Chapter Five

Single-Cylinder Engines

This chapter covers the Yanmar 1GM and 1GM10 single-cylinder, diesel engines.

The engine consists of a cast-iron cylinder block, containing a full-length water jacket around the cylinder.

The crankshaft rotates counterclockwise as viewed from the flywheel. Two main bearings support the crankshaft, with the front bearing providing the thrust surfaces. The crankshaft gear drives the rotor-type oil pump located in the lower front of the engine block.

The camshaft is gear driven and located in the engine block above the crankshaft. One end of the camshaft is supported by a ball bearing (front), and the other rides directly in the block (rear). In addition to operating the valves, the camshaft operates the fuel transfer pump and has an actuating lobe for the injection pump attached at the front.

Valve actuation is via mechanical lifters and pushrods acting on the rocker arms mounted in the cylinder head.

Engine specifications (**Table 1**) and tightening torques (**Table 2**) are located at the end of this chapter.

DIESEL ENGINE FUNDAMENTALS

Diesel engines are compression ignition engines, as opposed to gasoline engines, which are identified as spark ignition engines. The intake, compression, ignition, expansion and exhaust cycle occur in the same sequence for compression ignition engines as for spark ignition engines. The major differences are how the fuel is introduced into the combustion chamber and how the ignition is accomplished.

The principle of operation for compression ignition engines is to compress air in the cylinder without fuel; as the pressure increases, so does the temperature. The temperature of the compressed air is sufficient to ignite the diesel fuel injected into the cylinder. To achieve the required high-compression pressure/temperature, diesel engines have compression ratios between 16:1 and 22:1. These high compression ratios raise the cylinder air temperature to approximately 1000° F. Diesel fuel will ignite at approximately 750° F. Therefore, diesel fuel injected into the cylinder will immediately begin to burn.

A high-pressure fuel delivery system is necessary to inject fuel into the cylinder. The injector pressure must be higher than air pressure in the cylinder, and the fuel must be forced through the small openings in the fuel injector to properly atomize the fuel. Refer to Chapter Seven for fuel and governor system operation.

Refer to **Figure 1**. During the intake stroke, air is drawn into the cylinder.

During the compression stroke, the air is compressed to raise its temperature. The seal between the piston and the

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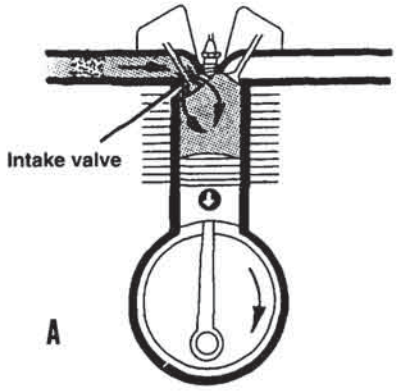
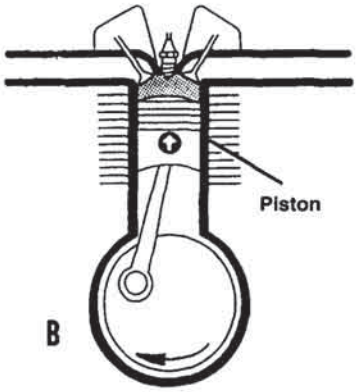
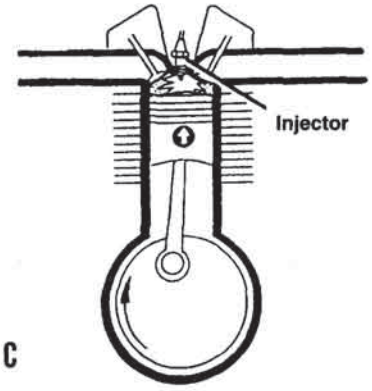
4-STROKE DIESEL ENGINE PRINCIPLES



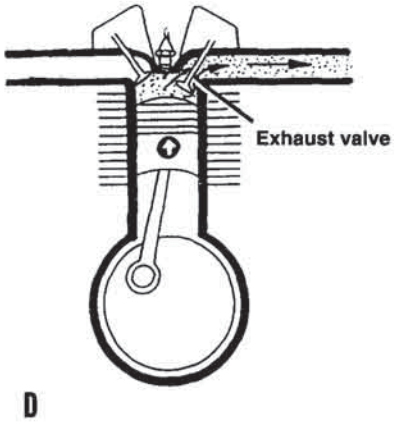
As the piston travels downward, the exhaust valve closes and the intake valve opens, allowing air to be drawn into the cylinder. When the piston reaches the bottom of its travel (BDC), the intake valve closes and remains closed for the next 1 1/2 revolutions of the crankshaft.



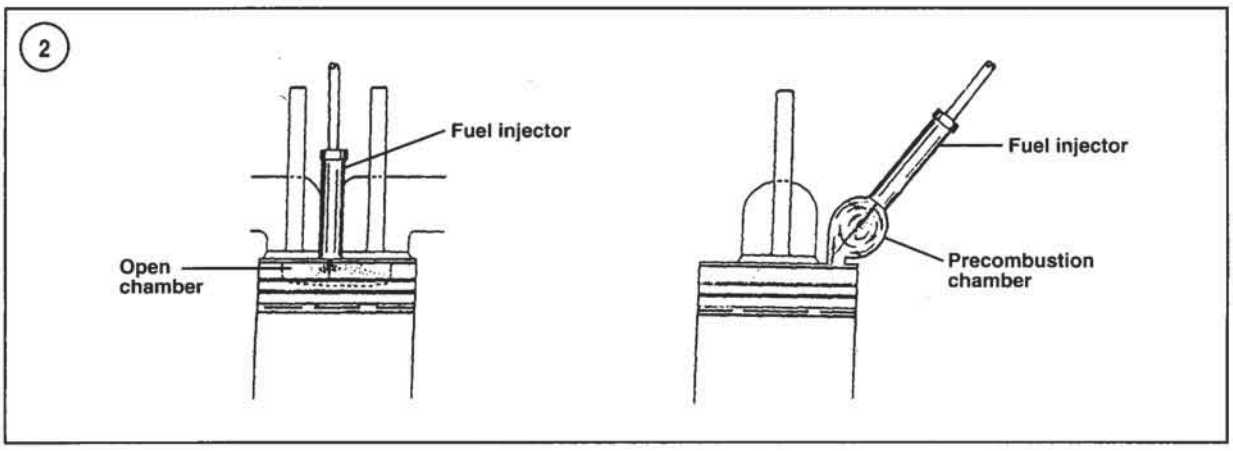
When the crankshaft continues to rotate, the piston moves upward, compressing the air.



As the piston almost reaches the top of its travel, the injector sprays fuel into the combustion chamber. The fuel is ignited by the heat of compression. The piston continues to top dead center (TDC) and is pushed downward by the expanding gases.



When the piston almost reaches BDC, the exhaust valve opens and remains open until the piston is near TDC. The upward travel of the piston forces the exhaust gases out of the cylinder. After the piston has reached TDC, the exhaust valve closes and the cycle repeats.



cylinder must not permit compression leakage, which could lower the temperature of the compressed air. Also, the cylinder must not contain fuel that could ignite prematurely during compression.

Near the end of the compression stroke, fuel is injected into the cylinder and ignited by compressed air. Fuel injection continues during several degrees of crankshaft rotation, depending upon desired speed and load. Expansion of the air caused by the burning fuel pushes the piston down on the expansion (power) stroke.

The exhaust valve opens just before the piston reaches the bottom of travel. The exhaust valve remains open as the piston moves upward pushing burned (exhausted) gasses from the cylinder.

Different combustion chamber designs may be used on diesel engines to accomodate specific engine operating criteria. An open combustion chamber (direct injection) design is illustrated in **Figure 2**. The fuel and air are confined to one area. Usually the piston crown is concave to form the combustion chamber and provide turbulence required for mixing the fuel with the compressed air. The shape of the combustion chamber and the shape of the injection spray pattern are matched so that fuel will be distributed evenly throughout the chamber.

The Yanmar engines covered in this manual are equipped with a precombustion chamber for each cylinder (**Figure 2**). The precombustion chamber increases combustion efficiency, which produces greater power with reduced emmissions. Combustion first occurs in the precombustion chamber when hot, compressed air enters the precombustion chamber just as fuel is injected. Combustion continues as the fuel and air are mixed and forced from the precombustion chamber into the engine cylinder. Additional mixing and ignition are completed in the cylinder.

ENGINE SERIAL NUMBER AND CODE

The engine serial number and model designation are located on a plate attached to the rocker cover (**Figure 3**). The engine serial number is also stamped on the side of the cylinder block (**Figure 4**).

Have the engine model number and serial number available when ordering parts. Record the engine model and serial numbers and store them for future reference in case the identification plate on the engine is defaced or lost.

REPLACEMENT PARTS

When installing new parts on the engine, make sure the part is designed for use on a marine engine. Automotive and marine engine parts may look similar; however, automotive parts may not be capable of operating in a harsh marine environment.

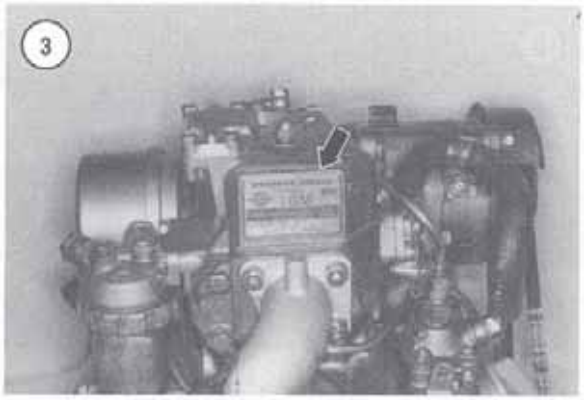
Use only Yanmar parts or parts approved for use on marine engines.

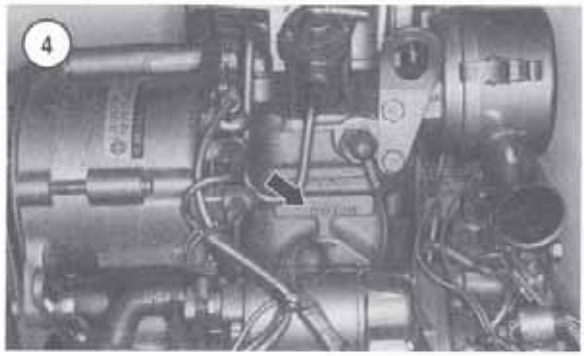
ENGINE REMOVAL PRECAUTIONS

Some service procedures can be performed with the engine in the boat; others require removal. The boat design and service procedure to be performed determines whether the engine must be removed.

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. Make sure the hoist is designed to lift engines and has enough load capacity for your engine.
4. Make 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 vessel.

Removal/Installation

While specific procedures cannot address all engine installations, refer to the following general instructions when removing the engine.

1. Disconnect the negative battery cable.
2. Close the seacock and drain the cooling system as described in Chapter Four.
3. Disconnect the intake water hose from the seawater cooling pump.
4. Close the fuel shutoff valve and disconnect the fuel line and the fuel return line.
5. Disconnect the remote control cables.
6. Disconnect the electrical wiring harness connectors.
7. Disconnect the electrical wires from the electric starter motor and solenoid that will interfere with engine removal.
8. Detach the exhaust system.
9. Detach the driveshaft from the transmission output flange.
10. Remove the engine retaining bolts.
11. Remove the engine and transmission.
12. Remove the transmission from the engine as described in Chapter Ten.
13. Engine installation is the reverse of removal, plus the following:
    a. Tighten the engine mounting bolts securely.
    b. Securely tighten the output flange-to-driveshaft bolts.
    c. Bleed the fuel system at the fuel filter as described under Fuel Filter in Chapter Three.

5

VALVE COVER

Refer to **Figure 5**.

To remove the valve cover, proceed as follows:

1. Make sure the decompression lever is in the OFF position.
2. Unscrew the retaining nut (**Figure 6**).
3. Remove the valve cover.
4. Remove the gasket.
5. Clean the gasket surfaces on the valve cover and cylinder head.
6. Reverse the removal steps to install the valve cover. Be sure to install the breather pipe (19, **Figure 5**).

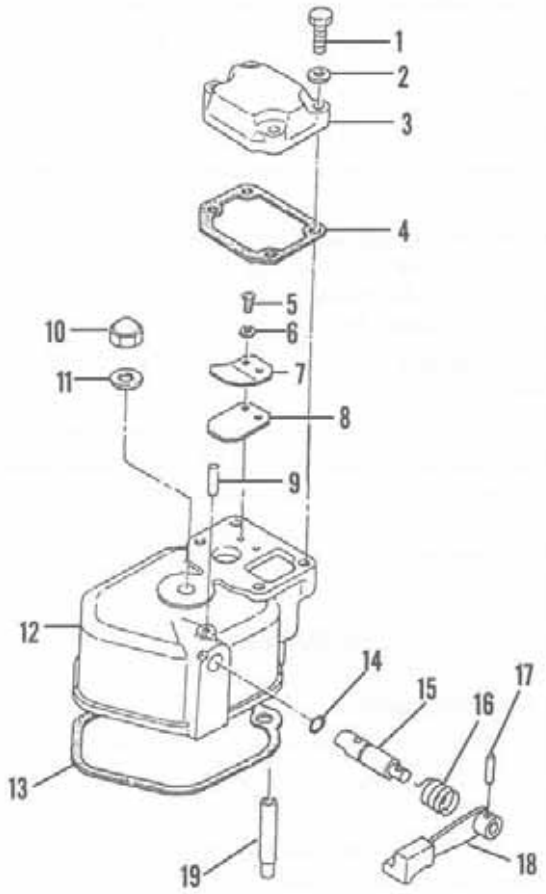
BREATHER ASSEMBLY

A reed-type breather is located in the valve cover. Refer to Chapter Three for a description of breather operation.

To service the reed portion of the breather, remove the breather cover (**Figure 7**). The reed (**Figure 8**) should lie flat. Replace the reed if it is split, cracked or otherwise damaged.

Check the oil return hole (**Figure 9**) inside the breather chamber in the valve cover. If the hole is obstructed, remove the valve cover and clean out the hole.

5 **VALVE COVER ASSEMBLY**



1. Bolt
2. Washer
3. Breather cover
4. Gasket
5. Screw
6. Washer
7. Valve stop
8. Breather valve reed
9. Pin
10. Nut
11. Washer
12. Valve cover
13. Gasket
14. O-ring
15. Decompression shaft
16. Spring
17. Pin
18. Decompression lever
19. Pipe

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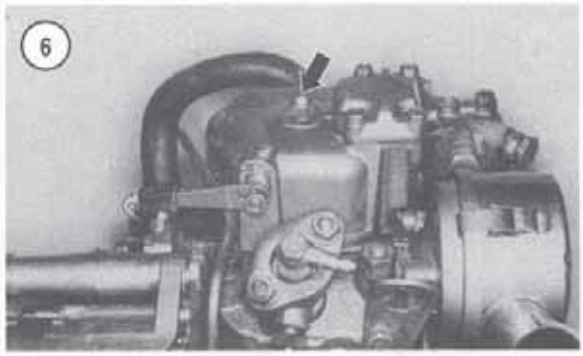

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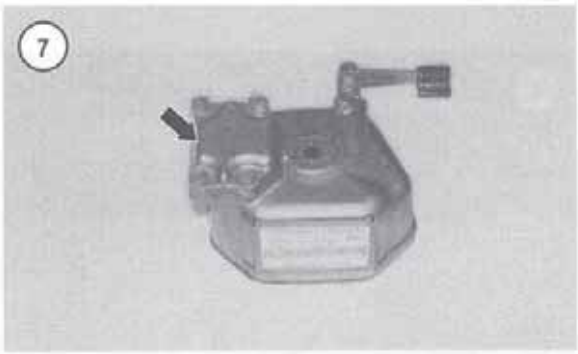

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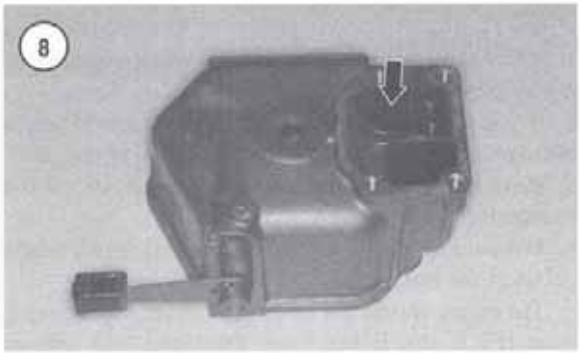

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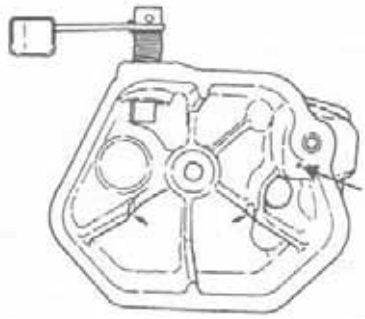
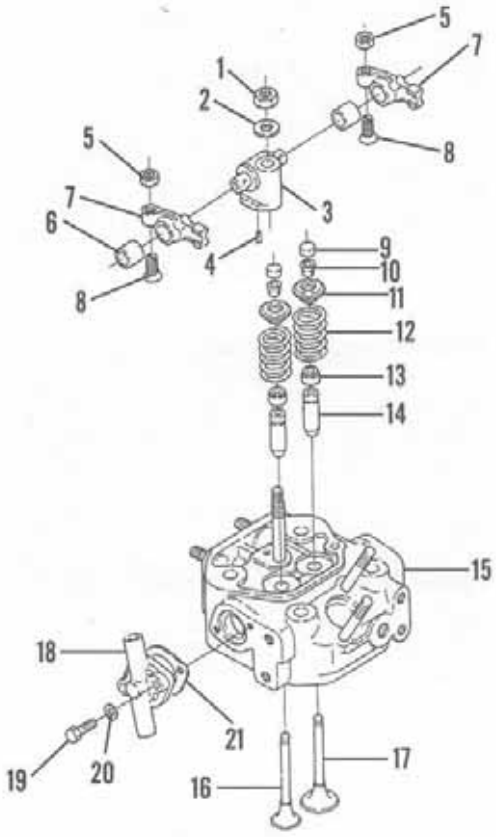


(10) **CYLINDER HEAD**



1. Nut
2. Washer
3. Rocker shaft stand
4. Pin
5. Nut
6. Bushing
7. Rocker arm
8. Adjuster
9. Wear cap
10. Keys
11. Valve spring retainer
12. Valve spring
13. Valve seal
14. Valve guide
15. Cylinder head
16. Exhaust valve
17. Intake valve
18. Thermostat housing
19. Bolt
20. Washer
21. Gasket

DECOMPRESSION MECHANISM

The decompression mechanism on the valve cover forces the exhaust valve open to reduce compression pressure in the cylinder. Reducing compression pressure enables the starter to rotate the crankshaft faster during starting.

If the mechanism must be repaired, proceed as follows:

1. Remove the valve cover as previously described.

NOTE

*The lever retaining pin (17, **Figure 5**) is tapered. Drive the pin out toward top of lever.*

2. Using a suitable punch, drive out the retaining pin.
3. Remove the shaft assembly from the valve cover.
4. Inspect the mechanism and replace any damaged parts.
5. Reverse the removal procedure to reassemble the decompression mechanism. Note the following:

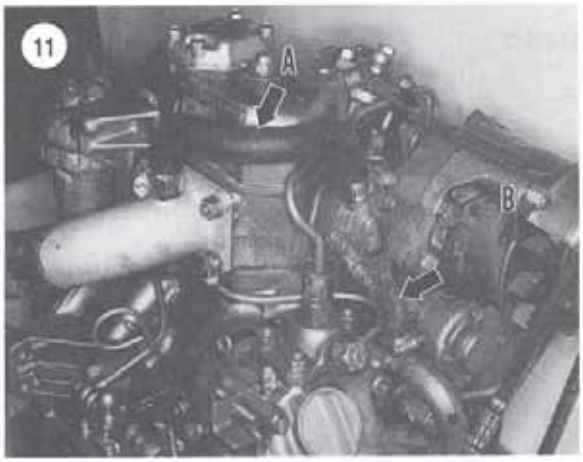
a. The straight end of the spring must sit behind the lug on the valve cover. Position the hooked spring end on top of the lever.

b. The shaft and lever must be properly assembled or the taper pin and tapered holes in the shaft and lever will not align. The cutout portion of the shaft must be down when the lever points toward the pulley end of the engine.

CYLINDER HEAD

Removal

In some instances, it may be possible to remove the cylinder head for service without removing the engine. If engine removal is necessary, refer to the previous engine removal procedure. Refer to **Figure 10** for an exploded view of the cylinder head assembly.

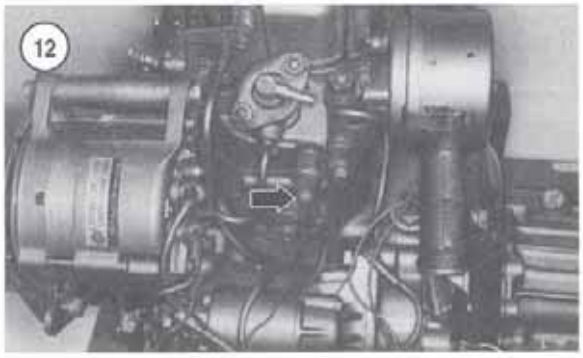


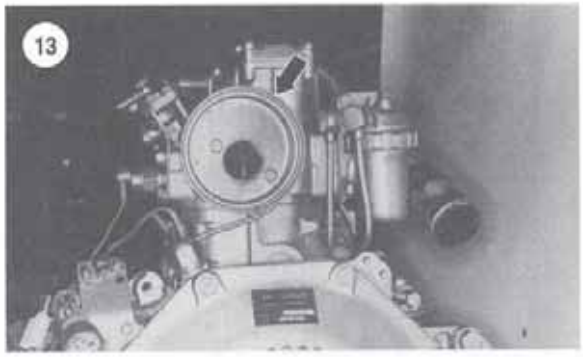
To remove the cylinder head, proceed as follows:

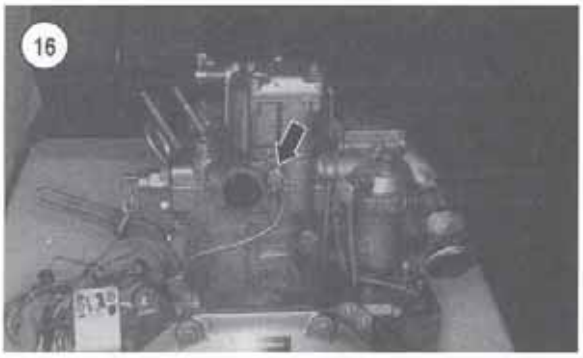
1. Disconnect the negative battery cable.
2. If not previously performed, drain the cooling system as described in Chapter Four.
3. Remove the alternator as described in Chapter Nine.
4. If not previously disconnected, detach the exhaust hose from the exhaust elbow.
5. Loosen the hose clamps and remove the water hose (A, **Figure 11**) from the exhaust elbow and thermostat housing.
6. Remove the exhaust elbow.
7. Disconnect the lower water hose (B, **Figure 11**) from the thermostat housing.
8. Disconnect the wire lead from the water temperature sender (**Figure 12**).
9. Remove the air cleaner and the air cleaner base (**Figure 13**).
10. Remove the fuel injector and precombustion chamber as described in Chapter Seven.
11. Remove the valve cover as previously described.
12. Remove the rocker arm stand retaining nut (A, **Figure 14**), then remove the rocker assembly (B).
13. Remove the push rods (**Figure 15**) and mark them so they can be reinstalled in their original positions.
14. Detach the oil line fitting (**Figure 16**) from the cylinder head.
15. Unscrew the cylinder head retaining nuts (**Figure 17**) in a crossing pattern.
16. Remove the cylinder head and head gasket.

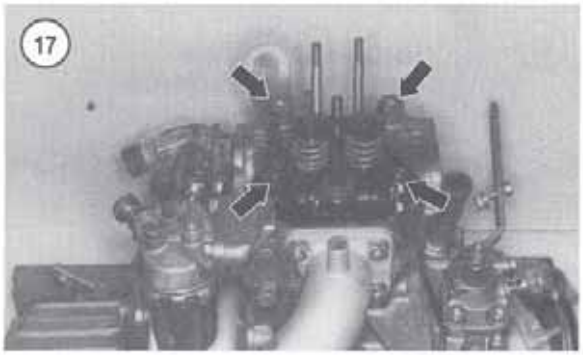
Inspection

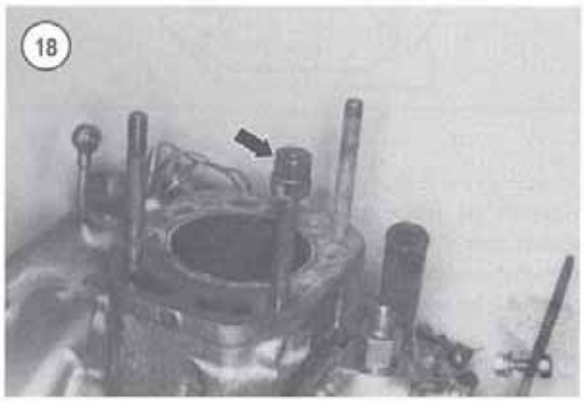
1. If service to the valves or rocker arm assembly is required, refer to the *Valves* and *Rocker Shaft Assembly* sections.







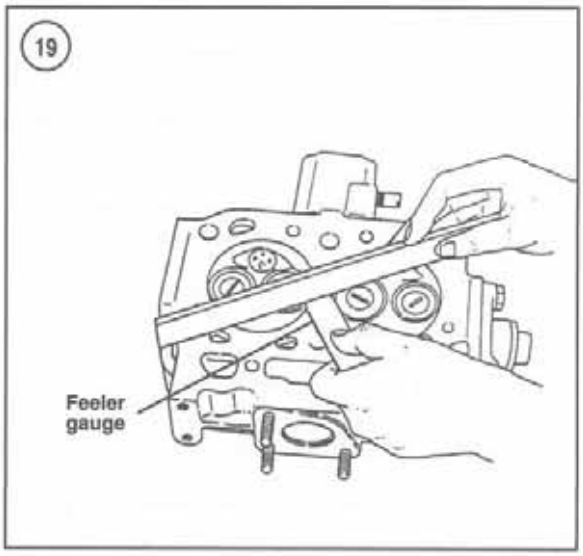




2. Check the cylinder head for signs of oil or water leakage before cleaning. Look for corrosion or foreign material in the oil and water passages.

3. Without removing the valves, remove all deposits from the combustion chamber. Use a fine wire brush dipped in solvent or make a scraper from hardwood. Be careful not to scratch or gouge the combustion chamber.

4. After all carbon is removed from the combustion chamber and ports, clean the entire head in solvent. Look for cracks or other visible signs of damage. Clean the passages with a stiff spiral brush, then blow the particles out with compressed air.



NOTE

If deposits are found in the intake or exhaust port, remove the valves and clean the ports.

5. Clean all carbon off the piston top.

6. Check the cylinder head studs for damage and replace them if necessary. If a stud is loose, tighten it using the following procedure:

   a. Install two nuts on the stud as shown in **Figure 18**.
   b. Rotate the nuts so they contact each other, then hold one nut and tighten the other nut against the first nut.
   c. Tighten the stud in the cylinder block by turning the top nut until reaching a torque of 60 N•m (44 ft.-lb.).
   d. Hold the bottom nut, loosen the top nut, and remove both nuts.

7. Check the threaded rocker arm support stud for damaged threads. Replace it if necessary.

8. Check for warpage of the cylinder head-to-block gasket surface with a straightedge and feeler gauge (**Figure 19**). Measure diagonally, as well as end to end. If the gap exceeds 0.07 mm (0.003 in.), have the head resurfaced by a machine shop.

Installation

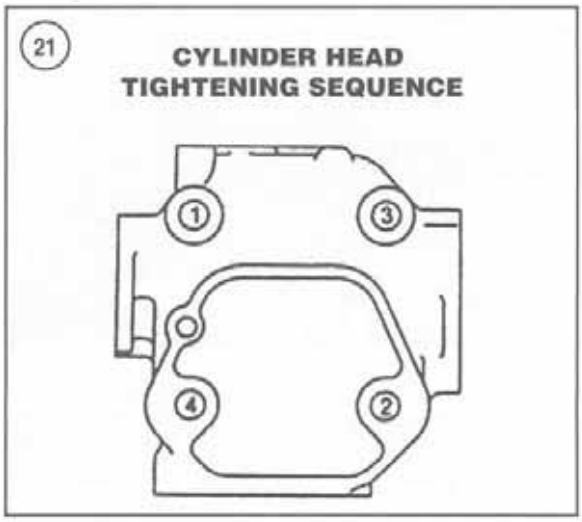
1. Make sure the cylinder head and block gasket surfaces are clean.

2. Recheck all oil and water passages for cleanliness.
3. Apply Three Bond 50 gasket sealer to both sides of a new cylinder head gasket.
4. Place the new head gasket over the cylinder head studs on the block. Make sure the TOP mark (**Figure 20**) on the gasket is up.
5. Carefully lower the head onto the cylinder block.
6. Apply engine oil to the threads on the cylinder head studs.
7. Install and tighten the cylinder head retaining nuts finger-tight.
8. Tighten the nuts following the sequence shown in **Figure 21** to a torque of 75 N•m (55 ft.-lb.). Tighten the nuts in three equal steps until reaching the final torque setting.
9. Attach the oil line fitting (**Figure 16**) to the cylinder head.
10. Install the push rods (**Figure 15**) in their original positions.
11. Install the rocker assembly (B, **Figure 14**) and the rocker arm stand retaining nut (A). Tighten the nut to 37 N•m (27 ft.-lb.).
12. Install the fuel injector and precombustion chamber as described in Chapter Seven.
13. Install the air cleaner base (**Figure 13**) and the air cleaner.
14. Connect the wire lead to the water temperature sender (**Figure 12**).
15. Connect the lower water hose (B, **Figure 11**) to the thermostat housing.
16. Install the exhaust elbow.
17. Install the alternator.
18. If the engine is installed in the boat, proceed as follows:
    a. Attach the water hose (A, **Figure 11**) to the exhaust elbow and thermostat housing, then tighten the hose clamps.
    b. Attach the exhaust hose to the exhaust elbow.
    c. Connect the negative battery cable to the negative battery terminal.
19. Adjust the valve clearance as described in Chapter Three.
20. Reinstall the valve cover.

ROCKER SHAFT ASSEMBLY

Each valve is actuated by a rocker arm that rides on a shaft (**Figure 22**). Each rocker arm is equipped with a bushing in the rocker arm bore. Ribs in the valve cover retain the rocker arms on the rocker shafts.

1. Remove the valve cover as previously described.
2. Remove the rocker arm stand retaining nut (A, **Figure 14**), then remove the rocker assembly (B).



3. Inspect the rocker arm. The pad on the rocker arm that contacts the valve stem must be smooth. Replace the rocker arm if the pad is damaged or excessively worn. Check the adjusting screw push rod seat for galling. Replace the adjusting screw if it is damaged or excessively worn.

4. Inspect and measure the inside diameter of the rocker arm bushing and the outside diameter of the rocker arm shaft. Replace the rocker arm or rocker arm shaft stand if the measurements exceed the specifications in **Table 1**.

NOTE
The rocker arm and bushing are available only as a unit assembly.

5. Reassemble and reinstall the rocker arm assembly by reversing the removal procedure. Adjust valve clearance as described in Chapter Three.

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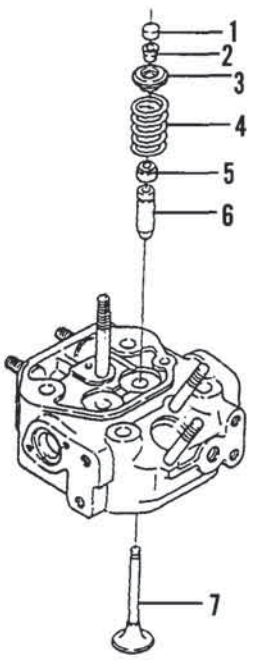
VALVE COMPONENTS



1. Wear cap
2. Keys
3. Valve spring retainer
4. Valve spring
5. Valve seal
6. Valve guide
7. Valve

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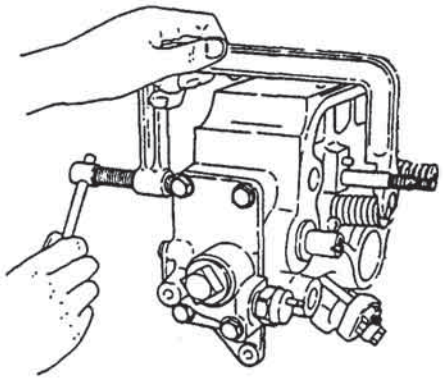


VALVES AND VALVE SEATS

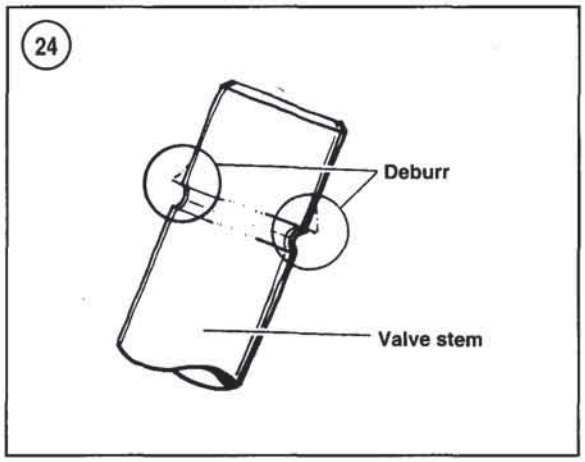
Servicing the valves, guides and valve seats must be done by a dealer or machine shop, as special knowledge and expensive machine tools are required.

A general practice among those who do their own service is to remove the cylinder head, perform all disassembly except valve removal and take the head to a dealer or 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 provided to acquaint the home mechanic with the procedure.

Valve Removal

Refer to **Figure 22**.

1. Remove the cylinder head as described in this chapter.
2. Remove the rocker shaft assembly as described in this chapter.
3. Remove the wear cap (1, **Figure 22**) on the valve stem.
4. Compress the valve spring with a compressor like the one shown in **Figure 23**.



5. Remove the valve keys (2, **Figure 22**) and release the spring tension.
6. Remove the valve spring retainer and valve spring.

CAUTION

*Remove any burrs from the valve stem lock grooves (**Figure 24**) before removing the valve to prevent damage to the valve guide.*

7. Remove the valve.
8. Remove and discard the valve stem seal (5, **Figure 22**).
9. Repeat Steps 3-8 for the remaining valve.

Inspection

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

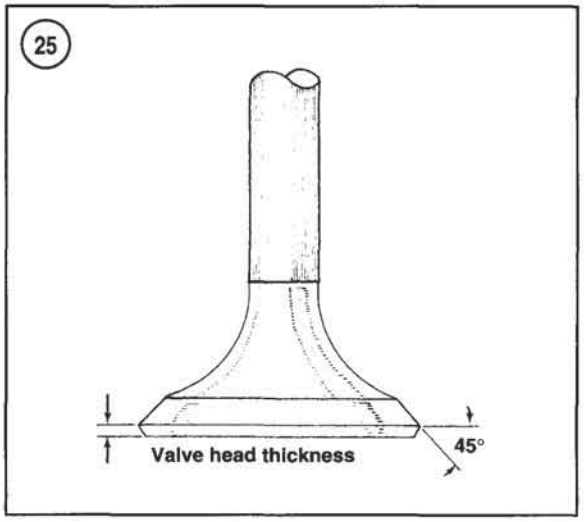
NOTE

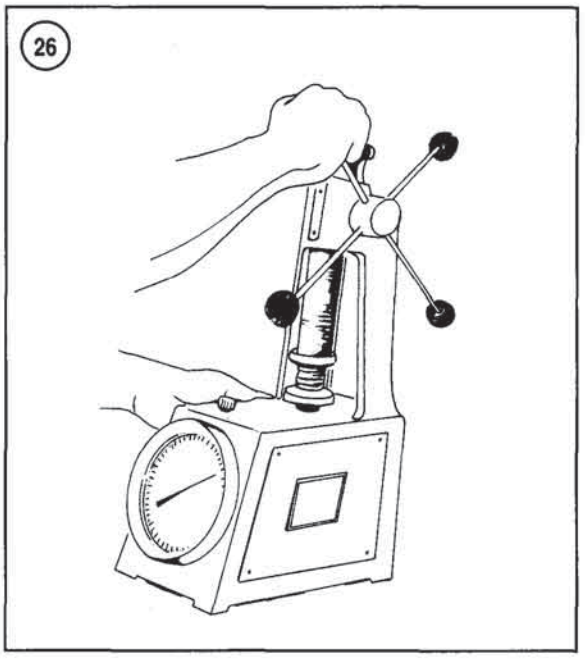
*Check the thickness of the valve edge or margin after the valves have been ground. See **Figure 25**. Any valve with a margin less than 0.75 mm (0.030 in.) should be discarded.*

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

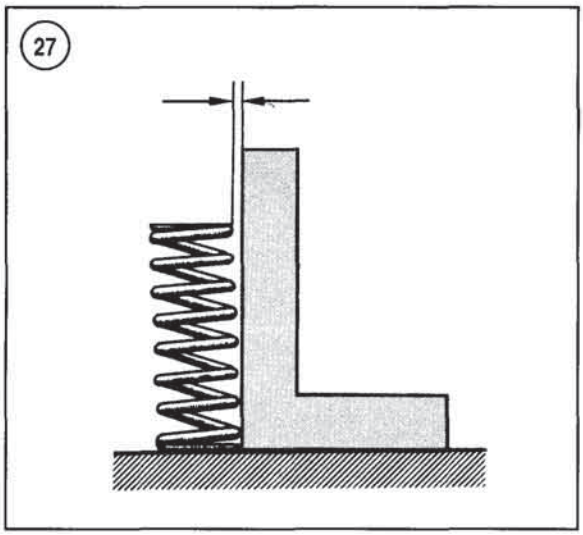
NOTE

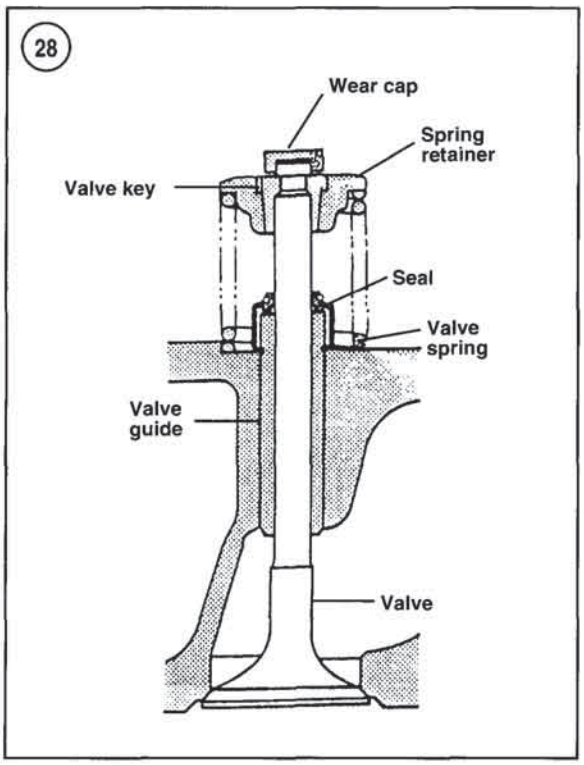
The next step assumes that all valve stems have been measured and are within specifications. Replace valves with worn stems before performing this step.





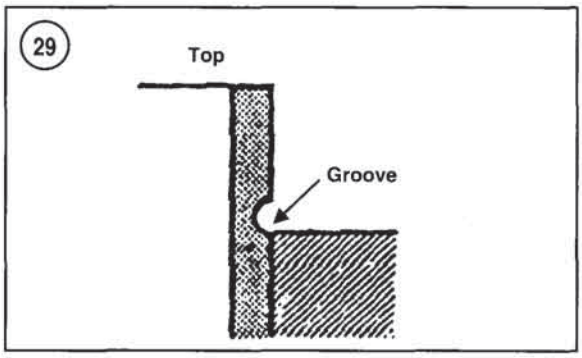
4. Insert each valve into the guide from which it was removed. Holding the valve just slightly off its seat, rock it back and forth in a direction parallel with the rocker arms. This is the direction in which the greatest wear normally occurs. If the valve stem rocks more than slightly, the valve guide is probably worn.
5. If there is any doubt about valve guide condition after performing Step 4, measure the valve guide. Compare the results with specifications in **Table 1**. Worn guides must be replaced.





6. Test the valve springs under load on a spring tester (**Figure 26**). Replace any spring that does not meet the specification in **Table 1**.

7. Inspect the valve seats. 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.



8. Check each spring on a flat surface with a steel square. See **Figure 27**. Slowly revolve the spring 360° and note the space between the top of the coil and the square. If it exceeds 1.4 mm (0.055 in.) at any point, replace the spring.

9. Check the valve guides (**Figure 28**) for wear and looseness. Refer to **Table 1** for valve guide specifications. A loose valve guide must be replaced.

Valve Guide Replacement

The cylinder head is equipped with replaceable valve guides (6, **Figure 22**). The intake and exhaust valve guides are identical. Take the cylinder head to a dealership or machine shop if valve guide replacement is required.

When installing the valve guides, the grooved end must be toward the top of the cylinder head. The groove must be flush with the head surface as shown in **Figure 29**.

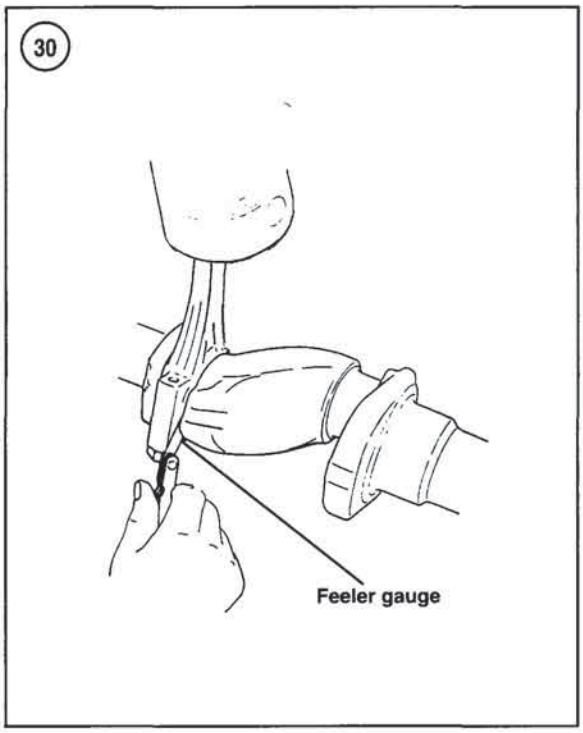
PUSH RODS

1. Remove the rocker arms as previously described.
2. Remove the push rods and mark them so they can be reinstalled in their original positions.
3. Inspect push rod ends for damage. Maximum allowable runout is 0.03 mm (0.0012 in.).
4. Reinstall the push rods by reversing removal procedure. Adjust valve clearance as described in Chapter Three.

PISTON/CONNECTING ROD ASSEMBLY

Piston/Connecting Rod Removal

1. Remove the engine as described in this chapter.
2. Place a suitable container under the oil pan and remove the drain plug. Let the crankcase oil drain, then reinstall the drain plug.



3. Remove the cylinder head as described in this chapter.

NOTE
Note the location of the long screw when removing the oil pan retaining screws.

4. Remove the oil pan.

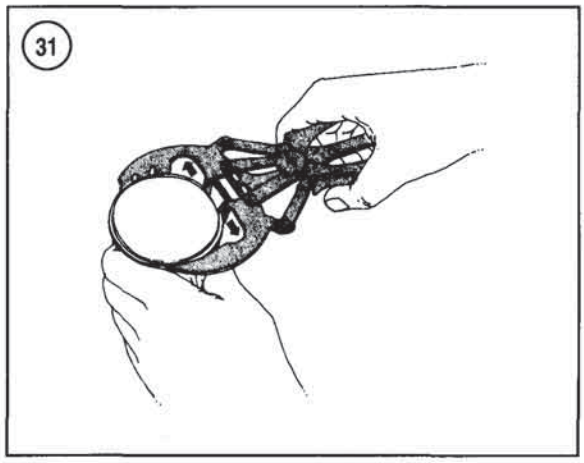
5. Rotate the crankshaft until the piston is at bottom dead center. Pack the cylinder bore with clean shop rags. Remove the carbon ridge at the top of the cylinder bore with a ridge reamer. These can be rented for use. Vacuum out the shavings, then remove the shop rags.

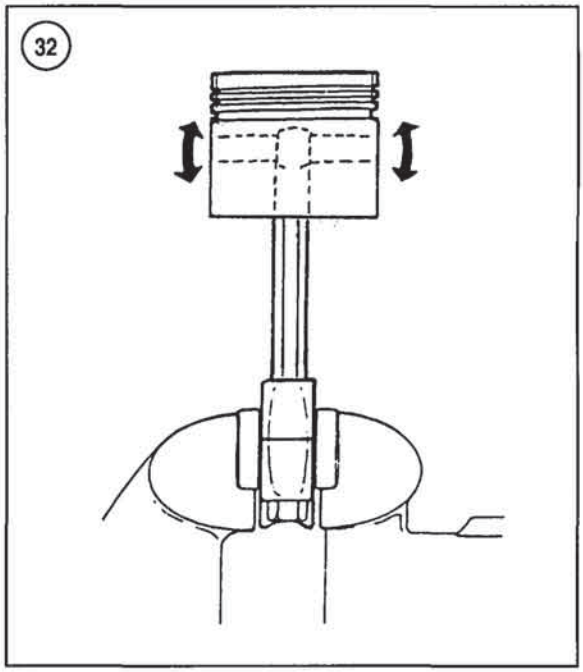
6. Rotate the crankshaft until the connecting rod is centered in the bore. Measure the connecting rod side clearance with a flat feeler gauge (**Figure 30**). If the clearance exceeds specifications (**Table 1**), replace the connecting rod during reassembly.

7. Remove the connecting rod bolts. Lift off the cap, along with the lower bearing insert.

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

9. Remove the piston rings with a ring remover (**Figure 31**).

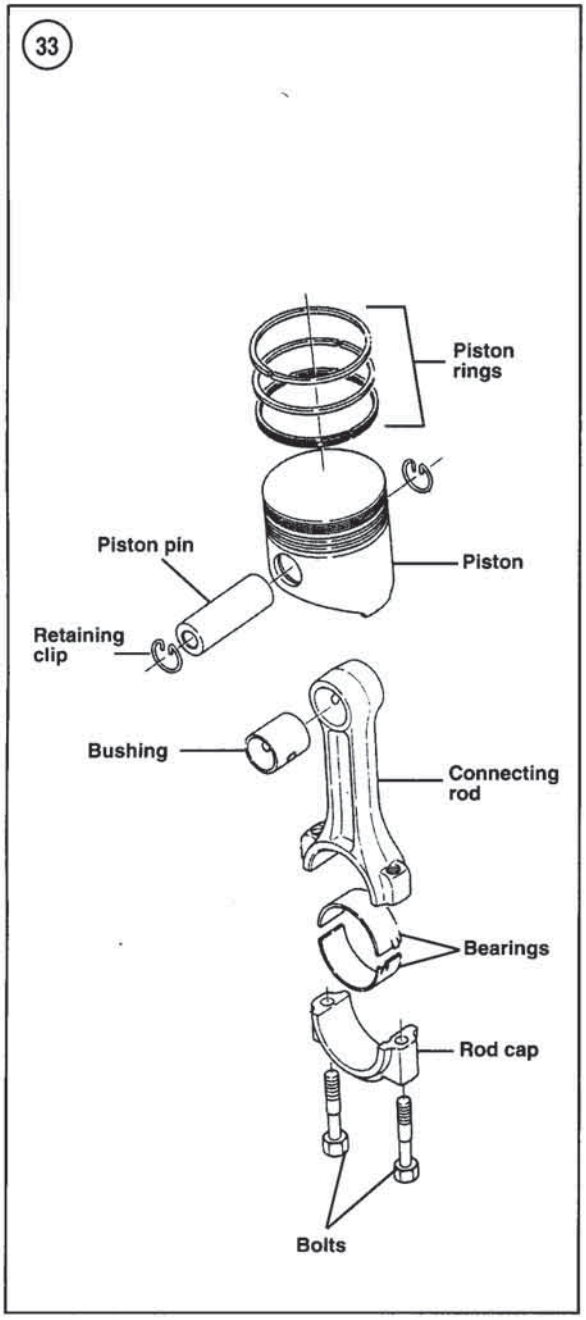




Piston Pin Removal/Installation

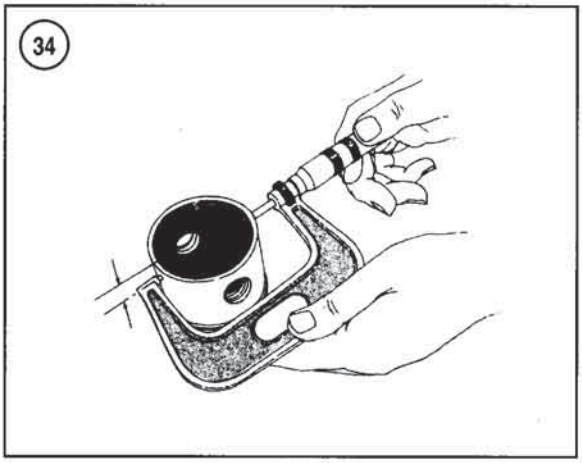
The steel piston pin rides directly in the piston and the connecting rod bushing. Circlips at each end retain the piston pin in the piston.

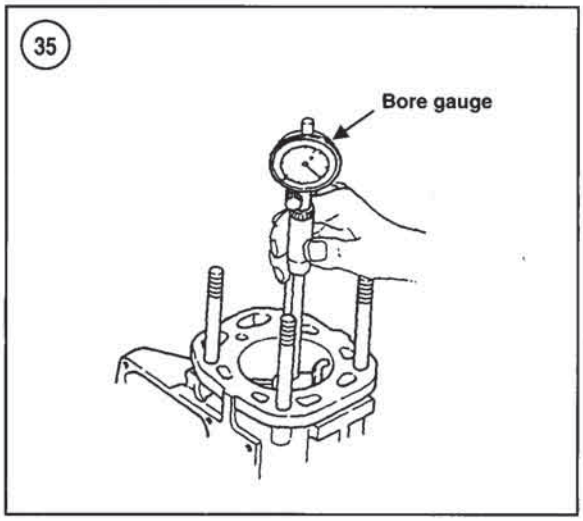
1. Before removing the piston, place the crankshaft end of the connecting rod in a vise with soft jaws. Rock the piston as shown in **Figure 32**. Any rocking motion (do not confuse with the normal sliding motion) indicates wear on the piston pin, piston pin bore or connecting rod small end bore (or a combination of these).



2. Remove the clip from each side of the piston pin bore (**Figure 33**) with a small screwdriver or scribe. Hold a thumb over one edge of the clip when removing it to prevent the clip from springing out.

3. Use a wooden dowel or suitable tool and push out the piston pin. If the pin is difficult to remove, heat the piston with a hair dryer. Separate the piston from the connecting rod.



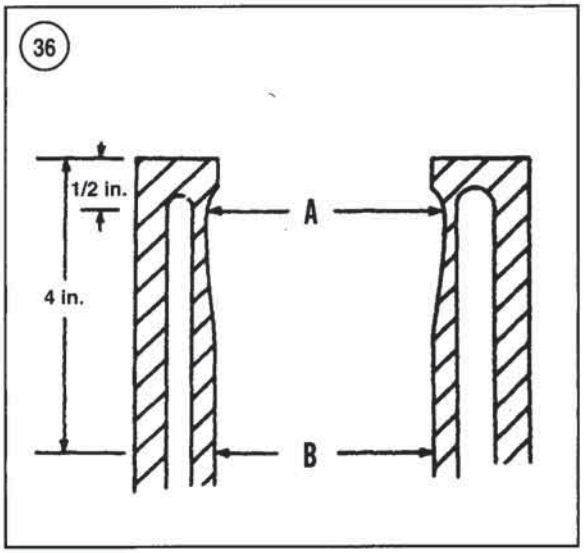


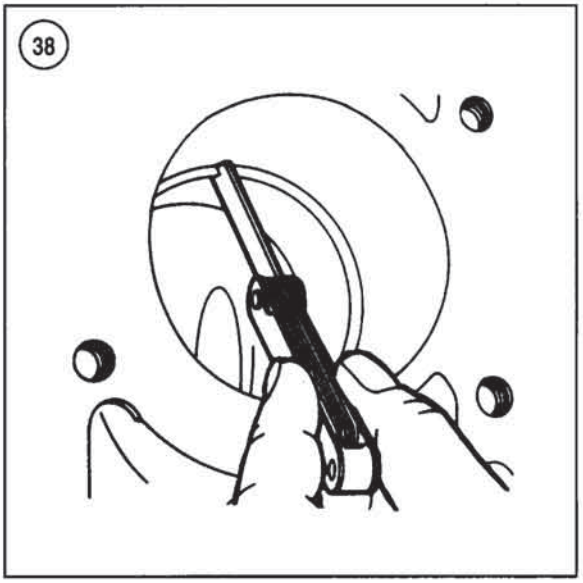
Piston/Cylinder Bore Check

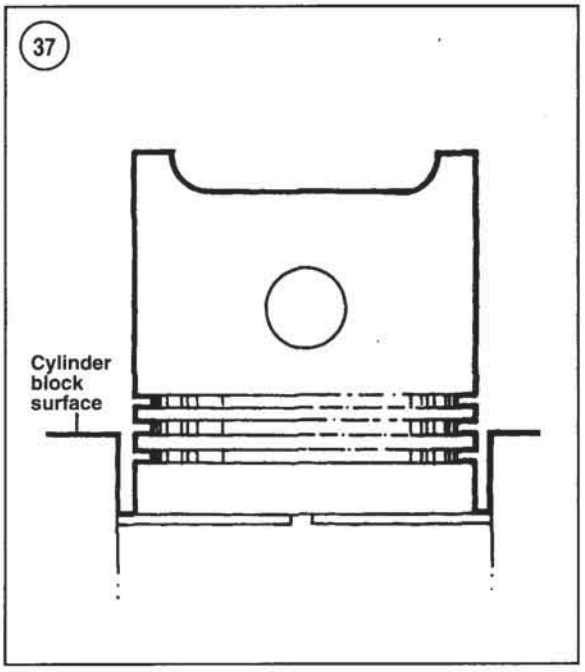
Unless precision measuring equipment is available, have this procedure done by a machine shop.

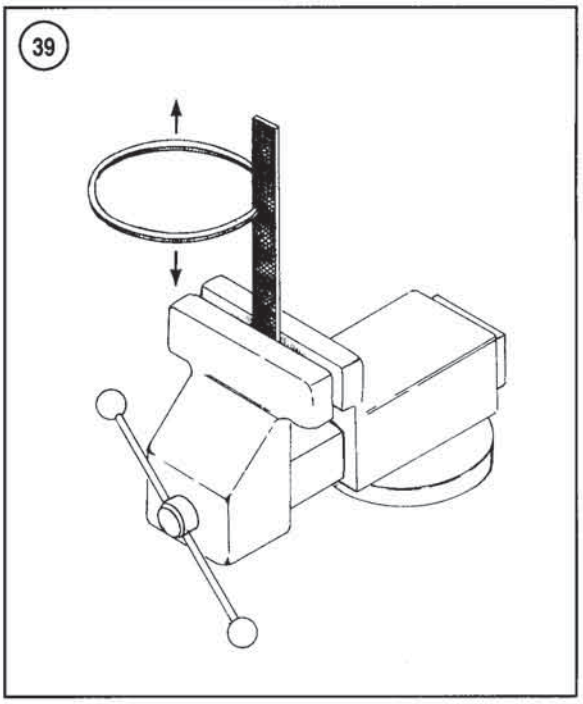
1. Measure the piston diameter with a micrometer (**Figure 34**) at a right angle to the piston pin bore 9 mm (0.35 in.) from the bottom of the piston skirt.

2. Measure the cylinder bore diameter at several points with a bore gauge (**Figure 35**). **Figure 36** shows the points of normal cylinder wear. If dimension A exceeds dimension B by more than 0.02 mm (0.0008 in.), rebore the cylinder and install a new piston/ring assembly.









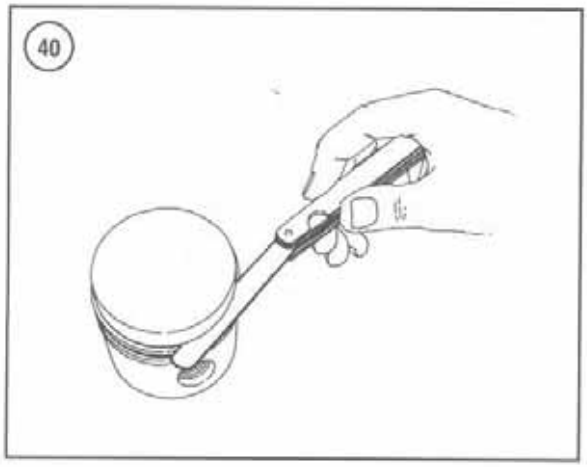
3. If the cylinder bore is damaged or excessively worn, rebore the cylinder bore and install a new piston. If the piston is worn, but the cylinder bore is acceptable, install a new piston.

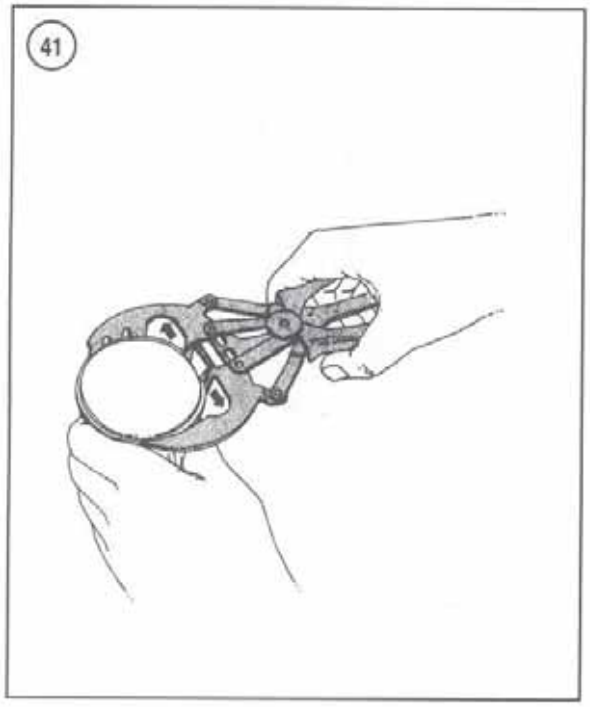
NOTE

Provide the machine shop with the new piston so the cylinder can be bored to the correct dimension.

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 37**.

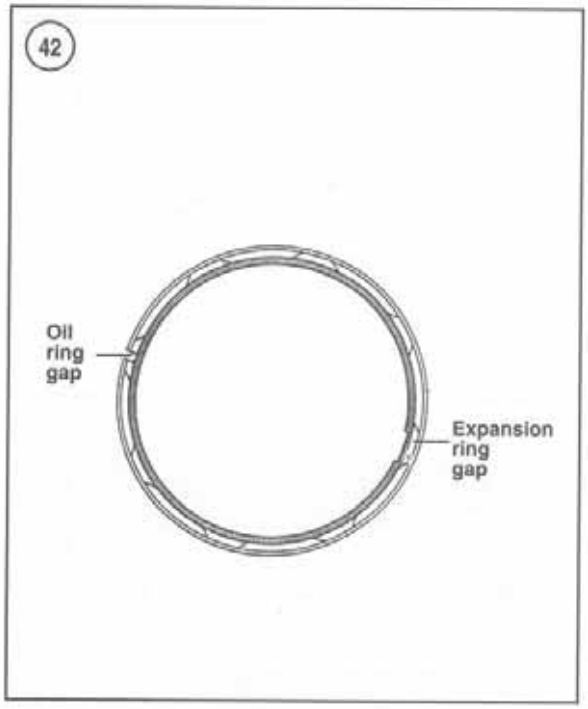




NOTE

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

2. Measure the ring gap with a feeler gauge as shown in **Figure 38**. Compare the measurement with specifications in **Table 1**. If the measurement is not within specification, the rings must be replaced as a set. Check the gap of new rings as well. If the gap is too small, file the ends of the ring to correct it (**Figure 39**).



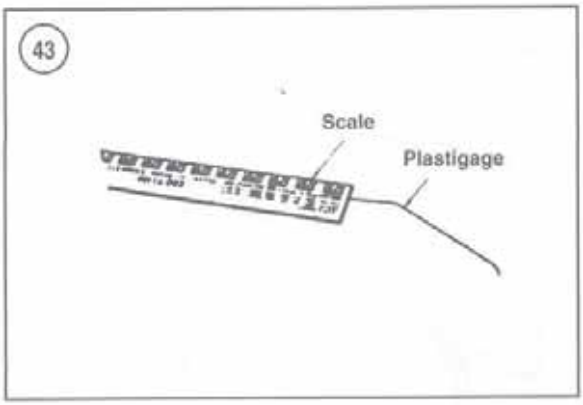
3. Check the side clearance of the rings as shown in **Figure 40**. Place the feeler gauge alongside the ring all the way into the groove. If the measurement is not within specifications (**Table 1**), either the rings or the ring grooves are worn. Inspect and replace them as required.

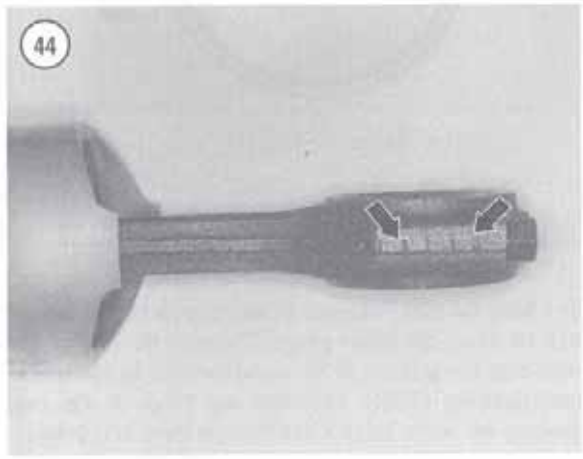
4. Use a ring expander tool (**Figure 41**) to carefully install the oil control ring, then the compression rings. The oil ring consists of two pieces, the outer ring and the inner expansion spring. Assemble the oil ring on the piston so the expansion spring gap is on the opposite side of the piston from the ring end gap. See **Figure 42**. The second compression ring is tapered while the top compression ring has a barrel face. The top of each compression ring is marked and must face toward the piston crown.

Connecting Rod Inspection

Have the connecting rod checked for straightness by a dealer or machine shop.

The piston pin end of the connecting rod is equipped with a bushing. Refer to **Table 1** for bushing specifications. If bushing replacement is required, a press is necessary to remove the old bushing and install a new bushing. The oil holes in the bushing and connecting rod must align. Ream the bushing to obtain the desired clearance in **Table 1**.





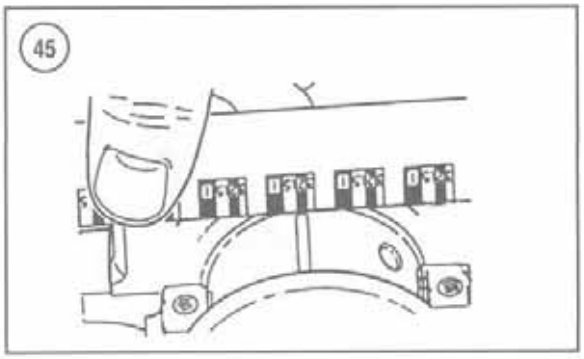
Connecting Rod Bearing Clearance Measurement

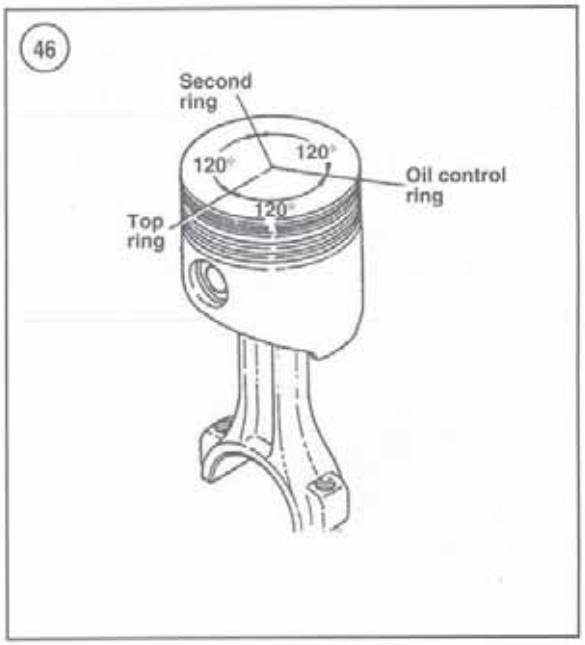
1. Place the connecting rod and upper bearing half on the connecting rod journal.
2. Cut a piece of Plastigage the width of the bearing (**Figure 43**). Place the Plastigage on the journal, then install the rod cap and bearing. Be sure to install the cap so the marks on the cap and rod are on the same side (**Figure 44**).

NOTE

Do not place Plastigage over the journal oil hole.

3. Tighten the connecting rod cap to the specification in **Table 2**. Do not rotate the crankshaft while the Plastigage is in place.
4. Remove the connecting rod cap. To determine bearing clearance, compare the width of the flattened Plastigage to the markings on the envelope (**Figure 45**). If the clearance is excessive, have the crankshaft reground and install undersize bearings.



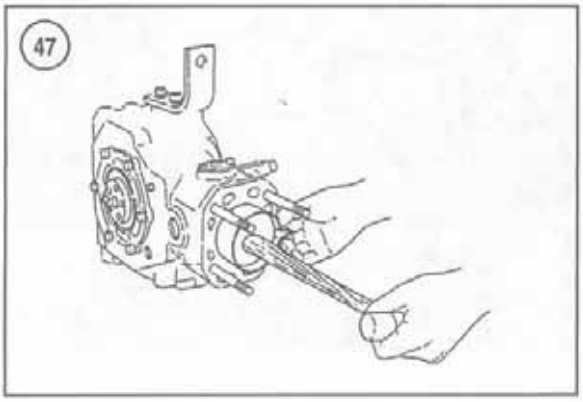


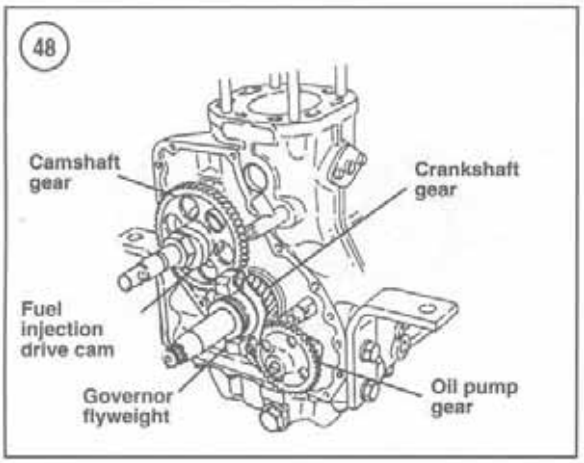
Piston/Connecting Rod Installation

1. Rotate the crankshaft so the crankpin is at bottom dead center.
2. Make sure the ring gaps are positioned as shown in **Figure 46**.
3. Immerse the entire piston in clean engine oil. Coat the cylinder wall with oil.
4. Install a piston ring compressor around the piston rings.

CAUTION

Use extreme care in Step 5 to prevent the connecting rod from nicking the crankshaft journal.





5. Position the piston so the numbered side of the rod (**Figure 44**) faces toward the camshaft side of the engine. Insert the piston/connecting rod assembly into the cylinder (**Figure 47**). Lightly tap on the piston crown with a wooden hammer handle to insert the piston. Make sure the rod does not bang against the crankshaft.

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

7. Pull the connecting rod and bearing into position against the crankpin. Lightly lubricate the connecting rod bolt threads with engine oil.

8. Install the connecting rod cap. Make sure the rod and cap are properly aligned. Install the bolts finger-tight.

9. Tighten the cap retaining bolts to the specifications in **Table 2**.

10. Check the connecting rod side play as described under *Piston/Connecting Rod Removal* in this chapter.

11. Reassemble the engine by reversing the disassembly procedures.

TIMING GEARCASE

The timing gearcase covers the camshaft and crankshaft gears and the oil pump (**Figure 48**). The timing gearcase also contains the governor mechanism and serves as the mounting location for the fuel injection pump. A ball bearing in the timing gearcase supports the outer end of the crankshaft.

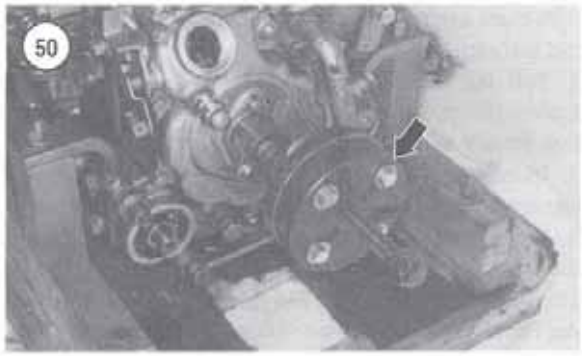
To remove and reinstall the timing gearcase, proceed as follows:

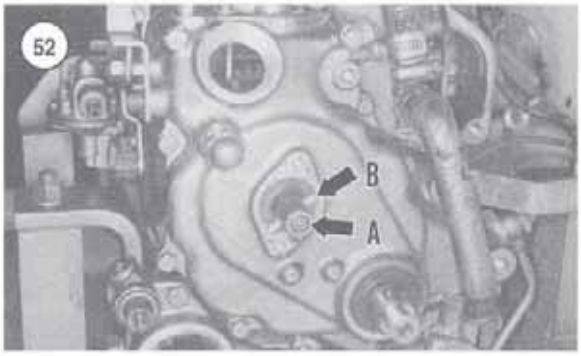
1. Disconnect the negative battery cable.
2. Remove the alternator as described in Chapter Eight.
3. Remove the oil filter.
4. Detach the control cables from the speed control lever and the stop lever (**Figure 49**).
5. Remove the fuel injection pump as described in Chapter Seven.

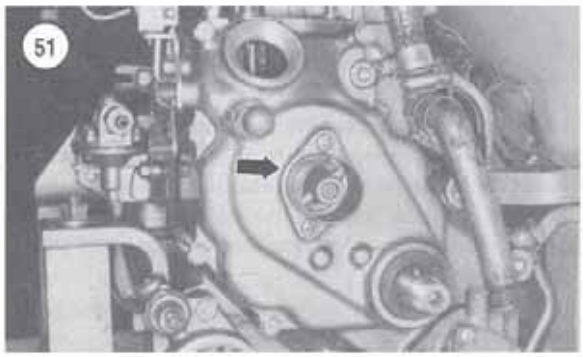
NOTE

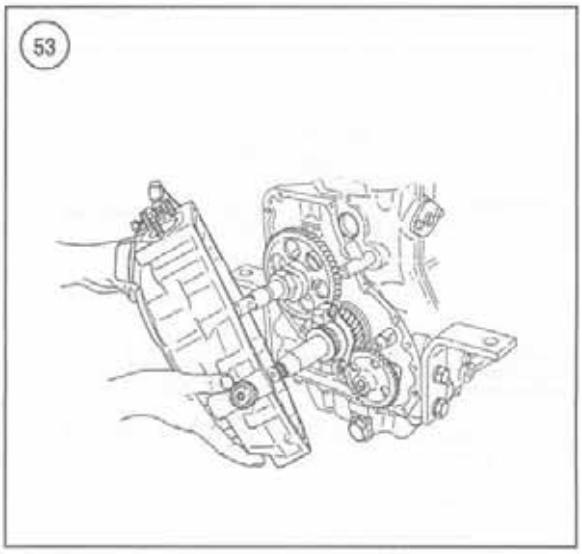
If a suitable tool is not available to hold the crankshaft pulley when unscrewing the retaining nut, remove the starter and prevent flywheel rotation by inserting a screwdriver into the ring gear teeth.

6. Remove the crankshaft pulley retaining nut. Use a suitable puller to remove the crankshaft pulley (**Figure 50**). Remove the drive key from the crankshaft.
7. Remove the water pump as described in Chapter Eight.
8. Remove the manual starter cover (**Figure 51**).
9. Remove the setscrew in the end of the camshaft (A, **Figure 52**), then remove the manual starter drive pin (B).
10. Remove the timing gearcase (**Figure 53**).
11. Remove the gasket and any residue from the gearcase and crankcase surfaces.
12. If crankshaft or starter seal replacement is necessary, proceed as follows:









a. Pry the old seal from the gearcase with a large screwdriver. Work carefully to prevent damage to the gearcase seal surface.
b. Clean the seal recess in the cover with solvent and blow it dry with compressed air.
c. Apply gasket sealer to the periphery of the seal.
d. Position a new seal in the cover recess with its open end facing the inside of the gearcase. Drive the seal into place with a suitably sized seal driver or socket.

13. If crankshaft bearing replacement is necessary, proceed as follows:

a. Refer to Chapter Seven to remove the governor shaft from timing gearcase.
b. Pry the seal from the gearcase with a large screwdriver. Work carefully to prevent damage to the gearcase seal surface.
c. Drive or press out the bearing (**Figure 54**). Force the bearing toward the inside of the gearcase.
d. Clean the seal and bearing recesses in the cover with solvent and blow them dry with compressed air.
e. Drive or press in a new bearing until the bearing seats in the recess in the gearcase.
f. Apply gasket sealer to the periphery of the seal.
g. Position a new seal in the cover recess with its open end facing the inside of the gearcase. Drive the seal into place with a suitably sized seal driver or socket.
h. Refer to Chapter Seven to reinstall the governor shaft.

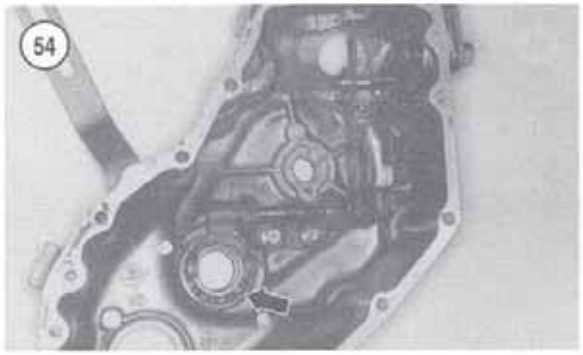
14. Reverse the removal procedure to reinstall the timing gearcase. Tighten the gearcase retaining screws to the specification in **Table 2**.

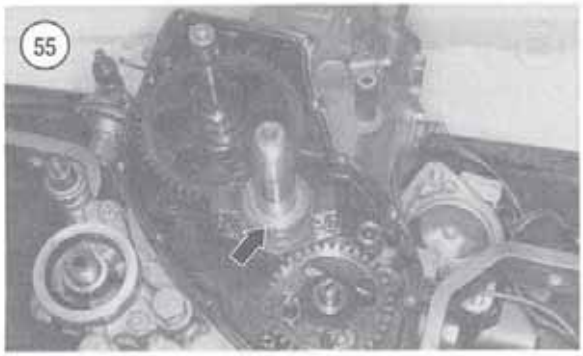
LUBRICATION SYSTEM

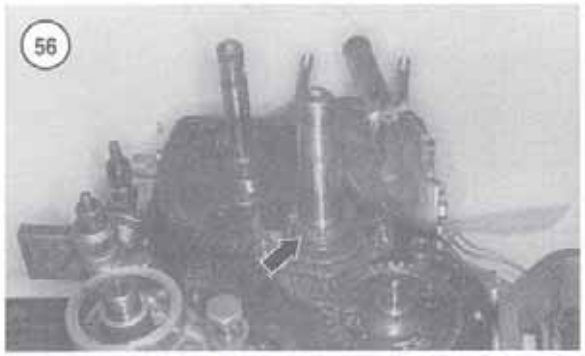
Refer to Chapter Two for lubrication system operation, diagrams and oil pressure test.

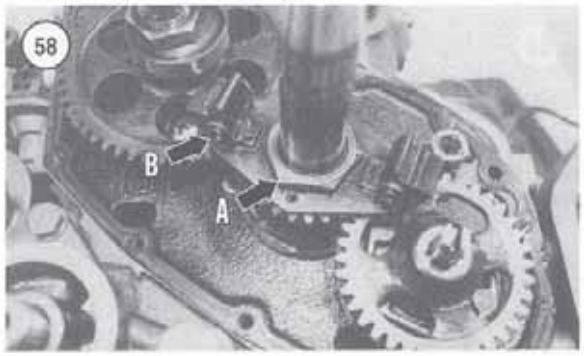
Oil Pump

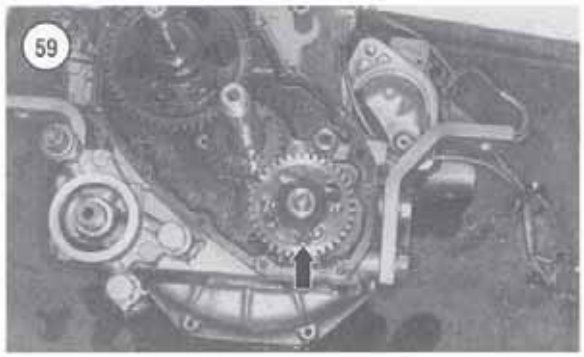
The engine oil pump is mounted on the front (timing gear) side of the cylinder block (**Figure 48**).









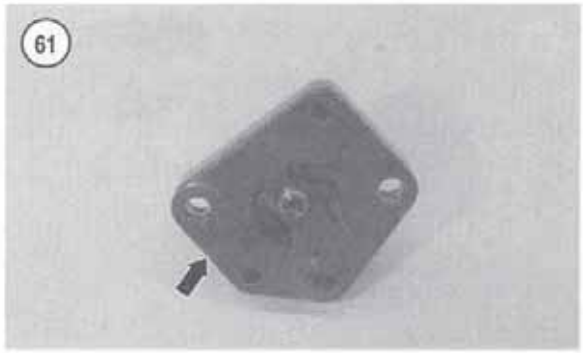


Removal and installation

1. Remove the timing gearcase as previously described.
2. Remove the governor thrust washer (**Figure 55**), thrust bearing (**Figure 56**) and thrust sleeve (**Figure 57**) from the crankshaft.
3. Using a suitable tool (if available, Yanmar special tool 124085-92700), unscrew the crankshaft nut (A, **Figure 58**).
4. Remove the governor flyweight assembly (B, **Figure 58**).

NOTE
Early model engines may be equipped with a nut on the oil pump shaft.

5. *Early models*—Unscrew the oil pump nut. To prevent the pump gear from rotating, insert an Allen wrench into a pump mounting screw through a hole in the oil pump drive gear.
6. Reach through the holes in the oil pump gear and unscrew the pump retaining screws (**Figure 59**).
7. Remove the oil pump and gasket.
8. Clean any gasket residue from the oil pump and engine.



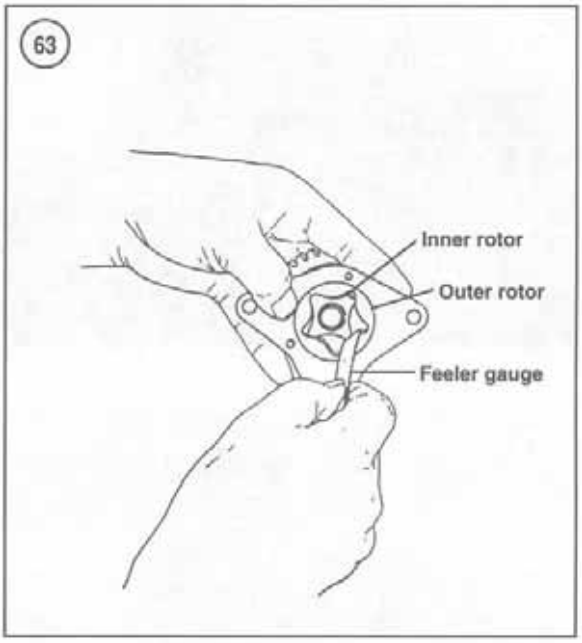
9. Installation is the reverse of removal. Tighten the oil pump retaining screws to the tightening torque specified in **Table 2**. Make sure the governor flyweight assembly is positioned on the locating pins (**Figure 60**). Tighten the crankshaft nut to the torque specified in **Table 2**.

Disassembly, inspection and reassembly

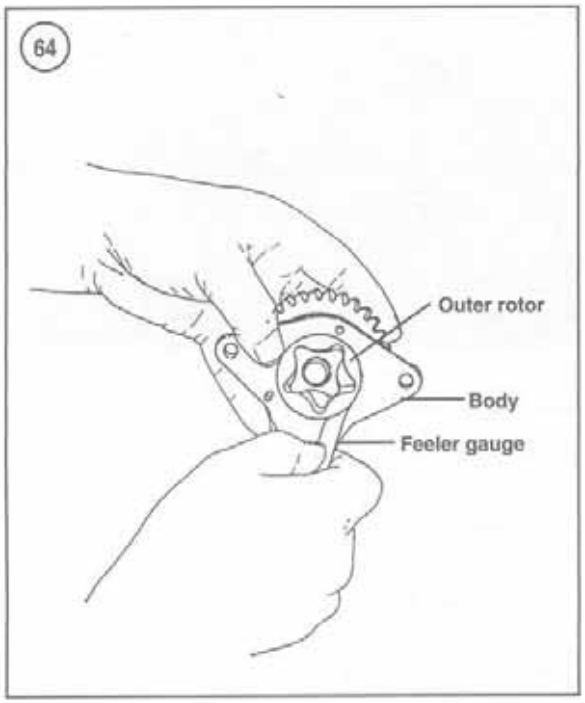
1. Remove the oil pump cover (**Figure 61**).
2. Lift out the inner and outer pump rotors (**Figure 62**).
3. Thoroughly clean all parts in solvent and dry with compressed air.
4. Check the drive spindle and pump rotors for signs of wear, scoring or damage. Replace damaged parts.

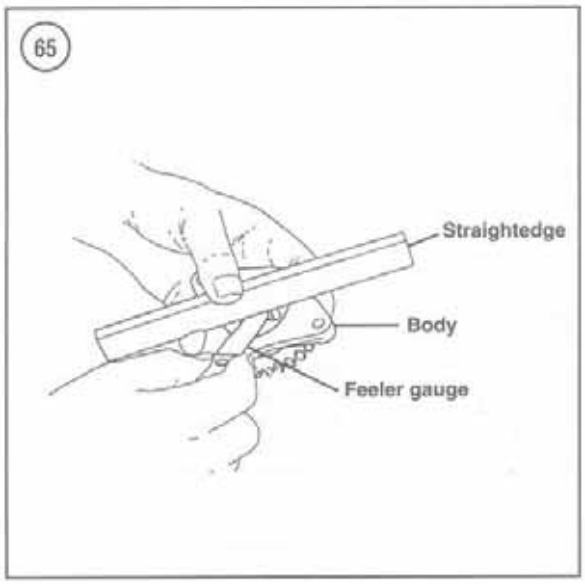
NOTE
Replace the oil pump as a unit if any parts are damaged.

5. Reinstall the inner rotor in the pump body. Reinstall the outer rotor in the pump body.
6. Measure the clearance between the inner rotor tip and outer rotor tip (**Figure 63**). Compare the measurement with the specification in **Table 1**.



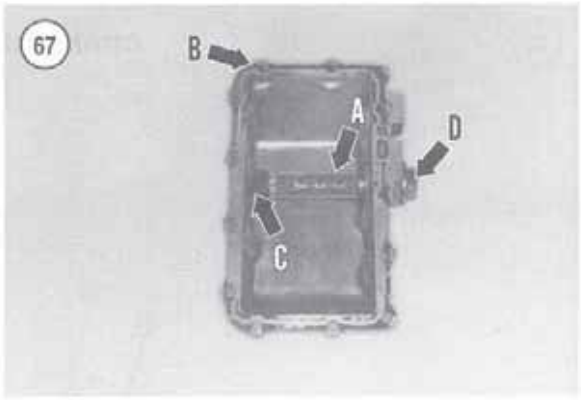
7. Measure the clearance between the outer rotor and the pump body (**Figure 64**). Compare the measurement with specifications in **Table 1**.
8. Place a straightedge across the pump body. Measure the side clearance between the rotors and straightedge with a flat feeler gauge (**Figure 65**). Compare with specifications in **Table 1**.
9. Measure the diameter of the inner rotor shaft. Measure the shaft bore of the pump body. Calculate shaft clearance and compare it with specifications in **Table 1**.
10. If any clearance measured in Steps 6-9 is not within specification, replace the pump. Individual components are not available. The pump must be replaced as a unit.
11. When reassembling the oil pump, make sure to lubricate the rotors, body and shaft with engine oil.





Pressure relief valve

An oil pressure relief valve is threaded into the front (timing gear) of the engine (**Figure 66**). When oil pressure exceeds 300-400 kPa (43-57 psi), the relief valve opens and expels oil into the timing gear area.



Do not attempt to disassemble the oil pressure relief valve. The valve is sealed and it must be replaced as a unit assembly.

Oil pickup

The oil pickup (A, **Figure 67**) is located in the oil pan (B). The pickup includes a strainer to prevent foreign matter from entering the lubrication system. A spring (C) keeps the pickup in position in the oil pan.

NOTE

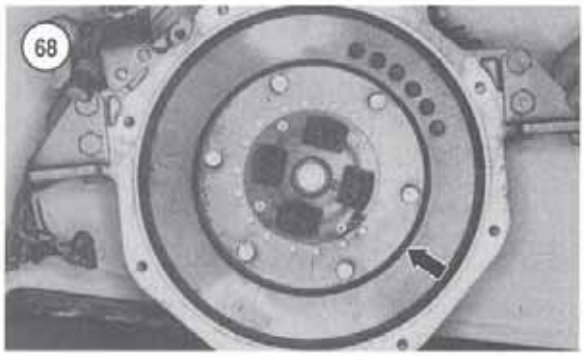
When removing the drain plug in the oil pan, be aware that the spring will force the plug out when the threads disengage.

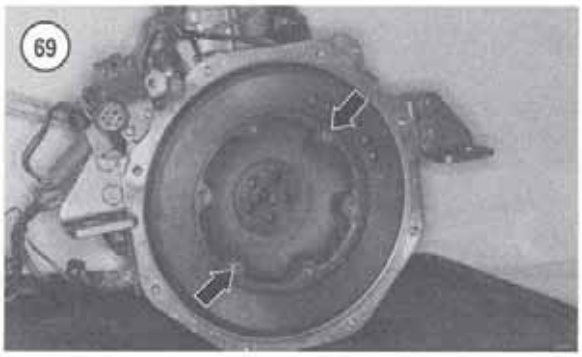
Remove the drain plug (D) for access to the oil pickup.

FLYWHEEL

Removal/Installation

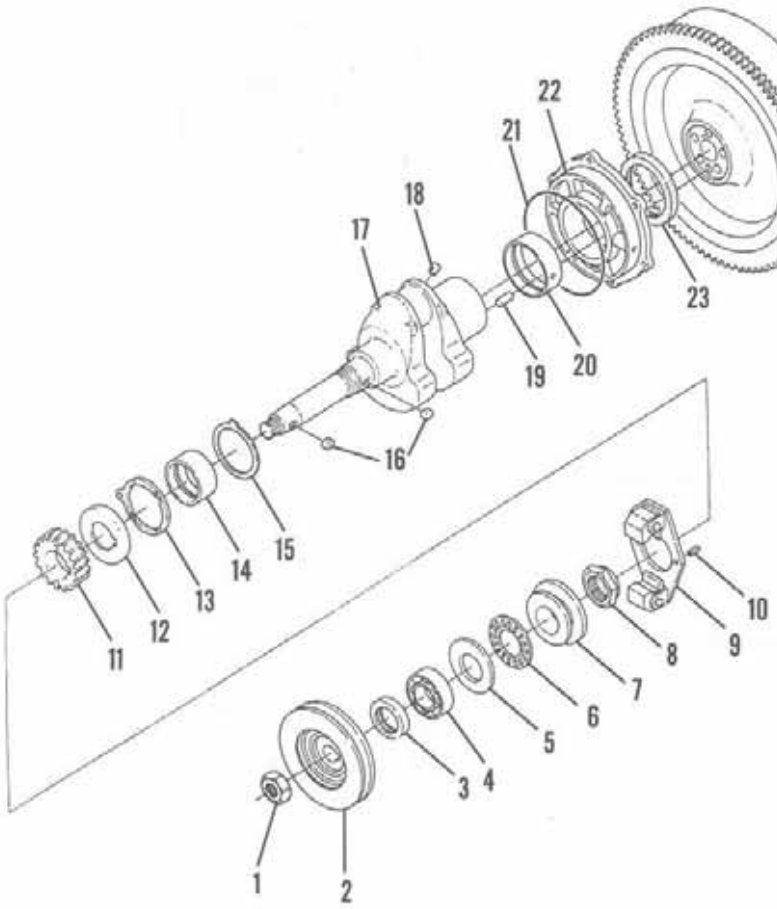
1. Remove the engine from the boat.
2. Remove the transmission.



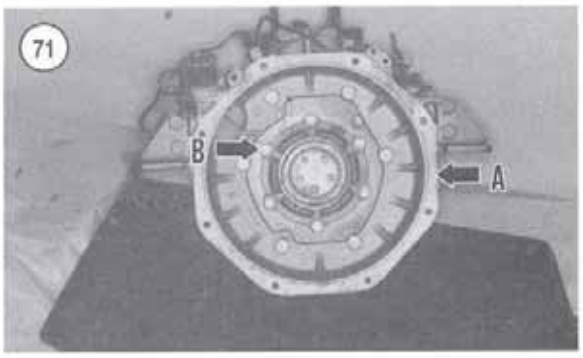


70

CRANKSHAFT ASSEMBLY



1. Nut
2. Pulley
3. Oil seal
4. Bearing
5. Thrust washer
6. Thrust bearing
7. Thrust sleeve
8. Nut
9. Governor flyweight assy
10. Pin
11. Gear
12. Thrust washer
13. Thrust bearing
14. Main bearing
15. Thrust bearing
16. Key
17. Crankshaft
18. Plug
19. Pin
20. Main bearing
21. O-ring
22. Main bearing holder
23. Oil seal
24. Flywheel
25. Bolt



3. Remove the drive disc (**Figure 68**).
4. Gradually loosen and remove the flywheel bolts, working in a diagonal pattern. Install two drive disc bolts into two outer holes in the flywheel (**Figure 69**), then use the screws to pull and remove the flywheel.
5. Inspect the ring gear. If the ring gear is excessively worn or damaged, use the following procedure to remove the ring gear:
   a. Heat the ring gear evenly, then drive the ring gear off the flywheel.
   b. Heat the ring gear prior to installation. Drive the ring gear onto the flywheel, being careful not to damage the gear teeth.
6. Reverse the removal procedure to install the flywheel. Tighten the flywheel retaining bolts to the torque specified in **Table 2**. Refer to Chapter Ten to install the drive disc and transmission.

5

DRIVE DISC

Refer to Chapter Ten for drive disc procedures (**Figure 68**).

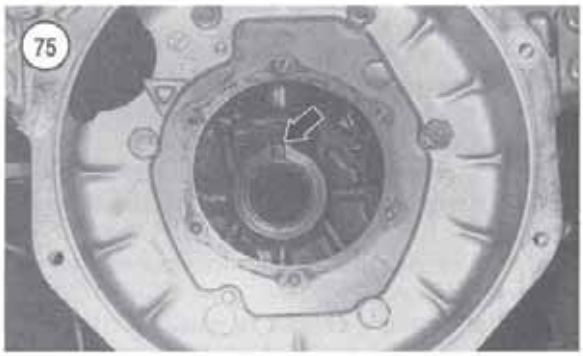
CRANKSHAFT

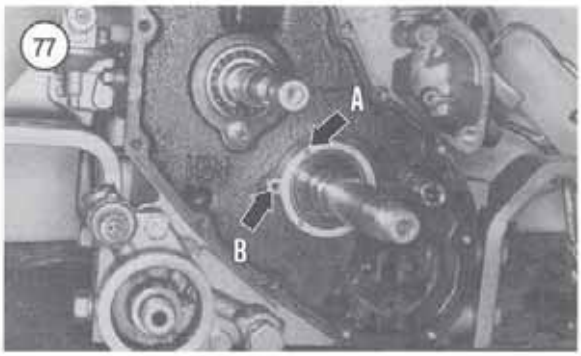
Removal and Installation

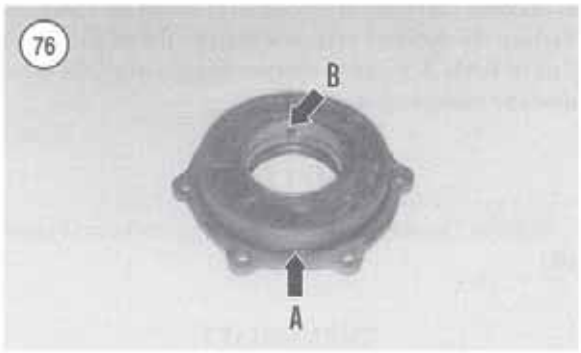
Refer to **Figure 70**.
1. Remove the flywheel as previously described.
2. Remove the bellhousing (A, **Figure 71**).
3. Remove the piston and connecting rod as previously described.
4. Remove the oil pump as previously described.
5. Remove the crankshaft gear (**Figure 72**).
6. Refer to *Camshaft* to remove the camshaft gear.
7. Remove the thrust washer (**Figure 73**) and thrust bearing (**Figure 74**).

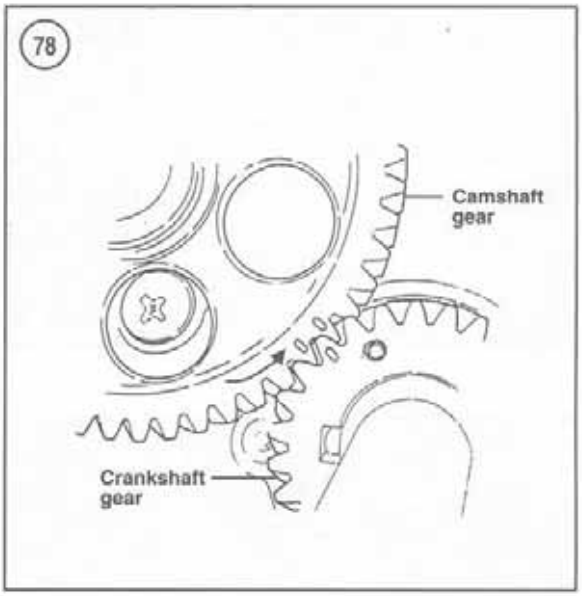
NOTE
Support the crankshaft while removing the main bearing housing in the next step.

8. Remove the main bearing housing (B, **Figure 71**).
9. Remove the crankshaft.
10. Proceed as follows to replace the crankshaft seal in the main bearing housing:
    a. Pry the old seal from the main bearing housing with a large screwdriver. Work carefully to prevent damage to the main bearing housing seal surface.
    b. Clean the seal recess in the housing with solvent and dry with compressed air.
    c. Apply gasket sealer to the periphery of the seal.









d. Position the new seal in the housing recess with its open end facing the inside of the bearing housing. Drive the seal into place with a suitably sized seal driver.

11. Refer to *Main Bearings* for information concerning inspection of the main bearings and thrust bearings.

12. Reinstall the crankshaft by reversing the removal procedure while noting the following:

a. Thoroughly lubricate the main bearings and thrust bearings.

b. Install the inner, front thrust bearing so the oil grooves are toward the inside of the crankcase and the tab fits into the recess (**Figure 75**) in the crankcase. Apply a light coating of grease to hold the thrust bearing in place.

c. Install a new O-ring (A, **Figure 76**) on the main bearing housing.

d. Tighten the main bearing housing bolts to the torque specified in **Table 2**.

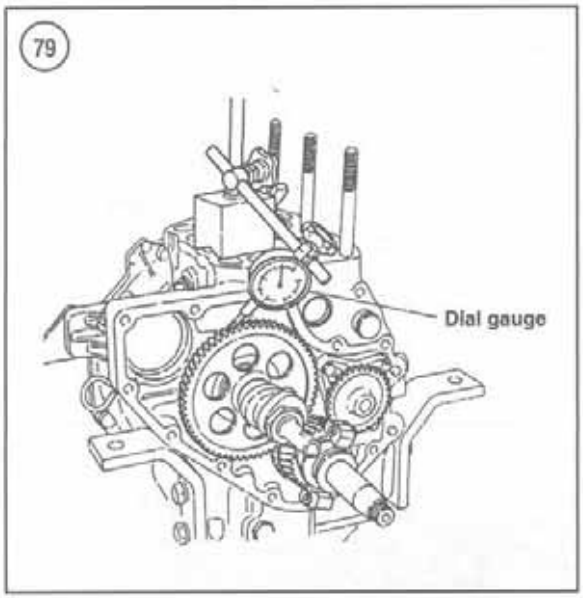
e. Install the outer front thrust bearing so the oil grooves (A, **Figure 77**) are toward the outside of the crankcase and the tab (B) fits onto the pin in the crankcase.

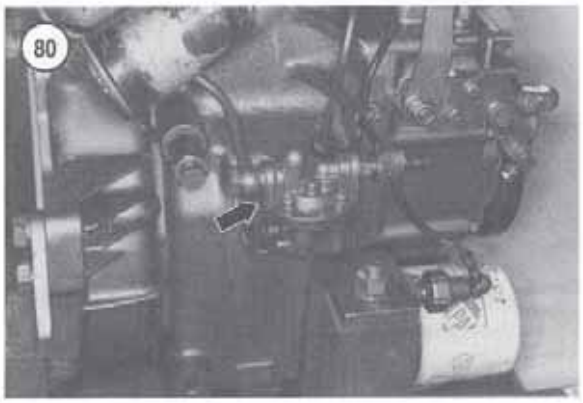
f. Install the thrust washer (**Figure 73**) so the beveled side of the inner hole is toward the crankcase.

g. Measure crankshaft end play by inserting a feeler gauge between the crankshaft main journal and the inner thrust bearing, or by installing a dial gauge that measures fore and aft movement of the flywheel or crankshaft. Using a large screwdriver, force the crankshaft back and forth. Measure crankshaft end play and compare the measurement with the specification in **Table 1**. Replace the inner thrust bearing to obtain the desired end play.

h. Align the timing marks (**Figure 78**) on the camshaft and crankshaft gears when installing the crankshaft gear.

i. Check gear backlash by installing a dial indicator as shown in **Figure 79** or by rotating the gear teeth with soft solder between the gear teeth. Compare the measurement with the specification in **Table 1**.





If gear backlash is incorrect, replace the camshaft and crankshaft gears.

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 wear, scratches, grooves, scoring or cracks. Check the oil seal contact surface for burrs, nicks or other sharp edges that might damage a seal during installation.

NOTE

Unless precision measuring equipment is available, have a machine shop perform Step 3.

3. Check all journals against specifications (**Table 1**) for out-of-roundness and taper. Have the crankshaft reground, if necessary, and install new undersize bearings.

MAIN BEARINGS

The crankshaft is supported at each end by bushing-type main bearings. The front main bearing is located in the crankcase and the rear main bearing is located in the removable main bearing carrier. Thrust bearings located at the front of the crankshaft control crankshaft end play. Refer to **Figure 70**.

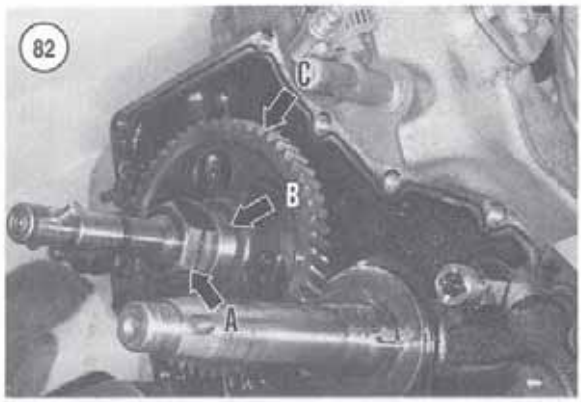
Remove the crankshaft as described in the previous section for access to the main bearings and thrust washers. Unless precision measuring equipment is available, have a dealership or machine shop measure main bearing dimensions. Refer to specifications in **Table 1**.

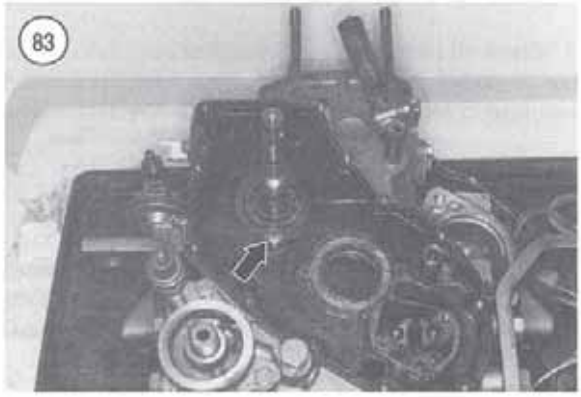
If bearing replacement is necessary, have the main bearings replaced by a dealership or machine shop. Make sure the oil holes (B, **Figure 76**) in the main bearings align with the oil passages in the crankcase and main bearing carrier.

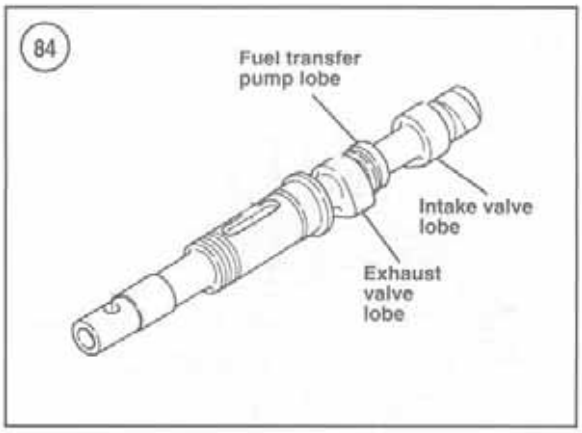
CAMSHAFT

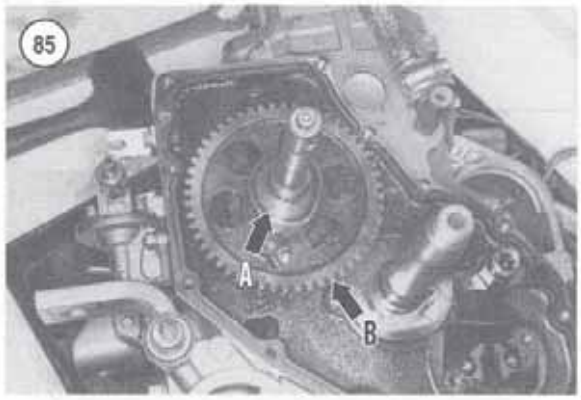
Removal and Installation

1. Remove the fuel transfer pump (**Figure 80**).
2. Remove the crankshaft as previously described.
3. Prevent rotation of the camshaft gear by holding a screwdriver or other tool against the camshaft bearing retaining screw (**Figure 81**).
4. Remove the camshaft gear nut (A, **Figure 82**), fuel injection pump cam (B) and camshaft gear (C).
5. Position the engine so the valve lifters will not fall out when the camshaft is withdrawn/removed.







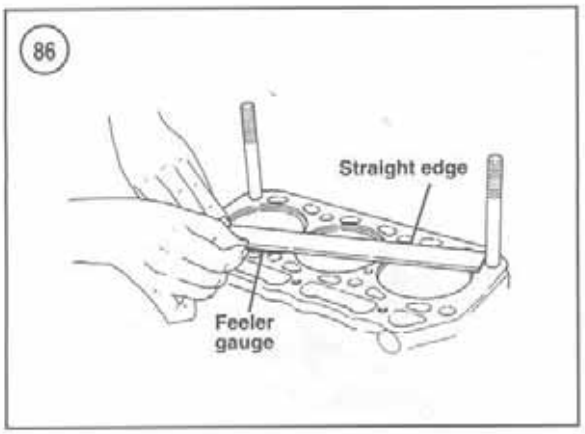


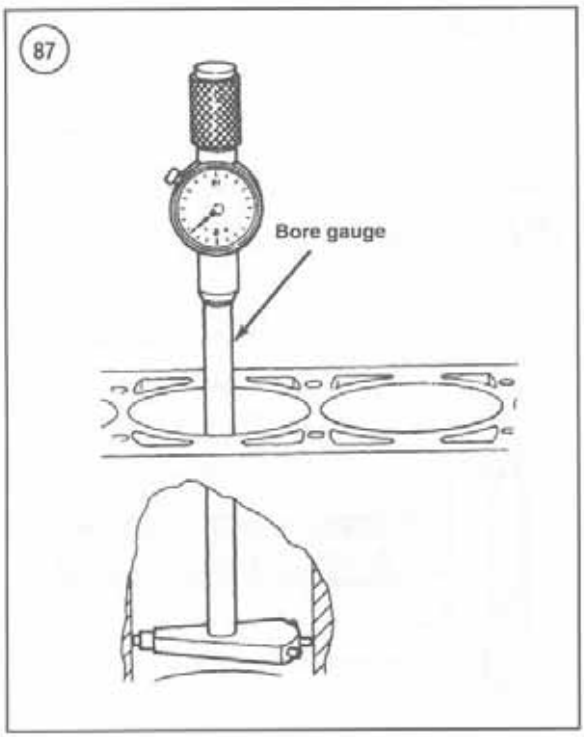
6. Remove the bearing retaining screw (**Figure 83**), then withdraw the camshaft.
7. Remove the valve lifters and mark them so they may be reinstalled in their original locations.
8. Check the rear bearing journal and lobes for signs of wear or scoring.

NOTE

If precision measuring equipment is not available, have a dealership or machine shop perform Step 9.

9. Measure the rear camshaft journal diameter and lobes (**Figure 84**) and compare the measurement to the specification in **Table 1**. Replace the camshaft if the journal or lobes do not meet specifications.
10. Measure the stem diameter of the valve lifters and compare the measurement to the specification in **Table 1**. Measure the lifter bores in the cylinder block. Calculate the lifter clearance and compare it with the specification in **Table 1**. Replace the valve lifters if they do not meet specifications. Replace the valve lifter if the lifter face is scored, galled, excessively worn or otherwise damaged.
11. Replace the ball bearing if it is damaged or feels rough during rotation.
12. Installation is the reverse of removal. Note the following:
    a. If installing a new camshaft, coat the camshaft lobes with camshaft break-in lubricant. If reinstalling the original camshaft, apply heavy oil to the camshaft lobes.
    b. Lubricate the camshaft bearing journal with heavy engine oil before reinstallation.
    c. Lightly tap the end of the camshaft to seat the ball bearing in the engine. Rotate the camshaft to be sure it rotates freely.
    d. Align the timing marks (**Figure 78**) on the camshaft and crankshaft gears when installing the camshaft gear.
    e. Install the fuel injection cam so the side marked with a zero is out (**Figure 85**).
    f. Check gear backlash by installing a dial indicator as shown in **Figure 79** or by rotating the gear teeth with soft solder between the gear teeth. Compare





the measurement with the specification in **Table 1**. If gear backlash is incorrect, replace the camshaft and crankshaft gears.

CYLINDER BLOCK

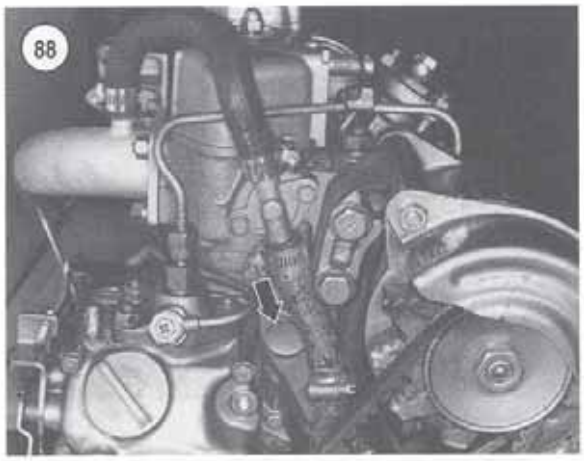
Cleaning and Inspection

1. Clean the block thoroughly with solvent. Remove any gasket or RTV sealant residue from the machined surfaces. Check all core plugs for leaks and replace any that are suspect. See *Core Plug Replacement* in this chapter. 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 make sure they are clean. If dirty, use a tap to restore the threads and remove any deposits.

2. Examine the block for cracks. To confirm suspicions about possible leakage areas, use a mixture of one part kerosene and two 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.

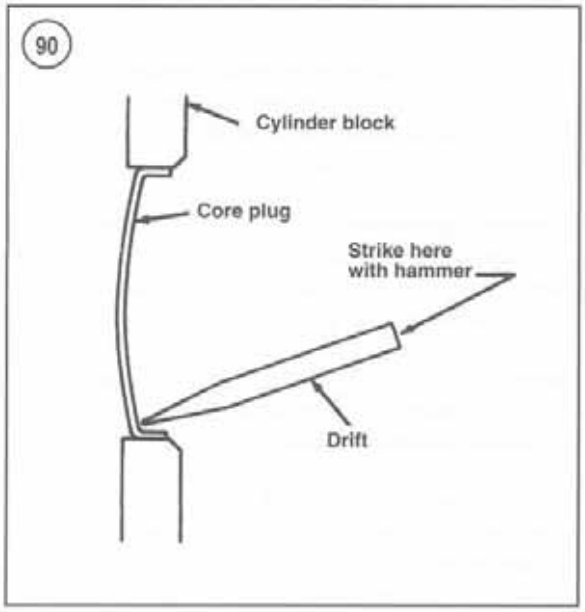
3. Check the flatness of the cylinder block deck or top surface. Place an accurate straightedge on the block. If there is any gap between the block and straightedge, measure it with a flat feeler gauge (**Figure 86**). Measure from end to end and from corner to corner. Have the block resurfaced if it is warped more than 0.07 mm (0.0028 in.).

4. Measure the cylinder bore with a bore gauge (**Figure 87**) for out-of-roundness or excessive wear as described in *Piston/Cylinder Bore Check* in this chapter. If the cylinder exceeds maximum tolerances, rebore the cylinder. Rebore the cylinder if the cylinder walls are badly scuffed, scored or otherwise damage.



Core Plug Replacement

Check the condition of the front (**Figure 88**) and rear (**Figure 89**) core plugs in the block whenever the engine is out of the boat for service. If any signs of leakage or corrosion are found around one core plug, replace both of them.



Core plugs in the cylinder block prevent damage to the block should the coolant freeze.

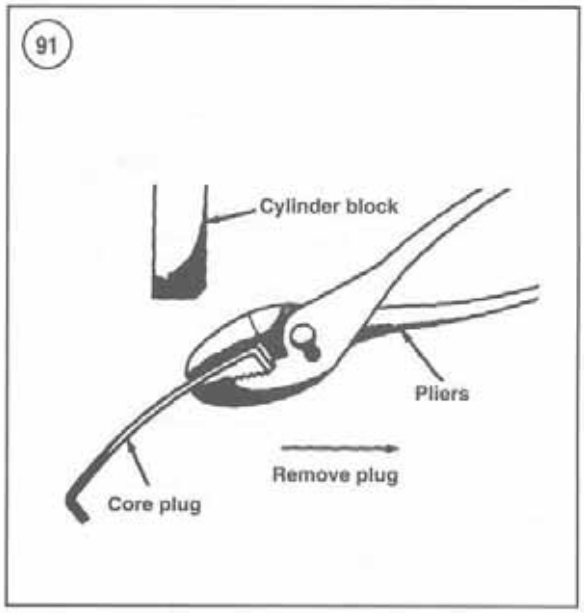
NOTE

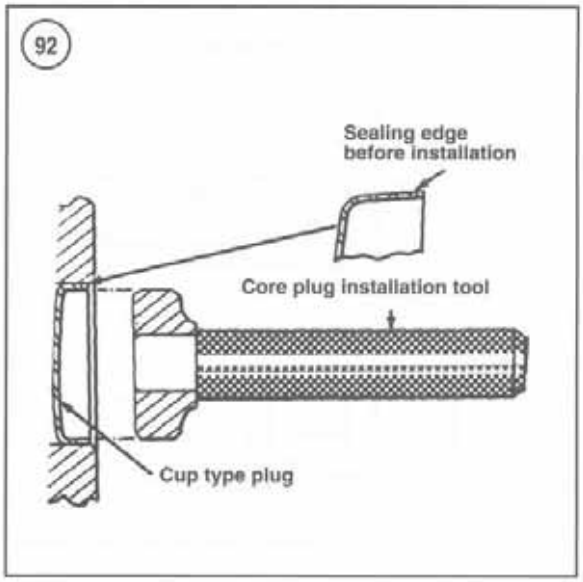
Core plugs can be replaced inexpensively by a machine shop. If machine work is being performed on the engine, have the core plugs replaced at the same time.

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 90**).

2. Grip the top of the plug firmly with pliers. Pull the plug from its bore (**Figure 91**) and discard it.

NOTE

The core plugs can also be removed by drilling a hole in the center of the plug and pry-

ing it out with an appropriate size drift or pin punch. When removing a large core plug, the use of a universal impact slide hammer is recommended.

3. Clean the plug bore thoroughly to remove all traces of the old sealer. Inspect the bore for any damage that might interfere with proper sealing of the new plug.
4. Coat the inside diameter of the plug bore and the outer diameter of the new plug with sealer. Use an oil-resistant sealer if the plug is to be installed in an oil gallery or a water-resistant sealer for plugs installed in the water jacket.
5. Install the new core plug with an appropriate size core plug installation tool (**Figure 92**), driver or socket. The outside edge of the plug should be 2-3 mm (0.08-0.12 in.) inside the block.
6. Repeat Steps 1-5 to replace each remaining core plug.

Table 1 ENGINE SPECIFICATIONS (1GM, 1GM10)

Bore	75 mm (2.95 in.)
Stroke	72 mm (2.83 in.)
Displacement	318 cc (19.4 cu. in.)
Number of cylinders	1
Cylinder bore diameter	75.000-75.030 mm (2.9528-2.9540 in.)
Bore out-of-round—max.	0.02 mm (0.0008 in.)
Cylinder block warpage—max.	0.07 mm (0.0028 in.)
Piston diameter	
Standard	74.910-74.940 mm (2.9492-2.9504 in.)
Wear limit	74.850 mm max. (2.9468 in.)
Piston top clearance	0.68-0.88 mm (0.027-0.035 in.)
Piston ring side clearance	
Top ring	0.065-0.100 mm (0.0026-0.0039 in.)
Second ring	0.035-0.070 mm (0.0014-0.0028 in.)
Oil ring	0.020-0.055 mm (0.0008-0.0022 in.)
Ring end gap (all rings)	0.20-0.40 mm (0.008-0.016 in.)
Piston pin diameter	19.991-20.000 mm (0.7870-0.7874 in.)
Piston pin hole diameter	
In piston	19.995-20.008 mm (0.7872-0.7877 in.)
In rod	20.000 mm (0.7874 in.)
Piston pin clearance	
In rod	0.025-0.047 mm (0.0010-0.0019 in.)
In piston	0.005 mm tight-0.017 mm loose (0.0002 in. tight-0.0007 in. loose)
Piston ring width	
Top & second ring	1.97-1.99 mm (0.0776-0.0783 in.)
Oil control ring	3.97-3.99 mm (0.1563-0.1571 in.)
Crankshaft main journal diameter	
Timing gear end	43.950-43.964 mm (1.7303-1.7309 in.)
Flywheel end	59.950-59.964 mm (2.3602-2.3608 in.)
Journal out-of-round—max.	0.01 mm (0.0004 in.)
Crankshaft end play	0.06-0.19 mm (0.0024-0.0075 in.)
Crankshaft runout—max.	0.15 mm (0.006 in.)
Main bearing clearance	
Timing gear end	0.036-0.092 mm (0.0014-0.0036 in.)
Flywheel end	0.036-0.095 mm (0.0014-0.0037 in.)
Crankshaft thrust bearing—min.	
Front	2.75 mm (0.108 in.)
Inner	2.25 mm (0.089 in.)
Crankpin diameter	39.950-39.964 mm (1.5728-1.5734 in.)
Journal out-of-round—max.	0.01 mm (0.0004 in.)
Crankpin bearing clearance	0.028-0.086 mm (0.0011-0.0034 in.)
Connecting rod side clearance	0.2-0.4 mm (0.008-0.016 in.)
Cylinder head warpage—max.	0.07 mm (0.003 in.)

(continued)

Table 1 ENGINE SPECIFICATIONS (1GM, 1GM10) (continued)

Camshaft	
Valve lobe lift	29.000 mm (1.1417 in.)
Fuel pump lobe lift	22.000 mm (0.8661 in.)
Journal diameter	20.000 mm (0.7874 in.)
Runout	0.02 mm max. (0.0008 in. max.)
Timing gear backlash	0.05-0.13 mm (0.002-0.005 in.)
Maximum allowable	0.3 mm (0.012 in.)
Push rod runout—max.	0.03 mm (0.0012 in.)
Valve lifter	
Type	Mechanical
Outside diameter	10.000 mm (0.3937 in.)
Outside diameter—min.	9.95 mm (0.3917 in.)
Clearance in block	0.025-0.060 mm (0.0010-0.0024 in.)
Max. clearance	0.10 mm (0.004 in.)
Valve face angle	45°
Valve seat angle	45°
Valve head margin	0.75-1.15 mm (0.030-0.045 in.)
Seat width (int. and exh.)	1.77 mm (0.070 in.)
Valve depth—max.	1.25 mm (0.049 in.)
Valve stem clearance (int. and exh.)	0.045-0.070 mm (0.0018-0.0028 in.)
Max. stem clearance	0.15 mm (0.006 in.)
Valve stem diameter	7.000 mm (0.2756 mm)
Valve stem wear limit	6.900 mm (0.2717 in.)
Valve stem runout—max.	0.03 mm (0.0012 in.)
Valve guide diameter	7.000 mm (0.2756 mm)
Valve guide wear limit	7.080 mm (0.2878 in.)
Valve guide protrusion	7.0 mm (0.276 in.)
Valve spring	
Standard free length	38.5 mm (1.52 in.)
Min. free length	37 mm (1.46 in.)
Installed height	29.2 mm (1.15 in.)
Pressure at installed height	16.16 kg at 29.2 mm (35.63 lb. at 1.15 in.)
Rocker arm shaft clearance	0.016-0.052 mm (0.0006-0.0020 in.)
Rocker arm shaft clearance—max.	0.15 mm (0.006 in.)
Rocker arm bore wear limit	12.10 mm (0.476 in.)
Rocker arm shaft wear limit	11.90 mm (0.468 in.)
Oil pump	
Inner rotor tip-to-outer rotor tip	0.050-0.105 mm (0.0020-0.0041 in.)
Max.	0.15 mm (0.006 in.)
Outer rotor-to-pump body	0.050-0.105 mm (0.0020-0.0041 in.)
Max.	0.15 mm (0.006 in.)
Rotor side clearance	0.030-0.080 mm
Max.	0.13 mm (0.005 in.)
Shaft clearance	0.015-0.050 mm (0.0006-0.0020 in.)
Max.	0.20 mm (0.0079 in.)

Table 2 TIGHTENING TORQUES

Fastener	N•m	ft.-lb.	in.-lb.
Camshaft gear	70-80	52-59	–
Connecting rod bolts	25	18	–
Crankshaft nut	80-100	59-74	–
Cylinder head nut	75	55	–
Exhaust elbow	45	33	–
Flywheel	65-70	48-52	–
Main bearing housing	25	18	–
Oil pump	9	–	80
Rocker shaft support	37	27	–
Timing gearcase	9	–	80