

11. Fill the closed system with a 50/50 mixture of ethylene glycol antifreeze and water. Connect the batteries and then start the engine and check for leaks.

**** CAUTION**

If the boat is out of the water, make sure that a flushing kit is installed before starting the engine.

TESTING

◆ See Figures 71 and 72

1. Inspect the thermostat at room temperature. If the thermostat is fully open, it is defective and must be replaced. Hold the thermostat up to the light and check it for leaks. A light leak around the perimeter indicates the thermostat is not closing, and therefore, it must be replaced.
2. Attach a length of thread to the thermostat. Now, suspend the thermostat and a thermometer inside a container filled with water (do not use distilled water or ethylene glycol!). Take care to be sure neither the thermostat or the thermometer touches the container. If either one does touch the container, the test will be unreliable. Stir the water occasionally to avoid direct heat being applied to the thermostat.
3. Heat the water until the thermostat just begins to open - when this happens confirm that the temperature is the same as the thermostat rating. The thermometer reading must agree with the rating stamped on the thermostat. If the unit fails the test, it must be replaced.
4. Continue to heat the water until a temperature 25° above the rating is reached. At this time the thermostat should be completely open; if not, replace it.
5. Turn the heat off and allow the water to cool to a temperature 10° below the rating. The thermostat should now be completely closed; if not, replace it.

Seawater Strainer

For removal and installation procedures, please refer to the Cooling System section.

Many models will utilize a seawater strainer, either factory or aftermarket. It is a good idea to check the unit with regularity, especially if the boat is operated in dirty waters.

CLEANING AND INSPECTION

◆ See Figure 73

For removal and installation procedures, please refer to the Cooling System section.

1. If your vessel is equipped with a seacock, close it. If not equipped, disconnect the seawater inlet line at the strainer and plug it securely to prevent water overflow.
2. Loosen the two retaining screws and then remove them and the strainer cover.
3. Carefully lift off the glass plate and the O-ring.
4. Remove the drain plug and washer from the bottom of the housing. You may want to have a container handy to collect the water from the housing.
5. Lift out the strainer and clear the mesh of any debris. Rinse the strainer and the housing with water.
6. Screw the drain plug in securely and then insert the strainer.
7. Check the condition of the O-ring and install it and the glass plate. We suggest replacing the O-ring regardless of its condition.
8. Install the cover and tighten the screws securely, but not so tight as to warp the cover.
9. Open the seacock, plug and reconnect the inlet line.
10. Start the engine and check for leaks.

Impeller

REMOVAL AND INSTALLATION

See Figures 74 thru 83

1. Remove the lower unit.
2. Pull the water tube and coupling seal out of the water pump body. Separate the tube and coupling, and discard the O-rings.
3. Slide the water seal up and free of the driveshaft. Discard the seal.
4. Remove the bolts securing the water pump body, and then slide the body up and free of the driveshaft. It may be necessary to use a few small

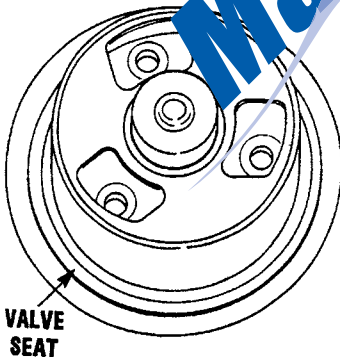
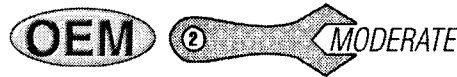
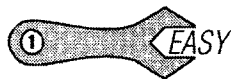
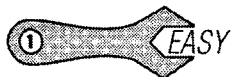


Fig. 71 Examine the perimeter of the thermostat for any visible light

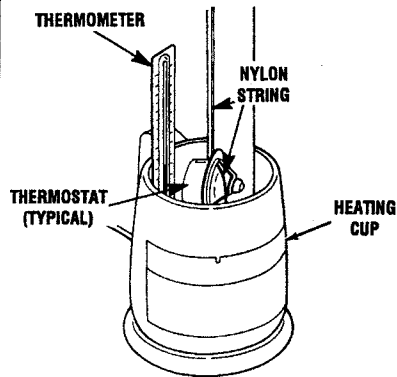
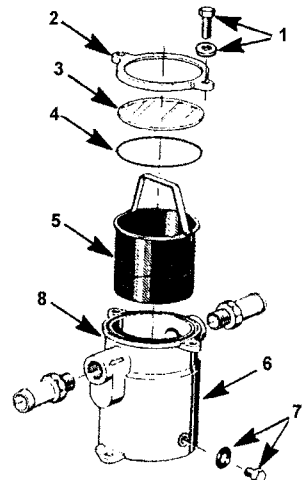


Fig. 72 Testing the thermostat



- 1- Screws and Washers
- 2- Cover
- 3- Glass
- 4- O-Ring
- 5- Strainer
- 6- Housing
- 7- Drain Plug and Sealing Washer
- 8- Gasket

Fig. 73 Exploded view of the seawater strainer

prybars - one on each mounting flange - to gently persuade the pump body to "break" loose from the plate.

5. Slide the impeller up and free of the driveshaft. Remove the Woodruff key from the cutout in the driveshaft.

6. Remove the gasket from the under side of the body. It is possible this gasket will remain on the plate when the body is removed.

■ **Although not strictly necessary, we recommend performing the following step as well. You've got the thing apart already, why takes chances?**

7. Slide the face plate and gaskets up and free of the driveshaft.

To install:

**** WARNING**

The water pump impeller must be in very good condition for satisfactory service. The pump performs an extremely important function by supplying sufficient water to properly cool the stern drive and the engine. Therefore, good shop practice dictates - replace the water pump impeller whenever the unit is disassembled, but then that's why you're here isn't it?

8. Inspect the water tube coupling for wear or damage. It's always a good idea to replace the two O-rings.

9. Inspect the impeller for any wear or damage. Replace as necessary.

10. Slide the small hole gasket down the driveshaft, followed by the face plate and the large hole gasket. Holes in the gaskets and plate will only align

with each other and the holes in the lower unit one way. If the holes do not align, one or more of the items is upside down. Correct the situation by turning one or more of the items over.

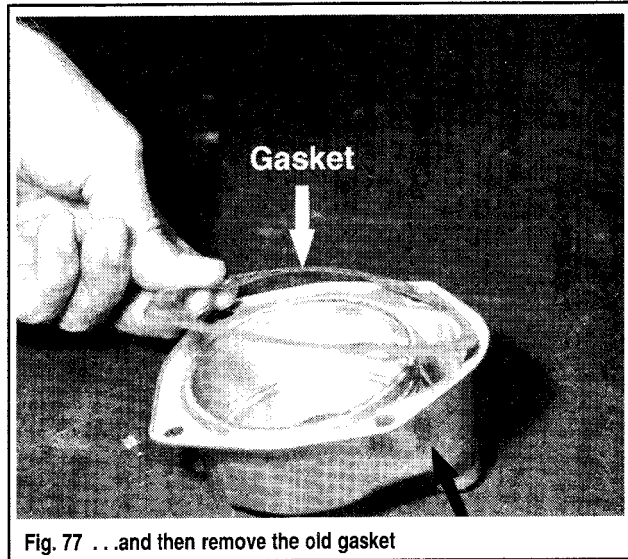
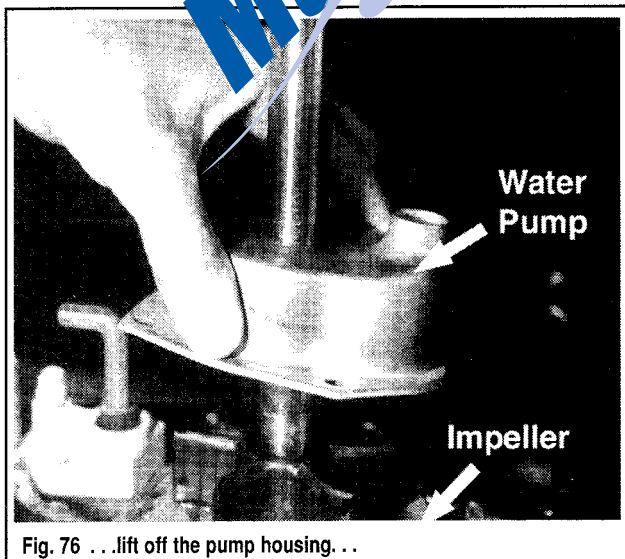
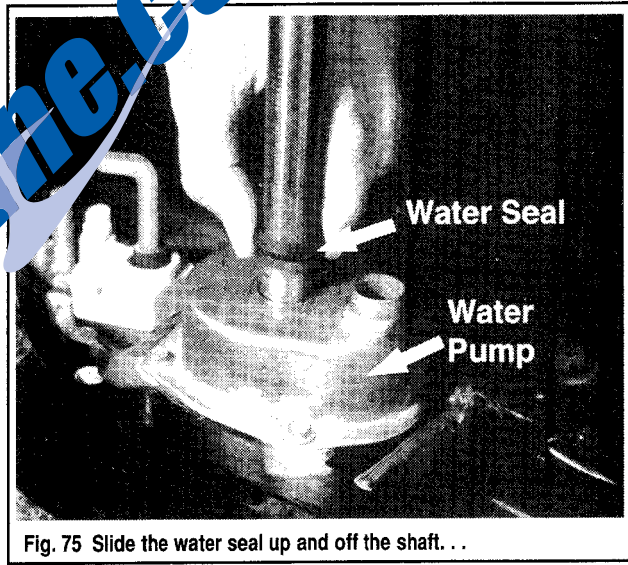
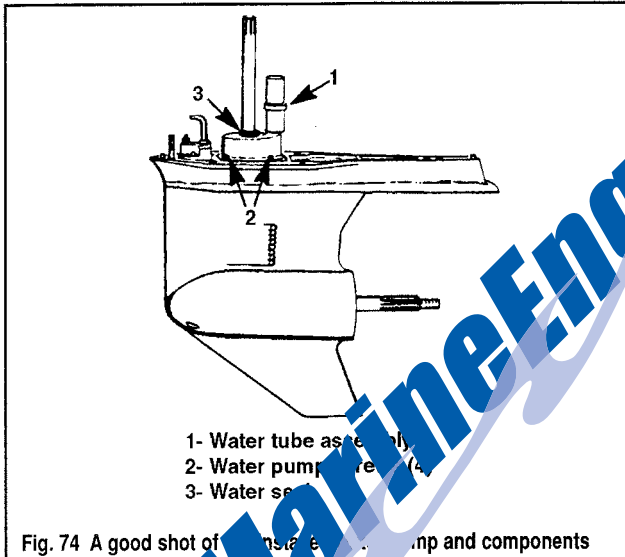
11. Apply just a "dab" of grease to the Woodruff key, and then place it in the driveshaft keyway. Slide the impeller down the driveshaft and onto the face plate with the cutout in the impeller indexed over the Woodruff key. If an old impeller with a "set" to the blades is being installed, face the curl of the blades in a counterclockwise direction. If the direction is reversed, premature impeller failure will surely occur.

12. Slide the pump body down the driveshaft and just to the top of the impeller. Keeping the gasket, impeller, and body mounting holes aligned is not an easy task. However, if a couple of pins are inserted down through just two opposite holes, as shown, the holes will stay aligned while the body is worked down over the impeller. The pins can be old drill bits, small diameter bolts, rod, whatever is handy. Exert some downward pressure on the pump body and at the same time rotate the driveshaft clockwise and the impeller blades will "set" in the proper direction.

13. Start a couple of the body mounting bolts, and then remove the two pins. Install the remaining mounting bolts, and tighten them all to 60 inch lbs. (7.9 Nm).

■ **A special water pump seating tool is required to properly seat the seal on top of the water pump case. This tool is only available from MerCruiser in a kit (#26-935-22).**

14. Apply a light amount of lubricant to the driveshaft. Slide the water pump face seal down the shaft until it is one inch above the pump body. Obtain special seating tool from the kit identified above. Slide the tool



ENGINE MECHANICAL

General Information

The MerCruiser 3.0L, 181 cubic inch displacement engine is manufactured by GM and has been a favorite combination when mated to the MerCruiser sterndrive.

This in-line four-cylinder powerplant uses a full pressure lubrication system with a disposable flow thru oil filter cartridge. Oil pressure is furnished by a gear-type oil pump, driven by the distributor, which is driven by a helical gear on the camshaft. A regulator on the oil pump controls the amount of oil pressure output. The oil pump scavenges oil from the bottom of the oil pan and feeds it through the oil filter and then to the main oil gallery in the block. Drilled passages in the block and crankshaft distribute oil to the camshaft and crankshaft to lubricate the rod, main and camshaft bearings. The main oil gallery also feeds oil to the valve lifters, which pump oil up through the hollow pushrods to the rocker arms to lubricate the valve train in the cylinder head. Cylinder numbering and firing order is identified in the illustrations at the end of the Maintenance section.

All 3.0L engines are left hand (counterclockwise) rotation when viewed from the stern of the boat. This does not necessarily indicate that your prop rotation is the same - always check them both!

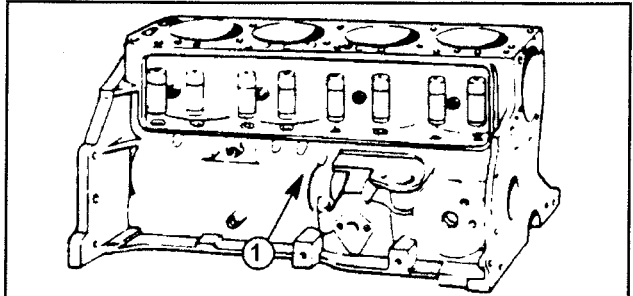
NEVER, NEVER attempt to use standard automotive parts when replacing anything on your engine. Due to the uniqueness of the environment in which they are operated in, and the levels at which they are operated at, marine engines require different versions of the same part; even if they look the same. Stock and most aftermarket automotive parts will not hold up for prolonged periods of time under such conditions. Automotive parts may appear identical to marine parts, but be assured, Mercury marine parts are specially manufactured to meet Mercury marine specifications. Most marine items are super heavy-duty units or are made from special metal alloy to combat against a corrosive salt water atmosphere.

Mercury marine electrical and ignition parts are extremely critical. In the United States, all electrical and ignition parts manufactured for marine application must conform to stringent U.S. Coast Guard requirements for spark or flame suppression. A spark from a non-marine cranking motor solenoid could ignite an explosive atmosphere of gasoline vapors in an enclosed engine compartment.

Engine Identification

◆ See Figure 1

All engines can be identified by a code number stamped on the starboard side of the engine block, aft of the distributor. The last two letters of the code designate the engine size. Older models carry **RX** on engines below serial number 0L199 (12.3/1 in. flywheel), and **RP** on engines with serial number 0L170 and above (w/14 in. flywheel). This code is stamped on all complete replacement engines and all partial replacement engines (but not on individual cylinder blocks).



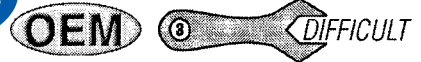
1- 4 cylinder-in-line engine code (next to distributor)

Fig. 1 The engine identification code can be found here. The last two letters are the engine designation

In the event that the engine serial number plates or stickers are missing from the engine, this is a good way to ensure that you know the exact engine in your vessel when ordering parts.

Engine

REMOVAL & INSTALLATION



◆ See Figures 2, 3, and 4

Remove the stern drive unit as detailed in the appropriate section.

Remove the engine hatch cover.

Disconnect the battery cables (negative first) at the battery and then disconnect them from the engine block and starter.

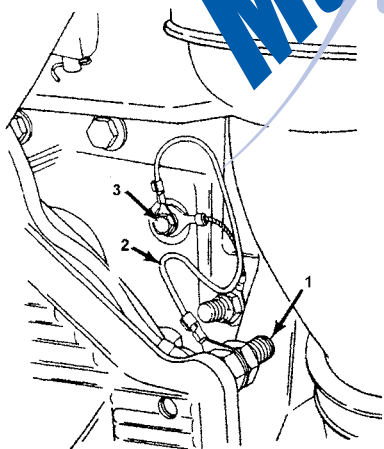
Loosen the hose clamp on the engine wiring harness connector and unplug the instrumentation wiring harness. Label it and move it aside.

Disconnect the fuel inlet line at the fuel pump and quickly plug it (the line and the pump). Make sure you have rags handy as there will be some spillage.

Pull the cotter pin from the clevis, remove the lock nut and disconnect the shift assist assembly. Disconnect the shift cables and position them out of the way.

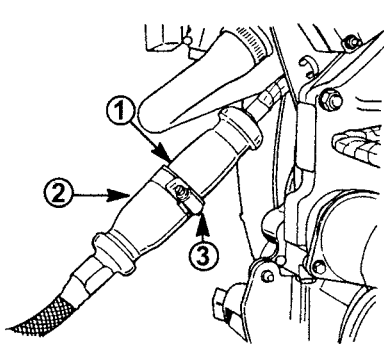
Disconnect the throttle cable at the carburetor and position it out of the way.

Carefully loosen and remove the two lines at the power steering control valve. Plug the hose ends and the control valve fittings. Tag the lines and fittings and move them aside.



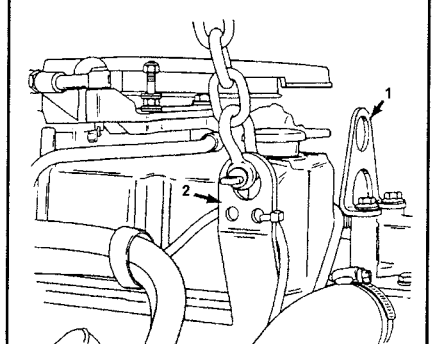
- 1- Flywheel Grounding Stud
- 2- Ground Wire
- 3- Inner Transom Plate grounding screw

Fig. 2 Tag and disconnect the engine ground wire.



- 1- Engine Wiring Harness Receptacle
- 2- Instrumentation Wiring Harness
- 3- Hose Clamp

Fig. 3 Disconnect the instrument wiring harness



- 1- Center Lift eye- DO NOT use to lift engine
- 2- Use this lifting eye

Fig. 4 Attach an engine hoist at the lifting eyes.

9. Loosen the hose clamps and disconnect the exhaust elbow bellows from the upper pipe. Remove it.
10. Tag and disconnect the trim sender wires at the engine harness. Follow the wires back to the transom and disconnect or remove them from any clamps so they may be moved out of the way.
11. Tag and disconnect the shift cut-out switch wires (near the arrestor).
12. On models equipped with the MerCathode system, tag and disconnect the wires at the controller.
13. Loosen the hose clamp and remove the water inlet line at the water tube where it exits from the transom. Plug the hose and the fitting.
14. Tag and disconnect the engine ground wire at the stud.
15. Tag and disconnect any remaining lines, wires or hoses at the engine. Carefully move them out of the way.
16. Attach a suitable engine hoist to the lifting eyes and take up any slack until it is just taut.

■ **DO NOT use the front lifting eye attached to the thermostat housing as this used only for alignment purposes.**

17. Locate the front engine mount and remove the two 3/8 inch lag bolts.
18. Locate the rear engine mount and remove the two mounting bolts.
19. Slowly and carefully, lift out the engine. Try not to hit the power steering control valve; or anything else for that matter.

To install:

◆ See Figures 5 thru 10

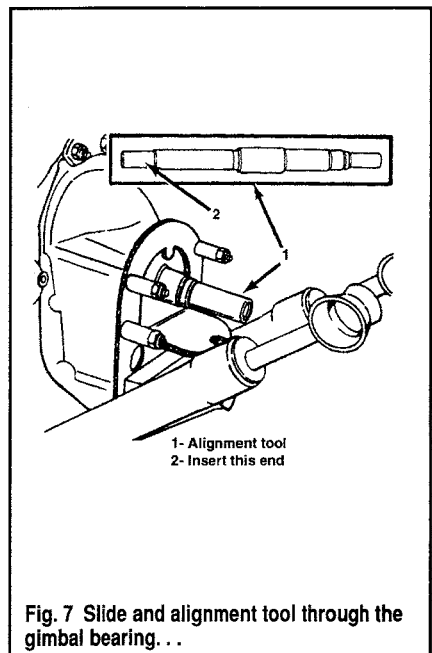
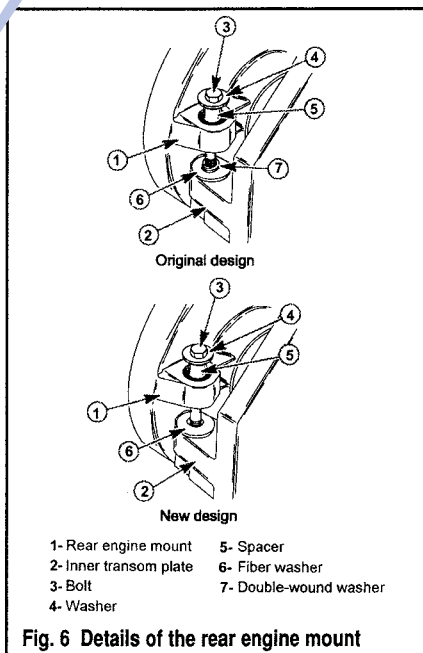
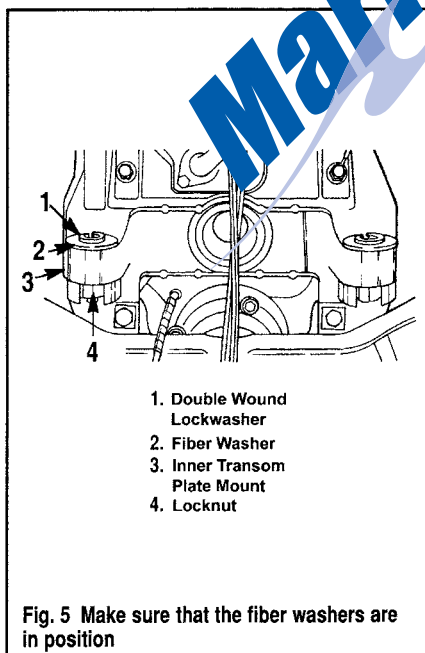
■ **An engine alignment tool (#91-805475A1) is necessary to reinstall the engine. Even if the mounts have not been removed from the engine it is still a good idea to re-align the unit.**

20. Make sure that the fiber washers are in position on the inner transom plate. Take a look at their condition and replace them if they look damaged or worn.
21. Install a double wound lockwasher into the fiber washer and make sure that the engine mount locknuts are in position as shown in the illustration.

■ **Starting in 2003 Mercruiser has replaced the double wound lockwasher with a single stainless steel washer.**

22. Lubricate the exhaust bellows with soapy water for later installation. Apply Quicksilver Engine Coupler grease to the splines of the engine coupler.
23. Attach the engine to a hoist if you disconnected it and lower it to position in the vessel, over the mounting spots. Align the engine over the holes in the transom plate, making sure exhaust tubes and hoses are lined up.
24. Slide a large steel washer and a metal spacer into the mounting bolt and then run them through the mount and transom plate. Tighten the bolts to 38 ft. lbs (52 Nm).

25. Carefully lower the engine fully until the front mount is resting on the stringers. Relieve the hoist tension, disconnect it and then reconnect it to the lifting eye in the thermostat housing
26. Slide the solid end of the alignment tool into the center of the gimbal housing bearing and then into the engine coupler splines - you may have to pivot the bearing slightly. **DO NOT FORCE THE TOOL!** Use the hoist to raise (or lower) the front of the engine until the tool slides completely into the coupler (with no binding).
27. Loosen the jam and lock nuts on the front mount(s) and then turn the adjusting nut (top of the mount) so that the mount base sits true on the stringer. Check that the alignment tool still slides freely between the engine and gimbal housing. Install the mount base lag bolts and tighten them securely. Tighten the adjusting nut and the jam nut.
28. Recheck that the alignment tool still slides freely and then remove it. Remove the engine hoist.
29. Reconnect the exhaust bellows and tighten the clamps securely (2 on each side).
30. Reconnect the water inlet hose and tighten the hose clamp securely.
31. Reconnect the instrument harness and tighten the clamp securely.
32. Carefully, and quickly, connect the power steering lines and tighten to 23 ft. lbs. (31 Nm). Don't forget to bleed the system when you are finished with the installation.
33. Reconnect the trim sender leads, the engine ground wire, the battery cables and the wires, lines or hoses that were disconnected during removal.
34. Unplug the fuel and pump fitting and reconnect them.
35. Connect the MerCathode lines to the controller and coat them with liquid paraffine. If you forgot to tag the wires as we suggested, refer to the illustration for proper hook-up.
36. Move the remote control handle to the Neutral position. Install the anchor eye on the throttle lever and then push the barrel toward the end of the throttle lever to create a slight preload, reducing cable slack. Position the barrel so that it aligns with the anchor stud.
37. Secure the cable. Tighten the locknut on the end guide until it just makes contact and then back it off one full turn. Tighten the anchor screw securely, but not too tight.
38. Move the remote control lever to the full throttle position and confirm that the throttle valves in the carburetor are fully open and the throttle shaft lever is just coming in contact with the carburetor body.
39. Now move the control lever to the Neutral position and check that the throttle lever is touching the end of the idle speed screw.
40. Install and adjust the shift cables.
41. Install the drive unit. Connect the battery cables
42. Check and refill all fluids and go have fun!



Exhaust Valve (Flapper/Shutter)

REPLACEMENT



◆ See Figures 96 and 100

■ Although Mercury calls this an exhaust valve, many people also call it a flapper valve or a shutter valve. Whatever you call it, this is the small valve in the top of the exhaust pipe.

1. Remove the upper exhaust hose from the elbow and intermediate pipe. Now remove the intermediate pipe and the lower hose. The shutter is located in the upper end of the lower exhaust tube.

2. The valve is held in place by means of a pin running through two grommets in the sides of the pipe. Position a small punch over one end of the pin and carefully press the pin out of the pipe. Some people have had luck simply pulling upward on the assembly very carefully and popping the shutter and grommets right out of the pipe.

■ Make sure you secure the valve while removing it so nothing falls down into the exhaust pipe.

3. Press out the two grommets and discard them. Coat two new grommets with Scotch Grip Rubber Adhesive and press them back into the sides of the pipe.

4. Position the new valve into the pipe with the long side DOWN. When the valve is in place, coat the pin lightly with engine oil and slowly slide it through one of the grommets, through the two retaining holes on the valve and then through the opposite grommet. Make sure the pin ends are flush with the sides of the pipe on both sides.

5. Install the lower hose, intermediate pipe and upper hose.

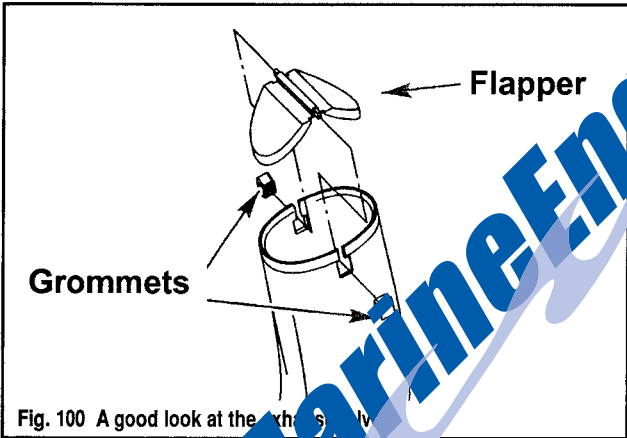


Fig. 100 A good look at the exhaust valve

Oil Pan

REMOVAL & INSTALLATION

All Engines Exc. 8.1L V8



◆ See Figures 101, 102 and 103

■ More times than not, this procedure will require the removal of the engine. Your boat and its unique engine installation will determine this, but the procedure is almost always easier with the engine removed from the boat.

1. Remove the engine as previously detailed in this section.

2. If you haven't already drained the engine oil, do it now. Make sure you have a container and lots of rags available. Disconnect the oil drain fitting and hose if equipped.

3. Certain models may require removing the outlet hose at the seawater pump to provide easier access (particularly if you are attempting this without removing the engine).

4. Remove the oil dipstick and then remove the dipstick tube(s). On inboard engines or engines equipped with an oil drain system, make sure you note the dipstick tube banjo fitting position and which tube goes where.

5. Loosen and remove the oil pan retaining bolts and nuts, starting with the center bolts and working out toward the pan ends. Pry off the reinforcing strips from each side if equipped. Lightly tap the pan with a rubber mallet to break the seal and then lift it off the cylinder block. If your engine stand will allow for rotating the engine, you'll find that this will be easier with the pan facing up.

To install:

6. Clean the pan mating surfaces of any residual gasket material with a scraper or putty knife. Make sure that no old gasket material has been pressed into the retaining bolt holes in the pan, block or front cover. Clean the pan itself thoroughly with solvent.

7. Apply a 5mm (13/64 in.) wide, by 25mm (1 in.) long bead of RTV sealer (Loctite Ultra Black 5900) to the joints on either side of the rear oil seal retainer and front cover, position a new pan gasket onto the pan being very careful to line up all the holes - do not use RTV sealant with this gasket other than where noted.

8. Move the pan and gasket onto the block; don't dawdle here because the RTV sealant applied in the previous step sets up very quickly. It is very important that you ensure all the holes line up correctly; sometimes a few bolts inserted through the pan and gasket will help the gasket stay in place. Make sure that the gasket is pressed into the grooves of the front cover and rear oil seal housing.

9. Position the reinforcing strips if equipped.

10. Install all bolts finger tight and then tighten the nuts and bolts to 18 ft. lbs. (25 Nm) on the early V6 engines without pan reinforcing strips. On all other engines, tighten the stud nuts to 18 ft. lbs. (25 Nm) and the other reinforcing bolts/nuts to 106 inch lbs. (12 Nm). Remember to start with the center bolts and work outward toward the ends of the pan.

11. Install the dipstick tube(s) and dipstick. If equipped with an oil drain, install the banjo fitting into the pan fitting and tighten it securely. Do the same with the seawater pump on the line. Position the banjo correctly and tighten the nut to 150 inch lbs. (20 Nm).

12. Reinstall the engine (if removed). Run the engine up to normal operating temperature, shut it off and check the pan for any leaks.

All Engines



■ More times than not, this procedure will require the removal of the engine. Your boat and its unique engine installation will determine this, but the procedure is almost always easier with the engine removed from the boat.

1. Remove the engine as previously detailed in this section.

2. If you haven't already drained the engine oil, do it now. Make sure you have a container and lots of rags available.

3. Remove the oil dipstick and then remove the dipstick tube and/or the oil drain hose. Make sure you note the dipstick tube banjo fitting position on the bottom of the pan.

4. Remove the cool fuel cell on the port side of the engine.

5. Loosen and remove the oil pan retaining bolts and nuts, starting with the center bolts and working out toward the pan ends. Lightly tap the pan with a rubber mallet to break the seal and then lift it off the cylinder block. If your engine stand will allow for rotating the engine, you'll find that this will be easier with the pan facing up.

To install:

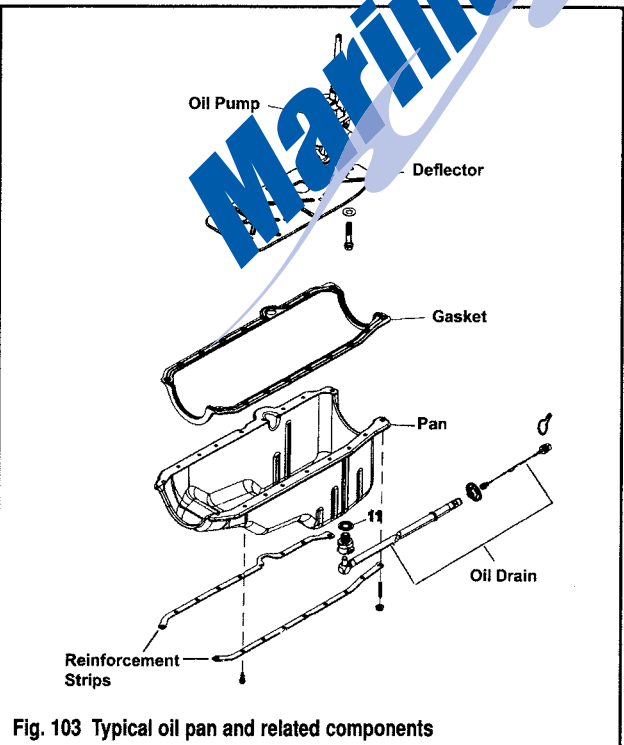
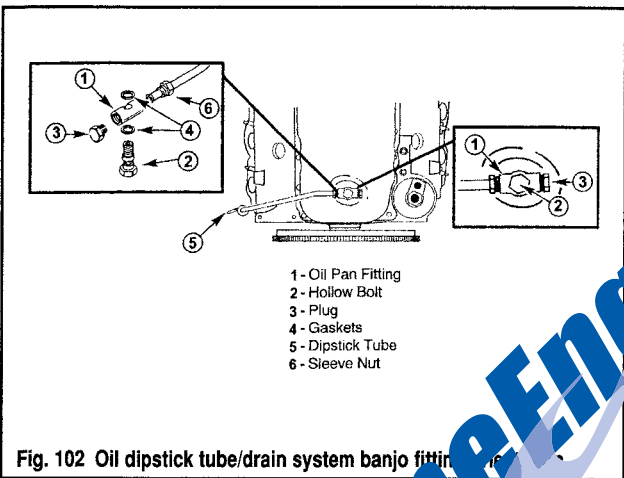
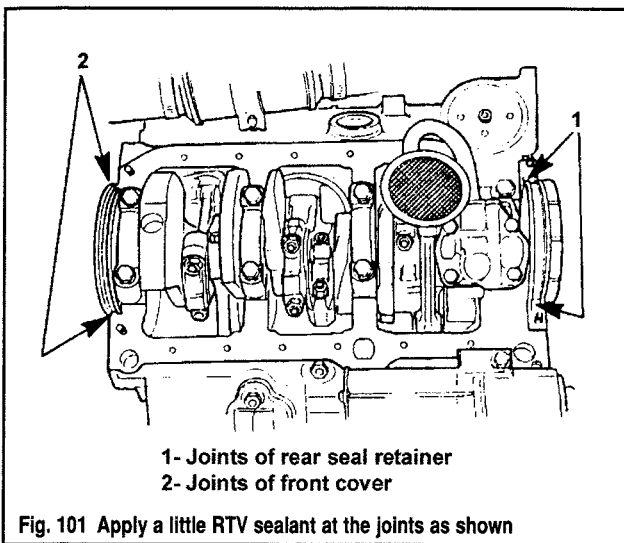
6. Clean the pan mating surfaces of any residual gasket material with a scraper or putty knife. Make sure that no old gasket material has been pressed into the retaining bolt holes in the pan, block or front cover. Clean the pan itself thoroughly with solvent.

7. Apply a small dab of RTV sealer to the joints on either side of the rear oil seal retainer and front cover, position a new pan gasket onto the pan being very careful to line up all the holes - do not use RTV sealant with this gasket other than where noted.

8. Move the pan and gasket onto the block; don't dawdle here because the RTV sealant applied in the previous step sets up very quickly. It is very important that you ensure all the holes line up correctly; sometimes a few bolts inserted through the pan and gasket will help the gasket stay in place.

9. Install all bolts finger tight and then tighten them to 19 ft. lbs. (25 Nm). Remember to start with the center bolts and work alternately outward toward the ends of the pan.

10. Install the oil drain system, dipstick tube and dipstick and then install the engine (if removed). Run the engine up to normal operating temperature, shut it off and check the pan for any leaks.



Oil Pump
REMOVAL & INSTALLATION



◆ See Figures 104 thru 107

The two-piece oil pump utilizes two pump gears and a pressure regulator valve enclosed in a two-piece housing. A baffled pick-up tube is press-fit into the body of the pump. The pump is driven via the distributor shaft which is itself driven from a gear on the camshaft. Oil passes through the pick-up screen, through the pump and then through the oil filter.

1. Remove the oil pan as previously detailed. Remember that you probably need to remove the engine for this procedure.

2. Most engines utilize an oil deflector (baffle) plate; remove the 3 or 5 retaining nuts/bolts and lift out the baffle (this should not be necessary on 8.1L V8 and 2001 V6 engines).

3. Remove the spacers under the baffle on the early 6.2L engines.

4. Loosen and remove the pump mounting bolt(s) and lift off the pump assembly.

5. Check that the pump body mating surfaces are clean. Check that the pump locator dowel pin is .25 in. (6.4mm) on all engines but 2001 carbureted/TBI engines.

6. Position the pump on the block so that the pump extension shaft is aligned with the distributor drive shaft. Do not use a gasket or RTV sealant.

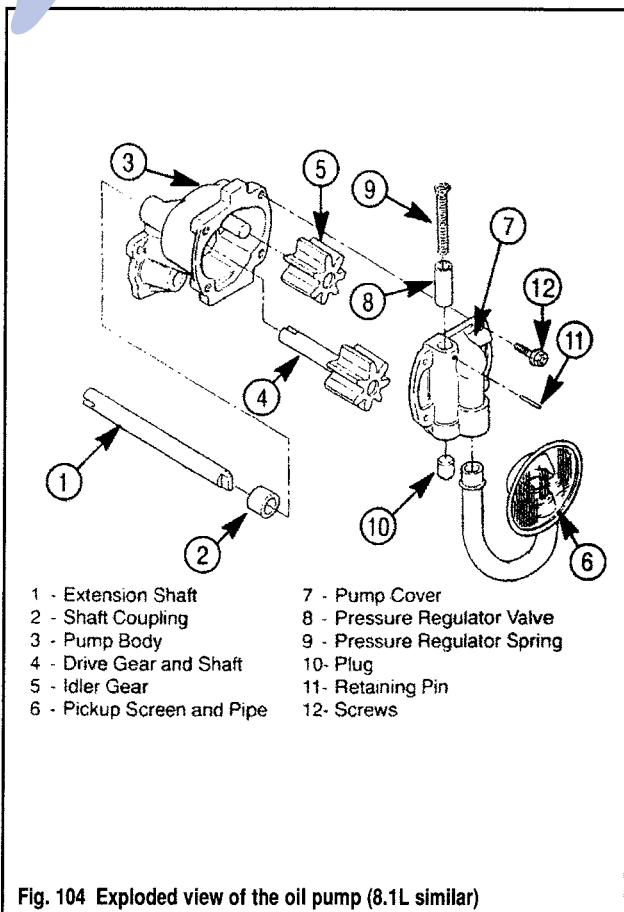
7. Tighten the pump mounting bolts to:

- 56 ft. lbs. (75 Nm) - 8.1L engines
- 65 ft. lbs. (88 Nm) - 2001 V6 and V8 engines
- 20 ft. lbs. (27 Nm) and then an additional 65° - 2002 and later V6 and V8 engines (to 8.1L)

8. If the oil baffle is used, and tighten the nuts to 30 ft. lbs. (40 Nm) on 2002-06 V8 engines, or 25 ft. lbs. (34 Nm) on early V8 engines.

9. Lubricate the spacers on the 6.2L engine.

10. Install the oil pan and engine. Fill the crankcase with oil, start the engine and check for leaks.



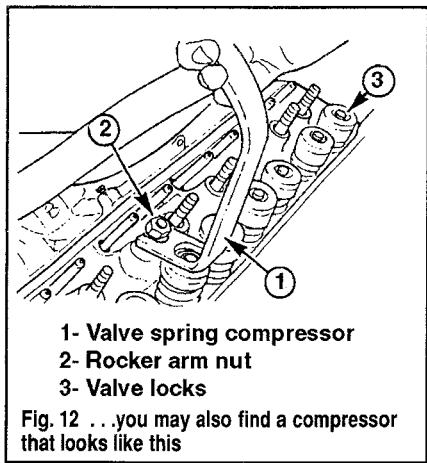


Fig. 12 ... you may also find a compressor that looks like this

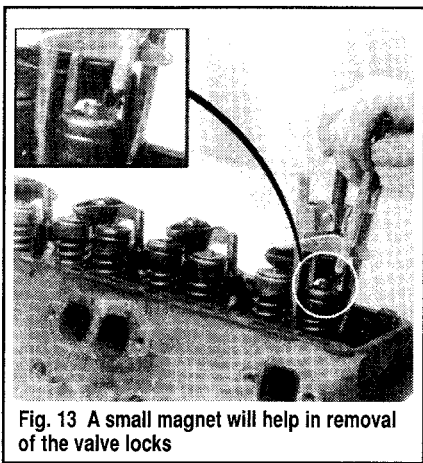


Fig. 13 A small magnet will help in removal of the valve locks

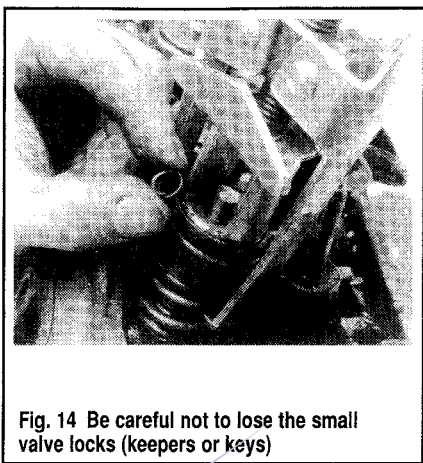


Fig. 14 Be careful not to lose the small valve locks (keepers or keys)

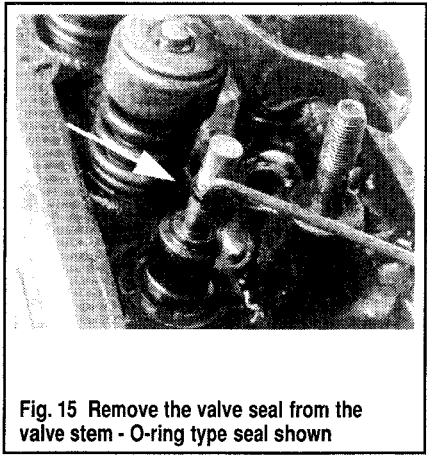


Fig. 15 Remove the valve seal from the valve stem - O-ring type seal shown

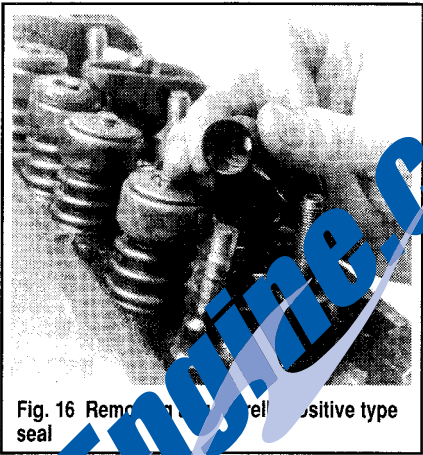


Fig. 16 Remove the self-positive type seal

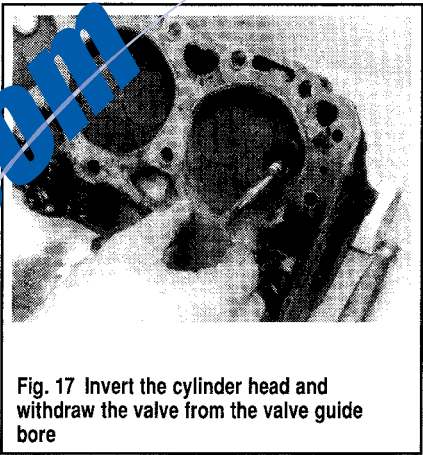


Fig. 17 Invert the cylinder head and withdraw the valve from the valve guide bore

4. Remove the valve locks from the valve tip and/or retainers. A small magnet may help in removing the locks.
 5. Lift the valve spring(s), tool and all, off of the valve.
 6. Remove the valve seal from the stem and guide. In some cases, the seal to remove with the valve in place, try removing the valve first, then the seal. Follow the steps below for valve removal.
 7. Position the head to allow access for the removal of the valve.
- **Cylinder heads that have seen a lot of use and/or abuse may have mushroomed the valve lock groove, causing difficulty in removal of the valve. If this has happened, use a metal file to carefully remove the high spots around the lock groove and/or tip. Only file it enough to allow removal.**
8. Remove the valve from the cylinder head.
 9. If equipped, remove the valve spring shim. A small magnetic tool or screwdriver will aid in removal.
 10. Repeat Steps 3 through 9 until all of the valves have been removed.

INSPECTION



Now that all of the cylinder head components are clean, it's time to inspect them for wear and/or damage. To accurately inspect them, you will need some specialized tools:

- A 0-1 in. micrometer for the valves
- A dial indicator or inside diameter gauge for the valve guides
- A spring pressure test gauge

If you do not have access to the proper tools, you may want to bring the components to a shop that does.

Valves
◆ See Figures 21 and 22

The first thing to inspect are the valve heads. Look closely at the head, margin and face for any cracks, excessive wear or burning. The margin is

the best place to look for burning. It should have a squared edge with an even width all around the diameter. When a valve burns, the margin will look melted and the edges rounded. Also inspect the valve head for any signs of tulipping. This will show as a lifting of the edges or dishing in the center of the head and will usually not occur to all of the valves. All of the heads should look the same; any that seem dished more than others are probably bad. Next, inspect the valve lock grooves and valve tips. Check for any burrs around the lock grooves, especially if you had to file them to remove the valve. Valve tips should appear flat, although slight rounding with high mileage engines is normal. Slightly worn valve tips will need to be machined flat. Last, measure the valve stem diameter with the micrometer. Measure the area that rides within the guide, especially towards the tip where most of the wear occurs. Take several measurements along its length and compare them to each other. Wear should be even along the length with little to no taper. If no minimum diameter is given in the specifications, then the stem should not read more than 0.001 in. (0.025mm) below the unworn area of the valve stem. Any valves that fail these inspections should be replaced.

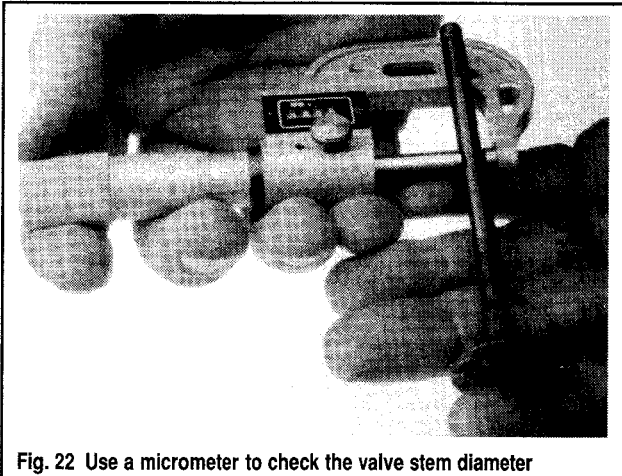
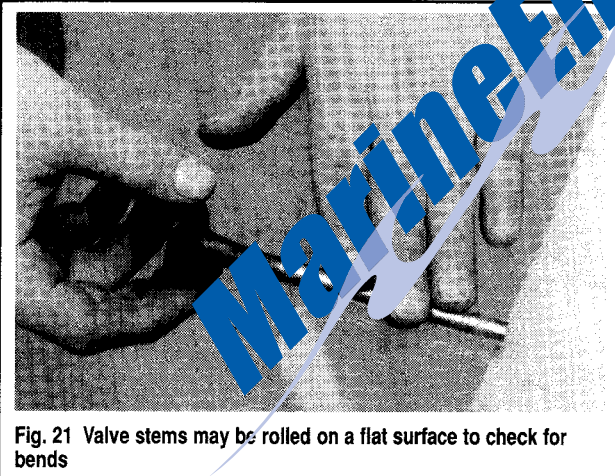
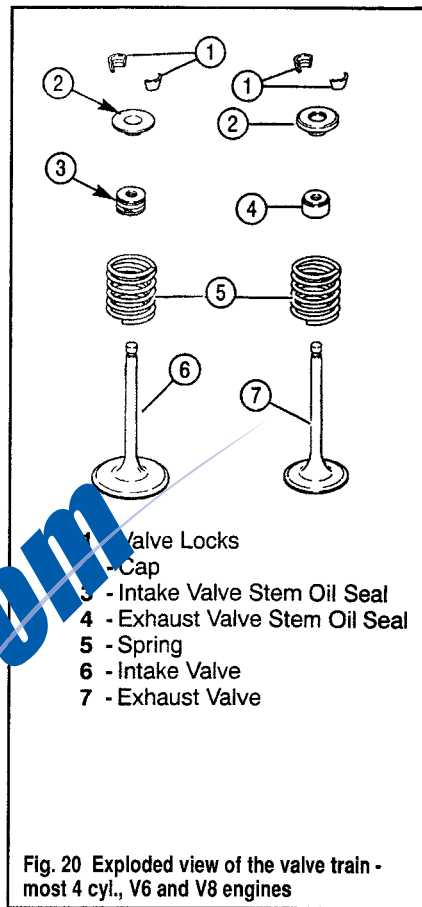
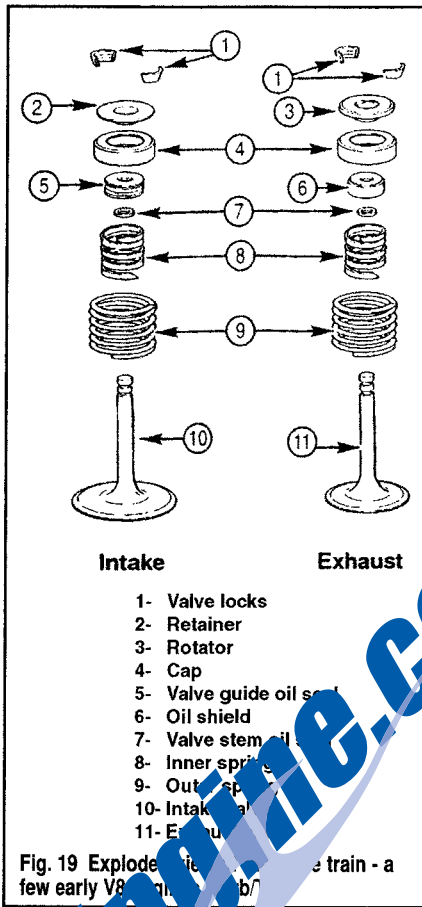
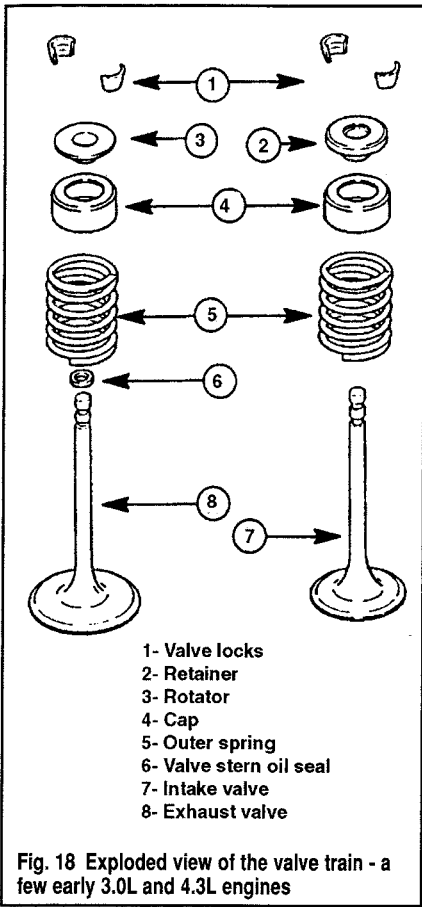
Springs, Retainers and Valve Locks

◆ See Figures 23 and 24

The first thing to check is the most obvious, broken springs. Next check the free length and squareness of each spring. If applicable, insure to distinguish between intake and exhaust springs. Use a ruler and/or carpenter's square to measure the length. A carpenter's square should be used to check the springs for squareness. If a spring pressure test gauge is available, check each spring's rating and compare to the specifications chart. Check the readings against the specifications given. Any springs that fail these inspections should be replaced.

The spring retainers rarely need replacing, however they should still be checked as a precaution. Inspect the spring mating surface and the valve lock retention area for any signs of excessive wear. Also check for any signs of cracking. Replace any retainers that are questionable.

Valve locks should be inspected for excessive wear on the outside contact area as well as on the inner notched surface. Any locks which appear worn or broken and its respective valve should be replaced.



Valve Guides

◆ See Figure 25

Now that you know the valves are good, you can use them to check the guides, although a new valve, if available, is preferred. Before you measure anything, look at the guides carefully and inspect them for any cracks, chips or breakage. Also if the guide is a removable style (as in most aluminum heads), check them for any looseness or evidence of movement. All of the guides should appear to be at the same height from the spring seat. If any seem lower (or higher) from another, the guide has moved. Mount a dial indicator onto the spring side of the cylinder head. Lightly oil the valve stem and insert it into the cylinder head. Position the dial indicator against the valve stem near the tip and zero the gauge. Grasp the valve stem and wiggle towards and away from the dial indicator and observe the readings. Mount the dial indicator 90 degrees from the initial point and zero the gauge and again take a reading. Compare the two readings for a out of round condition.

Check the readings against the specifications given. An Inside Diameter (I.D.) gauge designed for valve guides will give you an accurate valve guide bore measurement. If the I.D. gauge is used, compare the readings with the specifications given. Any guides that fail these inspections should be replaced or machined.

Valve Seats

A visual inspection of the valve seats should show a slightly worn and pitted surface where the valve face contacts the seat. Inspect the seat carefully for severe pitting or cracks. Also, a seat that is badly worn will be recessed into the cylinder head. A severely worn or recessed seat may need to be replaced. All cracked seats must be replaced. A seat concentricity gauge, if available, should be used to check the seat run-out. If run-out exceeds specifications the seat must be machined (if no specification is given use 0.002 in. or 0.051mm).