

Chapter Nine

MerCruiser 60, 80 and 90 Engines

This chapter covers the early MerCruiser **4-cylinder inline** engines manufactured by Renault. Although differing in displacement, these engines share many features.

All use an aluminum block of sleeved design, with removable cylinder liners. The 60 combines an alternator **stator** with a front flywheel; the 80 and 90 flywheel contains an alternator rotor.

The 60 and 80 cylinder head contains intake and exhaust valves mounted **inline**; the 90 is a crossflow design, with intake valves on one side and exhaust valves on the other. Rocker arms are retained on a rocker arm shaft, with camshaft motion transferred to the rocker arms by pushrods.

The cylinders are numbered 4-3-2-1 from front to rear. Engine firing order is 1-3-4-2. The 80 and 90 are mounted with the front of the engine facing the transom.

The crankshaft is supported by 5 main bearings, with washers in the center main bearing taking the thrust. Crankshaft rotation is counterclockwise when seen from the front of the engine.

The block is line-bored to accept the chain-driven camshaft located above the crankshaft in the engine block.

The oil pump is flange-mounted on the block and driven by the distributor shaft.

Specifications (**Table 1**) and tightening torques (**Table 2**) are at the end of the chapter.

ENGINE SERIAL NUMBER

The engine serial number is stamped on a plate mounted on the left side of the engine block above the oil filter on MerCruiser **60** engines (**Figure 1**) and on the left rear side of the engine block under the intake manifold on 80 and **90** engines (**Figure 2**).

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. While these tools can sometimes be rented from rental dealers, they can always be purchased from your MerCruiser dealer.

REPLACEMENT PARTS

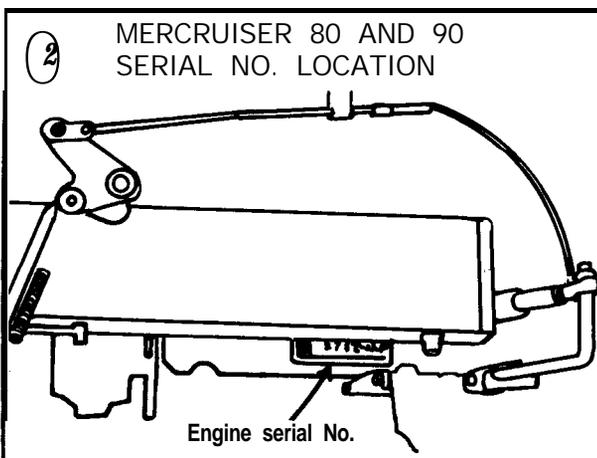
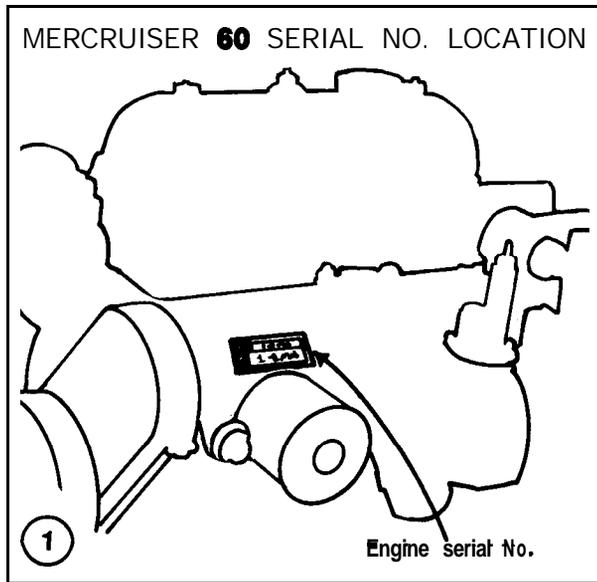
Various changes are made to automotive engine blocks used for marine applications. Numerous part changes are required due to operation in fresh and salt water. For example, the cylinder head gasket must be corrosion-resistant. Marine engines use head gaskets of copper or stainless steel instead of the standard steel-type 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 stem 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 any 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 instrument panel harness plug at the harness receptacle.
4. Disconnect the fuel line, throttle and shift control cables. Plug the fuel line to prevent leakage.
5. Disconnect the Ride-Guide steering cable at the steering rod.
6. Loosen the steering rod-to-clevis locknut. Remove the cotter pin, washer and clevis pin and separate clevis from steering arm.

7A. MerCruiser 60—disconnect the tilt switch leads at the ignition coil and condenser mounting bracket. See **Figure 3**.

7B. MerCruiser 80 and 90—disconnect the tilt switch and ground leads from the starter solenoid and engine harness. See **Figure 4**.

8. Remove the hydraulic shift unit from the mounting bracket/shift lever without disconnecting the hydraulic lines. See **Figure 5** (MerCruiser 60) or **Figure 6** (MerCruiser 80 and 90).

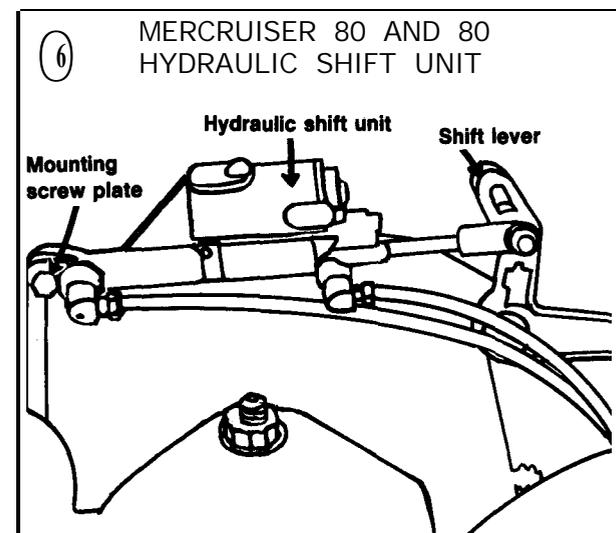
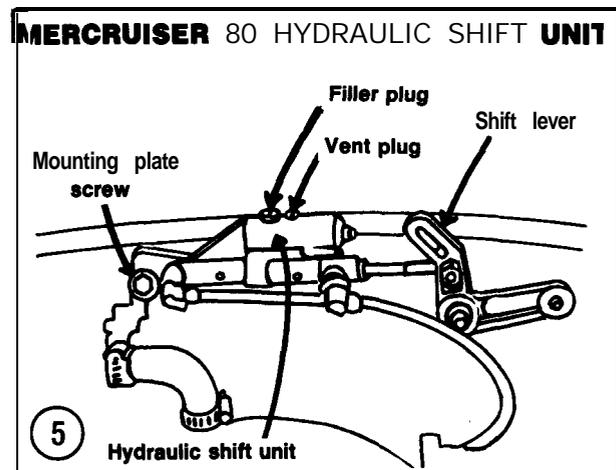
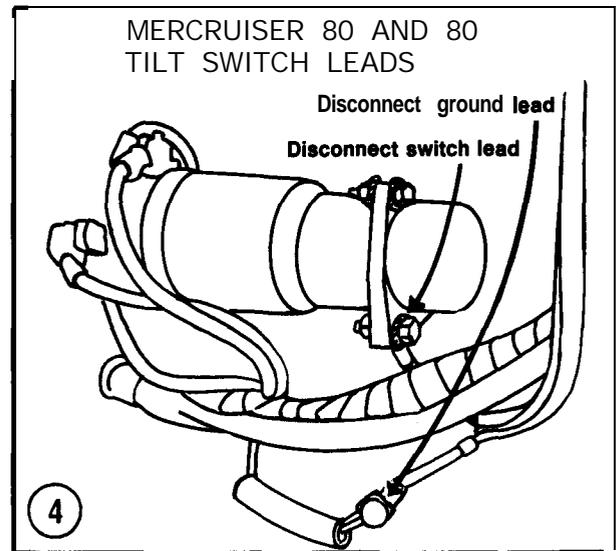
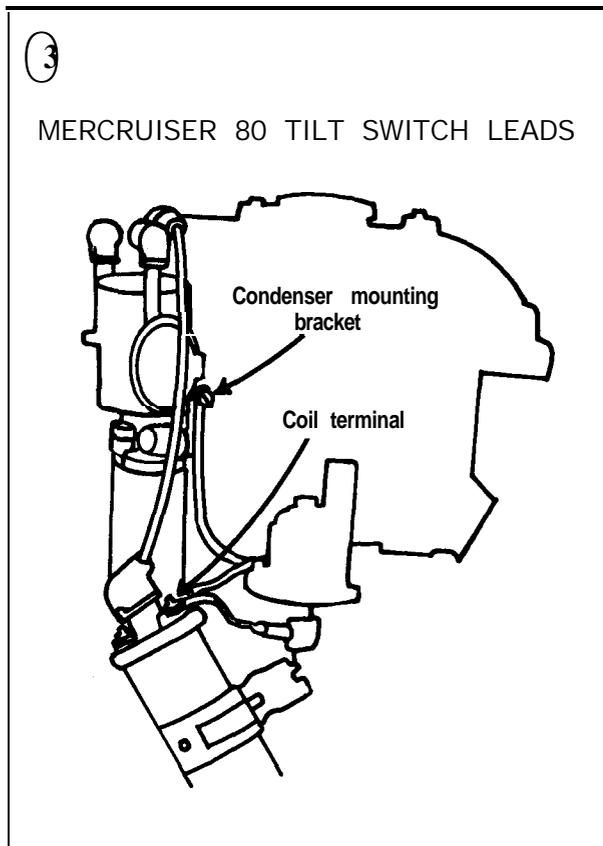
9. Attach a lifting bracket to the engine lifting eyes. Connect the bracket to an engine hoist and elevate it enough to remove all slack.

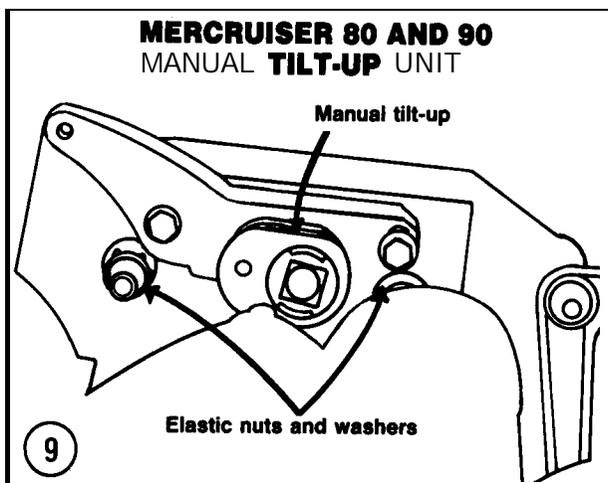
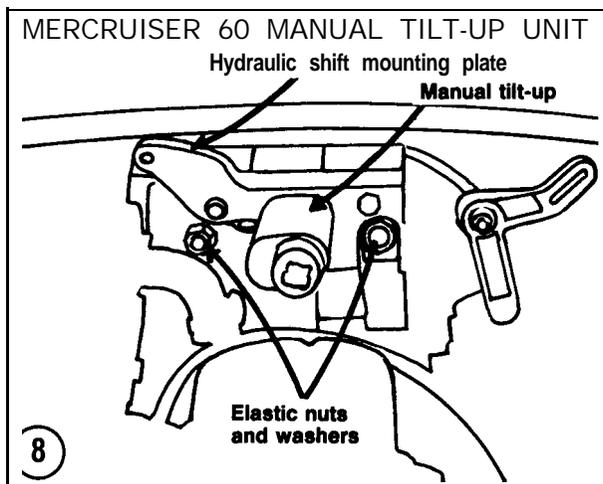
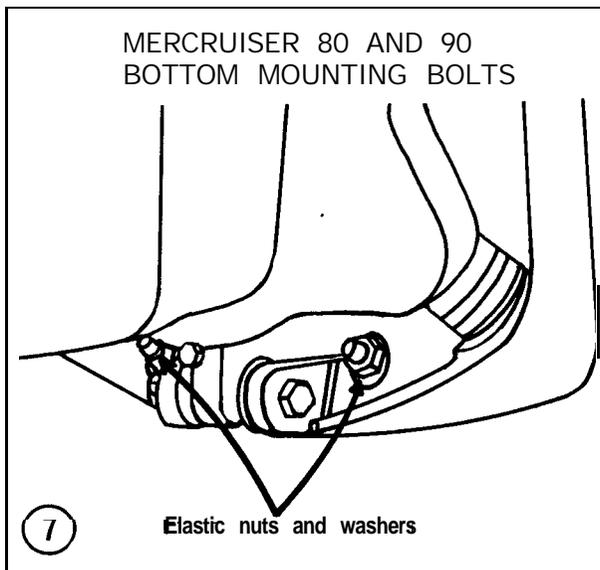
10. Remove the nuts/washers from the lower transom plate screws, then remove the screws (**Figure 7**).

11. Remove manual tilt-up cable from stem drive unit top cover.

12. Remove nuts/washers from the upper transom screws. Remove screws and manual tilt-up unit from transom. See **Figure 8** (MerCruiser 60) or **Figure 9** (MerCruiser 80 and 90).

13. Disconnect any accessories connected to the engine that will interfere with removal.





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.

14. Slide the engine forward sufficiently to disengage the inner transom plate from the stern drive unit.

15. Drain the engine coolant and crankcase oil.

16. Remove the engine from the boat with the hoist.

ENGINE INSTALLATION

1. Install gimbal housing, if removed.

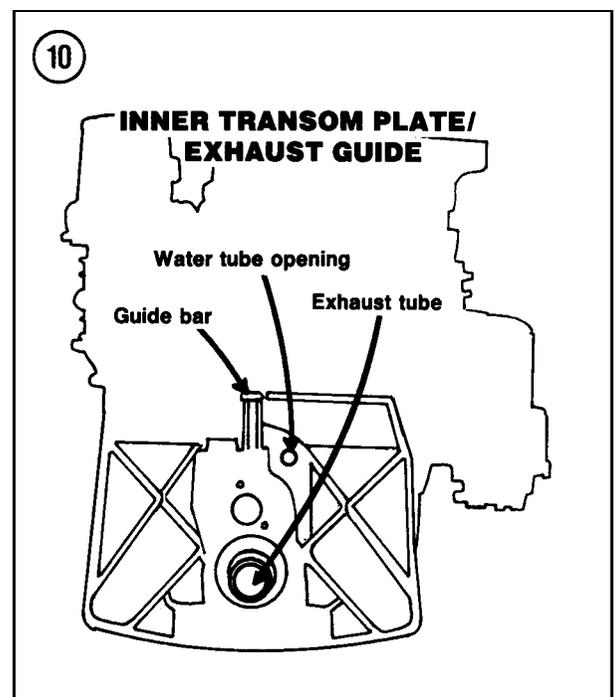
2. Coat the water tube, guide bar and exhaust tube with Multipurpose Lubricant (part No. C-92-63250). See Figure 10.

3. Align exhaust tube and guide bar on inner transom plate with the bar groove and tube opening on the gimbal housing.

CAUTION

Do not rock engine from side to side in Step 4 or the water tube seal in the inner transom plate may be damaged, resulting in a water leak.

4. Make sure water tube enters inner transom plate hole as engine is guided into place.



NOTE

Route power tilt hose on **MerCruiser 60 and 80** to port side of engine in Step 5.

5. From outside the boat, install the manual tilt unit (**Figure 11**) or hydraulic inlet cover (**Figure 12**) with hoses through the transom opening. Move the hydraulic shift unit mounting plate up or down as required to provide clearance for tilt unit. See **Figure 13**.

6. Install washers on 2 carriage bolts (**Figure 14** or **Figure 15**) and install bolts from outside of boat through the tilt unit, transom and inner transom plate.

CAUTION

Only early units require the sealing washer shown in **Figure 15**. Keep transom seal in place when tightening the bolts. 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.

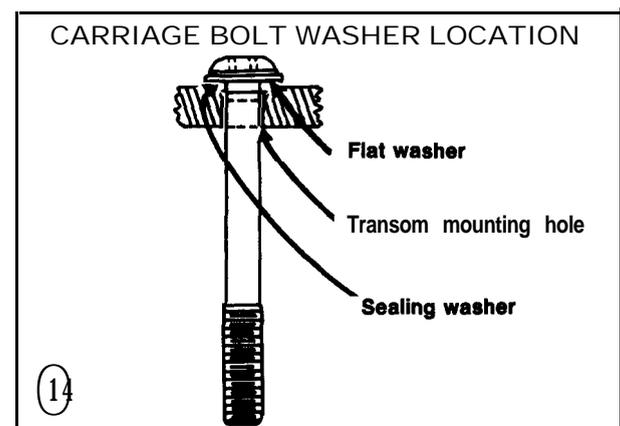
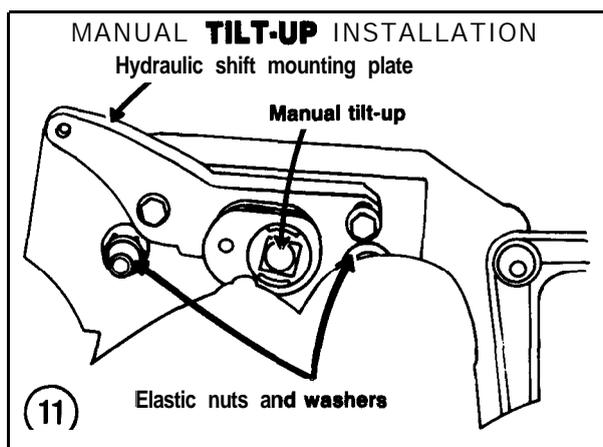
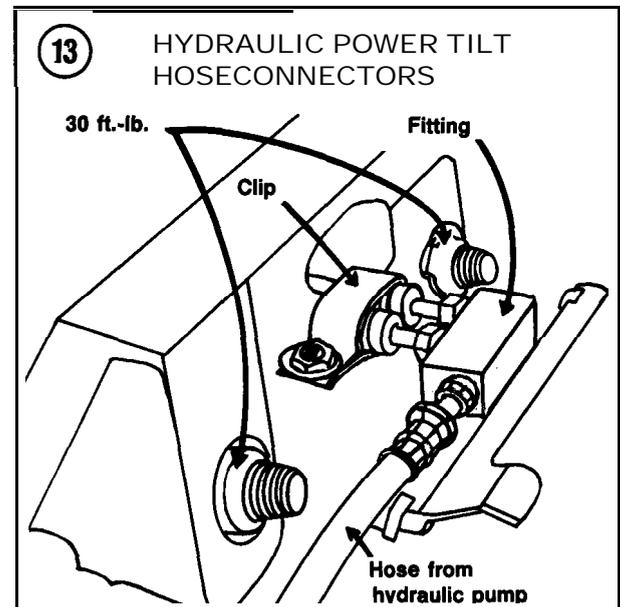
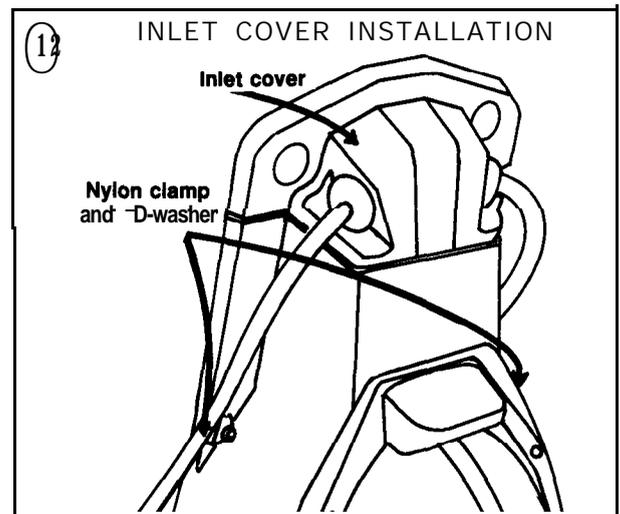
7. Place a flat washer and elastic stop nut on each bolt. Hold bolt head with a 5/16 in. Allen wrench and tighten nut to 20-25 ft.-lb.

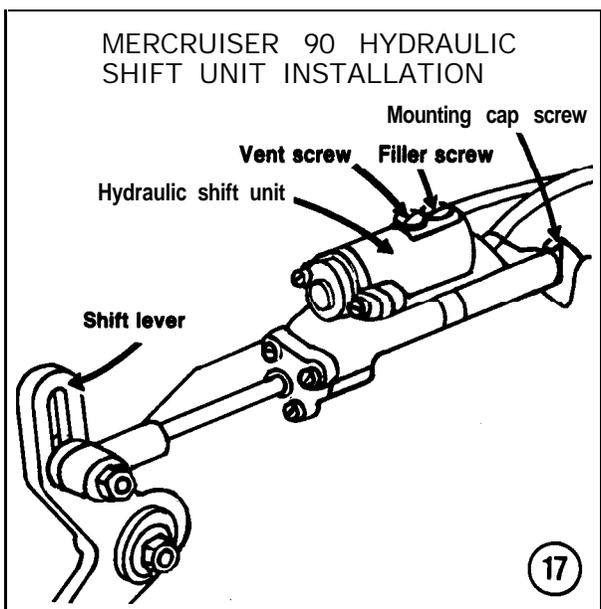
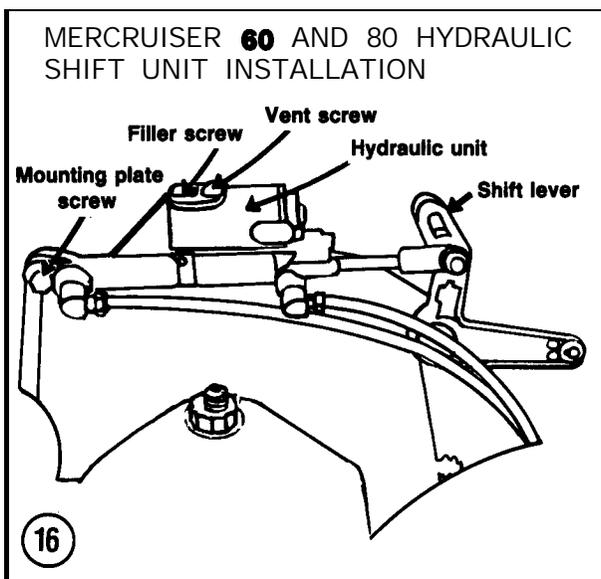
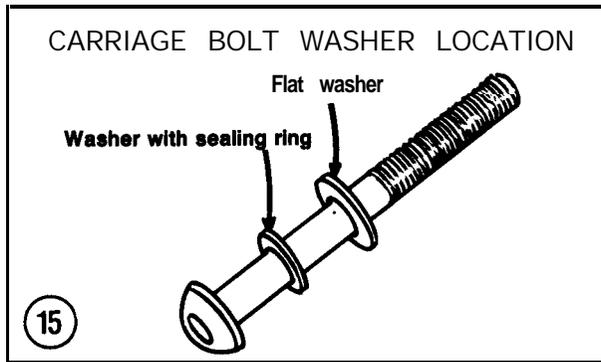
8. Repeat Step 6 and Step 7 to install 2 bolts through bottom holes of gimbal housing, transom and inner transom plate.

9. Relieve hoist tension and remove from engine.

10. **MerCruiser 60 and 80** only-install shift unit mounting plate to inner transom plate screws and tighten securely.

11. Position hydraulic shift unit piston to shift lever stud. Install shift unit to mounting or





transom plate with cap screw, spacer, washers and nut. See Figure 16 or Figure 17.

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.

12. Install shift unit piston to shift lever mounting stud with spacer, washer and elastic stop nut, but do not tighten securely as piston pivots freely on stud.

13. Install tilt hose to transom plate with metal clip, screw and washer. See Figure 13. Remove hose and fitting caps and quickly make the connection to prevent oil loss.

14. Reverse Steps 1-7 of **Removal** in this chapter to complete installation. Engine alignment is not required for this type of mounting.

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 assembly.
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 cylinder liners, pistons and connecting rods.
4. Remove the piston/connecting rod assemblies from the cylinder liners.
5. 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.
6. Assemble by reversing Steps 1-5.

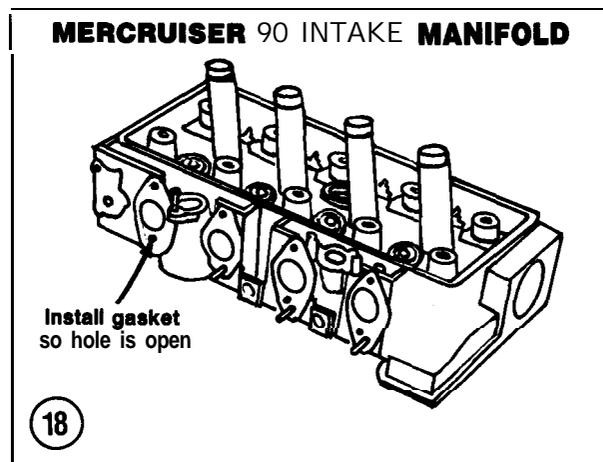
General Overhaul

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 assembly.
13. Remove the front cover. Remove the timing gear and sprockets.
14. Remove the cylinder head.
15. Remove the camshaft.
16. Remove the oil pan and oil pump.
17. Remove the cylinder liners, pistons and connecting rods.
18. Remove the crankshaft.
19. Inspect the cylinder block.
20. Assemble by reversing Steps 1- 18.

ROCKER ARM COVER

Removal/Installation

1. Remove the crankcase vent line from the rocker arm cover.
2. On **MerCruiser 90**, disconnect the spark plug wires and remove retaining clips from rocker arm cover.
3. Remove the cover attaching nuts. Tap the rocker arm cover with a plastic mallet to break the gasket seal. Remove the rocker arm cover.
4. Clean any gasket residue from the cylinder head and rocker arm cover with degreaser and a putty knife.
5. Install the cover on the cylinder head with a new gasket.
6. Install the attaching nuts and tighten to specifications (**Table 3**).
7. Install the crankcase vent line in the rocker arm cover.
8. On Met-Cruiser 90, install spark plug wires.



INTAKE/EXHAUST MANIFOLDS

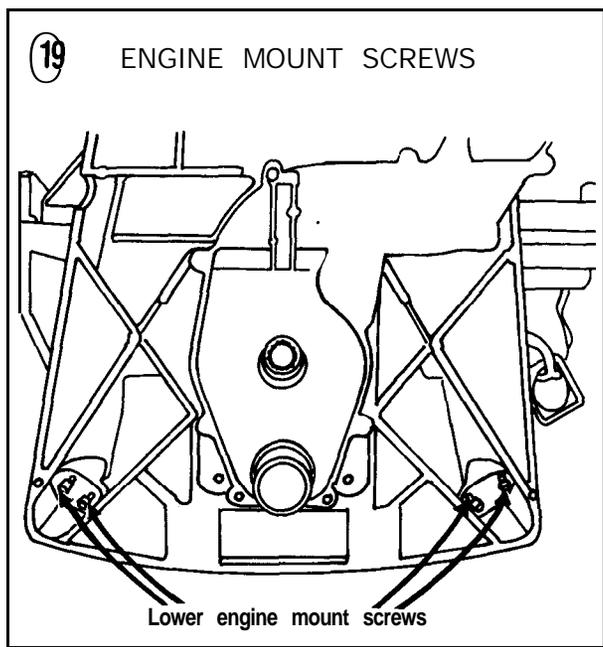
MerCruiser 60 and 90 engines use separate intake and exhaust manifolds; the MerCruiser 80 manifolds are combined in a single unit.

Intake Manifold

Removal/Installation

(MerCruiser 60 and 90)

1. Disconnect the negative battery cable.
2. Disconnect the fuel line at the carburetor. Plug the line to prevent leakage.
3. Disconnect the choke heat tube, if so equipped.
4. Disconnect the throttle cable at the carburetor and remove the return spring. Disconnect the fuel line clamp.
5. Remove the crankcase vent line at the rocker arm cover.
6. Disconnect the manifold cooling hose at the bottom of the manifold.
7. Remove manifold attaching nuts. Remove the manifold assembly with carburetor attached. Discard the manifold gasket.
8. Clean all gasket residue from the cylinder head and manifold mating surfaces with degreaser and a putty knife.
9. Install a new manifold gasket on the cylinder head. Gasket must be positioned on 90 engines so that only the hole shown in **Figure 18** is open to cooling water.
10. Install manifold to head and tighten fasteners to specifications (**Table 2**) working from the center to the ends. The remainder of installation is the reverse of removal.



Exhaust Manifold

Removal/Installation

(MerCruiser 60 and 90)

1. Remove bolts holding electrical panel to manifold.
2. On MerCruiser 60, disconnect cooling hoses and choke assembly.
3. Remove exhaust outlet hose.
4. Remove manifold attaching nuts. Remove the manifold assembly and discard the gasket.
5. Clean all gasket residue from the cylinder head and manifold mating surfaces with degreaser and a putty knife.
6. Install a new manifold gasket on the cylinder head.
7. Install manifold to head and tighten fasteners to specifications (Table 2) working from the center to the ends. The remainder of installation is the reverse of removal.

Intake/Exhaust Manifold

Removal/Installation

(MerCruiser 80)

1. Disconnect manifold cooling hoses.
2. Remove wiring harness and electrical component bracket from the manifold.
3. Remove manifold attaching nuts. Remove the manifold assembly with carburetor attached. Discard the manifold gasket.

4. Clean all gasket residue from the cylinder head and manifold mating surfaces with degreaser and a putty knife.
5. Install a new manifold gasket on the cylinder head.
6. Install manifold to head and tighten fasteners to specifications (Table 2) working from the center to the ends. The remainder of installation is the reverse of removal.

Intake/Exhaust

Manifold Inspection

1. Remove carburetor from intake manifold.
2. Check manifold for cracks or distortion. Replace as required.
3. Check mating surfaces for nicks, burrs or deep scratches. Small burrs may be removed with an oilstone.
4. Check water passages for sand, silt or other contamination. Clean as required.
5. Remove pipe plugs from exhaust manifold elbow and exhaust pipe elbow. Check for contamination and clean as required.
6. Inspect engine exhaust ports for signs of rust or corrosion. Replace manifold if such signs are found.

INNER TRANSOM PLATE

Removal/Installation

1. Remove engine from boat as described in this chapter.
2. Remove interlock nut/bolt at base of transom plate.
3. Disconnect wires and harness leads connected to transom plate.
4. Disconnect and remove water inlet hose at rear of engine block.
5. Loosen exhaust bellows-to-manifold clamp.
6. Remove lower engine mount-to-transom plate screws. See Figure 19.
7. Remove large Ride-Guide steering tube nut. Remove tube from support.
8. Remove transom plate by pulling outward and down.

9. Remove large washers on each side of Ride-Guide tube support.
10. Remove upper engine mount-to-cylinder head bracket.
11. Installation is the reverse of removal.

FRONT COVER AND SEAL

Removal/Installation (MerCruiser 60)

1. Remove alternator flywheel and **stator** as described in this chapter.
2. Remove cover attaching screws. Remove the cover and gasket. Discard the gasket.
3. Clean all gasket residue from cover and engine block mating surfaces.
4. Install cover with a new gasket. **DO** not tighten screws at this time.
5. Install alternator flywheel on crankshaft to align oil seal.
6. Tighten cover screws securely and remove flywheel.
7. Install alternator flywheel and **stator** as described in this chapter.

Removal/Installation (MerCruiser 80 and 90)

1. Remove the cover attaching bolts.
2. Remove the cover and gasket. Discard the gasket.
3. Clean all gasket residue from the cover and engine block mating surfaces.
4. Install the cover with a new gasket. Tighten cover bolts to specifications (Table 2).

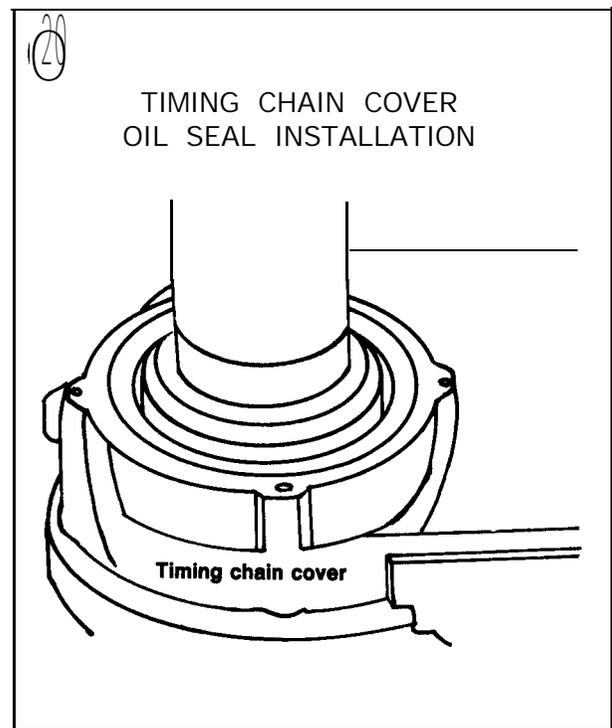
Seal Replacement

1. Remove front cover as described in this chapter.
2. Place cover on a clean flat workbench surface.
3. Pry old seal from 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 seal lips facing toward timing chain. Support cover at seal area and drive seal into place with appropriate size installer. See Figure 20.
6. Install front cover as described in this chapter.

ROCKER ARM ASSEMBLY

Removal/Installation

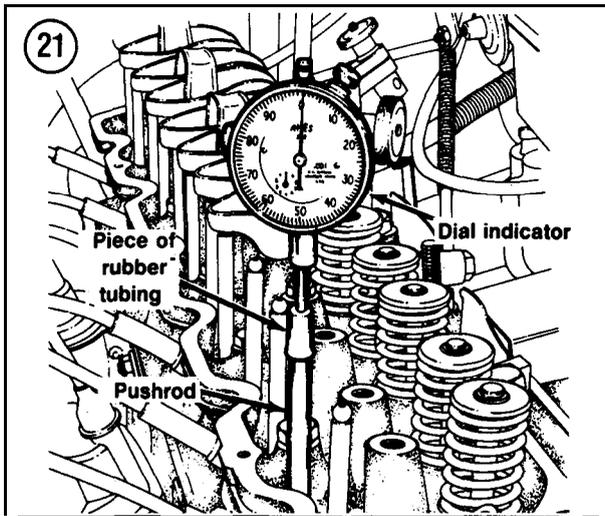
1. Remove the rocker arm cover as described in this chapter.



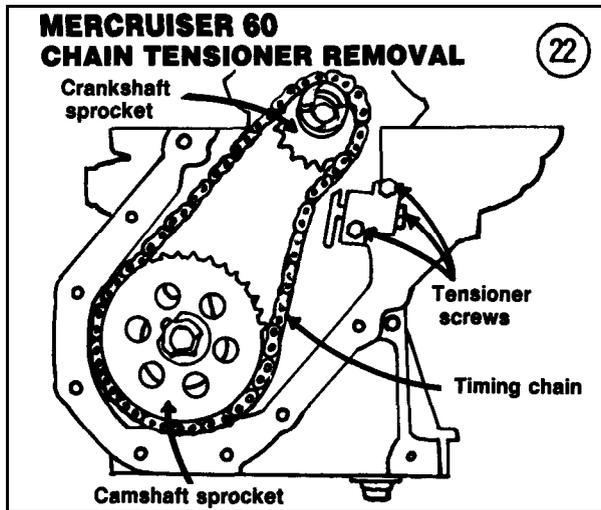
2. Remove the bolts holding the rocker arm shaft(s) in place.
3. Remove rocker arm assembly.
4. Remove the **pushrods** and place in order of removal for reinstallation in the same position from which they were removed.
5. Installation is the reverse of removal. On **MerCruiser 90** engines, install rocker arms and torque bolts to specifications (Table 2), then loosen and install pushrods. Adjust valve clearance with engine stopped, as described in this chapter.

Inspection

1. Grasp each rocker arm and twist it. If there is any rocking motion (not sliding), have the rocker arms and shaft checked for wear by a machine shop.
2. Remove the pin or keeper holding the rocker arm shaft in the mount. Slide shaft from mount.
3. Mark position of rocker arms and springs for reinstallation in the same position from which they were removed.
4. Clean all parts thoroughly in solvent. Use compressed air to blow out the oil passages in the pushrods. Inspect **pushrods** for damage and excessive wear (0.002 in. or greater). Replace damaged or worn parts.



1. Remove the rocker arm cover as described in this chapter.
2. Remove the rocker arm assembly 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 21**.
5. Turn the crankshaft in the normal direction of rotation until the valve tappet 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 (**Table 1**).
7. Repeat Steps 4-6 for each **pushrod**. If all lobes are within specifications, reinstall the rocker arm assemblies and adjust the valves as described in this chapter.
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.



5. Check rocker arm contact surfaces for scuffing, pitting or excessive wear. Slight wear marks may be removed with an oilstone.
6. 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.
7. If a **pushrod** is worn from lack of lubrication, replace the corresponding tappet and rocker arm as well.

CAMSHAFT AND TIMING CHAIN

Lobe Lift Measurement

Camshaft lobe lift can be measured with the camshaft in the block and the cylinder head in place.

Removal (MerCruiser 60)

1. Remove the alternator flywheel and **stator** as described in this chapter.
2. Remove the cylinder head as described in this chapter.
3. Remove the front cover as described in this chapter.
4. Remove the distributor. See Chapter Thirteen.
5. Remove the oil pump drive pinion with a pencil-type magnet.
6. Remove the valve tappets and place in a rack or other container in the order removed so they may be reinstalled in their original locations.
7. Unlock and remove the screw at the rear of the tensioner. Release the tension on the chain with a No. 3 Allen wrench and remove tensioner assembly. See **Figure 22**.
8. Bend the tab washer back and remove the lock screw from the camshaft sprocket. See **Figure 22**.
9. Remove the camshaft and crankshaft sprockets with the timing chain. Remove the key from the crankshaft.

10. Remove the 2 screws holding the camshaft thrust plate in place (**Figure 23**). Carefully withdraw the camshaft from the block to prevent damage to the camshaft or block.

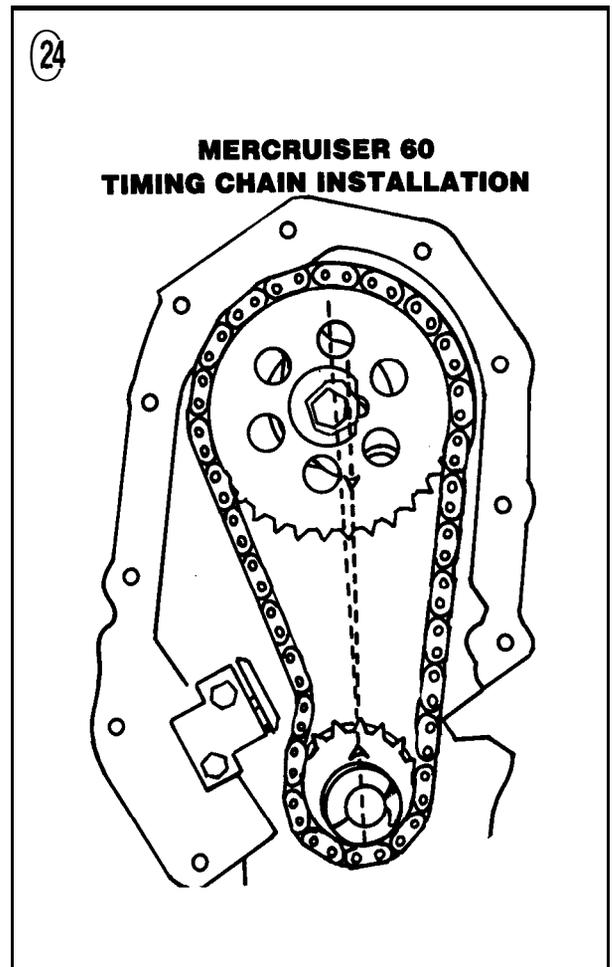
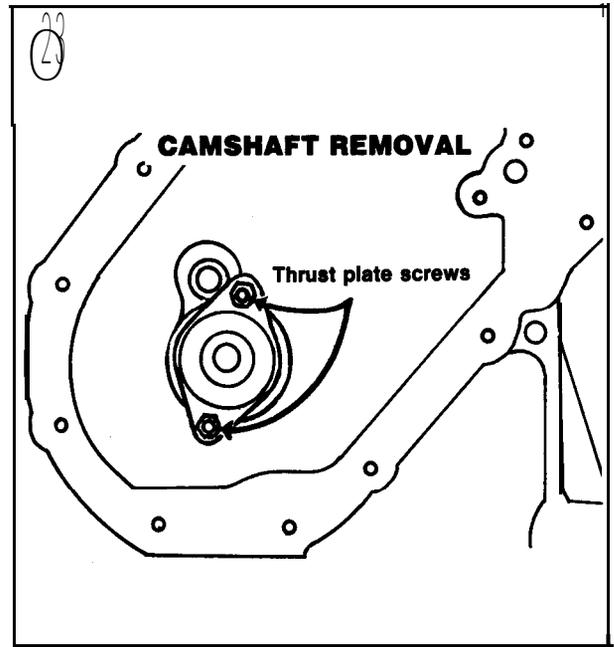
Installation (MerCruiser 60)

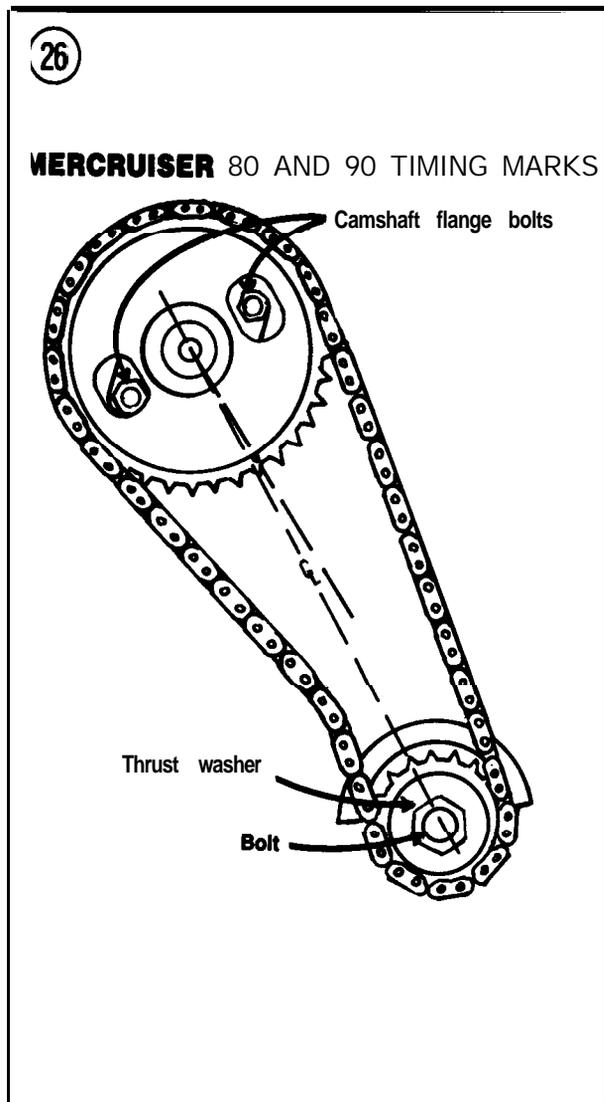
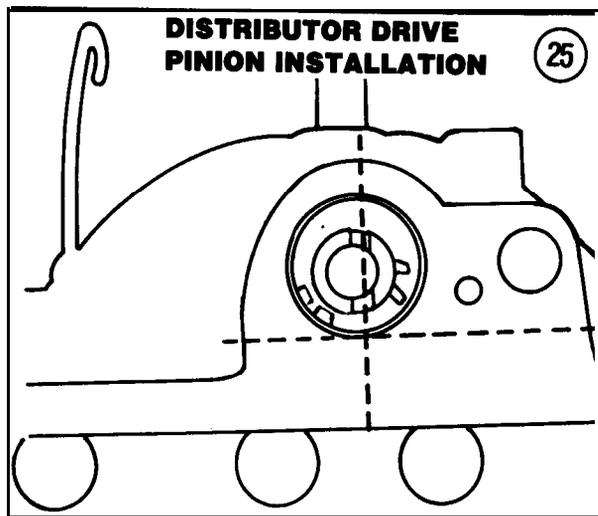
1. Coat the camshaft lobes and journals with heavy engine oil and reinstall in the block.
2. Install and securely tighten the thrust plate screws.
3. Install the key in the crankshaft **keyway**, then install the crankshaft sprocket.
4. Position camshaft sprocket and align the reference marks on the 2 sprockets with the camshaft and crankshaft centerlines.

NOTE

*When the chain is installed in Step 5, the reference marks aligned in Step 5 will not align with the camshaft axis due to the normal slack in the chain. See **Figure 24**.*

5. Remove the camshaft sprocket. Install the timing chain on the camshaft sprocket and reinstall sprocket/chain assembly. Tighten the camshaft sprocket locking screw and bend the tab washer over the camshaft screw.
6. Install front cover as described in this chapter.
7. Install cylinder head as described in this chapter.
8. Rotate crankshaft 360° to position the No. 1 piston at TDC. No. 4 cylinder valves should be partially open and the alternator flywheel/front cover timing marks should align.
9. Install oil pump drive pinion. Slot in gear should be at a right angle to the engine centerline, with large offset facing dipstick. See **Figure 25**.
10. Remove distributor cap. Align rotor with No. 1 spark plug terminal in cap.
11. Install distributor to engine block. It may be necessary to turn the rotor slightly to seat the distributor shaft in the oil pump drive pinion slot.
12. Rotate distributor housing until breaker points just start to open and tighten the hold-down clamp.
13. Reinstall distributor cap. Make sure rotor points to No. 1 terminal in the cap.





Removal (MerCruiser 80 and 90)

1. Remove cylinder head as described in this chapter.
2. Remove front cover as described in this chapter.
3. Remove crankshaft sprocket retaining bolt and thrust washer. See **Figure 26**.
4. Remove chain tensioner bolts.
5. Remove distributor drive pinion gear from the block.
6. Rotate the camshaft slightly as necessary and remove the flange bolts through the holes in the sprocket. See **Figure 26**.
7. Check to see if crankshaft sprocket will slide off. If not, install an appropriate puller and loosen sprocket. Pull camshaft and crankshaft sprocket forward with the chain as an assembly and remove from the engine.

Installation (MerCruiser 80 and 90)

1. Coat the camshaft lobes and journals with heavy engine oil and partially reinstall in the block.
2. Rotate crankshaft to position keyway at the top and install the key.
3. Align camshaft and crankshaft sprocket timing marks with camshaft/crankshaft centerlines.
4. Install timing chain over camshaft and crankshaft sprockets (marks still aligned).
5. Fit crankshaft sprocket on crankshaft while pushing camshaft into block. Seat crankshaft sprocket with a plastic hammer.
6. Install the crankshaft sprocket thrust washer and retaining bolt (**Figure 26**). Tighten bolt to specifications (**Table 1**).
7. Install and securely tighten camshaft flange bolts (**Figure 26**).
8. Install chain tensioner. This will cause the timing marks to move off their centerlines. See **Figure 26**.

9. Install distributor drive pinion with gear slot positioned as shown in **Figure 27 (80)** or **Figure 28 (90)**.

10. Install front cover and cylinder head as described in this chapter.

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.

NOTE

If you do not have precision measuring equipment, have Step 2 done by a machine shop.

2. Measure the camshaft journal diameters with a micrometer (**Figure 29**). If any journal exceeds 0.001 in. out-of-round, replace the camshaft.

3. Suspend the camshaft between V-blocks and check for **warpage** with a dial indicator. See **Figure 30**. Replace if reading is greater than 0.0015 in.

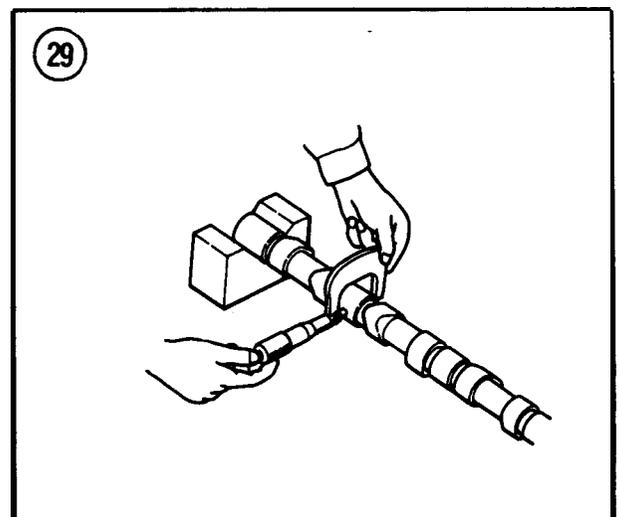
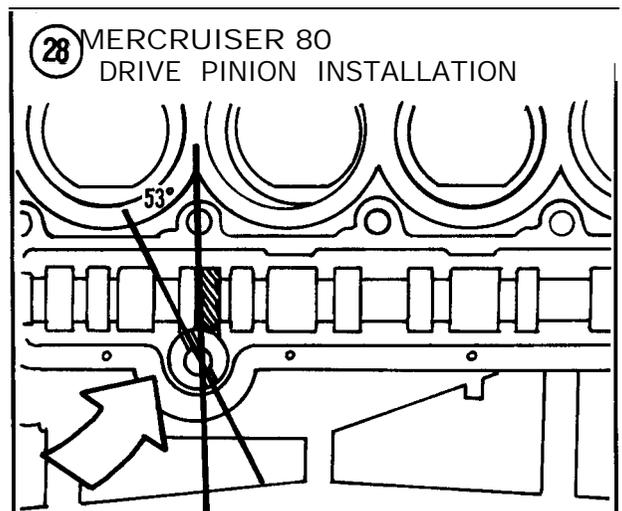
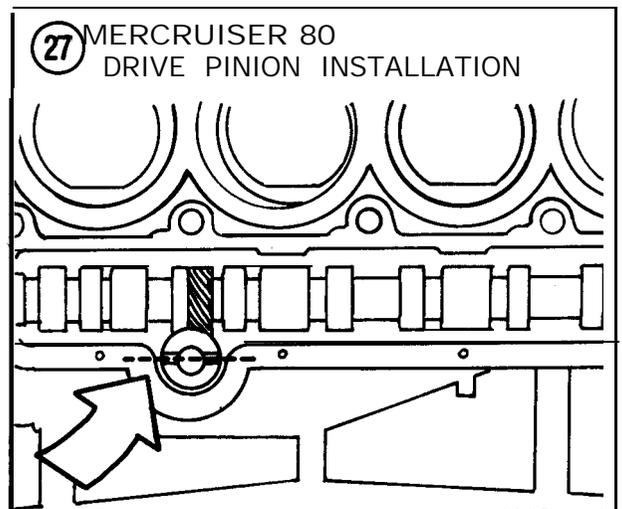
4. Check the distributor drive gear for excessive wear or damage.

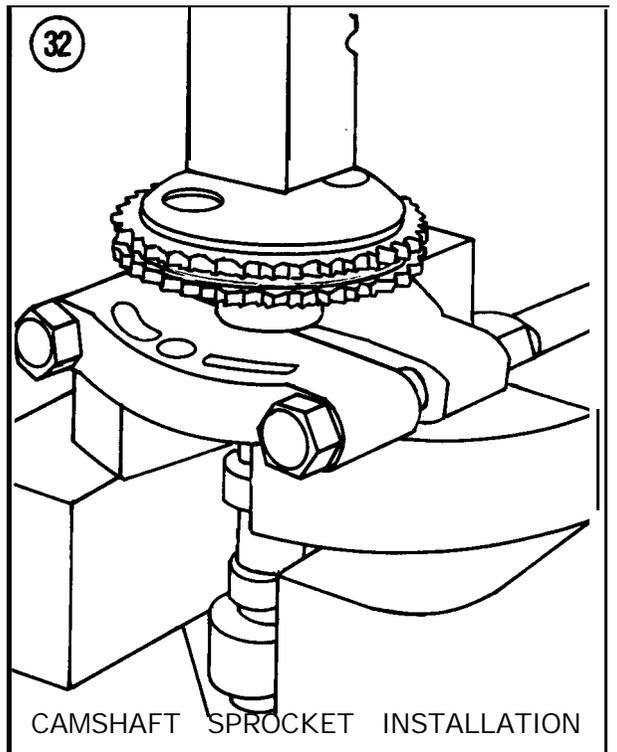
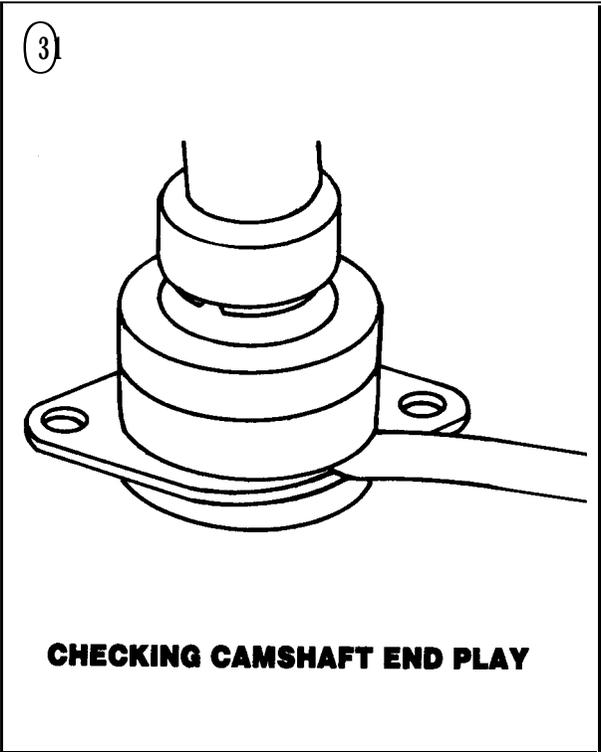
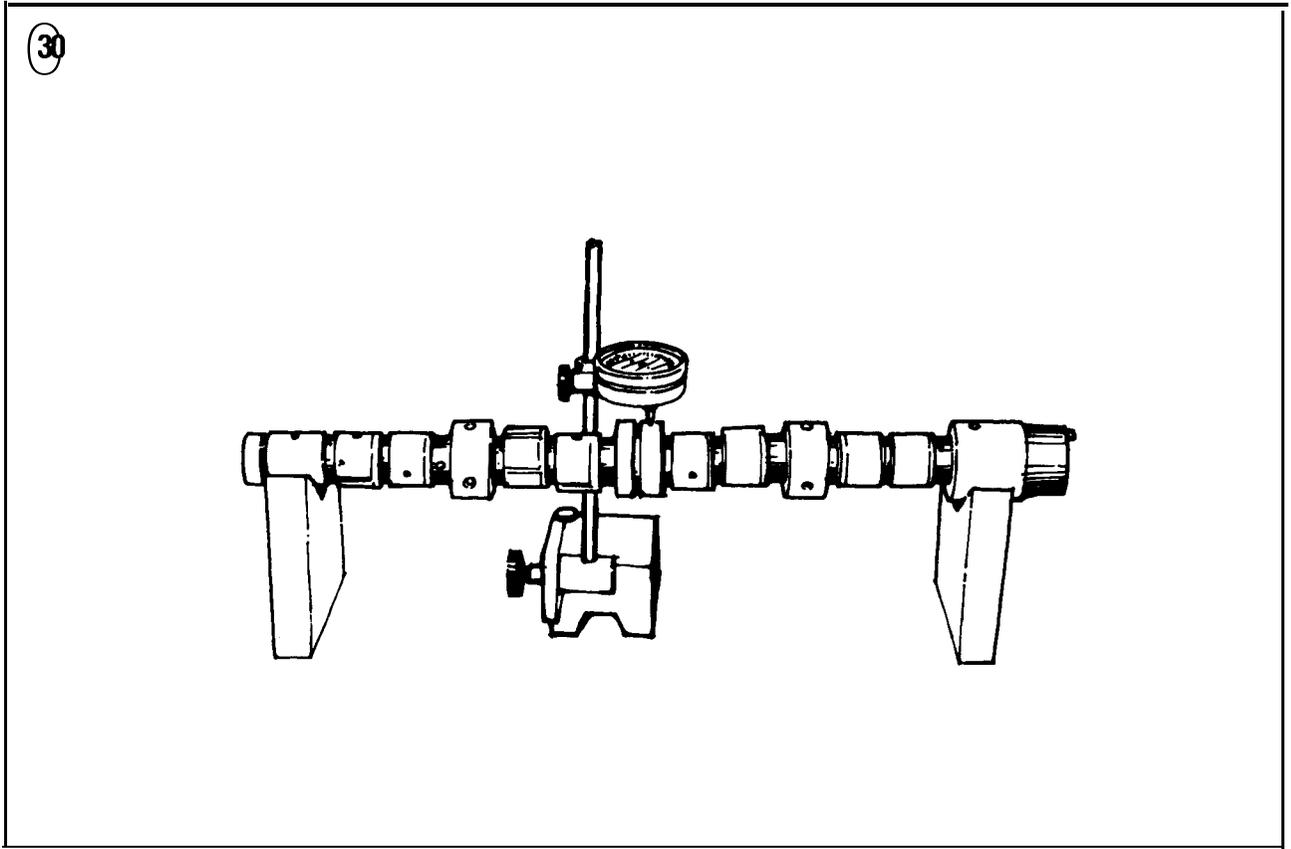
5. Check camshaft gear and thrust plate for wear or damage. Insert a feeler gauge between the thrust plate and camshaft to measure end play. **Figure 31** shows the 80 camshaft; the 90 is similar but the thrust plate is at the sprocket end. If end play exceeds 0.005 in., remove the camshaft sprocket as described in this chapter and replace the thrust plate and/or spacer as required. When thrust plate/spacer is replaced, recheck end play before installing camshaft.

Camshaft Sprocket Replacement

The camshaft sprocket is retained by a lock screw on the **MerCruiser 60** engine and pressed onto the camshaft on the 80 and 90 engines. This procedure is for removing the sprocket on 80/90 engines.

1. Remove camshaft from engine as described in this chapter.
2. Support camshaft sprocket and press from the shaft.
3. Installation is the reverse of removal. Support camshaft with a universal puller positioned under the first bearing shoulder (**Figure 32**).
4. Check end play as described in Step 5, **Inspection** in this chapter.





OIL PAN

Removal/Installation

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 pan attaching screws. Remove the oil pan and discard the gasket.
5. Installation is the reverse of removal. Use a new gasket and tighten pan screws to specifications (Table 2).

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.

OIL PUMP

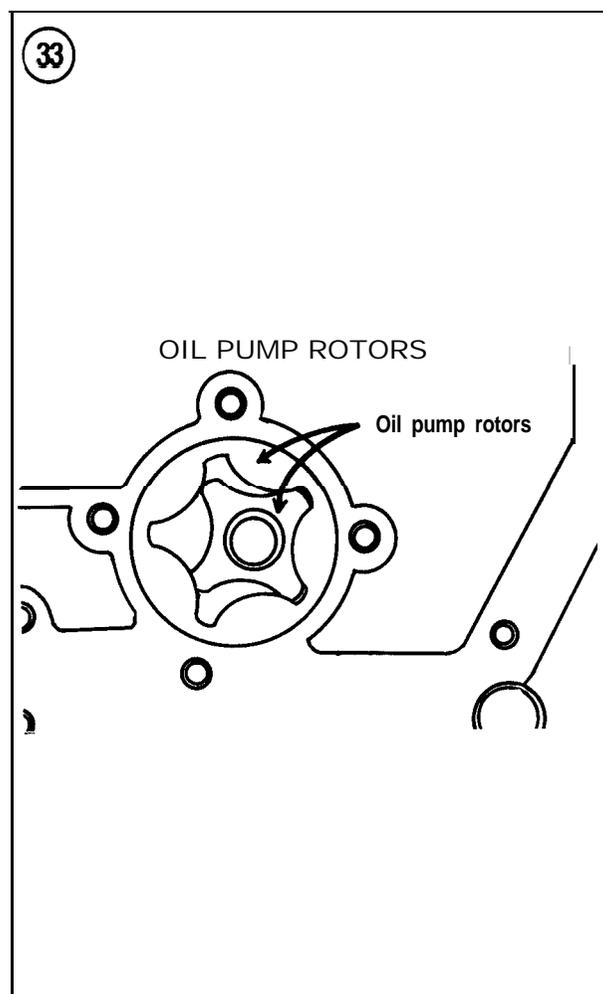
Removal/Installation

1. Remove the oil pan as described in this chapter.
2. Remove the oil pump attaching bolts. Remove the oil pump and gasket from the engine block. On **MerCruiser 80** and **90** engines, remove pump rotors from block. See **Figure 33**.
3. Installation is the reverse of removal. Tighten bolts to specifications (Table 2).

Disassembly/Assembly (MerCruiser 60)

Refer to **Figure 34** for this procedure.

1. Remove the cover screws, holding cover in place. Separate cover from body carefully, as pressure regulator assembly is under compression. Regulator spring seat and ball should come out as cover is removed.

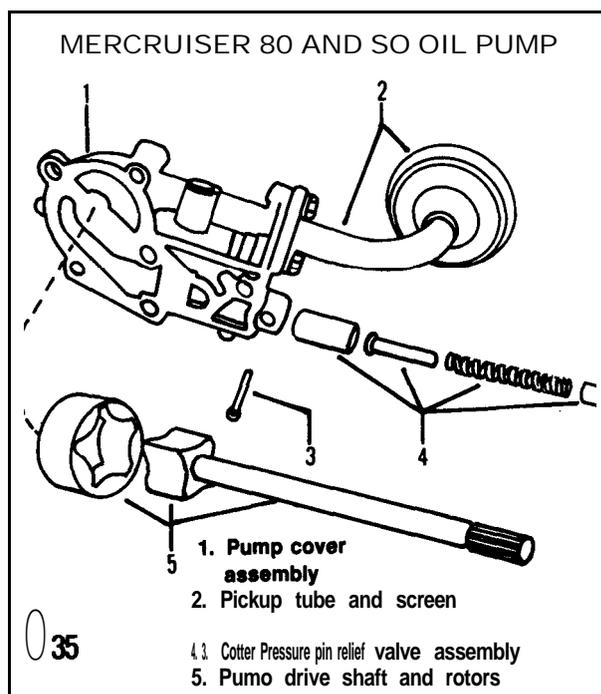
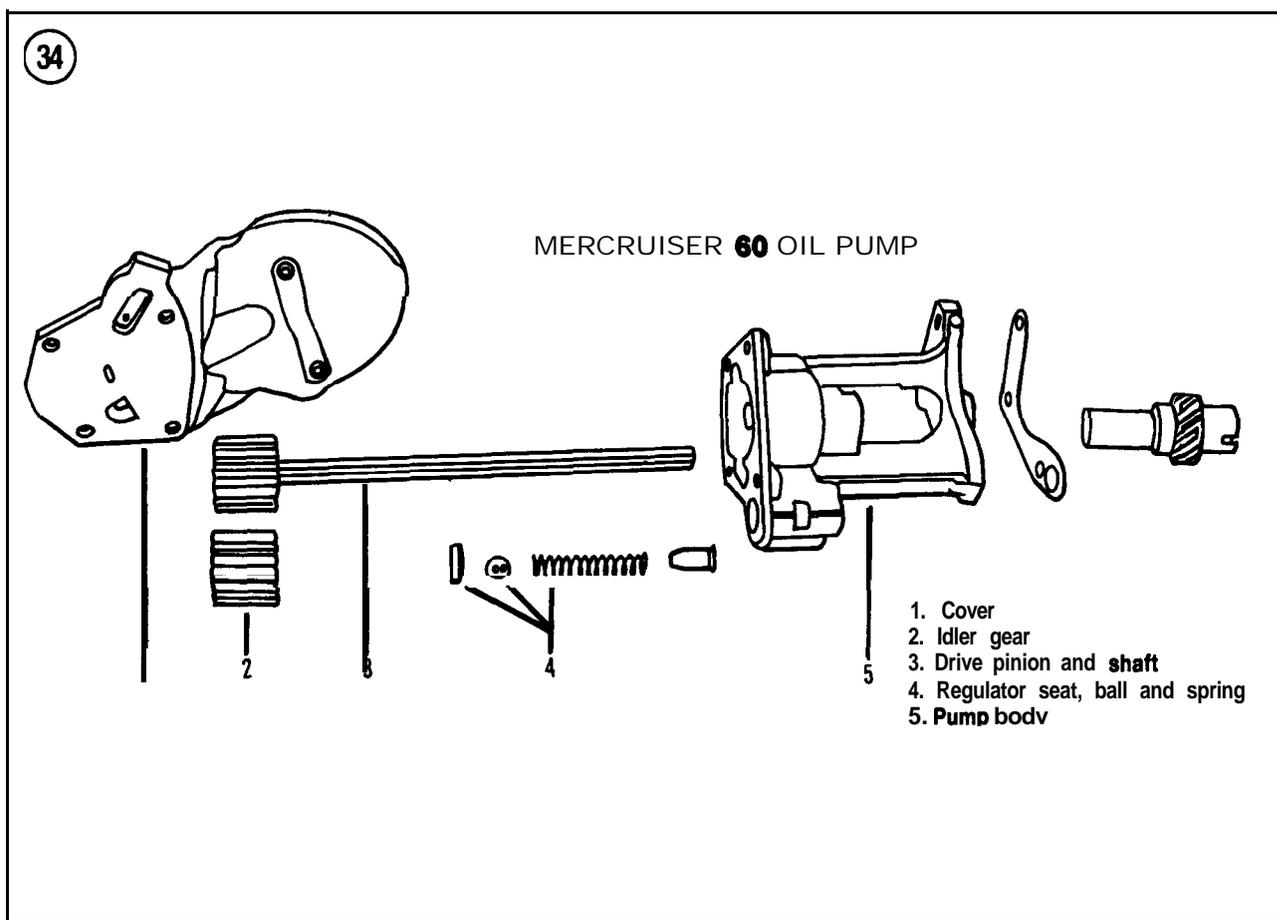


2. Mark gear teeth to assure reassembly with identical gear indexing and remove idler gear and drive pinion with shaft from the body.
3. Oil all parts thoroughly before reassembly.
4. Assembly is the reverse of disassembly. Index gear marks, install a new cover gasket and rotate pump drive shaft by hand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

Disassembly/Assembly (MerCruiser 80 and 90)

Refer to **Figure 35** for this procedure.

1. Remove retaining cotter pin from pump body and carefully remove pressure relief valve components.
2. Straighten the tab washers on the pickup tube attaching screws. Remove screws and separate pickup tube from pump body.
3. Oil all parts thoroughly before reassembly.



4. Assembly is the reverse of disassembly. Index gear marks, install a new cover gasket and rotate pump drive shaft by hand to check for smooth operation.

Inspection

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 drive gear shaft-to-body fit for excessive looseness.
5. Check the inside of the pump cover for wear that could allow oil to leak around the ends of the gears.

6. Install inner rotor in outer rotor and check clearances with a feeler gauge as shown in **Figure 36** and **Figure 37**. If clearance exceeds 0.010 in. (**Figure 36**) or 0.007 in. (**Figure 37**), replace both rotors.

CYLINDER HEAD

Removal

1. Remove the engine from the boat as described in this chapter.
2. Remove the inner transom plate as described in this chapter.

NOTE

Intake and exhaust manifold are combined in one assembly on MerCruiser 80.

3. Remove the intake and exhaust manifolds as described in this chapter.
4. Remove the distributor cap, mark rotor position on distributor housing/block and remove distributor from engine.

CAUTION

Do not use air-operated tools to remove the head bolts in Step 5 as the head bolt threads in the aluminum block may be damaged.

5. Remove the cylinder head bolts.
6. Remove the rocker arm assembly as described in this chapter.
7. Drive the head sideways with a plastic mallet to prevent damage to the seals below the cylinder liner. Lift head off block.

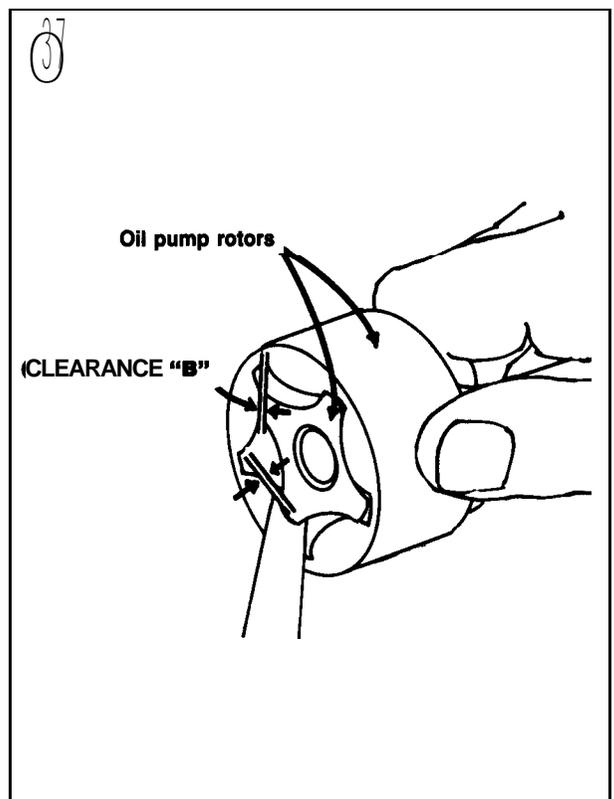
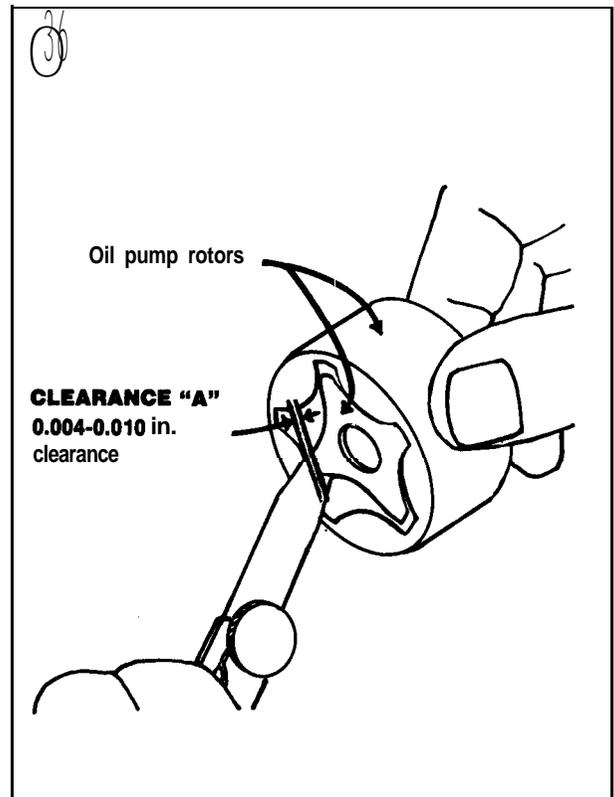
CAUTION

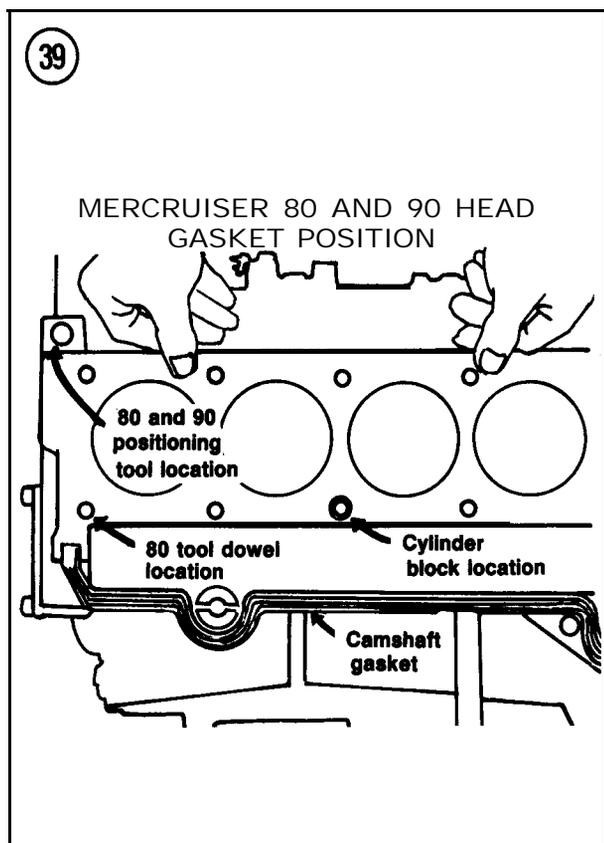
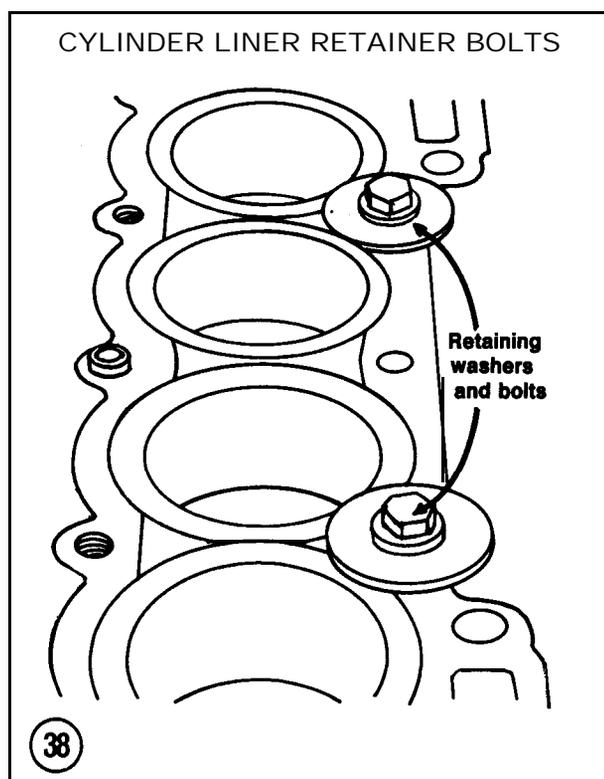
Place the head on its side to prevent damage to the spark plugs or head gasket surface.

8. Install 2 cylinder head bolts with washers as shown in **Figure 38** to retain cylinder liners in place.
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, especially in the exhaust port and combustion chamber areas. Look for corrosion or foreign material in the oil and water passages. Clean the passages with a stiff spiral brush, then blow them out with compressed air.

3. Check the cylinder head studs for damage and replace, if necessary.

4. Check the threaded rocker bolt holes for damaged threads. Replace if necessary.

5. Have any spark plug hole threads that are stripped repaired by a machine shop using a 14 mm heli-coil insert.

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.

3. Remove liner retaining bolts and washers.

4. Install a new head gasket. The beaded edge must face the cylinder block.

5A. MerCruiser 80—install head positioning tool part No. C-91-46956 in the location shown in Figure 39.

5B. MerCruiser 90—install head positioning tool part No. C-91-58595 in the location shown in Figure 39.

NOTE

The MerCruiser 60 engine does not require a head positioning tool.

6. **MerCruiser 80 and 90**-install rubber gasket around camshaft recess in block. Do not overlap head gasket at either end.
7. Install cylinder head to block and align with locating tool.

CAUTION

Do not use air-operated tools to install the head bolts in Step 8 as the head bolt threads in the aluminum block may be damaged.

8. Install head bolts and tighten to specifications following the sequence shown in **Figure 40**
9. Install rocker arm assembly as described in this chapter.
10. Adjust valve clearance as described in this chapter.

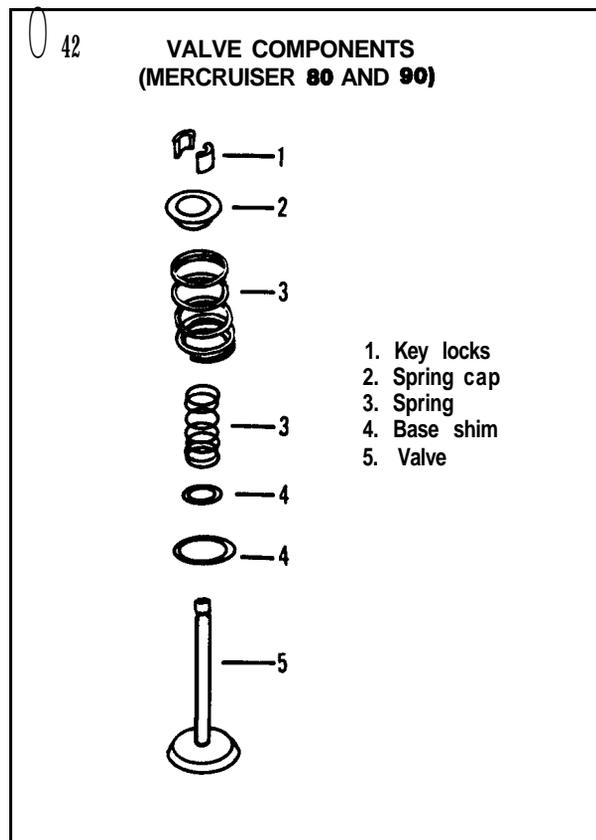
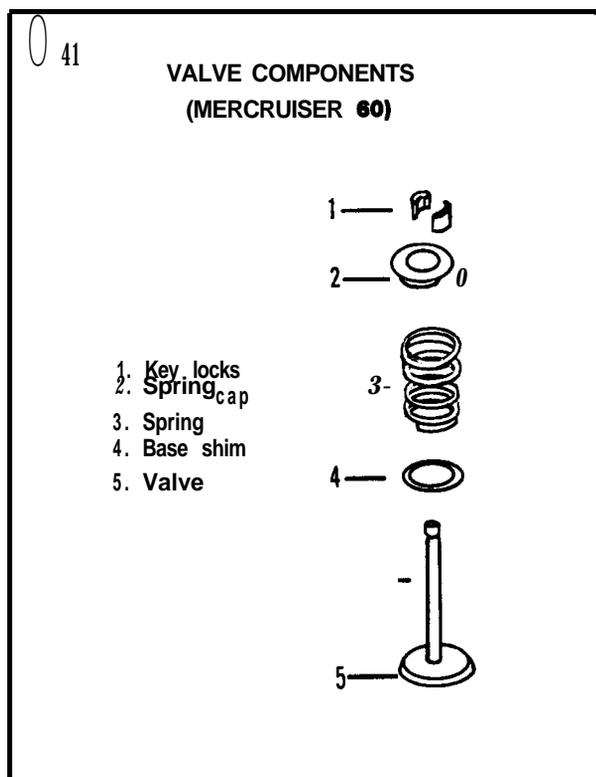
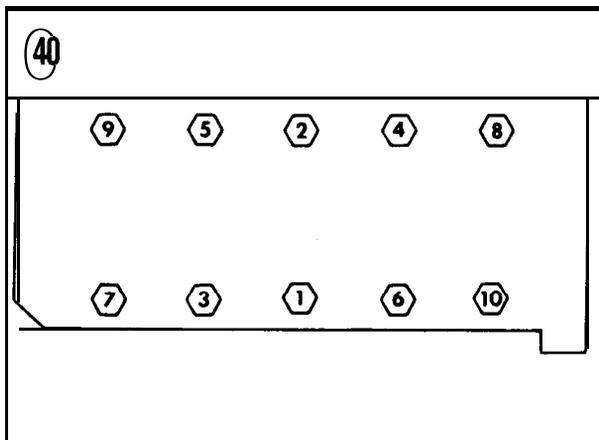
NOTE

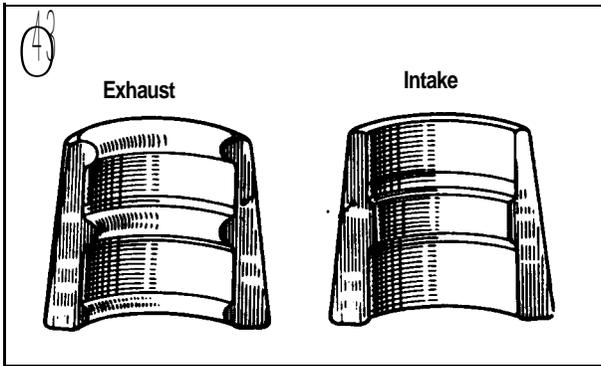
Retorque cylinder head bolts after running engine.

11. Reverse Steps 1-4 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 41** or 42 for this procedure.

1. Remove the cylinder head as described in this chapter.
2. Remove the rocker arm assemblies as described in this chapter.

NOTE

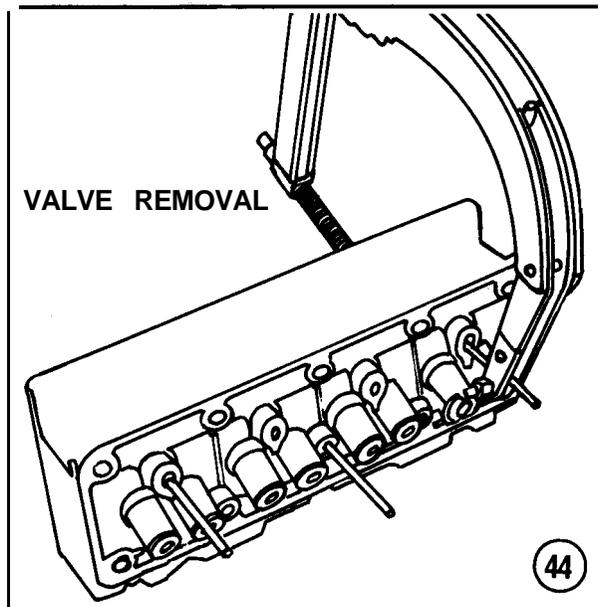
Different valve keys are used on intake and exhaust valves (Figure 43). Keep them separate as removed for proper reinstallation.

3. Compress the valve spring with a compressor tool like the one shown in **Figure 44**. Remove the valve keys and release the spring tension.
4. Remove the valve spring cap, spring and base washers.

CAUTION

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

5. Remove the valve and repeat Step 3 and Step 4 on each remaining valve.
6. Arrange the parts in order so they can be returned to their original positions when reassembled.
7. Remove the valve tappets.



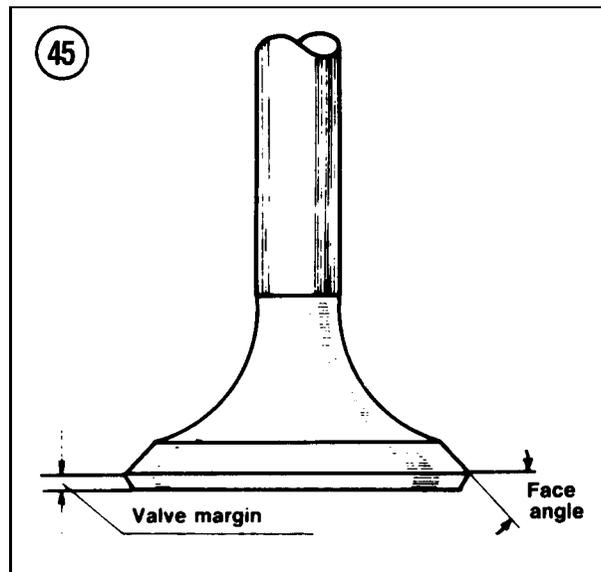
Inspection

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 45. 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.

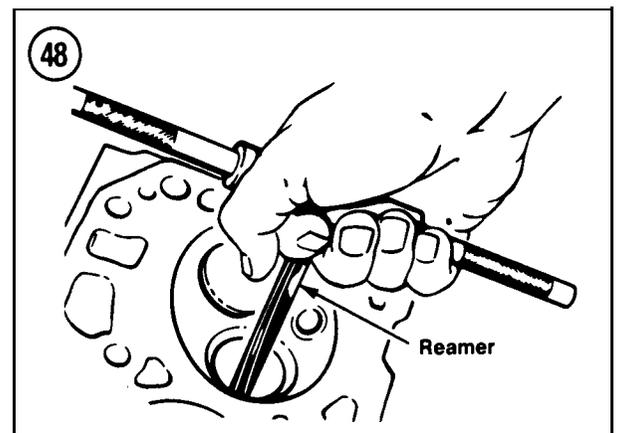
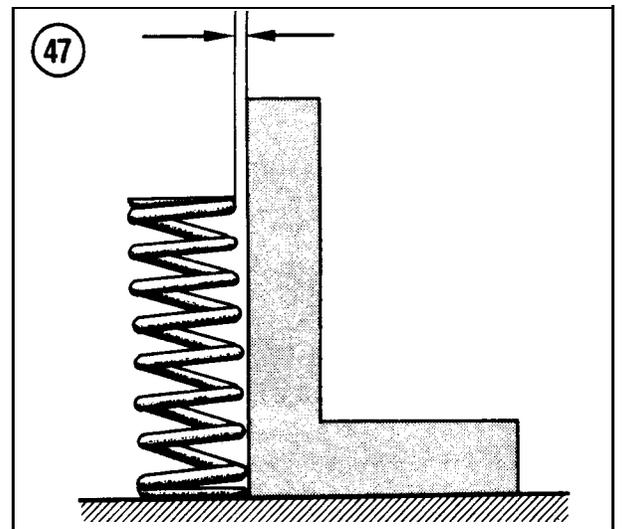
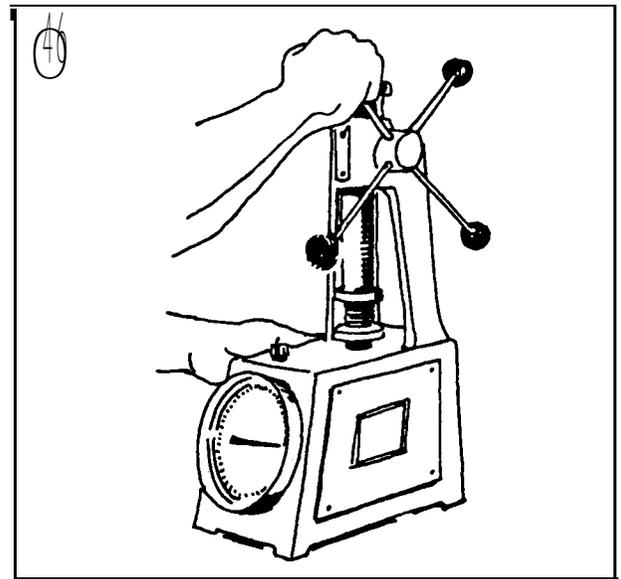
4. Insert each valve into the guide from which it was removed. Holding the valve just slightly off its seat, rock it back and forth in a direction parallel with the rocker arms. This is the direction in which the greatest wear normally occurs. If the valve stem rocks more than slightly, the valve guide 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 (Table 1). Worn guides must be reamed for the next oversize valve stem.
6. Test the valve springs under load on a spring tester (Figure 46). Replace any weak springs.
7. Check each spring on a flat surface with a steel square. See Figure 47. 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.

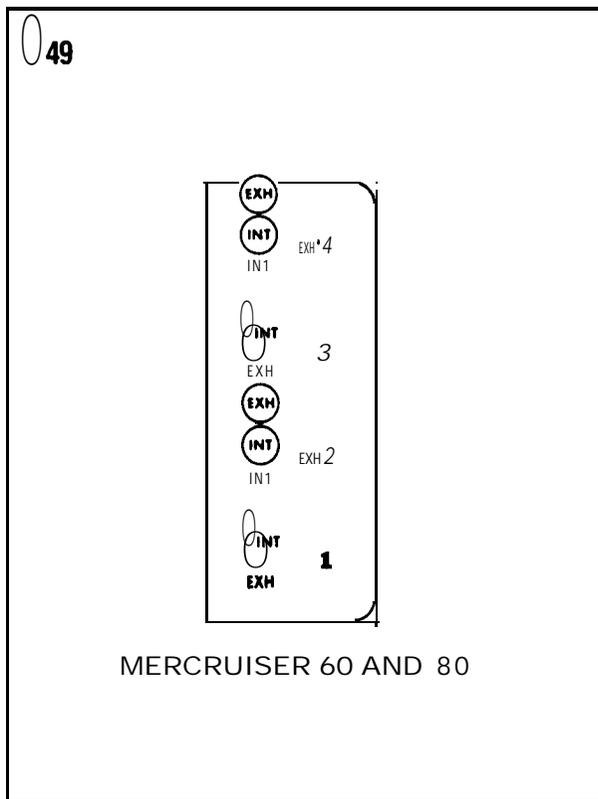
Valve Guide Reaming

Worn valve guides must be reamed to accept a valve with an oversize stem. Reaming must be done by hand (Figure 48) 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 (Table 1) 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. Install the No. 1 cylinder exhaust valve in the head.

NOTE

Install valve springs with closed coil end facing cylinder head in Step 2.

2. Drop the valve base washer, spring and cap over the valve.
3. Compress the spring and install the valve keys. Make sure to use the correct keys on the exhaust and intake valves. See Figure 43.
4. Repeat Steps 1-3 for each remaining valve.
5. Install valve tappets.

Valve Adjustment

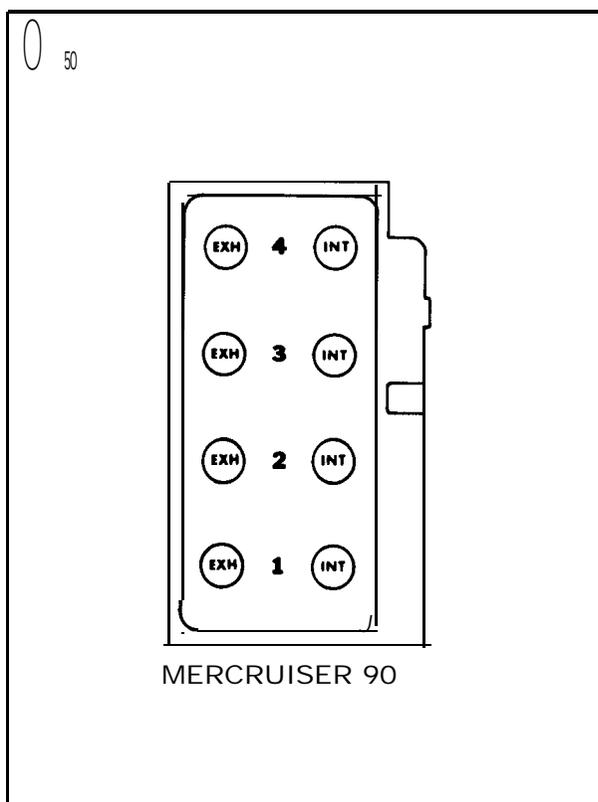
Engine running

CAUTION

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

Refer to Figure 49 or Figure 50 for this procedure.

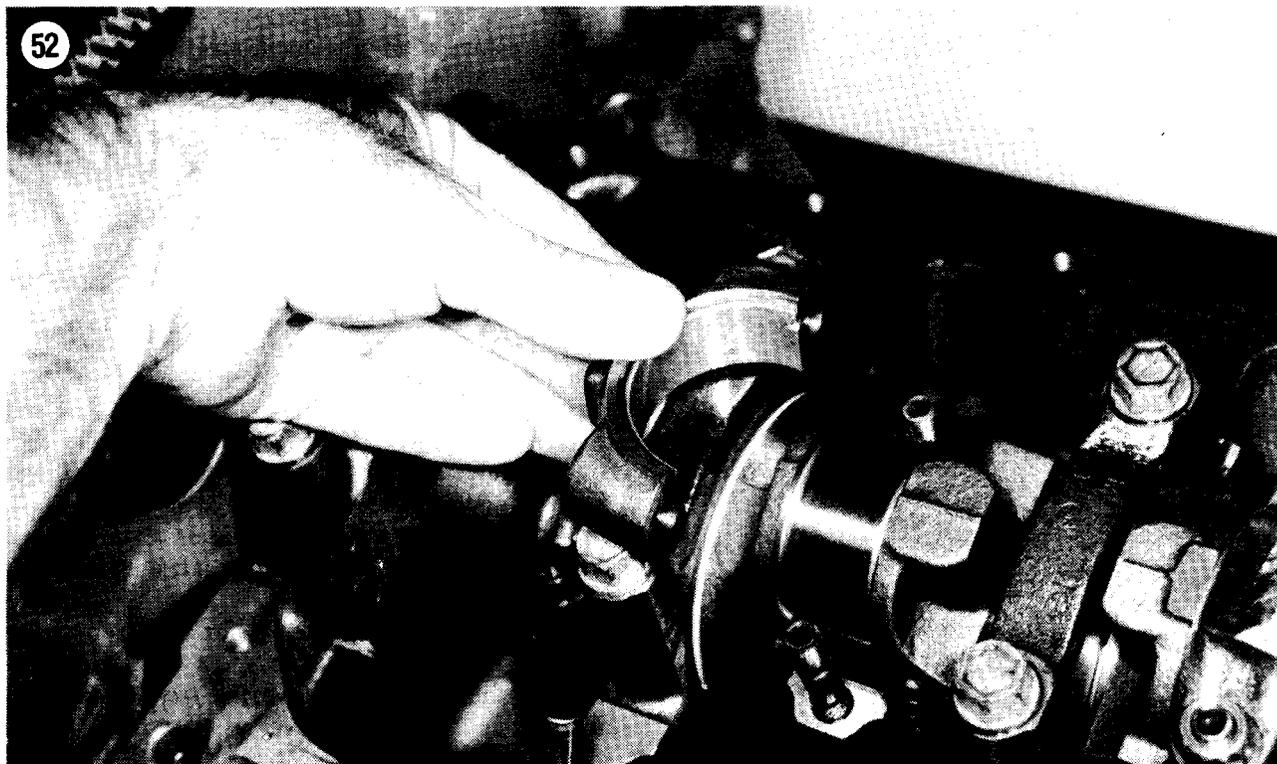
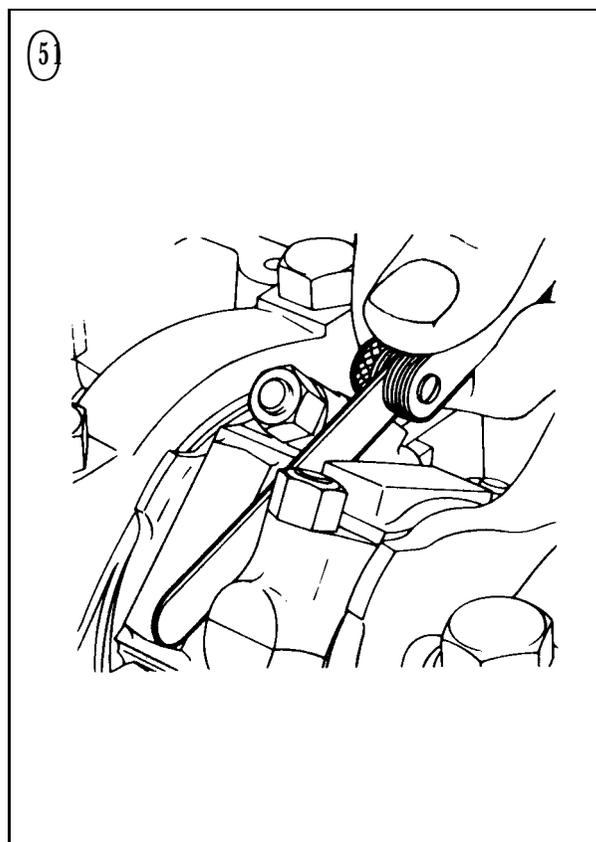
1. Warm the engine to normal operating temperature.
2. Remove the rocker arm cover as described in this chapter and temporarily install a reworked cover.
3. With the engine idling, back off one rocker arm nut and insert a feeler gauge of the proper thickness between the rocker arm and valve stem.
4. Turn adjusting screw in or out as required until a slight drag is felt on the feeler gauge and tighten the rocker arm nut.
5. Repeat Step 3 and Step 4 for each remaining valve.
6. Stop the engine. Remove the reworked cover. Install the rocker arm cover as described in this chapter.

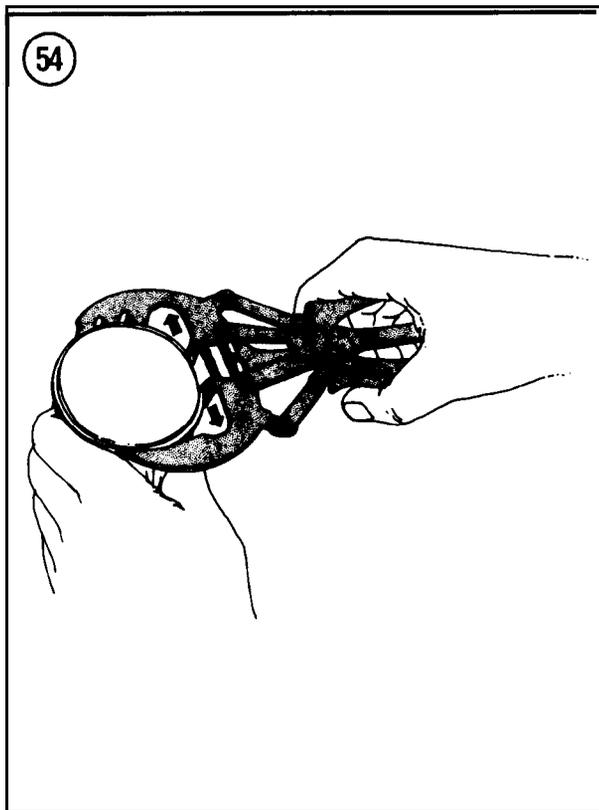
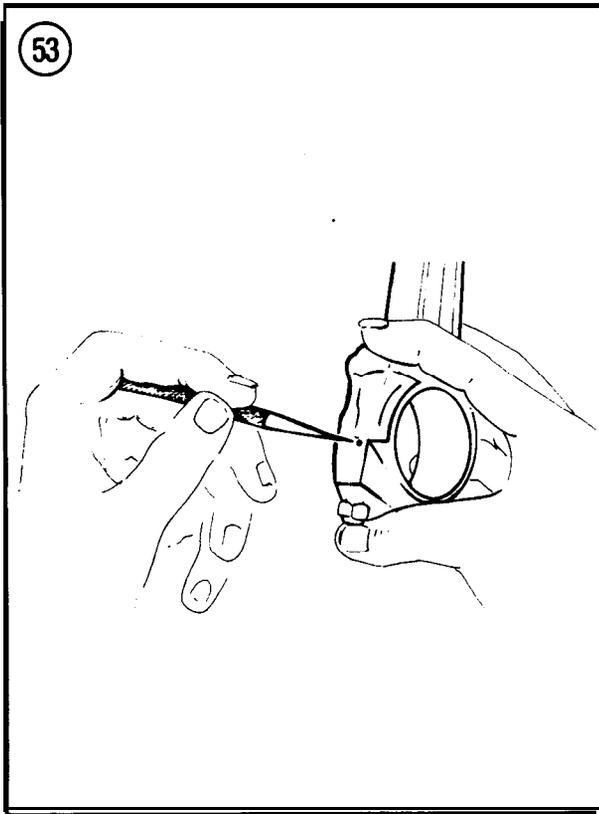


Engine Stopped

Refer to **Figure 49** or **Figure 50** for this procedure.

1. Remove the valve cover as described in this chapter.
2. Rotate the crankshaft until the No. 1 exhaust valve is open and adjust No. 3 intake and No. 4 exhaust valves. Back off rocker arm nut, insert a feeler gauge of the proper thickness between the rocker arm and valve stem and turn adjusting screw in or out until a slight drag is felt on the feeler gauge. Tighten the rocker arm nut.
3. Rotate crankshaft until No. 3 exhaust valve is open and adjust No. 4 intake and No. 2 exhaust valves.
4. Rotate crankshaft until the No. 4 exhaust valve is open and adjust No. 2 intake and No. 1 exhaust valves.
5. Rotate crankshaft until the No. 2 exhaust valve is open and adjust No. 1 intake and No. 3 exhaust valves.
6. Install rocker arm cover as described in this chapter.
7. Start the engine and warm to normal operating temperature. Shut engine off and recheck valve





clearances. If incorrect, adjust valves with engine running 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 cylinder head as described in this chapter.

NOTE

Disregard Step 8 of Cylinder Head Removal as the liners are to be removed later in this procedure.

4. Remove the oil pan and oil pump as described in this chapter.
5. Rotate the crankshaft so the connecting rod is centered in the cylinder bore.
6. Measure the clearance between each connecting rod and the crankshaft journal flange with a feeler gauge (Figure 51). If the clearance exceeds specifications (Table 1), replace the connecting rod.
7. Remove the nuts holding the connecting rod cap. Lift off the cap, together with the lower bearing insert (Figure 52).

NOTE

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

8. Use a wooden hammer handle to push the piston, connecting rod and cylinder liner from the bore as an assembly.

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 (Figure 53).

9. Remove the piston rings with a ring remover (Figure 54).

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 pin, 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 55**). Measure just below the rings at right angles to the piston pin bore.
2. Measure the cylinder liner diameter with a bore gauge (**Figure 56**). Measure at the top, center and bottom of the liner bore, in front-to-rear and side-to-side directions.
3. Subtract the piston diameter from the largest cylinder liner bore reading. If the difference exceeds specifications (**Table 1**), replace the liner.

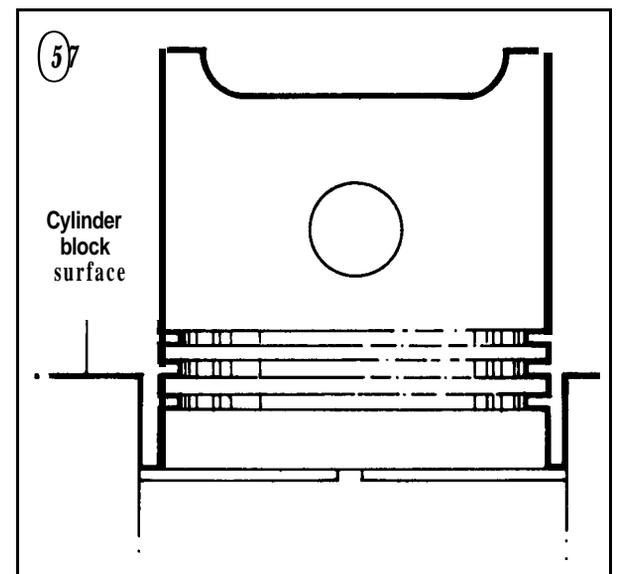
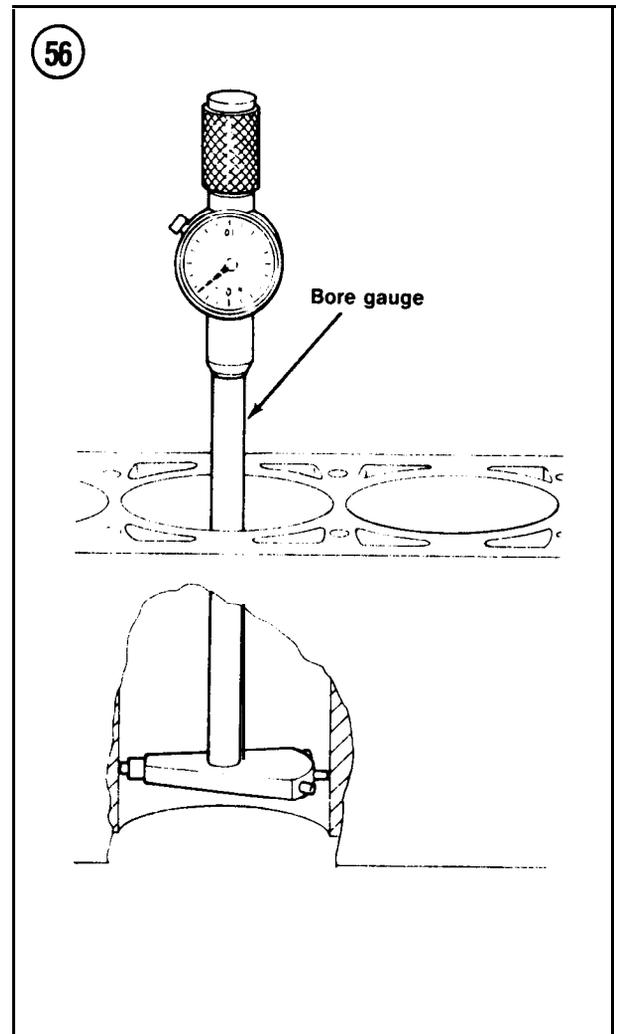
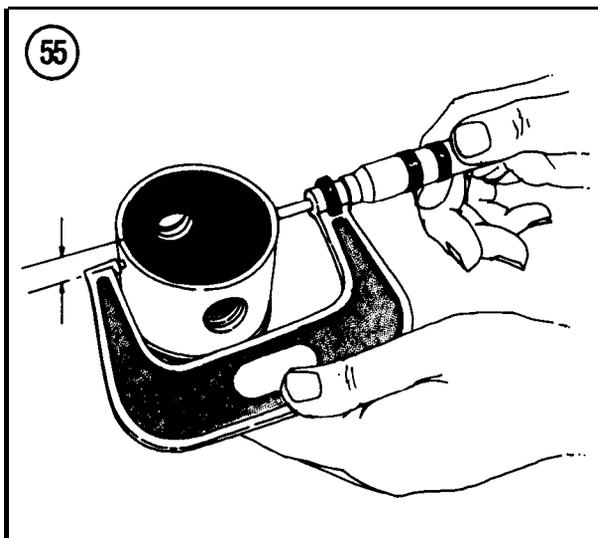
Piston Ring Fit/Installation

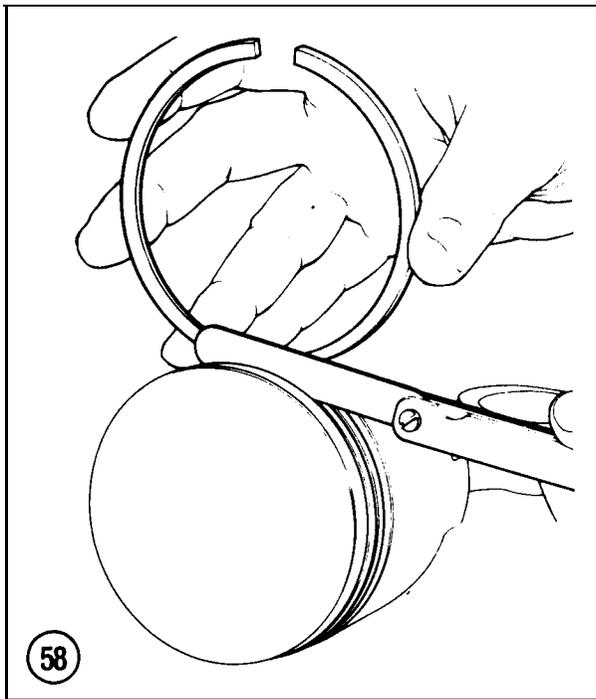
1. Check the ring gap of each piston ring. To do this, position the ring at the bottom of the ring travel area in the liner and square it by tapping gently with an inverted piston. See **Figure 57**.

NOTE

If the cylinder liners have not been honed or replaced, check the gap at the bottom **of** the ring travel, where the liner is least worn.

2. Check the side clearance of the compression rings as shown in **Figure 58**. Place the feeler gauge





alongside the ring all the way into the groove. If the measurement is not within specifications (**Table 1**), either the rings or ring grooves are worn. Inspect and replace as necessary.

3. Using a ring expander tool (**Figure 59**), carefully install the oil control ring, then the compression rings.

4. Position the ring gaps at 120° to each other.

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.

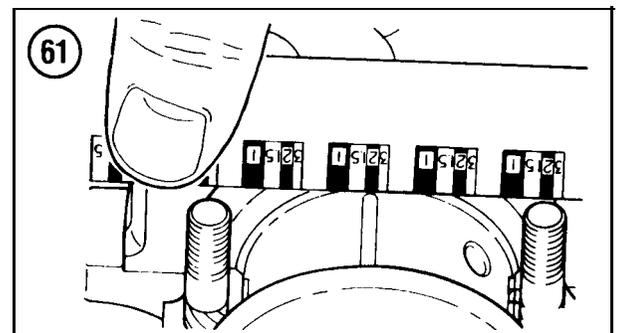
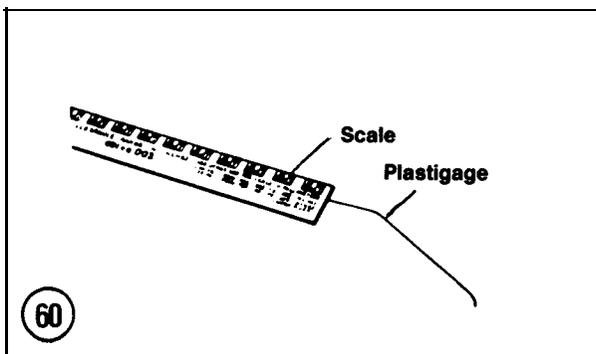
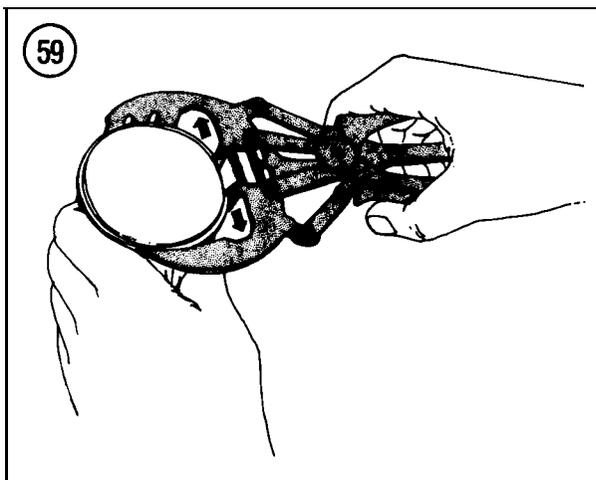
2. Cut a piece of Plastigage the width of the bearing (**Figure 60**). Place the Plastigage on the journal, then install the lower bearing half and cap.

NOTE

Do not place Plastigage over the journal oil hole.

3. Tighten the connecting rod cap to specifications (**Table 2**). 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 61**. 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 arrow on the piston must face up and the number on the connecting rod large end must face to the right-hand side.
2. Make sure the ring gaps are positioned at 120° to each other.
3. Immerse the entire piston in clean engine oil. Coat the cylinder liner wall with oil.
4. Install piston and connecting rod assembly through the bottom of its cylinder liner with a ring compressor tool.
5. Install new bottom seals on the liner and set it into the block with the arrow on the piston top facing the flywheel end.
6. Depress liner and hold. Check liner height with a straightedge and flat feeler gauge as shown in **Figure 62**. If liner height is not within specifications (**Table 1**), remove the bottom seal and install one of a thickness that will bring the height into specifications.
7. Take 2 height measurements at 180° intervals. If the difference in readings exceeds 0.001 in., rotate the liner 180° and remeasure.
8. Install liner retaining washers and bolts (**Figure 63**).
9. 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.
10. Install the connecting rod cap. Use new lock tabs under the cap nuts and tighten nuts to specifications (**Table 2**).
11. Check the connecting rod big-end play as described under *Piston Removal*.

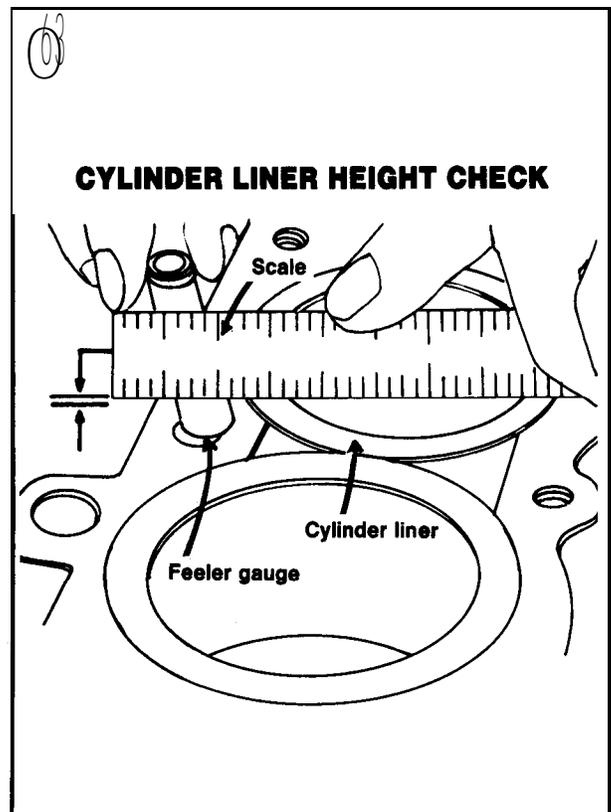
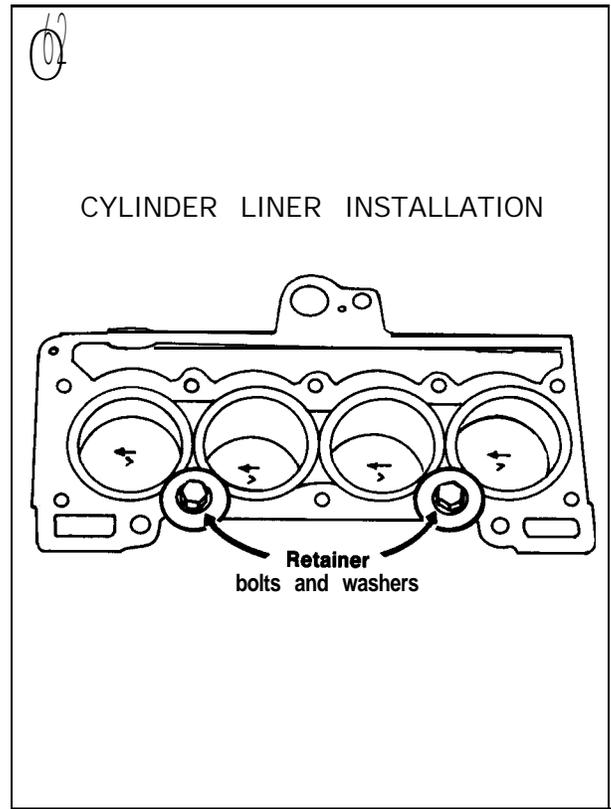
CRANKSHAFT

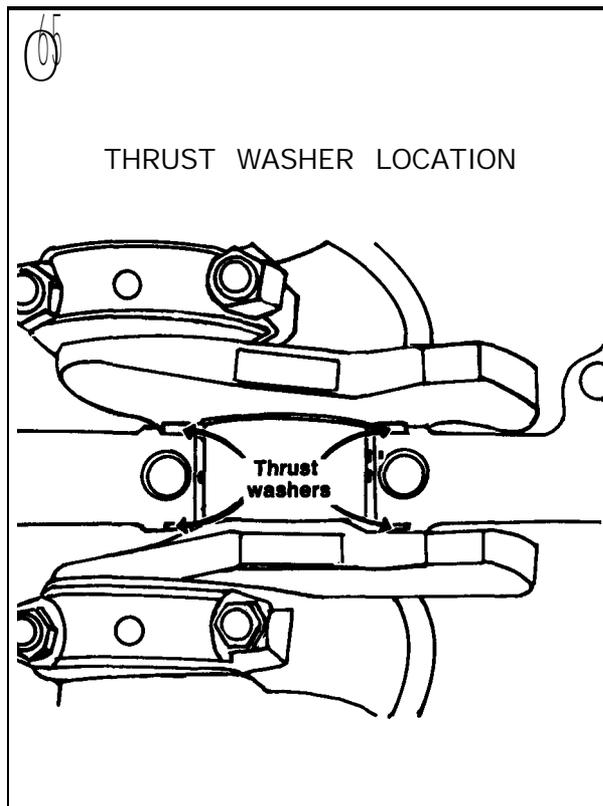
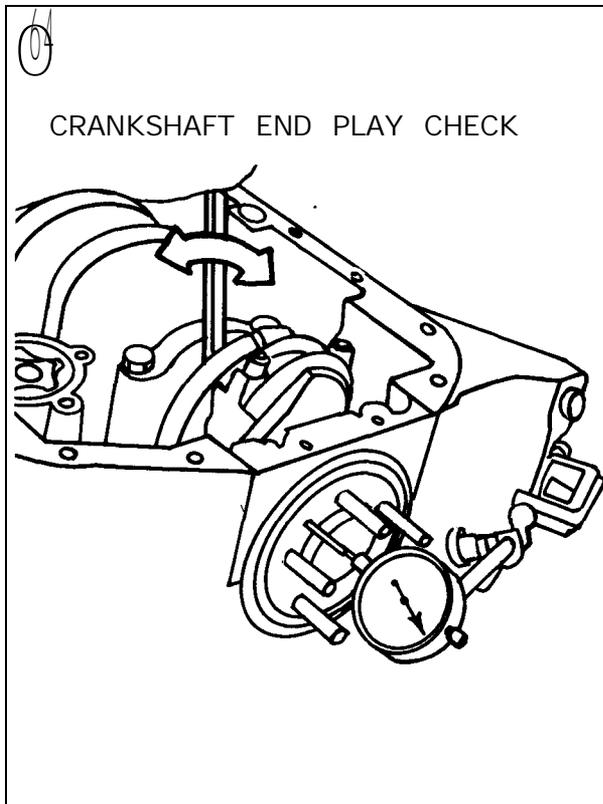
End Play Measurement

1. Pry the crankshaft to the rear of the engine with a large screwdriver.
2. Install a dial indicator as shown in **Figure 64** with its plunger end resting against the crankshaft flange parallel to the crankshaft axis.
3. Zero the dial indicator and force the crankshaft forward as far as it will go. Read the indicator and compare to specifications (**Table 1**).

NOTE

Thrust washers are available in 3 thicknesses: 0.091 in., 0.094 in. and 0.096 in.





4. If end play is excessive, replace the thrust washers with ones that will bring it into specifications. If less than specified, check the thrust washer faces for imperfections.

Removal

1. Remove the engine as described in this chapter.
2. Drain the crankcase oil and engine coolant. See Chapter Four.
3. Remove the flywheel and inner transom plate as described in this chapter.
4. Mount the engine on an engine stand, if available.
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 front cover as described in this chapter.
8. Remove the crankshaft sprocket as described in this chapter.
9. Rotate the crankshaft to position one connecting rod at bottom of its stroke.
10. Remove the connecting rod bearing cap and bearing.
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. Remove the thrust washers from the center main bearing (Figure 65).
15. Carefully lift the crankshaft from the engine block. Lay the crankshaft, main bearings and bearing caps in order on a clean workbench.
16. 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

If you do not 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.
4. Support crankshaft on V-blocks and check **runout** of front and rear intermediate journals with a dial indicator. If **runout** exceeds 0.002 in., replace the crankshaft.

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.

Installation

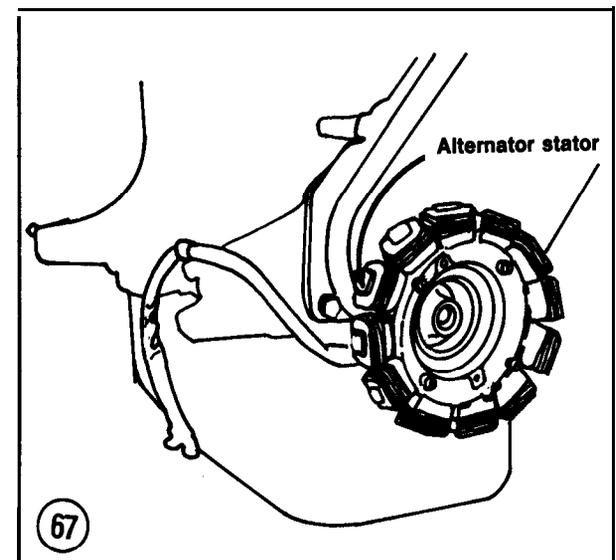
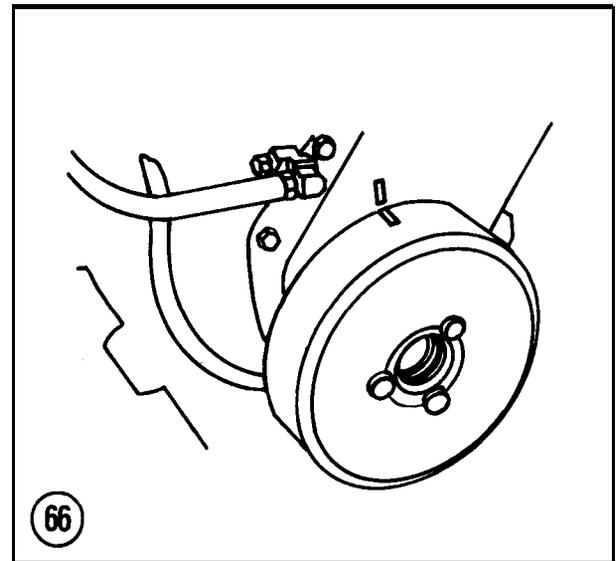
1. Install a new rear main bearing oil seal in the cylinder block and bearing cap grooves. Seal lip should face inside of engine.
2. Lubricate seal lip with clean engine oil. Make sure oil is kept away from the parting line surface.
3. Install the main bearing inserts in the bores with their tangs engaging the slots provided in the block.
4. Install the main bearing inserts in the bearing caps.
5. Carefully lower the crankshaft into position in the block, then install the thrust washers as shown in **Figure 65**.
6. Install main bearing caps and connecting rod caps. Tighten cap bolts/nuts to specifications (**Table 2**).
7. Measure crankshaft end play as described in this chapter.
8. Reverse Steps 1-8 of *Removal* in this chapter.

FLYWHEEL

Removal/Installation

(MerCruiser 60 Rear Flywheel)

1. Remove the engine as described in this chapter.
2. Remove the inner transom plate as described in this chapter.

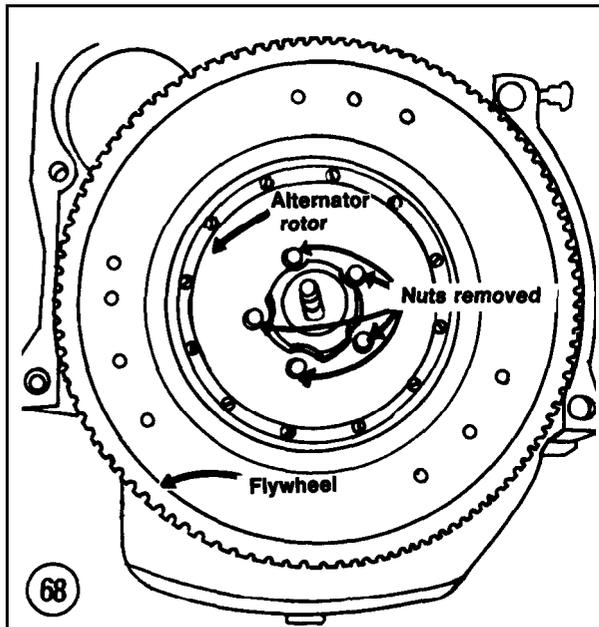


3. Remove the flywheel housing.
4. Remove the flywheel nuts. Slide coupler and flywheel off crankshaft studs.
5. Installation is the reverse of removal. Use new elastic stop nuts and tighten securely.

Removal/Installation

(MerCruiser 60 Front Flywheel/Alternator)

1. Remove screw and washer holding alternator flywheel to crankshaft.
2. Install puller part No. C-91-38835A1 or equivalent and remove flywheel (**Figure 66**).
3. Remove alternator stator (**Figure 67**).



5. Remove the elastic stop nuts holding the alternator rotor to the flywheel (**Figure 68**). Slide the flywheel and rotor off the crankshaft studs.

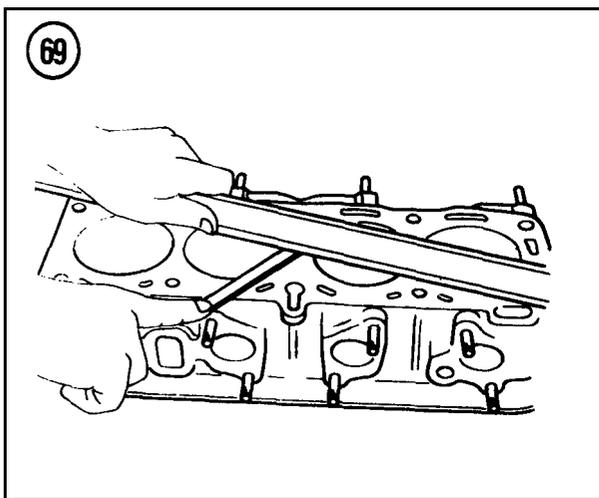
6. Installation is the reverse of removal. Use new elastic stop nuts and tighten to specifications (**Table 2**).

Inspection

1. Visually check the flywheel surfaces for cracks, deep scoring, excessive wear, heat discoloration and checking.

2. 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.

3. 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-92-74058A1) for better results.



4. Installation is the reverse of removal. Wipe front cover with a thin coat of grease before installing flywheel.

Removal/Installation (MerCruiser 80 and 90)

1. Remove the engine as described in this chapter.
2. Remove the inner transom plate as described in this chapter.
3. Insert a socket with extension through the coupler splines and remove the coupler stop nut.
4. Remove the flywheel cover and housing with alternator stator.

CYLINDER BLOCK

Cleaning and Inspection

1. Clean the block thoroughly with solvent. Remove any gasket residue from the machined surfaces. Check all core plugs 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 with liners removed. 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 69**. If distortion exceeds 0.002 in., have the block resurfaced by a machine shop or dealer.

4. Measure the cylinder liner bores with a bore gauge (Figure 70) as described in Step 2, **Piston Clearance** Check in this chapter. If the liner bores exceed maximum tolerances, they must be replaced. Replacement is also necessary if the liner walls are badly scuffed or scored. Light scuffing or scoring can be corrected by having the liners honed by a machine shop or dealer.

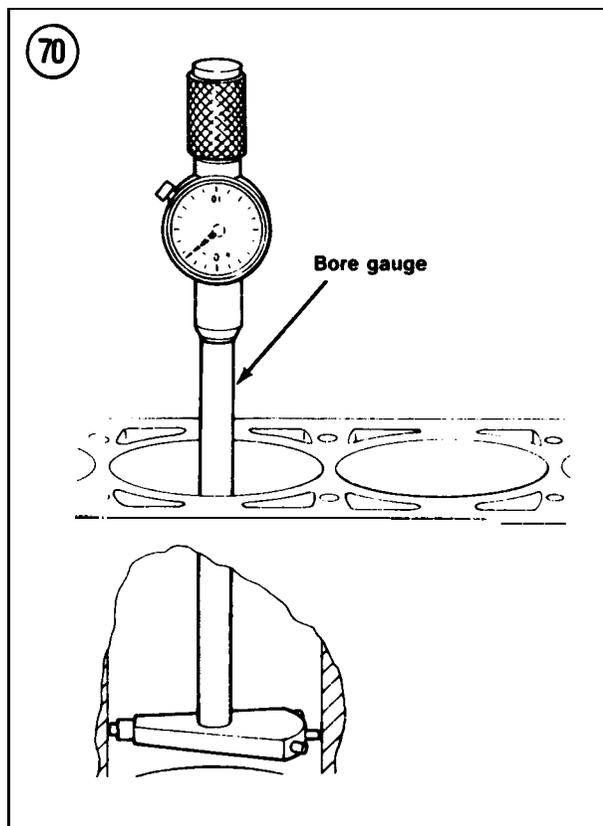
CORE PLUGS

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 71).

2. Grip the top of the plug with pliers. Pull the plug from its bore (Figure 72) 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.

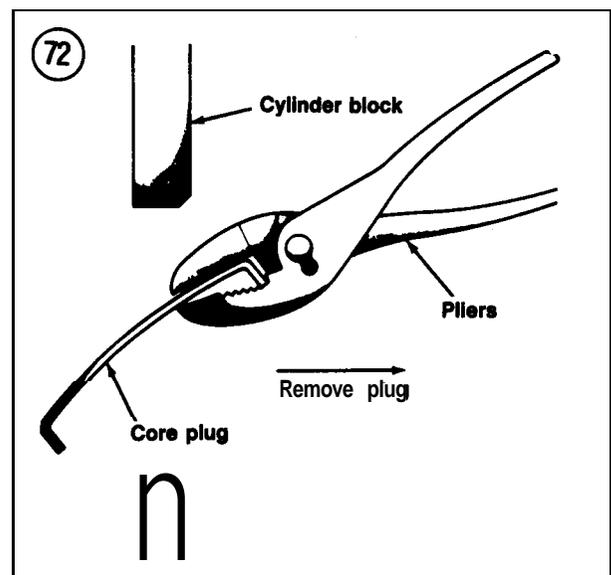
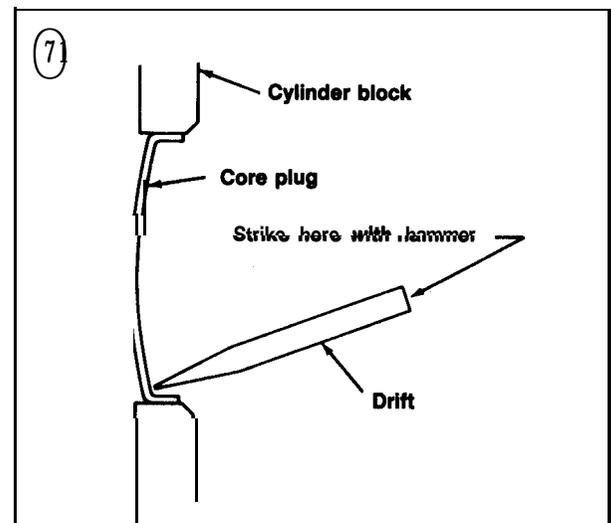


Table 1 ENGINE SPECIFICATIONS

Type	Inline 4-cylinder
Displacement	
Model 60	67.56 cid
Model 60	69.70 cid
Model 90	95.50 cid
Cylinder numbering (front to rear)	1-2-3-4
Firing order	1-3-4-2
Cylinder liner	
Diameter	
Model 60	2.7461-2.7569 in.
Model 60	2.9921-3.0031 in.
Model 90	3.0315-3.0425 in.
Height above block	
Model 60	0.003-0.005 in.
Model 80, 90	0.006-0.008 in.
Out-of-round	0.002 in. max.
Taper	0.005 in. max.
Piston clearance	0.0035 in. max.
Piston rings	
Groove clearance	
1st compression	0.0015-0.0035 in.
2nd compression	0.0015-0.0035 in.
Oil	0.001-0.006 in.
Piston pin	
Diameter	
Model 60	0.7067 in.
Model 80, 90	0.7674 in.
Clearance	0.0035 in. max.
Fit in rod	interference
Crankshaft	
Main journal diameter	
Model 60	1.6110 in.
Model 80, 90	2.125 in.
Main journal taper	0.001 in. max.
Main journal out-of-round	0.001 in. max.
Main bearing clearance	
Model 60	0.001-0.003 in.
Model 80, 90	0.0015-0.0031 in.
End play	
Model 60	0.0016-0.0075 in.
Model 80, 90	0.0018-0.0091 in.
Crankpin diameter	
Model 60	1.731 in.
Model 80, 90	1.6696 in.
Crankpin taper	0.001 in. max.
Crankpin out-of-round	0.001 in. max.

(continued)

Table 1 ENGINE SPECIFICATIONS (continued)

Connecting rod	
Bearing clearance	
Model 60	0.001-0.003 in.
Model 80, 90	0.0015-0.0031 in.
Side clearance	0.004-0.010 in.
Camshaft	
Intake lobe lift	
Model 60	0.2059 in.
Model 60	0.1979 in.
Model 90	0.1979 in.
Exhaust lobe lift	
Model 60	0.2109 in.
Model 60	0.1595 in.
Model 90	0.1979 in.
Journal diameter	
Model 60	1.4961 in.
Model 80, 90	1.6535 in.
End play	
Model 60	0.0018-0.0075 in.
Model 80, 90	0.002-0.0045 in.
Runout	0.0015 in. max.
Valves	
Lifter	Mechanical
Lash	
Model 60	
Intake	0.005 in.
Exhaust	0.006 in.
Model 80, 90	
Intake	0.006 in.
Exhaust	0.010 in.
Face angle	45°
Seat angle	46°
Seat runout	0.002 in. max.
Seat width	
Intake	
Model 60	0.055 in.
Model 60	0.099 in.
Model 90	0.067 in.
Exhaust	
Model 60	0.067 in.
Model 60	0.096 in.
Model 90	0.067 in.
Stem-to-guide clearance	
Intake	0.001-0.003 in.
Exhaust	0.0015-0.0045 in.
Valve springs	
Free length	
Model 60	1.65 in.
Model 60	1.690 in.
Model 90	2.127 in.
Damper free length	
Model 60	1.52 in.
Model 90	1.614 in.
Approximate No. of coils	
Model 60	5
Model 90	5

Table 2 TIGHTENING TORQUES

Fastener	Model 60	ft.-lb.	Model 80 and 90
Alternator flywheel	35		
Camshaft			
Sprocket	14.5		
Thrust plate		6	
Cover plate		15	
Crankshaft sprocket		50	
Connecting rod cap nuts	21	33	
Coupling-to-flywheel	25	33	
Cylinder head	43	56	
Distributor hold-down clamp	13	6	
Exhaust manifold elbow		8	
Fuel pump	13	14	
Flywheel		34	
Flywheel housing-to-block	33	38	
Front cover		9	
Main bearing cap	43	45	
Manifold-to-head	15	15	
Oil pan (side)		7	
Oil pan drain plug		18	
Oil pump			
Cover		15	
Pickup		18	
To block		6-13	
Rocker arm cover		3	
Rocker shaft support		18	
Rocker shaft		13	
Spark plugs	13	21'	
Timing chain			
Tensioner		7	
Guide		9	

. Tapered plugs without gaskets, 15 ft.-lb.