mercruiser

SERVICE MANUAL

INDEX

Number 10

MARINE ENGINES

GM 4 Cylinder

Printed in U.S.A.

90-14693--1 1-194

Models Covered in This Manual

MODEL	SERIAL NUMBER
MCM 120 MR	6853914-0A492055
MCM 120 Alpha I	0A492056-0B531853
MCM 2.5L	0C856450 and Above
MCM 140 MR	6852270-0A484072
MCM 140 Alpha I	0A484073-0B450800
MCM 3.0L	0C856450 and Above
Sea Ray 3.0L	0B787205-B917530

NOTICE

MCM 2.5L - Same as MCM 120.
MCM 3.0L
Sea Ray 3.0L - Same as MCM 140 (Later Models are rated at 130 HP and have 9.2:1 Compression ratio.)

IMPORTANT: Refer to engine identification, page.

NOTICE

Refer to Appropriate Stern Drive service manual for transom assembly and Stern Drive unit repair.

Notice

Throughout this publication, "Dangers," "Warnings" and "Cautions" are used to alert the mechanic to special instructions concerning a particular service or operation that may be hazardous if performed incorrectly or carelessly. —— Observe them carefully!

These "Safety Alerts" alone cannot eliminate the hazards that they signal. Strict compliance to these special instructions when performing the service, plus "common sense" operation, are major accident prevention measures.

⚠DANGER

DANGER — Immediate hazards which WILL result in severe personal injury or death.

⚠WARNING

WARNING — Hazards or unsafe practices which COULD result in severe personal injury or death.

⚠CAUTION

CAUTION — Hazards or unsafe practices which could result in minor personal injury of product or property damage.

Notice To Users of This Manual

This service manual has been written and published by the service department of Mercury Marine to aid our dealers, mechanics and company service personnel when servicing the products described herein.

It is assumed that these personnel are familiar with the servicing procedures of these products, or like or similar products manufactured and marketed by Mercury Marine. That they have been trained in the recommended servicing procedures of these products which includes the use of mechanics common hand tools and the special Mercury Marine or recommended tools from other suppliers.

We could not possibly know of and advise the service trade of all conceivable procedures by which a service might be performed and of the possible hazards and/or results of each method. We have not undertaken any such wide evaluation. Therefore, anyone who uses a service procedure and/or tool, which is not recommended by the manufacturer, first must completely satisfy himself that neither his nor the product's safety will be endangered by the service procedure selected.

All information, illustrations and specifications contained in this manual are based on the latest product information available at time of publication.

It should be kept in mind, while working on the product, that the electrical system and ignition system is capable of violent and damaging short circuits or severe electrical shocks. When performing any work where electrical terminals could possibly be grounded or touched by the mechanic, the battery cables should be disconnected at the battery.

Any time the intake or exhaust openings are exposed during service they should be covered to protect against accidental entrance of foreign material which could enter the cylinders and cause extensive internal damage when the engine is started.

It is important to note that, during any maintenance procedure, replacement fasteners must have the same measurements and strength as those removed, whether metric or customary. Numbers on the heads of the metric bolts and on surfaces of metric nuts indicate their strength. Customary bolts use radial lines for this purpose, while most customary nuts do not have strength markings. Mismatched or incorrect fasteners can result in damage or malfunction, or possibly personal injury. Therefore, fasteners removed should be saved for re-use in the same locations whenever possible. Where the fasteners are not satisfactory for re-use, care should be taken to select a replacement that matches the original.

Replacement Parts

Electrical, ignition and fuel system components on MerCruiser Engines and Stern Drives are designed and manufactured to comply with U.S. Coast Guard Rules and Regulations to minimize risks of fire or explosion.

Use of replacement electrical, ignition or fuel system components, which do not comply to these rules and regulations, could result in a fire or explosion hazard and should be avoided.

When servicing the electrical, ignition and fuel systems, it is extremely important that all components are properly installed and tightened. If not, any electrical or ignition component opening would permit sparks to ignite fuel vapors from fuel system leaks, if they existed.

Engine Mechanical Components

Many of the engine mechanical components are designed for marine applications. Unlike automotive engines, marine engines are subjected to extended periods of heavy load and wide-open-throttle operation, therefore, require heavy-duty components. Special marine engine parts have design and manufacturing specifications which are required to provide long life and dependable performance. Marine engine parts also must be able to resist the corrosive action of salt or brackish water that will rust or corrode standard automotive parts within a short period of time.

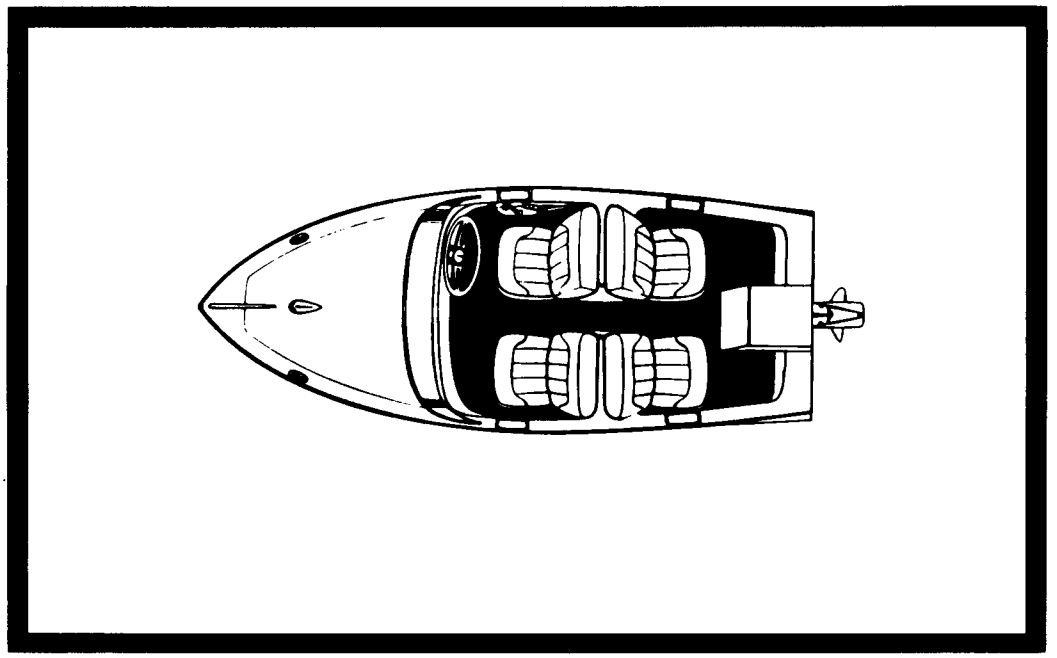
Failure to use recommended Quicksilver service replacement parts can result in poor engine performance and/or durabilty, rapid corrosion of parts subjected to salt water and possibly complete failure of the engine.

Use of parts other than recommended service replacement will void the warranty on those parts which are damaged as a result of the use of other than recommended parts.

Service Manual Outline

IMPORTANT INFORMATION

1A



mercruiser
STERN DRIVES & INBOARDS

INDEX

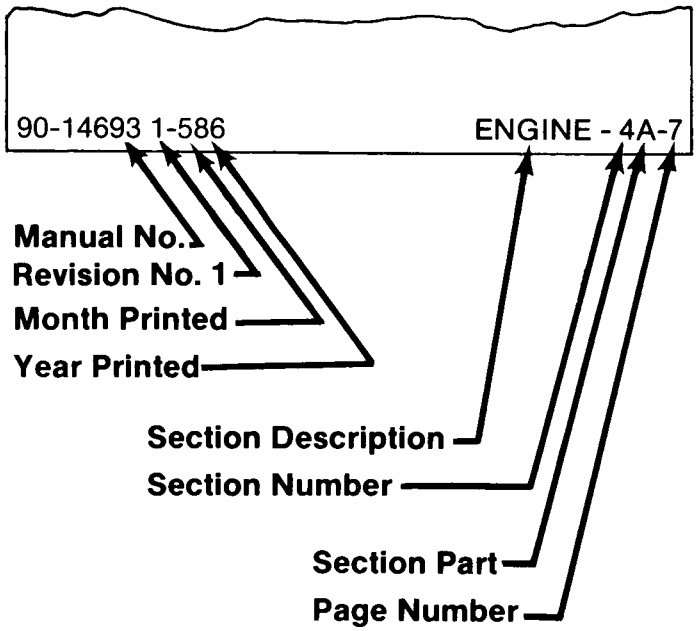
How to Use This Manual

This manual is divided into sections which represent major components and systems.

Some sections are further divided into parts which more fully describe the component.

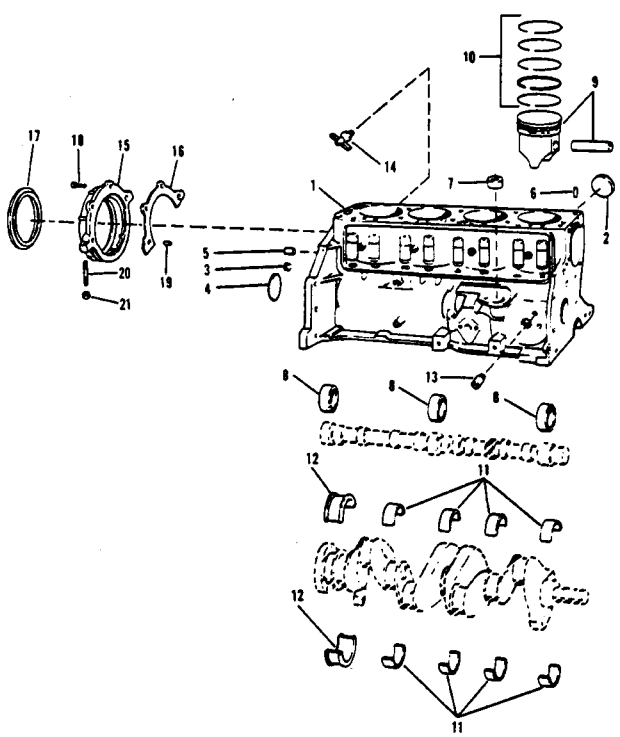
Page Numbering

Two number groups appear at the bottom of each page. Following is an example and description.



How to Read Parts Manual

CYLINDER BLOCK, PISTON and BEARINGS



PART NO.	REF. NO.	DESCRIPTION	QUAN.
839- 810839	1	CYLINDER BLOCK ASSEMBLY	1
19- 34270	2	EXPANSION PLUG (1-5/8" DIA.)	2
19- 34271	2	EXPANSION PLUG (2" DIA.)	1
19- 37531	3	PLUG	1
19- 34488	4	EXPANSION PLUG	1
19- 34487	5	PIPE PLUG (3/8")	2
17- 35465	6	DOWEL PIN	2
23- 35168	7	BEARING	1
23- 43293	8	BEARING UNIT	1
733- 810852	9	PISTON/PIN (STD.)	4
733- 810853	9	PISTON/PIN (.020 O.S..)	AR
39- 17464	10	PISTON RING UNIT (STD.)	4
39- 17465	10	PISTON RING UNIT (.020 O.S.)	AR
23- 818469	11	BEARING UNIT (STANDARD)	4
23- 85676	11	BEARING UNIT (.001 U.S.)	AR
23- 85713	11	BEARING UNIT (.010 U.S.)	AR
23- 85714	11	BEARING UNIT (.020 U.S.)	AR
23- 85715	12	BEARING UNIT (REAR - STANDARD)	1
23- 85670	12	BEARING UNIT (REAR - .001 U.S.)	AR
23- 85718	12	BEARING UNIT (REAR - .010 U.S.)	AR
23- 85719	12	BEARING UNIT (REAR - .020 U.S.)	AR
34543	13	VALVE	1
22- 16951A1	14	DRAIN FITTING	1
14239	15	RETAINER (REAR)	1
#27- 14241	16	GASKET	1
#26- 14240	17	OIL SEAL (REAR)	1
10- 810844	18	BOLT	2
17- 14263	19	DOWEL PIN	1
16- 11989	20	STUD	2
11- 810847	21	NUT, oil pan stud	2

839-810839 Cylinder Block Assembly includes only standard pistons, piston rings, crankshaft bearings and camshaft bearings.

PARTIAL ENGINE
(Includes Internal Parts and Cylinder Heads)
815509A1 (3.0L)
815510A1 (3.0LX)

GASKET SETS AND SEALANTS - required for complete overhaul
= 27-810846A90 GASKET SET, engine overhaul
92-91601--1 SEALER, red RTV (where applicable)
92-34227--1 PERFECT SEAL (where applicable)

A. **Part Number:** part must be ordered by complete part number.

B. **Reference Number:** number of part on exploded parts view.

C. **Description:** this column provides important information.

(1) Description of part: Reference 1, on the parts list, is a CYLINDER BLOCK ASSEMBLY; reference 14 is drain fitting.

(2) What parts are included: Reference 1, on the parts, is "CYLINDER BLOCK ASSEMBLY." Parts listed under the assembly are indented, which indicates that they are included. So, if Part No. 839-810839 is ordered, you will receive the Cylinder Block Assembly, including all of the parts listed below down to reference 14 DRAIN FITTING.

(3) Serial number break: If serial number is listed, check product serial number to ensure that correct part is ordered.

(4) Special Information: Will often appear after the description, i.e.: "NUT, oil pan stud." This information enables you to select correct parts.

D. **Quantity:** specifies quantity which must be ordered.

E. **Special Information Block:** provides additional information, part numbers for gasket sets, etc.

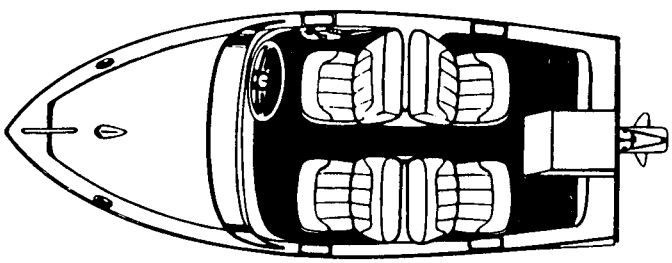
Introduction

This comprehensive overhaul and repair manual is designed as a service guide for the MerCruiser models previously listed. It provides specific information, including procedures for disassembly, inspection, assembly and adjustment, to enable dealers and service mechanics to repair and tune these engines.

Before attempting repairs or tune up, it is suggested that the procedure first be read through to gain knowledge of the methods and tools used and the cautions and warnings required for safety.

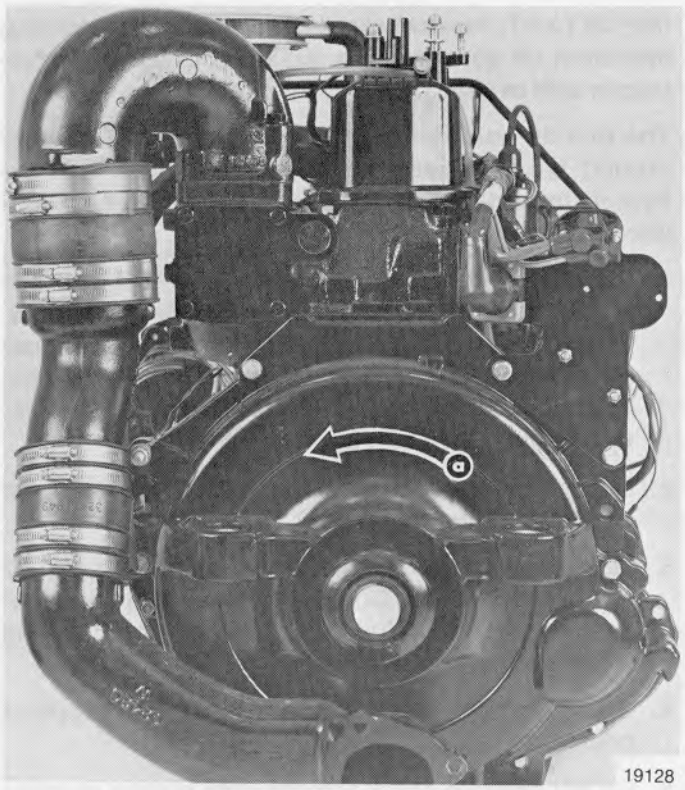
Directional References

Front of boat is bow; rear is stern. Starboard side is right side; port side is left side. In this maintenance manual, all directional references are given as they appear when viewing boat from stern, looking toward bow.



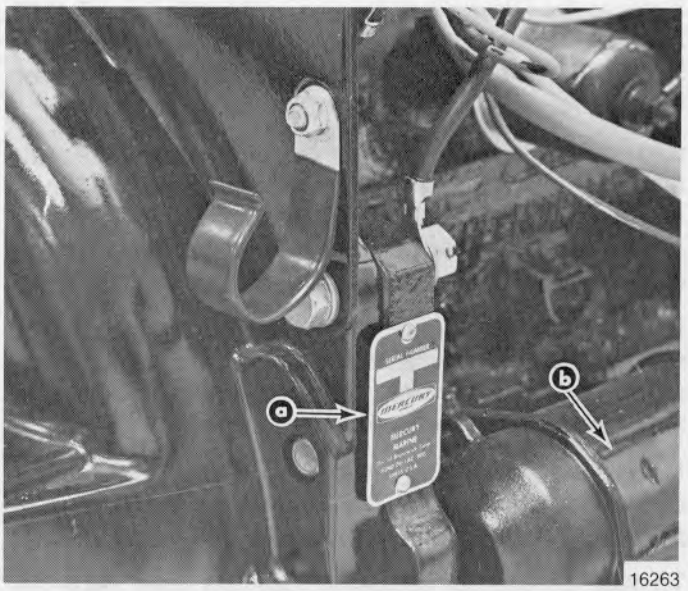
Engine Rotation

Engine rotation is determined by observing flywheel rotation from the rear (stern drive end) of the engine looking forward (water pump end). Propeller rotation is not necessarily the same as engine rotation. When ordering replacement engine, short blocks or parts for engine, be certain to check engine rotation. Do not rely on propeller rotation in determining engine rotation.



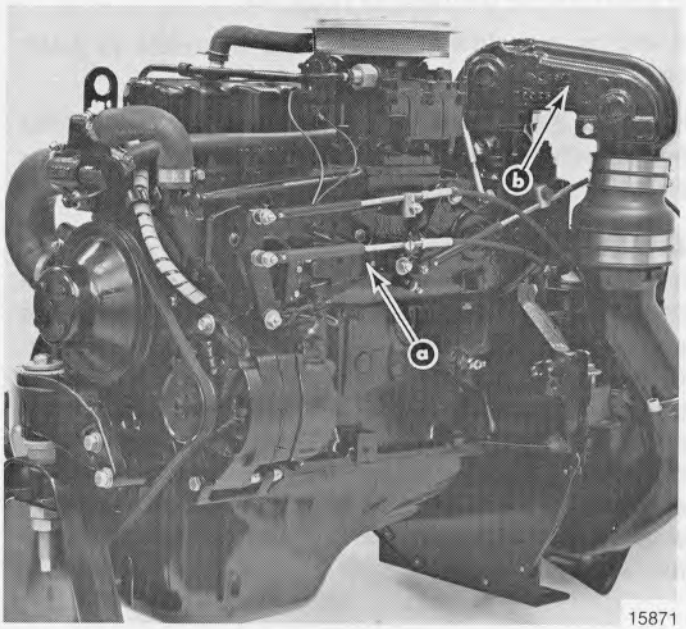
a - Standard Left-Hand Rotation

Serial Number Location



a - Serial Number Plate
b - Starter Motor

Engine Identification



a - Shift Plate On Side of Exhaust Manifold
b - Off-Set Exhaust Elbow

Propeller Information

Refer to the "Propeller" section in "MerCruiser IR-IMR Service Manual" 90-12934 or order publication P/N 90-86144 "What You Should Know About Quicksilver Propellers . . . and Boat Performance Information".

Changing diameter, pitch or coupling a propeller will affect engine RPM and boat performance. The blade configuration also will affect performance. Two like propellers, same pitch and diameter, from two different manufacturers also will perform differently.

It is the responsibility of the boat manufacturer and/or selling dealer to equip the boat with the correct propeller, to allow the boat motor to operate within its specified RPM range at wide open throttle (W.O.T).

Because of the many variables of boat design and operation, only testing will determine the best propeller for the particular application.

To test for correct propeller, operate boat (with an average load onboard) at W.O.T. and check RPM with an accurate tachometer. Engine RPM should be near top of the specified range so that under heavy load engine speed will not fall below specifications.

If engine exceeds the recommended RPM, an increase in pitch and/or diameter is required.

If engine is below rated RPM, a decrease in pitch and/or diameter is required.

Normally a change of approximately 300 to 500 RPM will be achieved for each single pitch change of propeller.

⚠CAUTION

If a propeller is installed that does not allow engine RPM to reach the specified full-throttle RPM range, the engine will "labor" and will not produce full power. Operation under this condition will cause excessive fuel consumption, engine overheating and possible piston damage (due to detonation). On the other hand, installation of a propeller, that allows engine to run above the specified RPM limit, will cause excessive wear on internal engine parts which will lead to premature engine failure.

Hi-Performance Boating

Written by Marine Engineers, order publication P/N 90-86168, entitled "Hi-Performance Boat Operation".

Engine 20-Hour Break-In Period

IMPORTANT: Proper break-in is essential to obtaining minimum oil consumption, maximum engine performance and service.

The first 20 hours of operation is the engine (new or rebuilt) break-in period. During this period, it is extremely important that the engine is operated, as outlined following.

1. Do not operate engine below 1500 RPM for extended periods of time during the first 10 hours. During this period, shift into gear as soon as possible after starting engine and advance throttle so that RPM is above 1500 (provided that conditions permit safe operation at this speed).
2. Do not operate at any one constant speed for extended periods of time.
3. Do not exceed 3/4 of full throttle during the first 10 hours of operation. During the next 10 hours, occasional operation at full throttle (5 minutes at-a-time maximum) is permissible.
4. Avoid full throttle acceleration from stopped position.
5. Do not operate at full throttle until engine reaches normal operating temperature.
6. Observe instrumentation carefully. If an abnormal reading occurs, stop engine immediately and determine cause.
7. Frequently check crankcase oil level and add oil, if necessary. It is normal for oil consumption to be somewhat high during the break-in period.
8. At end of 20-hour break-in period, drain break-in oil from crankcase and replace oil filter. Fill crankcase with correct grade and viscosity oil.

20-Hour Checkup

After first 20 hours of operation, an Authorized MerCruiser Dealer should be contacted for the following maintenance. The boat owner is responsible for any charges.

- Change crankcase oil and filter.
- Check all fluid levels.
- Cooling System - Inspect all hoses for damage and deterioration; check all hose clamps for adequate tightness.

- Check carburetor adjustment.
- Inspect ignition system and timing.
- Check for loose, missing or damaged parts.
- Check shift and throttle cable adjustments - lubricate and inspect for loose, damaged or missing parts.
- Steering System - Lubricate and inspect for loose, damaged or missing parts.
- Inspect all drive belts.
- Check engine alignment.
- Complete Engine Exhaust System Inspection - Inspect for damage and deterioration; check all hose clamps for adequate tightness.
- Retorque gimbal ring clamping U-bolt to 40 lb. ft. (54 N·m).

Water Testing New Engines

Use care during the first 20 hours of operation on new MerCruisers, or possible engine failure may occur. If a new engine has to be water-tested at full throttle before the break-in period is complete, follow this procedure.

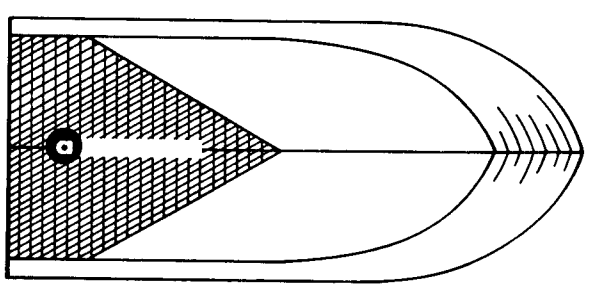
1. Start engine and run at idle RPM until normal operating temperature is reached.
2. Run boat up on plane.
3. Advance engine RPM (in 200 RPM increments) until engine reaches its maximum rated RPM.

IMPORTANT: Do not run at maximum RPM for more than 2 minutes.

Boat and Engine Performance

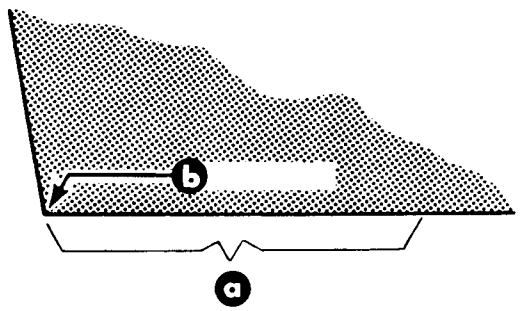
Boat Bottom

For maximum speed, a boat bottom should be as flat as possible in a fore-aft direction (longitudinally) for approximately the last 5 ft. (1.5m).



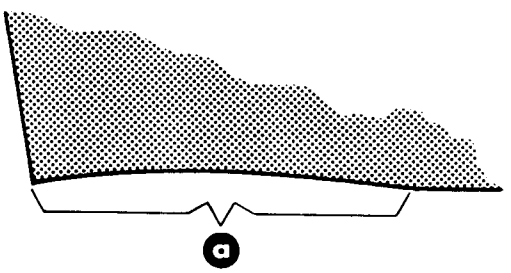
a - Critical Bottom Area

For best speed and minimum spray, the corner between the bottom and the transom should be sharp.



a - Flat
b - Sharp Corner

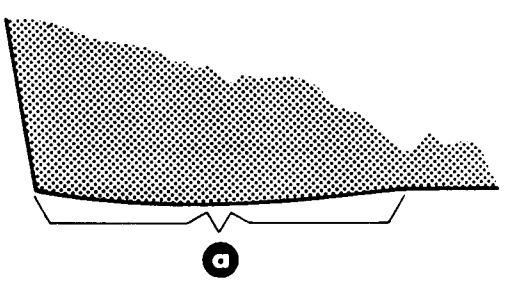
The bottom is referred to as having a "hook" if it is concave in the fore-and-aft direction. A hook causes more lift on the bottom near the transom and forces the bow to drop. This increases wetted surface and reduces boat speed, but it helps planing and reduces any porpoising (rythmical bouncing) tendency. A slight hook is often built in by the manufacturer. A hook can also be caused by not trailering or storing the boat with support directly under the transom.



a - Hook

A "rocker" is the reverse of a hook. The bottom is convex or bulged in the fore-and-aft direction. It can cause the boat to porpoise.

Any hook, rocker or surface roughness on the bottom, particularly in the all-important center-aft portion will have a negative effect on speed, often several miles-per-hour on a fast boat.



a - Rocker

Marine Fouling

Fouling is an unwanted buildup (usually animal-vegetable-derived) occuring on the boat's bottom and drive unit. Fouling adds up to drag, which reduces boat performance. In fresh water, fouling results from dirt, vegetable matter, algae or slime, chemicals, minerals and other pollutants. In salt water, barnacles, moss and other marine growth often produce dramatic build-up of material quickly. So it's important to keep the hull as clean as possible in all water conditions to maximize boat performance.

Special hull treatments, such as anti-fouling paint, will reduce the rate of bottom fouling. However, due to the fact that drive units (outboard or stern drive) are made primarily of aluminum, be sure to select an anti-fouling paint having a copper-free, organo-tin base. The BIS (Tri Butyl Tin) Adipate (TBTA) base paint will not set up a galvanic corrosion "cell" as it is completely compatible with aluminum and avoids any electrolysis problems connected with many other paints. Applied according to instruction, it is also very effective.

Weight Distribution

Weight distribution is extremely important; it affects a boat's running angle or attitude. For best top speed, all movable weight — cargo and passengers — should be as far aft as possible to allow the bow to come up to a more efficient angle (3° to 5°). On the negative side of this approach is the problem that, as weight is moved aft, some boats will begin an unacceptable porpoise.

Secondly, as weight is moved aft, getting on plane becomes more difficult.

Finally, the ride in choppy water becomes more uncomfortable as the weight goes aft. With these factors in mind, each boater should seek out what weight locations best suit his needs.

Weight and passenger loading placed well forward increases the "wetted area" of the boat bottom and, in some cases, virtually destroys the good performance and handling characteristics of the boat. Operation in this configuration can produce an extremely wet ride, from wind-blown spray, and could even be unsafe in certain weather conditions or where bow steering may occur.

Weight distribution is not confined strictly to fore and aft locations, but also applies to lateral weight distribution. Uneven weight concentration to port or starboard of the longitudinal centerline can produce a severe listing attitude that can adversely affect the boat's performance, handling ability and riding comfort. In extreme rough water conditions, the safety of the boat and passengers may be in jeopardy.

Water in Boat

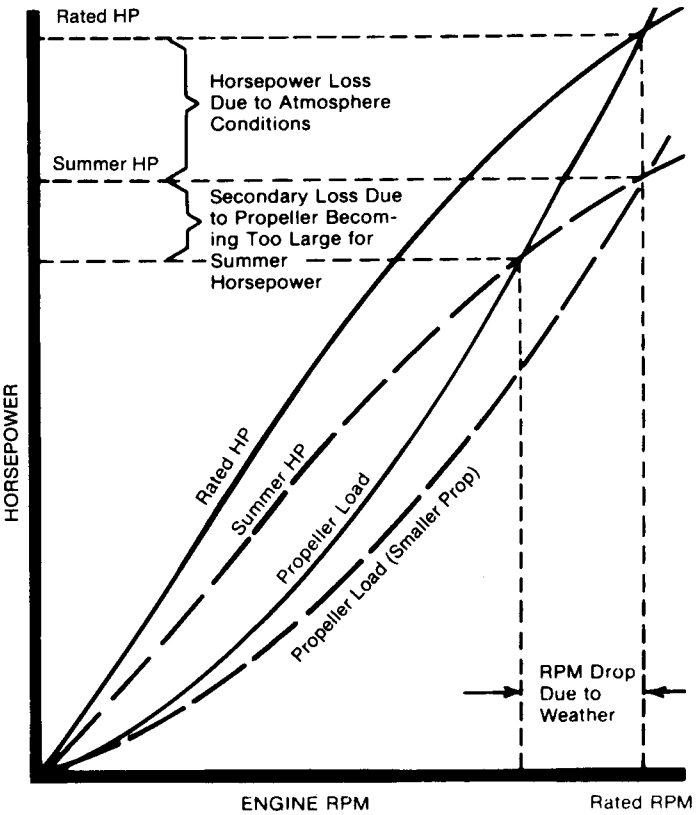
When a boat loses performance, check bilge for water. Water can add considerable weight to the boat thereby decreasing the performance and handling.

Make certain that all drain passages are open for complete draining.

Elevation and Climate

Elevation has a very noticeable effect on the wide-open-throttle power of an engine. Since air (containing oxygen) gets thinner as elevation increases, the engine begins to starve for air. Humidity, barometric pressure and temperature do have a noticeable effect on the density of air. Heat and humidity thin the air. This phenomenon can become particularly annoying when an engine is propped out on a cool, dry day in spring and later, on a hot, sultry day in August, doesn't have its old zip. (See chart)

Although some performance can be regained by dropping to a lower-pitch propeller, the basic problem still exists. The propeller is too large in diameter for the reduced power output. The experienced marine dealer or a Quicksilver Propeller Repair Station can determine how much diameter to remove from a lower-pitch propeller for specific high-elevation locations. In some cases, a gear-ratio change to the drive unit to more reduction is possible and very beneficial. It is a known fact that weather conditions exert a profound effect on power output of internal combustion engines. Therefore, established horsepower ratings refer to the power that the engine will produce at its rated RPM under a specific combination of weather conditions.



MAINTENANCE

Location and Service	When Starting Engine Each Day	After First 20 Hours of Operation	Every 50 Hours of Operation
Engine Crankcase Oil - Check level	●		
Closed Cooling Coolant - Check coolant level	●		
Remote Control and Steering System - Check for proper operation	●		
Power Package (Entire) - Observe for obvious leaks (water, fuel, oil, exhaust, etc.)	●		
Ignition System - Check timing and adjust, if necessary		■	
Crankcase Oil and Oil Filter - Change		●	

INDEX

MAINTENANCE CHART

Only perform maintenance which applies to your particular power package.

● = To Be Performed by Owner
■ = To Be Performed by an Authorized MerCruiser Dealer
F = Freshwater Areas Only
S = Saltwater Areas Only

TASK	INTERVAL			
Location and Service	Weekly	Every 50 Hours or 60 Days	Every 100 Hours or 120 Days	At Least Once a Year
Engine Crankcase Oil - Check level	●			
Closed Cooling Coolant - Check level	●			
Ignition System - Check timing; adjust if needed				■
Crankcase Oil and Oil Filter - Change			■	■
Power Steering Fluid - Check level	●			
Stern Drive Unit Oil - Check level	●			
Steering System - Lubricate and inspect for loose, damaged or missing parts		S■	F■	■
Battery - Check level and inspect for damage	●			
Electrical System (Entire) - Check for loose or damaged wiring		S■	F■	■
Fuel Pump Sight Tube - Check for fuel	●			
Cooling System Hoses and Clamps - Inspect for damage and deterioration. Check clamps for tightness		S■	F■	■
Engine Exhaust System- Inspect for damage, deterioration and restrictions. Check clamps for tightness		S■	F■	■
Drive Belts (All) - Inspect condition and check tension			●	●
Ignition System - Clean and inspect condition			■	■
Flame Arrestor and Crankcase Ventilation Hose - Clean and inspect			■	■
Continuity Circuit - Check components for loose connections, broken or frayed wires		S■	F■	■
Shift and Throttle Cable and Linkage - Lubricate and inspect for loose, damaged or missing parts		S■	F■	■
Power Trim Pump Oil - Check level	●			

TASK	INTERVAL			
Location and Service	Weekly	Every 50 Hours or 60 Days	Every 100 Hours or 120 Days	At Least Once a Year
Stern Drive Unit Oil - Change			■	■
Propeller Shaft - Lubricate		S●	F●	●
Transom Gimbal Housing Assembly Swivel Shaft and Pin, Hinge Pins and Gimbal Bearing - Lubricate		S■	F■	■
Engine Coupling, Stern Drive Unit Universal Joint and Shaft Splines - Lubricate			■	■
Engine Alignment - Check			■	■
Fuel Filters - Replace				■
Power Package Exterior Surfaces - Clean and paint				●
Steering Head and Remote Control - Inspect and lubricate				■
Quicksilver MerCathode® System - Test output				■
Closed Cooling Coolant - Test for alkalinity				■
Heat Exchanger - Clean seawater section				■
Cooling System - Flush seawater section	S● AFTER USE EACH DAY			
Power Package Exterior Surfaces - Spray with rust preventive		S●	F●	●
Closed Cooling Coolant - Replace	■ EVERY 2 YEARS			
Zinc Alloy Trim Tab, Anodic Heads, Anodic Plate and Quicksilver Anticorrosion Anode Kit (Optional) - Inspect for erosion	●			
Gear Housing Water Pickups - Check for marine growth or debris	●			
Carburetor - Adjust				■

Fluid Capacities

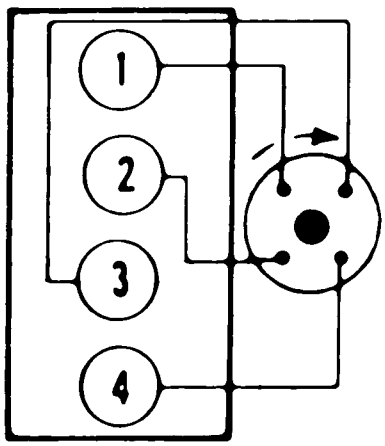
Capacities are approximate fluid measures.

MODEL	MCM 120 - 2.5L MCM 140 - 3.0L
Crankcase (with Filter)	4 Qts. (3.8L)
Standard Cooling System	9 Qts. (8.5L)
Closed Cooling System	9 Qts. (8.5L)

Specifications

MODEL	MCM 120/2.5 Litre	MCM 140	MCM 3.0 Litre
Horsepower (Kilowatts)	120 (90)	140 (104)	130 97
Number of Cylinders	4		
Displacement	153 CID (2.5L)	181 CID (3L)	
Bore/Stroke	3.87 In./3.25 In. (98.3/82.6mm)	4.00 In./3.60 In. (101.6/91.4mm)	
Compression Ratio	8.5:1		9.2:1
Compression Pressure	140 PSI (966 kPa)		
Idle RPM (In Forward Gear)	650-700		
Max. RPM (At W.O.T.)	4200-4600		
Oil PSI (At 2000 RPM)	30-60 PSI (207-414 kPa)		
Min. Oil PSI (At Idle)	4 PSI (28 kPa)		
Fuel Pump PSI (At 1000 RPM)	5 - 6-1/2 PSI (35 - 44 kPa)		
Electrical System	12 Volt Negative (-) Ground		
Min. Battery Requirements	375 / 90Ah		
Firing Order	1-3-4-2		
Spark Plug Type	AC-MR43T	Champion RV15YC4 NGK-BR6FS	
Spark Plug Gap	.035 In. (0.9mm)		
Breaker Point Gap	.022 In. (0.5mm)		
Dwell	28° - 34°		
Breaker Point Spring Tension	19-23 Oz. (540-650g)		
Timing (At Idle RPM)	8° BTDC	6° BTDC	
Preliminary Idle Mixture	1-1/4 Turns		
Thermostat	143°F (62°C)		

L.H. ROTATION
FRONT



Firing Order
1-3-4-2

Left-Hand Rotation Engine Firing Order

Fuel, Oil, Fluid and Coolant Specifications

Fuel

The use of any good grade regular leaded, premium, low-lead or lead-free automotive gasolines with a minimum posted octane rating of US and Canada 87 (R + M/2) all other areas than US and Canada should use 92 RON rating or higher (leadaed or unleaded) fuels, are satisfactory for use in these engines. However, gasolines containing alcohol, either methyl alcohol (methanol) or ethyl (ehtanol) may cause increased:

- Corrosion of metal parts.
- Deterioration of elastomer and plastic parts.
- Fuel permeation through flexible fuel lines.
- Wear and damage of internal engine parts.
- Starting and operating difficulties.

Some of these adverse effects are due to the tendency of gasolines containing alcohol to absorb moisture from the air, resulting in a phase of water and alcohol separating from the gasoline in the fuel tank.

The adverse effects of alcohol are more severe with methyl alcohol (methanol) and are worse with increasing alcohol content.

⚠WARNING

FIRE AND EXPLOSION HAZARD: Fuel leakage from any part of the fuel system can be a fire and explosion hazard which can cause serious bodily injury or death. Careful periodic inspection of the entire fuel system is mandatory, particularly after storage. All fuel components including fuel tanks, whether plastic, metal or fiberglass, fuel lines, primer bulbs, fittings, fuel filters and carburetors should be inspected for leakage, softening, hardening, swelling or corrosion. Any sign of leakage or deterioration necessitates replacement before further engine operation.

Because of the possible adverse effects of alcohol in gasoline, it is recommended that only alcohol-free gasoline be used where possible. If only alcohol-containing fuel is available, or if the presence of alcohol is unknown, increased inspection frequency for leaks and abnormalities is required.

IMPORTANT: When operating a MerCruiser engine on gasoline containing alcohol, storage of gasoline in the fuel tank for long periods of time should be avoided. Long periods of storage, common to boats, create unique problems: In cars, alcohol-blend fuels normally are consumed before they can absorb enough moisture to cause trouble, but boats often sit idle long enough for phase separation to take place. In addition, internal corrosion may take place during storage if alcohol has washed protective oil films from internal components.

NO LEAD GASOLINE

U.S. Environmental Protection Agency (EPA) and Canadian government regulations require the removal of lead (anti-knock compound) from all gasoline because lead emission in exhaust is a health hazard.

In order to maintain octane ratings, many gasoline manufacturers are adding ethyl alcohol (ethanol) or methyl alcohol (methanol) to the gasoline to replace the lead.

The use of any good grade unleaded regular or premium gasolines with a minimum posted octane rating US and Canada 87 (R + M/2) all other areas than US and Canada should use 92 RON rating or higher (leaded or unleaded) fuels, are satisfactory for use in your engine. In areas where unleaded regular or premium gasolines are not available, a good grade **leaded** regular with a minimum posted actane rating (A.K.I.) of 89 may be used.

GASOLINE/ALCOHOL BLENDS

Many new motor vehicle owner manuals are warning about the potential damage from using gasoline containing alcohol, especially **METHANOL.** They cite possible fuel system damage and performance problems. These are just two of the hazards that may be caused by alcohol. These same problems as well as the additional safety risk of fire and explosion from fuel system leaks apply to marine engines. **METHANOL** is more severe in its bad effects than is **ETHANOL.** Alcohol also is more severe in older engines since newer engines have materials which are more resistant to alcohol.

EFFECTS OF GASOLINE/ALCOHOL BLENDS ON MARINE ENGINES

Corrosion of metals may result from use of alcohol-gasoline blends. Portable or permanently installed fuel tanks of metal or fiberglass, fuel filters, fuel lines and float bowls may be affected by alcohol blended fuels. Many fiberglass fuel tanks are slowly dissolved by alcohol, leading immediately to filter and carburetor plugging and eventually to fuel tank failure.

Alcohol containing fuels will absorb moisture from the air. At first, this moisture will remain in solution, but once the water content of the fuel has built up to about one-half of one percent, it will separate out, (phase separation) bringing the alcohol with it. This alcohol-water mixture settles to the bottom of the fuel tank and if this mixture gets into the engine, engines can be seriously damaged internally, as it may wash the protective film of oil off the bore of any cylinder that it enters. Before the engine can be restarted, it is necessary to remove the separated alcohol and water layer, flush out the fuel system with clean fuel and remove and dry the spark plugs.

BOAT/MOTOR STORAGE

When operating a MerCruiser on gasoline containing alcohol, storage of gasoline in the fuel tank for long periods of time should be avoided.

Long periods of storage, common to boats, create unique problems. In cars, gasoline/alcohol blend fuels normally are consumed before they can absorb enough moisture to cause trouble, but boats often sit idle long enough for phase separation to take place. In addition, internal corrosion may take place during storage if alcohol has washed protective oil films from internal components.

WINTER STORAGE

If boat is to be placed in winter storage, carburetors must be run dry at idle RPM. Permanent fuel tanks should be drained completely and Quicksilver Gasoline Stabilizer and Conditioner added to any fuel remaining in the tank. Portable fuel tanks should be emptied completely.

It also is recommended to coat the internal engine parts with Quicksilver Storage Seal. Follow the directions on the container. This coating will reduce possibilities of internal parts becoming rusted from moisture accumulation during storage.

WARRANTY

Performance problems, fuel system or other damage resulting from the use of gasoline-alcohol blended fuels is not the responsibility of Mercury Marine and will not be covered under our warranty.

CONTINUING EVALUATIONS

The effects of gasoline blended with ETHANOL and METHANOL are still being evaluated by the United States Coast Guard, the National Marine Manufacturers Association (NMMA), Mercury Marine and other engine and boat manufacturers.

We have recommended pump posting of alcohol content of gasoline. Further, we recommend using gasoline known not to contain any METHANOL or ETHANOL when possible.

TEST FOR ALCOHOL CONTENT IN GASOLINE

The following is an acceptable and widely used field procedure for the detection of alcohol in gasoline. Use any small transparent bottle or tube that can be capped and is or can be provided with graduations or a mark at about 1/3 full. A pencil mark on a piece of adhesive tape may be used.

1. Fill the container with water to the mark.
2. Add fuel almost to fill the container, leaving some air space; then, cap the container. The proportions of fuel to water are not critical, but there should be 2-3 times as much fuel as water.
3. Shake container vigorously and allow it to sit upright for up to about 3-5 minutes. **If the volume of water appears to have increased, alcohol is present.** If you are not sure, there is no need for concern. If the dividing line between water and fuel becomes cloudy, use the middle of the cloudy band.

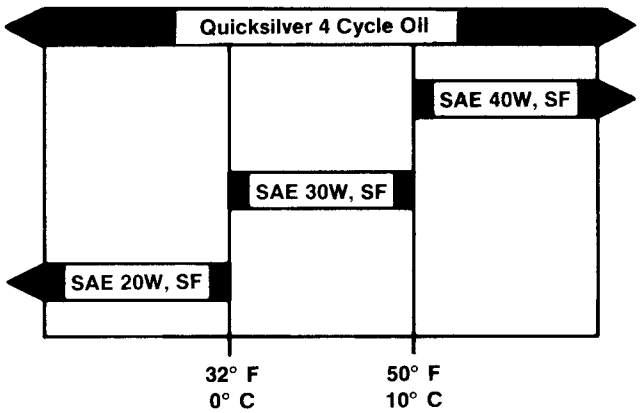
CRANKCASE OIL

To help obtain optimum engine performance and to provide maximum protection, we strongly recommend the use of Quicksilver 4-Cycle Marine Engine Oil. If not available, a good grade, straight weight, detergent automotive oil of correct viscosity, with an API classification of SF, may be used.

The chart below is a guide to crankcase oil selection. Oil filter should always be changed with oil.

In those areas where recommended straight weight oil is not available, a multi-viscosity 20W-40 (SF) or, as a second but less preferable choice, 20W-50 (SF) may be used.

IMPORTANT: The use of non-detergent oils, multi-viscosity oils (other than 20W-40 or 20W-50), low quality oils or oils which contain solid additives specifically are not recommended.



Power Steering Fluid

IMPORTANT: Use only Quicksilver Power Trim and Steering fluid, or automatic transmission fluid (ATF), Dexron II, in Power Steering System.

Coolant

⚠CAUTION

Alcohol or Methanol base anti-freeze or plain water, are not recommended for use in fresh water section of cooling system at any time.

We recommended that the coolant section of Closed Cooling System be filled with a 50/50 mixture of ethylene glycol anti-freeze and water. In areas where the possibility of freezing DOES NOT exist, it is permissible to use a solution of rust inhibitor and water (mixed to manufacturer's recommendations).

MerCruiser engines can use any type of permanent anti-freeze or any brand anti-freeze solution that meets G.M. specification 1825M.

Maintaining Crankcase Oil Level

Overfilled Engine Crankcase

Overfilled crankcases (oil level being too high) can cause a fluctuation or drop in oil pressure and rocker arm "clatter", on MerCruiser engines. The over-full condition results in the engine crankshaft splashing and agitating the oil, causing it to foam (become aerated). The aerated oil causes the hydraulic valve lifters to "bleed down". This, in turn, results in rocker arm "clatter" and loss of engine performance, due to the valves not opening properly.

Care must be taken when checking engine oil level. Oil level must be maintained between the "ADD" mark and the "FULL" mark on the dipstick. To ensure that you are not getting "false reading", make sure the following steps are done before checking the oil level.

- Boat "at rest" in the water, OR
- If boat is on a trailer, raise or lower bow until the boat is setting at the approximate angle that it would be if setting "at rest" in the water.
- Allow sufficient time for oil to drain into the crankcase, if engine has just been run or oil has just been added.

Checking Engine Oil Level/Filling

1. Stop engine and allow boat to come to a rest.
2. Allow oil to drain back into oil pan - approximately 5 minutes.
3. Remove dipstick. Wipe clean and reinstall. Push dipstick all-the-way into dipstick tube.
4. Remove dipstick and note the oil level.
5. Oil level must be between the "FULL" and "ADD" marks.
6. If oil level is below "ADD" mark, proceed to 7 and 8.
7. Remove oil filler cap from valve rocker arm cover.
8. Add required amount of oil to bring level up to, but not over, the "FULL" mark on dipstick.

Changing Oil and Filter

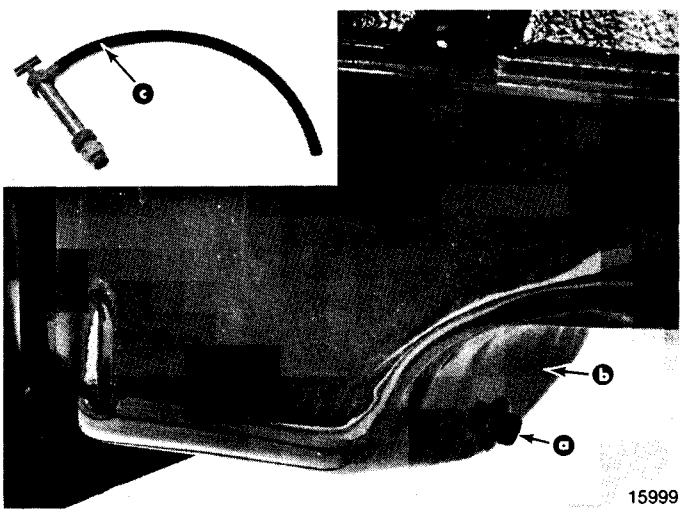
1. Start engine and run until it reaches normal operating temperatures.

IMPORTANT: Change oil when engine is warm from operation, as it flows more freely, carrying away more impurities.

2. Stop engine.
3. Remove drain plug from oil pan.

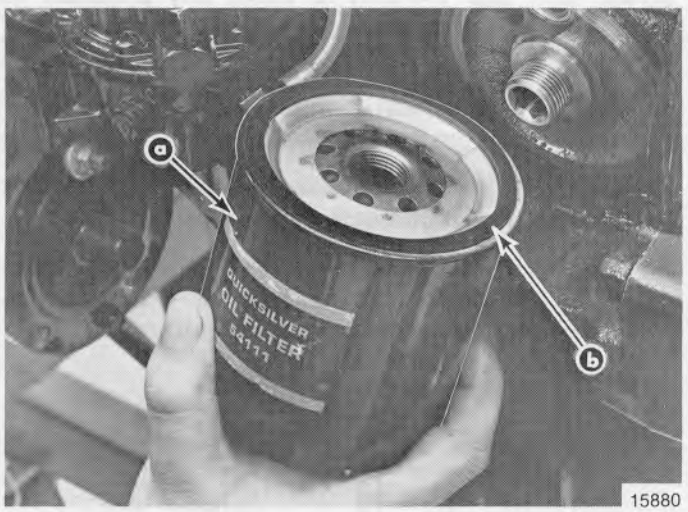
NOTE: If drain plug is not accessible because of boat construction, oil may be removed thru dipstick tube, using a Quicksilver Crankcase Oil Pump. (See Quicksilver Accessory Guide.)

4. After oil has drained completely, reinstall drain plug and tighten securely.



a - Drain Plug
b - Oil Pan
c - Quicksilver Crankcase Oil Pump

5. Remove and discard oil filter and its sealing ring.
6. Coat sealing ring on new filter with engine oil, and install new filter. Tighten filter securely (following filter manufacturer's instructions). But do not over-tighten
7. Fill crankcase with oil.



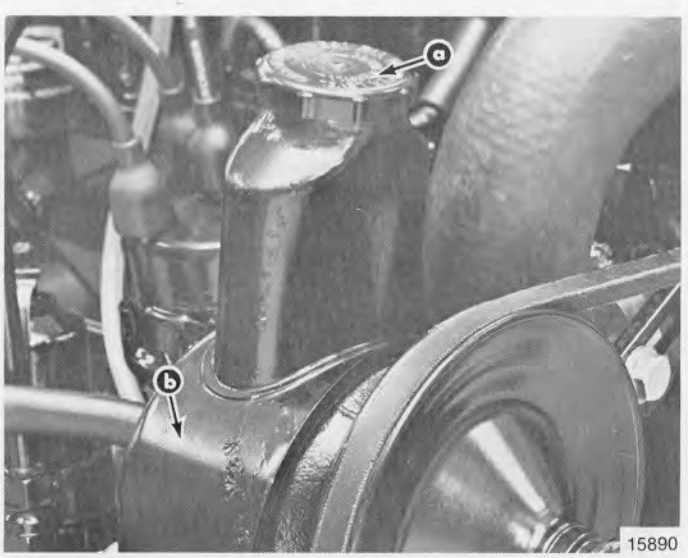
15880

a - Oil Filter
b - Sealing Ring

Maintaining Power Steering Pump Fluid Level

With Engine Warm from Operation

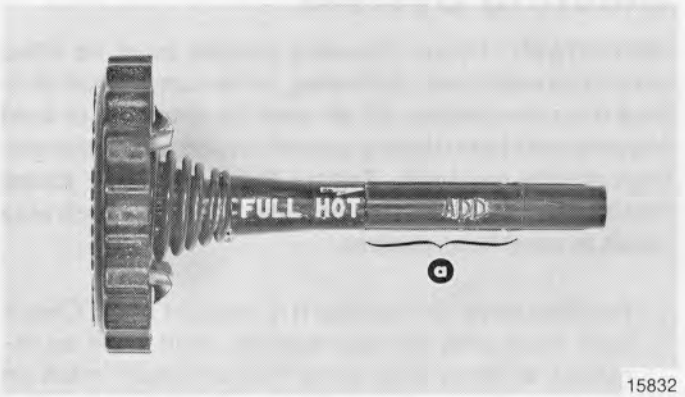
1. Stop engine and position drive unit so that it is straight back.
2. Remove fill cap/dipstick from Power Steering pump and note fluid level.



15890

a - Fill Cap/Dipstick
b - Pump

3. Level should be between the "FULL HOT" mark and "ADD" mark on dipstick.



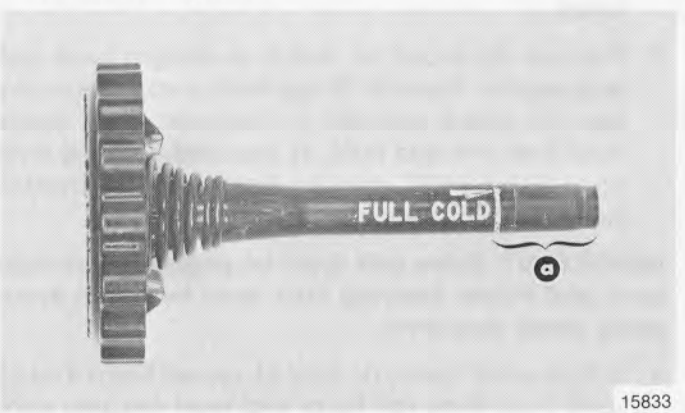
15832

a - Proper Fluid Level with Engine Warm

4. If level is low (below "ADD" mark), but fluid is still visible in pump reservoir, add required amount of fluid thru fill cap opening, to bring level up to "FULL HOT" mark on dipstick - do not overfill.
5. If fluid is not visible in reservoir, a leak exists in Power Steering System.

With Engine Cold

1. Stop engine and position drive unit so that it is straight back.
2. Remove fill cap/dipstick from Power Steering pump and note fluid level.
3. Level should be between "FULL COLD" mark and bottom of dipstick.



15833

a - Proper Fluid Level with Engine Cold

4. If fluid level is below bottom of dipstick, but fluid is still visible in pump reservoir, add required amount of fluid, thru fill cap opening, to bring level up to "FULL COLD" mark on dipstick - Do not overfill.
5. If fluid is not visible in reservoir, a leak exists in Power Steering System.

Filling and Bleeding Power Steering System

IMPORTANT: Power Steering system must be filled exactly as explained, following, to be sure that all air is bled from the system. All air must be removed, or fluid in pump may foam during operation and be discharged from pump reservoir. Foamy fluid also may cause Power Steering system to become spongy, which may result in poor boat control.

1. Position drive unit so that it is straight back. Check fluid level with fill cap/dipstick. Add fluid as required, to bring level up to "FULL-COLD" mark on dipstick.

IMPORTANT: Use only Quicksilver Power Trim and Steering fluid, or Dexron II automatic transmission fluid (ATF), in power steering system.

2. Turn steering wheel back-and-forth to end of travel in each direction several times; then, recheck fluid level and add fluid, if necessary.
3. Install fill cap/dipstick.

⚠CAUTION

DO NOT operate engine without water being supplied to seawater pickup pump in stern drive unit, or pump impeller may be damaged and subsequent overheating damage to engine may result.

4. Start engine and run at fast idle (1000-1500 RPM) until engine reaches normal operating temperature. During this time, turn steering wheel back-and-forth to end of travel in each direction several times.
5. Position drive unit so that it is straight back and stop engine. Remove fill cap from pump. Allow any foam in pump reservoir to disperse; then, check fluid level and add fluid, as required, to bring level up to "FULL-HOT" mark on dipstick. Do not overfill. Reinstall fill cap securely.

IMPORTANT: Drive unit must be positioned straight back and Power Steering fluid must be hot to accurately check fluid level.

6. If fluid is still foamy (in Step 5), repeat Steps 4 and 5 until fluid does not foam and level remains constant.

Maintaining Coolant Level

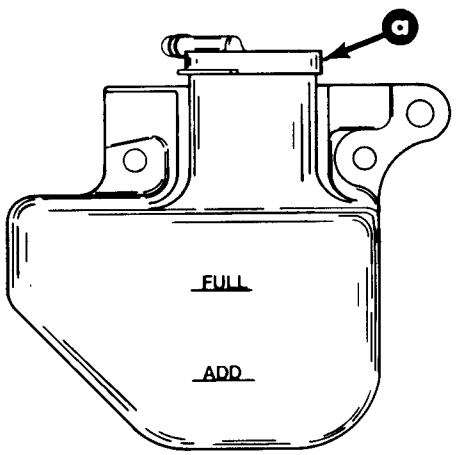
⚠WARNING

Allow engine to cool down before removing pressure cap. Sudden loss of pressure could cause hot coolant to boil and discharge violently. After engine has cooled down, turn cap 1/4-turn to allow any pressure to escape slowly; then, push down and turn cap all-the-way off.

1. Coolant level in heat exchanger should be within 1 in. (25mm) from bottom of filler neck.

IMPORTANT: When reinstalling pressure cap, be sure to tighten it until it contacts stop on filler neck.

2. Coolant level should be between the "ADD" and "FULL" mark on coolant recovery reservoir with engine at normal operating temperature.



193-HR

a - Coolant Recovery Reservoir

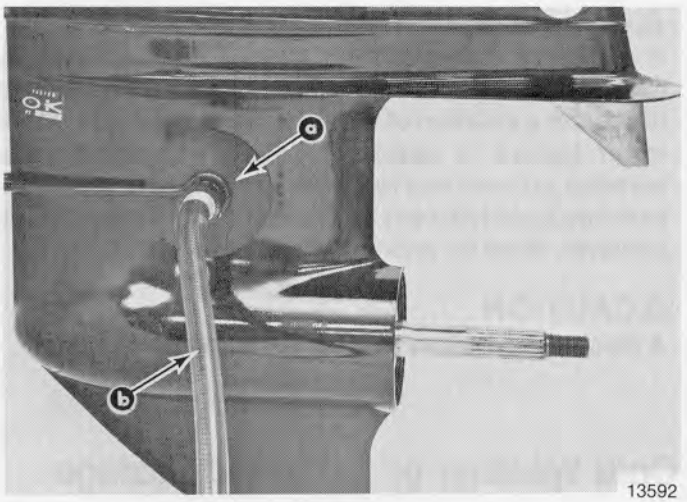
Flushing Cooling System

⚠CAUTION

DO NOT run engine above 1500 RPM when flushing, as suction created by seawater pickup pump in drive unit may collapse garden hose and cause engine and/or drive unit to overheat.

Boat Out-of-Water

1. Install Flush Test Device over water pickup holes in gear housing. Attach a garden hose between the device and water tap.



13592

a - Flush Test Device
b - Hose

2. Partially open water tap (approximately 1/2 maximum capacity). Do not use full city water pressure.

⚠WARNING

When flushing cooling system, be certain that area in vicinity of propeller is clear and that no person(s) is nearby. As a precautionary measure, it is recommended that propeller be removed.

3. Place remote control in neutral, idle speed position, and start engine.
4. Operate engine at idle speed in neutral for 10 minutes, or until discharge water is clear; then, stop engine.
5. Shut off water tap. Remove Flush Test Device and garden hose.

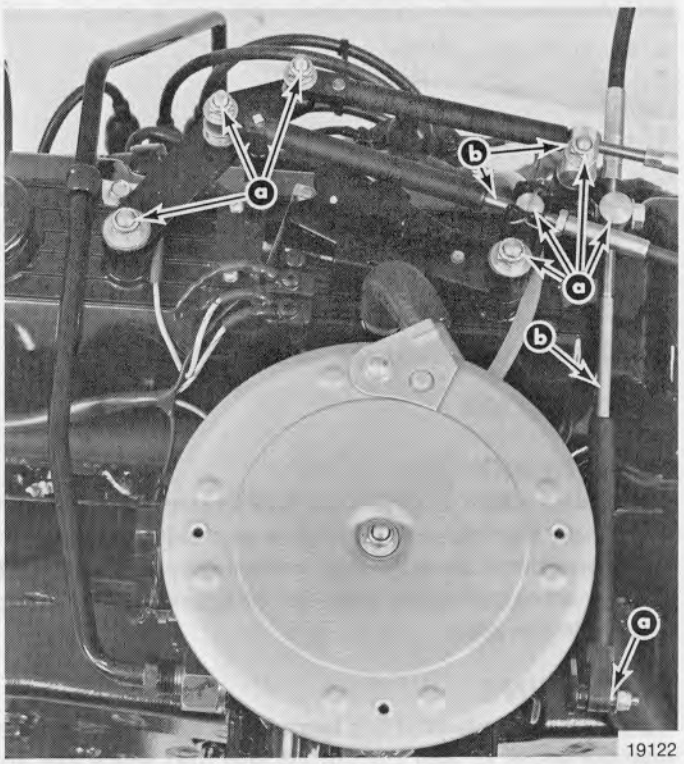
Boat In-the-Water

1. Raise drive unit to full "Up" position.
2. Install Flush Test Device over water pickup holes in gear housing. Attach a garden hose between the device and water tap.
3. Lower drive unit to full "In" position.
4. Follow Steps 2 thru 4 under "Boat Out-of-Water".
5. Shut-off water tap.
6. Raise drive unit to full "Up" position - Remove Flush Test Device and garden hose.

Lubrication

Throttle and Shift Cable

1. Lubricate pivot points with SAE 30 engine oil.
2. Lubricate cable end guide contact surfaces with Quicksilver 2-4-C Marine Lubricant.

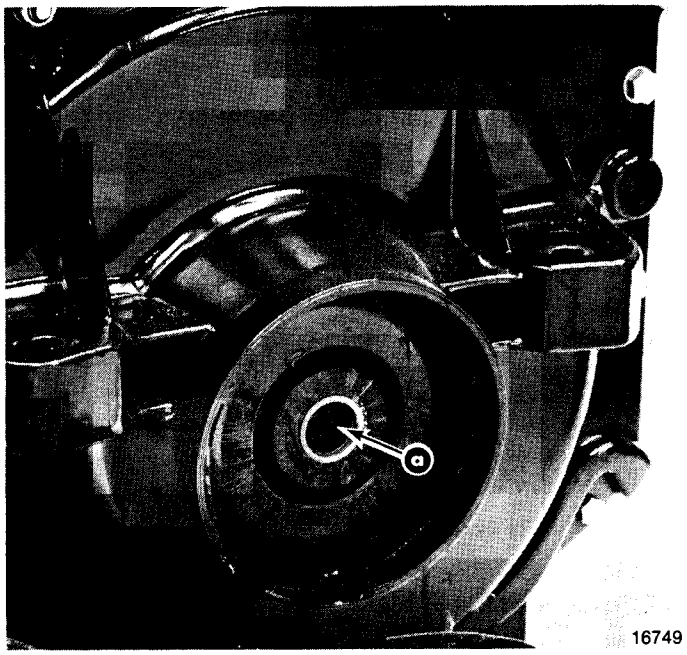


19122

a - Pivot Points
b - Guide Contact Surface

Engine Coupling

1. Lubricate engine coupling splines with Quicksilver Engine Coupler Spline Grease.



a - Engine Coupling Splines

U-Joint Splines

1. Lubricate U-joint shaft splines and O-rings with Quicksilver Engine Coupler Spline Grease. Refer to "MerCruiser Stern Drive Service Manual.

Out-of-Season Storage

Precautions

⚠WARNING

Be careful while working on fuel system; gasoline is extremely flammable and highly explosive under certain conditions. Be sure that ignition key is "OFF" and do not smoke or allow sources of spark and/or open flames in the area.

⚠WARNING

To prevent a potential fire hazard, be sure that engine compartment is well ventilated and that there are no gasoline vapors present during starting or fogging of engine.

⚠CAUTION

DO NOT operate engine without cooling water being supplied to seawater pickup pump, or water pump impeller will be damaged and subsequent overheating damage to engine may result.

⚠CAUTION

Cooling system must be completely drained for storage, or trapped water may cause freeze and/or corrosion damage to engine. If engine has been exposed to freezing temperatures, the boat should be placed in a warm area before attempting to run engine or drain cooling system.

⚠CAUTION

If engine is equipped with Closed Cooling System, Closed Cooling section of cooling system must be kept filled with a solution of ethylene glycol anti-freeze and water (mixed to anti-freeze manufacturer's recommended proportions to protect engine to lowest temperature to which it will be exposed). Seawater section, however, must be drained completely.

⚠CAUTION

A discharged battery can be damaged by freezing.

Cold Weather or Extended Storage

NOTICE

Refer to "Precautions", in this section, BEFORE proceeding.

1. Fill fuel tank(s) with fresh gasoline that does not contain alcohol and a sufficient amount of Quicksilver Gasoline Stabilizer and Conditioner to treat the gasoline.

IMPORTANT: If boat is to be placed in storage (with fuel containing alcohol in fuel tanks), carburetors must be run dry at idle RPM. Fuel tanks should be drained completely and Quicksilver Gasoline Stabilizer and Conditioner added to any fuel remaining in the tank. Also, refer to "Fuel Requirements"; see "Index".

2. Replace all fuel filters.
3. Start engine and check for fuel leaks.
4. Run engine sufficiently to bring it up to normal operating temperature. Shut off engine and change oil and filter.
5. If boat has been operated in salty, polluted or mineral-laden waters, flush cooling system.

6. Remove flame arrestor assembly and restart engine. While operating engine at fast idle (100-1500 RPM), fog internal surfaces of induction system and combustion chanbers by squirting approximately 8 ounces (227 grams) of Quicksilver Storage Seal Rust Inhibitor or SAE 20 SE engine oil into carburetor bores. Stall engine by squirting 2 ounces (57 grams) of Storage Seal Rust Inhibitor or oil rapidly into carburetor. Turn ignition "OFF".
7. Close fuel shut off valve, if so equipped.
8. Clean flame arrestor and crankcase ventilation hoses and reinstall.
9. Lubricate all items outlined in "Lubrication".
10. Closed Cooling System Models, test coolant in closed cooling section to ensure that it will withstand lowest temperature expected during storage.
11. Service batteries
12. Clean outside of engine and repaint any areas required with Quicksilver Primer and Spray Paint. After paint has dried, spray Quicksilver Corrosion Guard or wipe down with SAE 20 SE engine oil.
13. For Stern Drive Unit, refer to "Stern Drive Manual".

Draining Instructions Seawater Cooling

Draining Precautions

IMPORTANT: If the possibility of freezing exists, cooling system must be drained to prevent freeze damage to cooling system. Cooling system also should be drained if boat is to be stored for an extended period of time to prevent corrosion damage.

⚠CAUTION

Cooling system, must be completely drained for storage, or trapped water may cause freeze and/or corrosion damage to engine.

⚠CAUTION

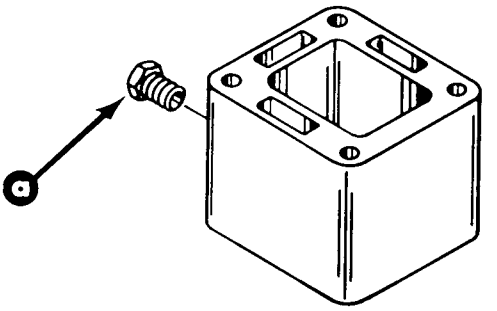
If boat is in the water, water inlet valve (if so equipped) must be left closed until engine is to be restarted, to prevent water from flowing back into cooling system. If boat is not fitted with a valve, water inlet hose must be left disconnected and plugged, to prevent water from flowing into cooling system and/or boat. As a precautionary measure, attach a tag to the ignition switch or steering wheel with the warning that the valve must be opened or the water inlet hose reconnected prior to starting the engine.

IMPORTANT: A wire should be inserted into drain holes to ensure that foreign material is not obstructing the drain holes. On later models with two piece petcocks, removal of petcock may be required so that wire can be inserted completely into drain hole.

IMPORTANT: To prevent threads in manifolds, elbows and cylinder blocks from rusting out during storage, reinstall plugs using Perfect Seal on threads. Never leave drain plugs out during storage.

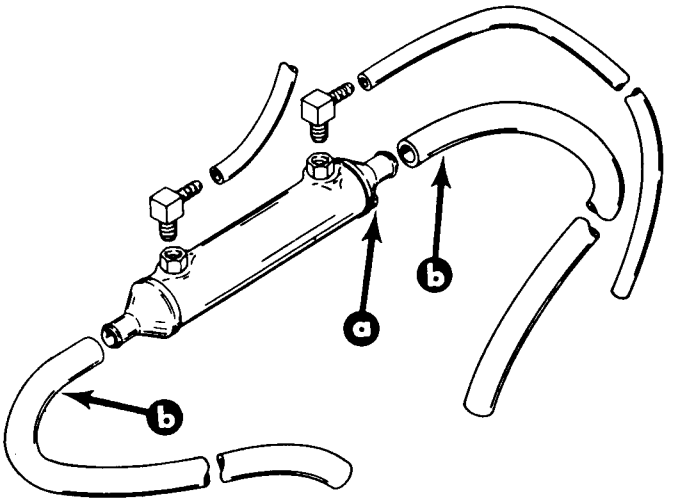
NOTE: If possible, place a container under drains to prevent water from draining into boat.

1. Engine must be level or front of engine slightly higher to properly drain cooling system.
2. Drain system as shown.



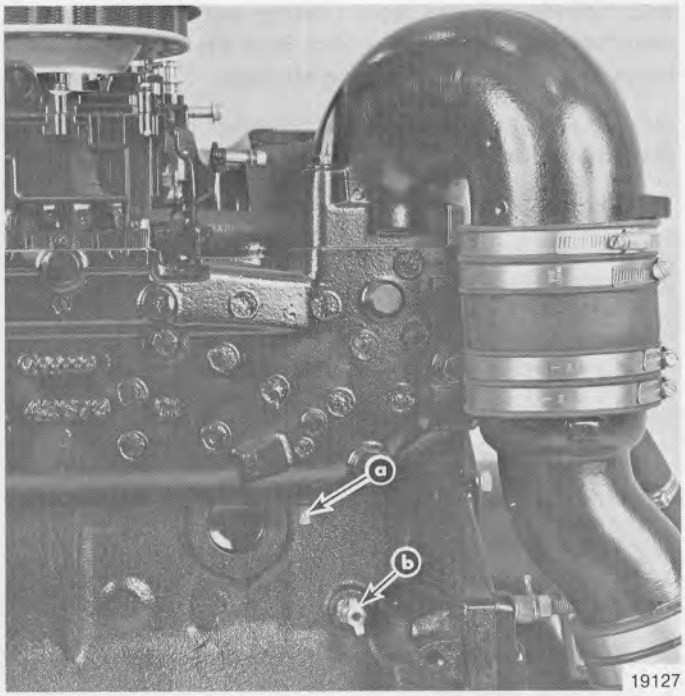
a - Drain Plug - Remove

3" or 6" Risers (If Equipped)



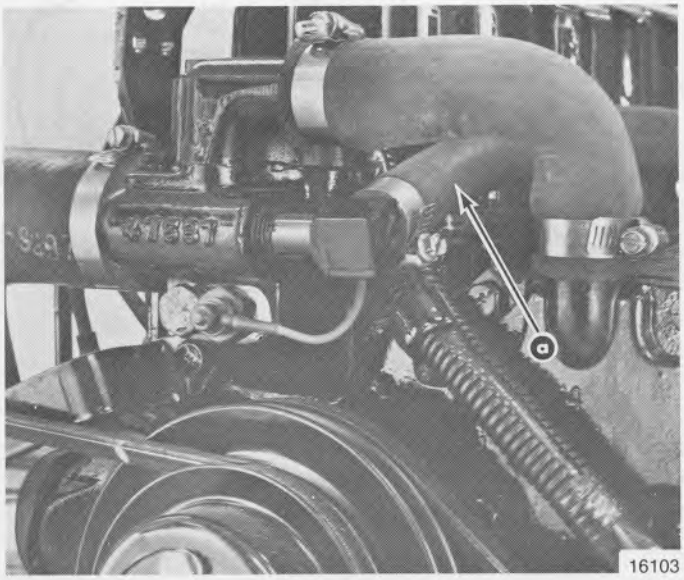
a - Drain Plug - Remove
b - Cooler Without Drain Plug - Remove Hoses

Power Steering Fluid Cooler (If Equipped)



a - Drain Plug
b - Petcock

Engine Drain Location



a - Remove Hose and Lower to Drain

Draining Inlet Hose

3. **Drive Shaft Extension Models:**
   Disconnect water inlet hose from gimbal housing. Lower to drain hose (and power steering fluid cooler, if equipped).

a - Water Tube
b - Hose Clamp (Tighten Securely)
c - Water Hose

4. **Power Steering Models:** Fluid cooler will drain back thru stern drive unit.
5. After cooling system has drained completely, coat threads of drain plugs with Perfect Seal and reinstall. Close petcock.
6. For additional assurance against freezing and rust, fill the cooling system with a solution of permanent antifreeze and water (mixed to proportions recommended by manufacturer for lowest temperature to which engine will be exposed to during storage).

a - Remove Cover and Thermostat. Fill with Coolant until Block and Head are Full. Using New Gasket, Install Thermostat and Cover. Torque Screw to Specifications
b - Remove Hose. Fill Manifold with Coolant. Reinstall Hose and Tighten Clamp Securely

Draining Instructions Closed Cooling

Closed Cooling Section

Closed cooling section of Closed Cooling System should be kept filled year around with recommended coolant solution. Do not drain closed cooling section for storage, as this will promote rusting of internal surfaces. If engine will be exposed to freezing temperatures, make sure that closed cooling section is filled with an ethylene glycol anti-freeze and water solution, mixed to manufacturer's recommended proportion, to protect engine to lowest temperature to which it will be exposed. If necessary, change coolant.

Draining Seawater Section

⚠CAUTION

If the possibility of freezing exists, seawater section must be drained to prevent freeze damage to cooling system and engine. Seawater section also should be drained if boat is to be stored for an extended period of time, to prevent corrosion damage.

⚠CAUTION

If boat is in the water, water inlet valve (if so equipped) must be left closed until engine is to be restarted, to prevent water from flowing back into cooling system. If boat is not fitted with a valve, water inlet hose must be left disconnected and plugged to prevent water from flowing into cooling system and/or boat. As a precautionary measure, attach a tag to the ignition switch or steering wheel with the warning that the valve must be opened or the water inlet hose reconnected prior to starting the engine.

IMPORTANT: A wire should be inserted into drain holes to ensure that foreign material is not obstructing the drain holes.

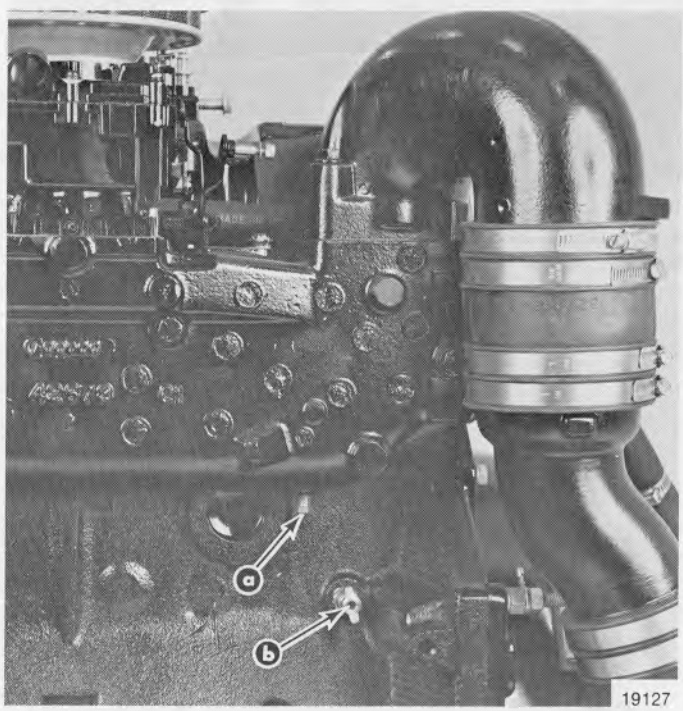
IMPORTANT: To prevent threads from rusting out during storage, reinstall plugs using Perfect Seal on threads. Never leave drain plugs out during storage.

NOTE: If possible, place a container under drains to prevent water from draining into boat.

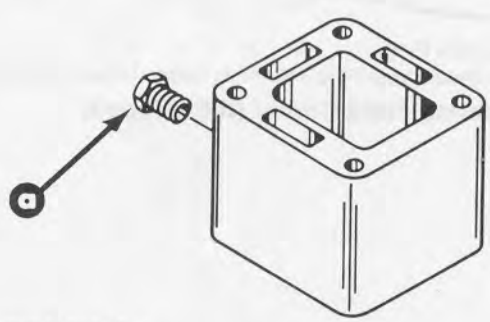
NOTICE

Refer to "Draining Precautions", in this section, before proceeding.

1. Engine must be level or front of engine slightly higher to properly drain cooling system.
2. Drain system as shown.

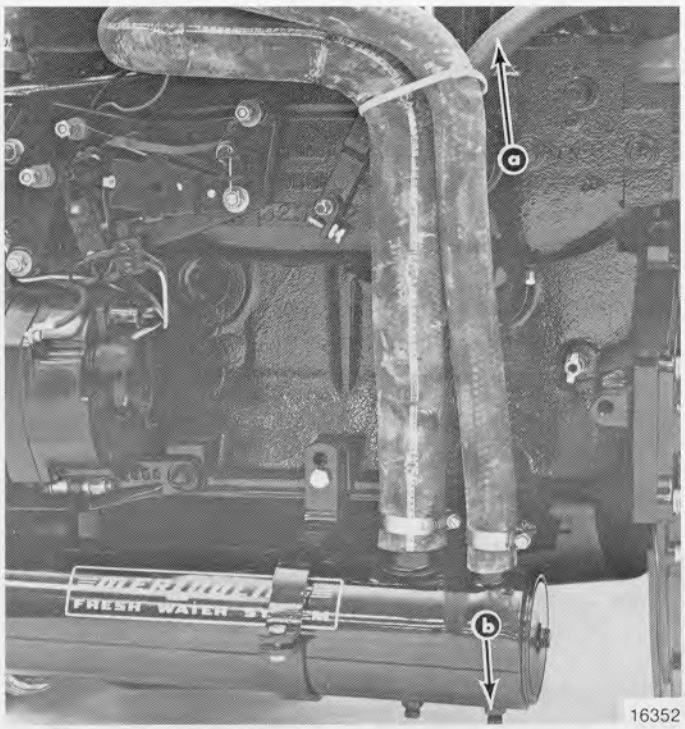


a - Drain Plug
b - Petcock

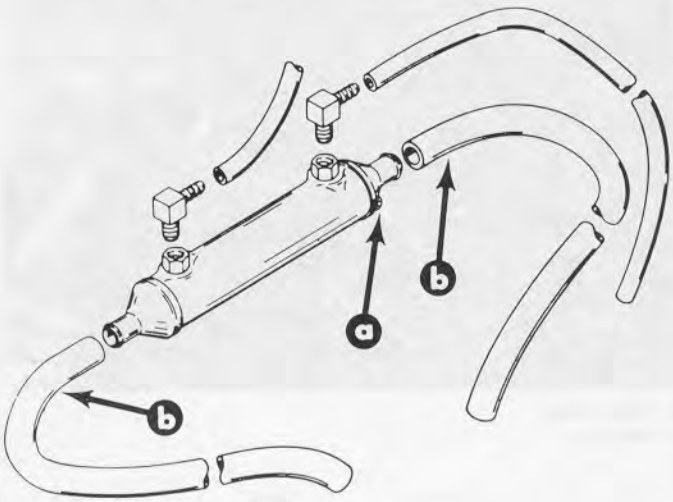


a - Remove Drain Plug

3" or 6" Risers (If Equipped)



a - Disconnect Seawater Inlet Hose and Lower to Drain
b - Remove Drain Plug (1)



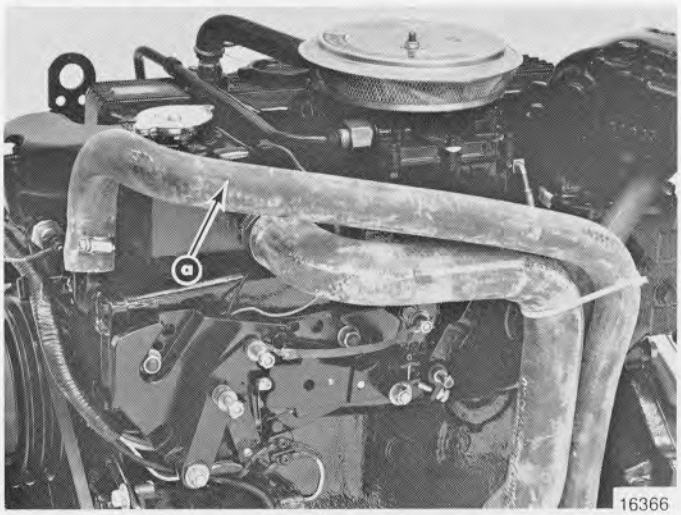
a - Remove Drain Plug
b - Cooler without Drain Plug - Remove Hoses Lower to Drain

Power Steering Fluid Cooler (If Equipped)

3. After cooling system has drained completely, coat threads of drain plugs with Perfect Seal and reinstall. Reconnect hose and tighten clamp securely.
4. **Driveshaft Extension Models:** Disconnect water inlet hose from gimbal housing and lower to drain hose.

a - Water Tube
b - Hose Clamp (Retighten Securely)
c - Remove Hose, Lower to Drain

5. For additional assurance against freezing and rust, fill the exhaust manifold and heat exchanger with a solution of permanent anti-freeze and water (mixed to proportions recommended by manufacturer for lowest temperature to which engine will be exposed to during storage). To fill manifold and exchanger refer to figure shown.



a - Remove Hose From Manifold End Cap. Pour Coolant into Manifold, Then into Hose until Heat Exchanger if Full. Reconnect Hose. Tighten Clamp Securely

Filling Closed Cooling Section

NOTICE
See "Specifications" for appoximate closed cooling system capacity and coolant recommendation.

1. Fill closed cooling section with coolant as follows:
   a. Thru reservior filler neck until coolant solution is 1" (25mm) below filler neck.

⚠CAUTION
Do not operate engine without water flowing thru seawater pickup pumps, as pump impeller may be damaged and subsequent overheating damage to engine or stern drive unit may result.

Front of engine should be higher than rear to purge trapped air out of the system during initial filling. This will minimize the posibility of air being trapped in the closed cooling section which can cause engine to overheat.

Models with belt drive seawater pickup pump must be in the water when running engine because garden hose will not supply enough water to system at higher RPM.

2. With pressure cap off, start engine and run at fast idle (1500-1800 RPM). Add coolant solution to heat exchanger, as required, to maintain coolant level 1" below filler neck.
3. After engine has reached normal operating temperature (themostat is fully open), and coolant level remains constant, fill heat exchanger to bottom of filler neck.
4. Observe engine temperature gauge to make sure that engine operating temperature is normal. If gauge indicates excessive temperature, stop engine immediately and examine for cause.
5. Install pressure cap on heat exchanger.
6. Remove cap from coolant recovery reservoir and fill to "Full" mark with coolant solution. Reinstall cap.
7. With engine still running, check hose connections, fittings and gaskets for leaks. Repeat step 4.

IMPORTANT: Engine overheating is often due to air being trapped in fresh water section. Purge air by running engine at 2000 RPM for 10 minutes.

⚠WARNING
Allow engine to cool down before removing pressure cap. Sudden loss of pressure could cause hot coolant to boil and discharge violently. After engine has cooled down, turn cap 1/4-turn to allow any pressure to escape slowly, then, push down and turn cap all-the-way off.

8. Recheck coolant level after first open-throttle boat test and add coolant, if necessary.
9. Maintain coolant level in coolant recovery reservoir between "Add" and "Full" marks with engine at normal operating temperature.

Cooling System Flow Diagrams