

These measurements must be equal. It is normal for an old belt to be slightly longer than a new one. After a new belt is installed correctly, properly adjust the tension.

When removing more than one belt, be sure to mark them for identification. This will help avoid confusion when replacing the belts.

Thermostat

The thermostat is a simple temperature sensitive valve that opens and closes to control cooling water flow through the engine. In operation, the thermostat hovers somewhere between open and closed. As engine load and temperature increase, the thermostat opens to allow more cooling water into the engine. As temperature and load decrease, the thermostat closes.

A sticking thermostat will either allow the temperature to rise well above the normal operating temperature before it opens, or, if stuck in the open position, will never allow the engine to reach operating temperature.

All thermostats are rated based on the temperature at which they open and this rating should always be stamped somewhere on the thermostat, usually on the flange area. All engines covered here utilize a 160°F thermostat except for the 7.4L/8.2L engines which use a thermostat rated at 140°F; or models with a closed cooling system which generally use a 170°F thermostat.

On all engines covered here, the thermostat housing can be found on the front, top of the engine—easily identifiable by the large hoses attached to it.

** CAUTION

Serious damage may result from operating your engine without a thermostat! Don't even consider this!

** CAUTION

NEVER use an automotive thermostat in a marine engine. No matter how tempting this may seem, forget it!!

REMOVAL & INSTALLATION

2.3L, 2.5L And 3.0L Engines—1986-96

◆ See Figures 46 and 47



On all engines covered here, the thermostat housing can be found on the front, top of the engine—easily identifiable by the large hoses attached to it.

** CAUTION

Serious damage may result from operating your engine without a thermostat! Don't even consider this!

** CAUTION

NEVER use an automotive thermostat in a marine engine.

1. Open or remove the engine hatch cover and disconnect the negative battery cables.
2. Drain all water from the cylinder block and exhaust manifold(s) as detailed in the Cooling System section.
3. Locate the thermostat housing at the front of the engine, loosen the hose clamps and then wiggle all coolant hoses off of the thermostat housing. In many cases you may have to use a small prybar to persuade them off of the fitting—be careful that you don't damage the hose end in the process.

Although it is not absolutely necessary to remove the coolant hoses, we feel that it makes the job easier.

4. Loosen and remove the alternator bracket mounting bolt on 2.5L/3.0L engines.

5. Remove the 4 mounting bolts (2 on the 2.3L) with their lock washers and then remove the upper thermostat housing cover. Some models may have a lifting eye incorporated in the housing—take note of its positioning.

6. Remove the gasket and be sure to scrape of any remaining material from the two mating surfaces.

7. Lift out the thermostat and discard it. If you are not sure that it is inoperable, perform the testing procedures outlined in this section. Don't forget to remove the cork seal if it doesn't come out with the thermostat.

To install:

8. Once again, make sure that any remaining gasket material has been removed from the thermostat housing and cover.

9. Position a NEW cork seal in the housing.

10. Insert a new thermostat (160°F) into the housing. The element must be pointing into the housing so that the pointy end of the thermostat is facing upward on the 2.5L/3.0L or outward on the 2.3L. Make sure that a new cork seal is positioned over the base of the thermostat.

11. Coat both sides of a new 2.5L/3.0L housing gasket with OMC Gasket Sealing compound (or similar) and position it onto the housing so that the holes line up.

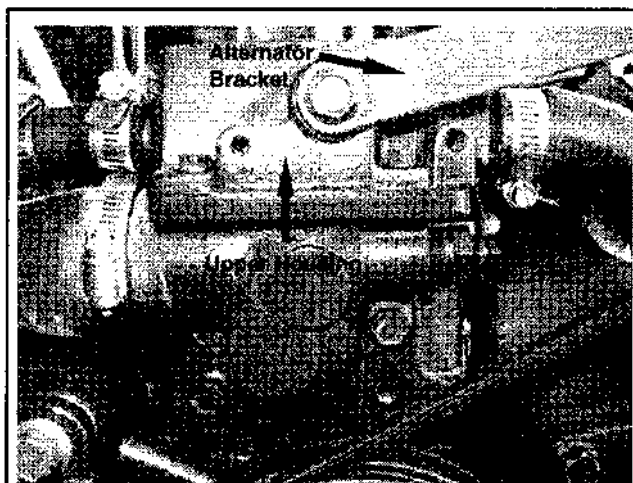


Fig. 46 A good shot of the thermostat housing—3.0L engines

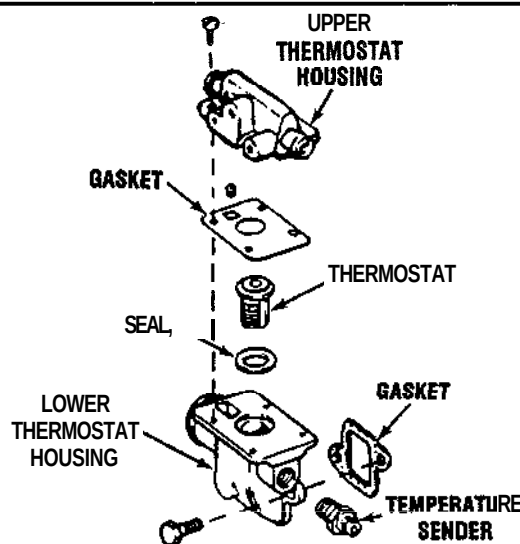


Fig. 47 Exploded view of the thermostat and housing—3.0L engines

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12. Install the upper housing cover and mounting bolts/washers and tighten to 5-7 ft. lbs. (7-9 Nm) on the 2.5L/3.0L. On the 2.3L engine, install the housing and bolts, long bolt in the lower hole, and then tighten to 20-25 ft. lbs. (27-34 Nm).

13. Reconnect the hoses and tighten the clamps being careful not to pinch the hose. This is a good time to inspect the hoses!

14. Reattach the alternator mounting bracket, recheck the belt tension adjustment and then tighten the bolt securely.

15. Connect the batteries and then start the engine and check for leaks.

3.0L Engines—1997-98



■ On all engines covered here, the thermostat housing **can** be found on the front, top of the **engine**—**easily** identifiable by the large hoses attached to it.

×× CAUTION

Serious damage may result from operating your engine without a thermostat! Don't even consider this!

×× CAUTION

NEVER use an automotive thermostat in a marine engine.

1. Open or remove the engine hatch cover and disconnect the negative battery cables.

2. Drain all water from the cylinder block and exhaust manifold(s) as detailed in the Cooling System section.

3. Locate the thermostat housing at the front of the engine, loosen the hose clamps and then wiggle the four coolant hoses off of the thermostat housing. In many cases you may have to use a small prybar to persuade them off of the fitting—be careful that you don't damage the hose end in the process.

4. Tag and disconnect (unscrew the nut) the coolant temperature sender lead from the front of the housing and position it out of the way.

5. Loosen the alternator adjusting bolt. Loosen and remove the alternator bracket mounting bolt and pivot it out of the way.

6. Remove the two mounting bolts with their lock washers and then remove the thermostat housing.

7. Remove the gasket and be sure to scrape off any remaining material from the two mating surfaces.

8. Lift out the thermostat and discard it. If you are not sure that it is inoperable, perform the testing procedures outlined in this section. Don't forget to remove the O-ring if it doesn't come out with the thermostat—it holds the thermostat in place, so it should already be out.

To install:

9. Once again, make sure that any remaining gasket material has been removed from the thermostat housing and cylinder head.

10. Insert a new thermostat (160°F) into the housing. The element must be facing you and the pointed end should be pointing into the housing.

11. Position a NEW O-ring into the groove in the housing so that it retains the thermostat.

12. Position a new housing gasket onto the cylinder head so that the holes line up.

13. Install the housing and tighten the bolts to 12-16 ft. lbs. (16-22 Nm).

14. Reattach the alternator mounting bracket and tighten the bolt to 26-30 ft. lbs. (35-41 Nm). Adjust the belt tension and then tighten the adjusting bolt.

15. Attach the coolant temperature sender lead to the front of the housing and tighten the nut securely.

16. Reconnect the hoses and tighten the clamps being careful not to pinch the hose. This is a good time to inspect the hoses!

17. Connect the batteries and then start the engine and check for leaks.

V6 and V8 Engines



◆ See Figures 48, 49, 50, 51 and 52

□ On all engines covered here, the thermostat housing can be found on the front, top of the engine—easily identifiable by the large hoses attached to it.

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×× CAUTION

NEVER use an automotive thermostat in a marine engine.

1. Open or remove the engine hatch cover and disconnect the negative battery cables.

2. Drain all water from the cylinder block and exhaust manifold(s) as detailed in the Cooling System section.

3. Locate the thermostat housing at the front of the engine, loosen the hose clamps and then wiggle the four coolant hoses off of the thermostat housing. In many cases you may have to use a small prybar to persuade them off of the fitting—be careful that you don't damage the hose end in the process.

■ EFI models will have five hoses that need to be removed.

1. Remove the two mounting bolts with their lock washers and then remove the thermostat housing. Some models may have a lifting eye attached to the housing—take note of its positioning before removing it. On certain later models you will also need to unscrew the temperature sender and move it out of the way.

2. Remove the gasket and be sure to scrape off any remaining material from the two mating surfaces.

3. Pry out the O-ring that holds the thermostat in place and then lift out the thermostat and discard it. If you are not sure that it is inoperable, perform the testing procedures outlined in this section.

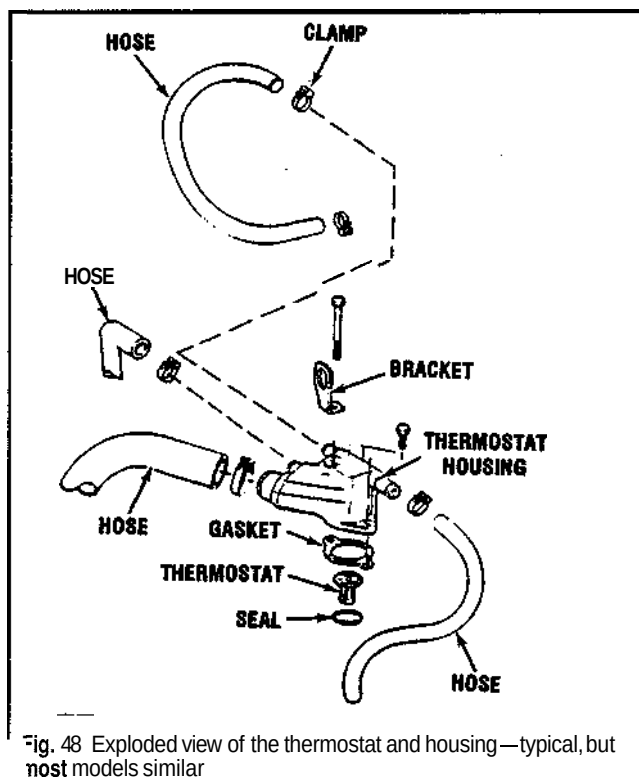


Fig. 48 Exploded view of the thermostat and housing—typical, but most models similar

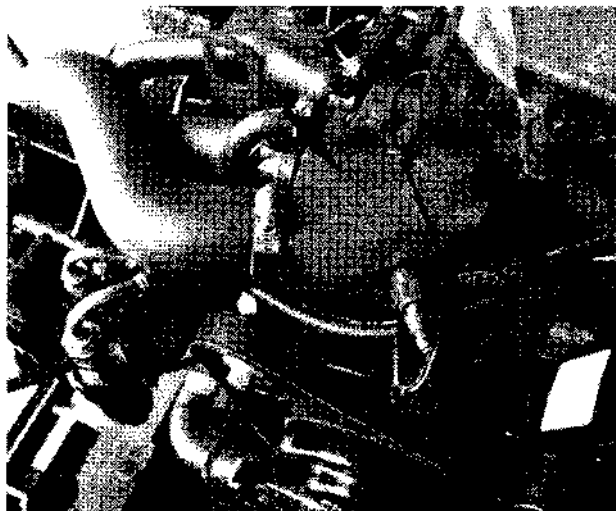


Fig. 49 Thermostat housing—4.3L engines (Gi shown)

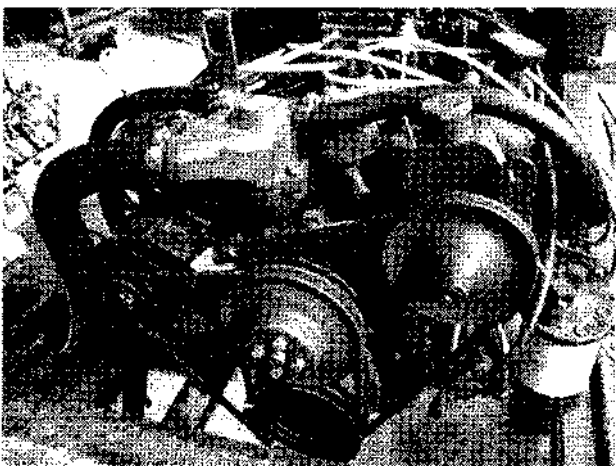


Fig. 51 Thermostat housing—5.0L/5.8L Ford engines

To install:

4. Once again, make sure that any remaining gasket material has been removed from the thermostat housing and cylinder head.
5. Insert a new thermostat (160°F except 7.4L/8.2L which use a 140°F) into the housing. The element must be facing you when installed in the housing so that it goes into the engine when installed.
6. Position a **NEW** O-ring into the groove in the housing so that it retains the thermostat. Make sure the O-ring is fully seated in the groove!
7. Coat both sides of a new housing gasket with OMC Gasket Sealing compound (or similar) and position it onto the manifold so that the holes line up.
8. Install the housing and lifting eye, then tighten the bolts to 20-25 ft. lbs. (27-34 Nm).
9. Reconnect the hoses and tighten the clamps being careful not to pinch the hose. This is a good time to inspect the hoses!

✖✖ CAUTION

Always ensure that the water supply hose is attached to the correct nipple. On the side with three hoses (or four) it's the lower one in the middle.

10. Connect the batteries and then start the engine and check for leaks.

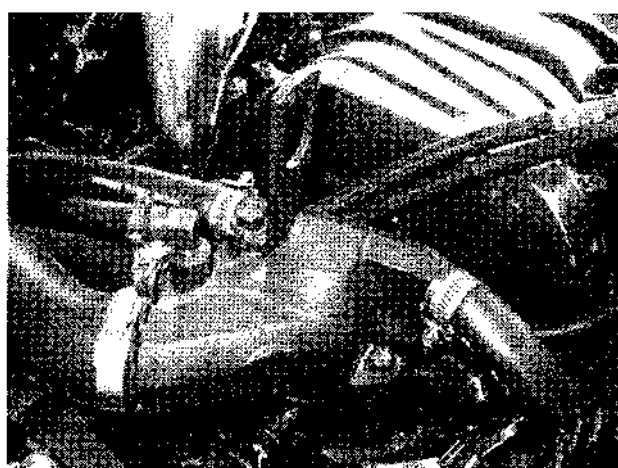


Fig. 50 Thermostat housing—5.7L/7.4L/8.2L engines

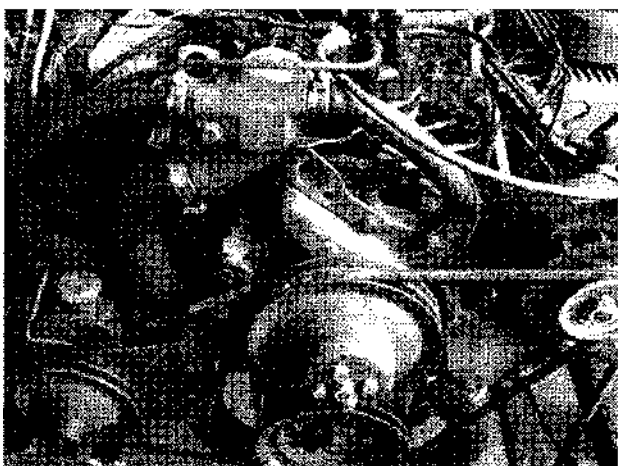


Fig. 52 Thermostat housing—7.5L engines

TESTING



◆ See Figures 53, 54, 55 and 56

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.
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; 157-163°F for a 160°F thermostat, or 138-142°F for the 140°F unit. If the unit fails the test, it must be replaced.
4. Continue to heat the water until a temperature of 182°F is reached; on 7.4L/8.2L engines, it should reach 162°F. At this time the thermostat should be completely open to 5/32 in. (3.96mm); 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.

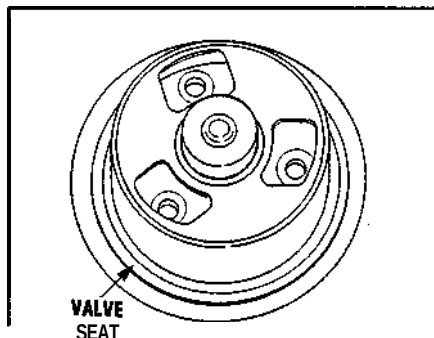


Fig. 53 Examine the perimeter of the thermostat for any visible light

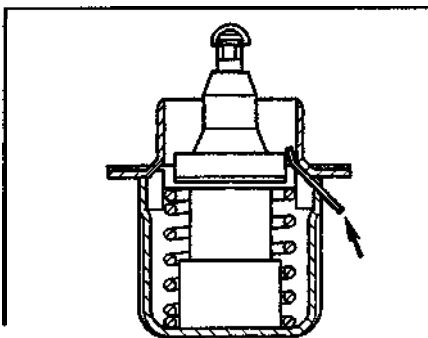


Fig. 54 Check the opening gap here on inline engine thermostats

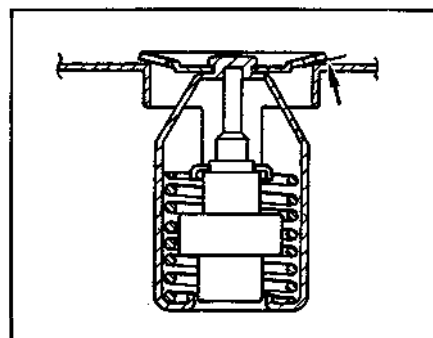


Fig. 55 Check the opening gap here on V6 and V8 engine thermostats

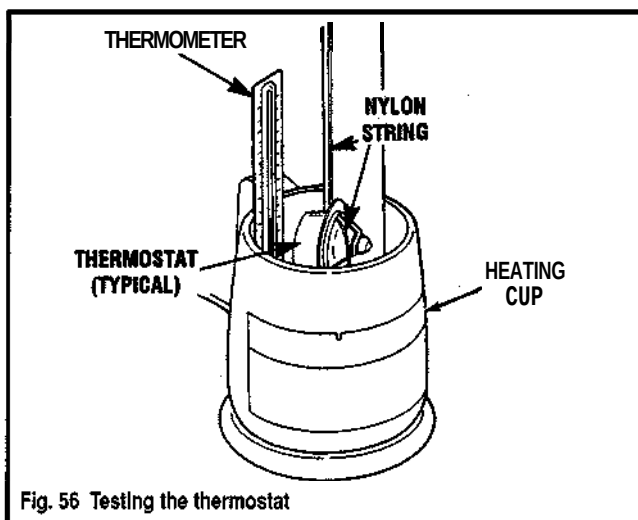


Fig. 56 Testing the thermostat

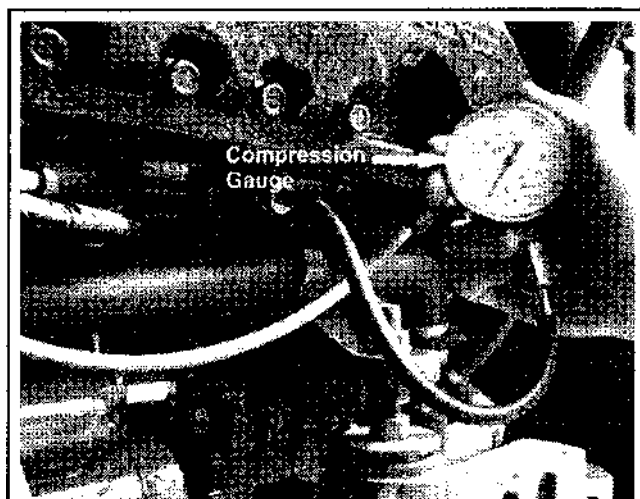


Fig. 57 When checking the compression, always use a quality gauge

Cylinder Compression

Cylinder compression test results are extremely valuable indicators of internal engine condition. The best marine mechanics automatically check an engine's compression as the first step in a comprehensive tune-up. A compression test will uncover many mechanical problems that can cause rough running or poor performance.

CHECKING COMPRESSION

◆ See Figures 57 and 58



1. Make sure that the proper amount and viscosity of engine oil is in the crankcase, then ensure the battery is fully charged.
2. Warm-up the engine to normal operating temperature, then shut the engine OFF. If the boat is out of the water, make sure to install a flush test kit.

3. Remove the flame arrestor and open the choke or throttle fully.

4. Disable the ignition system by doing the following:

1986-89 engines

- Disconnect the high tension lead running between the ignition coil and the distributor at the distributor. Ground the lead to the engine to prevent any sparking.

1990 engines

- All Cobra engines except 4.3L HO: Disconnect the high tension lead running between the ignition coil and the distributor at the distributor. Ground the lead to the engine to prevent any sparking.

- 4.3L HO: Tag and disconnect the 14-pin connector at the ignition module. Position it out of the way.

- All King Cobra engines: Remove the mounting bolt and then disconnect the lead at the ignition module. Position it out of the way.

1991-93 engines

- On all 3.0L engines: tag and disconnect the upper 2-wire connector at the ignition coil and position it out of the way.

- V6 and V8 carbureted Cobra engines except the 1991 4.3L HO: remove both distributor primary wires at the coil. Tape the terminals to avoid grounding.

- 1991 4.3L HO: tag and disconnect the 14-pin connector at the ignition module. Position it out of the way.

- V8 carbureted King Cobra engines except the 5.7 LE: tag and disconnect the 14-pin connector at the ignition module. Position it out of the way.

- 5.7 LE: remove both distributor primary wires at the coil. Tape the terminals to avoid grounding.

- EFI engines: disconnect the 2-way connector at the ignition coil.

1994-95 engines

- 3.0L and 4.3L engines and 7.4L EFI engines: tag and disconnect the upper 2-wire connector at the ignition coil and position it out of the way..

- 5.0FL, 5.7GL and 5.8FL engines: remove both distributor primary wires at the coil. Tape the terminals to avoid grounding

- 7.4GL engines: tag and disconnect the 14-wire connector at the ignition module.

- EFI engines except the 7.4 EFI: tag and disconnect the 2-way connector at the ignition coil

1996 engines

- 3.0L, 4.3L, 5.7Gi and 7.4Gi engines: tag and disconnect the upper (grey) 2-wire connector at the ignition coil and position it out of the way..

- 5.0FL and 5.8FL engines: remove both distributor primary wires at the coil. Tape the terminals to avoid grounding

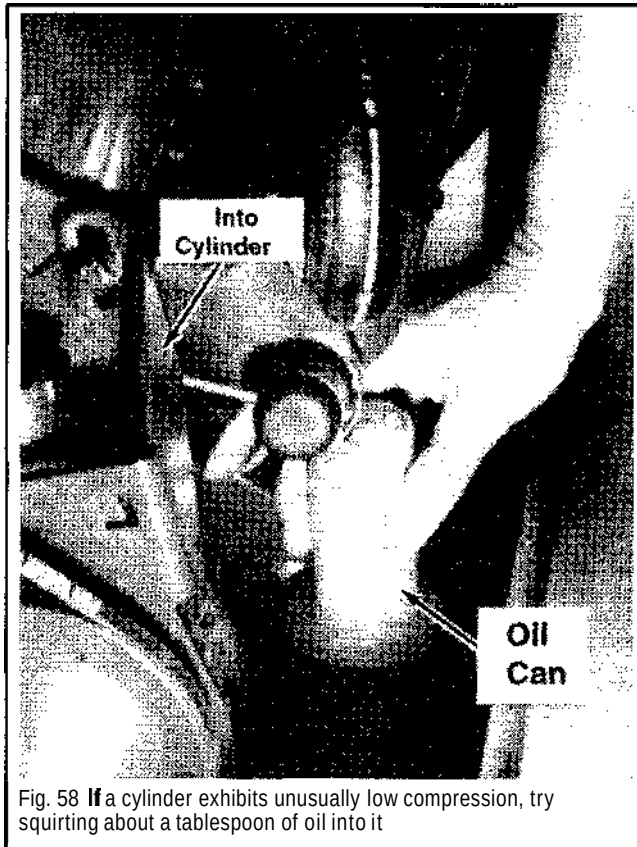


Fig. 58 If a cylinder exhibits unusually low compression, try squirting about a tablespoon of oil into it

- 5.0Fi, 5.8Fi and 5.8FSi engines: tag and disconnect the 2-way connector at the ignition coil
- 7.4GL engines: tag and disconnect the 14-wire connector at the ignition module.

1997-98 engines

- All except 5.7GL/GS and 7.4GL engines: disconnect the grey 2-wire connector at the ignition coil, it has purple and grey wires
 - 5.7GL/GS engines: remove both distributor primary wires at the coil. Tape the terminals to avoid grounding
 - 7.4GL: Disconnect the 14-wire connector at the ignition module.
1. Tag and disconnect all spark plug wires and then remove the plugs themselves.
 2. Install a screw-in type compression gauge into the No. 1 cylinder spark plug hole until the fitting is snug. Please refer to the firing order illustrations for location of the No. 1 cylinder. When fitting the compression gauge adapter to the cylinder head, make sure the bleeder of the gauge (if equipped) is closed.
 3. According to the tool manufacturer's instructions, connect a remote starting switch to the starting circuit.
 4. With the ignition switch in the OFF position, use the remote starting switch to crank the engine through at least five compression strokes (approximately 5 seconds of cranking) and record the highest reading on the gauge.
 5. Repeat the test on each cylinder, cranking the engine approximately the same number of compression strokes and/or times as the first.
 6. Compare the highest readings from each cylinder to that of the others. The indicated compression pressures are considered within specifications if the lowest reading cylinder is within 75 percent of the pressure recorded for the highest reading cylinder. For example, if your highest reading cylinder pressure was 150 psi (1034 kPa), then 75 percent of that would be 113 psi (779 kPa). So the lowest reading cylinder should be no less than 113 psi (779 kPa).
 7. Compression readings that are generally low indicate worn, broken, or sticking piston rings, scored pistons or worn cylinders.
 8. If a cylinder exhibits an unusually low compression reading, squirt a tablespoon of clean engine oil into the cylinder through the plug or injector

hole and repeat the compression test. If the compression rises after adding oil, it means that the cylinder's piston rings and/or cylinder bore are damaged or worn. If the pressure remains low, the valves may not be seating properly (a valve job is needed), or the head gasket may be blown near that cylinder.

9. If compression in any two adjacent cylinders is low (with normal compression in the other cylinders), and if the addition of oil doesn't help raise compression, there is leakage past the head gasket. Oil and coolant in the combustion chamber, combined with blue or constant white smoke from the tailpipe, are symptoms of this problem. However, don't be alarmed by the normal white smoke emitted from the tailpipe during engine warm-up during cold weather. There may be evidence of water droplets on the engine oil dipstick and/or oil droplets in the cooling system if a head gasket is blown.

Spark Plugs

The spark plug performs four main functions:

- It fills a hole in the cylinder head.
- It acts as a dielectric insulator for the ignition system.
- It provides spark for the combustion process to occur.
- It removes heat from the combustion chamber.

It is important to remember that spark plugs do not create heat, they help remove it. Anything that prevents a spark plug from removing the proper amount of heat can lead to pre-ignition, detonation, premature spark plug failure and even internal engine damage.

In the simplest of terms, the spark plug acts as the thermometer of the engine. Much like a doctor examining a patient, this "thermometer" can be used to effectively diagnose the amount of heat present in each combustion chamber.

Spark plugs are valuable tuning tools, when interpreted correctly. They will show symptoms of other problems and can reveal a great deal about the engine's overall condition. By evaluating the appearance of the spark plug's firing tip, visual cues can be seen to accurately determine the engine's overall operating condition, get a feel for air/fuel ratios and even diagnose drivability problems.

As spark plugs grow older, they lose their sharp edges and material from the center and ground electrodes is slowly eroded away. As the gap between these two points grows, the voltage required to bridge this gap increases proportionately. The ignition system must work harder to compensate for this higher voltage requirement and hence there is a greater rate of misfires or incomplete combustion cycles. Each misfire means lost horsepower, reduced fuel economy and higher emissions. Replacing worn out spark plugs with new ones (with sharp new edges) effectively restores the ignition system's efficiency and reduces the percentage of misfires, restoring power, economy and reducing emissions.

How long spark plugs last will depend on a variety of factors, including engine compression, fuel used, gap, center/ground electrode material and the conditions in which the engine is operated.

SPARK PLUG HEAT RANGE

- ◆ See Figure 59

Spark plug heat range is the ability of the plug to dissipate heat from the combustion chamber. The longer the insulator (or the farther it extends into the engine), the hotter the plug will operate; the shorter the insulator (the closer the electrode is to the block's cooling passages) the cooler it will operate.

Selecting a spark plug with the proper heat range will ensure that the tip will maintain a temperature high enough to prevent fouling, yet be cool enough to prevent pre-ignition. A plug that absorbs little heat and remains too cool will quickly accumulate deposits of oil and carbon since it is not hot enough to burn them off. This leads to plug fouling and consequently to misfiring. A plug that absorbs too much heat will have no deposits but, due to the excessive heat, the electrodes will burn away quickly and might possibly lead to pre-ignition or other ignition problems.

Pre-ignition takes place when plug tips get so hot that they glow sufficiently to ignite the air/fuel mixture before the actual spark occurs. This early ignition will usually cause a pinging during heavy loads and if not corrected will result in severe engine damage. While there are many other things that can cause pre-ignition, selecting the proper heat range spark plug will ensure that the spark plug itself is not a hot-spot source.

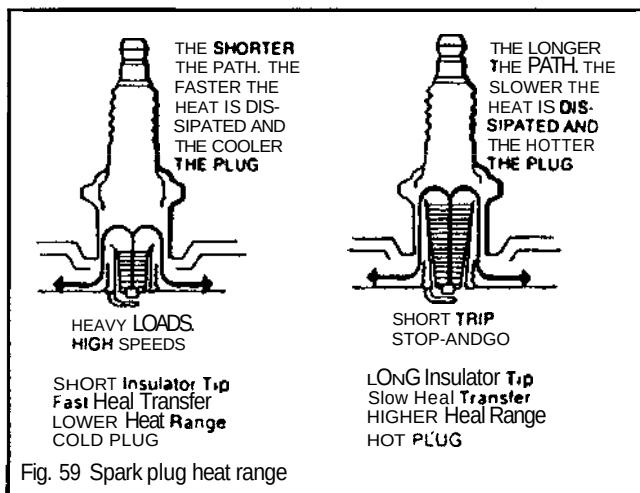
2-18 ENGINE AND DRIVE MAINTENANCE

SPARK PLUG SERVICE

□ New technologies in spark plug and ignition system design have pushed the recommended replacement interval higher and higher. However, this depends on usage and conditions.

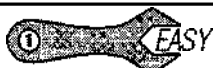
Spark plugs should only require replacement once a season. The electrode on a new spark plug has a sharp edge but with use, this edge becomes rounded by wear, causing the plug gap to increase. As the gap increases, the plug's voltage requirement also increases. It requires a greater voltage to jump the wider gap and about two to three times as much voltage to fire a plug at high speeds than at idle.

Tools needed for spark plug replacement include: a ratchet, short extension, spark plug socket (there are two types; either 13/16 inch or 5/8 inch, depending upon the type of plug), a combination spark plug gauge and gapping tool and a can of anti-seize type compound.



REMOVAL & INSTALLATION

◆ See Figures 60 and 61



1. When removing spark plugs, work on one at a time. Don't start by removing the plug wires all at once, because unless you number them, they may become mixed up. Take a minute before you begin and number the wires with tape.

2. Disconnect the negative battery cable or turn the battery switch OFF.

3. If the engine has been run recently, allow the engine to thoroughly cool. Attempting to remove plugs from a hot cylinder head could cause the plugs to seize and damage the threads in the cylinder head, especially on aluminum heads!

4. Carefully twist the spark plug wire boot to loosen it, then pull the boot using a twisting motion to remove it from the plug. Be sure to pull on the boot and not on the wire, otherwise the connector located inside the boot may become separated from the high-tension wire.

A spark plug wire removal tool is recommended as it will make removal easier and help prevent damage to the boot and wire assembly.

5. Using compressed air (and safety glasses), blow debris from the spark plug area to assure that no harmful contaminants are allowed to enter the combustion chamber when the spark plug is removed. If compressed air is not available, use a rag or a brush to clean the area. Compressed air is available from both an air compressor or from compressed air in cans available at photography stores.

□ Remove the spark plugs when the engine is cold, if possible, to prevent damage to the threads. If plug removal is difficult, apply a few drops of penetrating oil to the area around the base of the plug and allow it a few minutes to work.

6. Using a 5/8 in. spark plug socket that is equipped with a rubber insert to properly hold the plug, turn the spark plug counterclockwise to loosen and remove the spark plug from the bore.

×× WARNING

Avoid the use of a flexible extension on the socket. Use of a flexible extension may allow a shear force to be applied to the plug. A shear force could break the plug off in the cylinder head, leading to costly and frustrating repairs. In addition, be sure to support the ratchet with your other hand—this will also help prevent the socket from damaging the plug.

7. Evaluate each cylinder's performance by comparing the spark plug condition. Check each spark plug to be sure they are all of the same manufacturer and have the same heat range rating. Inspect the threads in the spark plug opening of the block and clean the threads before installing the plug.

8. When purchasing new spark plugs, always ask the dealer if there has been a spark plug change for the engine being serviced. Many times manufacturers will update the type of spark plug used in an engine to offer better efficiency or performance.

9. Crank the engine through several revolutions to blow out any material that might have become dislodged during cleaning. Always use a new gasket (if applicable), but never use gaskets on taper seat plugs. The gasket must be fully compressed on clean seats to complete the heat transfer process and to provide a gas tight seal in the cylinder.

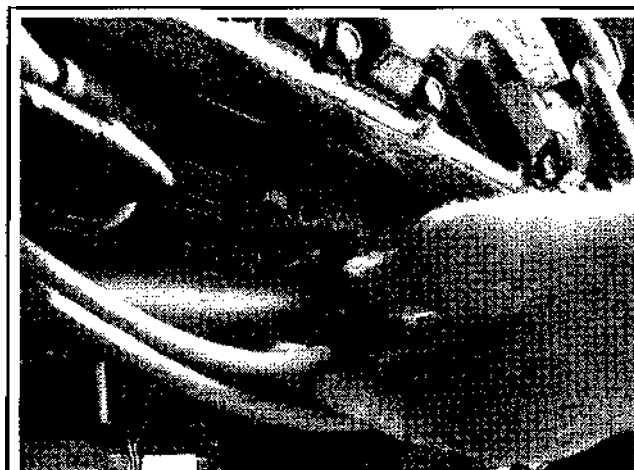


Fig. 60 Grab the plug wire boot and twist while removing it

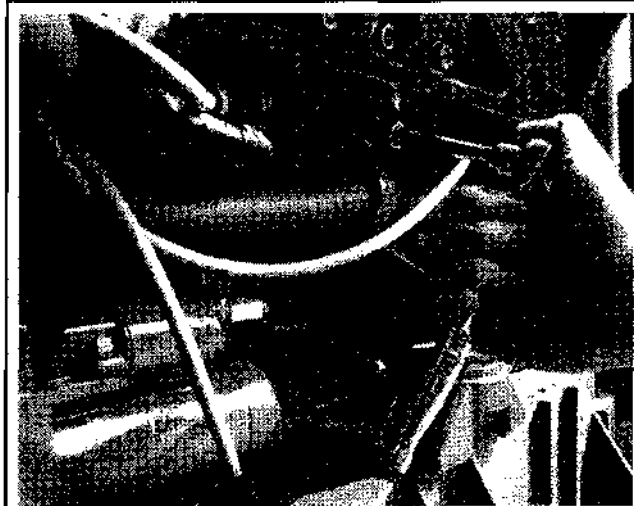


Fig. 61 Removing the spark plug

10. Inspect the spark plug boot for tears or damage. If a damaged boot is found, the spark plug boot and possibly the entire wire will need replacement.

11. Check the spark plug gap prior to installing the plug. Most spark plugs do not come gapped to the proper specification.

12. Apply a thin coating of anti-seize on the thread of the plug. This is extremely important on aluminum head engines.

13. Carefully thread the plug into the bore by hand. If resistance is felt before the plug completely bottomed, back the plug out and begin threading again.

❖❖ WARNING

Do not use the spark plug socket to thread the plugs. Always carefully thread the plug by hand or using an old plug wire to prevent the possibility of cross-threading and damaging the cylinder head bore.

14. Carefully tighten the spark plug. If the plug you are installing is equipped with a crush washer, tighten the plug until the washer seats, then turn it 1/4 turn to crush the washer. Whenever possible, spark plugs should be tightened to the factory torque specification:

1986-88 engines

- All engines—15 ft. lbs. (20 Nm)

1989 engines

- 2.3L—5-10 ft. lbs. (7-13 Nm)
- 3.0L, 4.3L, 5.7L, 262,350—22 ft. lbs. (30 Nm)
- Ford 5.0L/5.8L—15-20 ft. lbs. (20-27 Nm)
- 460 King Cobra—5-10 ft. lbs. (7-13 Nm)

1990 engines

- 2.3L—5-10 ft. lbs. (7-13 Nm)
- GM Cobras—22 ft. lbs. (30 Nm)
- GM King Cobras—20 ft. lbs. (27 Nm)
- Ford V8—15-20 ft. lbs. (20-27 Nm)

1991-98 engines

- GM—20 ft. lbs. (27 Nm)
- Ford—5-10 ft. lbs. (7-13 Nm)

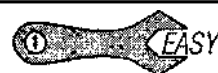
15. Apply a small amount of silicone dielectric grease to the end of the spark plug lead or inside the spark plug boot to prevent sticking, then install the boot to the spark plug and push until it clicks into place. The click may be felt or heard. Gently pull back on the boot to assure proper contact.

16. Connect the negative battery cable or turn the battery switch **ON**.

17. Start the engine and insure proper operation.

READING SPARK PLUGS

◆ See Figures 62 thru 68



Reading spark plugs can be a valuable tuning aid. By **examining** the insulator firing nose color, you can determine much about the engine's overall operating condition.

In general, a light tan/gray color tells you that the spark plug is at the optimum temperature and that the engine is in good operating condition.

Dark coloring, such as heavy black wet or dry deposits usually indicate a fouling problem. Heavy, dry deposits can indicate an overly rich condition, too cold a heat range spark plug, possible vacuum leak, low compression, overly retarded timing or too large a plug gap.

If the deposits are wet, it can be an indication of a breached head gasket, oil control from ring problems or an extremely rich condition, depending on what liquid is present at the firing tip.

Look for signs of detonation, such as silver specs, black specs or melting or breakage at the firing tip.

Compare your plugs to the illustrations shown to identify the most common plug conditions.

Fouled Spark Plugs

A spark plug is fouled when the insulator nose at the firing tip becomes coated with a foreign substance, such as fuel, oil or carbon. This coating makes it easier for the voltage to follow along the insulator nose and leach back down into the metal shell, grounding out, rather than bridging the gap normally.

Fuel, oil and carbon fouling can all be caused by different things but in any case, once a spark plug is fouled, it will not provide voltage to the firing tip and that cylinder will not fire properly. In many cases, the spark plug cannot be cleaned sufficiently to restore normal operation. It is therefore recommended that fouled plugs be replaced.

Signs of fouling or excessive heat must be traced quickly to prevent further deterioration of performance and to prevent possible engine damage.

Overheated Spark Plugs

When a spark plug tip shows signs of melting or is broken, it usually means that excessive heat and/or detonation was present in that particular combustion chamber or that the spark plug was suffering from thermal shock.

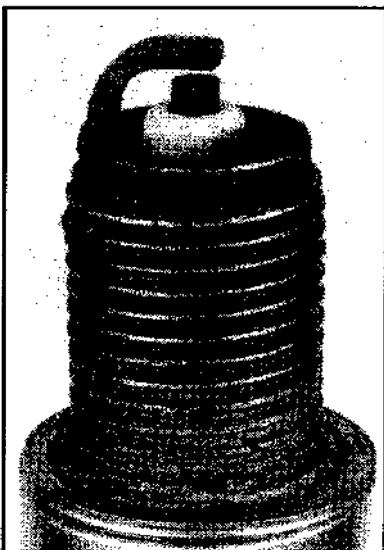


Fig. 62 A normally worn spark plug should have light tan or gray deposits on the firing tip (electrode)

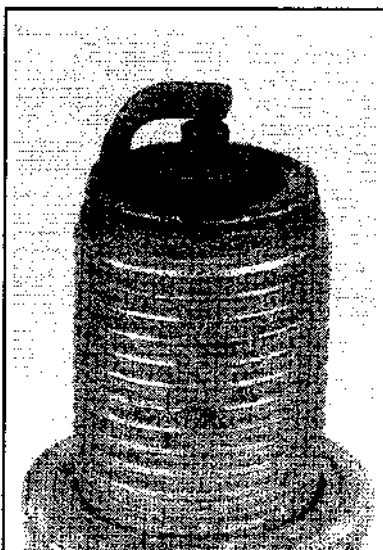


Fig. 63 A carbon-fouled plug, identified by soft, sooty black deposits, may indicate an improperly tuned engine

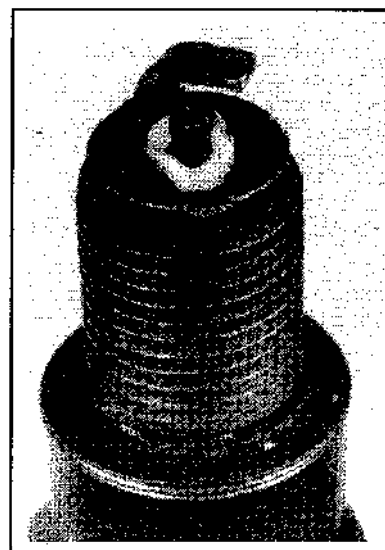


Fig. 64 A physically damaged spark plug may be evidence of severe detonation in that cylinder. Watch the cylinder carefully between services, as a continued detonation will not only damage the plug but will most likely damage the engine

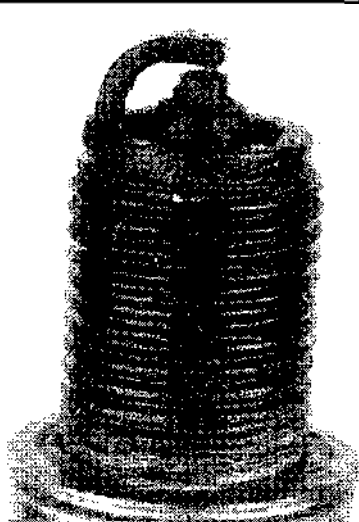


Fig. 65 An oil-fouled spark plug indicates an engine with worn piston rings



Fig. 66 This spark plug has been left in the engine too long, as evidenced by the extreme gap. Plugs with such an extreme gap can cause misfiring and stumbling accompanied by a noticeable lack of power



Fig. 67 A bridged or almost bridged spark plug, identified by the build-up between the electrodes caused by excessive carbon or oil build-up on the plug

Since spark plugs do not create heat by themselves, one must use this visual clue to track down the root cause of the problem. In any case, damaged firing tips most often indicate that cylinder pressures or temperatures were too high. Left unresolved, this condition usually results in more serious engine damage.

Detonation refers to a type of abnormal combustion that is usually preceded by pre-ignition. It is most often caused by a hot spot formed in the combustion chamber.

As air and fuel is drawn into the combustion chamber during the intake stroke, this hot spot will "pre-ignite" the air fuel mixture without any spark from the spark plugs.

Detonation

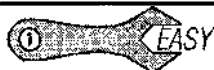
Detonation exerts a great deal of downward force on the pistons as they are being forced upward by the mechanical action of the connecting rods. When this occurs, the resulting concussion, shock waves and heat can be severe. Spark plug tips can be broken or melted and other internal engine components such as the pistons or connecting rods themselves can be damaged.

Left unresolved, engine damage is almost certain to occur, with the spark plug usually suffering the first signs of damage.

When signs of detonation or pre-ignition are observed, they are symptom of another problem. You must determine and correct the situation that caused the hot spot to form in the first place.

INSPECTION & GAPPING

◆ See Figures 69 and 70



A particular spark plug might fit hundreds of engines and although the factory will typically set the gap to a pre-selected setting, this gap may not be the right one for your particular engine.

Insufficient spark plug gap can cause pre-ignition, detonation, even engine damage. Too much gap can result in a higher rate of misfires, noticeable loss of power, plug fouling and poor economy.

Check the spark plug gap before installation. The ground electrode (the L-shaped one connected to the body of the plug) must be parallel to the center electrode and the specified size wire gauge must pass between the electrodes with a slight drag.

Do not use a flat feeler gauge when measuring the gap on a used plug,

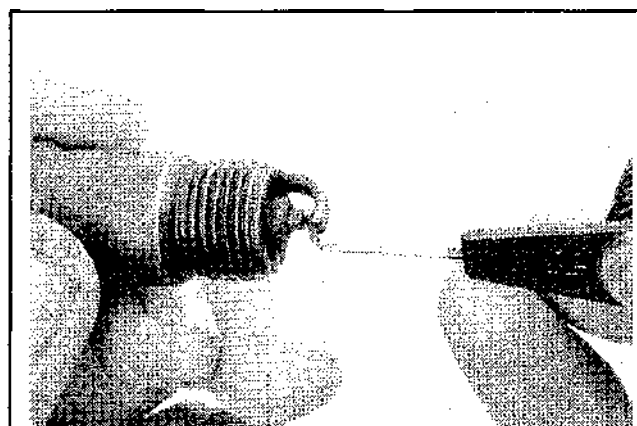


Fig. 69 Using a wire-type spark plug gapping tool to check the distance between center and ground electrodes

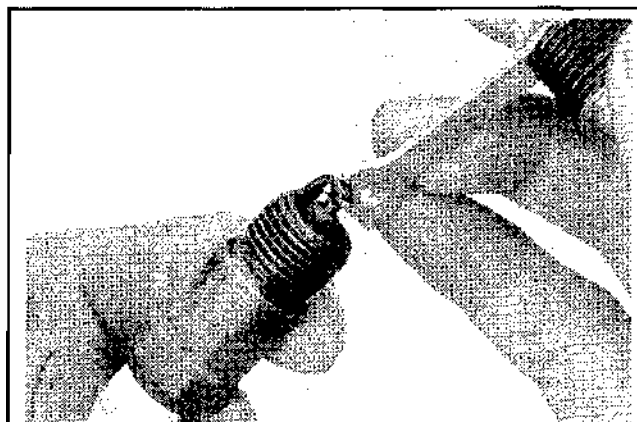
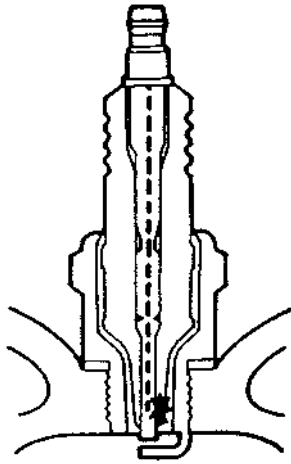
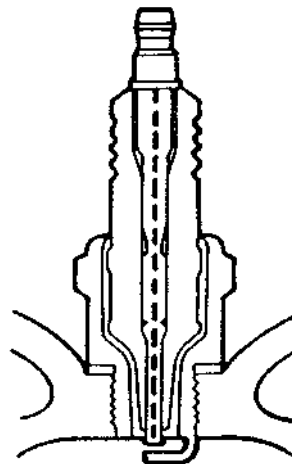


Fig. 70 Most spark plug gapping tools have an adjusting tool used to bend the ground electrode. USE IT! This tool greatly reduces the chance of breaking off the electrode and is much more accurate

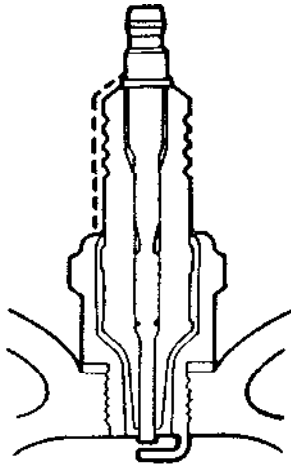
Tracking Arc
High voltage arcs between a fouling deposit on the insulator tip and spark plug shell. This ignites the fuel/air mixture at some point along the insulator tip, retarding the ignition timing which causes a power and fuel loss.



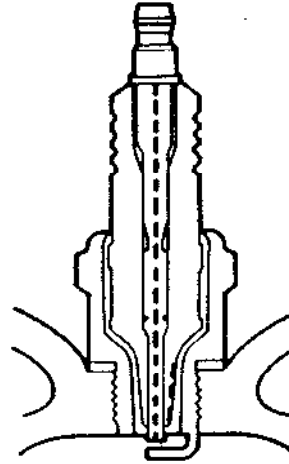
Wide Gap
Spark plug electrodes are worn so that the high voltage charge cannot arc across the electrodes. Improper gapping of electrodes on new or "cleaned" spark plugs could cause a similar condition. Fuel remains unburned and a power loss results.



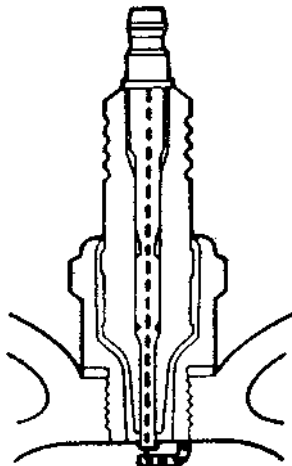
Flashover
A damaged spark plug boot, along with dirt and moisture, could permit the high voltage charge to short over the insulator to the spark plug shell or the engine. AC's buttress insulator design helps prevent high voltage flashover.



Fouled Spark Plug
Deposits that have formed on the insulator tip may become conductive and provide a "shunt" path to the shell. This prevents the high voltage from arcing between the electrodes. A power and fuel loss is the result.



Bridged Electrodes
Fouling deposits between the electrodes "ground out" the high voltage needed to fire the spark plug. The arc between the electrodes does not occur and the fuel air mixture is not ignited. This causes a power loss and exhausting of raw fuel.



Cracked Insulator
A crack in the spark plug insulator could cause the high voltage charge to "ground out." Here, the spark does not jump the electrode gap and the fuel air mixture is not ignited. This causes a power loss and raw fuel is exhausted.

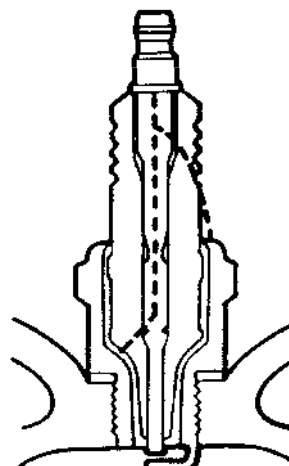


Fig. 68 Typical spark plug problems showing damage that may indicate engine problems

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because the reading may be inaccurate. A round wire-type gapping tool is the best way to check the gap. The correct gauge should pass through the electrode gap with a slight drag. If you're in doubt, try a wire that is one size smaller or larger. The smaller gauge should go through easily, while the larger one shouldn't go through at all.

Wire gapping tools usually have a bending tool attached. Use this tool to adjust the side electrode until the proper distance is obtained. Never attempt to bend the center electrode. Also, be careful not to bend the side electrode too far or too often as it may weaken and break off within the engine, requiring removal of the cylinder head to retrieve it.

Spark Plug Wires

TESTING DVOM

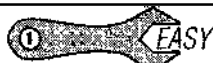


Each time you remove the engine cover, visually inspect the spark plug wires for burns, cuts or breaks in the insulation. Check the boots on the coil and at the spark plug end. Replace any wire that is damaged.

Once a year, usually when you change your spark plugs, check the resistance of the spark plug wires with an ohmmeter. Wires with excessive resistance will cause misfiring and may make the engine difficult to start. In addition worn wires will allow arcing and misfiring in humid conditions.

Remove the spark plug wire from the engine. Test the wires by connecting one lead of an ohmmeter to the coil end of the wire and the other lead to the spark plug end of the wire. Resistance should measure approximately 3000-7000 ohms per foot of wire. If a spark plug wire is found to have excessive (high) resistance, the entire set should be replaced.

REMOVAL & INSTALLATION



When installing a new set of spark plug wires, replace the wires one at a time so there will be no confusion. Coat the inside of the boots with dielectric grease to prevent sticking. Install the boot firmly over the spark plug until it clicks into place. The click may be felt or heard. Gently pull back on the boot to assure proper contact. Repeat the process for each wire.

■ It is important to route the new spark plug wire the same as the original and install it in a similar manner on the engine. Improper routing of spark plug wires may cause engine performance problems.

Ignition Timing

As the engine must be running while performing this operation we recommend that it is undertaken with the boat in the water. If not, make certain that an engine flushing kit has been installed.

ADJUSTMENT



■ If you are unsure of which ignition system your engine has been equipped with, please refer to the Ignition System Applications chart.

Breaker Point Ignition Systems



◆ See Figures 71, 72 and 73

■ If you are unsure of which ignition system your engine has been equipped with, please refer to the Ignition System Application chart found in the Ignition Systems section.

Failure to follow the timing procedure instructions exactly will result in improper timing and cause performance problems at the least and possibly severe engine damage. If the timing is completely off, or if the distributor has been removed and the engine rotated, please refer to the initial timing procedures detailed in the Distributor Installation section.

1. Confirm that the dwell angle is within specifications, adjust if necessary.
2. Connect a suitable timing light to the No. 1 spark plug lead (see Firing Order illustrations for location of the No. 1 cylinder). Connect the power supply lead to the battery as detailed in the light manufacturer's instructions.
3. Connect a tachometer to the engine as detailed by the manufacturer. Do not use the tachometer on the instrument panel as it will not provide the necessary accuracy.
4. Locate the timing mark scale on the engine's timing chain cover (just above the crankshaft pulley/harmonic balancer) and place a bit of white paint where the proper mark should be (TDC is usually marked with a 0, while each mark or gradation should equal 2°). Also, paint a dab on the mark stamped into the pulley (4 cyl.) or harmonic balancer (V6/V8). On Ford engines, the scale is actually on the harmonic balancer and there is a small pointer attached to the front cover.

Please refer to the **Tune-Up** Specifications chart for the correct timing figure. You may also be able to check the ignition timing specification on the engine tune-up sticker affixed to the engine. If this figure differs from that which is listed here, ALWAYS go with the figure on the sticker.



Fig. 71 Typical timing mark tab—GM engine

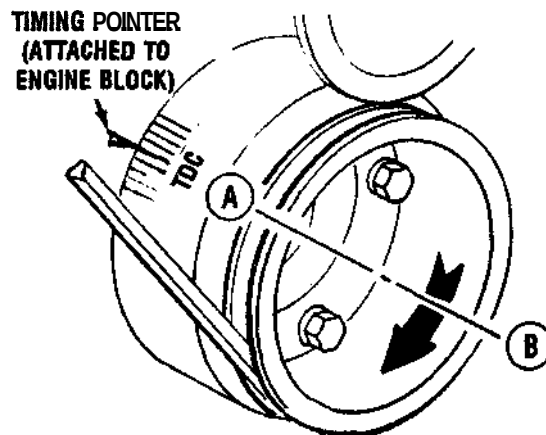


Fig. 72 Typical timing mark tab—Ford engine

5. Start the engine and allow it to reach normal operating temperature at idle—the choke valve should be wide open.
6. Check that the idle speed is to specification (as per the Tune-Up Specifications chart) with the engine in gear and then shift it to Neutral.
7. While still idling, point the light at the timing marks. The strobe will make it appear that the mark on the tab and the mark on the pulley stand still in alignment.
8. If the timing requires adjustment, loosen the clamp bolt at the base of the distributor and then carefully rotate the distributor or sensor until the correct marks line up.
9. Tighten the clamp bolt to 20 ft. lbs. (27 Nm) and check the timing one last time.
10. Turn off the engine.

■ Please refer to the Tune-up Specifications chart for the correct timing figure. You may also be able to check the ignition timing specification on the engine tune-up sticker affixed to the engine. If this figure differs from that which is listed here, ALWAYS go with the figure on the sticker.

11. Turn off the engine. Disconnect the timing light and the tachometer.

BID And HEI Ignition Systems



- ◆ See Figures 71, 72 and 73

If you are unsure of which ignition system your engine has been equipped with, please refer to the Ignition System Application chart in the Ignition Systems section.



Fig. 73 Always use a timing light to adjust the ignition timing

Failure to follow the timing procedure instructions exactly will result in improper timing and cause performance problems at the least and possibly severe engine damage.

1. Connect a suitable timing light to the No. 1 spark plug lead (see firing order illustrations for location of the No. 1 cylinder). Connect the power supply lead to the battery as detailed in the light manufacturer's instructions.
2. Connect a tachometer to the engine as detailed by the manufacturer. Do not use the tachometer on the instrument panel as it will not provide the necessary accuracy.
3. Locate the timing mark scale on the engine's timing chain cover (just above the crankshaft pulley/harmonic balancer) and place a bit of white paint where the proper mark should be (TDC is usually marked with a 0, while each mark or gradation should equal 2°). Also, paint a dab on the mark stamped into the pulley (4 cyl.) or harmonic balancer (V6/V8). On Ford engines, the scale is actually on the harmonic balancer and there is a small pointer attached to the front cover.

□ Please refer to the Tune-Up Specifications chart for the correct timing figure. You may also be able to check the ignition timing specification on the engine tune-up sticker affixed to the engine. If this figure differs from that which is listed here, ALWAYS go with the figure on the sticker.

4. Start the engine and allow it to reach normal operating temperature at idle—the choke valve should be wide open.
5. Check that the idle speed is to specification (as per the Tune-Up Specifications chart) with the engine in gear and then shift it to Neutral.

■ Always ensure the air gap between the sensor and the trigger wheel is correct before checking ignition timing.

6. While still idling, point the light at the timing marks. The strobe will make it appear that the mark on the tab and the mark on the pulley stand still in alignment.
7. If the timing requires adjustment, loosen the clamp bolt at the base of the distributor and then carefully rotate the distributor or sensor until the correct marks line up.
8. Tighten the clamp bolt to 20 ft. lbs. (27 Nm) and check the timing one last time.
9. Restart the engine and recheck the idle speed and mixture. Adjust as necessary.

□ Please refer to the Tune-Up Specifications chart for the correct specifications. You may also be able to check the ignition timing specification on the engine tune-up sticker affixed to the engine. If this figure differs from that which is listed here, ALWAYS go with the figure on the sticker.

EST Ignition Systems



■ If you are unsure of which ignition system your engine has been equipped with, please refer to the Ignition System Application chart found in the Ignition Systems section.

Carbureted Engines

- See Figures 71, 72, 73 and 74

■ Failure to follow the timing procedure instructions exactly will result in improper timing and cause performance problems at the least and possibly severe engine damage.

1. Connect a suitable timing light to the No. 1 spark plug lead (see firing order illustrations for location of the No. 1 cylinder). Connect the power supply lead to the battery as detailed in the light manufacturer's instructions.
2. Connect a tachometer to the engine as detailed by the manufacturer. Do not use the tachometer on the instrument panel as it will not provide the necessary accuracy.

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3. Locate the timing mark scale on the engine's timing chain cover (just above the crankshaft pulley/harmonic balancer) and place a bit of white paint where the proper mark should be (TDC is usually marked with a **0**, while each mark or gradation should equal 2°). Also, paint a dab on the mark stamped into the pulley (4 cyl.) or harmonic balancer (V6/V8). On Ford engines, the scale is actually on the harmonic balancer and there is a small pointer attached to the front cover.

Please refer to the Tune-Up Specifications chart for the correct timing figure. You may also be able to check the ignition timing specification on the engine tune-up sticker affixed to the engine. If this figure differs from that which is listed here, **ALWAYS** go with the figure on the sticker.

4. Before moving forward, you must bypass the electronic spark advance function of the EST system. Disconnect the 4-wire connector on the side of the distributor and install OMC Adaptor #986662 across the two white leads. Connect the bare wire to a 12-volt engine power source.

□ Not all models will have a harness connected to the 4-wire connector on the distributor. If there is nothing attached, simply remove the connector cover.

5. Start the engine and allow it to reach normal operating temperature at idle—the choke valve should be wide open.

6. Check that the idle speed is to specification (as per the Tune-Up Specifications chart) with the engine in gear and then shift it to Neutral.

7. While still idling, point the light at the timing marks. The strobe will make it appear that the mark on the tab and the mark on the pulley stand still in alignment.

8. If the timing requires adjustment, loosen the clamp bolt at the base of the distributor and then carefully rotate the distributor or sensor until the correct marks line up.

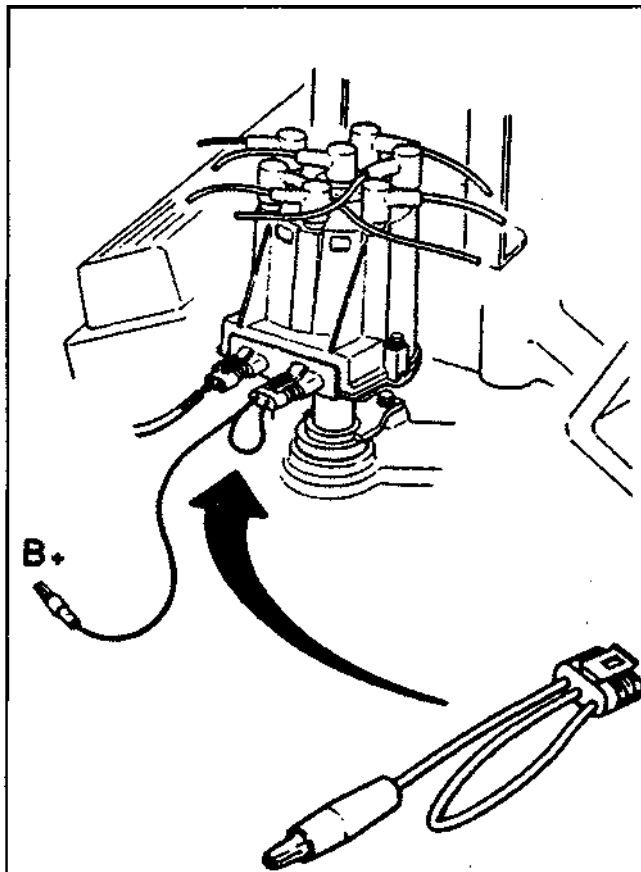


Fig. 74 Before checking the ignition timing on EST systems, you must install the special connector harness

9. Tighten the clamp bolt securely and check the timing one last time.
10. Turn off the engine, remove the adapter plug from the distributor and reconnect the 4-wire connector (or install the cap if there was no connector).
11. Restart the engine. With the timing light still connected and the engine running at 1000 rpm, check that the timing advanced to 15° BTDC on all 1991-94 engines. Re-adjust as necessary by rotating the distributor.

□ Please refer to the Tune-Up Specifications chart for the correct timing figure. You may also be able to check the ignition timing specification on the engine tune-up sticker affixed to the engine. If this figure differs from that which is listed here, **ALWAYS** go with the figure on the sticker.

12. Turn off the engine. Disconnect the timing light and the tachometer.

EFI Engines

◆ See Figures 71, 72, 73 and 75

Although ignition timing is adjustable on these models, it is generally controlled by the EFI electronic control module. In order to adjust the timing, the ECM must be forced to enter into its service mode by using a scan tool. This done, the ECM will stabilize the base timing to allow for adjustment by conventional means of rotating the distributor.

The idle speed must be correctly adjusted and within specifications before performing this procedure.

1. Open or remove the engine compartment hatch.
2. Connect a suitable timing light to the No. 1 spark plug lead (see firing order illustrations for location of the No. 1 cylinder). Connect the power supply lead to the battery as detailed in the light manufacturer's instructions.
3. Connect a tachometer to the engine as detailed by the manufacturer. Do not use the tachometer on the instrument panel, as it will not provide the necessary accuracy.
4. Locate the timing mark scale on the engine's timing chain cover (just above the crankshaft pulley/harmonic balancer) and place a bit of white paint where the proper mark should be (TDC is usually marked with a **0**, while each mark or gradation should equal 2°). Also, paint a dab on the mark stamped into the pulley (4 cyl.) or harmonic balancer (V6/V8).

Please refer to the Tune-Up Specifications chart for the correct timing figure. You may also be able to check the ignition timing specification on the engine tune-up sticker affixed to the engine. If this figure differs from that which is listed here, **ALWAYS** go with the figure on the sticker.

5. Start the engine and allow it to reach normal operating temperature at idle. Set the idle speed to 1000 rpm.

6. Turn off the engine, locate the data link connector (DLC) on the EFI/MPI main harness (usually at the front of the engine on the upper starboard side) and plug in OMC's Marine Diagnostic Trouble Code (MDTC) tool—please refer to the Fuel System section for further details on this. If an MDTC is not available, use a jumper wire and connect it between the whitelblack and black wire terminals on the DLC.

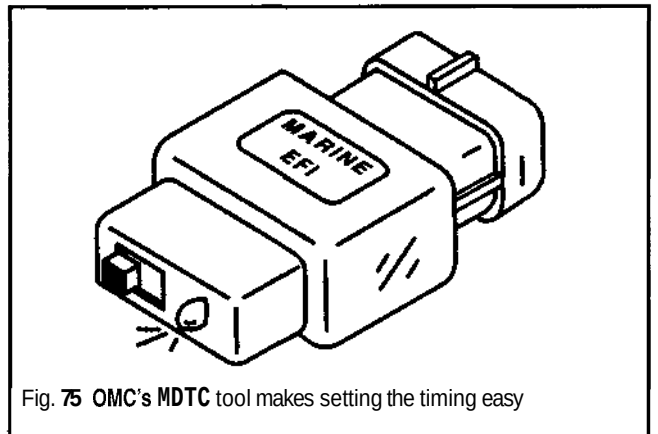


Fig. 75 OMC's MDTC tool makes setting the timing easy

7. Restart the engine and allow the idle to stabilize.
8. Set the MDTC to the ON position.
9. While still idling, point the light at the timing marks. The strobe will make it appear that the mark on the tab and the mark on the damper/pulley stand still in alignment.
10. If the timing requires adjustment, loosen the clamp bolt at the base of the distributor and then carefully rotate the distributor until the correct marks line up.
11. Tighten the clamp bolt securely and then recheck the timing.
12. Disconnect the tool or the jumper wire.
13. Check the timing one last time. If still correct, disconnect the light and tachometer.

Spitfire EEM Ignition Systems

These engine utilize a timing ring mounted on the crankshaft between the flywheel and the engine coupler which directs the EEM module when to fire a particular cylinder. No ignition timing adjustment is necessary or required. Please refer to the Ignition Systems section for further information on the Spitfire system.

Thick Film Integrated (TFI-IV) Ignition Systems



† See Figures 72 and 73

■ If you are unsure of which **ignition** system your engine has been **equipped** with, please refer to the Ignition System Application chart found in the Ignition Systems section.

■ Failure to follow the timing procedure instructions exactly will result in improper timing and cause performance problems at the least and **possibly** severe engine damage.

1. Position the shift lever in Neutral.
2. Connect a suitable variable advance, inductive timing light to the No. 1 spark plug lead (see Firing Order illustrations for location of the No. 1 cylinder). Connect the power supply lead to the battery as detailed in the light manufacturer's instructions.
3. Connect a tachometer to the engine as detailed by the manufacturer. Do not use the tachometer on the instrument panel as it will not provide the necessary accuracy.
4. Locate the timing mark scale on the harmonic balancer and place a bit of white paint where the proper mark should be (TDC is usually marked with a 0, while each mark or gradation should equal 2°).

■ Please refer to the Tune-up **Specifications** chart for the correct **timing figure**. You may also be able to check the **ignition timing specification** on the engine tune-up sticker **affixed** to the **engine**. If this figure differs from that which is listed here, **ALWAYS** go with the figure on the **sticker**.

5. Start the engine and allow it to reach normal operating temperature at idle.
6. Locate the two-wire SPOUT connector (near the front of the engine) and carefully pull out the shorting bar.
7. While still idling, point the light at the timing marks. The strobe will make it appear that the mark on the tab and the mark on the pulley stand still in alignment.
8. If the timing requires adjustment, loosen the clamp bolt at the base of the distributor and then carefully rotate the distributor until the correct marks line up.
9. Apply Electrical Terminal grease to the SPOUT connector terminals and then reinsert the shorting bar.
10. Check the timing advance to ensure it is advancing beyond the initial setting.
11. Disconnect the **timing light** and tachometer.
12. **Tighten the distributor clamp bolt to 17-25 ft lb (23-34 Nm).**
13. **Restart** the engine and recheck the idle speed and mixture. Adjust as necessary.

Please refer to the Tune-up Specifications chart for the correct specifications. You may also be able to check the ignition timing specification on the engine tune-up sticker affixed to the engine. If this figure differs from that which is listed here, **ALWAYS** go with the figure on the sticker.

Breaker Points and Condenser

All 1986-89 models and many 1990 models were equipped with a standard breaker points ignition system. There are two ways to check breaker point gap: with a feeler gauge or with a dwell meter. Either way you choose, you are adjusting the amount of time (in degrees of distributor rotation) that the points will remain open. If you adjust the points with a feeler gauge, you are setting the maximum amount the points will open when the rubbing block on the points is on one of the high points of the distributor cam. When you adjust the points with a dwell meter, you are measuring the number of degrees (of distributor cam rotation) that the points will remain closed before they start to open as a high point of the distributor cam approaches the rubbing block of the points.

Although using a feeler gauge is reasonably accurate when setting new point sets, this method can be unreliable when checking used points due to the rough surface caused by pitting associated with wear and tear. Adjusting the dwell should always be considered the more accurate method.

There are two rules that should always be followed when adjusting or replacing points:

- Points and condenser are a matched set; NEVER replace one without replacing the other.
- When you change the point gap or dwell of the engine, you also change the ignition timing. Always adjust the timing after a point or dwell adjustment.

Marine distributors have a corrosion-resistant coating applied to the return spring on top of the breaker plate and on the two small springs under the plate - NEVER use automotive parts as a replacement!

REMOVAL AND INSTALLATION

◆ See Figures 76, 77 and 78



1. Remove or open the engine compartment hatch cover. Disconnect the negative battery cable or turn the battery switch to OFF.
2. Loosen the distributor cap retaining screws (two) and carefully lift off the cap. Although it is not necessary remove the spark plug wires from the cap, we recommend that you first tag all the wires just to be safe.
3. Note the position of the rotor and pull the rotor straight up and remove it. Check the rotor carefully for a burned or corroded center contact, cracks or carbon tracks.
4. Loosen the primary terminal nut and then disconnect the lead wire. Do the same for the condenser lead wire.
5. Loosen the condenser/breakerpoint mounting screws and then lift them up and off the breaker plate. Clean any dirt or oil left on the plate.
6. Coat the distributor cam with a small amount of distributor Cam Lubricant (NEVER use grease or oil), wipe the new point set clean and position it on the breaker plate. Tighten the mounting screws, leaving the lock screw slightly loose.
7. Reconnect the lead wires for the condenser and primary.
8. Check that the points are in alignment. If not, carefully bend the stationary arm until they align properly. If you are still not satisfied, get a new set of points. Never adjust alignment on used points.
9. Adjust the point gap as detailed following. Install the rotor in the same position it was removed. Install the cap, connect the battery cables and check for proper operation.
10. Adjust the ignition timing

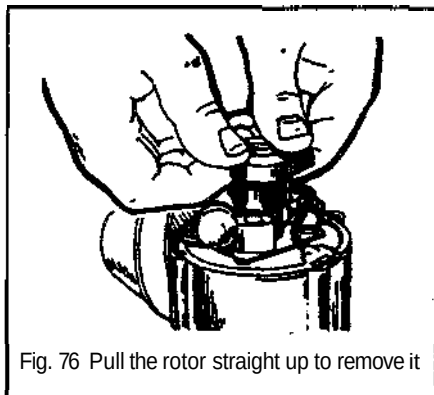


Fig. 76 Pull the rotor straight up to remove it

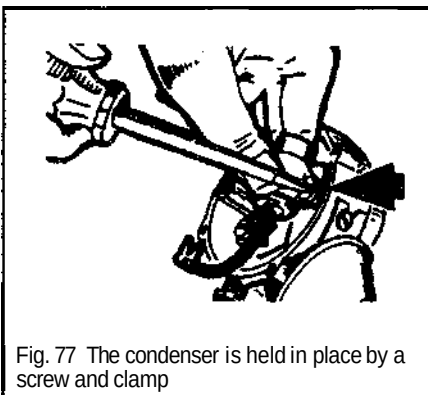


Fig. 77 The condenser is held in place by a screw and clamp

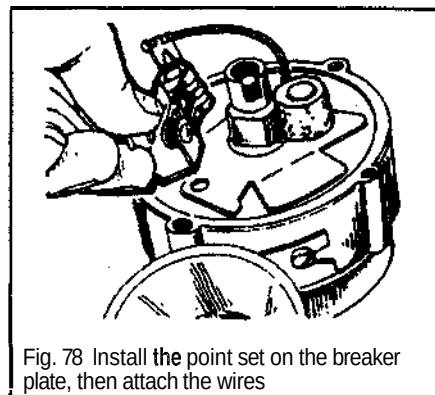
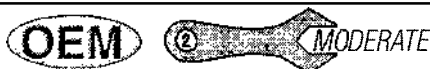


Fig. 78 Install the point set on the breaker plate, then attach the wires

ADJUSTMENT—FEELER GAUGE



◆ See Figures 79, 80 and 81

1. Perform the first three steps of the removal procedure above.
2. Connect a remote starter switch as detailed in the manufacturers' instructions. Have a friend bump the engine over until you see that the breaker point rubbing block is resting on the high point of the distributor cam—the points should open to their fullest extent.
3. Insert an feeler gauge between the points—please refer to the Tune-Up Specifications chart for correct point gap. The gauge should be snug but not tight. If adjustment is required, loosen the lock screw and insert a screwdriver in to the adjustment slot on the breaker plate; move the point set until a slight drag can be felt on the feeler gauge and then tighten the lock screw. Always check the gap a final time after tightening the screw as the points sometimes move when tightening the screw.
4. Install the rotor and distributor cap. Connect the battery cables and adjust the ignition timing.

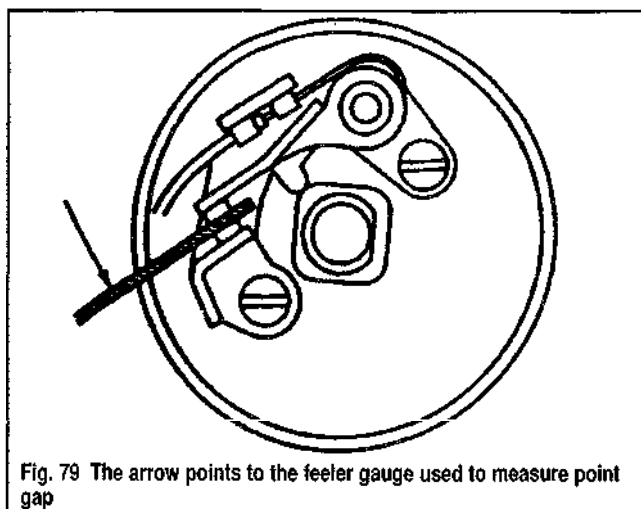


Fig. 79 The arrow points to the feeler gauge used to measure point gap

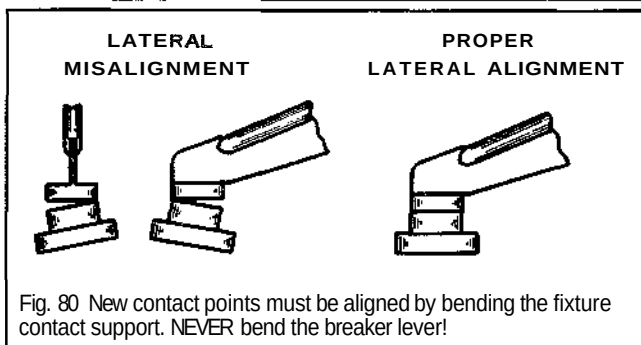
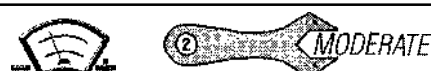


Fig. 80 New contact points must be aligned by bending the fixture contact support. NEVER bend the breaker lever!

ADJUSTMENT—DWELL METER



◆ See Figure 82

1. Perform the first three steps of the removal procedure above.
2. Connect a dwell meter as per the manufacturer's instructions - usually the positive lead of the meter to the negative side of the coil and the negative lead of the meter to ground.
3. Connect a remote starter switch as detailed in the manufacturer's instructions and then crank the engine. Observe the dwell reading on the meter, it should be as listed in the Tune-Up Specifications chart. If not in range, loosen the lock screw slightly and then adjust the point opening by means of the adjustment slot. Increasing the point gap lowers the dwell reading, while decreasing the gap raises it. When the reading is within specifications, tighten the lock screw and then recheck the dwell one final time.
4. Install the rotor and distributor cap. Connect the battery cables and adjust the ignition timing.

✖ ✖ CAUTION

Dwell should be checked between idle and 1750 rpm. Any dwell variations of more than 3° from idle to 1750 rpm indicate possible wear in the distributor.

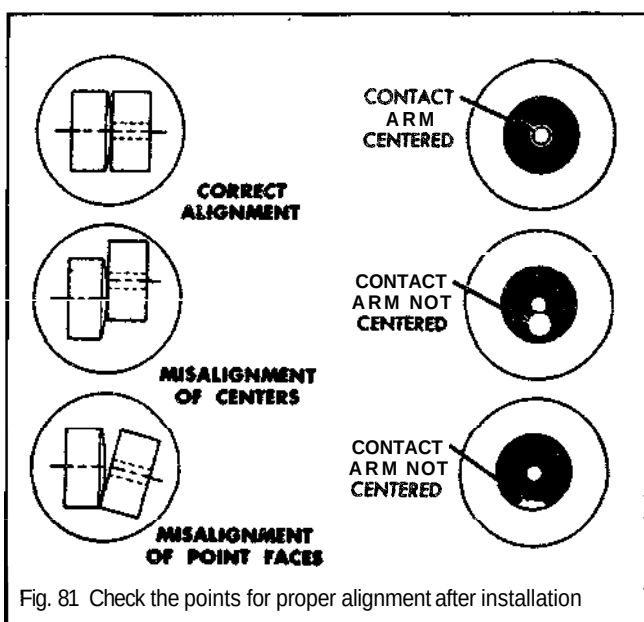


Fig. 81 Check the points for proper alignment after installation

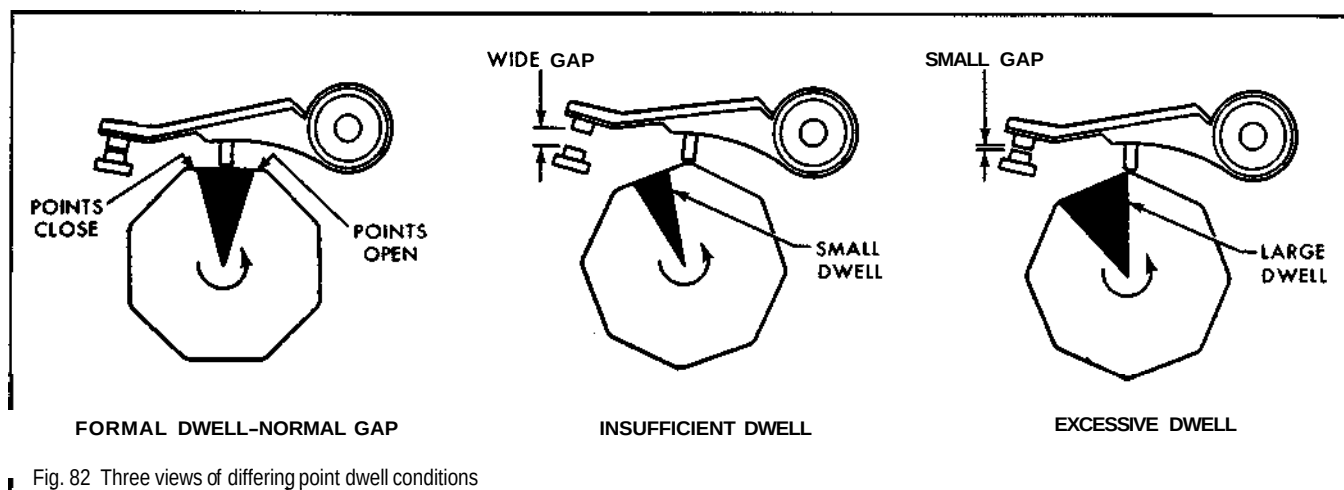


Fig. 82 Three views of differing point dwell conditions

Distributor Air Gap

All models equipped with BID ignition systems require an air gap adjustment between the sensor wheel and the trigger wheel; particularly after the distributor has been removed. It is also a good idea to ensure that the air gap is within specification prior to performing any ignition timing procedures.

ADJUSTMENT—BID DISTRIBUTORSONLY

◆ See Figure 83



1. Open or remove the engine hatches.
2. Remove the distributor cap and pull off the rotor as detailed in the Ignition System section.
3. Connect a remote starter switch as detailed in the manufacturer's instructions.
4. Check the sensor coil, trigger wheel and teeth for signs of wear or other obvious damage. Using the remote starter, crank the engine around until a tooth on the wheel aligns with the contact on the coil.
5. Insert a nonmetallic flat-bladed feeler gauge between the sensor and trigger wheel tooth. The gap should be 0.008 in. (0.20mm).
6. If not within specification, loosen the small screw on the trigger coil slightly and move the coil carefully until the gap is within spec. Tighten the screw securely—but not too tight—and recheck that the gap has not changed.
7. Disconnect the remote starter.
8. Install the rotor and distributor cap.

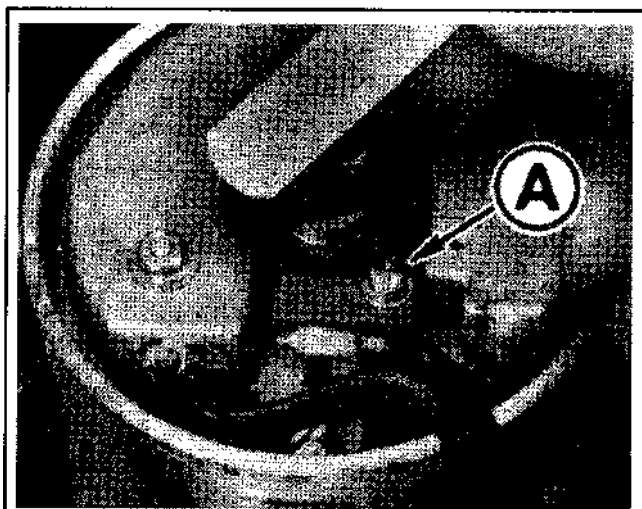


Fig. 83 Checking the distributor air gap

Idle Speed And Mixture

ADJUSTMENT

All Engines W/2bbl Carburetor



◆ See Figures 84 and 85

1. Locate the idle speed screw on your carburetor and turn it in or out until it is just resting on the idle cam, but is not moving it. The idle screw is threaded into the throttle linkage on the side of the carburetor and has a spring between the screw head and the linkage.

2. Locate the idle mixture screw on the base of the carburetor and turn it in (clockwise) until it just lightly seats itself and then back it out:

- 1986-89 2.5L/3.0L engines—2 turns
- 1986-89 2.3L, 4.3L and 5.0L engines—2 1/2 turns
- 1988-90 Rochester—2 turns
- 1988-90 2.3L engines—1 1/2 turns
- 1988-93 3.0L engines—3/4 turn
- 1988-93 3.0L HO engines—1 turn on starboard screw; 1 1/2 turn on port screw
- 1994 3.0GL engines—3/4 turn
- 1994-98 3.0GS engines—1 turn on starboard screw; 1 1/2 turn on port screw
- 1988-94 4.3L engines—5/8 turn
- 1995-98 4.3GL engines—5/8 turn
- 1996-97 4.3GS engines—3/4 turn
- 1988-90 5.0L engines—1 1/2 turns
- 1991-93 5.0L engines—1 1/8 turns
- 1990-93 5.0L HO engines—1 turn
- 1994-96 5.0FL engines—1 turn
- 1994 5.7GL engines—3/4 turn
- 1997-98 5.7GL/GS engines—3/4 turn

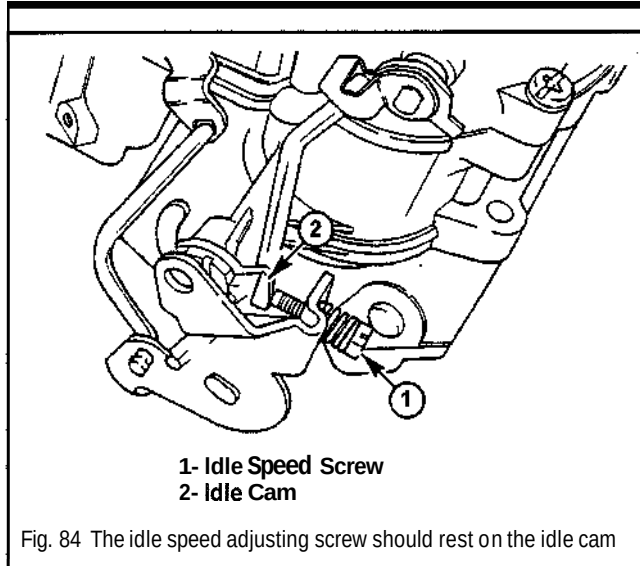
✖ CAUTION

Be careful not to turn the idle mixture screw in past the seated position or you risk damaging the seat or needle. Both the screw tip and the casting seat can be affected. Replace any screws suspected of damage.

3. Ensure that the flame arrestor is in place and is free of debris and obstructions. A clogged filter will greatly impact this adjustment.

4. Connect a tachometer as per the manufacturer's instructions—do not use the tach on your boat!

5. Start the engine and allow it to run at idle until it reaches normal operating temperature.



❖❖ CAUTION

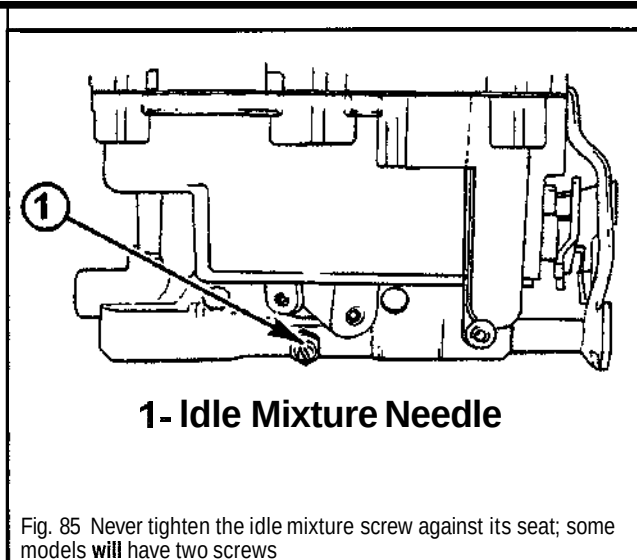
Water must circulate through the lower unit and to the engine anytime the engine is being run. Severe damage could result otherwise. If the boat is not in the water, **make** sure a flushing attachment has been installed properly.

6. You will need to disconnect the throttle cable from the throttle lever before performing the next step because the boat will need to be in gear.
7. With the engine still running and the tach hooked up, move the shift lever into F and turn the mixture screw(s) in (clockwise), carefully and slowly, until the engine speed JUST begins to drop due to a LEAN condition. Jot down the number of turns. If your carburetor has two screws, and it most likely will, there are two schools of thought here—you can adjust them individually or alternately. We prefer the alternating method; that is, turning each screw in a little at a time, the same amount, until you get the LEAN condition. If you go this route, we suggest turning them alternately no more than 118th turn at a time.
8. Now, back the screw(s) out (counterclockwise), evenly and alternately, until you achieve the correct idle speed as detailed in the Tune-Up Specifications chart. If the idle begins to drop before you get to the correct speed (due to a RICH condition this time) then back them down slightly until it runs smooth again.
9. Recheck the idle speed and compare it to the recommended speed in the chart. If adjustment is required, now you can use the idle speed stop screw—turn it, gradually and evenly, until the correct idle is achieved.
10. Turn the engine off and reconnect the throttle cable. Disconnect the tachometer.

All Engines W/4BBL Carburetor



1. Locate the idle speed screw on your carburetor and turn it in or out until it is just resting on the idle cam, but is not moving it. The idle screw is threaded into the throttle linkage on the side of the carburetor and has a spring between the screw head and the linkage.
2. Locate the idle mixture screw on the base of the carburetor and turn it in (clockwise) until it just lightly seats itself and then back it out:
 - 1986 engines—3 3/4 turns
 - 1987-89 engines w/Rochester—3 3/4 turns
 - 1987-89 engines w/Holley—1 1/2 turns
 - 1990-91 4.3L HO engines—3 1/4 turn
 - 1996-97 4.3GS engines—3 1/4 turn
 - 1998 4.3GS engines—I 1 1/8 turns
 - 1990-92 5.7L engines—1 1/4 turn
 - 1990-91 5.7L LE engines—1 turn
 - 1991-92 5.7L engines—1 1/2 turn
 - 1997 5.7GS engines—1 1/2 turn



- 1990 350 engines—1 turn
- 1990 5.8L engines—1 1/2 turns
- 1991-96 5.8L engines—7/8 turn
- 1990 454 engines—1 turn
- 1991-97 7.4L/8.2L engines—1 1/4 turn
- 1990 460 engines—I 1 1/2 turns

❖❖ CAUTION

Be careful not to turn the idle mixture screw in past the seated position or you risk damaging the seat or needle. Both the screw tip and the casting seat can be affected. Replace any screws suspected of damage.

3. Ensure that the flame arrestor is in place and is free of debris and obstructions. A clogged filter will greatly impact this adjustment.
4. Connect a tachometer as per the manufacturer's instructions—do not use the tach on your boat!
5. Start the engine and allow it to run at idle until it reaches normal operating temperature.

❖❖ CAUTION

Water must circulate through the lower unit and to the engine anytime the engine is being run. Severe damage could result otherwise. If the boat is not in the water, **make** sure a flushing attachment has been installed properly.

6. You will need to disconnect the throttle cable from the throttle lever before performing the next step because the boat will need to be in gear.
7. With the engine still running and the tach hooked up, move the shift lever into F and turn the mixture screw(s) in (clockwise), carefully and slowly, until the engine speed JUST begins to drop due to a LEAN condition. Jot down the number of turns. If your carburetor has two screws, and it most likely will, there are two schools of thought here—you can adjust them individually or alternately. We prefer the alternating method; that is, turning each screw in a little at a time, the same amount, until you get the LEAN condition. If you go this route, we suggest turning them alternately no more than 118th turn at a time.
8. Now, back the screw(s) out (counterclockwise), evenly and alternately, until you achieve the correct idle speed as detailed in the Tune-Up Specifications chart. If the idle begins to drop before you get to the correct speed (due to a RICH condition this time) then back them down slightly until it runs smooth again.
9. Recheck the idle speed and compare it to the recommended speed in the chart. If adjustment is required, now you can use the idle speed stop screw—turn it, gradually and evenly, until the correct idle is achieved.
10. Turn the engine off and reconnect the throttle cable. Disconnect the tachometer.

Fuel Injected Engines

Idle speed is constantly monitored by the electronic control module (ECM) and controlled by the idle air control valve (IAC). Idle speed and mixture are not adjustable. Please refer to the Fuel System section for further information on the fuel injection system.

PCV Valve

Many engines are equipped with a positive crankcase ventilation (PCV) circuit that utilizes a PCV valve in the rocker cover in order to ventilate unburned crankcase gases back into the engine via the intake manifold in order that they can be re-burned. The PCV valve should be replaced every boating season or 100 hours of operation.

A PCV system that is malfunctioning can cause rough running or idle, and also increased fuel consumption. Do not attempt to disconnect or bypass the system.

REMOVAL & INSTALLATION

◆ See Figure 86



1. Locate the PCV valve in the cylinder head cover—usually the—port but it could be either.
2. Carefully wiggle it back and forth while pulling upward on the valve itself until it pops out of the cover.
3. Loosen the clamp (if equipped) and disconnect the breather hose from the valve.
4. Reconnect the hose and press the valve back into the cylinder head.

□ PCV valves are not serviceable. If your valve is clogged or otherwise not working properly, it must be replaced with a new one.

INSPECTION

◆ See Figure 87



Start the engine and allow it to reach normal operating temperature. Pop out the PCV valve as detailed above and cover the opening with your thumb. You should be able to feel significant vacuum; if not replace the valve. With the valve still in your fingers, shake it back and forth a few times; you should be able to hear the inside components moving around—a significant clicking sound.

If the valve passes these two tests, it is functioning properly. If it fails either of the tests and there are no leaks in any of the hoses or connections, it will require replacement.

PCV valves are not serviceable. If your valve is clogged or otherwise not working properly, it must be replaced with a new one.

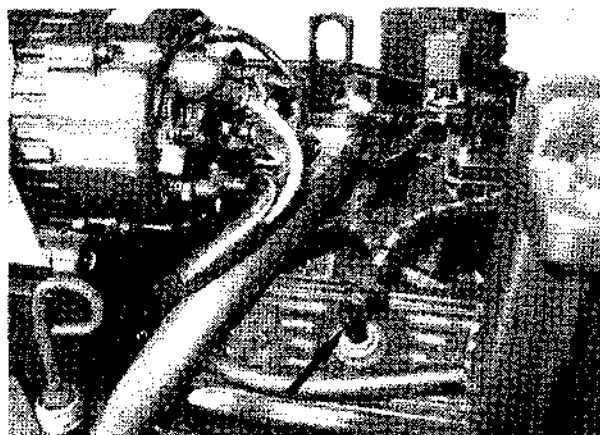


Fig. 86 Typical PCV valve

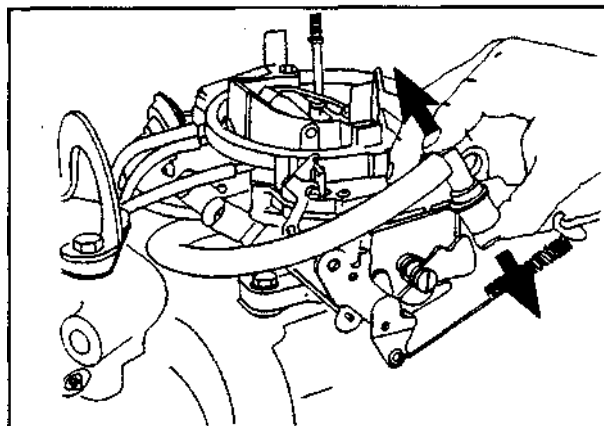


Fig. 87 Testing the PCV valve

Valve Adjustment

All engines covered in this manual are equipped with hydraulic valve lifters and do not require periodic valve adjustment. Adjustment to zero lash is maintained automatically by the hydraulic pressure in the lifters. For initial adjustment procedures after cylinder head work or if a problem is expected, please refer to the appropriate Engine Mechanical section.

FLUIDS AND LUBRICANTS

Fluid Disposal

Used fluids such as engine oil, gear oil, antifreeze and power steering fluid are hazardous waste and must be disposed of properly and responsibly. Before draining any fluids it is always a good idea to check with your local authorities; in many areas there are recycling programs available for easy disposal. Service stations, Parts stores and Marinas also often will accept waste fluids for recycling.

Be sure of your local recyclers' policies before draining any fluids, as many will not accept fluids that have been mixed together.

Fuel And Oil Recommendations

FUEL

All engine covered in this manual are designed to run on unleaded fuel. Never use leaded fuel in your boat's engine. The minimum octane rating of fuel being used for your engine must be at least 86 AKI (outside the US, 90

RON), on early models and 89 AKI (93 RON) on all others, but some engines may require higher octane ratings. OMC actually recommends the use of 89 AKI (93 RON) fuel as the ideal—in fact, anything less than this on many 4.3L, 5.0GL and 5.7L engines will require a change to the ignition timing. Fuel should be selected for the brand and octane that performs best with your engine. Check your owner's manual if in doubt.

The use of a fuel too low in octane (a measure of anti-knock quality) will result in spark knock. Newer systems have the capability to adjust the engine's ignition timing to compensate to some extent, but if persistent knocking occurs, it may be necessary to switch to a higher grade of fuel. Continuous or heavy knocking may result in engine damage.

ENGINE OIL

Nothing affects the performance and durability of an engine more than the engine oil. If inferior oil is used, or if your engine oil is not changed regularly, the risk of piston seizure, piston ring sticking, accelerated wear of the cylinder walls or liners, bearings and other moving components increases significantly.

2-30 ENGINE AND DRIVE MAINTENANCE

Maintaining the correct engine oil level is one of the most basic (and essential) form of engine maintenance. Get into the habit of checking your oil on a regular basis; all engines naturally consume small amounts of oil, and if left neglected, can consume enough oil to damage the internal components of the engine. Assuming the oil level is correct because you "checked it the last time" can be a costly mistake.

If your engine has not been operated for more than 6 months it should be primed prior to starting.

When shutting the engine down, always let the engine idle a few minutes to bring engine temperature down to a normal level. Since the engine is, at least in part, cooled by engine oil, it is necessary to allow the engine oil temperature to stabilize prior to shutdown. Not allowing the temperature to stabilize can damage vital engine components.

Every container of engine oil for sale in the U.S. should have a label describing what standards it meets. Engine oil service classifications are designated by the American Petroleum Institute (API), based on the chemical composition of a given type of oil and testing of samples. The ratings include "S" (normal gasoline engine use) and "C" (commercial, fleet and diesel) applications. Over the years, the "S" rating has been supplemented with various letters, each one representing the latest and greatest rating available at the time of its introduction. During recent years these ratings have changed and most recently (at the time of this manual's publication), the rating is "SG" or "CH-4". Each successive rating usually meets all of the standards of the previous alpha designation, but also meets some new criteria, meets higher standards and/or contains newer or different additives. Since oil is so important to the life of your engine, you should obviously NEVER use an oil of questionable quality. Oils that are labeled with modern API ratings, including the "energy conserving" donut symbol, have been proven to meet the API quality standards. Always use the highest grade of oil available. The better quality of the oil, the better it will lubricate the internals of your engine.

In addition to meeting the classification of the API, your oil should be of a viscosity suitable for the outside temperature in which your engine will be operating. Oil must be thin enough to get between the close-tolerance moving parts it must lubricate. Once there, it must be thick enough to separate them with a slippery oil film. If the oil is too thin, it won't separate the parts; if it's too thick, it can't squeeze between them in the first place—either way, excess friction and wear takes place. To complicate matters, cold-morning starts require a thin oil to reduce engine resistance, while high speed boating requires a thick oil which can lubricate vital engine parts at temperatures.

According to the Society of Automotive Engineers' (SAE) viscosity classification system, an oil with a high viscosity number (such as SAE 40 or SAE 50) will be thicker than one with a lower number (SAE 10W). The "W" in 10W indicates that the oil is desirable for use in winter operation, and does not stand for "weight". Through the use of special additives, multiple-viscosity oils are available to combine easy starting at cold temperatures with engine protection at high speeds. For example, a 10W40 oil is said to have the viscosity of a 10W oil when the engine is cold and that of a 40 oil when the engine is warm. The use of such an oil will decrease engine resistance and improve efficiency.

All OMC engines require the use of SAE 30 oil at temperatures above 32°F (0°C). Engines operating in 0°F (-18°C) to 32°F (0°C) temperatures ranges should use SAE 20W-20 oil; while anyone operating under 0°F (-18°C) should use SAE 10W oil.

☐ Although acceptable in a pinch and also in certain weather conditions, multi-viscosity oils such as 10W-30 and 10W-40 are not recommended. OMC suggests any recommendation that you may find on your engine regarding a multi-viscosity oil should be ignored. These references are for automotive use only and not intended for marine applications.

Priming

Anytime your boat's engine has not been run for more than 6 months it is a good idea to prime the engine prior to starting it.

1. Check that the proper amount of oil is in the crankcase (see the Capacities chart).
2. Remove the spark plugs.
3. With the ignition key in the **OFF** position, connect a remote starter according to the manufacturer's instructions.

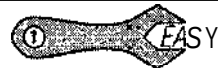
4. Crank the engine for 15 seconds and then allow the starter to cool for 1 minute. Repeat this sequence 2 more times until a total cranking time of 45 seconds has been reached.

5. Remove the remote starter.

6. Install the spark plugs and start the engine.

OIL LEVEL CHECK

◆ See Figures 88 thru 94



×× CAUTION

The EPA warns that prolonged contact with used engine oil may cause a number of skin disorders, including cancer! You should make every effort to minimize your exposure to used engine oil. Protective gloves should be worn when changing the oil. Wash your hands and any other exposed skin areas as soon as possible after exposure to used engine oil. Soap and water, or waterless hand cleaner should be used.

When checking the oil level, it is best that the boat be level and the oil be at operating temperature. Checking the level immediately after stopping the engine will give a false reading; always wait about 5 minutes before checking.

It is normal for an engine to naturally consume oil during the course of operation, particularly during break-in on a new engine. You should not be alarmed if the oil level in your engine drops slightly between inspections. In fact, certain of OMC's high performance engines may use up to a quart of oil every 5 hours when operated at full throttle.

1. Also the color of the oil is usually a pitch black color. Smelling the oil is a better indicator of oil condition than the color. If the oil smells burned, it should be replaced immediately.

Over-filled crankcases can cause a fluctuation or drop in oil pressure, and, particularly on OMC engines, clattering from the rocker arms. Take great care in checking and filling your engine with oil. Always maintain it between the **ADD** and **FULL** or **OP RANGE** markings on the dipstick. Beware of false readings by checking the level too soon after adding oil.

It takes a little while for fresh oil poured into the engine to reach the crankcase. Wait for about 3 minutes and then check the oil level again.

Oil level should be checked each day the engine is operated and it is best to check it while in the water.

2. Run the engine until it reaches normal operating temperature. Shut it off and allow the oil to settle for at least 5 minutes.

3. Locate the engine oil dipstick—almost always on either side and toward the front of the engine.

4. Clean the area around the dipstick to prevent dirt from entering the engine.

5. Remove the dipstick and note the color of the oil. Wipe the dipstick clean with a rag.

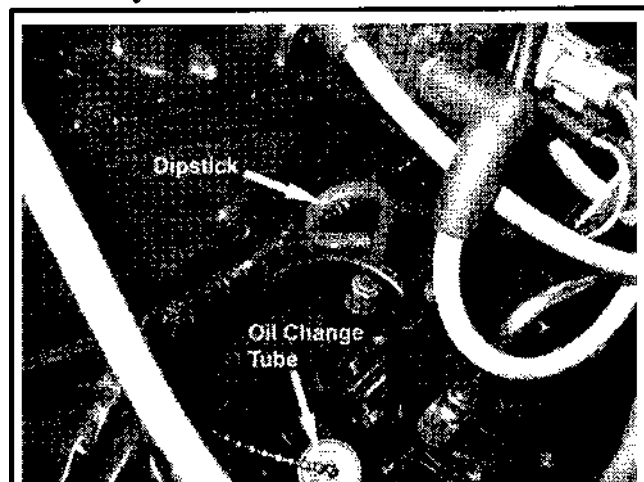


Fig. 88 The oil dipstick on the 3.0L is on the starboard side. Note the top of the oil withdrawal tube

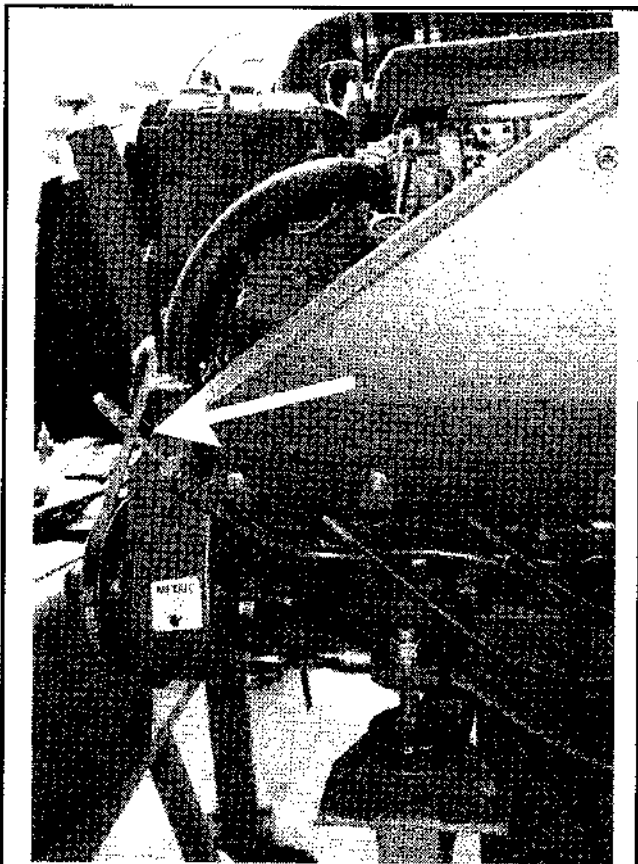


Fig. 89 The oil dipstick on the 4.3L is on the starboard side, near the power steering pump



Fig. 91 The oil dipstick on the 5.0L GM is on the front port side of the engine

6. Insert the dipstick fully into the tube and remove it again. Hold the dipstick horizontal and read the level on the dipstick. The level should always be at the upper limit. If the oil level is below the upper limit, sufficient oil should be added to restore the proper level of oil in the crankcase. Most dipsticks are marked with ADD and FULL or **OP RANGE** gradations.

7. See Engine Oil Recommendations for the proper viscosity and type of oil.

8. Oil is added through the filler port cap in the top of the cylinder head cover. Add oil slowly and check the level frequently to prevent overfilling the engine.

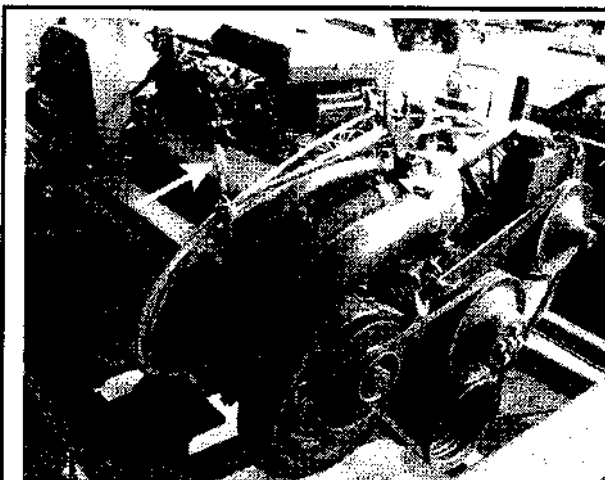


Fig. 90 The oil dipstick on the 5.0L Ford is on the front starboard side of the engine

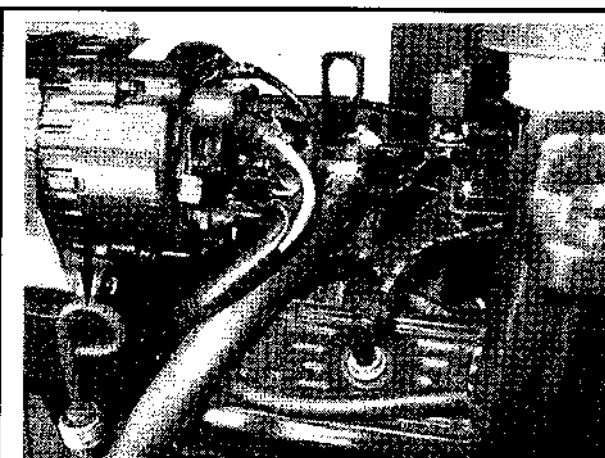


Fig. 92 The oil dipstick on the 5.7L is on the front of the engine, near the alternator

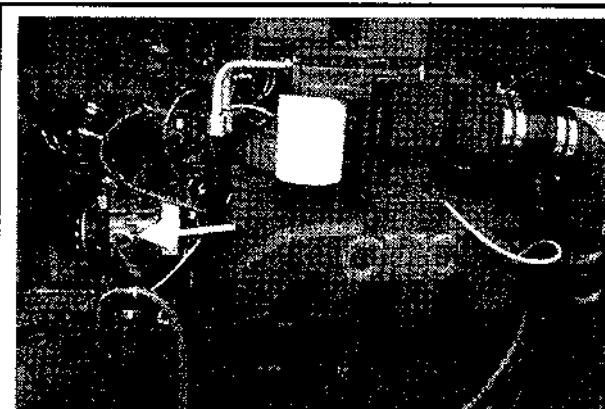


Fig. 93 The oil dipstick on the 7.4L is on the port side of the engine, near the front (8.2L similar)

×× WARNING

Do not overfill the engine. If the engine is overfilled, the crankshaft will whip the engine oil into a foam causing loss of lubrication and severe engine damage.

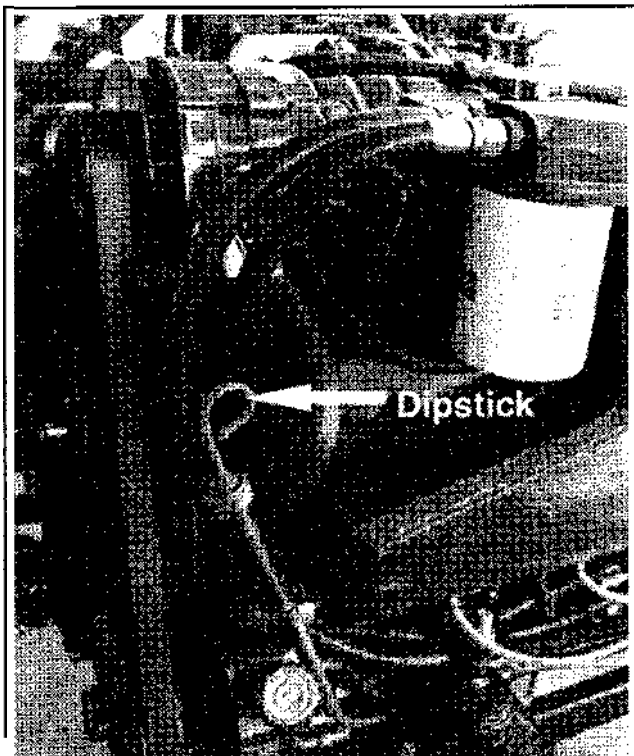
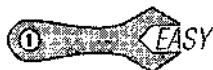


Fig. 94 The oil dipstick on the 7.5L is on the port side of the engine, near the front (8.2L similar)

OIL & FILTER CHANGE

◆ See Figures 95 thru 102



※※ CAUTION

The EPA warns that prolonged contact with used engine oil may cause a number of skin disorders, including cancer! You should make every effort to minimize your exposure to used engine oil. Protective gloves should be worn when changing the oil. Wash your hands and any other exposed skin areas as soon as possible after exposure to used engine oil. Soap and water, or waterless hand cleaner should be used.

A few precautions can make the messy job of oil and filter maintenance much easier. By placing oil absorbent pads, available at industrial supply stores, into the area below the engine, you can prevent oil spillage from reaching the bilge.

It is a good idea to warm the engine oil first so it will flow better; and the contaminants in the bottom of the pan will be suspended in the oil. This is accomplished by starting the engine and allowing it to reach normal operating temperature.

Changing engine oil is sometimes complicated by the location of the drain plug. Most boats equipped with inboard engines use an evacuation pump to remove the used engine oil through the dipstick tube. If you don't have a permanently mounted oil suction pump in your engine compartment, you may want to consider installing one. This pump sucks waste oil out through either the dipstick tube or a connection on the oil drain plug and is available from your OMC dealer or from any number of aftermarket sources. They come in a variety of configurations: motorized, hand-pumped or attachments for an ordinary household drill.

The maintenance interval for oil and filter change is every 100 hours of engine operation or annually, whichever comes first. This interval should be strictly kept; in fact we recommend cutting the interval in half!

■ Since you will be hanging into the engine compartment, gather all the tools and spare parts necessary for the job. Don't forget plenty of rags to clean up any spills, and most importantly, remember a container or plastic milk jug to drain the oil into.

1. Start the engine and run it until it reaches normal operating temperature. Turn the engine off and remove the dipstick and/or the withdrawal tube cap.

2. Connect the evacuation pump hose to the dipstick tube or insert it into the withdrawal tube. Position the other hose, or the outlet at the bottom of the pump in your container. Keep in mind that the fast flowing oil, which will spill out of the pump hose, will flow with enough force that it could miss the container and end up all over the deck or in the bilge. Position the container accordingly and be ready to move it if necessary. Some models are equipped with a quick drain oil hose attachment; be sure to pull the tether through the bilge drain before removing the drain plug from the hose.

※※ CAUTION

Use caution around the hot oil; when at operating temperature, it is hot enough to cause a severe burn.

3. Allow the oil to drain until nothing but a few drops come out of the pump. It should be noted that depending on the angle of the engine, some oil may be left in the crankcase. This is normal and should not cause the engine harm.

4. Remove the evacuation pump and reinsert the dipstick or withdrawal tube cap.



Fig. 95 A good shot of the filter—3.01 shown

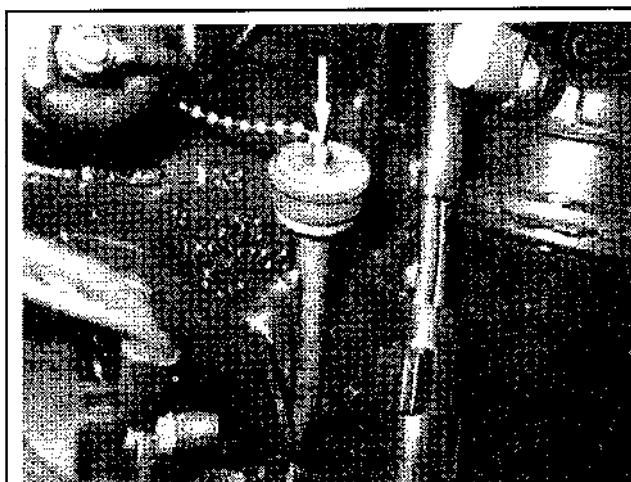


Fig. 96 Although most engines use the dipstick tube to remove the old engine oil, certain engines (2.5/3.0L) may use a separate tube

5. Position a drain pan, or a cut-down milk jug under the oil filter. Some filters are mounted horizontally and some vertically. In either case, there is usually oil left in the filter. When the filter is removed, oil will flow out of the engine and the filter. If you are not prepared, you will have a mess on your hands. It may also be necessary to use a funnel or fashion some type of drain shield to guide the oil into the drain pan. This can be as simple as a recycled oil bottle with the bottom cut off or an elaborate creation made of tin. In any case, its purpose is to prevent oil from spilling all over the engine and bilge.

6. To remove the filter, you will probably need an oil filter strap wrench (available at almost any place that sells marine or automotive parts and fluids). Heat from the engine tends to tighten even a properly installed filter and makes it difficult to remove. Place the wrench on the filter as close to the engine as possible, while still leaving room to work. This will put the wrench at the strongest part of the filter (near the threaded end) and prevent crushing the filter. Loosen the filter with the wrench using a counterclockwise turning motion

■ Some later models may utilize a remote oil filter.

7. Once loosened, wrap a rag around the filter and unscrew it from the engine. Make sure that the drain pan and shield are positioned properly before you start unscrewing the filter. Should some of the hot oil happen to get on your hands and burn you, dump the filter into the drain pan.



Fig. 97 On the newer V6/V8 engines with fuel injection (5.0L shown), the remote filter is on the port side near the top

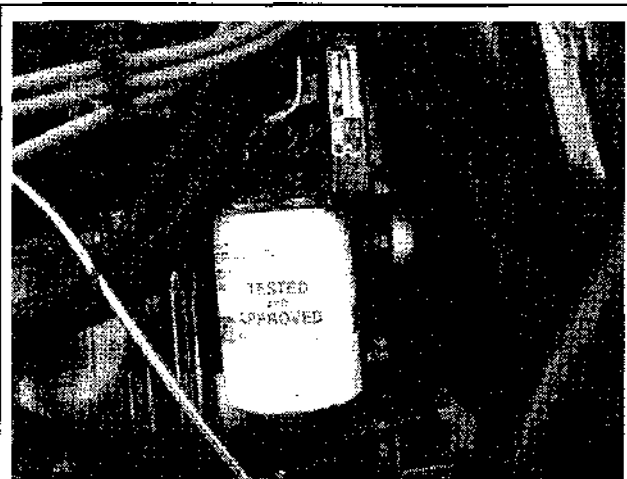


Fig. 98 On the older V6/V8 engines and most V6/V8 engine with a carburetor (5.7L shown), look on the side of the engine block

8. Wipe the base of the mounting boss with a clean, dry lint-free rag. If the filter is installed vertically, you may want to fill the filter about half way with oil prior to installation. This will prevent oil starvation when you fire the engine up again. Pre-filling the oil filter is usually not possible with horizontally mounted filters. Smear a little bit of fresh oil on the filter gasket to help it seat properly on the engine.

9. Install the filter and tighten it approximately a quarter-turn after it contacts the mounting boss (always follow the filter manufacturer's instructions). This usually equals "hand tight." Using a wrench to tighten the filter is not required, nor should it be considered.

✖✖ WARNING

Never operate the engine without engine oil. Severe and costly engine damage will result in a matter of seconds without proper lubrication.

10. If any oil has gotten into the bilge, remove it using an oil absorbent pad. These pads are specially formulated to only absorb oil and will not soak up any water in the bilge. Perform a visual inspection and make sure all connections are tight.

11. Carefully remove the drain pan from under the oil filter and transfer the oil into a suitable container for recycling.

12. Refill the engine with the proper quantity and quality of oil immediately (see the Capacities chart). You may laugh at the severity of this warning, but if you wait to refill the engine and someone unknowingly tries to start it, severe and costly engine damage will result.

13. Refill the engine crankcase slowly through the filler cap on the cylinder head cover. Use a funnel as necessary to prevent spilling oil. Check the level often. You may notice that it usually takes less than the amount of oil listed in the Capacities chart to refill the crankcase. This is only until the engine is started and the oil filter is filled with oil.

14. To make sure the proper level is obtained, run the engine to normal operating temperature, turn the engine **OFF**, allow the oil to drain back into the oil pan and recheck the level after about 5 minutes. Top off the oil to the correct mark on the dipstick.

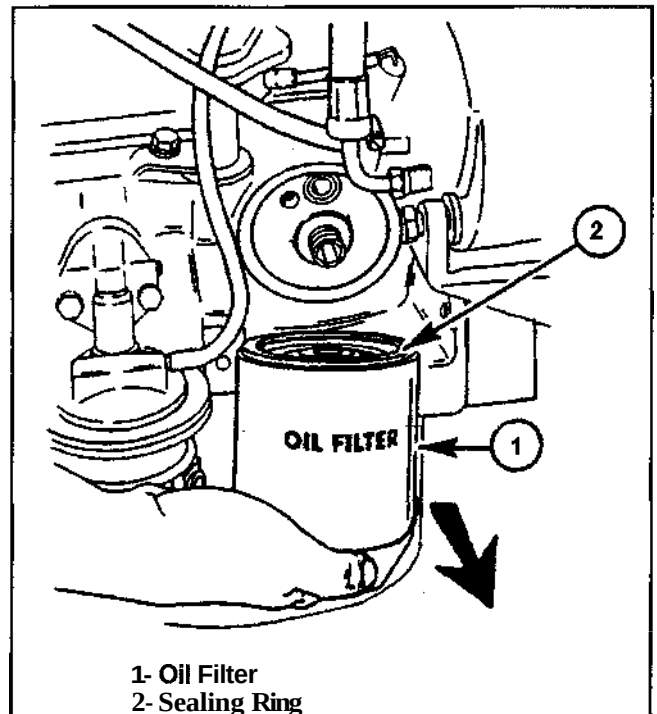


Fig. 99 Removing the oil filter

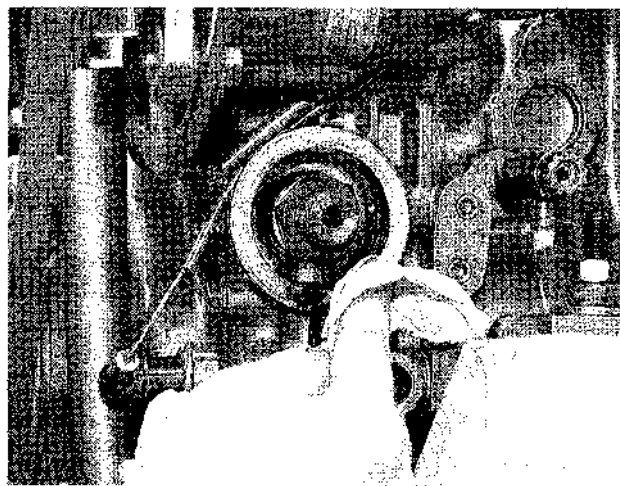


Fig. 100 Before installing the new filter, wipe the gasket mating surface clean



Fig. 101 Dip a finger into a fresh bottle of oil, and lubricate the gasket of the new filter

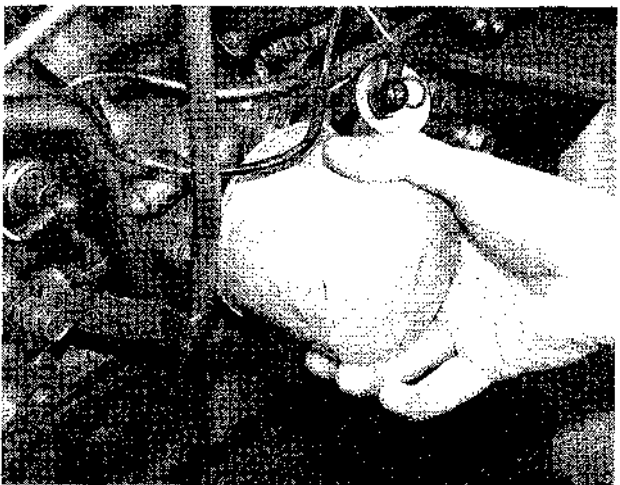


Fig. 102 Tighten the new filter 1/4 to 1/2 of a turn after the gasket contacts the mating surface. Do not use a wrench to tighten the filter!

Power Steering

FLUID LEVEL

◆ See Figures 103 and 104



■ Power steering fluid level should always be checked with the engine hot if at all possible.

1. Start the engine and run it until it reaches normal operating temperature.
2. Rotate the steering wheel lock-to-lock about 10 times to ensure that the fluid is warm.
3. Turn the engine OFF and place the drive unit so that it is straight back.
4. Locate the dipstick cap on top of the power steering fluid reservoir. Unscrew the cap and remove the dipstick. Wipe down the dipstick with a clean rag and reinsert it into the reservoir making sure that the cap is screwed all the way down.
5. Remove the dipstick again and check that the fluid level is up to the FULL HOT mark (FULL COLD if the level is being checked cold). If the level is between the FULL mark and the indent on the stick, it's OK. Below the indent or hash mark and you must add fluid. Use OMC Power Trim/Tilt & Steering Fluid, GM Power Steering Fluid, or Dexron® III ATF fluid. Do not overfill!
6. It is always a good idea to bleed the system after adding fluid.

BLEEDING THE SYSTEM



■ It is important that all air be removed from the system after filling or component removal. If air is left in the system, the fluid in the pump may foam during operation causing discharge or spongy steering.

1. With the engine stopped and the drive unit positioned straight back, check that the fluid level is at the FULL COLD mark on the dipstick.
 2. Turn the steering wheel all the way over to Port and then check the fluid level again. Add fluid if necessary.
 3. Install the cap/dipstick onto the reservoir, start the engine and run it at idle for a minute and then shut it OFF again. Remove the reservoir cap allowing any foam in the pump to escape.
 4. Reinsert the dipstick and check the fluid again, making sure that it is at the FULL HOT mark this time. Add fluid as necessary. Repeat this step as necessary until the system no longer requires fluid.
 5. Start the engine again and move the steering wheel slowly from lock to lock several times. Remember the reservoir cap should still be off, so while you're moving the wheel, observe the fluid level in the reservoir—it should be above the pump body, if not, carefully add fluid so that the level stays above the body.
 6. Fluid containing air will be foamy and light red or tan in color. This is normal, but you must make sure that the fluid level is high enough so that the foam DOES NOT enter the pump inlet. Continue moving the wheel and adding fluid until there is no foam left, indicating the absence of air bubbles.
- If you see excessive foaming during the previous step, shut the engine down and let everything sit for 30 minutes before trying it again.
7. Once the foam has disappeared, position the steering wheel at the center position and shut the engine Off. Screw in the cap/dipstick and recheck the fluid level. If not at the FULL HOT level, add fluid slowly until it is.

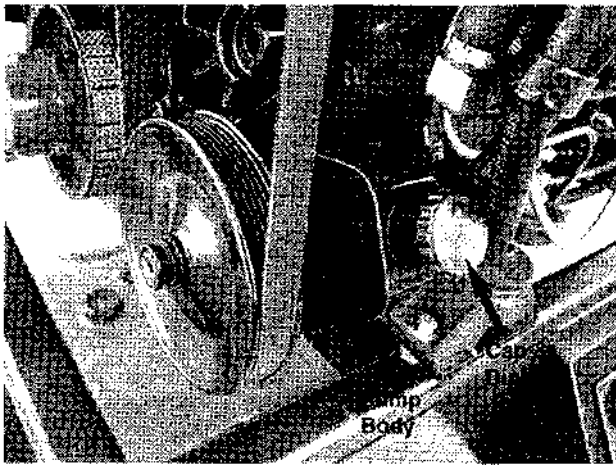


Fig. 103 Typical power steering pump

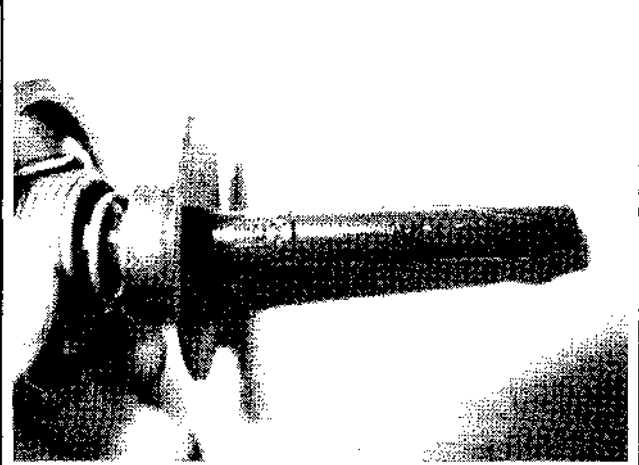


Fig. 104 Power steering fluid dipstick

Cooling System

All engines covered in this manual utilize one of two cooling systems, or variations thereof. Simply, there is a Seawater Cooling system, sometimes called Raw Water system and a Closed Cooling system.

Seawater systems are just that...they utilize the water that the boat is operating in to cool and lubricate the drive and engine. Water is drawn in through the stern drive unit and circulated to, and through, the engine and its components. The heated water is then returned overboard through the exhaust system.

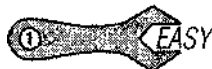
Closed Cooling systems are actually two systems working together; a seawater system and a closed system consisting of antifreeze—very similar to an automotive system, without the radiator. The two systems work together in a variety of ways.

Complete information on individual system operation, and component repair procedures is detailed in the Cooling Systems section. In this section we will only deal with checking fluid levels, draining and filling, and flushing the systems.

LEVEL CHECK

Closed Cooling System Only

◆ See Figure 105



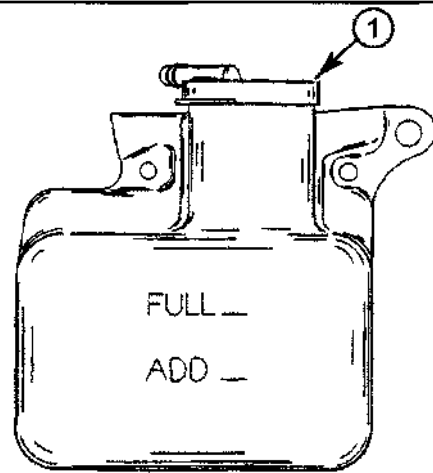
Always allow the engine to cool down before checking the coolant level. If possible, check cold. Opening a pressure cap with the engine hot can cause a violent discharge of steam and water, resulting in severe injury. If the engine is anything but cold, always remove the cap a quarter turn at a time in order to allow any residual pressure to escape slowly.

1. Remove the pressure cap at the top of the heat exchanger. Coolant should be visible at the bottom of the filler neck, or within 1 in. (25mm) of the bottom of the neck.
2. Reinstall the cap on the heat exchanger making sure that it seats on its stops on the filler neck.
3. Start the engine and run it until it reaches normal operating temperature. Turn off the engine and check that the coolant level is to the FULL line on the side of the coolant recovery tank.
4. Fill the system with a 50/50 mixture of distilled water and ethylene glycol antifreeze.

FLUSHING THE SYSTEM



If your boat is operated in **saltwater, heavy mineral fresh water or** severely polluted water, flush the cooling system regularly—after each usage if at all possible! Always flush the system before draining and/or winter storage.



1- Coolant Recovery Reservoir

Fig. 105 Check that the coolant level is to the FULL line on the coolant recovery tank when the engine is hot (early model shown, late models utilize a rectangular tank)

Seawater Systems W/O Fresh Water Flush

Boat Out Of Water

◆ See Figure 106



✖ CAUTION

NEVER run the engine when the boat is out of the water without water being supplied to the stern drive.

1. Connect a flushing attachment over the water intake openings in the stern drive gear housing. These devices are available at your local OMC dealer or through a variety of aftermarket suppliers.
2. Connect a garden hose between the flushing attachment and a water spigot.
3. Open the spigot(s) slowly, no more than half way, and allow the drive and cooling system to fill completely. You'll know the system is full when water begins to flow out of the drive unit, or through the propeller on closed systems.

✖✖ CAUTION

Never allow the water to reach the flushing device at anything more than low pressure.

4. With the drive in Neutral, start the engine and let it idle for 10 minutes or until the water being discharged is clear and then turn the engine off. Never run the engine above 1500 rpm with the flushing device attached and always keep an eye on the temperature gauge incase the engine begins to overheat.

5. Turn off the water from the spigot(s), disconnect the hose(s) and remove the flushing attachment.

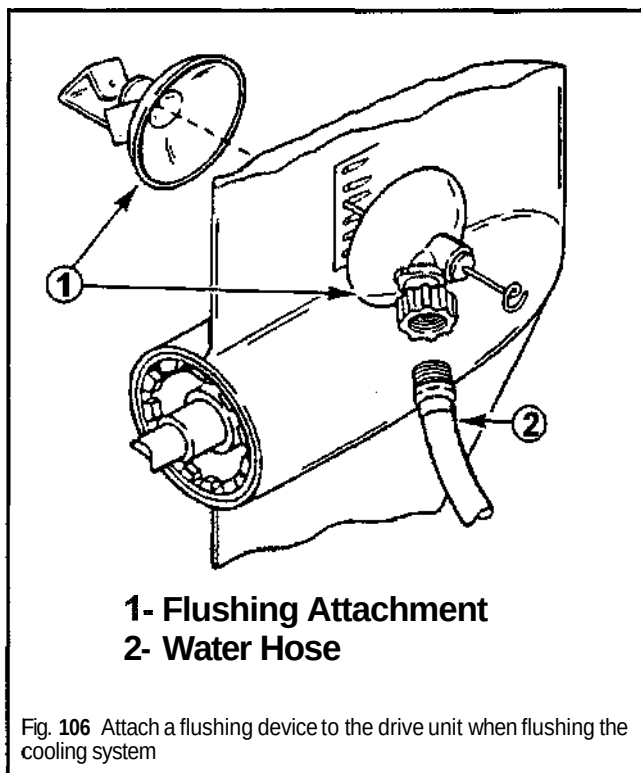
Boat In Wafer

◆ See Figure 106

✖✖ CAUTION

If your boat has a **seacock** (a water inlet valve), it must remain closed during this procedure in order to prevent water from flowing back into the boat. If your **boat** does not have a **seacock**, locate the water inlet hose at the seawater supply pump, disconnect it and plug it. We highly recommend that you leave a note to yourself in the vicinity of the ignition key reminding of the fact that this procedure has been done so that you, or someone else doesn't **start** the engine after flushing without reopening the **seacock** or reconnecting the inlet hose. Seem silly? Do it anyway!

1. Raise the stern drive unit to the full UP position.
2. Connect a flushing attachment over the water intake openings in the stern drive gear housing. These devices are available at your local OMC dealer or through a variety of aftermarket suppliers.
3. Connect a garden hose between the flushing attachment and a water spigot.
4. Lower the stern drive unit to the full IN/DOWN position.
5. Open the spigot(s) slowly, no more than half way, and allow the drive and cooling system to fill completely. You'll know the system is full when water begins to flow out of the drive unit, or through the propeller on closed systems.



✖✖ CAUTION

Never allow the water to reach the flushing device at anything more than low pressure.

6. With the drive in Neutral, start the engine and let it idle for 10 minutes or until the water being discharged is clear and then turn the engine off. Never run the engine above 1500 rpm with the flushing device attached and always keep an eye on the temperature gauge incase the engine begins to overheat.

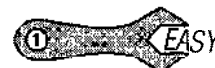
7. Turn off the water from the spigot(s).

8. Raise the drive unit to the UP position again, disconnect the hose and remove the flushing attachment.

9. Lower the unit and make sure you open the seacock and reconnect the inlet hose (don't forget to unplug it first!).

Seawater Systems With Fresh Water Flush

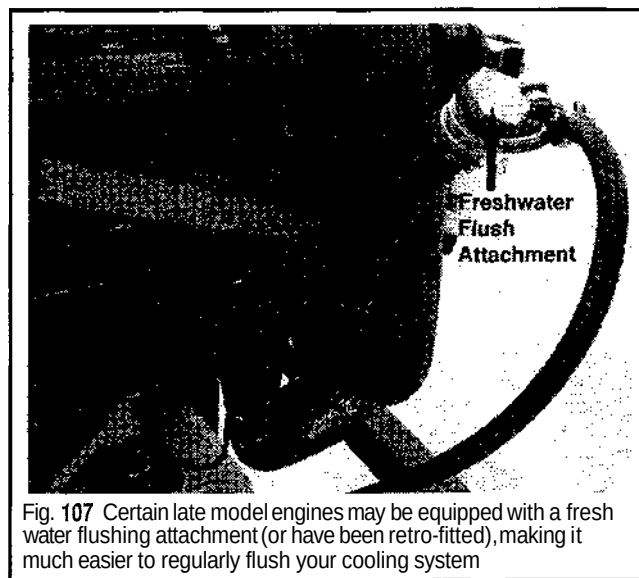
◆ See Figure 107



✖✖ WARNING

Do not, under any circumstance, start the engine while performing this procedure!

1. Locate the flush valve connected to a black hose on the side of the engine. There should be flush socket attachment with a cap connected to it.
2. Remove the socket from the cap, connect a garden hose and then plug into the flush valve.
3. Turn the hose spigot to its highest pressure and allow the engine to flush for 5 minutes.
4. Turn off the water and remove the hose/socket from the valve.
5. Unscrew the socket from the hose and insert it back into the cap.
6. You're done! That was easy—now you know why people spend the time and money to retro-fit these onto their engines..



Closed Systems

The very name of this systems implies that it is not necessary to flush it. If for some reason you absolutely must flush the closed portion of this system, simply follow the drain and fill procedures. Remember though that the closed system uses a conventional seawater cooling system in conjunction with its closed portion—this system **MUST** be flushed on a regular basis and all procedures are detailed previously under Seawater Systems.

PRESSURE CAP TESTING

Closed System Only

◆ See Figures 108, 109 and 110



The pressure cap on the coolant reservoir is designed to maintain closed system pressure at approximately 14 psi when the engine is at normal operating temperature. Clean, inspect and pressure test the cap at the end of your first season and then every 100 hours (or once a year) thereafter.

*** WARNING

Make sure the engine is cool before attempting to remove the cap. To be safe, always turn the cap 114 turn and allow any residual pressure to escape before removing it completely. Use a heavy rag or wear gloves.

1. Remove the cap and wash it thoroughly to remove any debris from the sealing surfaces.
2. Inspect the gasket and rubber seal for tears, cuts or cracks. If you notice anything, we recommend replacing the entire cap although you can replace the gasket on some older engines if you like.
3. Make sure that the locking tabs on the cap are not bent or damaged in any way. If so, replace the cap.
4. Use a cooling system pressure tester and, following the manufacturer's instructions, install the cap. Check that the cap relieves pressure at 14 psi and holds pressure for 30 seconds without falling below 11 psi. Replace the cap if it fails.
5. Check the inside of the filler neck for debris; it should be completely smooth. Check that the lock flanges on the filler neck are not bent or damaged and then install the cap.

PRESSURE TEST

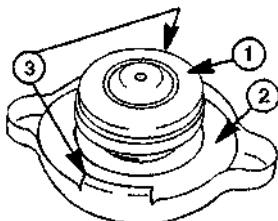
Closed System Only



*** WARNING

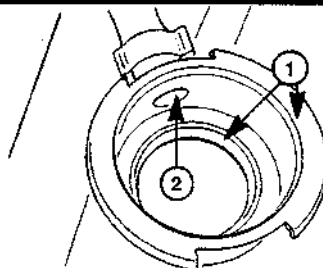
Make sure the engine is cool before attempting to remove the cap. To be safe, always turn the cap 114 turn and allow any residual pressure to escape before removing it completely. Use a heavy rag or wear gloves.

1. Remove the pressure cap from the reservoir or heat exchanger.
2. Perform the pressure cap Testing procedure. If the cap is bad, this may be your problem. Replace the cap and ensure that the problem does not go away; if it persists, move to the next step.
3. Add coolant so that the level is within one inch of the bottom of the filler neck. Attach a cooling system pressure tester to the filler neck and pressurize the system to 17 psi.
4. Watch the gauge for about 2 minutes. If the pressure remains steady, you're OK. If the pressure drops, move to the next step.
5. Maintain the specified pressure and check the entire closed system for any leaks—hoses, plugs, petcocks, pump seals, etc.). Also, listen very closely for any hissing or bubbling.
6. If you've still not found any leaks, test the heat exchanger as detailed in the Cooling section.



- 1- Rubber Seal
- 2- Gasket
- 3- Locking Tabs

Fig. 108 Check the pressure cap carefully...



- 1- Inspect for damage
- 2- Clean coolant recovery passages

Fig. 109 ...and then check the filler neck

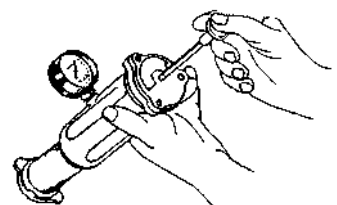


Fig. 110 Using a pressure tester to check the cap

7. If the exchanger is OK then you most likely have a problem with loose head bolts, a bad head gasket or a warped cylinder head, not the cooling system.

DRAINING & FILLING



The cooling system should be drained, cleaned, and refilled each season, although OMC's recommendations are for every two years on normal anti-freeze systems. We think it's cheap insurance to do it every season, but you certainly can't go wrong by following the factory's suggestion. The bow of the boat must be higher than the stern to properly drain the cooling system. If the bow is not higher than the stern, water will remain in the cylinder block and in the exhaust manifold. Insert a piece of wire into the drain holes, but not in the petcock, to ensure sand, silt, or other foreign material is not blocking the drain opening.

If the engine is not completely drained for winter storage, trapped water can freeze and cause severe damage. The water in the oil cooler—if so equipped—must also be drained.

Seawater System--4 Cylinder Engines

◆ See Figure 111



1. If the boat is in the water, close the seacock to prevent water from entering the cooling system. If the boat is not equipped with a seacock, disconnect the seawater inlet line and plug it. Make sure you leave yourself a note by the ignition switch reminding yourself to turn the valve back on or connect the line, especially if the boat is going to sit for a period of time. Sound silly? Do it!
2. Position suitable containers under all drain plugs and hoses (if space permits) to catch any water being drained or else it will collect in the bilge.
3. Loosen the clamp and disconnect the long supply hose at the thermostat housing. Slowly lower the hose and allow the water to drain.
4. Loosen the clamp and disconnect the large hose running from the thermostat housing to the engine water pump, at the pump. Allow all water to drain.
5. Remove the drain plug on the side of the cylinder block (port on 2.5L/3.0L; starboard on 2.3L) and allow all water to drain.
6. Remove the drain plug on the exhaust manifold or elbow. If your engine is not equipped with a drain, simply disconnect the hose from the lower fitting.
7. On models equipped with power steering, disconnect the lower seawater hose at the cooler—some models may actually have a drain plug on the bottom side of the cooler. If the cooler is mounted horizontally, loosen the mounting bolt and tilt the cooler to aid in the draining.
8. Loosen the clamps and disconnect both hoses at the seawater pump (if equipped). Allow all water to drain and then reconnect the hoses.
9. On engines with closed cooling, remove the drain plug from the bottom of the heat exchanger. If there is no plug, disconnect the seawater inlet hose at the bottom of the exchanger.
10. Disconnect and remove the lower end of any other hoses and hold them as low as possible while draining. Reconnect when all water has stopped draining. On models with closed cooling, refer to the flow diagrams in the Cooling section so that you do not disconnect any hoses used for the closed portion of the system.

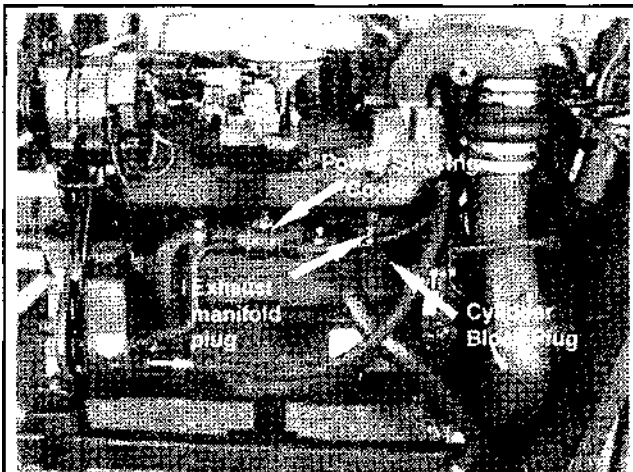


Fig. 111 Both drain plugs are on the port side—3.0L shown

11. Using a stiff piece of wire, clean out all drain holes. Don't forget any drain holes in the drive unit!

12. Tilt the drive unit to the full UP position and then remove the water drain plug from the port side of the pivot housing; this can be found toward the front of the upper housing where it attached to the bell housing.

13. Turn the ignition switch ON and crank the engine over a few times to force out any residual water in the block or seawater pump, DO NOT START THE ENGINE!

14. Coat the threads of all drain plugs with sealer and then reinstall them. Tighten the plugs and petcock securely.

15. If you are winterizing the boat and its going to sit for a few months, it's a good idea to remove the thermostat housing and fill the cylinder block and head with a mixture of water and anti-freeze. Remove the inlet line at the exhaust manifold and do the same. Make sure you drain all coolant into a suitable container prior to refilling the system with seawater next season.

16. If you closed the seacock or disconnected the water inlet line, make sure you open or reconnect it PRIOR to restarting the engine.

Seawater System—V6 And V8 Engines

◆ See Figures 112 thru 120



Specific drain locations and disconnections vary from engine to engine. Please review the following items for the actual description for your engine before beginning the procedure:

- 1987-90 2.3L engines—long hose at thermostat housing, large hose at engine water pump running from thermostat housing, starboard side exhaust manifold petcock and port side cylinder block petcock. If equipped with power steering or other oil cooler, remove the drain plug or lowest hose at the cooler.

- 2.5L/3.0L engines—long hose at thermostat housing, large hose at engine water pump running from thermostat housing, port side exhaust manifold petcock and port side cylinder block petcock. If equipped with power steering or other oil cooler, remove the drain plug or lowest hose at the cooler.

- 1986-87 4.3L engines—long hose at thermostat housing, large hose at engine water pump running from thermostat housing, exhaust manifold and cylinder block petcocks on port and starboard sides. If equipped with power steering or other oil cooler, remove the drain plug or lowest hose at the cooler.

- 1988-95 4.3L engines—long hose at thermostat housing, large hose at engine water pump running from thermostat housing, cylinder block petcocks on port and starboard sides, hose at aft end of each exhaust manifold. If equipped with power steering or other oil cooler, remove the drain plug or lowest hose at the cooler.

- 1996-98 4.3L engines—long hose at thermostat housing, large hose at engine water pump running from thermostat housing, cylinder block petcocks on port and starboard sides, hose at aft end of each exhaust manifold. If equipped with power steering or other oil cooler, remove the drain plug or lowest hose at the cooler. On 4.3Gi engines, remove the bypass hose at the check valve also.

- 1986-88 5.0L and 5.7L engines—long hose at thermostat housing, large hose at engine water pump running from thermostat housing, cylinder block petcocks on port and starboard sides, two rubber caps at fore and aft sides of each exhaust manifold. If equipped with power steering or other oil cooler, remove the drain plug or lowest hose at the cooler.

- 1998 5.0L engines—large hose at engine water pump running from thermostat housing, cylinder block petcocks on port and starboard sides, rubber hose at aft end of each exhaust manifold. If equipped with power steering or other oil cooler, remove the drain plug or lowest hose at the cooler.

- 1989-96 5.7L engines—long hose at thermostat housing, large hose at engine water pump running from thermostat housing, cylinder block petcocks on port and starboard sides, rubber capihose at aft end of each exhaust manifold. If equipped with power steering or other oil cooler, remove the drain plug or lowest hose at the cooler. On 5.7Gi engines, remove the bypass hose at the check valve also.

- 1997-98 5.7L engines—large hose at engine water pump running from thermostat housing, cylinder block petcocks on port and starboard sides, rubber hose at aft end of each exhaust manifold. If equipped with power steering or other oil cooler, remove the drain plug or lowest hose at the cooler. On Gi and GSi engines, remove the small bypass hose at the top of the thermostat housing also.

- 1989-90 5.0L and 5.8L engines—long hose at thermostat housing, large hose at engine water pump running from thermostat housing, cylinder block petcocks on port and starboard sides, exhaust manifold petcocks on port and starboard sides, rubber cap at aft end of each exhaust manifold. If equipped with power steering or other oil cooler, remove the drain plug or lowest hose at the cooler.

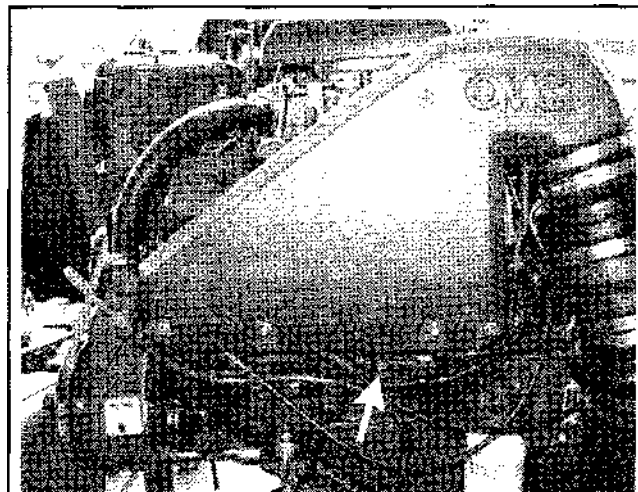


Fig. 112 Port drain plug—4.3L engines

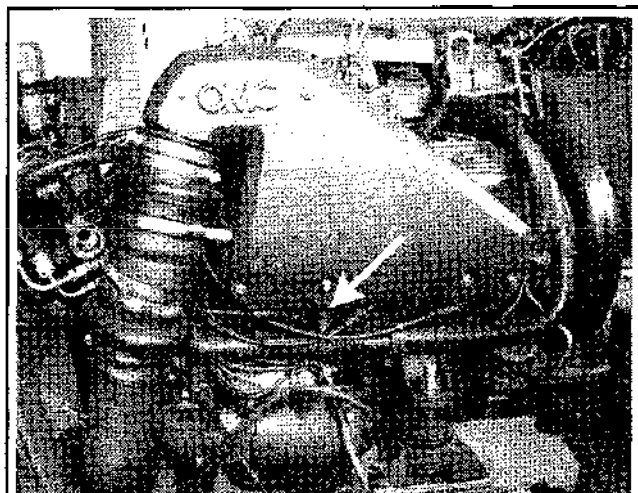


Fig. 113 Starboard drain plug—4.3L engines

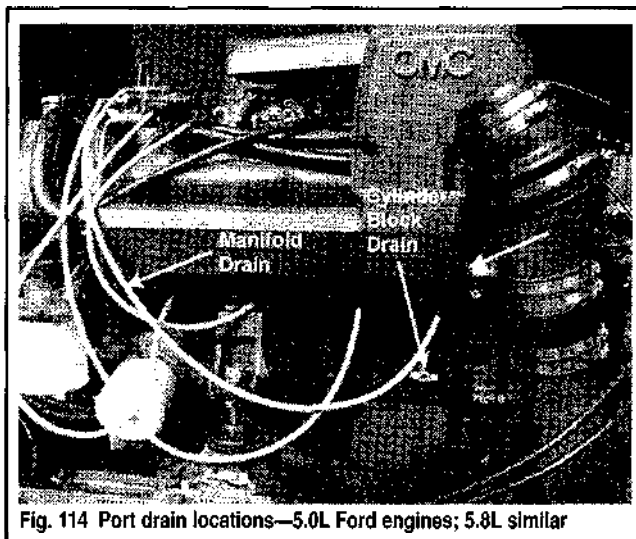


Fig. 114 Port drain locations—5.0L Ford engines; 5.8L similar

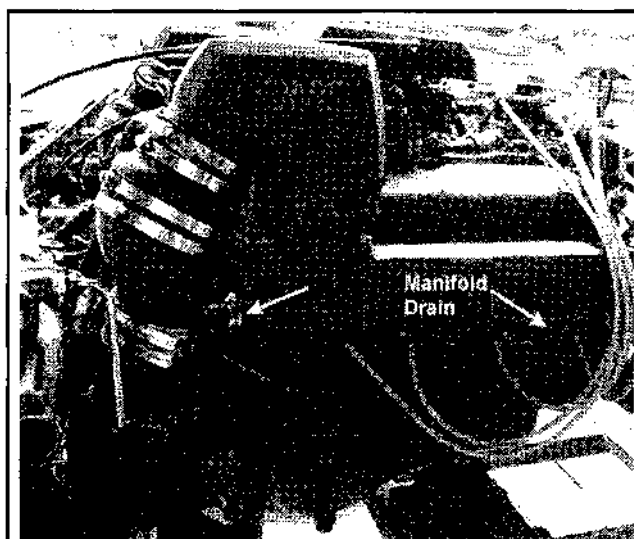


Fig. 115 Starboard drain locations—5.0L Ford engines; 5.8L similar



Fig. 116 Disconnect the long water supply hose—5.0L/5.7L GM engines; and the small by-pass hose—EFI engines, others similar

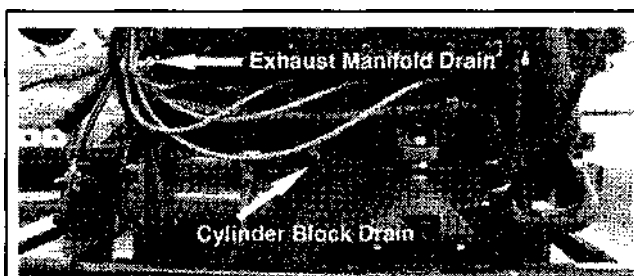


Fig. 117 Loosen the starboard drain plugs—5.0L/5.7L GM engines, others similar

- 1991-96 5.0L and 5.8L engines—long hose at thermostat housing, large hose at engine water pump running from thermostat housing, cylinder block petcocks on port and starboard sides, rubber cap hose at aft end of each exhaust manifold. If equipped with power steering or other oil cooler, remove the drain plug or lowest hose at the cooler. On Fi and FSi engines, remove the bypass hose at the check valve also.

- 1988-98 7.4L/8.2L engines—long hose at thermostat housing, large hose at engine water pump running from thermostat housing, cylinder block petcocks on port and starboard sides, rubber cap hose at aft end of each exhaust manifold. If equipped with power steering or other oil cooler, remove the drain plug or lowest hose at the cooler. On Gi and GSi engines, remove the bypass hose at the check valve also.

- 1987-90 7.5L engines—long hose at thermostat housing, large hose at engine water pump running from thermostat housing, cylinder block petcocks on port and starboard sides, rubber cap hose at aft end of each exhaust manifold. If equipped with power steering or other oil cooler, remove the drain plug or lowest hose at the cooler.

1. If the boat is in the water, close the seacock to prevent water from entering the cooling system. If the boat is not equipped with a seacock, disconnect the seawater inlet line and plug it. Make sure you leave yourself a note by the ignition switch reminding yourself to open the valve or reconnect the line, especially if the boat is going to sit for a period of time. Sound silly? Do it!

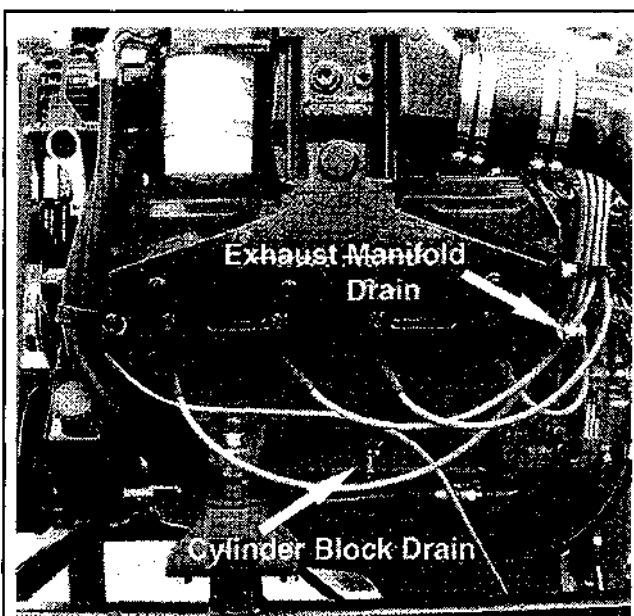


Fig. 118 Loosen the port drain plugs—5.0L/5.7LGM engines, others similar

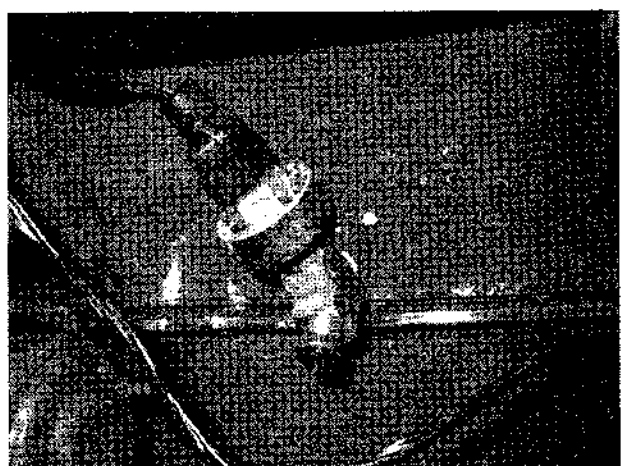


Fig. 119 A nice close-up of a cylinder block drain plug

2. Position suitable containers under all drain plugs and hoses (if space permits) to catch any water being drained or else it will collect in the bilge.
3. Loosen the clamp and disconnect the long supply hose at the thermostat housing. Slowly lower the hose and allow the water to drain.
4. Loosen the clamp and disconnect the large hose running from the thermostat housing to the engine water pump, at the water pump. Allow all water to drain.
5. On most fuel injected engines, loosen the clamp and disconnect the small water by-pass hose on top of the thermostat housing, bend it down and allow the water to drain.
6. On 1998 4.3L engines, remove the drain plug at the front of the intake manifold and allow the manifold to drain. You may need to lower the bow slightly in order to get all of the water out. Reinstall the plug when draining is complete.
7. Remove the drain plug on the side of the cylinder block and allow all water to drain. Repeat this with the plug on the other side if you have a V-engine.
8. Remove the drain plug on the exhaust manifolds or elbow. If your engine is not equipped with a drain, simply disconnect the hose from the lower fitting. Some engines may have these covered with a rubber cap.

■ On certain late model 7.4Gi engines, there is no port side cylinder block drain plug; simply remove the knock sensor.

9. On models equipped with power steering, disconnect the hoses at the cooler—some models may actually have a drain plug on the bottom side of the cooler. If the cooler is mounted horizontally, loosen the mounting bolt and tilt the cooler to aid in the draining.
10. Loosen the clamps and disconnect both hoses at the seawater pump (if equipped). Allow all water to drain and then reconnect the hoses.
11. On engines with closed cooling, remove the drain plug from the bottom of the heat exchanger. If there is no plug, disconnect the seawater inlet hose at the bottom of the exchanger.
12. Disconnect and remove the lower end of all hoses and hold them as low as possible while draining. Reconnect when all water has stopped draining. On models with closed cooling, refer to the flow diagrams at the rear of this section so that you do not disconnect any hoses used for the closed portion of the system.
13. Using a stiff piece of wire, clean out all drain holes. Don't forget any drain holes in the drive unit!
14. On models with SP drives, tilt the drive unit to the full UP position and then remove the water drain plug from the port side of the pivot housing; this can be found toward the front of the upper housing where it attached to the bell housing. Many models will also have a vent and drain plug on the starboard side of pivot housing as well.
15. On King Cobra models, remove the 3 bolts and pull off the water pump access cover. Remove the water passage drain plug and move the drive to the full Down position.

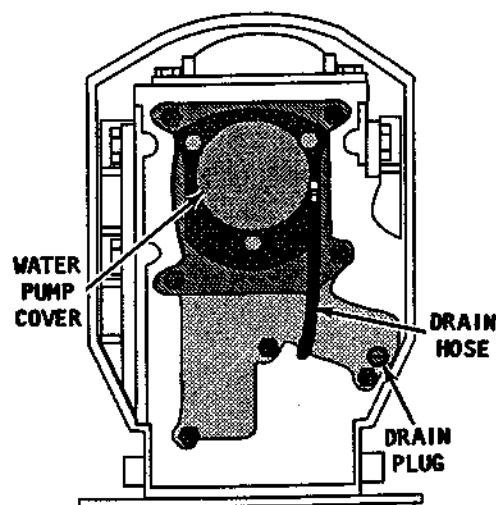


Fig. 120 The drain plug on a King Cobra is below the water pump

16. Turn the ignition switch ON and crank the engine over a few times to force out any residual water in the block or seawater pump. **DO NOT START THE ENGINE!**
17. Install the drain plug and access cover on King Cobra models.
18. Coat the threads of all drain plugs with sealer and then reinstall them. Tighten the plugs and petcock securely.
19. If you are winterizing the boat and its going to sit for a few months, it's a good idea to remove the thermostat housing and fill the cylinder block and head with a mixture of water and anti-freeze. Remove the inlet line at the exhaust manifold and do the same. Make sure you drain all coolant into a suitable container prior to refilling the system with seawater next season.
20. If you closed the seacock or disconnected the water inlet line, make sure you open or reconnect it PRIOR to restarting the engine.

Closed System



This system should be kept filled with the appropriate water and anti-freeze solution year-round; even if laying the boat up for the winter. Coolant should be changed at least every other year.

■ Don't forget to drain the seawater system if winterizing the boat.

1. Carefully remove the pressure cap from the system. Follow the precautions detailed in the Pressure Cap procedures in this section if the engine is hot.
2. Loosen and remove the petcock(s) or drain plug(s) on the cylinder block making sure you have a suitable container under the drains or else the coolant will flow into the bilge.
3. Disconnect the coolant hose (the other is a seawater hose—refer to the flow diagrams) from the engine circulating pump at the heat exchanger. Loosen and remove the drain plug at the bottom of the exchanger.
4. Clean all drain holes with a stiff piece of wire.
5. If equipped with a coolant recovery or overflow tank, drain it also.
6. Coat the threads of all plugs with sealer and install them securely. Reconnect the coolant hose at the heat exchanger.
7. Pour the appropriate mix of water and anti-freeze into the reservoir filler neck until the level is within 1 in. of the bottom of the neck.
8. With the cap still off, start the engine and run it at 1500-1800 rpm. Add additional coolant until the level is within 1 in. of the bottom of the filler neck. If the boat is out of the water, don't forget to attach a flushing device to ensure proper flow of seawater.
9. After the engine has reached normal operating temperature, check that the level in the filler neck is correct; add coolant if necessary.
10. Install the pressure cap, check the coolant recovery reservoir and fill it to the FULL line.
11. If any leakage or overheating is noticed, shut the engine down immediately and look for the cause of the problem.

Stern Drive Unit**FLUID LEVEL**

◆ See Figures 121, 122, 123 and 124



Check the fluid level after the first 20 hours of operation and then at least every 50 hours of operation or once a season, whichever comes first. It's never a bad idea to check your unit more frequently, particularly if you use your boat in severe service conditions. We recommend checking the fluid level weekly as air pockets during a fluid fill or change may cause an initially false reading; which is to say that the initial level may drop on its own over the first 10 hours of operation or so. OMC recommends using OMC Hi-Vis Gear Case Lubricant in 1986-93 drives, OMC Ultra HPF Gear Case lube in 1994-95 drives, and Mobilube 1 SHC Fully Synthetic SAE 75W-90 gear lubricant in 1996-98 units. Never substitute regular automotive grease.

1. Position the drive unit in the full IN/DOWN position so that the anti-ventilation plate is level.

□ The oil level should always be checked with the drive unit cold.

2. Remove the oil level dipstick found on top of the upper gear unit wipe it down with a clean lint-free rag and reinsert it. Remove it once again and check that the lubricant is up to the line on the stick. If the level is satisfactory, check the condition of the washer and then install it and the dipstick. It's a good idea to replace the washer on a regular basis regardless of its visible condition.

3. If the level is low, add oil lubricant, very slowly, through the dipstick opening and then reinstall the dipstick and washer.

4. Let it sit for a moment and then recheck it.

×× **CAUTION**

The unit should never require more than 2 oz. of lubricant. If more is required, you've got an oil leak and the unit should not be operated until it is found and fixed.

5. Clean any excess oil from the housing. Recheck the oil level on the dipstick again a final time after the next use.

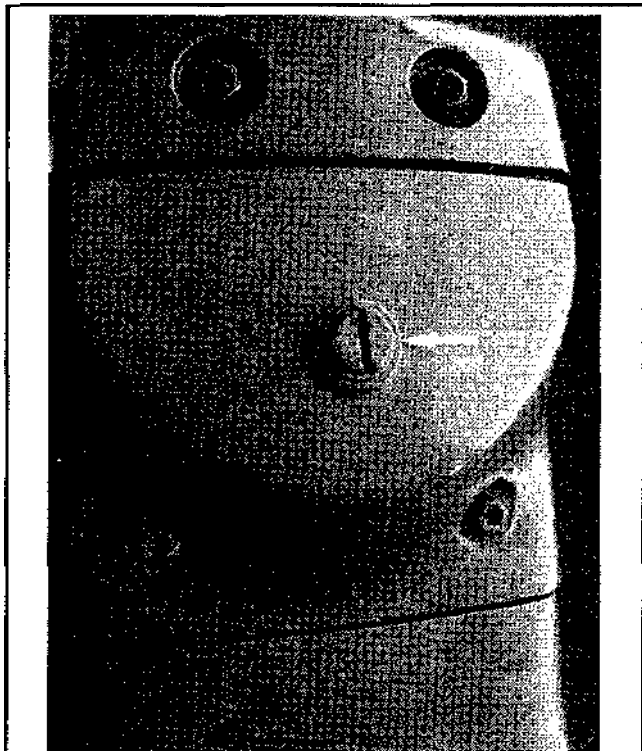


Fig. 121 A close up of the oil dipstick nut (SP/DP shown)

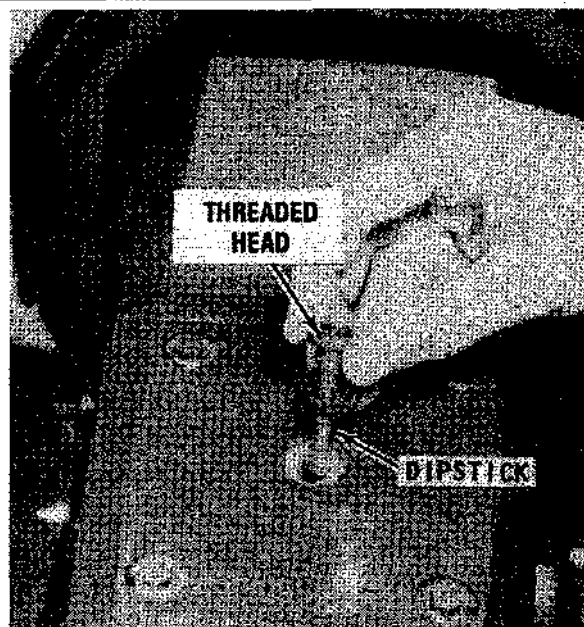


Fig. 122 Use the dipstick to check the fluid level—Cobra and King Cobra models

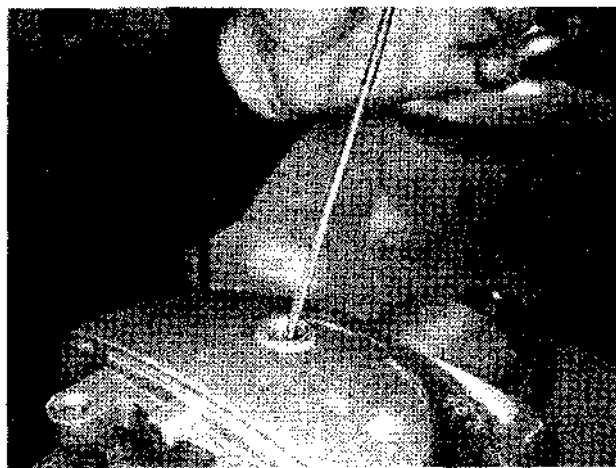


Fig. 123 Use the dipstick to check the fluid level—SPIDP models

CHECKING FOR WATER

It is a good idea to check the unit periodically for water contamination. Water in the drive oil usually indicates a bad seal somewhere on the unit and should be corrected immediately.

1. With the engine off and the stern drive, unit cold, trim the drive to the full UP position.

2. Remove the oil fill/drain plug and take a small sample of the lubricant—a teaspoon worth is more than enough.

3. If the oil sample looks milky brown then there is likely a leaking seal in the drive unit and it should be located and replaced before operating the boat again.

4. Most units covered in the manual have magnetic fill/drain plugs, so be sure to check that the end of the plug is free of any metal filings. If you find any metallic particles on the plug it can be an indication of greater problems within the drive unit.

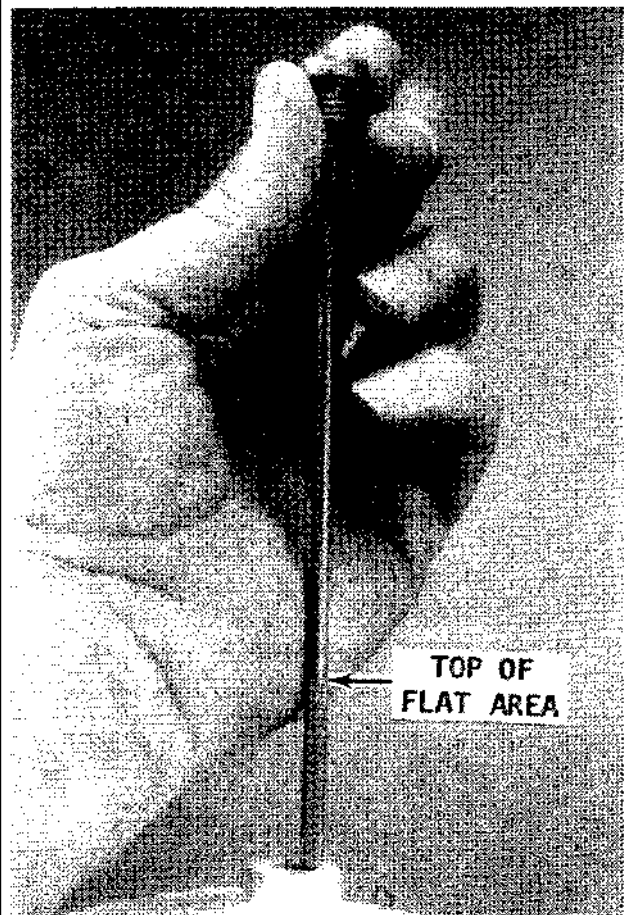
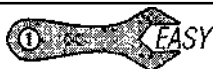


Fig. 124 The top of the flat area indicates the case is full

DRAIN AND REFILL



The oil in the stern drive should be changed at least every 50 hours of operation or twice a season on Cobra and King Cobra drives, 100 hours of operation or once a season on SP/DP drives; whichever comes first. It's never a bad idea to change the fluid in your unit more frequently, particularly if you use your boat in severe service conditions. OMC recommends using only OMC Hi-Vis Gear Case Lubricant in 1986-93 drives, OMC Ultra HPF Gear Case lube in 1994-95 drives, and Mobilube 1 SHC Fully Synthetic SAE 75W-90 gear lubricant in 1996-98 units. Never substitute regular automotive grease.

1986-93 Cobra Units

◆ See Figure 125

*** CAUTION

Stern drive oil should always be changed with the unit cold.

☐ Take a look at the oil as it is being drained, if the oil is milky brown in color there is a good chance there is a leak in the unit. The stern drive unit should not be operated until the leak is found and corrected.

1. Trim the stern drive to the full IN/DOWN position.
2. Position an oil drain pan or an old plastic milk jug under the drain hole on the bottom of the drive unit and then remove the drain plug (starboard side of lower gearcase). Removing the oil dipstick at this time will help the oil drain quicker.

3. When the old oil has completely drained, install the drain plug and tighten it securely.

4. Remove the oil fill plug on the starboard side of the drive, just above the anti-cavitation plate. Insert the dipstick into the hole so that it is just resting on the upper surface of the bore; do not screw it in.

5. Pump the proper lubricant into the drive through the fill hole until it reaches upper mark on the dipstick. This will give a false reading (slightly high) in order to account for a fluid level drop once the air bubbles are purged when you start the engine.

■ Please refer to the Capacities chart for lubricant capacities on a specific drive unit.

*** WARNING

Fill the drive unit slowly! Adding lubricant too quickly will cause too many air bubbles and could lead to an inaccurate level reading or even more severe damage.

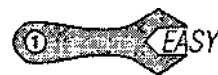
6. With the lube pump still attached, screw in the oil level dipstick securely. Quickly remove the pump and install the fill plug and washer.

7. After allowing the oil to settle for a few minutes, check the level using the dipstick. Add lubricant slowly through the dipstick hole as required.

8. Clean any excess oil on the housing. Check the oil level a final time and then recheck it again after the first use.

1989-92 King Cobra Units

◆ See Figure 126



*** CAUTION

Stern drive oil should always be changed with the unit cold.

■ Take a look at the oil as it is being drained, if the oil is milky brown in color there is a good chance there is a leak in the unit. The stern drive unit should not be operated until the leak is found and corrected.

1. Trim the stern drive to the full IN/DOWN position.

2. Position an oil drain pan or an old plastic milk jug under the drain hole on the bottom of the drive unit and then remove the drain plug (port side of lower gearcase). Removing the oil dipstick at this time will help the oil drain quicker.

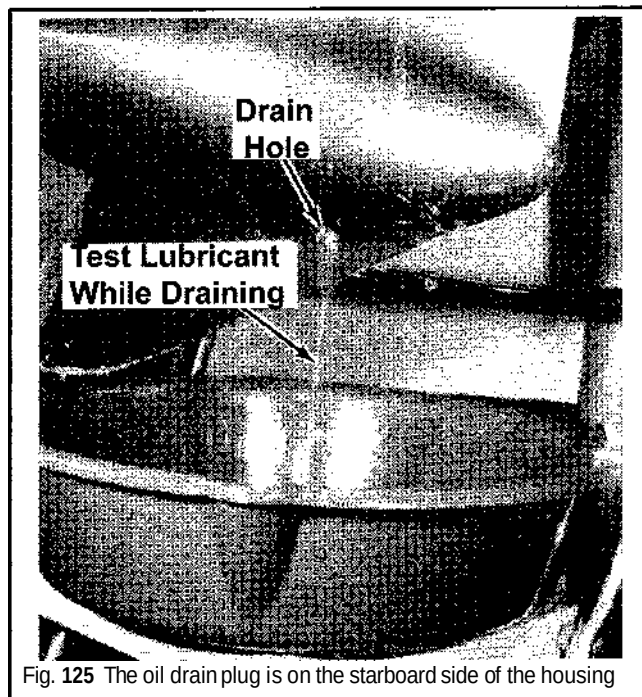


Fig. 125 The oil drain plug is on the starboard side of the housing

3. When the old oil has completely drained, install the drain plug and tighten it securely.
4. Pump the proper lubricant into the drive through the oil dipstick hole until it reaches the upper mark on the dipstick with the dipstick just sitting in the bore--do not screw it into the hole. This will give a false reading (slightly high) in order to account for a fluid level drop once the air bubbles are purged when you start the engine.

■ Please refer to the Capacities chart for lubricant capacities on a specific drive unit.

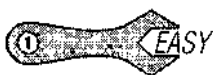
** WARNING

Fill the drive unit slowly! Adding lubricant too quickly will cause too many air bubbles and could lead to an inaccurate level reading or even more severe damage.

5. After allowing the oil to settle for a few minutes, check the level using the dipstick. Add lubricant slowly through the dipstick hole as required.
6. Clean any excess oil on the housing. Check the oil level a final time and then recheck it again after the first use.

1993-95 King Cobra Units

◆ See Figure 126

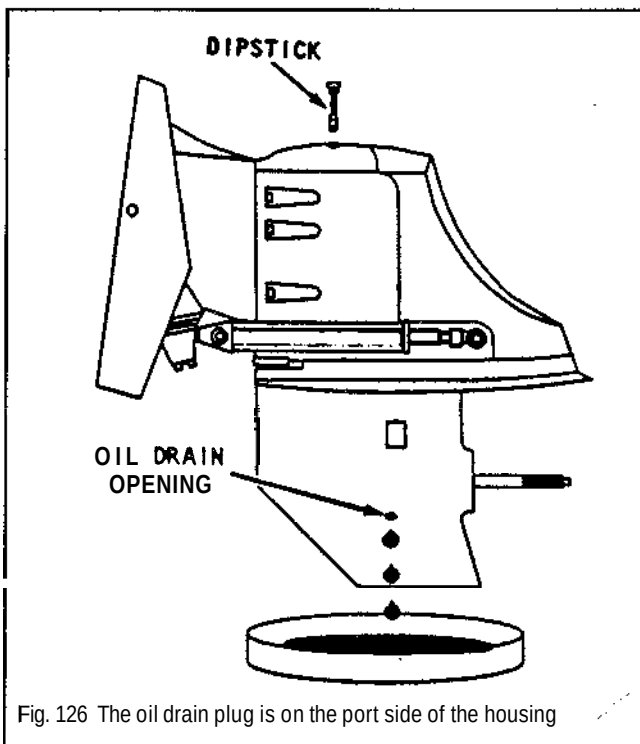


** CAUTION

Stern drive oil should always be changed with the unit cold.

■ Take a look at the oil as it is being drained, if the oil is milky brown in color there is a good chance there is a leak in the unit. The stern drive unit should not be operated until the leak is found and corrected.

1. Trim the stern drive to the full IN/DOWN position.
2. Position an oil drain pan or an old plastic milk jug under the drain hole on the bottom of the drive unit and then remove the fill/drain plug (port side of lower gearcase). Removing the oil dipstick at this time will help the oil drain quicker.
3. When the old oil has completely drained, install an appropriate pump into the drain plug and tighten it securely.



4. Pump the proper lubricant into the drive until it reaches the upper mark on the dipstick with the dipstick just sitting in the bore--do not screw it into the hole. This will give a false reading (slightly high) in order to account for a fluid level drop once the air bubbles are purged when you start the engine.

■ Please refer to the Capacities chart for lubricant capacities on a specific drive unit.

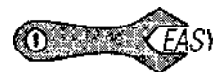
** WARNING

Fill the drive unit slowly! Adding lubricant too quickly will cause too many air bubbles and could lead to an inaccurate level reading or even more severe damage.

5. With the lube pump still attached, thread in the dipstick and tighten it securely. Quickly remove the pump and install the fill/drain plug and washer; tighten it to 60-84 inch lbs. (6.8-9.5 Nm). Reinstall the oil level dipstick with a new seal and tighten it to 48-72 inch lbs. (5.4-8.1 Nm). Use sealing compound on the threads of the oil fill/drain and level plugs.
6. After allowing the oil to settle for a few minutes, check the level using the dipstick. Add lubricant slowly through the dipstick hole as required.
7. Clean any excess oil on the housing. Check the oil level a final time and then recheck it again after the first use.

1994-95 Cobra Units And 1996-98 SP Units

◆ See Figures 127, 128 and 129



** CAUTION

Stern drive oil should always be changed with the unit cold.

■ Take a look at the oil as it is being drained, if the oil is milky brown in color there is a good chance there is a leak in the unit. The stern drive unit should not be operated until the leak is found and corrected.

1. Trim the stern drive to the full IN/Down position.
2. Position an oil drain pan or an old plastic milk jug under the drain hole on the bottom of the drive unit and then remove the fill/drain plug (port side of lower gearcase). Remove the oil dipstick at this time which will help the oil drain quicker.
3. While waiting for the oil to drain, remove the three shift lever cover retaining screws (two on the upper gear housing, one on the intermediate housing). Remove the cover and then remove the oil level plug to starboard of the shift lever.
4. When the old oil has completely drained, position and install a suitable lubricant pump into the drain hole.
5. Pump the proper lubricant into the drive through the fill/drain hole until it reaches the level at the bottom of the oil level hole on the upper gear housing.

■ Please refer to the Capacities chart for lubricant capacities on a specific drive unit.

** WARNING

Fill the drive unit slowly! Adding lubricant too quickly will cause air bubbles that could lead to an inaccurate level reading or even more severe damage.

6. With the lube pump still attached, reinstall the oil level plug with a new seal, tighten it to 48-72 inch lbs. (5.4-8.1 Nm). Do the same with the oil dipstick and then quickly remove the pump and install the fill/drain plug and washer; tighten it to 60-84 inch lbs. (6.8-9.5 Nm). Use sealing compound on the threads of the oil fill/drain and level plugs.
7. After allowing the oil to settle for a few minutes, check the level using the dipstick. Add lubricant slowly through the dipstick hole as required.
8. Install the shift cover and tighten the three bolts to 108-132 inch lbs. (12.2-14.9 Nm).
9. Clean any excess oil on the housing. Check the oil level a final time and then recheck it again after the first use.

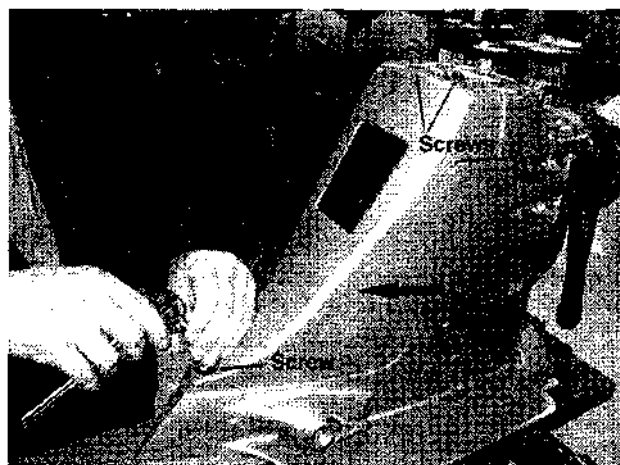


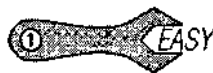
Fig. 127 After removing the shift cover...



Fig. 129 The oil drain plug is on the port side of the housing

1996-98 DP Units

◆ See Figures 127 thru 131



✖ ✖ CAUTION

Stern drive oil should always be changed with the unit cold.

Take a look at the oil as it is being drained, if the oil is milky brown in color there is a good chance there is a leak in the unit. The stern drive unit should not be operated until the leak is found and corrected.

1. Remove the propeller(s) as detailed in the Drive Systems section.
2. Trim the stern drive to the full IN/Down position.
3. Position an oil drain pan or an old plastic milk jug under the bottom of the drive unit and then remove the fill/drain plug just inside the lower gear case housing, under the propeller shaft. Remove the oil dipstick at this time which will help the oil drain quicker.
4. While waiting for the oil to drain, remove the shift lever cover retaining screws (one, two or three depending on the model, but usually three). Remove the cover and then remove the oil level plug to starboard of the shift lever.
5. When the old oil has completely drained, position and install a suitable lubricant pump into the drain hole. Almost all models will require first screwing in a Fill Adaptor (# 3855932-4)

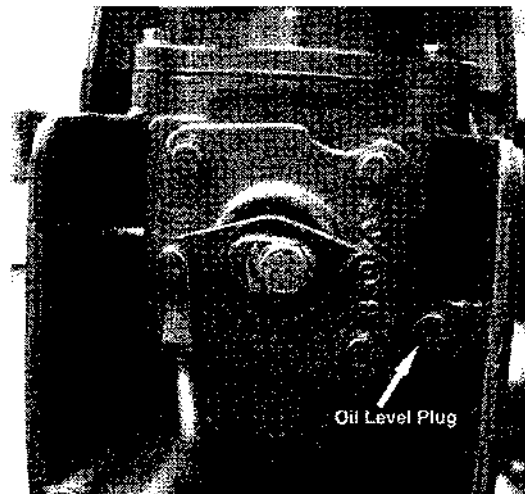


Fig. 128 ...remove the oil level plug

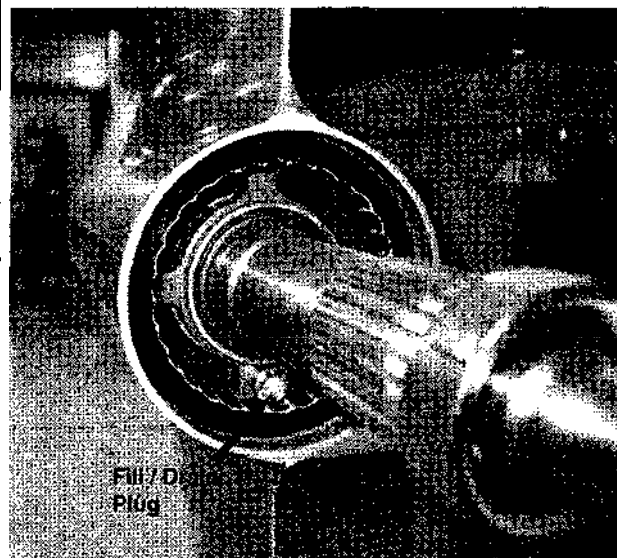


Fig. 130 The oil drain plug is inside the housing, behind the propellers...

6. Pump the proper lubricant into the drive through the fill/drain hole until it reaches the level at the bottom of the oil level hole on the upper gear housing.

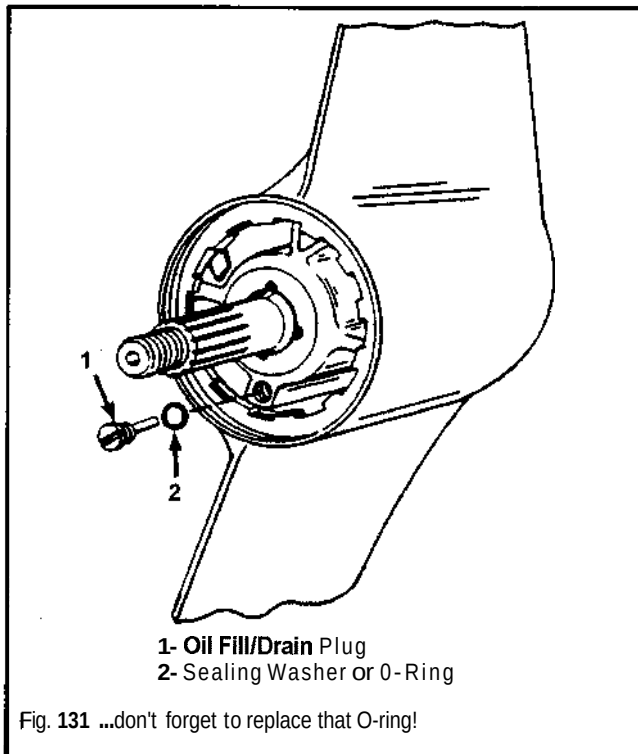
Please refer to the Capacities chart for lubricant capacities on a specific drive unit.

✖ ✖ WARNING

Fill the drive unit slowly! Adding lubricant too quickly will cause air bubbles that could lead to an inaccurate level reading or even more severe damage.

7. With the lube pump still attached, reinstall the oil level plug with a new seal, tighten it to 48-72 inch lbs. (5.4-8.1 Nm). Do the same with the oil dipstick and then quickly remove the pump and fill adaptor and install the fill/drain plug and washer; tighten it to 60-84 inch lbs. (6.8-9.5 Nm).

Don't forget to replace the O-rings when replacing the plugs!



8. Install the propellers.
9. After allowing the oil to settle for a few minutes, check the level using the dipstick. Add lubricant slowly through the dipstick hole as required.
10. Install the shift cover and tighten the retaining bolts to 108-132 inch lbs. (12.2-14.9 Nm).
11. Clean any excess oil on the housing. Check the oil level a final time and then recheck it again after the first use.

Power Trim/Tilt Pump

FLUID LEVEL

◆ See Figure 132



Fluid levels in the power trim/tilt pump should be checked every 100 hours of operation or once a season, whichever comes first. We recommend that you use OMC Power Trim/Tilt & Power Steering Fluid, although OMC suggests that in a pinch you can use Dexron® II ATF.

LUBRICATION POINTS

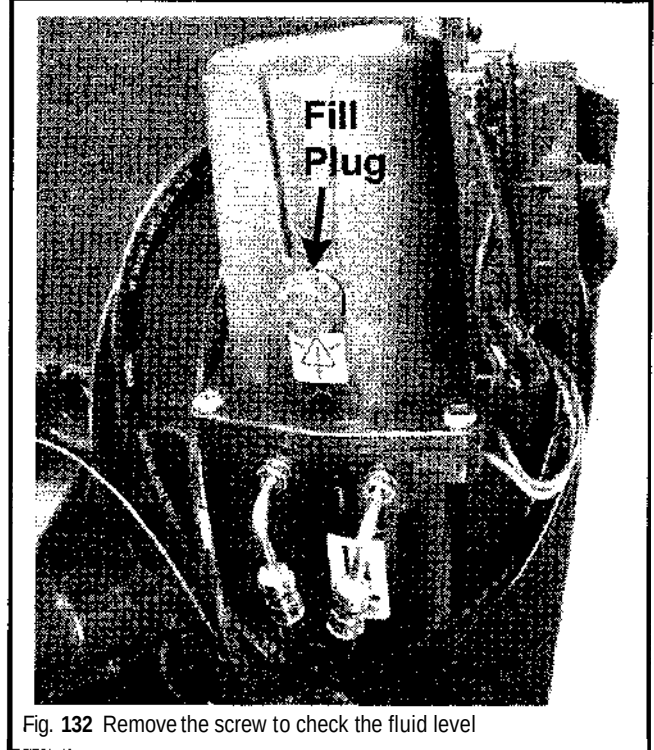
Propeller Shaft

Although OMC does not publish intervals for propeller shaft lubrication, we recommend lubricating the shaft every 100 hours or 6 months, whichever comes first when the vessel is being operated in fresh water. If the vessel is in salt water, every 50 hours or 2 months. Please refer to the Drive Systems section for details on propeller removal and installation.

Throttle Cable



Lubricate the cable pivot points every 100 hours or 6 months, whichever comes first when the vessel is being operated in fresh water. In salt water, lubricate every 50 hours or 2 months whichever comes first. Always use OMC Grease.



1. Position the stern drive in the full UP/OUT position in order to relieve all hydraulic pressure.

*** CAUTION

Failure to position the drive unit in the full UP/OUT position before removing the plug could result in hydraulic fluid spraying all over upon plug removal.

2. Loosen and remove the fill screw from the side of the pump housing.
3. Check that the lubricant is up to the bottom of the threads in the hole. If necessary, add more fluid slowly through the hole until the level is correct.
4. With the fill screw still out, move the drive through its full range 6-10 times in order to purge any air that may have entered the system. Lower the drive fully and recheck the fluid level again; repeat the process if necessary.
5. Install the fill screw and tighten it securely.

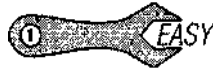
Shift Cable And Transmission Linkage Pivot Points



Lubricate the cable pivot points every 100 hours or 6 months, whichever comes first when the vessel is being operated in fresh water. In salt water, lubricate every 50 hours or 2 months whichever comes first. Always use OMC Grease.

Steering System

◆ See Figure 133



□ Always check the steering system and its components for loose, missing or damaged components and fittings before performing your lubrication procedures.

Lubricate the various steering system components every 50 hours or 2 months, whichever comes first when the vessel is being operated in fresh water. In salt water, lubricate every 25 hours or 30 days whichever comes first. Use only OMC Triple-GuardGrease

The transom end of the steering cable must be fully retracted into the cable housing before applying grease to the fitting.

Lubricate all pivot points on the system with SAE 20 or 30 motor oil.

The control valve grease fitting takes OMC Triple-Guard Grease as does the steering ram.

✖ ✖ CAUTION

Use only a hand operated grease gun when filling the zerk fitting. Never use a power operated gun!

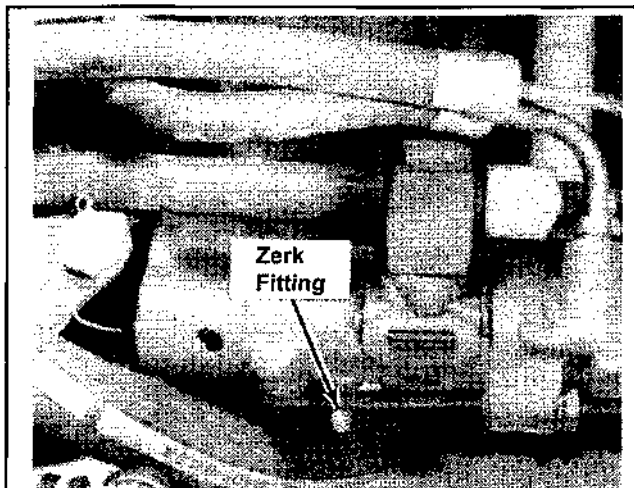


Fig. 133 Always use a hand operated grease gun when filling the control valve

Gimbal Bearing And U-Joints

+ See Figures 134 and 135



The gimbal bearing and the U-Joints must be lubricated every 100 hours of operation, or once a season; whichever comes first. OMC EP Wheel Bearing Grease should be used in both instances. Certain older units may not be equipped with grease fittings; if yours is not, the U-joints will require disassembly and greasing. Because OMC recommends removing the drive unit prior to performing this service, the perfect time to consider performing it is during your winterization.

✖ ✖ CAUTION

Failure to perform this service on a regular basis will result in severe damage to the transom assembly and drive unit.

1. Remove the drive unit as detailed in the Drive Unit section. Carefully support it in a holding assembly.

2. Connect a hand operated grease gun to the fitting for the bearing and slowly pump in grease until the all of the old grease has been forced out. Take note of the old grease as it is expelled—if any evidence of water is observed, inspect the bearing for damage and replace as necessary.

3. Now connect the grease gun to one of the fittings for the U-joints and slowly pump in grease until the all of the old grease has been forced out. Repeat this procedure for the second U-joint, being careful to force ALL of the old grease out.

✖ ✖ CAUTION

Use only a hand operated grease gun when filling the zerk fitting. Never use a power operated gun!

4. Wipe all old grease off of the driveshaft splines and then coat the splines thoroughly with new grease.

5. Carefully wipe any grease, oil or dirt from the two O-rings at the top of the shaft and then coat them thoroughly with light oil.

6. Check the bellows for any signs of damage or deterioration, replacing it if in doubt (as detailed in the Drive Unit section)

7. Check the engine alignment and then reinstall the drive unit.

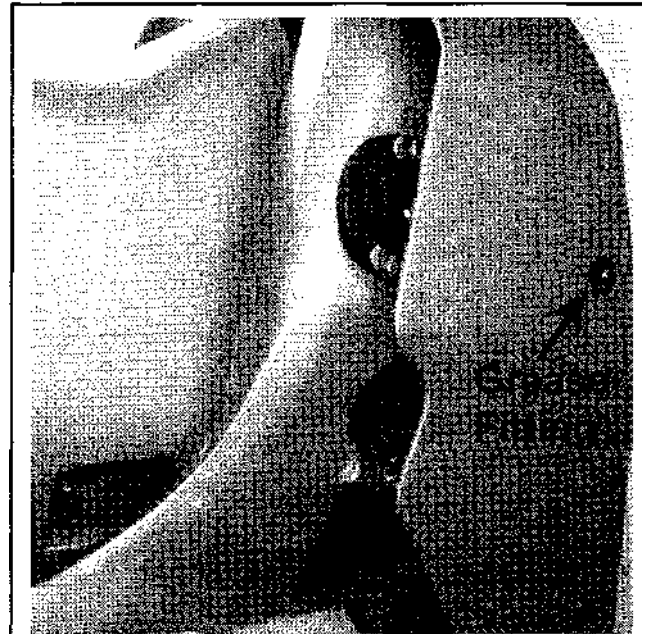


Fig. 134 The gimbal bearing is serviced via a grease (zerk) fitting on the starboard side of the housing

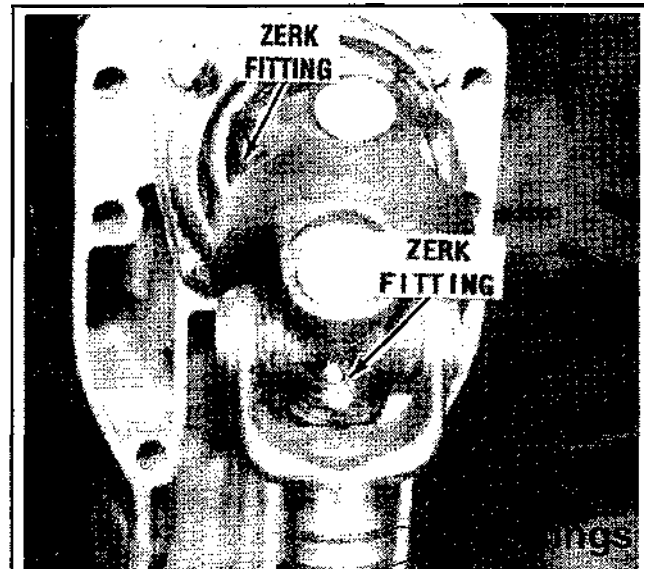


Fig. 135 Each of the U-Joints has a grease fitting. Don't forget to lube the two O-rings at the end of the shaft

BOAT MAINTENANCE

Inside The Boat

Probably the biggest surprise for boat owners is the extent to which mold and mildew develop in a boat's interior. Preventing this growth is a two-fold process. First, the boat's interior should be thoroughly cleaned. Second, ventilation should be provided to allow adequate air circulation.

Properly cleaning the boat includes removing as much as possible from it. The less there is on a boat, the less there is to attract mildew. Clothing, foul weather gear, shoes, books, charts, paper goods, leather, bedding, curtains, food stuffs, first aid supplies, odds and ends, etc., should be taken home. They're all fertile soil for mildew, as is dirt, grease, soap scum, etc.

The next step is to vacuum, scrub and polish every surface, especially galley and head surfaces. Use a polish that leaves a protective coating on which it's hard for mold to get a foothold. Mildew-preventive sprays are available for carpets and furniture. The cleaner and more highly polished the insides of lockers, cabinets, refrigerators, icemakers, drawers and shower stalls are when you leave them, the less likely it is you'll find mold. Marine stores sell cleaners and polishes specifically for boats and for the marine environment. Many people find that regular household products are satisfactory. It's the elbow grease that counts.

If dirt and grease are the growing medium, stagnant air is the fertilizer for mold and mildew (mildew is a form of mold). The more freely air can circulate in the interior of your boat the less conducive conditions will be for the growth of mold. Openings or vents at each end near the top can be fashioned to let air in. Flaps or stovepipe elbows can be used to keep rain out. Hatches and windows can then be left partially open. Visiting the boat on dry, sunny days and opening it up as much as possible is a great way to let fresh air in. Do this whenever possible.

The best way to protect navigation and communications equipment from deteriorating is to remove the units from the boat. Wrap them in towels, not plastic, and take them home. Television sets, VCRs and stereos should also be removed to keep them safe and to keep cold and dampness from affecting them adversely. Before storing electronics equipment, clean off the terminals and the connecting plugs and spray them with a moisture-displacing lubricant that specifically says it's intended for use on electronics. Antennas should also be stored in a safe, dry place to protect them from both the elements and accidental damage. All terminal blocks, junction blocks, fuse holders and the back of electrical panels should be cleaned and sprayed with an appropriate protectant. Remove any corrosion that has developed. Anything that could be easily stolen, such as anchors, flare guns, binoculars, etc., is best taken home.

The Boat's Exterior

◆ See Figure 136

Fiberglass reinforced plastic hulls are tough, durable, and highly resistant to impact. However, like any other material they can be damaged. One of the advantages of this type of construction is the relative ease with which it may be repaired. Because of its break characteristics, and the simple techniques used in restoration, these hulls have gained popularity throughout the world. From the most congested urban marina, to isolated lakes in wilderness areas, to the severe cold of northern seas, and in sunny tropic remote rivers of primitive islands or continents, fiberglass boats can be found performing their daily task with a minimum of maintenance.

A fiberglass hull has almost no internal stresses. Therefore, when the hull is broken or stove-in, it retains its true form. It will not dent to take an out-of-shape set. When the hull sustains a severe blow, the impact will either be absorbed by deflection of the laminated panel or the blow will result in a definite, localized break. In addition to hull damage, bulkheads, stringers, and other stiffening structures attached to the hull may also be affected and therefore, should be checked. Repairs are usually confined to the general area of the rupture.

The best way to care for a fiberglass hull is to first wash it thoroughly. Immediately after hauling the boat, while the bottom is still wet, is best, if possible. Remove any growth that has developed on the bottom. Use a pressure cleaner or a stiff brush to remove barnacles, grass, and slime. Pay particular attention to the waterline area. A scraper of some sort may be needed to attack tenacious barnacles. Pot scrubbers work well. Attend to any blisters: don't wait!

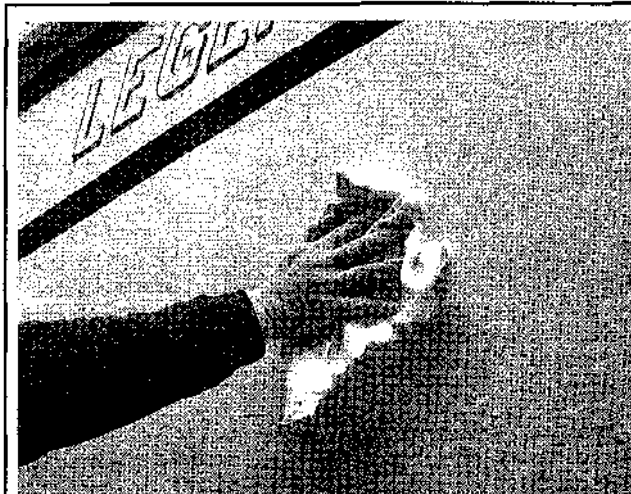


Fig. 136 The best way to care for a fiberglass hull is to wash it thoroughly to remove any growth that has developed on the bottom

Remove cushions and all weather curtains and enclosures and take them home. Make sure they are clean before storing them, and don't store them tightly rolled. After washing the topsides, remove any stains that have developed with one of the fiberglass stain removers sold in marine stores. For stubborn stains, wet-sanding with 600-grit paper may be necessary. Remove oxidation and stains from metal parts. Apply a coat of wax to everything.

BELOW WATERLINE

◆ See Figure 137, 138, 139 and 140

A foul bottom can seriously affect boat performance. This is one reason why racers, large and small, both powerboat and sail, are constantly giving attention to the condition of the hull below the waterline.

In areas where marine growth is prevalent, a coating of vinyl, anti-fouling bottom paint should be applied. If growth has developed on the bottom, it can be removed with a solution of Muriatic acid applied with a brush or swab and then rinsed with clear water. Always use rubber gloves when working with Muriatic acid and take extra care to keep it away from your face and hands. The fumes are toxic. Therefore, work in a well-ventilated area, or if outside, keep your face on the windward side of the work.

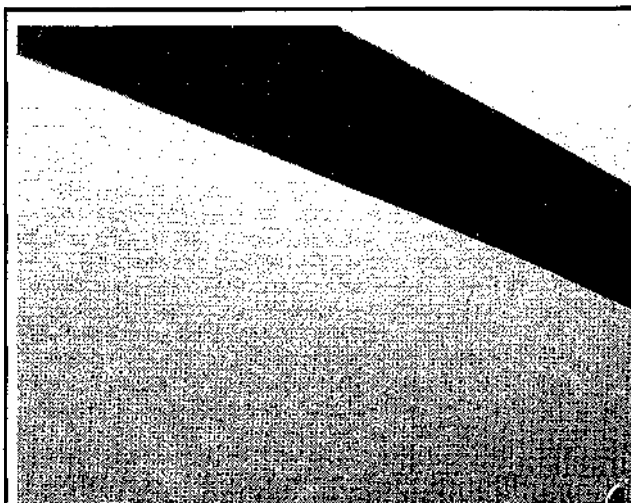


Fig. 137 This beautiful new fiberglass hull will not stay this good looking for long if it is not protected with anti-foul paint

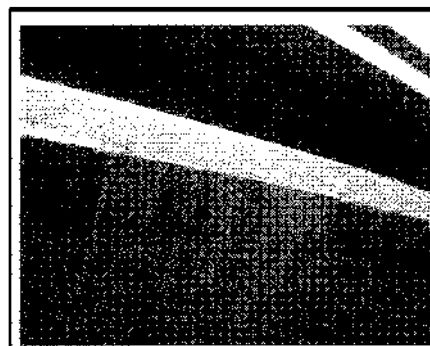


Fig. 138 In areas where marine growth is prevalent, a coating of vinyl, anti-fouling bottom paint should be applied

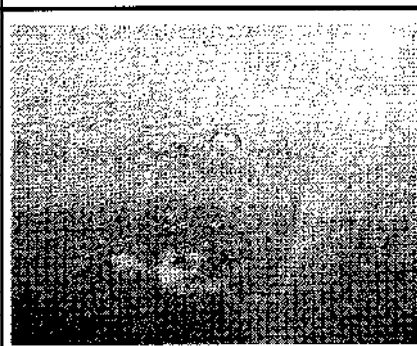


Fig. 139 This anti-foul paint has seen better days and must be replaced

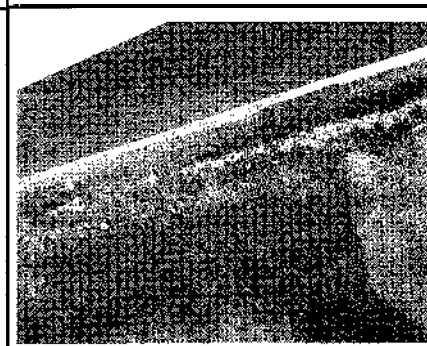


Fig. 140 This hull is in even worse condition and should be sand blasted and repainted

Barnacles have a nasty habit of making their home on the bottom of boats that have not been treated with anti-fouling paint. Actually they will not harm the fiberglass hull, but can develop into a major nuisance.

If barnacles or other crustaceans have attached themselves to the hull, extra work will be required to bring the bottom back to a satisfactory condition. First, if practical, put the boat into a body of fresh water and allow it to remain for a few days. A large percentage of the growth can be removed in this manner. If this remedy is not possible, wash the bottom thoroughly with a high-pressure fresh water source and use a scraper. Small particles of hard shell may still hold fast. These can be removed with sandpaper.

Anodes (Zincs)

The idea behind anodes is simple: When dissimilar metals are dunked in water and a small current is leaked between or amongst them, the less-noble metal (galvanically speaking) is sacrificed.

The zinc alloy that the anodes are made of is designed to be less noble than the aluminum alloy your drive unit is made from. If there's any electrolysis and there almost always is, the inexpensive zinc anodes are consumed in lieu of the expensive drive.

These zincs need a little attention in order to do their job. Make sure they're there, solidly attached to a clean mounting site and not covered with any kind of paint or wax.

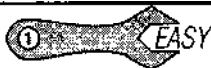
Periodically inspect them to make sure they haven't eroded too much. At a certain point in the erosion process, the mounting holes start to enlarge, which is when the zinc might fall off. Obviously, once that happens, your drive no longer has any protection.

Many OMCs offer an option of a zinc or magnesium anode, magnesium actually works better in fresh water - never use magnesium in saltwater! If you tend to use your vessel in fresh and saltwater, always go with the zincs.

OMC also offers an electronic corrosion control system, Active Protection System which is detailed later in this manual.

SERVICING

◆ See Figure 141, 142 and 143



Depending on what kind of drive your boat has, you might have any number of zincs. Regardless of the number, there are some fundamental rules to follow that will give your boat's sacrificial anodes the ability to do the best job protecting your boat's underwater hardware that they can.

The first thing to remember is that zincs (or magnesiums) are electrical components and like all electrical components, they require good clean connections. So after you've undone the mounting hardware and removed last year's zincs, you want to get the zinc mounting sites clean and shiny.

Get a piece of coarse emery cloth or some 80-grit sandpaper. Thoroughly rough up the areas where the zincs attach (there's often a bit of corrosion residue in these spots). Make sure to remove every trace of corrosion.

Zincs are attached with stainless steel machine screws that thread into the mounting for the zincs. Over the course of a season, this mounting hardware is inclined to loosen. Mount the zincs and tighten the mounting hardware securely. Tap the zincs with a hammer hitting the mounting screws squarely. This process tightens the zincs and allows the mounting hardware to become a bit loose in the process. Now, do the final tightening. This will

insure your zincs stay put for the entire season.

All units utilize anodes in at least two locations, many have three. The following list should point you in the right direction for your particular model:

a. Cobra—At the bottom of the transom shield/assembly; on the leading edge of the lower gear case, where it mates with the upper/intermediate unit; and attached to the bearing carrier inside the lower unit.

b. SP and King Cobra—At the bottom of the transom shield/assembly; on the leading edge of the lower gear case, where it mates with the upper/intermediate unit; and, on the aft edge of the lower gear case, just forward of the propeller.

c. DP—At the bottom of the transom shield/assembly; and, on the leading edge of the lower gear case, where it mates with the upper/intermediate unit.

INSPECTION



If you use your boat in salt water, and your zincs never wear, inspect them carefully. Paint or wax on zincs prevents them from working properly. They must be left bare. If the zincs are installed properly and not painted or waxed, inspect around them for signs of corrosion. If corrosion is found, strip it off immediately and repaint with a rust inhibiting paint. If in doubt, replace the zincs.

On the other hand, if your zinc seems to erode in no time at all, this may be a symptom of the zinc itself. Each manufacturer uses a specific blend of metals in their zincs. If you are using zincs with the wrong blend of metals, they may erode more quickly or leave you with diminished protection.

Batteries

Difficulty in starting accounts for almost half of the service required on boats each year. A survey by a major engine parts company indicated that roughly one third of all boat owners experienced a "won't start" condition in a given year. When an engine won't start, most people blame the battery when, in fact, it may be that the battery has run down in a futile attempt to start an engine with other problems.

Maintaining your battery in peak condition may be thought of as either tune-up or maintenance material. Most wise boaters will consider it to be both. A complete check up of the electrical system in your boat at the beginning of the boating season is a wise move. Continued regular maintenance of the battery will ensure trouble free starting on the water.

Complete battery service procedures are included in this section. The following are a list of basic electrical system service checks that should be performed.

- Check the battery for solid cable connections
- Check the battery and cables for signs of corrosion damage
- Check the battery case for damage or electrolyte leakage
- Check the electrolyte level in each cell
- Check to be sure the battery is fastened securely in position
- Check the battery's state of charge and charge as necessary
- Check battery voltage while cranking the starter. Voltage should remain above 9.5 volts
- Clean the battery, terminals and cables

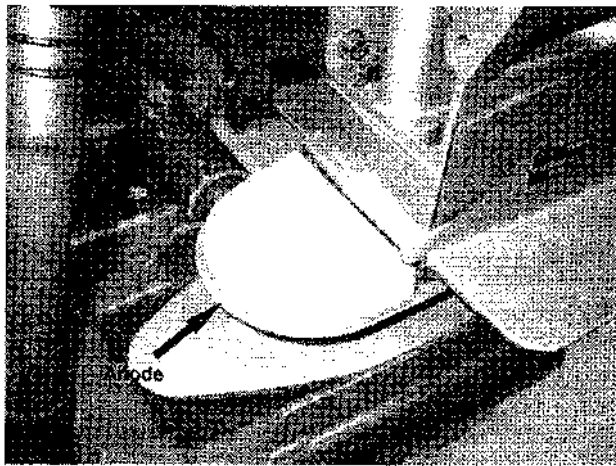


Fig. 141 Almost all drive units covered here utilize an anode on the leading edge of the unit

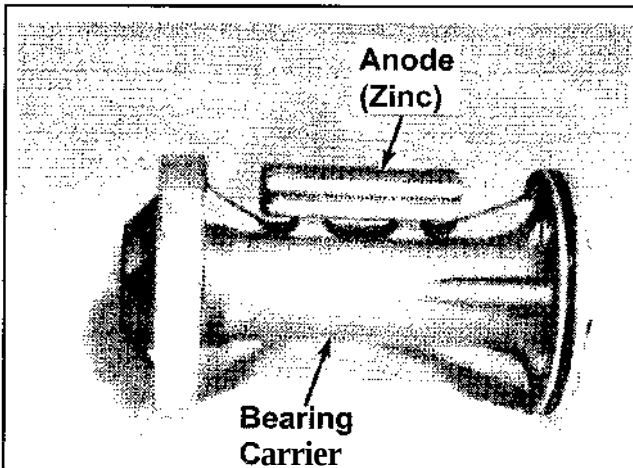


Fig. 142 Certain models utilize an anode attached to the bearing carrier...

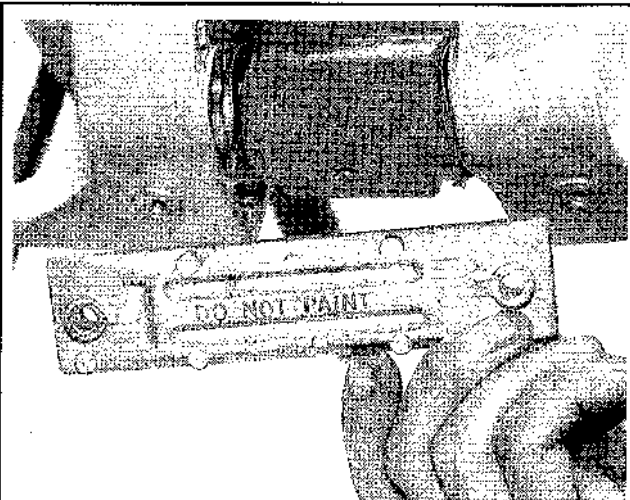
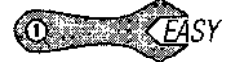


Fig. 143 ... while most models also use one like this, mounted on the bottom of the transom assembly

- Coat the battery terminals with dielectric grease or terminal protector
- Check the tension on the alternator belt.

Batteries that are not maintained on a regular basis can fall victim to parasitic loads (small current drains which are constantly drawing current from the battery, like clocks, small lights, etc.). Normal parasitic loads may drain a battery on boat that is in storage and not used frequently. Boats that have additional accessories with increased parasitic load may discharge a battery sooner. Storing a boat with the negative battery cable disconnected or battery switch turned OFF will minimize discharge due to parasitic loads.

CLEANING



Keep the battery clean; as a film of dirt can help discharge a battery that is not used for long periods. A solution of baking soda and water mixed into a paste may be used for cleaning, but be careful to flush this off with clear water.

- Do not let any of the solution into the filler holes on non-sealed batteries. Baking soda neutralizes battery acid and will de-activate a battery cell.

CHECKING SPECIFIC GRAVITY



The electrolyte fluid (sulfuric acid solution) contained in the battery cells will tell you many things about the condition of the battery. Because the cell plates must be kept submerged below the fluid level in order to operate, maintaining the fluid level is extremely important. In addition, because the specific gravity of the acid is an indication of electrical charge, testing the fluid can be an aid in determining if the battery must be replaced. A battery in a boat with a properly operating charging system should require little maintenance, but careful, periodic inspection should reveal problems before they leave you stranded.

** CAUTION

Battery electrolyte contains sulfuric acid. If you should splash any on your skin or in your eyes, flush the affected area with plenty of clear water. If it lands in your eyes, get medical help immediately.

As stated earlier, the specific gravity of a battery's electrolyte level can be used as an indication of battery charge. At least once a year, check the specific gravity of the battery. It should be between 1.20 and 1.26 on the gravity scale. Most parts stores carry a variety of inexpensive battery testing hydrometers. These can be used on any non-sealed battery to test the specific gravity in each cell.

Conventional Battery



- ◆ See Figure 144

A hydrometer is required to check the specific gravity on all batteries that are not maintenance-free. The hydrometer has a squeeze bulb at one end and a nozzle at the other. Battery electrolyte is sucked into the hydrometer until the float or pointer is lifted from its seat. The specific gravity is then read by noting the position of the float/pointer. If gravity is low in one or more cells, the battery should be slowly charged and checked again to see if the gravity has come up. Generally, if after charging, the specific gravity of any two cells varies more than 50 points (0.50), the battery should be replaced, as it can no longer produce sufficient voltage to guarantee proper operation.

Check the battery electrolyte level at least once a month, or more often in hot weather or during periods of extended operation. Electrolyte level can be checked either through the case on translucent batteries or by removing the cell caps on opaque-case types. The electrolyte level in each cell should be kept filled to the split ring inside each cell, or the line marked on the outside of the case.

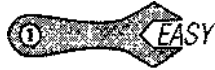
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■ **Never use mineral water or water obtained from a well. The iron content in these types of water is too high and will shorten the life of or damage the battery.**

If the level is low, add only distilled water through the opening until the level is correct. Each cell is separate from the others, so each must be checked and filled individually. Distilled water should be used, because the chemicals and minerals found in most drinking water are harmful to the battery and could significantly shorten its life.

If water is added in freezing weather, the battery should be warmed to allow the water to mix with the electrolyte. Otherwise, the battery could freeze.

Maintenance-Free Batteries

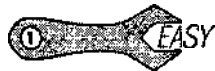


Although some maintenance-free batteries have removable cell caps for access to the electrolyte, the electrolyte condition and level is usually checked using the built-in hydrometer "eye." The exact type of eye varies between battery manufacturers, but most apply a sticker to the battery itself explaining the possible readings. When in doubt, refer to the battery manufacturer's instructions to interpret battery condition using the built-in hydrometer.

The readings from built-in hydrometers may vary, however a green eye usually indicates a properly charged battery with sufficient fluid level. A dark eye is normally an indicator of a battery with sufficient fluid, but one that may be low in charge. In addition, a light or yellow eye is usually an indication that electrolyte supply has dropped below the necessary level for battery (and hydrometer) operation. In this last case, sealed batteries with an insufficient electrolyte level must usually be discarded.

BATTERY TERMINALS

◆ See Figures 145 and 146



At least once a season, the battery terminals and cable clamps should be cleaned. Loosen the clamps and remove the cables, negative cable first. On batteries with top mounted posts, the use of a puller specially made for this purpose is recommended. These are inexpensive and available in most parts stores.

Clean the cable clamps and the battery terminal with a wire brush, until all corrosion, grease, etc., is removed and the metal is shiny. It is especially important to clean the inside of the clamp thoroughly (a wire brush is useful here), since a small deposit of foreign material or oxidation there will prevent

a sound electrical connection and inhibit either starting or charging. It is also a good idea to apply some dielectric grease to the terminal, as this will aid in the prevention of corrosion.

After the clamps and terminals are clean, reinstall the cables, negative cable last; do not hammer the clamps onto battery posts. Tighten the clamps securely, but do not distort them. To retard corrosion, give the clamps and terminals a thin external coating of clear polyurethane paint after installation.

Check the cables at the same time that the terminals are cleaned. If the insulation is cracked or broken, or if its end is frayed, the cable should be replaced with a new one of the same length and gauge.

BATTERY & CHARGING SAFETY PRECAUTIONS

Always follow these safety precautions when charging or handling a battery.

1. Wear eye protection when working around batteries. Batteries contain corrosive acid and produce explosive gas, a byproduct of their operation. Acid on the skin should be neutralized with a solution of baking soda and water made into a paste. In case acid contacts the eyes, flush with clear water and seek medical attention immediately.

2. Avoid flame or sparks that could ignite the hydrogen gas produced by the battery and cause an explosion. Connection and disconnection of cables to battery terminals is one of the most common causes of sparks.

✖✖ CAUTION

Always make sure that your stored battery is no where near any ignition source!

3. Always turn a battery charger **OFF**, before connecting or disconnecting the leads. When connecting the leads, connect the positive lead first, then the negative lead, to avoid sparks.

4. When lifting a battery, use a battery carrier or lift at opposite corners of the base.

5. Ensure there is good ventilation in a room where the battery is being charged.

6. Do not attempt to charge or load-test a maintenance-free battery when the charge indicator dot is indicating insufficient electrolyte.

7. Disconnect the negative battery cable if the battery is to remain in the boat during the charging process.

8. Be sure the ignition switch is **OFF** before connecting or turning the charger **ON**. Sudden power surges can destroy electronic components.

9. Use proper adapters to connect the charger leads to batteries with non-conventional terminals.

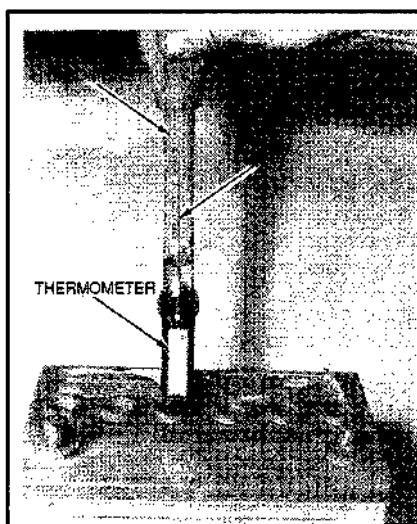


Fig. 144 The best way to determine the condition of a battery is to test the electrolyte with a battery hydrometer



Fig. 145 A battery post cleaner is used to clean the battery posts...

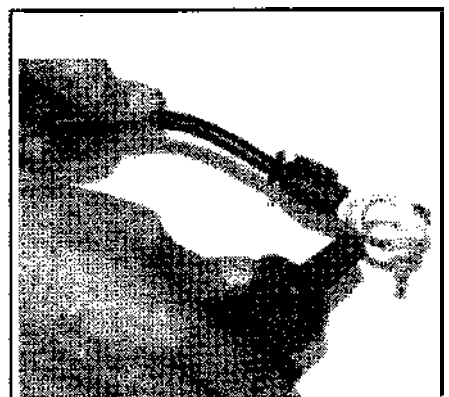


Fig. 146 ...and the battery terminals

BATTERY CHARGERS

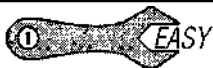
Before using any battery charger, consult the manufacturer's instructions for its use. Battery chargers are electrical devices that change Alternating Current (AC) to a lower voltage of Direct Current (DC) that can be used to charge a marine battery. There are two types of battery chargers—manual and automatic.

A manual battery charger must be physically disconnected when the battery has come to a full charge. If not, the battery can be overcharged, and possibly fail. Excess charging current at the end of the charging cycle will heat the electrolyte, resulting in loss of water and active material, substantially reducing battery life.

As a rule, on manual chargers, when the ammeter on the charger registers half the rated amperage of the charger, the battery is fully charged. This can vary, and it is recommended to use a hydrometer to accurately measure state of charge.

Automatic battery chargers have an important advantage—they can be left connected (for instance, overnight) without the possibility of overcharging the battery. Automatic chargers are equipped with a sensing device to allow the battery charge to taper off to near zero as the battery becomes fully charged. When charging a low or completely discharged battery, the meter will read close to full rated output. If only partially discharged, the initial reading may be less than full rated output, as the charger responds to the condition of the battery. As the battery continues to charge, the sensing device monitors the state of charge and reduces the charging rate. As the rate of charge tapers to zero amps, the charger will continue to supply a few milliamps of current—just enough to maintain a charged condition.

REPLACING BATTERY CABLES



Battery cables don't go bad very often, but like anything else, they can wear out. If the cables on your boat are cracked, frayed or broken, they should be replaced.

When working on any electrical component, it is always a good idea to disconnect the negative (-) battery cable. This will prevent potential damage

to many sensitive electrical components

Always replace the battery cables with one of the same length, or you will increase resistance and possibly cause hard starting. Smear the battery posts with a light film of dielectric grease, or a battery terminal protectant spray once you've installed the new cables. If you replace the cables one at a time, you won't mix them up.

■ **Any time you disconnect the battery cables, it is recommended that you disconnect the negative (-) battery cable first. This will prevent you from accidentally grounding the positive (+) terminal when disconnecting it, thereby preventing damage to the electrical system.**

Before you disconnect the cable(s), first turn the ignition to the **OFF** position. This will prevent a draw on the battery which could cause arcing. When the battery cable(s) are reconnected (negative cable last), be sure to check all electrical accessories are all working correctly.

STORAGE

If the boat is to be laid up for the winter or for more than a few weeks, special attention must be given to the battery to prevent complete discharge or possible damage to the terminals and wiring. Before putting the boat in storage, disconnect and remove the batteries. Clean them thoroughly of any dirt or corrosion and then charge them to full specific gravity reading. After they are fully charged, store them in a clean cool dry place where they will not be damaged or knocked over, preferably on a couple blocks of wood. Storing the battery up off the deck, will permit air to circulate freely around and under the battery and will help to prevent condensation.

Never store the battery with anything on top of it or cover the battery in such a manner as to prevent air from circulating around the filler caps. All batteries, both new and old, will discharge during periods of storage, more so if they are hot than if they remain cool. Therefore, the electrolyte level and the specific gravity should be checked at regular intervals. A drop in the specific gravity reading is cause to charge them back to a full reading.

In cold climates, care should be exercised in selecting the battery storage area. A fully-charged battery will freeze at about 60° below zero. A discharged battery, almost dead, will have ice forming at about 19° above zero.

WINTER STORAGE

Taking extra time to store the boat properly at the end of each season will increase the chances of satisfactory service at the next season. Remember, storage is the greatest enemy of a marine engine. In a perfect world the unit should be run on a monthly basis. The steering and shifting mechanism should also be worked through complete cycles several times each month. But who lives in a perfect world!

For most of us, if a small amount of time is spent in winterizing our beloved boats, the reward will be satisfactory performance, increased longevity and greatly reduced maintenance expenses.

Winter Storage Checklist

Proper winterizing involves adequate protection of the unit from physical damage, rust, corrosion, and dirt. The following steps provide guide to winterizing your marine engine at the end of a season.

1. Always keep a note or a checklist of just what maintenance needs to be done prior to starting the engine in the spring.
2. Replace the oil and oil filter. Normal combustion produces corrosive acids that are absorbed by the oil. Leaving dirty oil in the engine for an extended time allows these acids to attack and damage bearing surfaces.
3. Change the engine oil and filter. Used oil contains harmful acids and contaminants that should not be allowed to go to work on the engine all winter long. The drivetrain transmission oil should also be changed.
4. Replace the fuel filter elements--draining any water from the filter bowls.
5. Keeping the fuel tank full over the winter will help cut down on condensation. Using fuel additives, like OMC 2t4 Marine Fuel Conditioner/Stabilizer, that control bacterial growth or prevent gelling in cold climates are also popular with many boaters and are highly recommended. Be sure to follow the manufacturer's instructions on the side of the can.

□ **On models with a 4bbl carburetor, run the engine under sufficient load to circulate the conditioner through the secondary fuel system.**

6. Bleed the fuel system of air and replace the water separating fuel filter.
 - a. Flush the seawater circuit to remove corrosive salts.
 - b. Drain the seawater system, taking special care to empty all the low spots.
 - c. On closed cooling systems, replace the coolant with a clean, fresh, 50/50 mixture of water and antifreeze. Always mix the antifreeze and water mixture prior to pouring it into the engine.
7. Inspect all hoses for signs of softening, cracking or bulging, especially those routinely exposed to high heat. Check hose clamps for tightness and corrosion.
8. Close the fuel shut-off valve, if equipped, to stop all flow of fuel from the tanks to the engine.
9. On carbureted engines, remove the flame arrestor and start the engine. Allow it to reach normal operating temperature. Run the engine at fast idle and squirt about 213 of an 8 oz. (0.24L) of can of Storage Fogging Oil or 12 oz. (355 ml) spray into the carburetor or throttle body. Just as the engine is starting to sputter, squirt the remaining 113 of the container into the carburetor/throttle body and allow the engine to die. Install the flame arrestor.
10. On EFI engines, purchase a 6 gallon external fuel tank for an outboard. Add 5 gallons of fuel, 4 pints (64 oz.) of OMC Storage Fogging Oil and 113 cup (2.5 oz.) of 2+4 Marine Fuel Conditioner—mix thoroughly, and carefully. Carefully disconnect and plug the main fuel line from the boats fuel tank at the fuel pump. Hook a line from the 6 gallon fuel tank to the pump. Start the engine (using the fogging mixture as the fuel source) and run it at 1500 rpm for 5 minutes to ensure that all fuel system and internal engine components are completely coated and protected. Turn off the engine and reinstall the main fuel line.

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11. It's also a good idea to remove the spark plugs and pour about an ounce of Fogging Oil into each cylinder. You can also use SAE 20 motor oil. Crank the engine with the starter for a few seconds to make sure that the oil coats the cylinder bores completely.

12. On engines so equipped, remove the water separating fuel filter and pour in about 2 oz. of 2 cycle outboard oil. Reinstall the filter, start the engine and run it until it dies. Install a new filter.

13. Perform all the lubrication procedures detailed in this section.

14. Loosen the adjusting bolts or tensioners on all drive or serpentine belts until the tension is relieved.

15. Fully charge the batteries. Disconnect all leads. Unattended, a battery naturally discharges over a period of several weeks. The electrolyte on a discharged battery can freeze at 20°F (-7°C), so keep the batteries fully charged or, better still, remove them to a warmer storage area. Small automatic trickle chargers work well.

16. Treat battery and cable terminals with petroleum jelly, silicone grease, or a heavy-duty corrosion inhibitor.

17. Protect external surfaces with a heavy-duty corrosion inhibitor.

18. Grease all greaseable points on the drivetrain.

19. Lightly coat the alternator and starter with a light lubricant to disperse the water.

20. Ensure that all drain holes on the stern drive are open by inserting a piece of wire into them.

21. Make sure the stern drive is in the full IN/DOWN position.

22. Cover the engine with a waterproof sheet in case there are any leaks from above. Some boaters will take the time to seal all openings to the engine (air inlet, breathers, exhaust), however this traps moisture and may do more harm than good.

23. Place a checklist in a handy spot to remind you of just what maintenance needs to be done prior to starting the engine in the spring. If this sounds silly, DO IT ANYWAY!!

24. If you visit the boat during the winter, additional protection can be achieved using the starter to turn the engine over and circulate oil to the bearings and cylinder walls.

25. If the boat is to be stored out of the water, always remove the drain plug(s) if equipped. We suggest you attach the plug to the ignition key as added insurance that you remember to reinstall it in the spring - sound silly? Why take the chance!

■ **Special inhibiting oils are available that provide greater protection. Use these to replace the standard engine oil; run the engine briefly to coat all surfaces, and then drain the oil. Protection remains good, provided the engine is not turned.**

26. If the engine cannot be fully winterized, replace oil, coolant, and all filters and run the engine up to operating temperatures monthly.

SPRING COMMISSIONING

Satisfactory performance and maximum enjoyment can be realized if a little time is spent in commissioning your boat in the spring. Assuming you have followed the steps we recommended to winterize your vessel (in addition to any the manufacturer specifies) and the unit has been properly stored, a minimum amount of work should be required to prepare it for use.

After performing the spring commissioning and testing the boat on the water, it is a good idea to perform a full tune-up. Remember, you are relying on your engine to get you where you want to go. Treat it good now and it will treat you good later.

Spring Commissioning Checklist

The following steps outline a logical sequence of tasks to be performed before starting your engine for the first time in a new season.

1. Pick up the checklist you made to remind yourself of just what maintenance needs to be done prior to starting the engine in the spring. You did remember to write yourself a checklist...right?

2. **INSTALL THE DRAIN PLUG IF REMOVED!**

3. Remove the cover placed over the engine last winter. Unseal any engine openings (air inlet, breathers, exhaust) previously sealed.

4. Replace all zincs.

5. If you took our advice, you removed the battery for the winter. While

it was in storage, you should have kept it fully charged. It should be ready to go. So install the battery and connect the battery cables. Treat battery and cable terminals with petroleum jelly, silicone grease, or a heavy-duty corrosion inhibitor. Capacity test the batteries.

6. Tighten the alternator and other belts.

7. As you did in the winter, inspect all hoses for signs of softening, cracking or bulging, especially those routinely exposed to high heat. Check hose clamps for tightness and corrosion.

8. Ensure the exhaust manifolds are tight.

9. On closed system engines, check the condition of the coolant mixture with a coolant tester and adjust the mixture by adding antifreeze or water.

10. Bleed the fuel system of air.

11. Connect the spark plug wires and any other connections.

12. Start the engine and allow it to reach operating temperature.

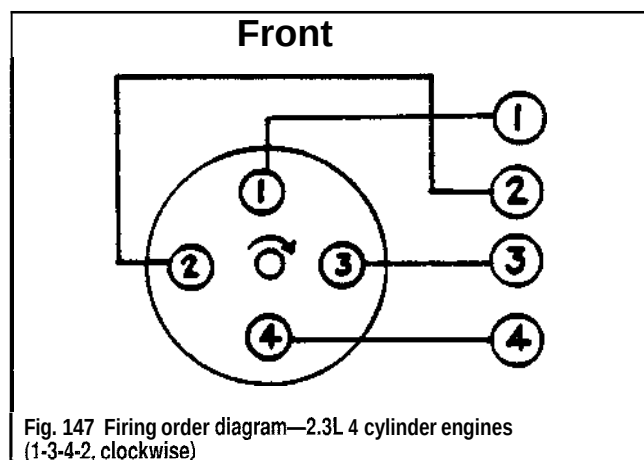
13. Once running, check the oil pressure, the raw water discharge and the engine for oil and water leaks.

14. Drain water from the filter bowls. If an excessive amount of water is noted in the fuel system, you may want to consider a fuel conditioner or replacing the old fuel with fresh fuel.

15. After testing the boat on the water, it is a good idea to change the engine oil and filter. The drivetrain transmission oil should also be changed. This eliminates the adverse effects of moisture in the oil.

FIRING ORDERS

◆ See Figures 147 thru 156



To avoid confusion, **ALWAYS** label the spark plug wires with a piece of tape before disconnecting them from the plug or distributor cap.

