

b. Remove any foreign matter from around spark plugs by blowing out with compressed air.

c. Remove and inspect all spark plugs. Install thread-type compression gauge in spark plug hole.



d. **All models except 4.3L HO:** With the ignition switch off, disconnect the high tension lead from ignition coil to distributor at distributor and **ground lead to engine to prevent sparking. 4.3L HO models only:** disconnect 14-pin connector at ignition module.

e. Position choke wide open. With throttle in the wide open position, crank engine through at least four compression strokes.

Test Conclusion

The indicated compression pressures are considered normal if the lowest reading cylinder is within 75% of the highest.

Example:

If the highest pressure reading was 140 psi, 75% of 140 is 105. Therefore, any cylinder reading less than 105 psi indicates an improperly seated valve or worn or broken piston rings. Any cylinder reading 105 psi or greater is within specifications, and compression is considered normal.

If one or more cylinders read low, squirt approximately one tablespoon of engine oil on top of the pistons in the low reading cylinders. Repeat compression pressure check on the cylinders.

1. If compression improves considerably, the piston rings are at fault.

2. If compression does not improve, valves are sticking or seating poorly.

3. If two adjacent cylinders indicate low compression pressures and squirting oil on the pistons does not increase the compression, the cause may be a cylinder head gasket leak between the cylinders. Engine oil and/or coolant in the cylinders could result from this problem.

It is recommended the following quick reference chart be used when checking cylinder compression pressures. The chart has been calculated so that the lowest reading number is 75% of the highest reading.

4. Clean and regap or replace spark plugs. Adjust alternator and power steering belts.

5. Check ignition timing and distributor dwell. Adjust carburetor and engine idle speed.



Quick Reference Compression Pressure Limit Chart

Max. PSI	Min. PSI	Max. PSI	Min. PSI	Max. PSI	Min. PSI	Max. PSI	Min. PSI
134	101	154	115	174	131	194	145
136	102	156	117	176	132	196	147
138	104	158	118	178	133	198	148
140	105	160	120	180	135	200	150
142	107	162	121	182	136	202	151
144	108	164	123	184	138	204	153
146	110	166	124	186	140	206	154
148	111	168	126	188	141	208	156
150	113	170	127	190	142	210	157
152	114	172	129	192	144	212	158

 **To prevent a possible explosion, operate the blower as recommended by the boat manufacturer before starting engine. If the boat is not equipped with a bilge blower, open engine cover or hatch prior to starting and leave open until after engine is running.**

6. Inspect battery and cables. Lake test boat for power and overall performance.

Tune-up Specifications

Spark Plugs

Model	Type	Gap	Torque
2.3 Litre	<i>Motorcraft AWSF-32</i> <i>Champion RS12YC</i>	0.035 in. (0,9 mm)	5-10 ft. lbs. (7-13 N·m)
3.0 Litre PWS	<i>AC-R43TS</i> <i>Champion RV12YC</i>	0.035 in. (0,9 mm)	22 ft. lbs. (30 N·m)
3.0 Litre HO	<i>AC-R43LTS</i> <i>Champion RS12YC</i>		
3.0 Litre PWC 4.3 Litre 4.3 Litre HO 5.7 Litre	<i>AC-MR43T</i> <i>Champion RV8C</i> <i>Motorcraft ARF-32M</i>		
5.0 Litre 5.0 Litre HO 5.8 Litre	<i>AC-MR43T</i> <i>Champion RV8C</i> <i>Motorcraft ARF-32M</i>	0.030 in. (0,76 mm)	15-20 ft. lbs. (20-27 N·m)



Tune-up Specifications

Oil Filters

Model	OMC Part No.
2.3, 5.0, 5.0 HO & 5.8 Litre	173231
3.0 Litre & 3.0 Litre HO	173232
4.3 Litre & 4.3 Litre HO	173834
5.7 Litre	173233

Fuel Pump Pressure

Model	Pressure
ALL OMC Cobra	5.75-7 PSI (40-48 kPa)

Engine Firing Order

Model	Firing Order
2.3 L, 3.0 L & 3.0 L HO	1-3-4-2
4.3 L & 4.3 L HO	1-6-5-4-3-2
5.0 L	1-5-4-2-6-3-7-8
5.0 L HO & 5.8 L	1-3-7-2-6-5-4-8
5.7 L	1-8-4-3-6-5-7-2

Timing

Models	Degrees-Fuel
2.3 L	10° BTDC - w/86 AKI or higher
3.0 L & 3.0 L HO	0° BTDC - w/86 AKI or higher Shunt-OMC P/N 986662 required
4.3 L	6° BTDC - w/89 AKI or higher 1° BTDC - w/86-88 AKI
4.3 L HO	<i>Spitfire™ Electronic Ignition</i> No Adjustment
5.0 L, 5.0 L HO & 5.8 L	10° BTDC - w/86 AKI or higher
5.7 L	8° BTDC - w/89 AKI or higher 3° BTDC - w/86-88 AKI

Tune-up Specifications

Operating RPM and Fuel Requirement

Model	Idle RPM*	W.O.T. RPM	Fuel Requirement
2.3 L	600-650*	5200-5600	86 AKI or higher @ 10° BTDC
3.0 L & 3.0 L HO	550-600*	4200-4600	86 AKI or higher
4.3 L	550-600*	4200-4600	89 AKI or higher @ 6° BTDC 86-88 AKI @ 1° BTDC
4.3 L HO	550-600*	4400-4800	86 AKI or higher
5.0 L, 5.0 L HO & 5.8 L	550-600*	4200-4600	86 AKI or higher @ 10° BTDC
5.7 L	550-600*	4200-4600	89 AKI or higher @ 8° BTDC 86-88 AKI @ 3° BTDC

*in forward gear

Distributor Specifications

All Models

Model	*Condenser Capacity	Dwell	Point Gap	Distributor Rotation
2.3 L	0,25-0,31	36° ±2°	0.019 in. (0,48 mm)	clockwise
3.0 L & 3.0 L HO	N/A - Delco® HEI			clockwise
4.3 L	0,21-0,25	39° ±2°	0.019 in. (0,48 mm)	clockwise
4.3 L HO	N/A - Spitfire™ electronic ignition system			
5.0 L, 5.0 L HO & 5.8 L	0,21-0,25	29° ±2°	0.018 in. (0,45 mm)	counter-clockwise
5.7 L	0,21-0,25	29° ±2°	0.018 in. (0,45 mm)	clockwise

*in microfarads

Oil Pressure

Model	Pressure (800 RPM)	Pressure (2000 RPM)
2.3 L	30-50 PSI (207-345 kPa)	50-80 PSI (345-552 kPa)
3.0 L & 3.0 L HO 4.3 L & 4.3 L HO 5.0 L, 5.0 L HO & 5.8 L 5.7 L	15-30 PSI (103-207 kPa)	30-50 PSI (207-345 kPa)

PCV Valves

Model	OMC P/N	Motorcraft
2.3 L	984710	EV-127
5.0 L, 5.0 L HO & 5.8 L	913183	EV-68

Initial Timing Procedure - All Models

Note Use this procedure if the distributor has been removed and the crankshaft rotated, or if ignition timing is completely off. If the distributor has not been removed and the engine will run, follow the Finish Timing Procedure, below.

1. Locate number 1 piston in firing position by removing rocker arm cover, cranking the engine until both valves for number 1 cylinder are completely closed, and the timing mark lines up with timing grid. Number 1 cylinder is now in position to fire.

1 → **3** 2. Install distributor onto engine. After distributor seats, rotor must be in position to fire number 1 cylinder.

If distributor does not seat in engine block, press down lightly on distributor housing while turning rotor. After distributor engages oil pump shaft, install distributor clamp with bolt, clamp, and spring bracket, leaving the bolt just loose enough to permit movement of distributor with heavy hand pressure. Rotate distributor slightly until contact points just start to open.

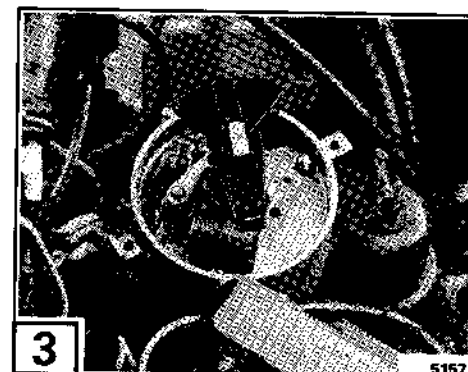
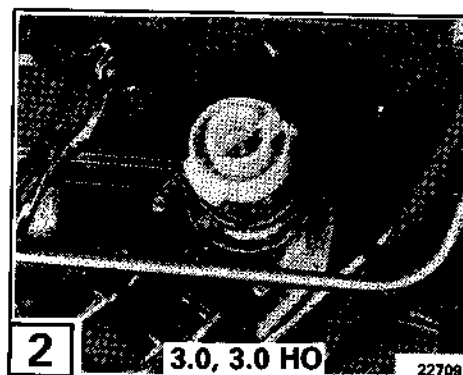
3. Place distributor cap in position and check to see that rotor lines up with terminal for number 1 spark plug.

4. Install cap, check all high tension wiring, and connect spark plugs wires if they have been removed.

5. Connect primary wire to coil negative (-) terminal.

! To prevent a possible explosion, operate the blower as recommended by the boat manufacturer before starting engine. If the boat is not equipped with bilge blower, open engine cover or hatch prior to starting and leave open until after engine is running.

6. Start the engine and set timing as described in Finish Timing Procedure, below.



Safety Related

Finish Timing Procedure - All Models

Dwell:

Breaker point dwell angle should always be checked before adjusting ignition timing, because point dwell affects ignition timing. As dwell increases, timing decreases, and vice versa.

Connect dwell meter per manufacturer's instructions, and set dwell per Tune-Up Specifications.

Timing:

4 → **6** The timing mark is stamped on the rim of the harmonic balancer. The timing mark grid is a pointer scale attached to the timing chain cover. It shows Top Dead Center (marked "O") and degrees of advance (before) or retard (after). Each division on the scale represents 2 degrees.

1. Connect a 12-volt power timing light to number 1 spark plug using a suitable adapter, and following the instructions of the manufacturer

⚠ Be careful not to puncture wire or boot as this would cause a high voltage leak. Make sure that spark plug wires are pushed all the way down into the distributor cap terminals and onto the spark plugs. Nipples must be firmly pushed over the terminals and boots over the spark plugs. Failure to do so can result in ignition of fuel vapors in engine compartment or bilge and may result in fire or explosion.

2. Connect a tachometer from distributor terminal of coil to ground.

3. Start engine and leave engine running until warmed up and choke valve is wide open.

⚠ • Have someone at controls.

⚠ • Keep hands, hair and clothing away from rotating parts while making adjustments when engine is running.

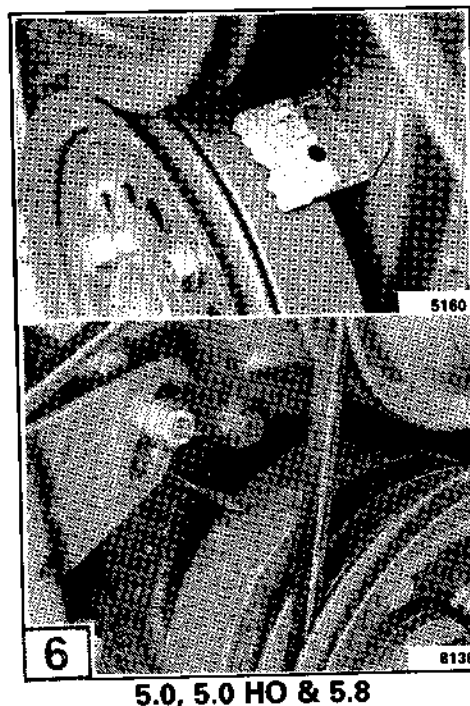
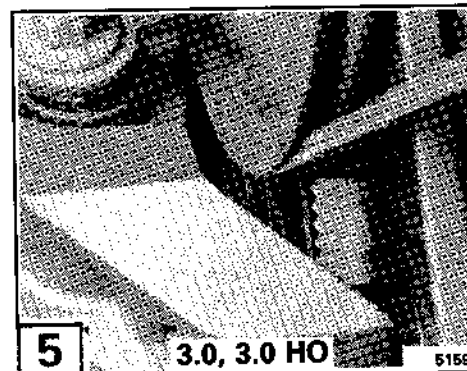
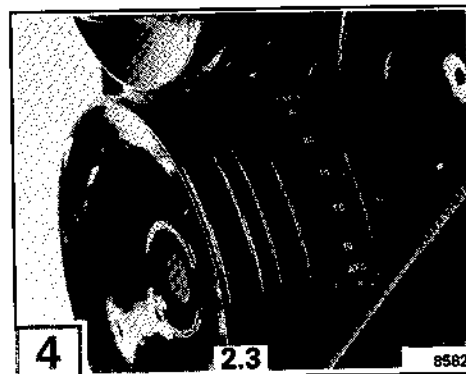
4. Adjust idle speed to specified rpm in gear, then shift into NEUTRAL.

5. Direct beam of timing light onto timing mark grid. Loosen distributor clamp, then turn distributor slowly by hand until timing mark is aligned with the correct degree on the timing mark grid per Tune-Up Specifications.

6. Recheck timing mark. Reset if necessary. Tighten clamp bolt.

7. Recheck idle speed and mixture adjustments.

8. Stop engine and remove timing light and tachometer.



Gasoline Requirements

Maximum performance the use of lead-free or leaded gasoline with the following minimum or higher octane specification:

Anti-Knock Index Number (AKI) - 89
Research Octane Number (RON) - 93

Note Use of gasoline with lower than 89 AKI (93 RON) octane in models 4.3 L & 5.7 L, without setting ignition timing as specified, will result in serious damage to your engine and will void the engine warranty.

If fuels with 89 AKI (93 RON) octane or higher are not available, the ignition timing on models 4.3 L & 5.7 L will have to be retarded so lower octane fuels, with minimum 86 AKI (90 RON) octane, can be used. Refer to "Timing" in Tune-up Specifications. When ignition timing is retarded, a slight decrease in power can be expected.

Note Engine damage resulting from the use of gasoline with octane lower than 86 AKI (90 RON), is considered misuse of the engine and will void the engine warranty.

To prevent gum formation and corrosion in the fuel system, use *OMC 2+4*® fuel conditioner in the gasoline. *OMC 2+4* fuel conditioner is available from your *OMC Cobra* dealer.

 Gasoline is extremely flammable and highly explosive under certain conditions. Always stop engine and do not smoke or allow open flames or sparks near the boat when refueling gas tanks.

When filling the gas tank, ground the tank to the source of gasoline by holding the hose nozzle firmly against the side of the deck filler plate or ground it in some other manner. This action prevents static electricity build-up which could cause sparks and ignite fuel vapors.

Gasolines Containing ALCOHOL

Many gasolines being sold today contain alcohol. Two commonly used alcohol additives are Ethanol (ethyl alcohol) and Methanol (methyl alcohol).

See your owner's manual for your boat to determine if the boat's fuel system is compatible with alcohol blended fuels. If it is compatible, your engine may be operated using gasolines blended with no more than 10% Ethanol (ethyl alcohol) meeting the minimum octane specification. Do not use any gasoline which contains **METHANOL** (methyl alcohol).



Note Serious damage will result from the continued use of fuel containing **METHANOL** (methyl alcohol).

If you use gasoline containing alcohol, be aware of the following:

- The engine will operate leaner with alcohol blended fuel. This may cause engine problems such as vapor lock, low speed stall, or hard starting.
- Alcohol blended fuels attract and hold moisture. Moisture inside fuel tanks can cause corrosion of the tank material. Inspect fuel tanks at least annually. Replace fuel tanks if inspection indicates leakage or corrosion.
- Inspect nonmetallic parts of fuel system frequently and replace if excessive stiffness, deterioration or fuel leakage is found.

! Fuel leakage can contribute to a fire and/or explosion.

Crankcase Oil

7 Initial factory fill is a high quality break-in oil for API Service SG/CD. During the break-in period (20 hours), frequently check the oil level. Somewhat higher oil consumption is normal until piston rings are seated. The oil level should be maintained in the safe range between the Add and Full marks on the dipstick. The safe range between the marks represents approximately 1 litre (1 quart). If it is necessary to add or change the motor oil, use a quality oil with API service category SG/CD that meets *General Motors* Standard GM-6094-M or the *Ford* Specification ESE-M2C153-E.

At the end of the break-in period (20 hours), change the crankcase oil and replace the oil filter. Refer to Lubrication and Inspection Chart for recommended oil change intervals.

Note The use of multi-viscosity oils, such as 10W-30 or 10W-40 is not recommended.

Draining and Filling the Engine Crankcase

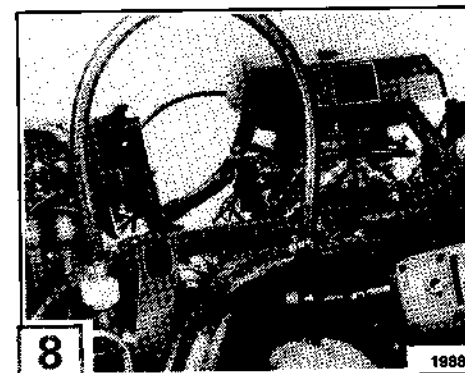
Motor oil and the oil filter are important factors affecting engine life. They affect ease of starting, fuel economy, combustion chamber deposits and engine wear. Drain and refill crankcase every 50 hours of operation or 6 months, whichever occurs first.

8 Check the motor oil level frequently with the dipstick. When oil is to be changed, remove dipstick and withdraw oil from crankcase through withdrawal/dipstick tube. The oil withdrawal tube is provided so oil does not have to be drained into the bilge. Withdraw oil with a suction pump or use OMC Accessory Oil Withdrawal Pump Kit, P/N 172473.

! To prevent fire and explosion, always make sure engine compartment is free of gasoline fumes before using any spark-producing tools such as the electric drill motor used with oil withdrawal pump kit.



Safety Related



Fill the crankcase to the specified capacity with a quality motor oil labeled for Service category SG/CD which meets *General Motors* Standard GM-6094-M or the *Ford* Specification ESE-M2C153-E. Oils conforming to this standard contain detergent and anti-wear additives.

When changing motor oil, select from the following chart the SAE viscosity that matches the temperature range in which the boat will be operated. If it is necessary to add motor oil use motor oil of the same viscosity.

IF THE LOWEST ANTICIPATED TEMPERATURE IS:	THE FOLLOWING SAE VISCOSITY OILS ARE RECOMMENDED:
32° F (0° C) and above	SAE 30
0° F (-18° C) to 32° F (0° C)	SAE 20W
Below 0° F (-18° C)	SAE 10W

Note Disregard any reference to multi-viscosity oil printed on engine. Such reference is intended for automotive use only and not marine application.

Note Do not fill above full mark. Overfilling results in high operating temperatures, foaming (air in oil), loss of power, and overall reduced engine life.

Crankcase Capacities

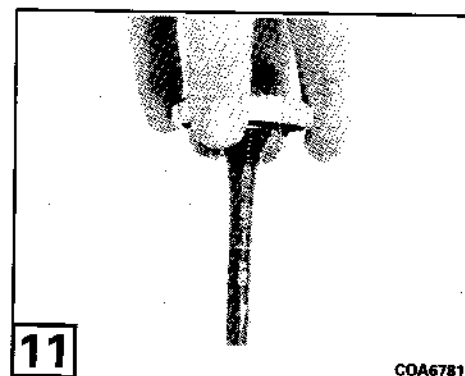
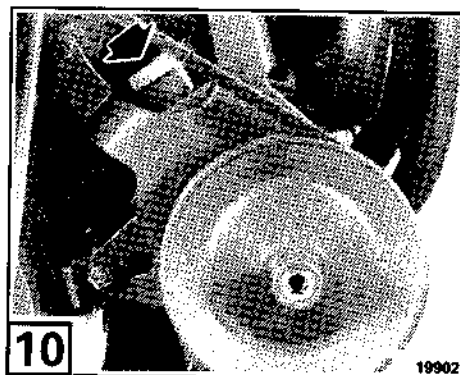
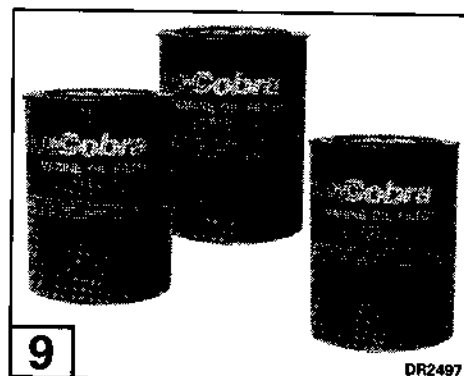
Model	w/o Filter	With Filter
2.3 L	4.0 qts. (3,8 litres)	5.0 qts. (4,7 litres)
3.0 L & 3.0 L HO	3.5 qts. (3,3 litres)	4.0 qts. (3,8 litres)
4.3 L & 4.3 L HO	4.0 qts. (3,8 litres)	4.5 qts. (4,3 litres)
5.0 L & 5.0 L HO	5.0 qts. (4,7 litres)	6.0 qts. (5,7 litres)
5.7 L & 5.8 L	5.0 qts. (4,7 litres)	6.0 qts. (5,7 litres)

Oil Filter

9 Replace the oil filter whenever the motor oil is changed. This filter is a self-contained, screw-on type. To remove, unscrew filter canister counterclockwise and discard. When attaching a new filter, be sure the gasket is lightly lubricated with motor oil. Hand tighten only, run engine and check for leaks. Do not run engine out of water. See Tune-up Specifications for model and filter requirements.

Power Steering Fluid Level

10 11 Whenever you check the engine oil level, also remove the power steering oil fill cap and check the fluid level. Maintain the level with *OMC Power Trim/Tilt and Power Steering Fluid* available from your *OMC Cobra* dealer. Approved power steering fluids such as *GM* power steering fluid or *Dexron II* automatic transmission fluid can also be used. Do not overfill the pump reservoir.



Steering System Lubrication

- 12 → 13 Every 60 days, grease the steering ram (A) with *OMC Triple-Guard®* grease.

Vertical Drive Lubrication

The vertical drive is filled at the factory with *OMC Hi-Vis®* gearcase lubricant.

Adding Lubricant to Vertical Drive

- 14 Occasionally check the oil level in the vertical drive. The oil level can be checked two ways:

- Screw dipstick fully into hole, remove and read oil level reference to the top mark on dipstick.
- Set dipstick into hole resting on the threads, remove and read oil level reference to the bottom mark on dipstick.

If oil level is low, add only enough lubricant to bring the oil level to the full mark.

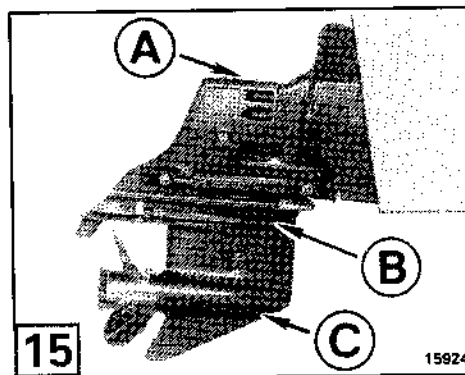
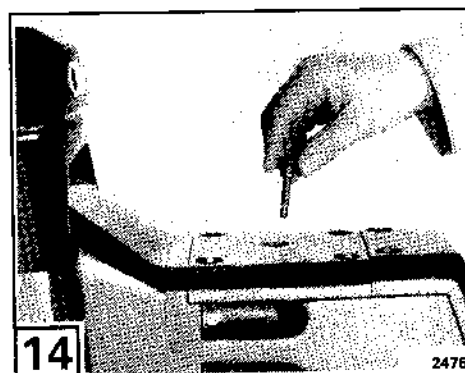
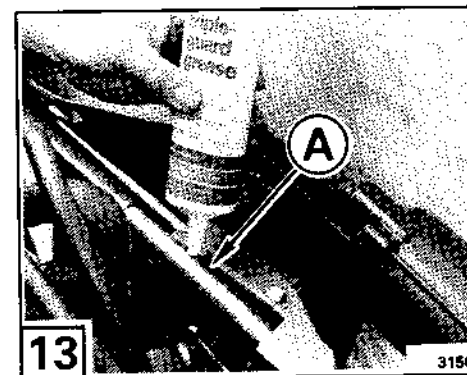
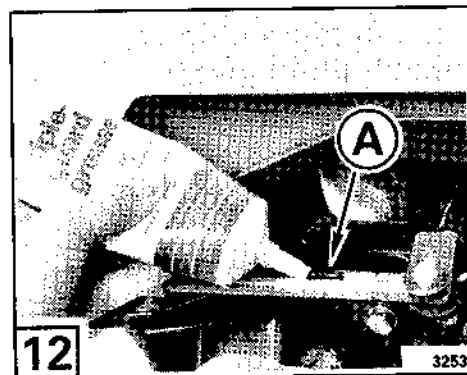
Vertical Drive Oil Capacity

Change Lubricant Every 50 Hours or Twice Each Season Use <i>OMC Hi-Vis®</i> Gearcase Lube	
2.3 L	60 oz. (1774 ml)
3.0 L & 3.0 L HO 4.3 L & 4.3 L HO 5.0 L & 5.0 L HO 5.7 L & 5.8 L	64 oz. (1892 ml)

2. Draining and Filling Vertical Drive

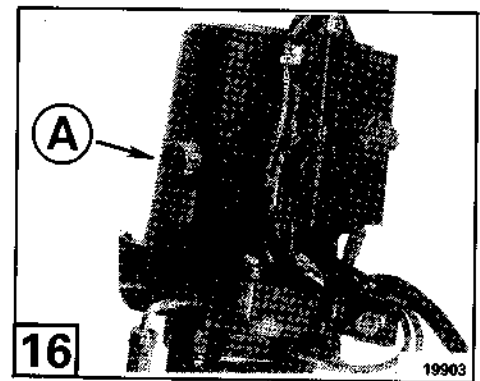
- 15 When a complete change of lubricant is required in the vertical drive, proceed as follows:

- Place vertical drive in the run (down) position:
- Remove the oil drain plug (C) (starboard side of lower gearcase) and the oil level dipstick (A) (top of vertical drive).
- After vertical drive has drained completely, replace oil drain plug and tighten securely.
- Remove the oil fill plug (B) (starboard side of vertical drive).



- Fill vertical drive with *OMC Hi-Vis* gearcase lubricant through the oil fill plug location. The vertical drive is properly filled when the oil level appears at the mark on the dipstick. Check oil level with the dipstick cap threads resting on top of the hole and read oil level reference to the mark on dipstick.
- Securely replace the oil level dipstick before installing the oil fill plug. This will create an air lock and will hold the oil in the drive unit while the oil fill plug is being replaced.

Note When completely changing the lubricant in the vertical drive, the oil level must be checked after the unit has been run and trapped air is purged. Improper oil level may result in serious vertical drive damage.



Power Trim/Tilt-Fluid Level Check

16 The trim/tilt assembly contains the electric motor, hydraulic pump, and reservoir. At the beginning of each boating season, check the fluid level in the reservoir as follows:

- With the vertical drive tilted up, remove the level/fill plug.

⚠ The trim/tilt hydraulics are pressurized when the vertical drive is in the down position. The vertical drive must be tilted up to relieve hydraulic pressure before removing level/fill plug **A**. Failure to tilt the vertical drive in the up position before removing level/fill plug would result in hydraulic oil being sprayed. Caution should always be taken when removing level/fill plug by placing a rag over the level/fill plug to prevent residual pressure from spraying oil.

- Check the fluid level. The fluid level should be at the bottom of the fill hole when the vertical drive is at full tilt.
- If necessary, add *OMC Power Trim/Tilt and Power Steering Fluid*. Replace the level/fill plug and tighten securely.

When checking fluid level, inspect the trim/tilt unit for leaks and proper operation.

Off-Season Storage Preparations

1. Condition the fuel system: Add *OMC 2+4*® fuel conditioner to fuel system at the recommended rate stated on the container. This will stabilize the fuel and prevent the formation of varnish and gum in the entire fuel system. Do this before continuing with the following procedures.



2. Change motor oil and oil filter:

- The engine should first be operated under load until the oil is thoroughly warmed up. If the oil is allowed to warm up before draining, a more complete draining will be accomplished. In addition, the accumulated impurities will be held in suspension by the oil and be removed during the draining operation.
- Drain the motor oil.
- Install a new oil filter and fill the crankcase with recommended oil.
- After changing the motor oil, with vertical drive in full down position, run the engine at a fast idle for a few minutes to distribute the clean oil through the engine.
- Check the oil filter gasket for leaks.
- Shut off the engine and check the oil level. Add oil if necessary to bring the oil level up to, but not over, the full mark.

Note Vertical drive must be submerged in water or an accessory flushing adaptor must be used while operating engine.

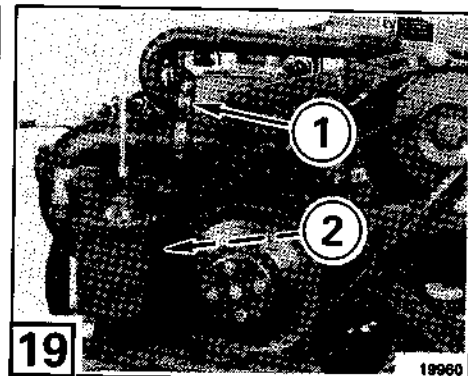
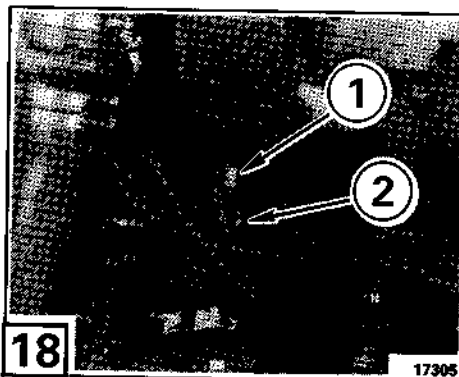
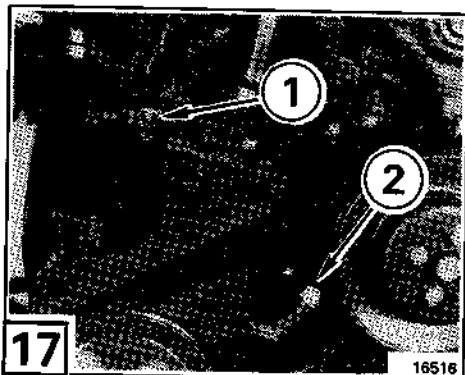
 **When using a flushing adaptor, remove the propeller before starting the engine to prevent accidental contact with moving propeller.**

3. Change vertical drive lubricant: Drain and refill with fresh *OMC Hi-Vis®* gearcase lube. Refer to Vertical Drive Lubrication.

4. Fog engine:

- Warm up engine to ensure fuel conditioner is throughout the fuel system.
- Use 0,25 litre (½ pint) of *OMC® Storage Fogging Oil* to fog engine.
- Remove flame arrestor from carburetor. Bring engine up to fast idle and slowly pour ¾ of fogging oil into carburetor.
- Keep engine running while pouring fogging oil into carburetor throat.
- Rapidly dump the remaining ¼ of fogging oil into carburetor, reduce throttle to idle and let engine die.
- Turn off ignition and replace flame arrestor.





5. Drain cooling system:

When draining the engine, raise or lower the bow of the boat to position the engine in a horizontal plane. This will provide for complete drainage of the block and manifold. If the bow of the boat is higher or lower than the stern, some water may be trapped in the block.

2.3 L Models

17 Front

- ① Loosen and slide clamp back. Remove and drain long hose at thermostat housing.
- ② Disconnect and drain large hose at water pump housing.

18 Starboard

- ① Open one exhaust manifold petcock.
- ② Open one cylinder block petcock.

3.0 L & 3.0 L HO Models

19 Front

- ① Loosen and slide clamp back. Remove and drain long hose at thermostat housing.
- ② Disconnect and drain large hose at water pump housing.

20 Port

- ① Open one exhaust manifold petcock.
- ② Open one cylinder block petcock.

4.3 L & 4.3 L HO Models

21 Front

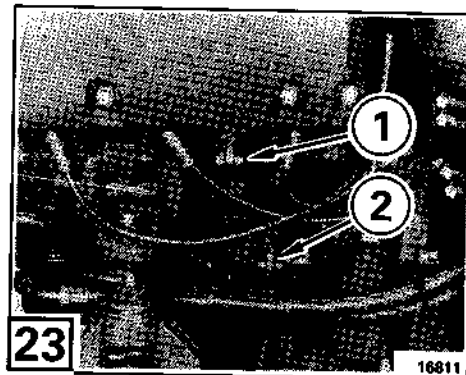
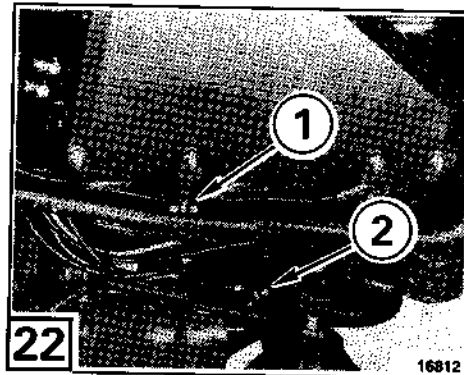
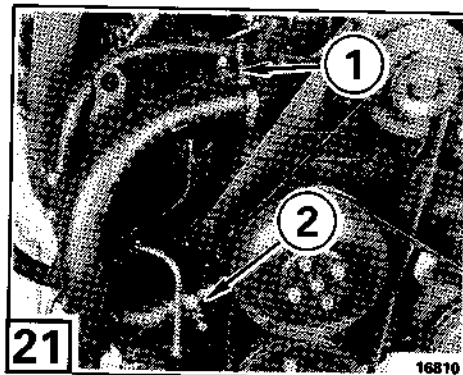
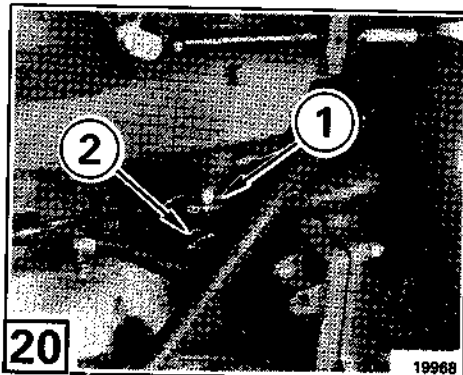
- ① Disconnect and drain long hose at thermostat housing.
- ② Disconnect and drain large hose at water pump housing.

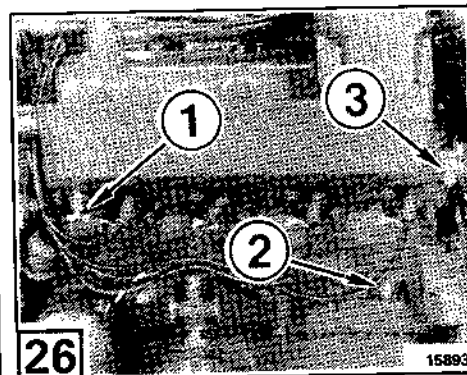
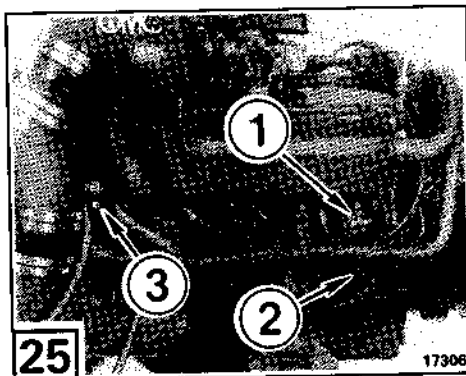
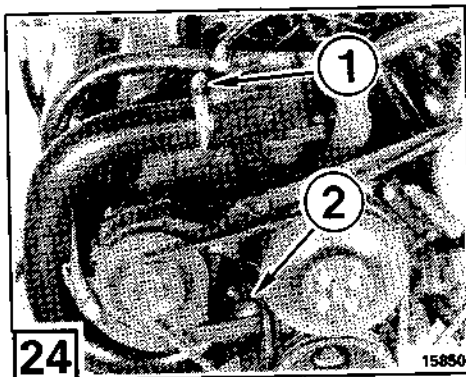
22 Starboard

- ① Open one exhaust manifold petcock.
- ② Open one cylinder block petcock.

23 Port

- ① Open one exhaust manifold petcock.
- ② Open one cylinder block petcock.





5.0 L, 5.0 L HO & 5.8 L Models

24 Front

- ① Disconnect and drain long hose at thermostat housing.
- ② Disconnect and drain large hose at water pump housing.

25 Starboard

- ① Open one exhaust manifold petcock.
- ② Open one cylinder block petcock.
- ③ Loosen clamp and remove rubber cap.

26 Port

- ① Open one exhaust manifold petcock.
- ② Open one cylinder block petcock.
- ③ Loosen clamp and remove rubber cap.

5.7 L Models

27 Front

- ① Disconnect and drain long hose at thermostat housing.
- ② Disconnect and drain large hose at water pump housing.

28 Starboard

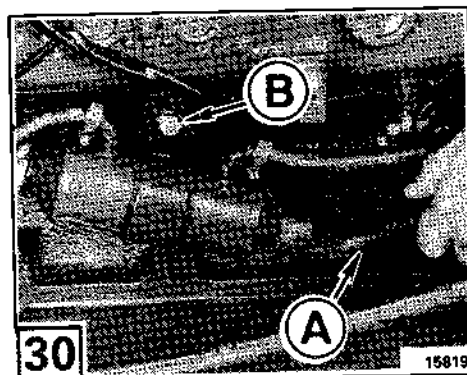
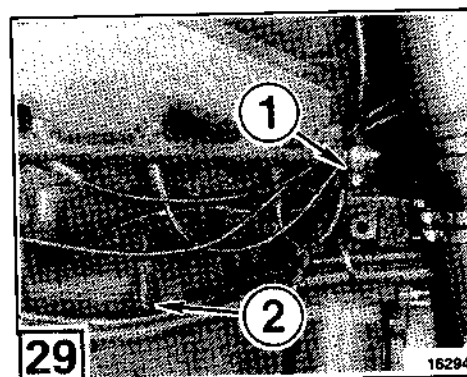
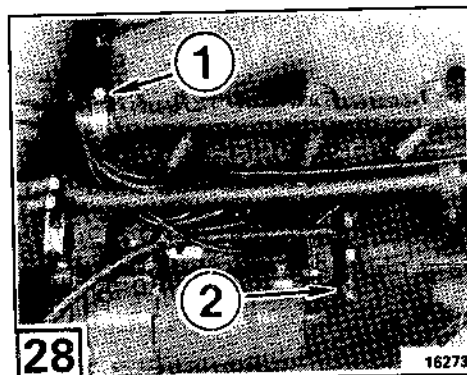
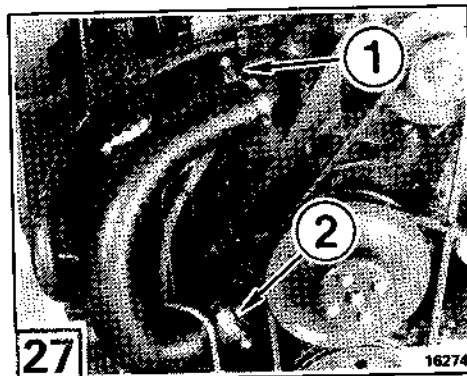
- ① Loosen clamp and remove rubber cap.
- ② Open one cylinder block petcock.

29 Port

- ① Loosen clamp and remove rubber cap.
- ② Open one cylinder block petcock.

Models With Oil Coolers

- 30 On models so equipped, remove the lower water hose from the power steering cooler. If cooler is mounted horizontally, remove one water hose A from oil cooler, loosen mounting bolt B, and tip oil cooler downward to drain.



6. Drain Pivot Housing:

31 **32** To drain cavities in pivot housing, tilt vertical drive to the full tilt (up) position and remove the water **drain plug** **A** from the port side of the pivot housing. Remove both the **vent plug** **B** and **drain plug** **C** on the starboard side of the pivot housing. Crank the engine momentarily to expel any water trapped in the drive water pump and cooling passages. Run the drive to the full tilt up position, allow unit to drain, then return to full down position. After unit has completely drained, replace pivot housing plugs. Inspect vertical drive water intake screen for obstructions.

Note Failure to completely drain the cooling system will result in serious damage to the engine, exhaust manifolds, and pivot housing when temperatures go below freezing. If complete drainage is in doubt, check drain opening with a piece of wire.

7. Lubricate gimbal bearing and universal joints: Refer to Gimbal Bearing and Universal Joint Lubrication.

8. Inspect vertical drive water pickup screens for obstructions.

9. Disconnect the battery and place in storage. When storage will be for a considerable length of time, periodically recharge the battery following the manufacturer's recommendations.

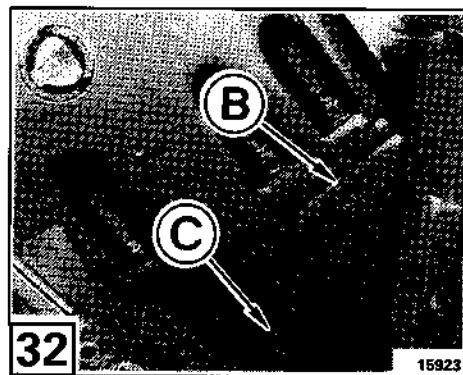
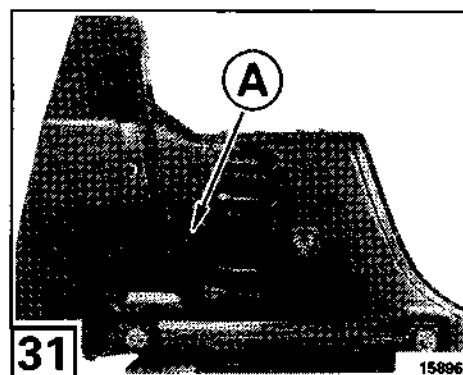
10. Spray entire engine and vertical drive with a rust preventative coating, such as CRC-6-66 or equivalent, following the directions on the container.

Preparation for Boating

1. Close all drain petcocks. Replace manifold rubber caps and clamps. Connect hoses and check the condition of hoses and connections. Install the boat drain plug, if removed.

2. All Model Except 3.0 L, 3.0 L HO & 4.3 L HO: Remove the distributor cap and rotor. Inspect the breaker points and check the point gap. Wipe the inside of the distributor cap dry with a clean cloth and spray with *CRC-6-66* or equivalent. Replace the rotor and cap.

3. Clean the battery terminals. With the ignition switch in the "OFF" position, install the battery and attach the battery cables. Spray terminals with CRC-6-66 or equivalent.



 4. Open the fuel shut-off valve and check all fuel line connections for leaks.

 5. Check the flame arrestor and clean if necessary. **Reinstall, make sure all parts are in place and tighten nut securely.**

6. Make a thorough check of the boat and engine for loose or missing nuts and screws. Pump the bilge dry and air out the engine compartment.

7. Test run engine: Launch boat or use a flushing adaptor installed on vertical drive.

 Safety Warning

- To prevent a possible explosion, operate the blower as recommended by the boat manufacturer before starting engine. If the boat is not equipped with a bilge blower, open engine cover or hatch prior to starting and leave open until after engine is running.
- If operating boat in water, tie boat securely to prevent forward or backward movement.
- When using a flushing adaptor, remove the propeller before starting engine to prevent accidental contact with moving propeller.

 **Note** Do not start engine out of water unless using a flushing adaptor. Always turn water on before starting engine. Control water pressure as full water pressure may cause damage to water pump and engine.

 8. With engine compartment open, start the engine. Monitor the ammeter, voltmeter, oil pressure and water temperature gauges frequently to be sure all systems are operating properly. **Check for fuel, oil, and water leaks.**

Engine Break-In

All *OMC Cobra* engines have been run for a short period of time as a final test at the factory. You must follow the **Engine Break-In** procedure during the first 20 hours of operation to ensure maximum performance and longest engine life.

Note To ensure proper lubrication during the break-in period, do not remove factory break-in oil until after the 20-hour break-in is completed.

First Two Hours

For the first five to ten minutes of operation, operate engine at a fast idle (above 1500 RPM). During the remaining first two hours of operation, accelerate to bring boat onto plane quickly and bring throttle back to maintain a planing attitude. During this period, vary the engine speed frequently by accelerating to approximately three-fourths throttle for two to three minutes, then back to minimum planing speed.

After the engine has reached operating temperature, momentarily reduce engine speed, then increase engine speed, to assist the break-in of rings and bearings. Maintain planing attitude to avoid excessive engine load.

DO NOT RUN ENGINE AT ANY CONSTANT RPM FOR PROLONGED PERIODS OF TIME FOR THIS INITIAL TWO HOURS OF BREAK-IN.

Next Eight Hours

During the next eight hours, continue to operate at approximately three-fourths throttle or less (minimum planing speed). Occasionally reduce throttle to idle speed for a cooling period. During this eight hours of operation it is permissible to operate at full throttle for periods of less than two minutes.

DO NOT RUN ENGINE AT A CONSTANT RPM FOR PROLONGED PERIODS OF TIME DURING THE BREAK-IN PERIOD.

Final Ten Hours

During the final ten hours of break-in, it is permissible to operate at full throttle for five to ten minutes at a time. After warming engine to operating temperature, momentarily reduce then increase engine speed. Occasionally reduce engine speed to idle to provide cooling periods.

DO NOT RUN ENGINE AT A CONSTANT RPM FOR PROLONGED PERIODS OF TIME DURING THE BREAK-IN PERIOD.

During the break-in period, be particularly observant during the initial running of the engine, as follows:

- A. Check motor oil level frequently. Maintain oil level in the safe range, between the "add" and "full" marks on dipstick.

Note If you have a problem getting a good oil level reading on dipstick, rotate dipstick 180° in tube.

B. Watch the oil pressure gauge. If the indicator fluctuates whenever the boat attitude (i.e. turning, climbing on plane, etc.) is changed, it may be the oil pickup screen is not covered with oil. Check crankcase dipstick. Add oil to the crankcase if required. DO NOT OVERFILL. If oil level is correct and condition still exists, check for possible gauge or oil pump malfunction.

Note Oil pressure will rise as RPM increases, and fall as RPM decreases. In addition, cold oil will generally show higher oil pressure for any specific RPM than hot oil. Both of these conditions reflect normal engine operation.

C. Watch the engine temperature indicator to be sure there is proper water circulation.

Note Failure to follow the break-in procedure will void the engine warranty.

At the end of the break-in period (20 hours), remove break-in oil and replace the oil filter. Fill crankcase with recommended 4-cycle motor oil.

Operation After Break-In

After break-in, the engine can be operated continuously at any RPM from idle to full throttle. However, cruising at 3600 RPM or less saves fuel, reduces noise, and prolongs engine life.

When starting a cold engine, always allow the engine to warm up gradually. Never run the engine at full throttle until the engine is thoroughly warmed up. Be sure to check the oil level frequently during the first 50 hours of operation, since the oil consumption will be high until the piston rings are properly seated.

Engine Submersion

Remove engine from water as quickly as possible.

It is imperative that your dealer remove all water from the engine and immediately relubricate all internal parts. All electrical devices must also be dried and inspected for water damage. Delay in completing these actions may allow extensive engine damage.

Frequently check engine compartment for gasoline fumes and excessive water accumulation; water depth in bilge should be kept well below flywheel housing.

OMC DEALER Service - 20-Hour Check

20-Hour Check includes:

1. Change engine oil and oil filter.
2. Drain, flush and refill vertical drive. Check the power steering and trim/tilt reservoirs for proper fluid level.

 3. Steering Cable – Lubricate cable ram with *OMC Triple-Guard* grease.

 Power Steering - Check power steering pump reservoir for correct fluid level.

4. Check tension on all drive belts.
5. All Models except 3.0 L, 3.0 L HO & 4.3 L HO - Check distributor dwell and engine timing.
6. Check and adjust carburetor for correct idle mixture and idle RPM.
7. Check all engine mount screws for tightness.
8. Lubricate all grease fittings on the vertical drive.
9. Check for any deficiencies, malfunctions, signs of abuse, etc. Correction of any problems at this time will prevent the worsening of a minor problem and help ensure a trouble-free boating season.

The 20-hour check is performed at dealer rate and paid for by the owner.



Belt Adjustments

Belt Tension

33 → **41** With engine stopped, the belt should be tight enough so that it will deflect 6-13 mm ($\frac{1}{4}$ to $\frac{1}{2}$ in.) when pressed with the finger at the point indicated **5**. If the belt is too tight, excessive belt and bearing wear can occur. If it is too loose, slippage can occur, resulting in belt wear, poor circulating pump, alternator, and power steering operation. Belt tension should be checked after 10 hours of service and every 50 hours thereafter.

- ① Crankshaft Pulley
- ② Power Steering Pump Pulley
- ③ Circulating Pump Pulley
- ④ Alternator Pulley
- ⑤ 6 mm to 13 mm ($\frac{1}{4}$ in. to $\frac{1}{2}$ in.) Deflection

Power Steering Pump Belt

Note Improper power steering belt adjustment will cause a loss of power steering assist, resulting in hard steering.

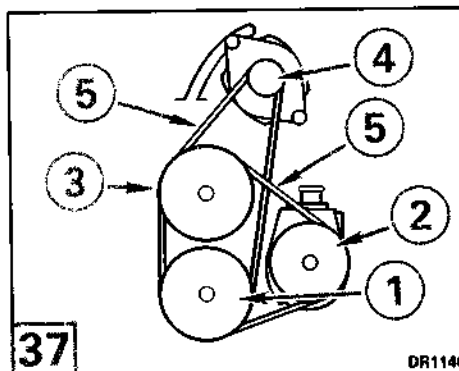
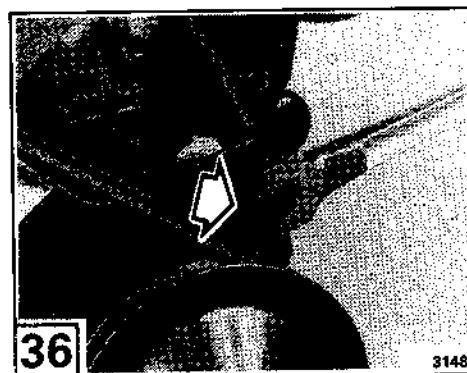
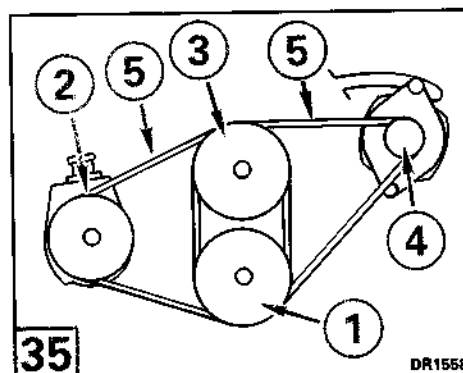
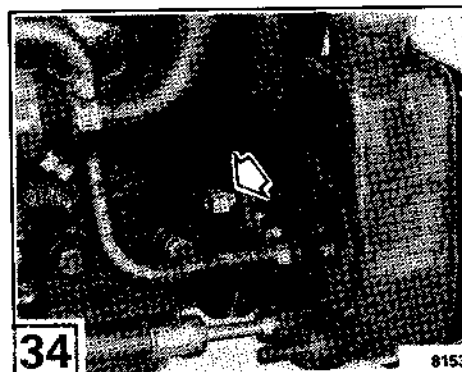
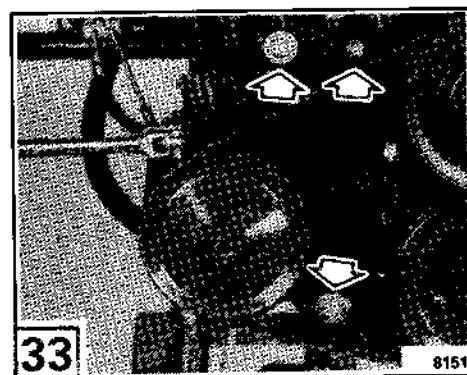
Check power steering belt tension midway between the circulating pump pulley and the power steering pump pulley.

Model 2.3 L

33 → **35** **To increase belt tension:** - Loosen the three screws in front and one screw in the rear that secure the pump mounting bracket. mounting bracket screws. Place a $\frac{1}{2}$ in. breaker bar into the square hole in the pump mounting bracket, and pivot pump away from engine as shown. While maintaining pressure on pump, retighten all mounting screws. Recheck belt tension. Never pry against the pump reservoir or pull filler neck.

Models 3.0 L & 3.0 L HO

36 **37** **To increase belt tension:** - Loosen nut on lower pivot bolt, and loosen screw on brace behind pulley. Place a $\frac{1}{2}$ in. breaker bar into the square hole in the pump mounting bracket, and pivot pump away from engine as shown. While maintaining pressure on pump, retighten all mounting screws. Recheck belt tension. Never pry against the pump reservoir or pull filler neck.



Models 4.3, & 4.3 L HO & 5.7 L

38 39 To increase belt tension: - Loosen pump mounting bracket screws, insert a ½ in. breaker bar into the square hole in the pump mounting bracket, and pivot pump away from engine as shown. While maintaining pressure on pump, retighten all mounting screws. Recheck belt tension. Never pry against the pump reservoir or pull filler neck.

4.3 L & 4.3 L HO Models not equipped with power steering have an idler pulley and bracket for adjusting belt tension. Loosen mounting screw and nut, and pivot pulley away from engine.

While maintaining pressure on pulley, retighten bottom nut, then top screw. Recheck belt tension.

Model 5.0 L, 5.0 L HO & 5.8 L

40 41 To increase belt tension: - Loosen nut on lower pivot bolt, and loosen screw on brace behind pulley. Place a ½ in. breaker bar into the square hole in the pump mounting bracket, and pivot pump away from engine as shown. While maintaining pressure on pump, retighten all mounting screws. Recheck belt tension. Never pry against the pump reservoir or pull filler neck.

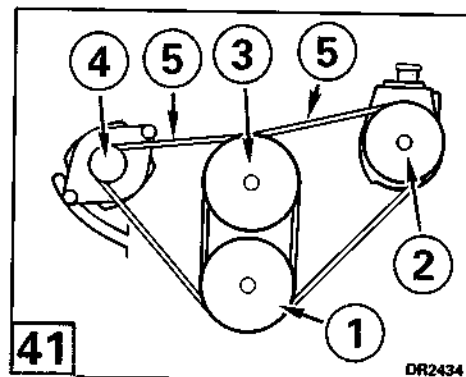
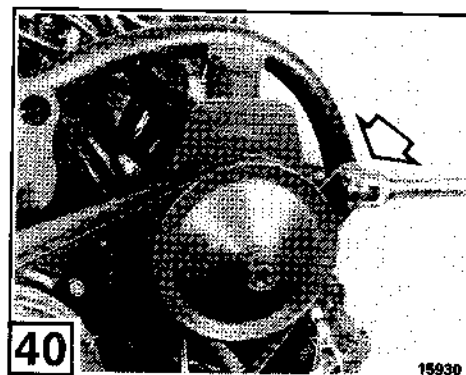
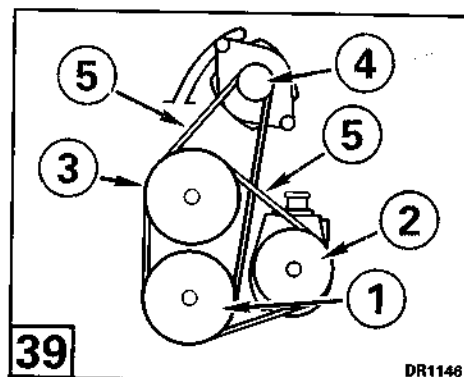
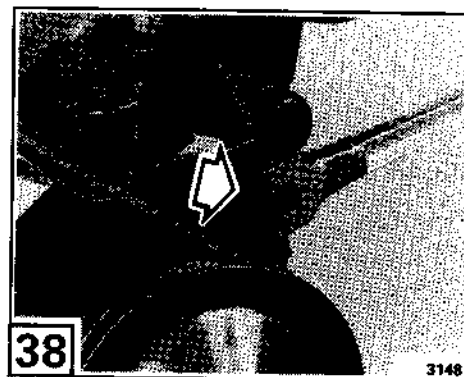
Alternator Belt

Check alternator belt tension midway between the circulating pump pulley and the alternator pulley.

Loosen alternator mounting screws and nuts, and pivot alternator away from engine to increase belt tension.

While maintaining pressure on alternator, retighten top screw and bottom screw and nut. Recheck belt tension.

Note The belts used for the alternator, circulating pump, and power steering pump are heavy-duty. Do NOT replace with automotive belts.



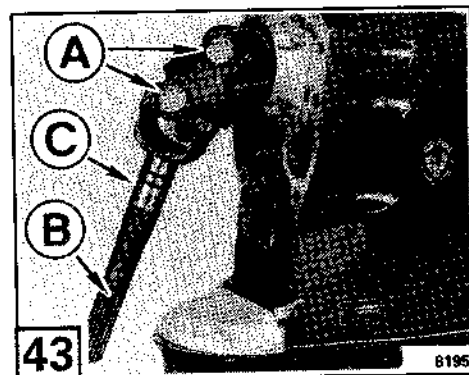
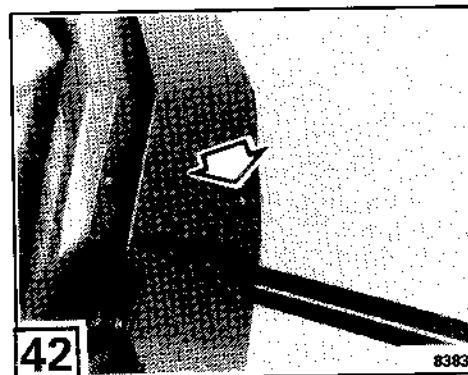
Gimbal Bearing and Universal Joints Lubrication

The gimbal bearing and universal joints **MUST** be lubricated each year. Lubricate the gimbal bearing and universal joints when preparing your boat for off-season storage. This requires the removal of the vertical drive; therefore, OMC recommends that your *OMC Cobra* dealer perform this operation.

Note Failure to lubricate the gimbal bearing and universal joints each year will result in damage to the vertical drive.

42 The gimbal bearing is lubricated by a grease fitting located on the port side of the gimbal housing. OMC recommends that the lubrication of the gimbal bearing be done with the vertical drive removed. This will allow observation of the old grease as it's being replaced by the new. If there is evidence of water, the bearing should be inspected and replaced, if damaged. Lubricate gimbal bearing with *OMC Marine Wheel Bearing Grease*. Apply grease until all the old grease has been removed and the new grease appears.

43 The vertical drive must be removed to lubricate the universal joints. Lubricate the universal joints with *OMC Marine Wheel Bearing Grease*. Apply grease to the two U-joint grease fittings **A** until all the old grease is removed. When the vertical drive is removed, the universal joint shaft splines **B** must be lubricated with *OMC Triple-Guard®* grease, and light oil applied to the shaft O-rings **C**. The bellows should be checked for damage and deterioration. Replace if necessary. Engine alignment must also be checked. Refer to Engine Alignment.



General Torque Specifications

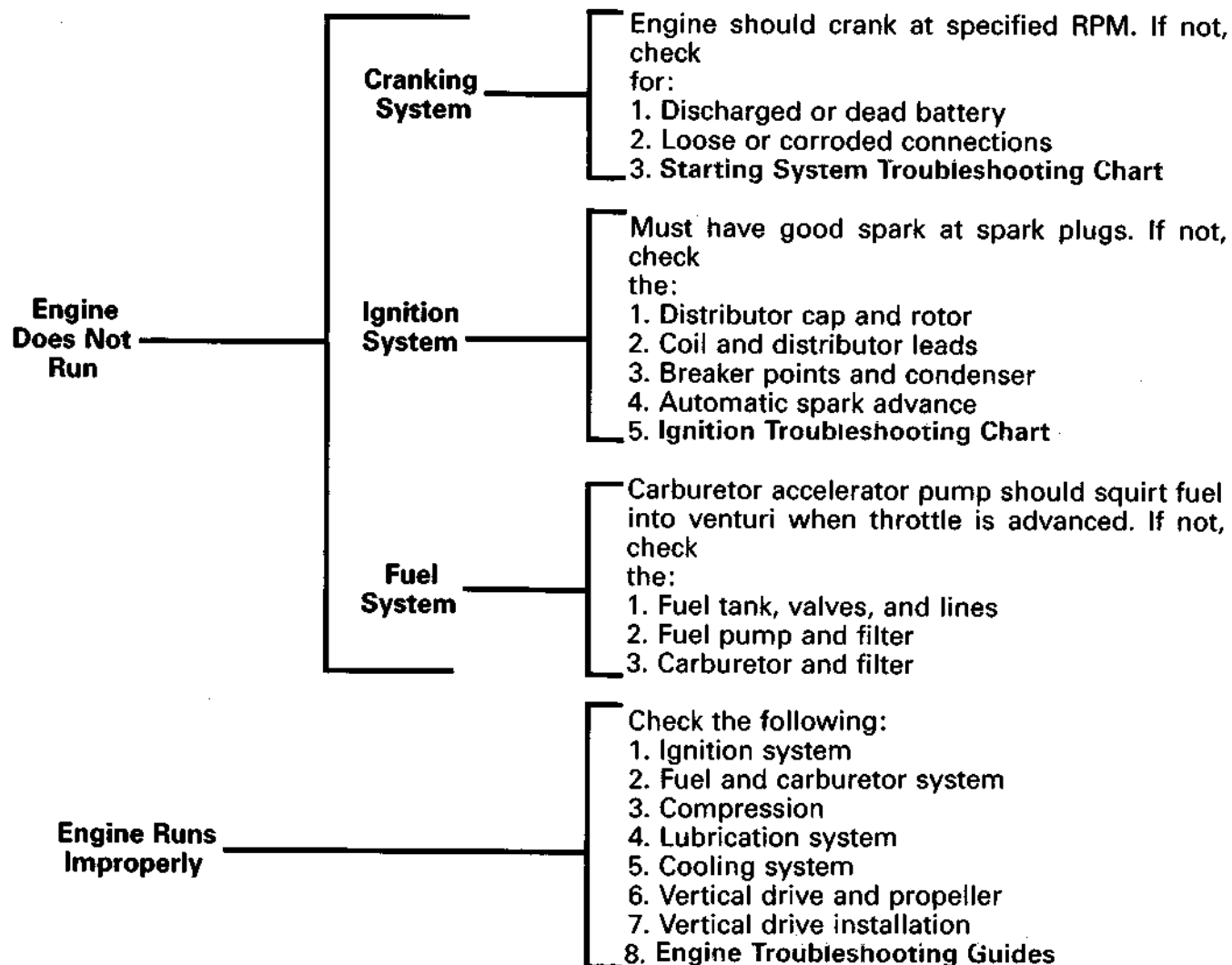
The following specifications are for nut and screw sizes not having specific torque recommendations.

U.S. Screw Sizes	Ft. Lbs.	N·m	Metric Thread Sizes	Ft. Lbs.	N·m
No. 6	...	1,1-1,6			
No. 8	...	2,2-2,8	M-6	6-9	8-12
No. 10	2-3.5	2,7-4,7	M-8	14-21	19-28
No. 12	3-4	4,1-5,4	M-10	28-40	38-54
No. ¼ in.	5-7	6,8-9,5	M-12	50-71	68-96
No. ⅝ in.	12-14	16-19	M-14	80-114	108-155
No. ¾ in.	20-25	27-34			
No. ⅞ in.	32-40	43-54			

Pound-inches x 0.11298 = newton-meters N·m
Pound-feet x 1.3558 = newton-meters N·m

Troubleshooting - System Isolation

The purpose of this chart is to help you isolate a malfunction of one or possibly several systems. After determining which systems are related to the malfunction, refer to the individual system troubleshooting charts to isolate the specific cause.



Engine Malfunction Guides

These guides were written to help you trace the symptoms of the trouble to the source, without having to read through and prove every possibility. Much of the information here will be familiar to well informed mechanics.

Also, many factors will seem insignificant but when you think of it, usually the toughest problem to troubleshoot is caused by the smallest error. The greatest aid to solving a service problem is information. Start gathering information from the boat operator and write it on his job card or work ticket. Find out pertinent facts, such as:

- When did this trouble start?
- How was the boat loaded?
- Did the trouble occur suddenly, or start gradually?

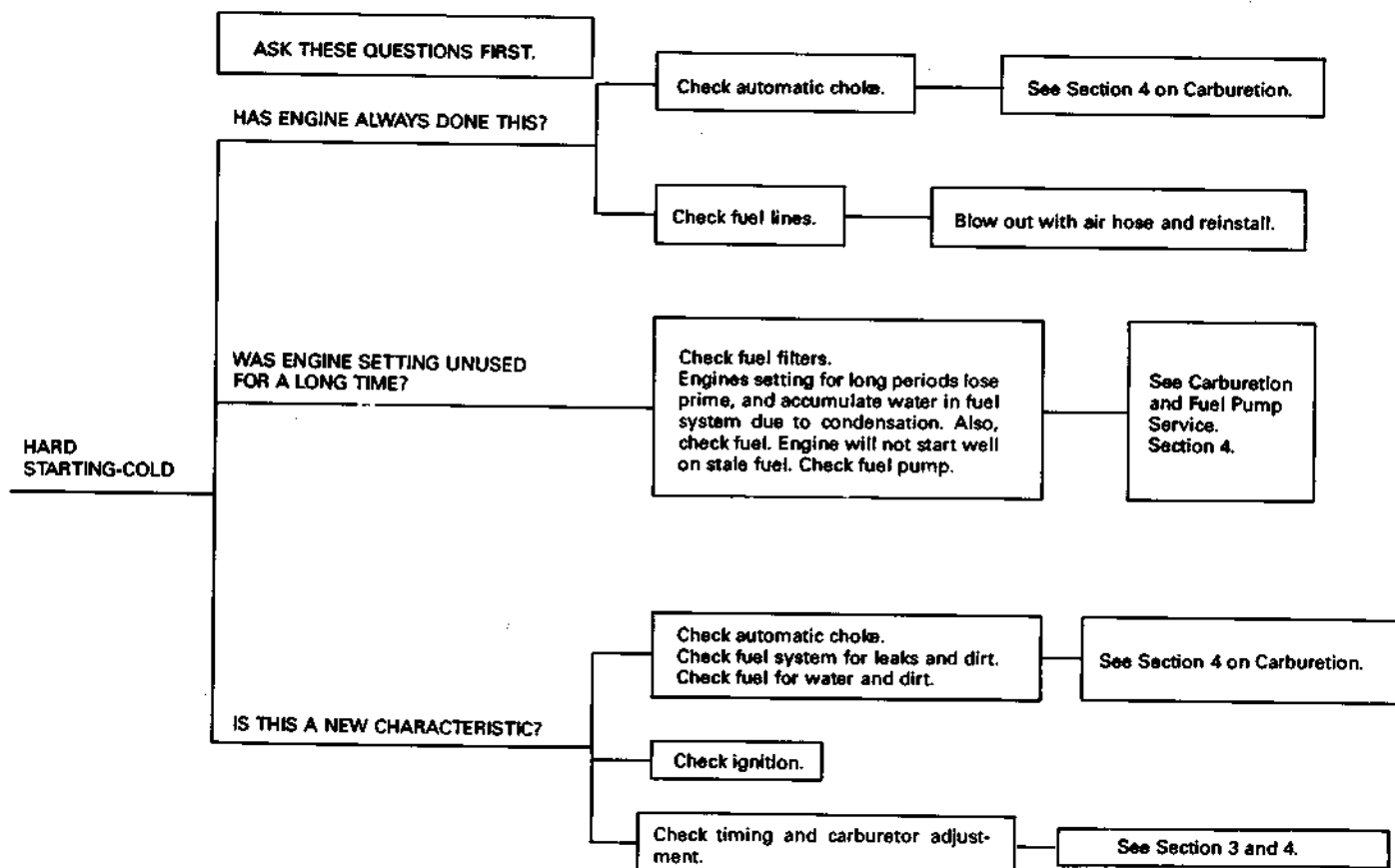
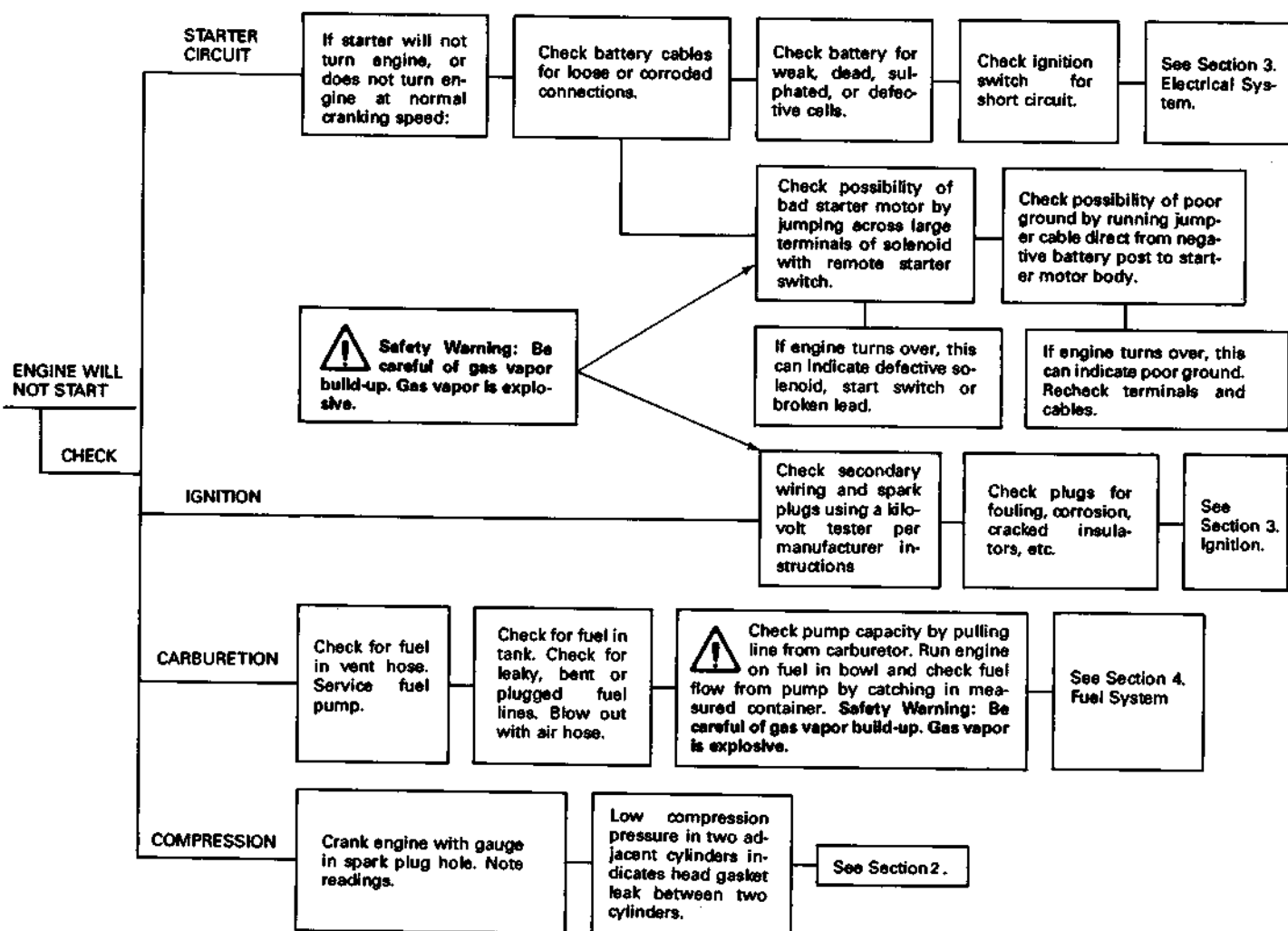
Analyze this information and try to match it to similar situations you have experienced in the past. Keep in mind the fundamental rules:

1. FUEL - Proper mixture of air and fuel.
2. COMPRESSION - Mixture inducted into cylinder and compressed.
3. SPARK - Proper intensity at the proper time.

There are very old rules, but necessary for the engine to run. Use these charts and the service information they refer to. Do not try to remember tolerances, settings, measurements, etc., as they are written in the service manual. Leave your mind free to analyze the problem.

Following is a list of the troubleshooting guides which may be found on the pages indicated.

Title	Page
1. Engine Will Not Start	2-29
2. Hard Starting - Cold	2-29
3. Hard Starting - Hot	2-30
4. Engine Runs Rough	2-30
5. Engine Noises and Vibrations	2-31
6. Engine Overheats	2-32
7. Engine Dies Out	2-32
8. Engine Won't Turn Up	2-31
9. Defective Lubricating System	2-34
10. Oil Pressure Warning System	2-34



ASK THESE QUESTIONS FIRST.

HARD
STARTING-HOT

HAS ENGINE ALWAYS DONE THIS?

Check automatic choke.

See Section 4.

IS THIS A NEW CONDITION?

Has operator recently changed:
1. Brand or type of fuel.
2. Spark plugs?

Check for water in fuel.

Check battery condition.
Rectify problems and
change spark plugs.

DID ENGINE REFUSE TO START
AFTER BEING RUN?

Check ignition primary.

See Section 3.

Check coil and condenser (these sometimes
"break down" when they become hot).
Check points and timing.

Check choke and carburetor.

See Section 4.

IF AT SLOW
SPEED CHECK

Idle speed, idle
mixture, manifold
vacuum.

See Section 4.

Timing, spark plugs.

See Section 3.

Fuel pump pressure,
dirt or water in fuel.

See Section 4 -
Fuel System

Gas - too low in
octane.

Note

See Section 2

Note

Failure of cylinder
to fire effectively
can be caused by either car-
buretor or ignition. There-
fore, symptoms will seem the
same.

ENGINE RUNS ROUGH

IF AT HIGH
SPEED CHECK

Ignition - Partial short or jumping,
high tension wiring. Defective points
or timing. Spark plugs.

Replace as needed.

Carburetor - Erratic RPM at high
speed would indicate that engine
was about to run out of fuel.

CHECK

Lines for leads, kinks,
loose connections.

Fuel filters.

Fuel pump for delivery
rate.

See Section 4.

Fuel too low in octane.

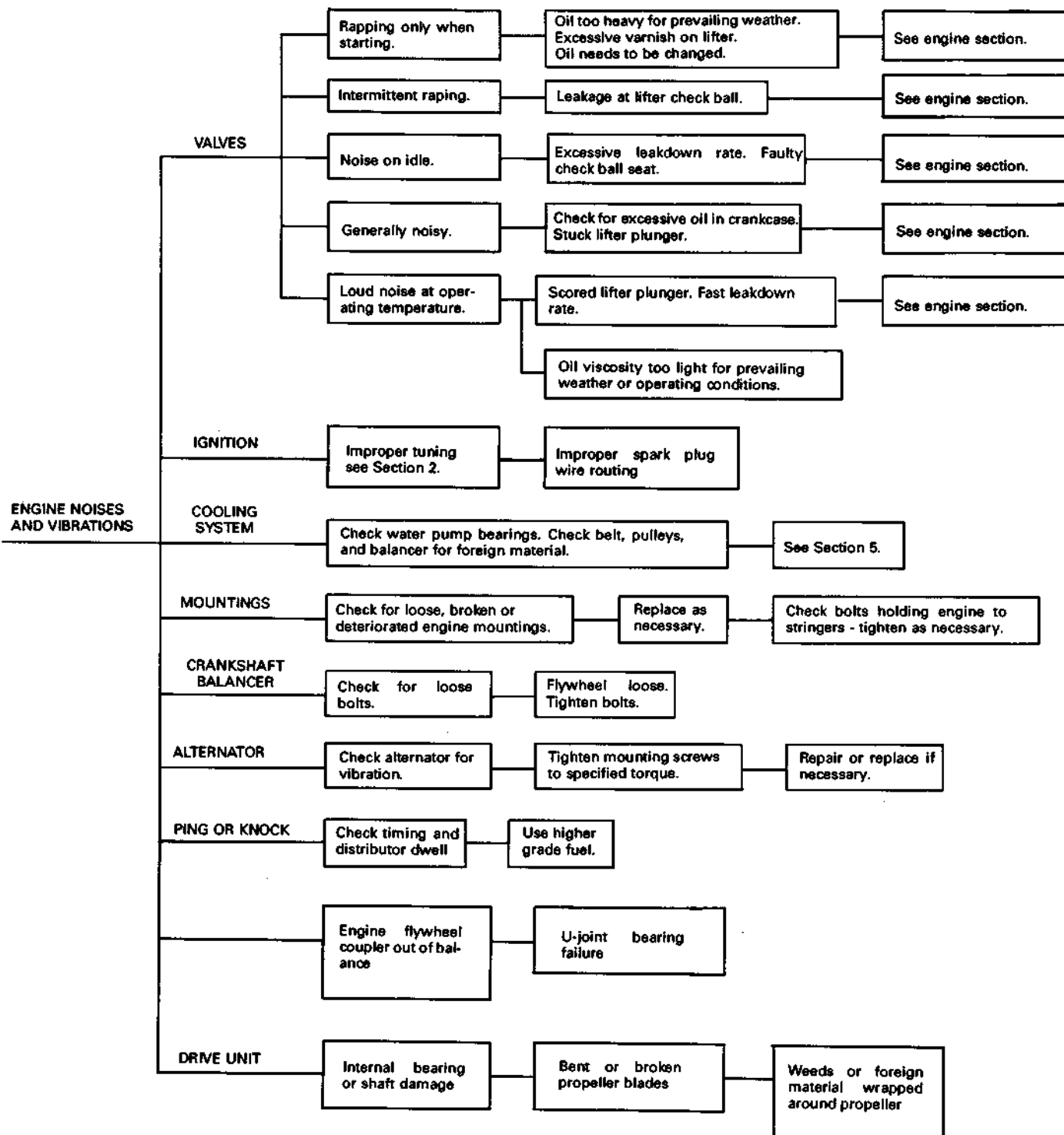
Compression - If low, check for
blown head gasket, sticking valves,
and ring blowby.

Low pressure in two adjacent
cylinders would indicate head
gasket blown between them.

See Section 2.
Replace as needed.

Water in cylinder - Check for
water in fuel.

See Section 5.



ENGINE OVERHEATS

IF GAUGE READS TOO HIGH

Verify actual engine temperature by checking with an accurate thermometer.

Gauge circuit might be grounded, giving a false warning, or sending unit is defective.

FOR POSITIVE CHECK OF THERMOSTAT FOR OVERHEATING

Adjust engine speed to 3000 RPM and touch 140° and 170° therom-melt sticks to lower thermostat housing. 140° stick should melt - 170° stick should not. Or, remove thermostat and check in a pan of water with an accurate thermometer.

Return throttle to idle and STOP ENGINE! Check intake screen for stoppage, moss, algae, barnacles, or foreign matter.

TO CHECK WATER PUMP IN POWERHEAD

See Section 5.

TO CHECK WATER PUMP IN DRIVE UNIT

See Section 7.

LOSS OF OR OUT OF FUEL.

Check fuel gauge. Check fuel in tanks against gauge. Prime fuel system and restart. As you perform these checks, watch for excessive dirt or water in fuel system.

If engine runs out of fuel, check for fuel or air leaks from lines, fittings, fuel pump and carburetor. Check fuel filters.

Note If engine dies out consistently on initial acceleration, go immediately to carburetor.

ENGINE DIES OUT

Note Keep in mind while checking these procedures the possibility of binding or locking of the drive unit, due to a seized bearing or foreign material caught between gears.

Check fuel pump output. See Section 4 - Fuel System

IF OUTPUT IS SUFFICIENT

Check carburetor for dirt, etc. See Section 4 on carburetor. Check fuel filters.

LOSS OF IGNITION.

If engine dies out and will not restart after being reprimed, it would indicate loss of ignition.

SEE

ENGINE WILL NOT START.

ENGINE STOPS OR DIES OUT DUE TO SEIZURE.

Pull head. Inspect cylinder walls for scuffing or scoring.

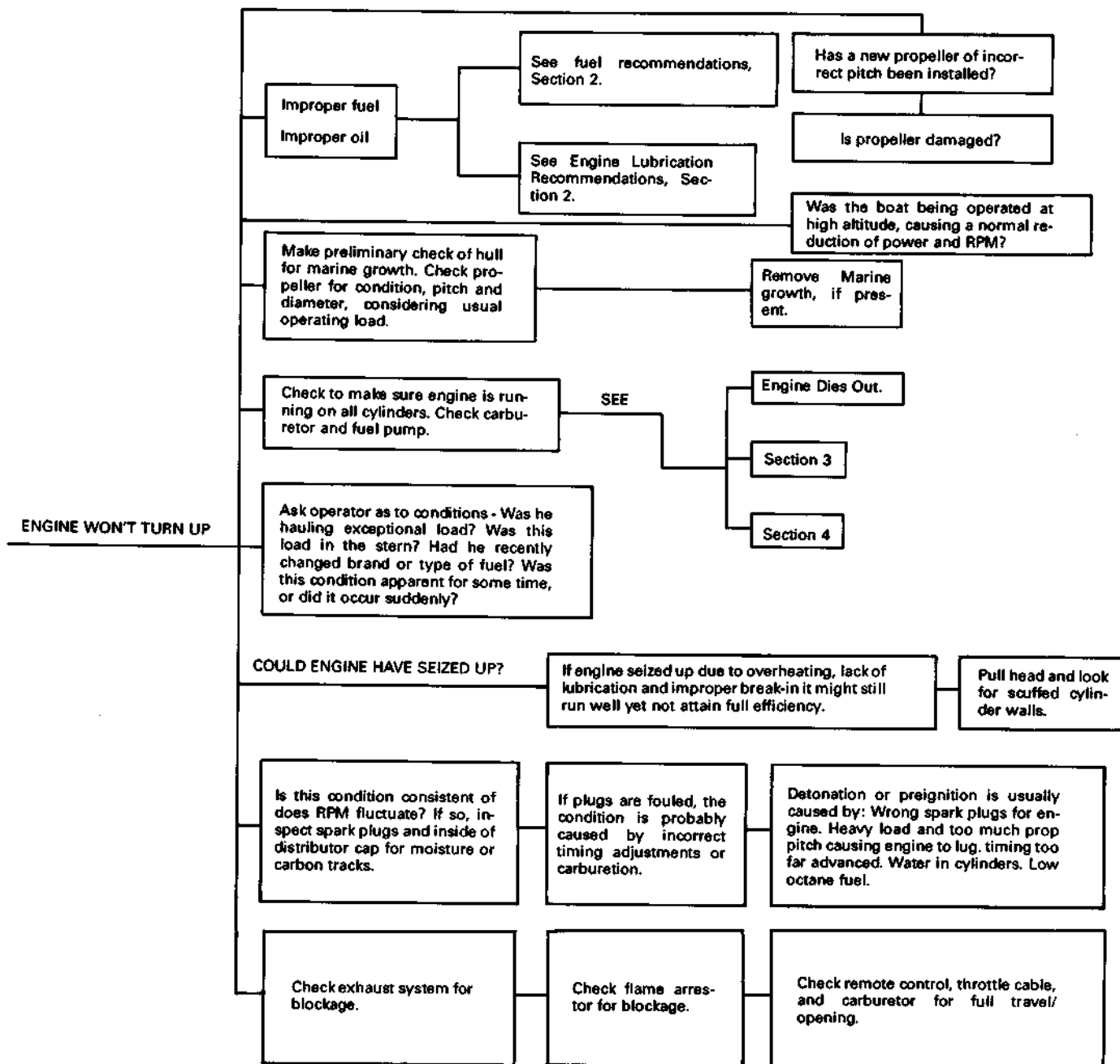
See engine section.

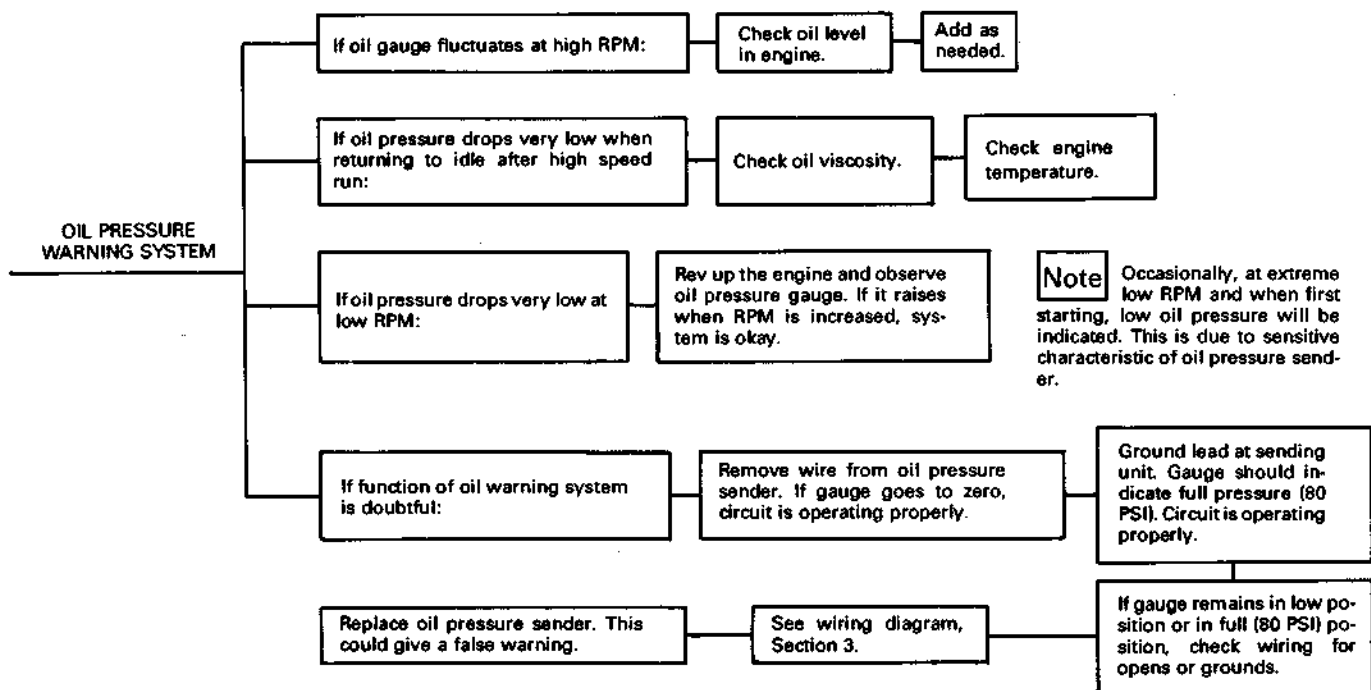
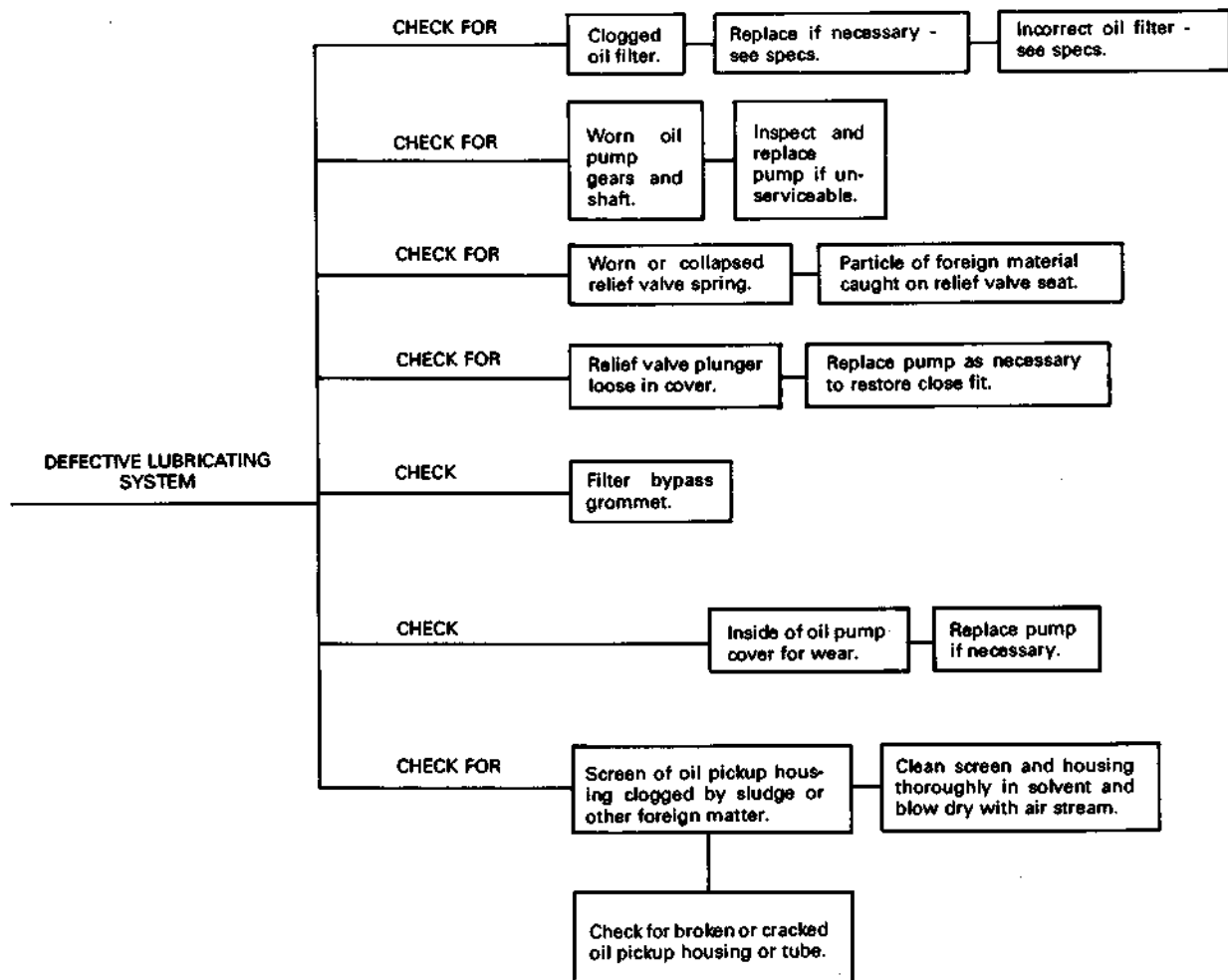
Check temperature gauge and cooling system output.

See Sections 3 and 5.

Check oil pressure gauge.

See Engine Lubrication. Section 2.





Items marked  **Safety Warning**, are safety related service points to prevent mechanical failures, fire and explosion. Make sure the safety related service is performed at these points and at the intervals specified.

SERVICE POINT	DAILY	EVERY 25 HOURS	EVERY 50 HOURS	OTHER	RECOMMENDATIONS
Crankcase	Check oil level.		Drain and refill.	Or every 6 months, whichever comes first.	Use recommended oil.
Oil Filter			Replace.		See Specifications
Vertical Drive			Drain and refill.*	Check level occasionally during boating season.	OMC Hi-Vis® gearcase lube
Gimbal Housing (Starboard Side)				Lubricate seasonally. Note Do not use a power operated grease gun.	OMC Marine Wheel Bearing Grease
Universal Joints					
Power Trim/Tilt				Seasonally check fluid level in reservoir. Check for leaks and proper operation.	OMC Power Trim/Tilt and Power Steering Fluid See your DEALER.
Power Steering Pump				Check reservoir fluid level.	OMC Power Trim/Tilt and Power Steering Fluid
 Electrical System			Check connections and insulation.		Tighten loose connections. Replace deteriorated wiring.
 Ignition Coil			Check for arcing or cracks in plastic portion of coil.		Replace with specified OMC component. See your DEALER.
Battery		Check electrolyte level and specific gravity.			Recharge battery if specific gravity reads below 1.220 temperature corrected.
 Distributor (Except 3.0L, 3.0L HO & 4.3L HO)			Adjust breaker points and timing.		See Specifications. After adjusting, secure cap firmly to base.
 Spark Plugs				Seasonally check ceramic for cracks and electrodes for gap. Clean and regap or replace.	See Specifications
 High Tension Leads and Distributor Cap			Check for deterioration or arcing. Boots must fit snugly on terminals.		If damaged, replace with specified OMC components. Maintain original routing and support.
Engine Alignment				Seasonally	DEALER check engine alignment.
Alternator Belt Power Steering Pump Belt			Check belt for tension and deterioration.		Adjust tension to 6-13mm (1/4 in. to 1/2 in.) give. Replace deteriorated belt. Keep spare on board.
 Fuel System	Check for leakage.				Tighten connections. Replace with specified OMC components.

* If water is apparent in the drained oil, or if an excessive amount of oil is being used between periodic checks or the 50 hour interval, contact your OMC DEALER for an inspection of the vertical drive oil reservoir.

** Due to your local conditions, it may be necessary to lubricate these components at more frequent intervals. Check with your OMC DEALER. He will be familiar with local requirements.

 **SAFETY WARNING:** To prevent fire and explosion, perform the safety related service at points marked  at the intervals specified.

SERVICE POINT	DAILY	EVERY 25 HOURS	EVERY 50 HOURS	OTHER	RECOMMENDATIONS
 Nonmetallic Fuel Hoses			Check for excessive stiffness, deterioration or leakage.	Or monthly, whichever comes first.	Replace as necessary with U.S.C.G. approved components.
 Fuel Pump and Filter	Check transparent vent tube for fuel leakage.			At start and periodically during boating season.	Inspect for dirt, replace filter element and gasket, if clogged. Check for leaks after starting engine. Have your OMC DEALER replace leaking fuel pump.
 Fuel Filter				Seasonally.	Replace fuel filter
Carburetor				Seasonally or as needed.	Adjust idle mixture and idle stop.
 Fuel Tank	Check supply. Open fuel valve, if equipped, for proper operation. Close fuel valve at end of day's operation.		Check for water in fuel tank.	Check seasonally for corrosion. Replace if corrosion or leakage is evident.	Keep tank filled with recommended fuel.
 Backfire Flame Arrestor	Check for damage to grill area. Must be firmly attached to carburetor.	Check for dirt.		Seasonally clean and inspect. Damaged unit may allow backfire flame to enter engine compartment.	If damaged, replace with specified OMC components. If dirty, clean in solvent, air dry before installation.
Cooling System	Check for leaks.	Check belts for correct tension.		Seasonally check for hose deterioration.	Drain after operation in freezing temperatures or during seasonal lay-up. Tighten connections.
 Bilge Area	Check for fuel fumes and leaks.				Repair or see your boat DEALER.
Control Linkage	Check operation.	Check adjustment. Lubricate.			Adjust as required. Use OMC Triple-Guard® grease. See your DEALER.
 Shift System	Check for smooth shifting in and out of forward and reverse gears.			Seasonally or every 100 hours, have DEALER check cable core wire and shift assist for proper function.	Replace shift cable core wire, if necessary. See your OMC DEALER.
Steering System Steering Ram			Lubricate.	Or every 60 days, whichever comes first.	OMC Triple-Guard grease
Hull		Check for marine growth.			See your boat DEALER for care.
Safety Equipment	Check remote control and emergency ignition cutoff switch, if equipped, for proper operation.			All boat safety equipment should be checked for condition and proper operation.	Be sure you have U.S.C.G. required equipment aboard (check Coast Guard regulations).
Trailer				Drain cooling system and bilge.	Be sure hull is properly supported. Check tie-downs for security.
Storage					See Off-Season Storage
Preparation for Boating Season					See Preparation for Boating

METRIC CONVERSION CHART

LINEAR

inches	X 25.4	= millimetres (mm)
feet	X 0.3048	= metres (m)
yards	X 0.9144	= metres (m)
miles	X 1.6093	= kilometres (km)
inches	X 2.54	= centimetres (cm)

AREA

inches ²	X 645.16	= millimetres ² (mm ²)
inches ²	X 6.452	= centimetres ² (cm ²)
feet ²	X 0.0929	= metres ² (m ²)
yards ²	X 0.8361	= metres ² (m ²)
acres	X 0.4047	= hectares (10 ⁴ m ²) (ha)
miles ²	X 2.590	= kilometres ² (km ²)

VOLUME

inches ³	X 16387	= millimetres ³ (mm ³)
inches ³	X 16.387	= centimetres ³ (cm ³)
inches ³	X 0.01639	= litres (l)
quarts	X 0.94635	= litres (l)
gallons	X 3.7854	= litres (l)
feet ³	X 28.317	= litres (l)
feet ³	X 0.02832	= metres ³ (m ³)
fluid oz	X 29.57	= millilitres (ml)
yards ³	X 0.7646	= metres ³ (m ³)

MASS

ounces (av)	X 28.35	= grams (g)
pounds (av)	X 0.4536	= kilograms (kg)
tons (2000 lb)	X 907.18	= kilograms (kg)
tons (2000 lb)	X 0.90718	= metric tons (t)

FORCE

ounces - f (av)	X 0.278	= newtons (N)
pounds - f (av)	X 4.448	= newtons (N)
kilograms - f	X 9.807	= newtons (N)

ACCELERATION

feet/sec ²	X 0.3048	= metres/sec ² (m/S ²)
inches/sec ²	X 0.0254	= metres/sec ² (m/S ²)

ENERGY OR WORK

		(watt-second - joule - newton-metre)
foot-pounds	X 1.3558	= joules (j)
calories	X 4.187	= joules (j)
Btu	X 1055	= joules (j)
watt-hours	X 3500	= joules (j)
kilowatt - hrs	X 3.600	= megajoules (MJ)

FUEL ECONOMY AND FUEL CONSUMPTION

miles/gal	X 0.42514	= kilometres/litre (km/l)
-----------	-----------	---------------------------

Note:

235.2/(mi/gal) = litres/100 km

235.2/(litres/100 km) = mi/gal

LIGHT

footcandles	X 10.76	= lumens/metre ² (lm/m ²)
-------------	---------	--

PRESSURE OR STRESS (newton/sq metre - pascal)

inches HG (60°F)	X 3.377	= kilopascals (kPa)
pounds/sq in	X 6.895	= kilopascals (kPa)
inches H ₂ O (60°F)	X 0.2488	= kilopascals (kPa)
bars	X 100	= kilopascals (kPa)
pounds/sq ft	X 47.88	= pascals (Pa)

POWER

horsepower	X 0.746	= kilowatts (kW)
ft-lbf/min	X 0.0226	= watts (W)

TORQUE

pound-inches	X 0.11299	= newton-metres (N-m)
pound-feet	X 1.3558	= newton-metres (N-m)

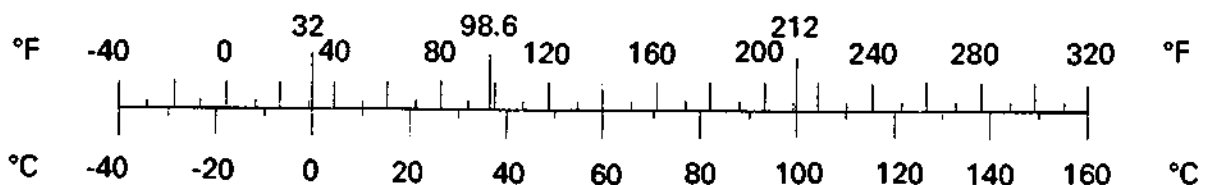
VELOCITY

miles/hour	X 1.6093	= kilometres/hour (km/h)
feet/sec	X 0.3048	= metres/sec (m/s)
kilometres/hr	X 0.27778	= metres/sec (m/s)
miles/hour	X 0.4470	= metres/sec (m/s)

TEMPERATURE

°Celsius = 0.556 (°F - 32)

°F = (1.8° C) + 32



Drill Size Conversion Chart

SHOWING MILLIMETER SIZES, FRACTIONAL AND DECIMAL INCH SIZES AND NUMBER DRILL SIZES

Milli-Meter	Dec. Equiv.	Frac-tional	Num-ber	Milli-Meter	Dec. Equiv.	Frac-tional	Num-ber	Milli-Meter	Dec. Equiv.	Frac-tional	Num-ber	Milli-Meter	Dec. Equiv.	Frac-tional	Num-ber	Milli-Meter	Dec. Equiv.	Frac-tional	Num-ber
.1	.0039			1.75	.0689			...	.1570		22	6.8	.2677			10.72	.4219	27/64	
.15	.0059			...	.0700		50	4.0	.1575		21	6.9	.2716			11.0	.4330		
.2	.0079			1.8	.0709			...	.1590		20	...	.2720	I		11.11	.4375	7/16	
.25	.0098			1.85	.0728			...	.1610			7.0	.2756			11.5	.4528		
.3	.0118			...	.0730		49	4.1	.1614			...	.2770	J		11.51	.4531	29/64	
...	.0135	80		1.9	.0748			4.2	.1654			7.1	.2795			11.91	.4687	15/32	
.35	.0138			...	.0760		48	...	.1660		19	...	.2811	K		12.0	.4724		
...	.0415	79		1.95	.0767			4.25	.1673			7.14	.2812	9/32	...	12.30	.4843	31/64	
.39	.0156	1/64	...	1.98	.0781	5/64	...	4.3	.1693			7.2	.2835			12.5	.4921		
.4	.0157			...	.0785		47	...	.1695		18	7.25	.2854			12.7	.5000	1/2	
...	.0160	78		2.0	.0787			4.37	.1719	11/64	...	7.3	.2874			13.0	.5118		
.45	.0177			2.05	.0807			...	.1730		17	...	.2900	L		13.10	.5156	33/64	
...	.0180	77		...	.0810		46	4.4	.1732			7.4	.2913			13.49	.5312	17/32	
.5	.0197			...	.0820		45	...	.1770		16	...	.2950	M		13.5	.5315		
...	.0200	76		2.1	.0827			4.5	.1771			7.5	.2953			13.89	.5469	35/64	
...	.0210	75		2.15	.0846			...	.1800		15	7.54	.2968	19/64	...	14.0	.5512		
.55	.0217			...	.0860		44	4.6	.1811			7.6	.2992			14.29	.5624	9/16	
...	.0225	74		2.2	.0866			...	.1820		14	...	.3020	N		14.5	.5709		
.6	.0236			2.25	.0855			4.7	.1850		13	7.7	.3031			14.68	.5781	37/64	
...	.0240	73		...	.0890		43	4.75	.1870			7.75	.3051			15.0	.5906		
...	.0250	72		2.3	.0905			4.76	.1875	3/16	...	7.8	.3071			15.08	.5937	19/32	
.65	.0256			2.35	.0925			4.8	.1890		12	7.9	.3110			15.48	.6094	39/64	
...	.0260	71		...	.0935		42	...	.1910		11	7.94	.3125	5/16	...	15.5	.6102		
...	.0280	70		2.38	.0937	3/32	...	4.9	.1929			8.0	.3150			15.88	.6250	5/8	
.7	.0276			2.4	.0945			...	.1935		10	...	.3160	O		16.0	.6299		
...	.0292	69		...	.0960		41	...	.1960		9	8.1	.3189			16.27	.6406	41/64	
.75	.0295			2.45	.0964			5.0	.1968			8.2	.3228			16.5	.6496		
...	.0310	68		...	.0980		40	...	.1990		8	...	.3230	P		16.67	.6562	21/32	
.79	.0312	1/32	...	2.5	.0984			5.1	.2008			8.25	.3248			17.0	.6693		
.8	.0315			...	.0995		39	...	.2010		7	8.3	.3268			17.06	.6719	43/64	
...	.0320	67		...	.1015		38	5.16	.2031	13/64	...	8.33	.3281	21/64	...	17.46	.6875	11/16	
...	.0330	66		2.6	.1024			...	.2040		6	8.4	.3307			17.5	.6890		
.85	.0335			...	.1040		37	5.2	.2047			...	.3320	Q		17.86	.7031	45/64	
...	.0350	65		2.7	.1063			...	.2055		5	8.5	.3346			18.0	.7087		
.9	.0354			...	.1065		36	5.25	.2067			8.6	.3386			18.26	.7187	23/32	
...	.0360	64		2.75	.1082			5.3	.2086			...	.3390	R		18.5	.7283		
...	.0370	63		2.78	.1094	7/64	...	...	.2090		4	8.7	.3425			18.65	.7344	47/64	
.95	.0374			...	.1100		35	5.4	.2126			8.73	.3437	11/32	...	19.0	.7480		
...	.0380	62		2.8	.1102			...	.2130		3	8.75	.3445			19.05	.7500	3/4	
...	.0390	61		...	.1110		34	5.5	.2165			8.8	.3465			19.45	.7656	49/64	
1.0	.0394			...	.1130		33	5.56	.2187	7/32	...	...	.3480	S		19.5	.7677		
...	.0400	60		2.9	.1141			5.6	.2205			8.9	.3504			19.84	.7812	25/32	
...	.0410	59		...	.1160		32	...	.2210		2	9.0	.3543			20.0	.7874		
1.05	.0413			3.0	.1181			5.7	.2244			...	.3580	T		20.24	.7969	51/64	
...	.0420	58		...	.1200		31	5.75	.2263			9.1	.3583			20.5	.8071		
...	.0430	57		3.1	.1220			...	.2280		1	9.13	.3594	23/64	...	20.64	.8125	13/16	
1.1	.0433			3.18	.1250	1/8	...	5.8	.2283			9.2	.3622			21.0	.8268		
1.15	.0452			3.2	.1260			5.9	.2323			9.25	.3641			21.04	.8218	53/64	
...	.0465	56		3.25	.1279			...	.2340		A	9.3	.3661			21.43	.8437	27/32	
1.19	.0469	3/64	...	...	.1285		30	5.95	.2344	15/64	...	...	.3680	U		21.5	.8465		
1.2	.0472			3.3	.1299			6.0	.2362			9.4	.3701			21.83	.8594	55/64	
1.25	.0492			3.4	.1338			...	.2380		B	9.5	.3740			22.0	.8661		
1.3	.0512			...	.1360		29	6.1	.2401			9.53	.3750	3/8	...	22.23	.8750	7/8	
...	.0520	55		3.5	.1378			...	.2420		C	...	.3770			22.5	.8858		
1.35	.0513			...	.1405		28	6.2	.2441			9.6	.3780			22.62	.8906	57/64	
...	.0550	54		3.57	.1406	9/64	...	6.25	.2460		D	9.7	.3819			23.0	.9055		
1.4	.0551			3.6	.1417			6.3	.2480			9.75	.3838			23.02	.9062	29/32	
1.45	.0570			...	.1440		27	6.35	.2500	1/4	E	9.8	.3858			23.42	.9219	59/64	
1.5	.0591			3.7	.1457			6.4	.2520			...	.3860			23.5	.9252		
...	.0595	53		...	.1470		26	6.5	.2559			9.9	.3839			23.81	.9375	15/16	
1.55	.0610			3.75	.1476			...	.2570		F	9.92	.3906	25/64	...	24.0	.9449		
1.59	.0625	1/16	...	...	.1495		25	6.6	.2598			10.0	.3937			24.21	.9531	61/64	
1.6	.0629			3.8	.1496			...	.2610		G	...	.3970			24.5	.9646		
...	.0635	52		...	.1520		24	6.7	.2638			...	.4040	Y		24.61	.9687	31/32	
1.65	.0649			3.9	.1535			6.75	.2657	15/64	...	10.32	.4062	13/32	...	25.0	.9843		
1.7	.0669			...	.1540		23	6.75	.2657			...	.4130	Z		25.03	.9844	63/64	
...	.0670	51		3.97	.1562	5/32	...	...	.2660		H	10.5	.4134			25.4	1.0000	1	

[illegible]

[illegible]

Section 3

Electrical System

Table of Contents

Battery and Cables	3-2
Charging Circuit	3-48
Cranking Circuit	3-8
Engine Wiring Diagrams	3-108
Circuit Protectors	3-5
Ignition Circuit	
2.3, PWC 3.0, 4.3, 5.0, 5.0 HO, 5.7 and 5.8 L Models	3-28
PWS 3.0 and 3.0 L HO Models	3-72
4.3 L HO Models	3-82
Spark Plugs, Leads and Firing Order	3-46
Instrument Panel Wiring Diagram	3-116
Power Trim/Tilt Circuit	3-62
Sending Units, Oil and Water	3-6
Solenoids	3-3



Safety Warnings

- Before working on any part of the electrical system, read the section called Safety at the beginning of this manual.
- The original mounting, support and routing of electrical system parts conform with U.S. Coast Guard requirements. It is important to maintain the original mounting, support and routing after servicing the electrical system to prevent possible fire and explosion in boat's engine compartment.
- To prevent possible explosion or fire, do not substitute automotive parts for the following marine components: starter, alternator, voltage regulator, distributor and related ignition parts; spark plugs, spark plug leads, solenoids, carburetor (and related parts) fuel pump or fuel filter. These components have been specifically designed not to emit fuel vapors or to cause ignition of fuel vapors in the bilge.

Battery and Cables

Special Tools Required: Battery Hydrometer

The primary function of the battery is to provide power to operate the starter motor. The battery also supplies power to operate the lights and other electrical equipment which may be used when the engine is not running. On battery ignition systems, the battery must supply the ignition current during the starting period and during the time that the alternator is not producing a sufficient charge to meet operating requirements.

Battery Requirements

The boat should be equipped with a 12 volt battery capable of handling all normal electrical needs. We recommend a 12 volt battery with a 360 amps cold cranking rating at 0° F (-18° C), 115 minutes reserve capacity rating at 80° F (27° C) as a minimum.

Battery Maintenance

There are two things which must be done periodically in order to obtain long life from a battery.

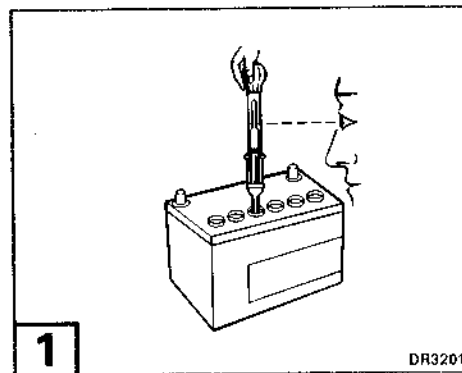
1. The electrolyte must be kept above the plates and separators at all times. The liquid level should be brought up to the level specified by the battery manufacturer. Acid should never be added except when it is definitely known that some has been lost by spilling, and then only by an experienced battery man.

⚠ Battery electrolyte is a corrosive acid and should be handled with care. If electrolyte is spilled or splashed on any part of the body, immediately flush the exposed area with liberal amounts of water and obtain medical aid as soon as possible.

1 2. Be sure that the battery is kept nearly at full charge at all times. The state of charge should be checked at frequent intervals by making specific gravity readings with a battery hydrometer. It is suggested that gravity readings and replacement of evaporated water be made every two weeks. Should the gravity fall more than 0.040 sp. gr. below a fully charged gravity reading, remove the battery and have it charged.

Note Full charge specific gravity is 1.260 at 80° F (27° C).

⚠ Do not use a jumper cable and a booster battery to start engine. Remove battery from boat and recharge. Fumes vented during charging battery can lead to an explosion.



Good Battery Servicing Includes the Following Nine Points:

- a. Protect boat against acid damage.
- b. Clean battery.
- c. Inspect cables.
- d. Clean terminals.
- e. Inspect hold-downs.
- f. Inspect casing for leaks.
- g. Make hydrometer test.
- h. Remove battery from boat for tests. Recharge battery if less than $\frac{3}{4}$ charged. Make load test.
- i. Add water.

If battery is not in a good state of charge or if it uses an excessive amount of water, check the charging system.

Clean the battery and terminals with a solution of baking soda and water. This will neutralize the acid on the battery. After washing in this solution, flush top of battery with clear water. Care must be taken when washing the battery so that the baking soda and water solution does not enter the battery cells.

Cable Requirements

Positive and negative battery cables must be a minimum of No. 4 gauge. Battery should be mounted as close to the engine as practical to cut down on battery cable lengths.

Note Follow U.S. Coast Guard recommendations if cable length exceeds 6 ft.

Solenoids

Special Service Tools Required: Test Light or Continuity Meter and Carbon Pile

The purpose of the solenoid assembly is to perform mechanical jobs electromagnetically. In the case of the solenoid used with the starter, this job consists of completing the heavy electrical circuit between the battery and the motor.

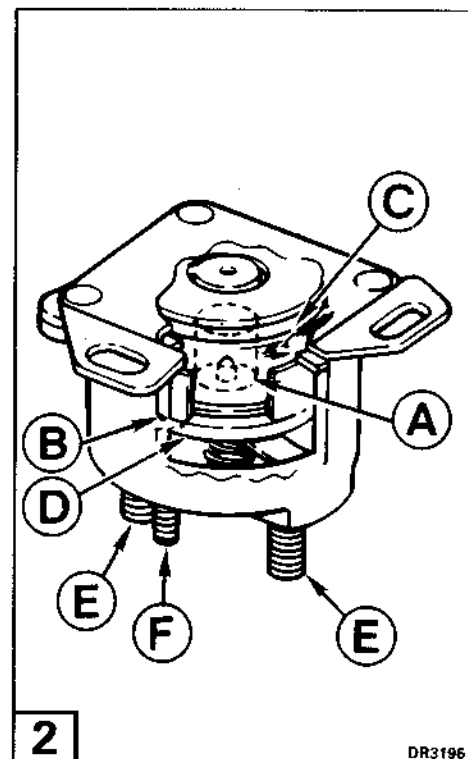
2 The solenoid is a completely sealed unit which consists of a plunger **A** and contact disk assembly **B**, a coil winding **C**, a contact disk return spring **D**, and three or four terminals which protrude from the solenoid body. The two larger terminals **E** are the battery and motor terminals while the smaller one **F** is the switch control or terminal for bypassing the resistor wire. Ground is internal (through bracket).

Note Recoat all electrical connections after reassembly with *OMC Black Neoprene Dip*.

⚠ To prevent possible explosion or fire, do not substitute automotive parts for the following Marine components: starter, alternator, voltage regulator, distributor and related ignition parts, spark plugs, spark plug leads, solenoids, carburetor (and related parts), fuel pump or fuel filter. These components have been specifically designed not to emit fuel vapors or to cause ignition of fuel vapors in the bilge.



Safety Related



DR3196

In operation, when ignition switch is closed, an electric current flows through the coil winding, causing the plunger and contact disk to be drawn inward. When drawn inward, the contact disk completes the circuit between the battery and motor terminals, allowing the battery current to flow from the battery to the motor.

A return spring is located just below the contact disk. When the electrical circuit as described above is completed, the spring is compressed by the magnetic pull on the plunger and contact disk. When the electrical circuit is broken (ignition switch released), the magnetic pull on the plunger and contact disk drops to zero. At this time, the compressed return spring breaks the circuit by pushing the contact disk away from the motor and battery studs of the solenoid.

Inspection Procedure

The solenoid used with the starter motor has proven to be trouble free under normal operating conditions. No periodic service is required other than a check to ensure that all connections are clean and tight.

Test Procedure

3 Being a completely sealed unit, repair or troubleshooting of detail parts is impractical. If a solenoid is suspected of being inoperative, it should be tested as follows.

Note Ensure solenoid has a good ground. Grounding is through base.

1. Connect a continuity light or test meter **(A)** to the two large terminals of the solenoid **(B)**.
2. Connect a carbon pile **(C)** in series with a battery **(D)** and reduce the voltage to less than six volts. Connect battery leads to the one small terminal of the solenoid and the base.
3. Increase the voltage until the continuity meter or test light shows a completed circuit. Stop and note the voltage reading - it should be between six and eight volts. If the solenoid requires more than eight volts to complete the circuit it should be replaced since, in actual use, it may not perform satisfactorily.

Service and Repair Procedure

None - replace a malfunctioning unit.

