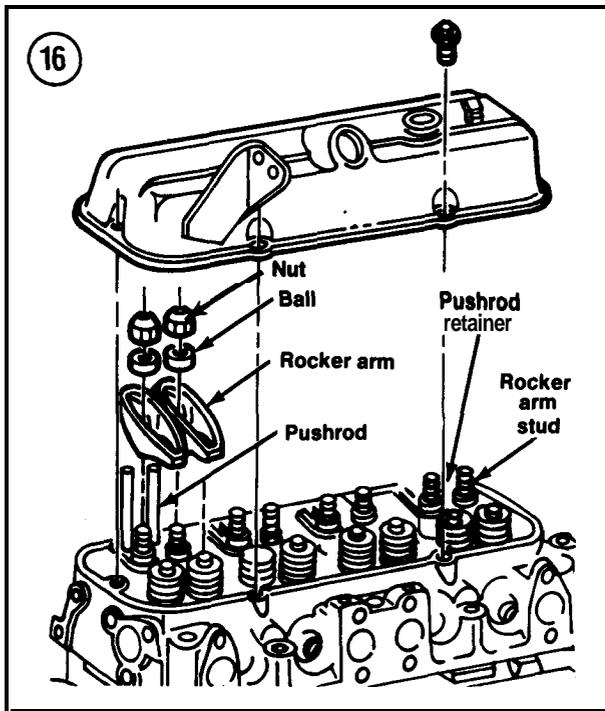
It is not necessary to remove the rocker arm for **pushrod** replacement; simply loosen the adjusting nut and move the arm away from the **pushrod**. Refer to **Figure 16** for the complete removal procedure.

1. Remove the rocker arm cover as described in this chapter.

2. Remove each rocker arm nut, ball, rocker arm and **pushrod**.

3. Place each rocker arm/**pushrod** assembly in a separate container or use a rack to keep them separated for reinstallation in the same position from which they were removed.



**NOTE**

When installing new valve lifters, rocker arms or rocker arm balls, coat the contact surfaces with engine oil or Molykote.

4. Install the pushrods, making sure that each fits into its lifter socket.
5. Install the rocker arms, balls and nuts.
6. Adjust the valves as described in this chapter.
7. Install the rocker arm cover as described in this chapter.

**Inspection**

1. Clean all parts with solvent and use compressed air to blow out the oil passages in the pushrods.
2. Check each rocker arm, pivot ball and pushrod for scuffing, pitting or excessive wear.
3. Check pushrods for straightness by rolling them across a flat, even surface such as a pane of glass. Replace pushrods that do not roll smoothly.
4. If a pushrod is worn from lack of lubrication, replace the corresponding lifter and rocker arm as well.

**CAMSHAFT****Lobe Lift Measurement**

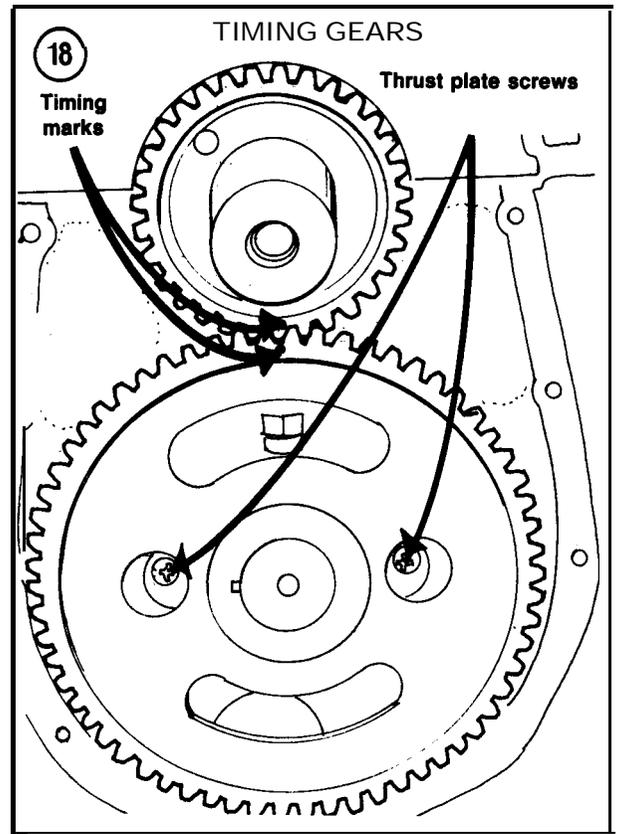
Camshaft lobe lift can be measured with the camshaft in the block and the cylinder heads in place. The lifters must be bled down slowly or the readings will be incorrect.

1. Remove the rocker arm covers as described in this chapter.
2. Remove the rocker arm assemblies as described in this chapter.
3. Remove the spark plugs.
4. Install a dial indicator with a ball socket adapter to fit over the pushrod. See Figure 17.
5. Turn the crankshaft in the normal direction of rotation until the valve lifter seats on the heel of the cam lobe. This positions the pushrod at its lowest point.
6. Zero the dial indicator, then slowly rotate the crankshaft until the pushrod reaches its maximum travel. Note the indicator reading and compare to specifications (Tables 1-3).
7. Repeat Steps 4-6 for each pushrod. If all lobes are within the specifications in Step 6, reinstall the rocker arm assemblies.
8. If one or more lobes are worn beyond specifications, replace the camshaft as described in this chapter.
9. Remove the dial indicator and reverse Steps 1-3.

**Removal/Installation**

1. Remove the rocker arm covers as described in this chapter.
2. Remove the intake manifold as described in this chapter.
3. Loosen the rocker arm adjusting nuts, swivel the arms off the pushrods and remove the pushrods. Identify each pushrod for reinstallation in its original location.

4. Remove the valve lifters with a **pencil-type magnet**. Place them in a rack in order of removal for reinstallation in their original location.
5. Remove the fuel pump and **pushrod**. See Chapter Eleven.
6. Remove the front cover as described in this chapter.
- 7A. If equipped with timing chain, remove the timing chain and camshaft sprocket as described in this chapter. Install two 5/16- 18 bolts in the camshaft sprocket bolt holes in the end of the camshaft.
- 7B. If equipped with timing gears, rotate the camshaft to align the timing gear marks, then remove the camshaft thrust plate screws through the holes in the camshaft gear. See **Figure 18**.
8. Withdraw camshaft slowly and carefully from the front of the block to avoid damage to the bearings.
9. Installation is the reverse of removal. Coat the camshaft lobes with Lubriplate or equivalent and the journals with heavy engine oil before reinstalling in the block. If equipped with timing gears, align timing marks on the gears as shown in **Figure 18** before installing camshaft. Check timing gear **runout** and backlash as described in this chapter.



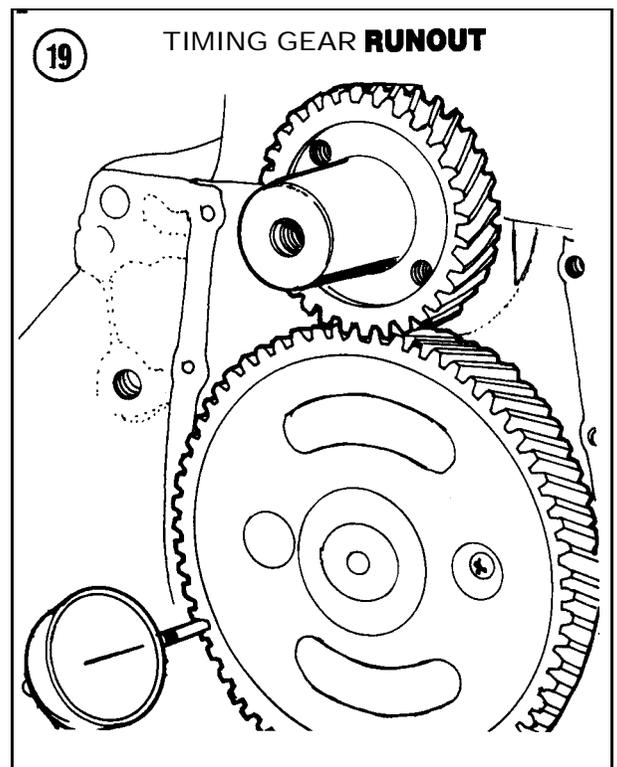
#### Timing Gear Runout and Backlash

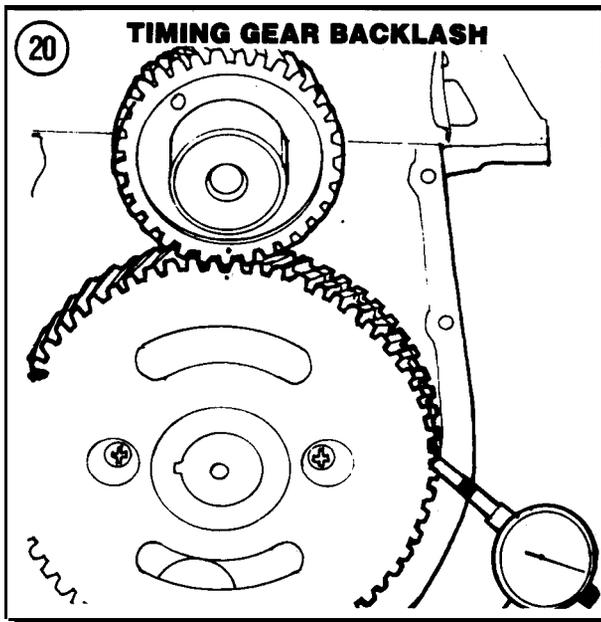
On engines equipped with timing gears, check **runout** and backlash after camshaft or crankshaft installation.

1. Install a dial indicator as shown in **Figure 19**. Rotate the crankshaft 360° and check **runout**. Reposition dial indicator to check camshaft gear. Rotate the camshaft 360° and check **runout**.
2. If camshaft gear **runout** exceeds 0.004 in. or crankshaft gear **runout** exceeds 0.003 in., remove the gear and clean any burrs from the shaft. Reinstall gear and repeat Step 1. If **runout** is still excessive, replace the gear.
3. Install the dial indicator as shown in **Figure 20** and check gear backlash. If backlash is less than 0.004 in. or greater than 0.006 in., replace the gear(s).

#### Inspection

1. Check the journals and lobes for signs of wear or scoring. Lobe pitting in the toe area is not sufficient





reason for replacement, unless the lobe lift loss is excessive.

2. Check each valve lifter for signs or wear, pitting or scoring. Replace as required.

#### NOTE

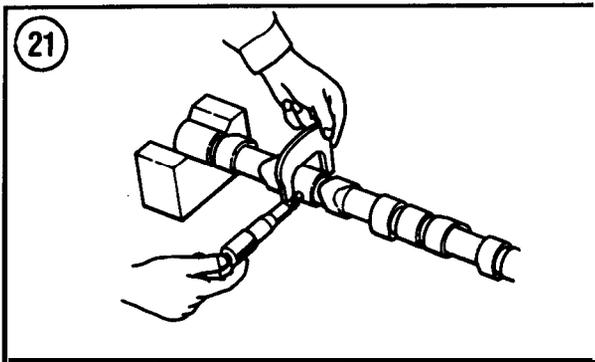
*If you do not have precision measuring equipment, have Step 3 done by a machine shop.*

3. Measure the camshaft journal diameters with a micrometer (**Figure 21**) and compare to specifications. Replace the camshaft if one or more journals do not meet specifications.

4. Suspend the camshaft between V-blocks and check for **warpage** with a dial indicator. Replace if reading is greater than 0.002 in.

5. Check the distributor drive gear for excessive wear or damage.

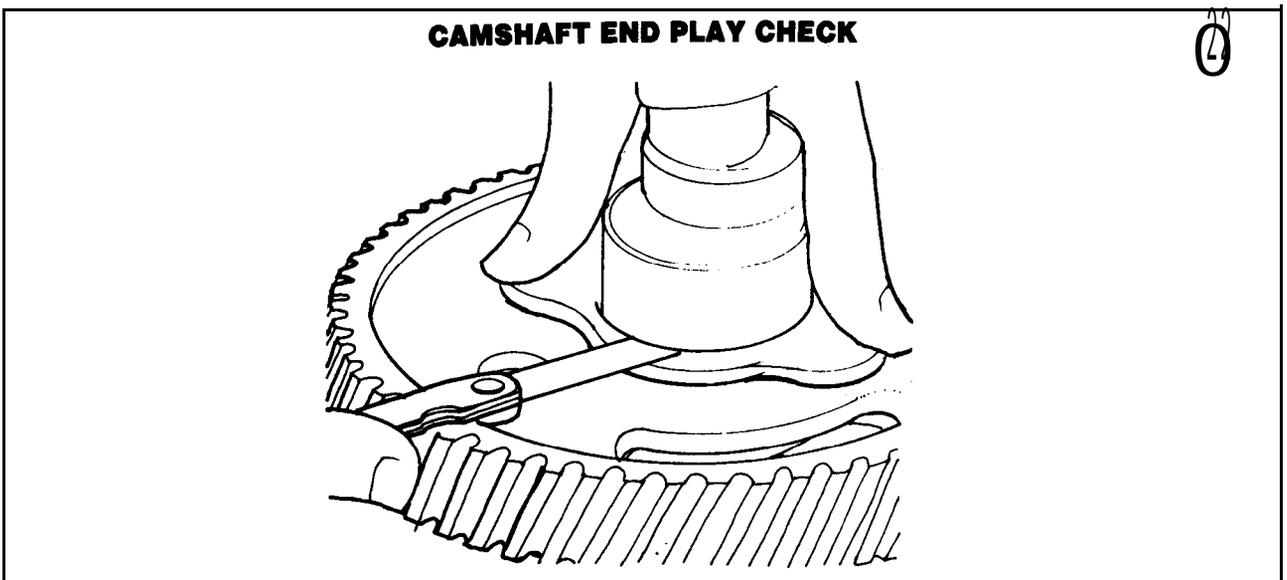
6. On 427 and 482 cid camshafts, check the camshaft gear and thrust plate for wear or damage. Insert a feeler gauge between the thrust plate and camshaft to measure end play. See **Figure 22**. If end play exceeds 0.005 in., remove the camshaft gear as described in **Timing Gear Replacement** in this chapter and replace the thrust plate.



#### Bearing Replacement

Camshaft bearings can be replaced without complete engine disassembly. Replace bearings in complete sets. Camshaft bearing/installer tool part No. J-6098 is required for bearing replacement.

1. Remove the camshaft as described in this chapter.

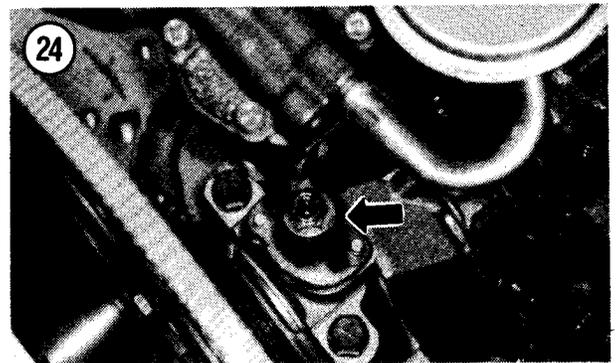
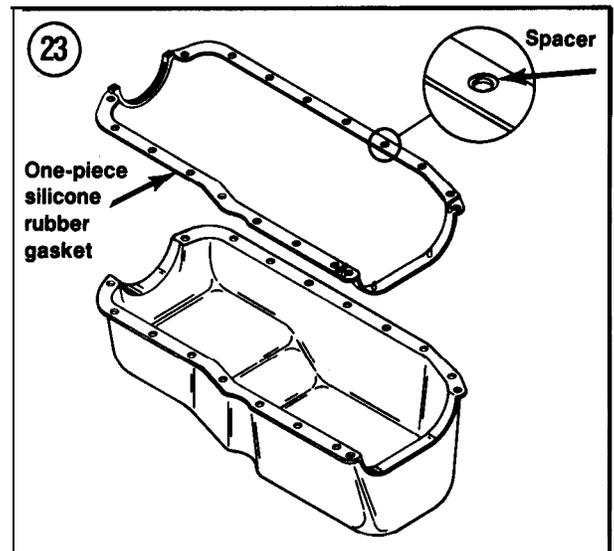


2. Remove the crankshaft as described in this chapter.
3. Drive the camshaft **welch** plug from the rear of the cylinder block.
4. Secure the connecting rods to the side of the engine to keep them out of the way while replacing the cam bearings.
5. Install the nut and thrust washer to tool part No. J-6098. Index the tool pilot in the front cam bearing. Install the puller screw through the pilot.
6. Install tool part No. J-6098 with its shoulder facing the front intermediate bearing and the threads engaging the bearing.
7. Hold the puller screw with one wrench. Turn the nut with a second wrench until the bearing has been pulled from its bore.
8. Repeat Steps 5-7 to remove the center bearing.
9. Remove the tool and index it to the rear bearing to remove the rear intermediate bearing from the block.
10. Remove the front and rear bearings by driving them toward the center of the block.
11. Installation is the reverse of removal. Use the same tool to pull the new bearings into their bores. Bearing oil holes must align with those in the block. Since the oil hole is on the top of the bearings (and cannot be seen during installation), align bearing oil hole with hole in bore and mark opposite side of bearing and block at bore to assist in positioning the oil hole during installation.
12. Wipe a new camshaft **welch** plug with Perfect Seal (part No. C-92-34227) and install it flush with the rear surface of the block.

### Timing Gear Replacement

If inspection indicates that the camshaft, gear or thrust plate should be replaced, press the gear from the camshaft with an appropriate size support sleeve. Position the thrust plate so that it will not be damaged by the Woodruff key in the shaft when it separates from the gear. If the gear is to be reused, support its hub before applying pressure or it will be ruined. Install the camshaft gear by pressing it onto the shaft, then check end play as described in Step 6, *Inspection* in this chapter.

To remove the crankshaft gear, install puller part No. J-8105 (427 and 482 cid) or puller part No. J-5825 (all others) and remove the gear. Use tool part No. J-21058 (427 and 482 cid) or part No. J-5590 (all others) to install the gear.



A 1-piece silicone rubber gasket (Figure 23) introduced on 1987 models supersedes all previous gaskets. The soft rubber fills in small gaps that might otherwise leak; metal spacers around each of the screw holes prevent damage from overtightening. This new gasket should be used as a replacement whenever the oil pan is removed from earlier models.

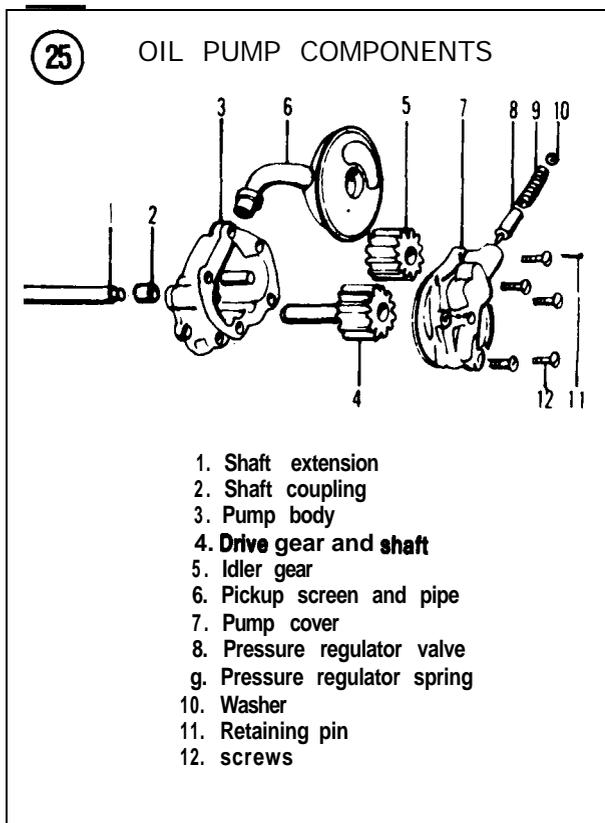
### OIL PAN

#### Removal

1. Remove the engine as described in this chapter.
2. Place a **6-quart** container under the oil pan drain plug. Remove the plug and let the crankcase drain.

#### NOTE

*A modification kit is available from marine dealers to assist in draining the oil when the*



*engine is in the boat. This kit can be installed on any engine oil pan when the engine is removed for service.*

3. If mounted in an engine stand, rotate the engine 180° to place the oil pan in an upright position.
4. Remove the oil dipstick and guide tube.
5. Remove the oil pan attaching screws. Remove the oil pan.
6. Remove and discard the 2-piece pan gasket and the front/rear seals.

#### Inspection

1. Remove all gasket residue from the oil pan flanges and crankcase side rails with degreaser and a putty knife.
2. Clean the pan thoroughly in solvent.
3. Check the pan for dents or warped gasket surfaces. Straighten or replace the pan as necessary.

#### Installation

1. Install a new 1-piece gasket on the pan flanges. Insert a screw on each side and at each end of the pan to position the gasket.

2. Carefully position the oil pan in place. Make sure the gasket is not misaligned and tighten the screws inserted in Step 1 finger-tight.
3. Install the remaining screws and tighten all to specifications (Table 4). Work from the center outward in each direction.
4. Install the dipstick and guide tube.
5. Install the engine in the boat as described in this chapter and fill the crankcase with oil recommended in Chapter Four.

## OIL PUMP

### Removal/Installation

1. Remove the oil pan as described in this chapter.

#### NOTE

*The oil pump pickup tube and screen are a press fit in the pump housing and should not be removed unless replacement is required.*

2. Remove the oil pump attaching nut (Figure 24). Remove the oil pump, gasket and extension drive shaft.
3. To install, align the slot on the extension shaft top with the drive tang on the lower end of the distributor drive shaft.

#### NOTE

*The bottom edge of the oil pump pickup screen should be parallel to the oil pan rails when pump is installed in Step 4.*

4. Install pump to rear main bearing cap. Tighten pump attaching bolts to specifications (Table 4).
5. Install the oil pan as described in this chapter.

### Disassembly/Assembly

Refer to Figure 25 or Figure 26 as appropriate for this procedure.

1. Remove the cover screws, cover and gasket. Discard the gasket.
2. Mark gear teeth to assure reassembly with identical gear indexing and remove idler and drive gear with shaft from the body.
3. Remove the pressure regulator valve pin, regulator, spring and valve.
4. Oil all parts thoroughly before reassembly.
5. Assembly is the reverse of disassembly. Index the gear marks, install a new cover gasket and rotate pump drive shaft by hand to check for smooth operation.

## Inspection

## NOTE

*The pump body and gears are serviced as an assembly. If one or the other is worn or damaged, replace the entire pump. No wear specifications are provided by the manufacturer.*

1. Clean all parts thoroughly in solvent. Brush the inside of the body and the pressure regulator chamber to remove all dirt and metal particles. Dry with compressed air, if available.
2. Check the pump body and cover for cracks or excessive wear.
3. Check the pressure regulator valve for a proper fit.
4. Check the pump gears for damage or signs of excessive wear.
5. Check the drive gear shaft-to-body fit for excessive looseness.
6. Check the inside of the pump cover for wear that could allow oil to leak around the ends of the gears.

## CYLINDER HEAD

## Removal

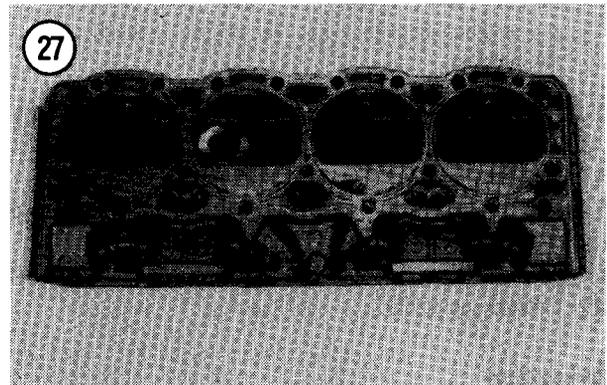
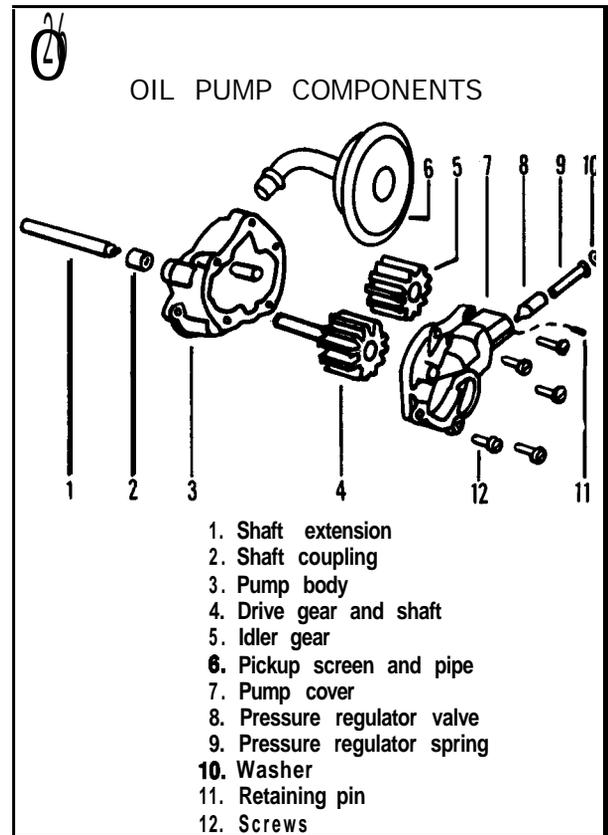
Perform Steps 1-4 if engine is in boat. If engine has been removed from boat, begin with Step 5.

1. Open the engine block drain(s) and drain all water from the block.
2. Remove the intake and exhaust manifolds as described in this chapter.
3. Remove the alternator and oil filter mounting brackets.
4. Disconnect the spark plug wires and remove the wire looms from the cylinder head.
5. Remove the rocker arm cover(s) as described in this chapter.
6. Loosen the rocker arms and rotate them to one side. Remove the **pushrods** and identify each for reinstallation in its original position.
7. Loosen the cylinder head bolts, working from the center of the head to the end in each direction.
8. Remove the head bolts. Tap the end of the head with a plastic hammer to break the gasket seal. Remove the head from the engine.

## CAUTION

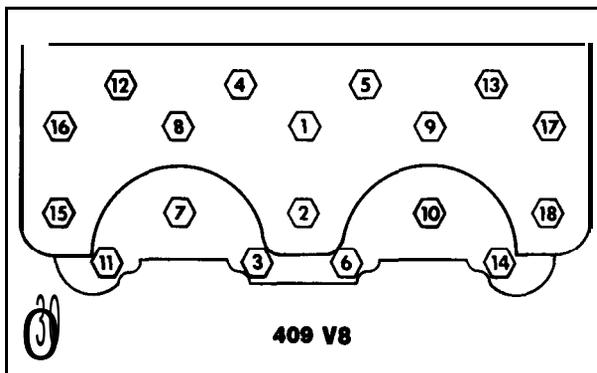
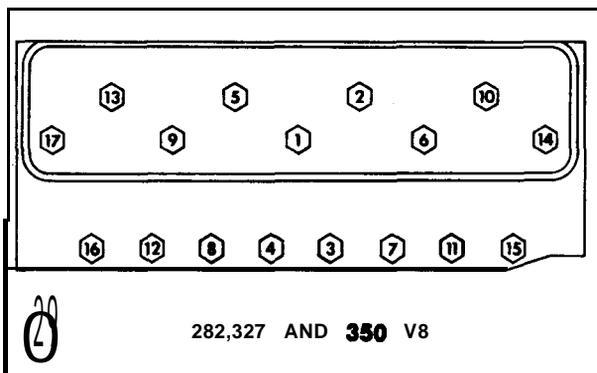
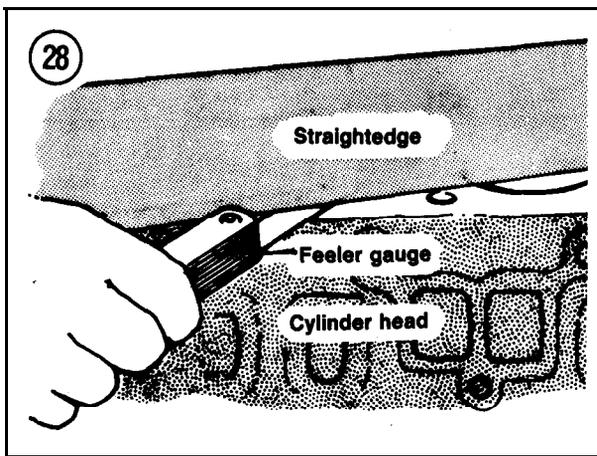
*Place the head on its side to prevent damage to the spark plugs or head gasket surface.*

9. Remove and discard the head gasket.



## Decarbonizing

1. Without removing the valves, remove all deposits from the combustion chambers, intake ports and exhaust ports. Use a fine wire brush dipped in solvent or make a scraper from hardwood. Be careful not to scratch or gouge the combustion chambers.
2. After all carbon is removed from the combustion chambers and ports, clean the entire head in solvent.



3. Clean away all carbon on the piston tops. Do not remove the carbon ridge at the top of the cylinder bore.
4. Remove the valves as described in this chapter.
5. Clean the **pushrod** guides, valve guide bores and all bolt holes. Use a cleaning solvent to remove dirt and grease.
6. Clean the valves with a fine wire brush or buffing wheel.

### Inspection

1. Check the cylinder head for signs of oil or water leaks before cleaning.
2. Clean the cylinder head thoroughly in solvent. While cleaning, look for cracks or other visible signs of damage. Look for corrosion or foreign material in the oil and water passages (**Figure 27**). Clean the passages with a stiff spiral brush, then blow them out with compressed air.
3. Check the cylinder head studs and **pushrod** guides for damage and replace, if necessary.
4. Check the threaded rocker arm studs or bolt holes for damaged threads. Replace if necessary.
5. Check the cylinder head-to-block surface for **warpage** with a straightedge and feeler gauge (**Figure 28**). Compare to specifications (**Tables 1-3**). If gap exceeds specifications, have the head resurfaced by a dealer or machine shop. If head resurfacing is required, do not remove more than 0.010 in. Replace the head if a greater amount must be removed to correct **warpage**.

### Installation

1. Make sure the cylinder head and block gasket surfaces and bolt holes are clean. Dirt in the block bolt holes or on the head bolt threads will affect tightening torque.
2. Recheck all visible oil and water passages for cleanliness.

#### CAUTION

*If a steel gasket is used, apply a thin coat of Perfect Seal (part No. C-92-34277) to both sides of the gasket. Do not use sealer on composition steel-asbestos gaskets.*

3. Fit a new head gasket over the cylinder dowels on the block.
4. Install the cylinder head to the block.
5. Wipe the head bolt threads with Perfect Seal (part No. C-92-34277) or equivalent and install finger-tight in cylinder head.
6. Tighten head bolts  $1/2$  turn at a time following the appropriate sequence (**Figures 29-32**) until specified torque is reached. See **Table 4**.
7. If engine is in boat, reverse Steps 1-4 of **Removal** in this chapter. If engine is out of boat, reverse Step 5 and Step 6 of **Removal** to complete installation.

## VALVES AND VALVE SEATS

Some of the following procedures must be done by a dealer or machine shop, since they require special knowledge and expensive machine tools. Others, while possible for the home mechanic, are difficult or time-consuming. A general practice among those who do their **own** service is to remove the cylinder head, perform all disassembly except valve removal, then take the head to a machine shop for inspection and service. Since the cost is low relative to the required effort and equipment, this is usually the best approach, even for experienced mechanics. The following procedures are given to acquaint the home mechanic with what the dealer or machine shop will do.

### Valve Removal

Refer to **Figure 33** for this procedure.

1. Remove the cylinder head as described in this chapter.
2. Remove the rocker arm assemblies as described in this chapter.
3. Compress the valve spring with a compressor tool like the one shown in **Figure 34**.
4. Remove the valve locks and release the spring tension.
5. Remove the cap (or exhaust valve rotator) and valve spring.
6. Remove the valve stem seal with a pair of pliers. Discard the seal. Remove the shim and spacer, if used.

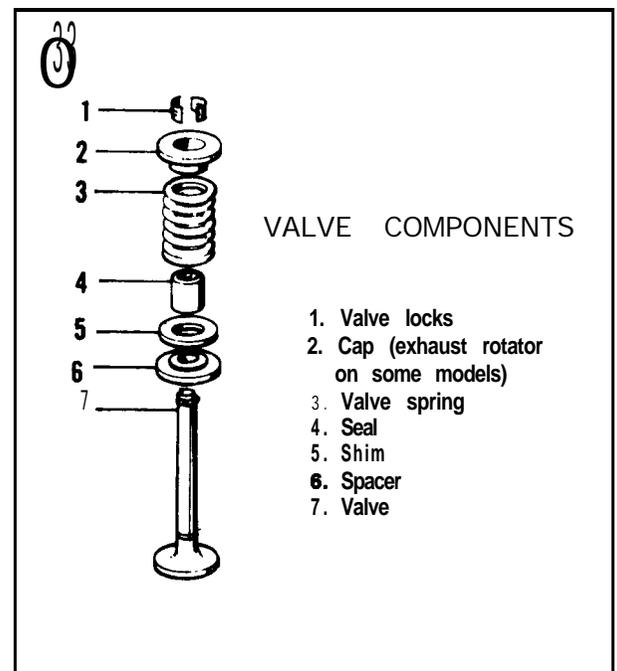
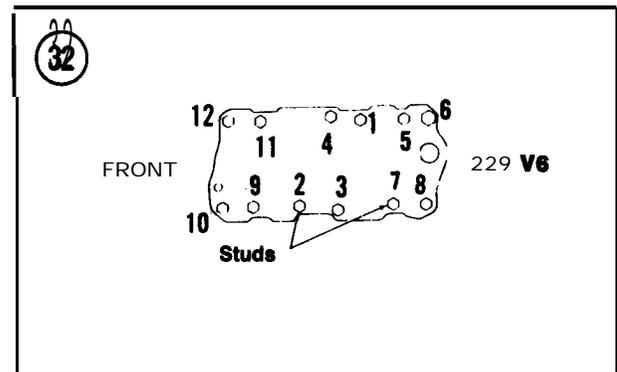
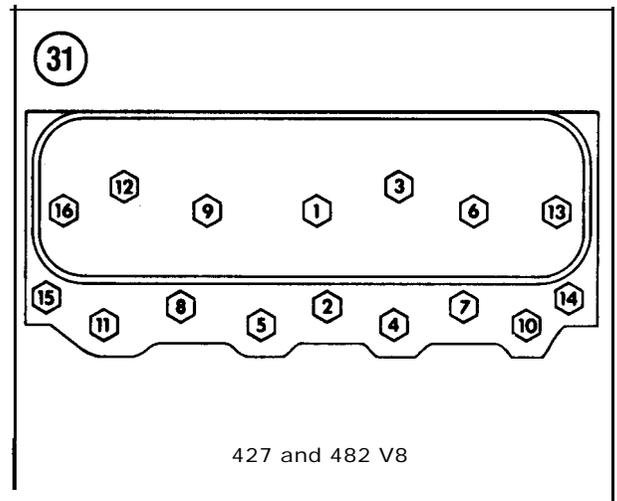
#### CAUTION

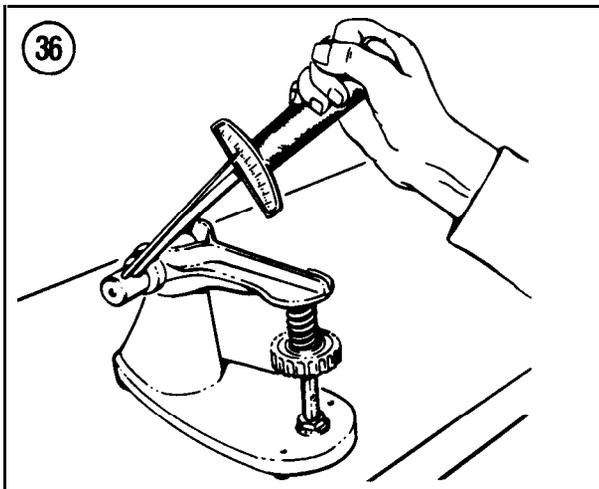
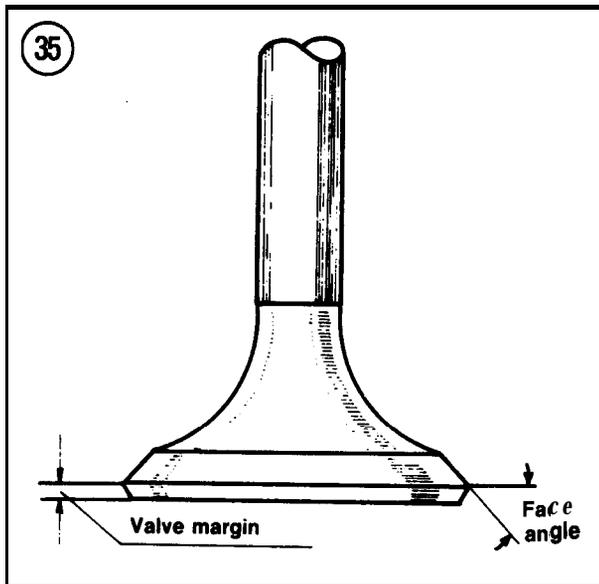
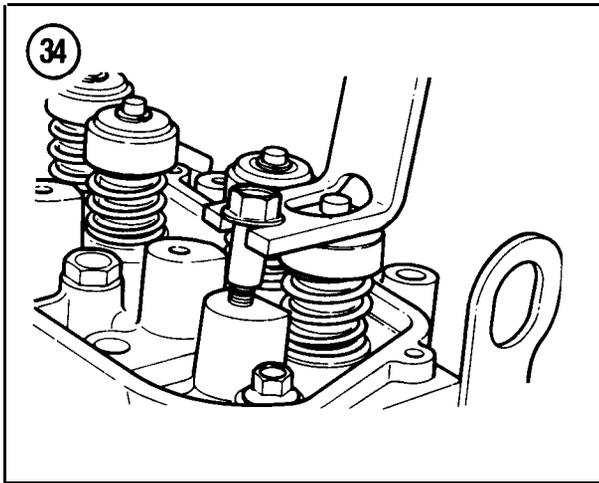
**Remove any burrs from the valve stem lock grooves before removing the valves or the valve guides will be damaged.**

7. Remove the valve and repeat Steps 3-5 on each remaining valve.
8. Arrange the parts in order so they can be returned to their original positions when reassembled.

### Inspection

1. Clean the valves with a fine wire brush or buffing wheel. Discard any cracked, warped or burned valves.
2. Measure valve stems at the top, center and bottom for wear. A machine shop can do this when the valves are ground. Also measure the length of each valve and the diameter of each valve head.





**NOTE**  
Check the thickness of the valve edge or margin after the valves have been ground. See Figure 35. Any valve with a margin of less than 1/32 in. should be discarded.

3. Remove all carbon and varnish from the valve guides with a stiff spiral wire brush.

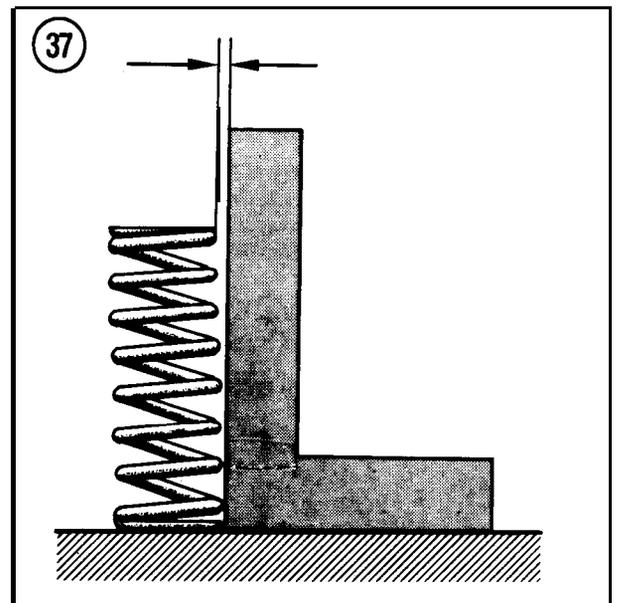
**NOTE**  
The next step assumes that all valve stems have been measured and are within specifications. Replace valves with worn stems before performing this step.

4. Insert each valve into the guide from which it was removed. Holding the valve just slightly off its seat, rock it back and forth in a direction parallel with the rocker arms. This is the direction in which the greatest wear normally occurs. If the valve stem rocks more than slightly, the valve guide is probably worn.

5. If there is any doubt about valve guide condition after performing Step 4, have the valve guide measured with a valve stem clearance checking tool. Compare the results to specifications (Tables I-3) according to engine. Worn guides must be reamed for the next oversize valve stem.

6. Test the valve springs under load on a spring tester (Figure 36). Replace any weak springs.

7. Check each spring on a flat surface with a steel square. See Figure 37. Slowly revolve spring 360 and note the space between the top of the coil and



the square. If it exceeds  $5/16$  in. at any point, replace the spring.

8. Inspect the valve seat inserts. If worn or burned, they must be reconditioned. This is a job for a dealer or machine shop, although the procedure is described in this chapter.

### Valve Guide Reaming

Worn valve guides must be reamed to accept a valve with an oversize stem. Reaming must be done by hand (**Figure 38**) and is a job best left to an experienced machine shop. The valve seat must be refaced after the guide has been reamed.

### Valve Seat Reconditioning

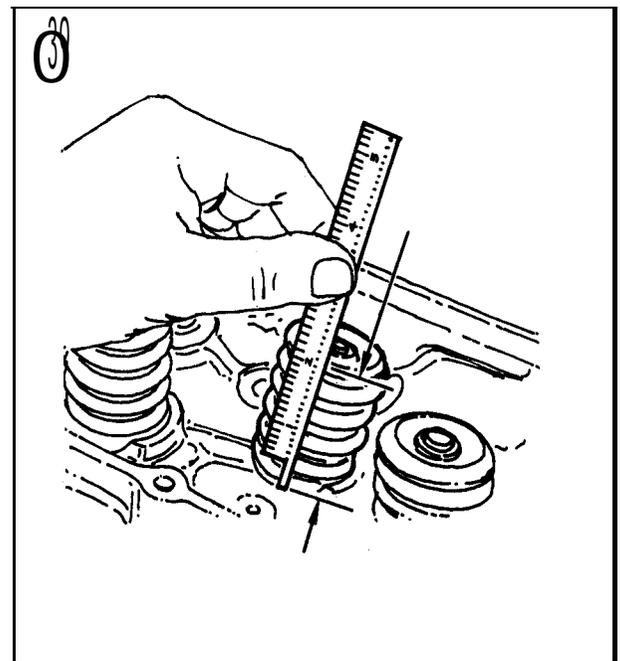
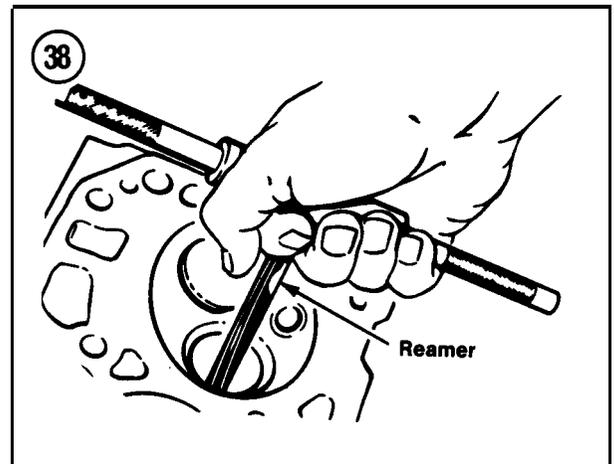
1. Cut the valve seats to the specified angle (Tables 1-3) with a dressing stone. Remove only enough metal to obtain a good finish.
2. Use tapered stones to obtain the specified seat width when necessary.
3. Coat the corresponding valve face with Prussian blue dye.
4. Insert the valve into the valve guide.
5. Apply light pressure to the valve and rotate it approximately  $1/4$  turn.
6. Lift the valve out. If it seats properly, the dye will transfer evenly to the valve face.
7. If the dye transfers to the top of the valve face, lower the seat. If it transfers to the bottom of the valve face, raise the seat.

### Valve Installation

#### NOTE

*Install all parts in the same positions **from** which they were removed.*

1. Coat the valves with oil and install them in the cylinder head.
2. Install new oil seals on each valve with a deep socket and hammer.
3. Drop the valve shim/spacer around the valve guide boss. Install the valve spring over the valve, then install the cap/rotator.
4. Compress the spring and install the locks. Make sure both locks seat properly in the upper groove of the valve stem.
5. Measure the installed spring height between the top of the valve seat and the underside of the cap/rotator. See **Figure 39**. If height is greater or less than specifications (**Tables 1-3**), install an extra spring shim about  $1/16$  in. thick and remeasure the height.

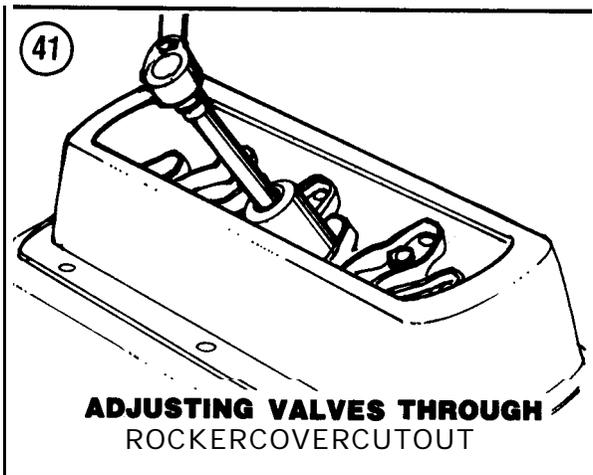
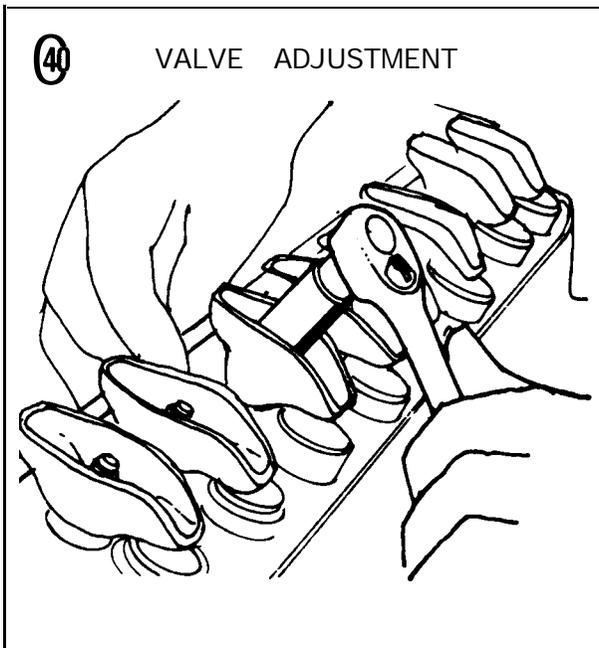


### Valve Adjustment

Valve adjustment is only required when the cylinder head valve train has been disassembled. Adjust the valves with the lifter on the base circle of the camshaft lobe. Hydraulic valve lash can be adjusted with the engine stopped or running. The mechanical lifters used on 409 cid engines must be adjusted with the engine running.

#### NOTE

*Intake valves are those closer to the intake manifold. Exhaust valves are those closer to the exhaust manifold.*



**Engine stopped**  
(hydraulic lifters only)

1. Remove the rocker arm cover as described in this chapter.
2. Rotate the crankshaft until the pulley notch aligns with the zero mark on the timing tab. This positions the No. 1 cylinder at TDC. This position can be verified by placing a finger on the No. 1 rocker arms as the pulley notch nears the zero mark. If the valves are moving, the engine is in the No. 6 (V8) or the No. 4 (V6) firing position. Rotate the crankshaft pulley one full turn to reach the No. 1 firing position.

3. With the engine in the No. 1 firing position, adjust the following valves:
  - a. Intake: 1, 2, 5, 7 (V8) or 1, 2, 3 (V6)
  - b. Exhaust: 1, 3, 4, 8 (V8) or 1, 5, 6 (V6)
4. Back off the adjusting nut until lash is felt at the **pushrod**, then turn the nut in to remove all lash. When lash has been removed, the **pushrod** will not rotate. Turn the nut in another full turn (305, 350, 454 cid), 1/2 turn (454 cid with roller rocker arm) or 3/4 turn (all others) to center the lifter plunger. See **Figure 40**.
5. Rotate the crankshaft one full turn to realign the pulley notch and the timing tab zero mark in the No. 6 (V8) or the No. 4 (V6) firing position. Adjust the following valves:
  - a. Intake: 3, 4, 6, 8 (V8) or 4, 5, 6 (V6).
  - b. Exhaust: 2, 5, 6, 7 (V8) or 2, 3, 4 (V6).
6. Install the rocker arm cover as described in this chapter.

**Engine running**  
(mechanical or hydraulic lifters)

To prevent oil from splashing out of the cylinder heads while performing this procedure, cut the top out of a used rocker arm cover. See **Figure 41**. Tape or file the cut edges of the reworked rocker arm cover to prevent injury to yourself while working.

1. Warm the engine to normal operating temperature.
2. Remove the rocker arm cover as described in this chapter and temporarily install a reworked cover.
3. With the engine idling, back off one rocker arm nut until the rocker arm starts to clatter.
- 4A. Hydraulic lifters:
  - a. Tighten the rocker arm nut until the clatter stops. This will remove all lash (zero lash position).
  - b. Tighten the nut another 1/4 turn. Wait 10 seconds to let the engine stabilize.
  - c. Repeat Step b two more times. This will tighten the nut an additional 3/4 turn from zero lash position.
  - d. Repeat Steps a-c for each valve.
- 4B. Mechanical lifters:
  - a. Insert the specified feeler gauge (**Table 3**) between an intake valve stem and rocker arm.
  - b. Tighten the rocker arm nut until a slight drag is felt on the feeler gauge.
  - c. Repeat Step a and Step b for each intake valve.

- d. Select the correct feeler gauge (Table 3) and adjust the exhaust valves in the same manner.
5. Stop the engine. Remove the reworked cover. Install the rocker arm cover as described in this chapter.

### PISTON/CONNECTING ROD ASSEMBLY

#### Piston Removal

1. Remove the engine as described in this chapter.
2. Place a 6-quart container under the oil pan and remove the drain plug. Let the crankcase oil drain.
3. Remove the intake and exhaust manifolds as described in this chapter.
4. Remove the cylinder head(s) as described in this chapter.
5. Remove the oil pan and oil pump as described in this chapter.
6. Pack the cylinder bore with clean shop rags. Remove the carbon ridge at the top of the cylinder bore with a ridge reamer. These can be rented for use. Vacuum out the shavings, then remove the shop rags. Repeat this step for each cylinder.
7. Rotate the crankshaft to center the connecting rod in the cylinder bore.
8. Measure the clearance between each connecting rod and the crankshaft journal flange with a feeler gauge (Figure 42). If the clearance exceeds specifications (Tables 1-3), replace the connecting rod.
9. Remove the nuts holding the connecting rod cap. Lift off the cap, together with the lower bearing insert (Figure 43).

#### NOTE

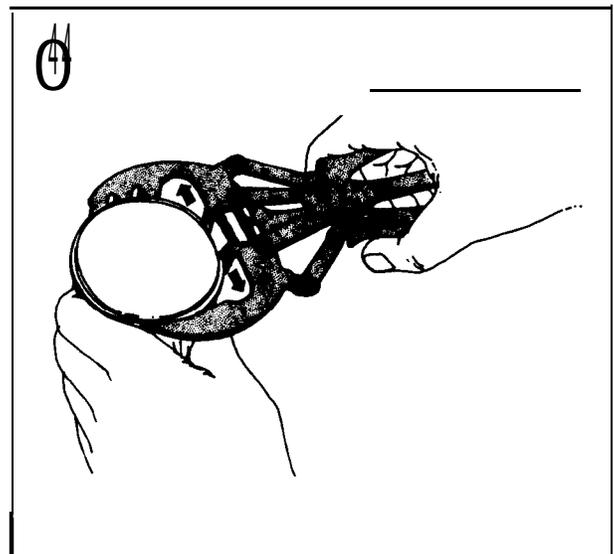
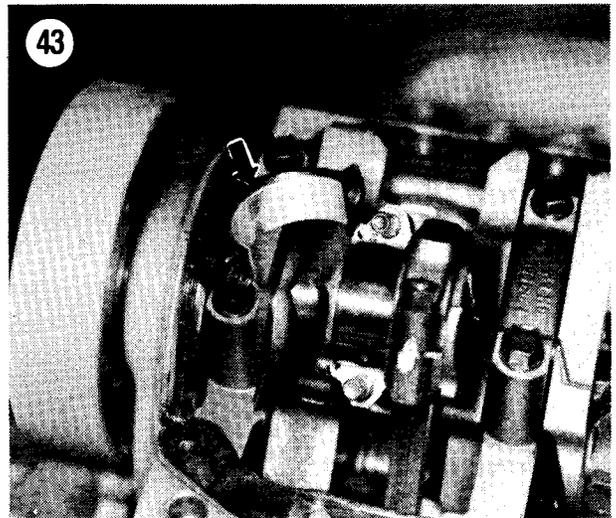
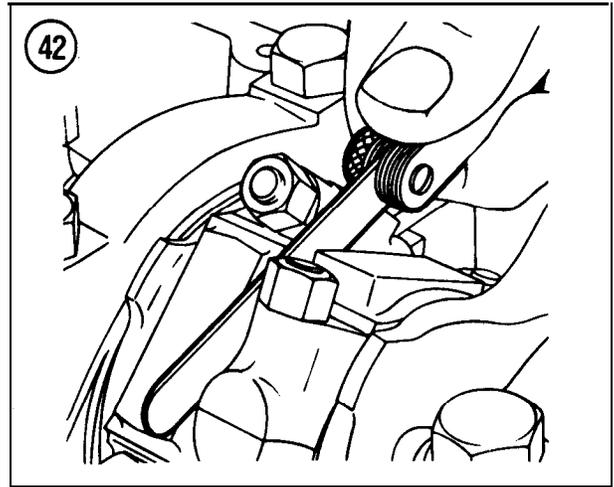
*If the connecting rod caps are difficult to remove, tap the studs with a wooden hammer handle.*

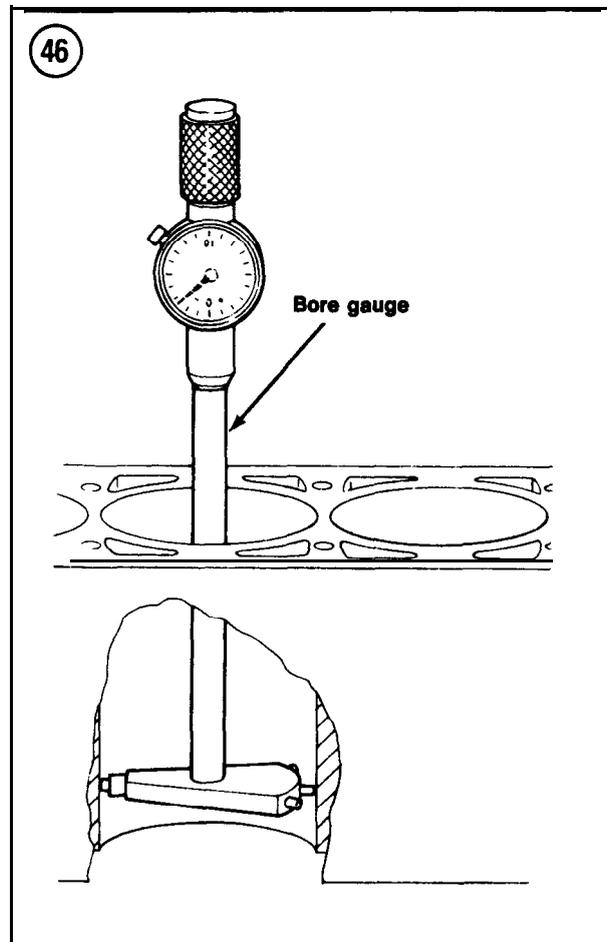
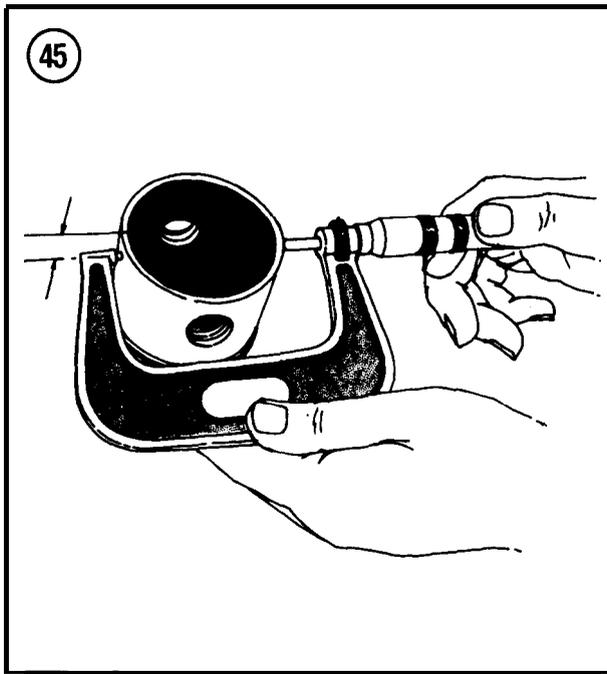
10. Use a wooden hammer handle to push the piston and connecting rod from the bore.

#### NOTE

*Mark the cylinder number on the top of each piston with quick-drying paint. Check for cylinder numbers or identification marks on the connecting rod and cap. If they are not visible, make your own.*

11. Remove the piston rings with a ring remover (Figure 44).





### Piston Pin Removal/Installation

The piston pins are press-fitted to the connecting rods and hand-fitted to the pistons. Removal requires the use of a press and support stand. This is a job for a dealer or machine shop equipped to fit the pistons to the pins ream the pin bushings to the correct diameter and install the pistons and pins on the connecting rods.

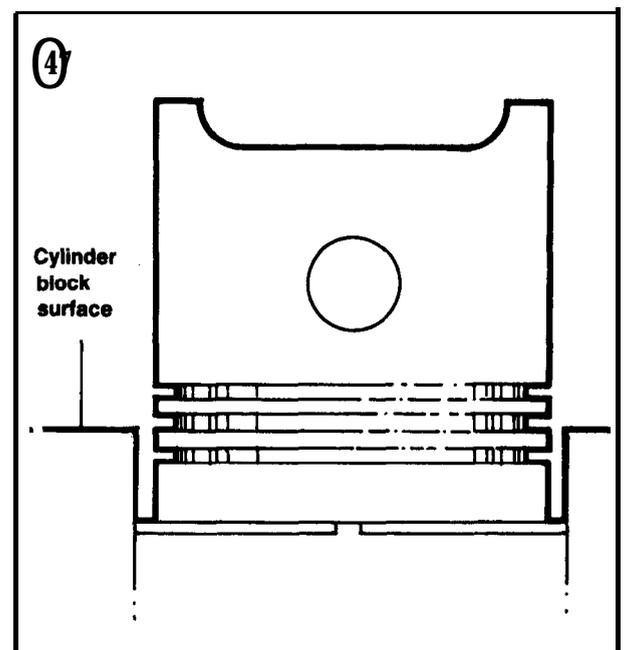
### Piston Clearance Check

Unless you have precision measuring equipment and know how to use it properly, have this procedure done by a machine shop.

1. Measure the piston diameter with a micrometer (**Figure 45**). Measure just below the rings at right angles to the piston pin bore.
2. Measure the cylinder bore diameter with a bore gauge (**Figure 46**). Measure at the top, center and bottom of the bore, in front-to-rear and side-to-side directions.
3. Subtract the piston diameter from the largest cylinder bore reading. If the difference exceeds specifications (**Tables 1-3**), the cylinder must be rebored and oversized pistons installed.

### Piston Ring Fit/Installation

1. Check the ring gap of each piston ring. To do this, position the ring at the bottom of the ring travel area and square it by tapping gently with an inverted piston. See **Figure 47**.



**NOTE**

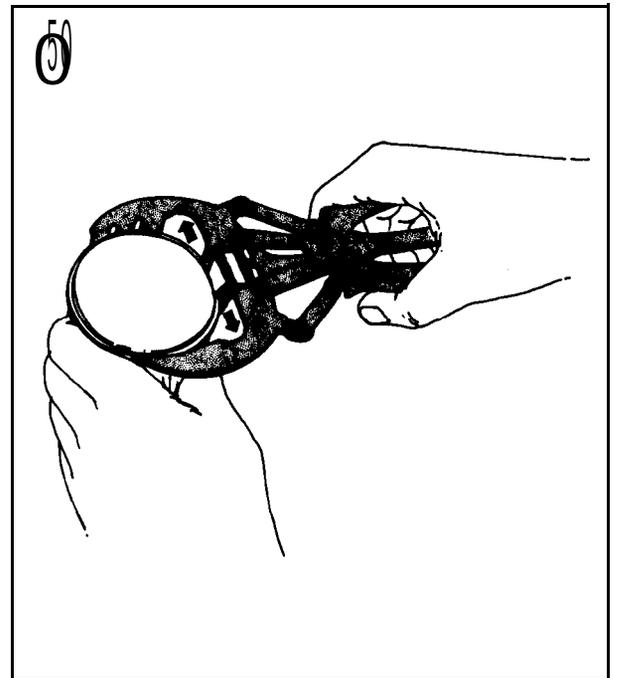
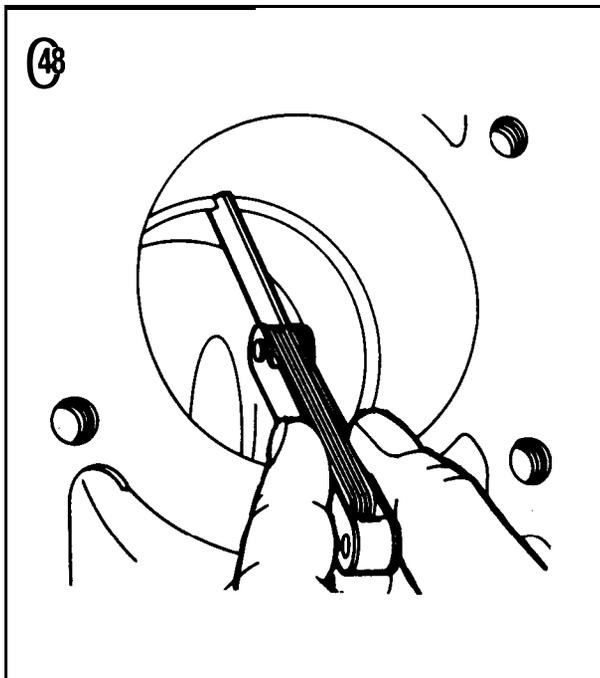
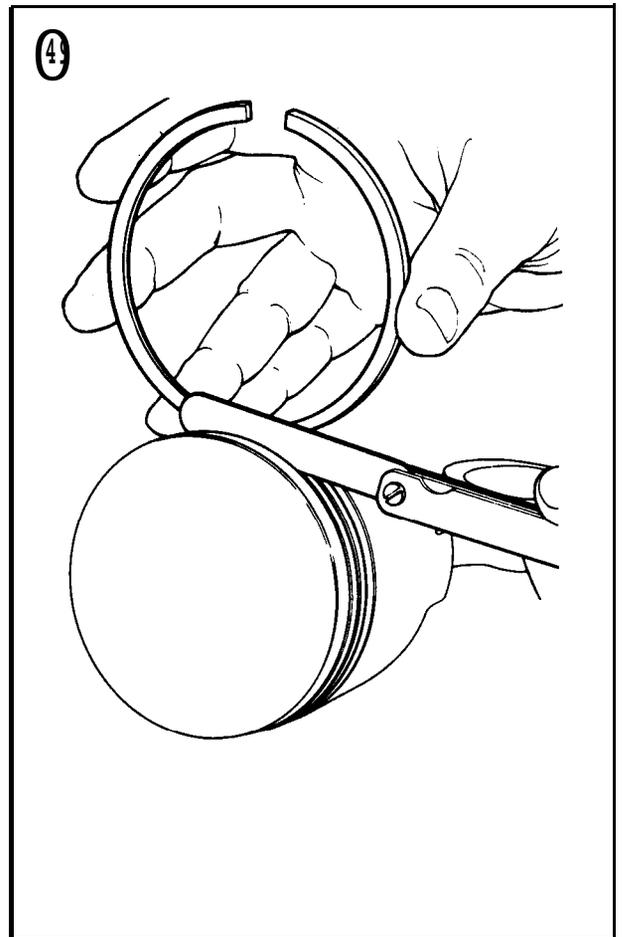
*If the cylinders have not been rebored, check the gap at the bottom of the ring travel, where the cylinder is least worn.*

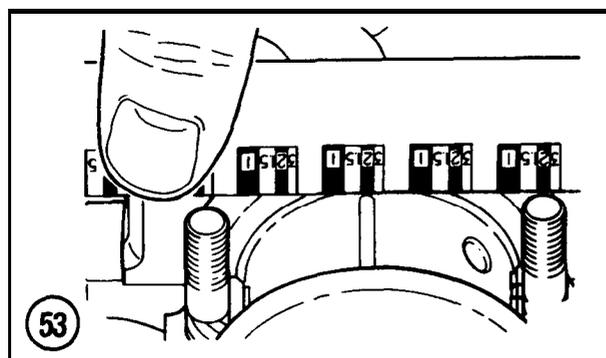
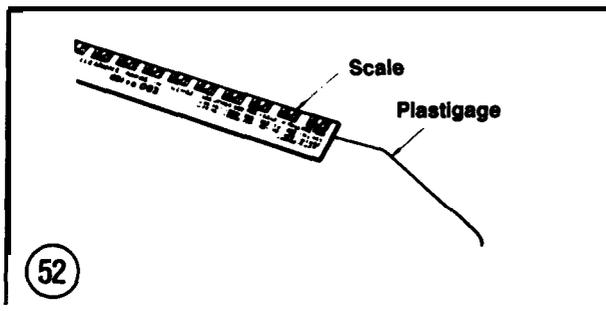
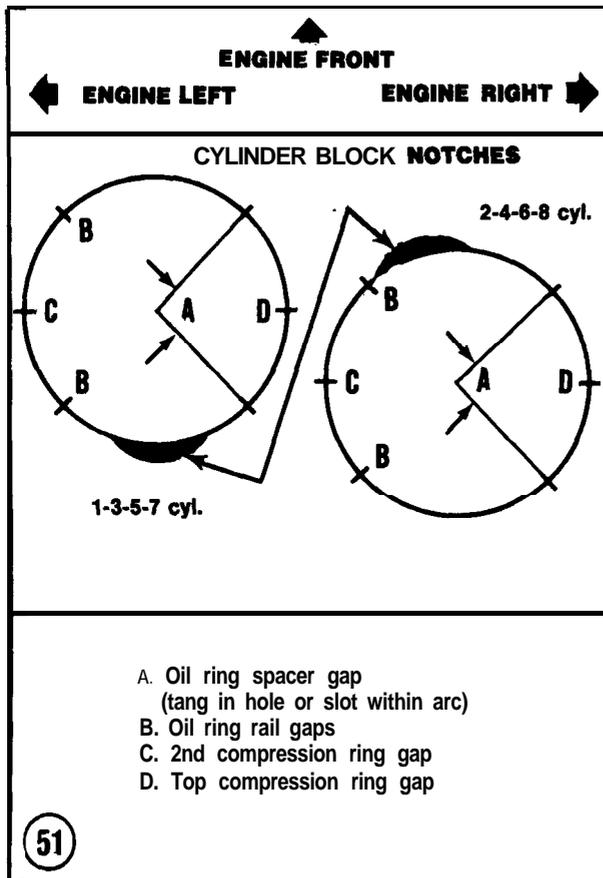
2. Measure the ring gap with a feeler gauge as shown in **Figure 48**. Compare with specifications. If the measurement is not within specifications (**Tables 1-3**), replace the rings as a set.
3. Check the side clearance of the compression rings as shown in **Figure 49**. Place the feeler gauge alongside the ring all the way into the groove. If the measurement is not within specifications (**Tables 1-3**), either the rings or ring grooves are worn. Inspect and replace as necessary.
4. Using a ring expander tool (**Figure 50**), carefully install the oil control ring, then the compression rings.

**NOTE**

*Oil rings consist of 3 segments. The wavy segment goes between the flat segments to act as a spacer. Upper and lower flat segments are interchangeable. The top sides of both compression rings are marked with a symbol. The marked side of the ring must face the top of the piston.*

5. Position the ring gaps as shown in **Figure 51**.





### Connecting Rod Inspection

Have the connecting rods checked for straightness by a dealer or machine shop. Connecting rods can spring out of alignment during shipping or handling. When installing new connecting rods, have them checked for misalignment before installing the piston and piston pin.

### Connecting Rod Bearing Clearance Measurement

1. Place the connecting rods and upper bearing halves on the proper connecting rod journals.
2. Cut a piece of Plastigage the width of the bearing (Figure 52). Place the Plastigage on the journal, then install the lower bearing half and cap.

#### NOTE

**Do not place Plastigage over the journal oil hole.**

3. Tighten the connecting rod cap to specifications (Table 4). Do not rotate the crankshaft while the Plastigage is in place.
4. Remove the connecting rod cap. Bearing clearance is determined by comparing the width of the flattened Plastigage to the markings on the envelope. See Figure 53. If the clearance is excessive, the crankshaft must be reground and undersize bearings installed.

### Installing Piston/Connecting Rod Assemblies

1. Make sure the pistons are correctly installed on the connecting rods. The notched side of the piston should be on the same side as the connecting rod tangs.
2. Make sure the ring gaps are positioned as shown in Figure 51.
3. Slip short pieces of hose over the connecting rod studs to keep them from nicking the crankshaft. Tape will work if you do not have the right diameter hose, but it is more difficult to remove.
4. Immerse the entire piston in clean engine oil. Coat the cylinder wall with oil.

5. Install the piston/connecting rod assembly in its cylinder as shown in **Figure 54**. Make sure the number painted on the top of the piston before removal corresponds to the cylinder number.

**NOTE**

*The notch on the piston must face the front of the engine. See Figure 55.*

6. Clean the connecting rod bearings carefully, including the back sides. Coat the journals and bearings with clean engine oil. Place the bearings in the connecting rod and cap.

7. Remove the protective hose or tape and install the connecting rod cap. Make sure the rod and cap marks align. Tighten the cap nuts to specifications (Table 4).

8. Check the connecting rod big-end play as described under *Piston Removal*.

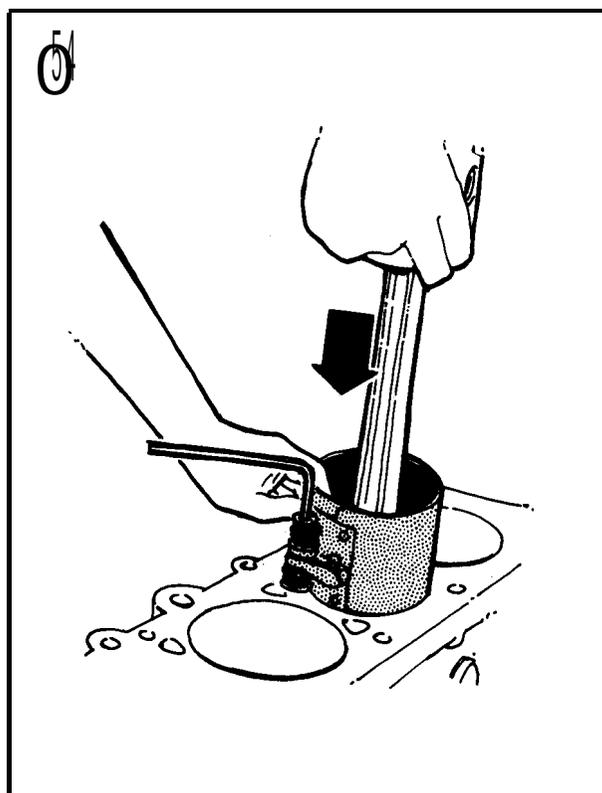
### CRANKSHAFT

#### End Play Measurement

1. Pry the crankshaft to the front of the engine with a large screwdriver.
2. Measure the crankshaft end play between the front of the rear main bearing and the crankshaft thrust surface with a feeler gauge. Compare to specifications (**Tables I-3**).
3. If end play is excessive, replace the rear main bearing. If less than specified, check the bearing faces for imperfections.

#### Removal

1. Remove the engine as described in this chapter.
2. Remove the flywheel as described in this chapter.
3. Mount the engine on an engine stand, if available.
4. Remove the starter.
5. Invert the engine to bring the oil pan to an upright position.
6. Remove the oil pan and oil pump as described in this chapter.
7. Remove the torsional damper and front cover as described in this chapter.
8. Remove the spark plugs to permit easy rotation of the crankshaft.
9. Rotate the crankshaft to position one connecting rod at the bottom of its stroke.
10. Remove the connecting rod bearing cap and bearing. Move the piston/rod assembly away from the crankshaft.



11. Repeat Step 9 and Step 10 for each piston/rod assembly.
12. Unbolt and remove the main bearing caps with bearing inserts.

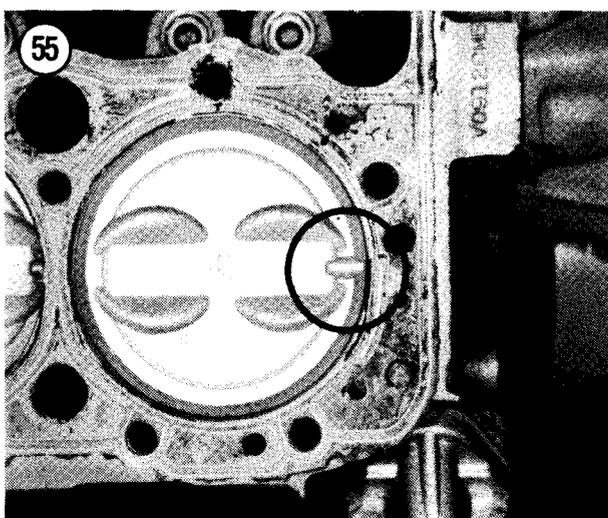
**NOTE**

*If the caps are difficult to remove, lift the bolts partway out, then pry the caps from side to side.*

13. Check the caps for identification numbers or marks. If none are visible, clean the caps with a wire brush. If marks still cannot be seen, make your own with quick-drying paint.
14. Carefully lift the crankshaft from the engine block. Lay the crankshaft, main bearings and bearing caps in order on a clean workbench.
15. Remove the main bearing oil seal from the cylinder block and rear bearing cap.

#### Inspection

1. Clean the crankshaft thoroughly with solvent. Blow out the oil passages with compressed air.
2. Check the main and connecting rod journals for scratches, grooves, scoring or cracks. Check oil seal surface for burrs, nicks or other sharp edges which might damage a seal during installation.

**NOTE**

*Unless you have precision measuring equipment and know how to use it, have a machine shop perform Step 3.*

3. Check all journals and crankpins against specifications for out-of-roundness and taper. If necessary, have the crankshaft reground and install new undersize bearings.

**Main Bearing Clearance Measurement**

Main bearing clearance is measured with Plastigage in the same manner as connecting rod bearing clearance, described in this chapter. Excessive clearance requires that the bearings be replaced, the crankshaft be reground or both.

**Sprocket Removal/Installation**

1. Remove torsional damper as described in this chapter.
2. Remove front cover as described in this chapter.
3. Remove camshaft sprocket and timing chain as described in this chapter.
4. Install tool part No. J- 16 19 and remove crankshaft sprocket.
5. Installation is the reverse of removal. Use tool part No. J-21058 to install sprocket to crankshaft.

**Installation**

1. Install a new rear main bearing oil seal as described in this chapter.

2. Install the main bearing inserts in the bores with their tangs engaging the slots provided in the block.
3. Install the main bearing inserts in the bearing caps.
4. Carefully lower the crankshaft into position in the block.
5. Install main bearing caps with their arrows pointing toward the front of the engine.
6. Tighten all bearing caps except the rear main to 10- 12 ft.-lb. Tighten rear main cap to specifications (Table 4). Tap front of crankshaft with a hammer to drive it rearward, then tap the rear to drive it forward. This aligns the rear main bearing and crankshaft thrust surfaces.
7. Retighten all main bearing caps to specifications (Table 4).
8. Measure crankshaft end play as described in this chapter.
9. Reverse Steps 1-10 of *Removal* in this chapter.

**REAR MAIN OIL SEAL****Replacement**

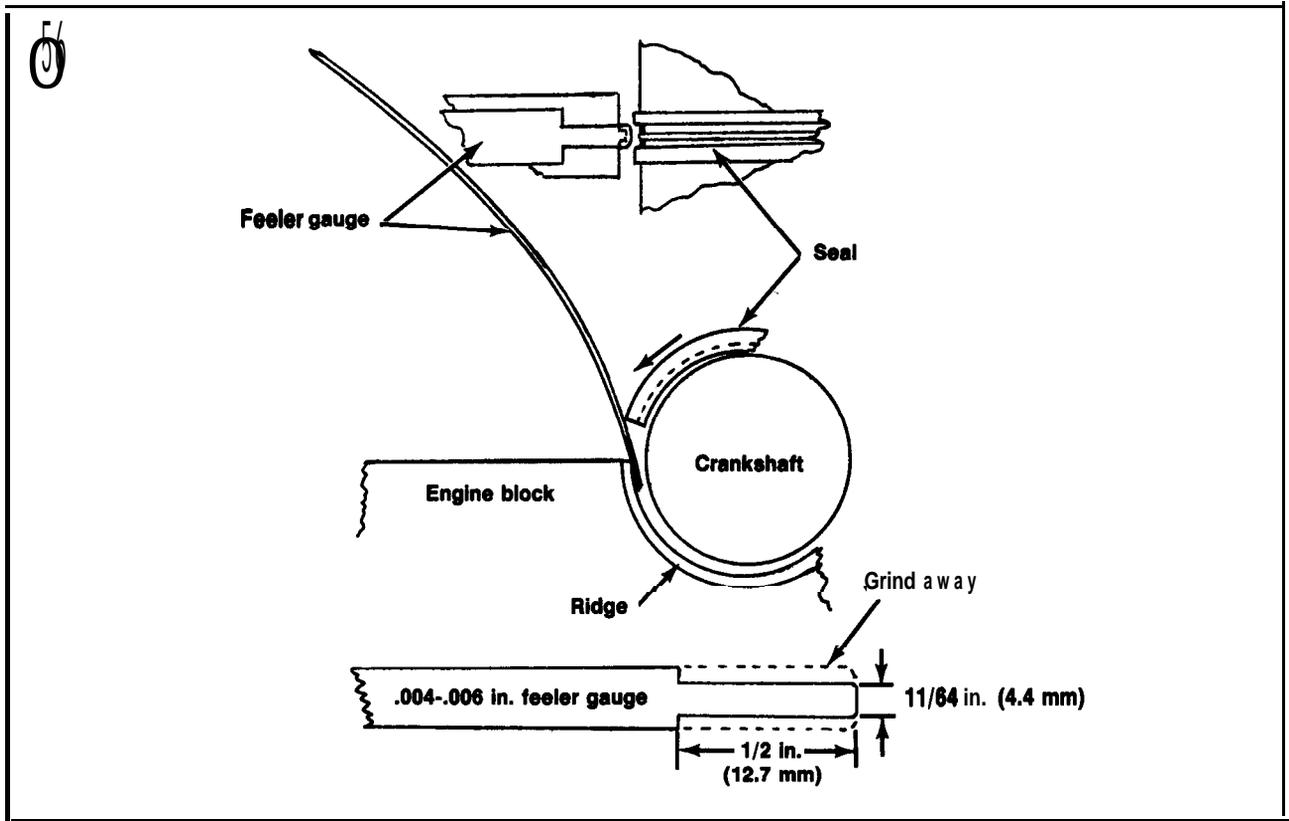
Refer to **Figure 56** for this procedure.

1. Remove the engine from the boat as described in this chapter.
2. Remove the oil pan and oil pump as described in this chapter.
3. Remove the rear main bearing cap.
4. Pry the old oil seal from the bottom of the rear main cap with a screwdriver.
5. Lightly lubricate the lip of a new seal with clean engine oil. Do not let oil touch parting line surface.
6. Install new seal into cap, taking care that the sharp edge of the ridge does not cut the bead in the center of the outer seal surface.
7. Remove upper half of seal from block with a brass pin punch and hammer. Tap on one end of seal and drive it from groove far enough for removal with pliers.

**NOTE**

*To properly modify a feeler gauge for use in Step 8, grind the sides of a 0.004 or 0.006 in. feeler gauge until it will fit into the "U" of the seal without scraping the seal sides. File ground edges of feeler gauge to prevent them from scratching the seal.*

8. Wipe crankshaft surface clean. Repeat Step 5 and Step 6, using a modified feeler gauge to protect the seal bead while seal is carefully fed into its groove by hand.

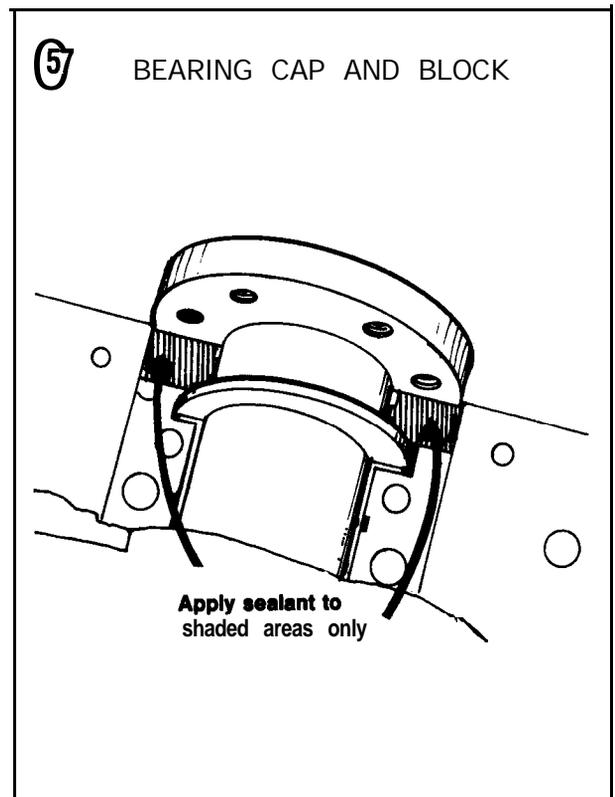


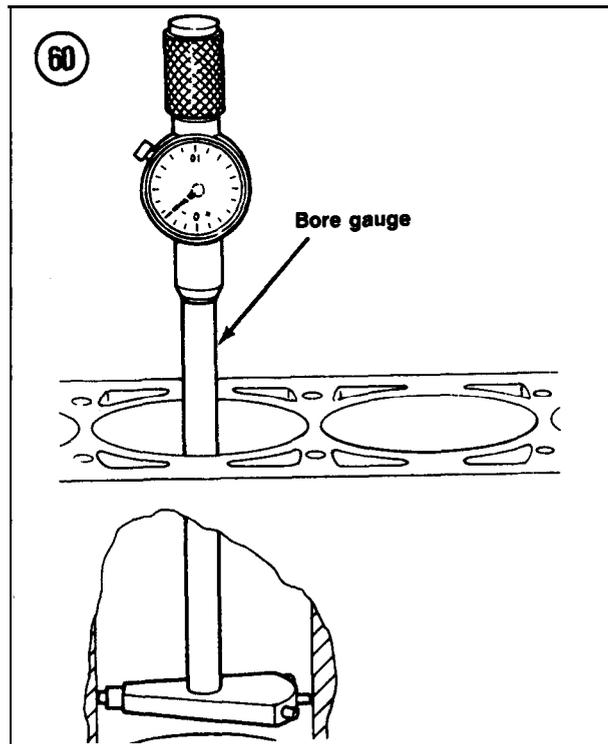
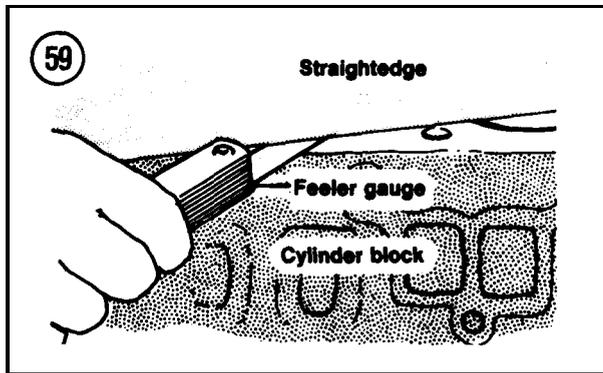
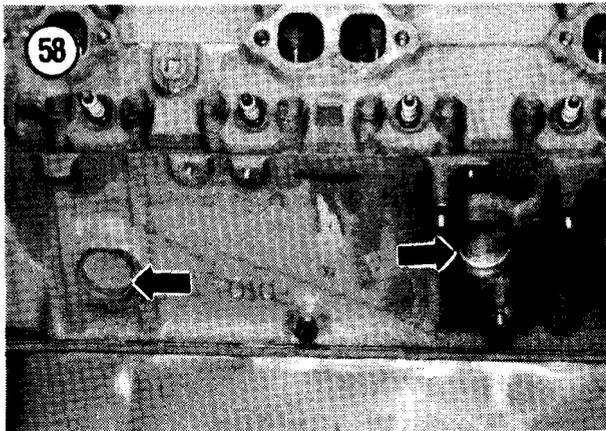
9. Coat the seal area of the block with Perfect Seal (part No. C-92-34227) or equivalent. See Figure 57.
10. Install the rear main bearing cap and tighten cap bolts to specifications (Table 4).
11. Install the oil pump and oil pan as described in this chapter.
12. Install the engine in the boat as described in this chapter.

### FLYWHEEL

#### Removal/Installation

1. Remove the engine as described in this chapter.
2. Remove the transmission, if so equipped.
3. Remove the flywheel housing and drive plate or coupling.
4. Unbolt and remove the flywheel.
5. To install, align dowel hole in flywheel with dowel hole in crankshaft flange and position flywheel on studs.
6. Fit drive plate or coupling on studs. Install washers and locknuts. Tighten nuts to specifications.
7. Install a dial indicator on machined surface of flywheel and check **runout**. If **runout** exceeds 0.008





- in., remove flywheel and check for burrs. If none are found, replace the flywheel.  
8. Reverse Steps 1-3 to complete installation.

### Inspection

1. Visually check the flywheel surfaces for cracks, deep scoring, excessive wear, heat discoloration and checking.
2. Check surface flatness with a straightedge and feeler gauge.
3. Inspect the ring gear teeth for cracks, broken teeth or excessive wear. If severely worn, check the starter motor drive teeth for similar wear or damage. Replace as indicated.
4. Lubricate engine coupling splines with Multipurpose Lubricant (part No. C-92-63250). If boat is used mainly for trolling, use Universal Joint Lubricant (part No. C-92-74057A1) for better results.

## CYLINDER BLOCK

### Cleaning and Inspection

1. Clean the block thoroughly with solvent. Remove any gasket residue from the machined surfaces. Check all core plugs (**Figure 58**) for leaks and replace any that are suspect. See *Core Plugs* in this chapter. Remove any plugs that seal oil passages. Check oil and coolant passages for sludge, dirt and corrosion while cleaning. If the passages are very dirty, have the block boiled out by a machine shop. Blow out all passages with compressed air. Check the threads in the head bolt holes to be sure they are clean. If dirty, use a tap to true up the threads and remove any deposits.
2. Examine the block for cracks. To confirm suspicions about possible leak areas, use a mixture of one part kerosene and 3 parts engine oil. Coat the suspected area with this solution, then wipe dry and immediately apply a solution of zinc oxide dissolved in wood alcohol. If any discoloration appears in the treated area, the block is cracked and should be replaced.
3. Check flatness of the cylinder block deck. Place an accurate straightedge on the block. If there is any gap between the block and straightedge, measure it with a feeler gauge. Measure from end to end and from corner to corner, as shown in **Figure 59**. Have a block resurfaced if out of specifications.
4. Measure the cylinder bores with a bore gauge (**Figure 60**) as described in Step 2, *Piston Clearance*

Check in this chapter. If the cylinders exceed maximum tolerances, they must be rebored. Reboring is also necessary if the cylinder walls are badly scuffed or scored. Before boring, install all main bearing caps and tighten the cap bolts to specifications in **Table 5**.

### CORE PLUGS

Check the condition of all core plugs in the block and cylinder head whenever the engine is out of the boat for service. If any signs of leakage or corrosion are found around one plug, replace them all.

#### Removal/Installation

##### CAUTION

*Do not drive core plugs into the engine casting. It will be impossible to retrieve them and they can restrict coolant circulation, resulting in serious engine damage.*

1. Tap the bottom edge of the core plug with a hammer and drift. Use several sharp blows to push the bottom of the plug inward, tilting the top out (**Figure 61**).
2. Grip the top of the plug with pliers. Pull the plug from its bore (**Figure 62**) and discard.
3. Clean the plug bore thoroughly to remove all traces of the old sealer.
4. Apply a light coat of Loctite Stud N' Bearing Mount or equivalent to the plug bore.
5. Install the new core plug with an appropriate size driver or socket. The sharp edge of the plug should be at least 0.02 in. inside the lead-in chamfer.

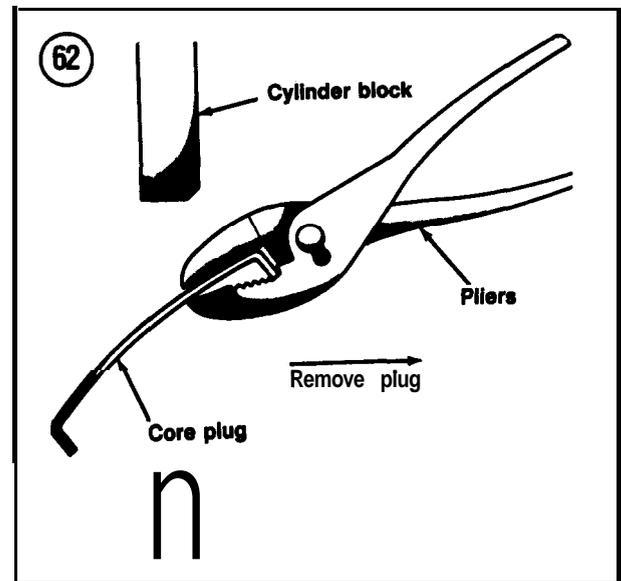
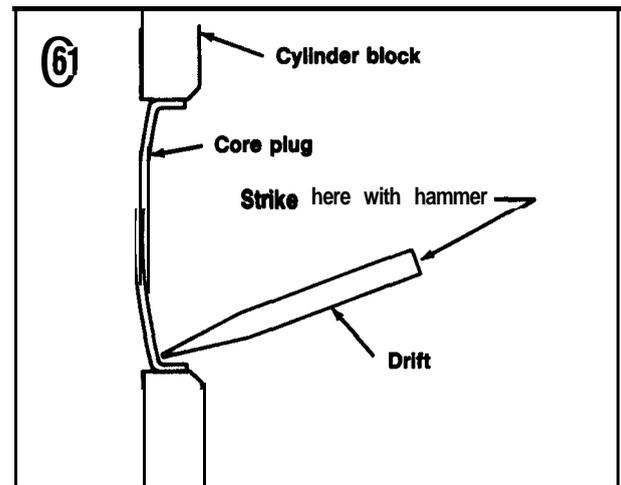


Table 1 229 CID **V6 ENGINE** SPECIFICATIONS

<b>Type</b>	Overhead valve <b>V6</b>
<b>Displacement</b>	229 cid
<b>Bore</b>	3.735 in.
<b>Stroke</b>	3.48 in.
<b>Cylinder numbering (front to rear)</b>	
Starboard bank	2-4-6
Port bank	1-3-5
<b>Firing order</b>	1-6-5-4-3-2
<b>Cylinder bore</b>	
Out-of-round	0.002 in. max.
Taper	
Thrust aide	0.0005 in. max.
Relief aide	0.001 in. max.
<b>Cylinder head</b>	
Gasket surface flatness	0.007 in. overall
<b>Piston clearance</b>	<b>0.0007-0.0017</b> in.
<b>Piston rings</b>	
Groove aide clearance	
1st compression	0.0012-0.0032 in.
2nd compression	0.0012-0.0032 in.
Oil	0.002-0.007 in.
<b>Gap</b>	
1st compression	0.010-0.020 in.
2nd compression	0.010-0.025 in.
Oil	0.015-0.055 in.
<b>Piston pin</b>	
Diameter	<b>0.9270-0.9273</b> in.
Clearance	0.0025-0.00035 in.
Fit in rod	<b>0.0008-0.0016</b> interference
<b>Crankshaft</b>	
Main journal diameter	
No. 1	2.4404-2.4493 in.
No. 2 and No. 3	<b>2.4481-2.4490</b> in.
No. 4	2.4479-2.4400 in.
Main journal taper	0.0002 in. max.
Main journal out-of-round	0.0002 in. max.
Main bearing clearance	
No. 1	0.0008-0.0020 in.
No. 2 and No. 3	0.0011-0.0023 in.
No. 4	0.0017-0.0032 in.
End play	0.002-0.006 in. max.
<b>Crankpin diameter</b>	<b>2.0986-2.0998</b> in.
<b>Crankpin taper</b>	0.0005 in. max.
Out-of-round	0.0005 in. max.
<b>Runout</b>	0.0015 in.

(continued)

Table 2 262 CID **V6 ENGINE** SPECIFICATIONS (continued)

<b>Piston rings</b>	
Groove side clearance	
Compression	
Production	0.0012-0.0032 in. <b>(0.0305-0.0813 mm)</b>
Service	0.001 in. (0.025 mm)
Oil	
Production	0.002-0.007 in. <b>(0.051-0.178 mm)</b>
Service	0.001 in. (0.025 mm)
<b>Gap</b>	
Compression	
Production	
<b>Top</b>	0.010-0.020 in. <b>(0.254-0.508 mm)</b>
2nd	0.010-0.025 in. <b>(0.0254-0.635 mm)</b>
<b>Service</b>	0.010 in. (0.254 mm)
Oil	
Production	0.015-0.055 in. <b>(0.381-1.397 mm)</b>
Service	0.010 in. (0.254 mm)
<b>Piston pin</b>	
Diameter	<b>0.9270-0.9273 in.</b> (23.5458-23.5534 mm)
Clearance	
Production	0.00025-0.00035 in. <b>(0.00635-0.00889 mm)</b>
Service	0.001 in. (0.025 mm) max.
Fit in rod	<b>0.0008-0.0016 in.</b> <b>(0.0203-0.0406 mm)</b>
<b>Crankshaft</b>	
Main journal	
Diameter	
No. 1	1.4484-1.4493 in. (82.1894-82.2122 mm)
No. 2 and 3	<b>2.4481-2.4490 in.</b> <b>(62.1817-62.2046 mm)</b>
No. 4	2.4479-2.4488 in. (82.1787-82.1995 mm)
Taper	
Production	0.0002 in. (0.0051 mm) max.
<b>Service</b>	0.001 in. (0.025 mm) max.
Out-of-round	
Production	0.0002 in. (0.0051 mm) max.
Service	0.001 in. (0.025 mm) max.
Main bearing clearance	
Production	
No. 1	<b>0.0008-0.0020 in.</b> <b>(0.0203-0.0508 mm)</b>
No. 2 and 3	0.0011-0.0023 in. <b>(0.0279-0.0584 mm)</b>
No. 4	0.0017-0.0032 in. <b>(0.0432-0.0813 mm)</b>
<b>Service</b>	
No. 1	0.001-0.0015 in. <b>(0.0254-0.0381 mm)</b>
No. 2 and 3	0.001-0.0025 in. <b>(0.0254-0.0635 mm)</b>

(continued)

Table 2 262 CID **V6 ENGINE** SPECIFICATIONS (continued)

<b>Main bearing clearance (cont'd.)</b>	
No. 4	0.0025-0.0035 in. <b>(0.0635-0.0889 mm)</b>
End play	<b>0.002-0.006</b> in. (0.051-0.152 mm)
<b>Runout</b>	0.0015 in. (0.0381 mm)
<b>Connecting rod journal</b>	
Diameter	2.0988-2.0998 in. <b>(53.3095-53.3349 mm)</b>
Taper	
Production	0.0005 in. (0.0127 mm) max.
Service	0.001 in. (0.025 mm) max.
Out-of-round	
Production	0.0005 in. (0.0127 mm) max.
Service	0.001 in. (0.025 mm) max.
<b>Rod bearing clearance</b>	
Production	0.0013-0.0035 in. <b>(0.330-0.889 mm)</b>
Service	0.003 in. (0.0782 mm) max.
<b>Rod side clearance</b>	<b>0.006-0.014</b> in. <b>(0.152-0.356 mm)</b>
<b>Camshaft</b>	
Journal diameter	1.8882-1.8692 in. <b>(47.452-47.478 mm)</b>
Journal out-of-round	0.001 in. (0.025 mm) max.
Lobe lift	0.273 in. $\pm$ <b>0.002</b> in. <b>(8.9342 mm <math>\pm</math> 0.051 mm)</b>
End play	0.004-0.012 in. (0.102-0.304 mm)
Timing chain deflection	<b>3/8</b> in. (9.5 mm) from taut position <b>(3/4 in. or 19.1 mm total)</b>
<b>Valve System</b>	
Lifter type	Hydraulic
Rocker arm ratio	<b>1.50:1</b>
Valve lash	1 turn down from zero lash
Face angle	45°
Seat angle	48°
Seat <b>runout</b>	0.002 in. (0.051 mm)
Seat width	
Intake	<b>1/32-1/16</b> in. (0.79-1.59 mm)
Exhaust	<b>1/16-3/32</b> in. (1.59-2.38 mm)
Stem clearance	
Production	0.0010-0.0027 in. <b>(0.0254-0.0888 mm)</b>
Service	
Intake	0.0037 in. (0.0940 mm)
Exhaust	0.0047 in. (0.1194 mm)
Valve spring	
Free length	2.03 in. (51.8 mm)
Installed height	1 <b>23/32</b> in. (43.7 mm)
Pressure	
Closed	78-84 lb. @ 1.70 in. <b>(34.5-38.1 kg @ 43.18 mm)</b>
Open	<b>194-206</b> lb. @ 1.25 in. <b>(88.1-93.5 kg @ 31.75 mm)</b>
Damper free length	1.88 in. (47.24 mm)
Flywheel <b>runout</b>	0.008 in. (0.203 mm) max.

Table 3 SMALL BLOCK V8 ENGINE SPECIFICATIONS

<b>Type</b>	Overhead valve V8
<b>Displacement</b>	
Model 190	283 cid
Model <b>225, 250, 260</b>	327 cid
Model 198, <b>228, 230, 898</b>	305 cid
Model <b>250, 255, 260, 270</b>	350 cid
<b>Bore</b>	
283 cid	3.875 in.
305, 327, 350 cid	4.000 in.
<b>Stroke</b>	
283 cid	3.25 in.
305 cid	3.48 in.
327 cid	3.80 in.
350 cid	3.48 in.
<b>Cylinder numbering (front to rear)</b>	
Starboard bank	24-8-8
<b>Port</b> bank	1-3-5-7
<b>Firing</b> order	1-8-4-3-8-5-7-2
<b>Cylinder bore</b>	
Out-of-round	0.002 in. max.
Taper	
Thrust side	0.0005 in. max.
Relief side	0.001 in. max.
<b>iston clearance</b>	
Model 190,225	0.0005-0.0011 in.
Model <b>250<sup>1</sup></b>	<b>0.0010-0.0016</b> in.
Model 228, 230, <b>250<sup>2</sup>, 255,</b> 270,898	<b>0.0007-0.0017</b> in.
<b>iston rings</b>	
Groove side clearance	
Top compression	
Model 190,225	0.0012-0.0027 in.
All others	0.0012-0.0032 in.
2nd compression	
Model 190,225	0.0012-0.0037 in.
Model 198, 228, 230,898	0.0012-0.0032 in.
All others	<b>0.0012-0.0042</b> in.
Oil	
Model <b>190, 225, 270</b>	0.000-0.005 in.
All othem	<b>0.002-0.007</b> in.
<b>Gap</b>	
Top compression	
Model 190,225	0.013-0.023 in.
All othem	0.010-0.020 in.
2nd compression	
Model 270	<b>0.013-0.023</b> in.
Model <b>198, 228, 230, 898</b>	0.010-0.025 in.
All others	0.013-0.025 in.
Oil	0.015-0.055 in.

(continued)

Table 3 SMALL BLOCK V8 ENGINE SPECIFICATIONS (continued)

<b>Piston pin</b>	
Diameter	0.9270-0.9273 in.
Clearance	
Model 190,225	<b>0.0015-0.00025</b> in.
All others	0.00025-0.00035 in.
Fit in rod	<b>0.0008-0.0016</b> Interference
<b>Crankshaft</b>	
Main journal diameter	
Model 190	2.2988-2.2998 in.
Model 225,250'	
No. 1, 2, 3, 4	2.4454-2.4493 in.
No. 5	2.4479-2.4488 in.
All others	
No. 1	2.4484 in.
No. 2, 3, 4	<b>2.4481-2.4490</b> in.
No. 5	2.4479-2.4488 in.
Main journal taper	0.0002 in. max.
Main journal out-of-round	0.0002 in. max.
Main bearing clearance	
Model 190	<b>0.0008-0.0018</b> in.
Model 225	
No. 1, 2, 3, 4	<b>0.0008-0.0020</b> in.
No. 5	0.0018-0.0034 in.
Model 250, 270	
No. 1, 2, 3, 4	0.0008-0.0024 in.
No. 5	<b>0.0010-0.0026</b> in.
All others	
No. 1	<b>0.0008-0.0020</b> in.
No. 2, 3, 4	0.0011-0.0023 in.
No. 5	0.0017-0.0032 in.
End play	
Model 225,250	0.003-0.011 in.
All others	<b>0.002-0.006</b> in.
<b>Crankpin diameter</b>	
Model 190, 225 (to serial No. 2399397)	1.999-2.000 in.
All others	2.099-2.100 in.
Taper	
Model <b>198, 228, 230, 898,</b>	
<b>255, 260, 270</b>	0.0005 in. max.
Model 225 (serial No. <b>2399398-on</b> ),	
all others	0.0003 in. max.
Out-of-round	
Model <b>198, 228, 230, 898,</b>	
255, 280, 270	0.0005 in. max.
All others	0.0002 in. max.
Connecting rod	
Bearing clearance	
Model 198, <b>228, 230, 898,</b>	
<b>255, 260, 270</b>	0.0013-0.0035 in.
All others	0.0007-0.0028 in.

(continued)

Table 3 SMALL BLOCK V8 **ENGINE** SPECIFICATIONS (continued)

Side clearance	
Model 270,310	0.019-0.025 in.
Model 225,250'	0.009-0.013 in.
All others	<b>0.008-0.014</b> in.
<b>Camshaft</b>	
Lobe lift	
intake	
Model 190	0.222 in.
Model <b>225, 250, 270</b>	0.260 in.
Model <b>198, 228, 230, 898,</b> 255, 280,270	0.288 in.
<b>Camshaft</b>	
Lobe lift (cont.)	
Exhaust	
Model 190	0.222 in.
Model 225, 250, 270	0.273 in.
Model 198,228, 230,898, 255, 280,270	0.289 in. max.
Journal diameter	1.8882-1 <b>.8692</b> in.
<b>Runout</b>	
Model 198, <b>228, 230, 898,</b> 255,260, 270	0.002 in. max.
All others	0.0015 in. max.
<b>Valves</b>	
Lifter	Hydraulic
Rocker arm ratio	<b>1.50:1</b>
Lash	
Model 198, 228, 230, 898, 255,280, 270	One turn down from zero lash
All others	<b>3/4</b> turn down from zero lash
Face angle (intake, exhaust)	45°
Seat angle	
Model 198, 228, 230, 898,255, 260,270	48°
All others	45°
Seat <b>runout</b> (intake, exhaust)	0.002 in. max.
Seat width	
intake	<b>1/32-1/16</b> in.
Exhaust	1/18-3/32 in.
Stem clearance	
intake	0.0010-0.0027 in.
Exhaust	
Model 190	<b>0.0016-0.0033</b> in.
Model <b>198, 228, 225,</b> <b>230, 250, 255,</b> 280, 270	0.0010-0.0027 in.
All others	0.0015-0.0032 in.
Valve springs	
Free length	
Model 190	2.03 in.
All others	2.08 in.

(continued)

Table 3 SMALL BLOCK **V8** ENGINE SPECIFICATIONS (continued)

Pressure	
Model 190,270	
Closed	78-88 lb. @ 1.88 in.
Open	170-180 lb. @ 1.28 in.
Model 225,250	
Closed	78-84 lb. @ 1.70 in.
Open	<b>194-206 lb. @ 1.25 in.</b>
installed height	
Model <b>190, 225, 250</b>	1 5132 in.
Model 270	1 <b>21/32</b> in.
Damper free length	1.94 in.
1. 327 cid.	
2. 350 cid.	

Table 4 LARGE BLOCK **V8** ENGINE SPECIFICATIONS

Type	Overhead valve V8
Displacement	
Model 310	409 cid
Model 325	427 cid
Model <b>330, 340, 370</b> and 400	454 cid
Model 390	482 cid
Bore	
409 cid	4.125 in.
427 cid	4.250 in.
454 cid	4.250 in.
482 cid	4.250 in.
Stroke	
409 cid	3.80 in.
427 cid	3.80 in.
454 cid	4.00 in.
482 cid	4.10 in.
Cylinder numbering	
Left bank	1-3-5-7
Right bank	2-4-8-8
Firing order	1-8-4-3-8-5-7-2
Cylinder bore	
Out-of-round	0.0005 in. max.
Taper	0.0005 in. max.
Piston clearance	
409 cid	0.0018-0.0020 in.
427 cid	<b>0.0034-0.0044</b> in.
454 cid	
Standard	0.0014-0.0024 in.
Hi-performance	0.0045-0.0085 in.
482 cid	<b>0.0040-0.0050</b> in.
(continued)	

Table 4 LARGE BLOCK V8 ENGINE SPECIFICATIONS (continued)

<b>Piston rings</b>	
Groove clearance	
1st compression	
409,454 cid	0.0017-0.0032 in.
427, 482 cid	0.0018-0.0038 in.
2nd compression	
409, 454 cid	<b>0.0017-0.0032</b> in.
427, 482 cid	0.0018-0.0038 in.
Oil	
409,454 cid	<b>0.0005-0.0065</b> in.
427, 482 cid	0.0020-0.0035 in.
<b>Gap</b>	
1st compression	0.01 0-0.020 in.
2nd compression	0.010-0.030 in.
Oil	
409 cid	0.010-0.020 in.
427, 482 cid	0.010-0.023 in.
454 cid	
Standard	0.015-0.055 in.
Hi-performance	0.020-0.035 in.
<b>Piston pin</b>	
Diameter	<b>0.9895-0.9898</b> in.
Clearance	0.0025-0.00035 in.
Fit in rod	<b>0.0008-0.0016</b> interference
<b>Crankshaft</b>	
Main journal diameter	
409 cid	
No. 1, 2, 3, 4	2.4977-2.4987 in.
No. 5	<b>2.4980-2.4990</b> in.
454 cid	
No. 1	2.7485-2.7494 in.
No. 2, 3, 4	<b>2.7481-2.7490</b> in.
No. 5	2.7478-2.7488 in.
427, 482 cid	
No. 1, 2, 3, 4	<b>2.7481-2.7490</b> in.
No. 5	2.7478-2.7488 in.
Main journal taper	0.0002 in. max.
Main journal out-of-round	0.0002 in. max.
Main bearing clearance	
409 cid	
No. 1, 2, 3, 4	<b>0.0006-0.0032</b> in.
No. 5	0.0018-0.0034 in.
454 cid	
No. 1, 2, 3, 4	0.0013-0.0025 in.
No. 5	0.0024-0.0040 in.
427, 482 cid	
No. 1, 2, 3, 4	0.0013-0.0025 in.
No. 5	0.0015-0.0031 in.
End play	
Except 409 cid	<b>0.006-0.0010</b> in. max.
409 cid	0.004-0.0012 in.

(continued)

Table 4 **LARGE** BLOCK V8 ENGINE SPECIFICATIONS (continued)

<b>Camshaft</b>	
<b>Valve lift</b>	
Intake	
409 cid	0.1914 in.
427, 482 cid	0.272 in.
454 cid	
Standard	0.271 in.
Hi-performance	0.294 in.
Exhaust	
409 cid	0.2849 in.
427, 482 cid	0.282 in.
454 cid (standard)	0.282 in.
454 cid (Hi-performance)	0.294 in.
Journal diameter	
409 cid	1.8887-1.8692 in.
427, 482 cid	1.9487-1.9497 in.
454 cid	1.9482-1.9492 in.
<b>Runout</b>	
454 cid	0.002 in. max.
All others	0.0015 in. max.
<b>Valves</b>	
Litter	
409 cid	Mechanical
All others	Hydraulic
Rocker arm ratio	
409 cid	<b>1.75:1</b>
All others	<b>1.70:1</b>
Lash	
409 cid (valves hot)	
Intake	0.008 in.
Exhaust	0.018 in.
427, 482 cid	<b>3/4</b> turn down <b>from</b> zero lash
454 cid	1 turn down from zero lash
454 cid w/roller rocker arm	<b>1/2</b> turn down from zero lash
<b>Crankpin</b> diameter	
Except 454 cid	2.199-2.200 in.
454 cid	2.1985-2.1995 in.
<b>Crankpin</b> taper	
Except 454 cid	0.0003 in. max.
454 cid	0.0005 in. max.
<b>Crankpin</b> out-of-round	
Except 454 cid	0.0002 in. max.
454 cid	0.0005 in. max.
Connecting rod	
Bearing clearance	
409 cid	0.0007-0.0028 in.
427, 482 cid	0.0007-0.0028 in.
454 cid	0.0009-0.0025 in.
Side clearance	
454 cid	0.013-0.023 in.
All others	0.019-0.025 in.

(continued)

Table 4 LARGE BLOCK V8 ENGINE SPECIFICATIONS (continued)

Face angle	
Except 427,482 cid exhaust	45°
427, 482 cid exhaust	46°
Seat angle	46°
Seat runout	0.002 in. max.
Seat width	
Intake	<b>1/32-1/16</b> in.
Exhaust	
Except 427, 482 cid	<b>1/16-3/32</b> in.
427, 482 cid	<b>3/32-1/8</b> in.
<b>Valves (cont.)</b>	
Stem clearance	
Intake	
Except 427,482 cid	<b>0.0010-0.0027</b> in.
427, 482 cid	0.0010-0.0025 in.
Exhaust	
409 cid	<b>0.0015-0.0032</b> in.
427, 482 cid	<b>0.0012-0.0027</b> in.
494 cid	<b>0.0010-0.0027</b> in.
Valve springs	
Free length	
409 cid	2.01 in.
427, 482 cid	2.09 in.
484 cid	
Single spring	2.12 in.
Two springs	
Inner	2.25 in.
Outer	2.125 in.
<b>Pressure</b>	
409 cid	
Closed	78-88 lb. @ 1.826 in.
Open	184-198 lb. @ 1.23 in.
427 cid	
Closed	<b>94-106</b> lb. @ 1.88 in.
Open	<b>303-327</b> lb. @ 1.38 in.
484 cid (single spring)	
Closed	74-88 lb. @ 1.88 in.
Open	288-312 lb. @ 1.38 in.
484 cid (two springs)	
Closed	<b>115-125</b> lb. @ 1.88 in.
Open	<b>305-325</b> lb. @ 1.38 in.
Installed height	
409 cid	1 <b>1/16</b> in.
All others	1 <b>7/8</b> in.
Damper free length	
427, 482 cid	<b>1.94-2.00</b> in.
494 cid	1.88 in.

**Table 5 TIGHTENING TORQUES**

Fastener	ft.-lb.
<b>Crankshaft</b>	
Thrust plate	20
<b>Sprocket</b>	
Except 409 cid	20
409 cid	18
<b>Carburetor</b> flange bolts	11
<b>Connecting rod</b> cap nuts	
<b>11/32-24</b>	33
<b>3/8-24</b>	
409 cid	40
427, 454 cid	
Standard	50
High-performance	65
All others	45
<b>Crankshaft</b> damper	
Except 427, 482 cid	60
427, 482 cid	85
<b>Cylinder</b> head bolts	
427, 454, 462 cid	80
262 cid	75
All others	65
<b>Distributor</b> clamp	20
<b>Drive</b> plate	35
Exhaust manifold	20
Flywheel	
1967	70
All others	
<b>V6</b>	40
427, 462 cid	65
All others	45
Flywheel-to-coupling	
1987	35'
All others	
<b>5/8</b> in. hex	45
<b>5/8</b> in. hex crownlock	40
<b>11/16</b> in. hex	35
Flywheel housing-to-block	
V6	30
V6	21
Front mount-to-block	
<b>3/8-16</b>	21
<b>1/4-20</b>	6
Fuel pump	
Except 427, 482 cid	30
427, 482 cid	20
Intake manifold	30
Main bearing cap	
229 cid V6	70
262 cid V6	85
Model 250, 270	75
Model 310	95
Model 325, <b>370, 390, 400</b>	110

(continued)

Table **5 TIGHTENING TORQUES** (continued)

Fastener	ft.-lb.
Model 330,340	80
All others	65
Oil cooler to housing	11
Oil pan	
<b>1/4-20</b>	
V6	80 in.-lb.
V8	7
<b>5/16-18</b>	
V6	165 in.-lb.
V8	11
Drain plug	20-23
Oil pump	
Cover	6
To block	65
Rocker arm cover	4
Spark plugs	
With gasket	25
Without gasket	15
Timing gear/chain cover	6
Water pump-to-block	30
. Wipe threads with type A Loctite.	

