

# OPERATOR'S MANUAL

**WESTERBEKE 46**

**Marine Diesel Engine**

Publication # 34468

Edition Two

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FOREWORD

Thank you for having selected a Westerbeke Diesel Engine for your use.

This manual describes the procedures for proper handling and routine maintenance of:

W-46

Marine Diesel Propulsion Engines

To obtain best operating condition and longest service life, it is important to use it sensibly and carry out operation and maintenance according to this manual.

If you have questions about your equipment or in the event of a failure, please contact your nearest distributor or dealer.

If, within 60 days of submitting your warranty registration card, you have not received a Customer Identification Card (see below) registering your warranty, please contact the factory in writing.

We look forward to your continued patronage.


from:	J.H. Westerbeke Corp. Avon Industrial Park Avon, MA 02322
Mail To:	 <b>J. H. WESTERBEKE CORP.</b> <small>AVON INDUSTRIAL PARK, AVON, MASS. 02322</small> <b>CUSTOMER IDENTIFICATION</b> W-46 1234C408 Pleasure Craft expires 9/15/85 Adam Smith 85 Maple Street Alden, IN 12234

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GENERAL SPECIFICATIONS

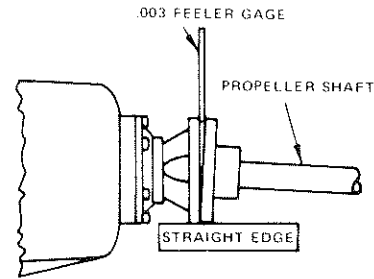
Model	Westerbeke 46
Type	4-cycle, fresh water cooled diesel engine with raw water exchanger system
# & Arrangement of Cylinders	4 cylinder-vertical-in line
Bore & Stroke	84 X 90mm (3.30 X 3.70 in.)
Dry Weight	535 lbs. (242kg)
Total Piston Displacement	2084cc (127 cu. in.)
Compression Ratio	21 : 1
Firing Order	1 - 3 - 4 - 2
Rotational Direction	Clockwise as viewed from front of engine
Fuel	# 2 fuel oil (cetane rating 45 or better)
Lubricating Oil	Mineral oil, heavy duty, A.P.I. CC or CD
Oil Pressure	Idle 20 - 30 P.S.I. (1.75 - 2.46 kg/cm <sup>2</sup> ) Under power 30 - 60 P.S.I. (2.46 - 4.21 kg/cm <sup>2</sup> )
Intermittent Power	47.5 horsepower at 3000 RPM
Westerbeke Rating	46 horsepower at 3000 RPM
Continuous Power	43 horsepower at 3000 RPM
Idle Speed	700-850 RPM
Cruise R.P.M.	2000-2500 RPM
Lubrication	Forced lubrication
Oil Pump	Trochoid pump
Oil Filter	Full-flow type with paper element
Oil Sump Capacity	7 quarts & filter
Cooling System	Forced circulation by centrifugal pump with thermostatically controled temperature
Operating Temperature	170 - 190° F
Fuel System	
Fuel Injection Pump	NIHON-CAV distributor type
Fuel Injection Nozzle	Bosch type, DNOSD
Governor	Flyweight type, built in pump
Fuel Filter	With paper element
Starting System	Electric starter with glow plugs in head

Starter	12V, 1.6KW pinion shift type
Alternator	12V - 50 ampere
Battery	12V - 100 ampere hour
Raw Water Flow Rate	9.5-10.0 gallons/minute at 3000 R.P.M. measured at discharge into exhaust elbow
Propeller Recommendations (using HBW-150 1.88:1 reduction)	18D x 10P-2 blade or 18D x 8P - 3 blade propeller should allow engine to reach its rated RPM (3000 $\pm$ 100) at full throttle underway

INSTALLATION, PREPARATION AND SUPPLY CAUTIONS

\* Check important aspects of installation before operating engine.

- (1) Alignment (Error to be no more than one thousandth of an inch per inch of coupling diameter)
- (2) Provide sufficient ventilation
- (3) Provide adequate service room around engine (See warranty clauses)



CHECKING COUPLING ALIGNMENT

- \* Fill fuel tank with CLEAN #2 diesel from a reputable manufacturer.
- \* Fill engine sump with lubricating oil to full mark on dipstick (Select readily available lubricating oil of grade CC or CD) (Sump capacity 7 quarts).
- \* Fill freshwater cooling system with suitable mixture of water and antifreeze to suit your temperature zone. Thoroughly mix antifreeze and freshwater BEFORE adding to cooling system.
- \* Plug-in Panel Harness Connection. After assembly, joint should be taped to prevent corrosion or, preferably, assembled using a silicon grease which can be obtained at an electronic store such as Radio Shack.

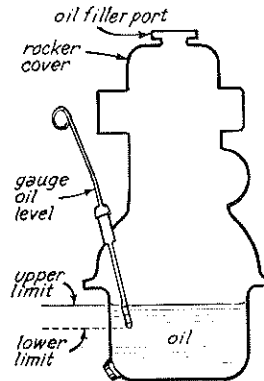
SAFETY PRECAUTIONS

- \* Never operate engine with inadequate ventilation. Confirm that there are no exhaust leaks inside engine compartment.
- \* Do not touch moving parts during operation.
- \* Do not touch hot parts such as exhaust pipe, and do not place combustible materials near the engine.
- \* Inspect and adjust parts of the engine only after it is stopped.
- \* Check and refill engine oil, cooling water and transmission lubricant only after the engine is brought to a stop.
- \* A coolant recovery bottle was supplied with the engine together with instructions for installation. Be sure that it is in place. Attempting to operate with only the manifold as an expansion tank exposes the operator to a severe steam burn if the manifold pressure cap is removed while the engine is hot. Follow instructions on Page 6.
- \* Always use tools that fit correctly and use caution during servicing.
- \* Be sure that current carrying wires are protected from abrasion and that all connections are tight.

PREPARATIONS

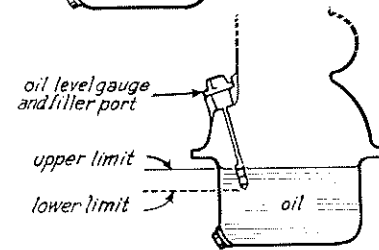
Take steps as shown below in starting your engine for the first time or after a prolonged shut-down.

1. a) Fill your engine with oil up to or near the upper limit on the dipstick. Use a good grade of oil with API specification of CC or better. For quantity of oil, you may refer to the General Specifications page.



b) Fill the transmission with the proper lubricant. NOTE: Some V-Drives are filled separately.

2. Your engine is supplied with a coolant recovery system to which the following instructions apply:



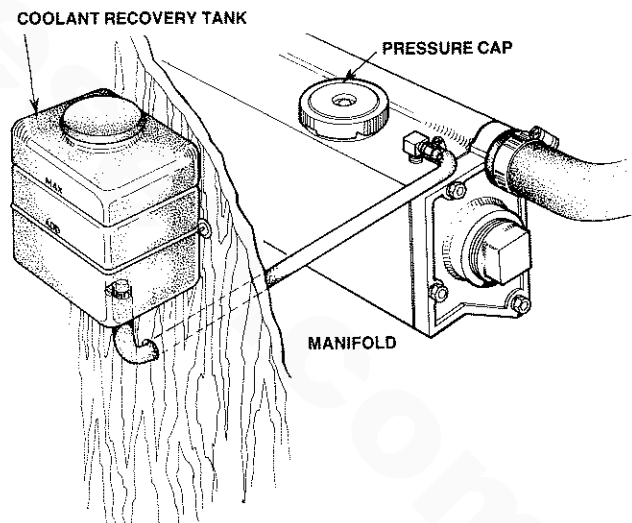
a) Fill engine completely to the neck of the manifold cap.

b) Then fill the recovery tank to the bottom add line. Need for adding coolant is indicated when a cold engine has coolant level below the bottom add line.

c) In winter add antifreeze as described on page 18. A mixture of antifreeze should be used year round and changed as needed.

3. Fill the fuel tank with #2 Diesel fuel with #45 Cetane rating or better. The interior of the fuel tank must be maintained clean. Be careful not to allow introduction of dirt when filling fuel.

4. Engine oil, coolant and transmission levels should be checked at least once a day prior to engine use.





BREAKING IN YOUR NEW ENGINE

While your engine has had at least one hour of test operations to demonstrate accurate assembly and correct operation of all systems, it still requires break in time.

Service life of your engine is dependent on how your engine is operated and serviced during initial break-in hours of operation.

Your new engine needs approximately fifty hours of initial conditioning operation for breaking in each moving part, thus helping maximizing performance and service life of engine. Perform this conditioning carefully, keeping the following points in mind.

1. Start engine, run at idle while checking that all systems are functioning - sea water pump, oil pressure, battery charge.
2. Warm engine, preferably by running propeller at fast idle while tied down, until water temperature gauge moves into the 130 - 140 degree range.
3. Then use engine at moderate load (RPM) until normal engine operating temperature of 170 - 190°F (77 - 88°C) is reached.
4. Avoid rapid acceleration especially with a cold engine.
5. Use caution not to overload engine. Grey or black smoke is a sign of overload. Select the correct propeller for the engine and transmission reduction.
6. Operate the engine in moderation, varying the running RPM under load during the break in period.

Explanation:

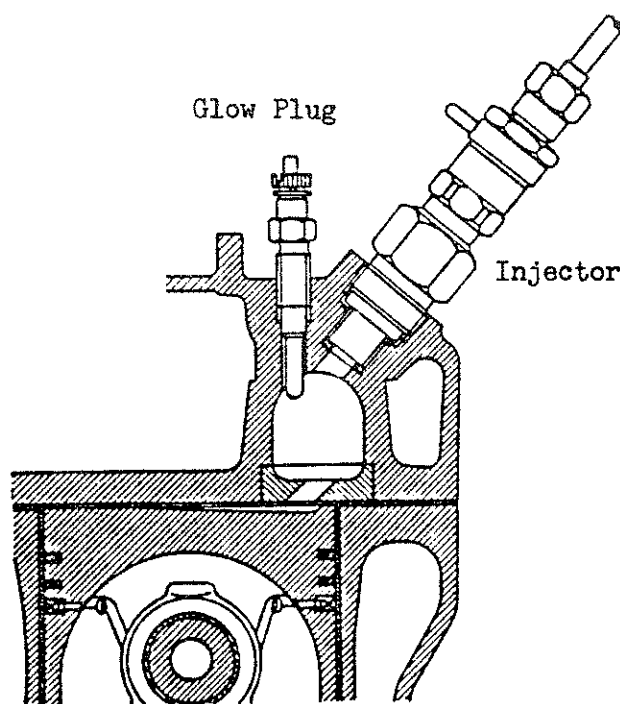
"Breaking in" a new engine is basically a seating of the piston rings to the cylinder walls. This is not accomplished by long periods of running idle, nor by early running under full load.

Idle running may glaze the cylinder walls causing oil consumption and smoky operation. Excessive speeds and loads may score cylinder walls with similar results, especially with the engine cold.

As indicated above, operate the engine in moderation during the initial 50 hours of break in. Don't baby it, yet do not abuse it.

DESCRIPTION OF STARTING SYSTEM

Model W-46 uses an electric starter assisted by glow plugs for both normal and cold weather starting. The figure is a cross section through one cylinder. The glow plug enters the combustion chamber so that the end is in the spray path of the injector nozzle. When the glow plugs are energized by the preheat button, they glow red at the tips and assist rapid ignition of the fuel. The result is rapid starts with less wear on the starter.



This system is common to Westerbeke Diesels. The start circuitry is designed so that, first, the preheat button must be depressed for the time specified in the glow plug use chart shown below.

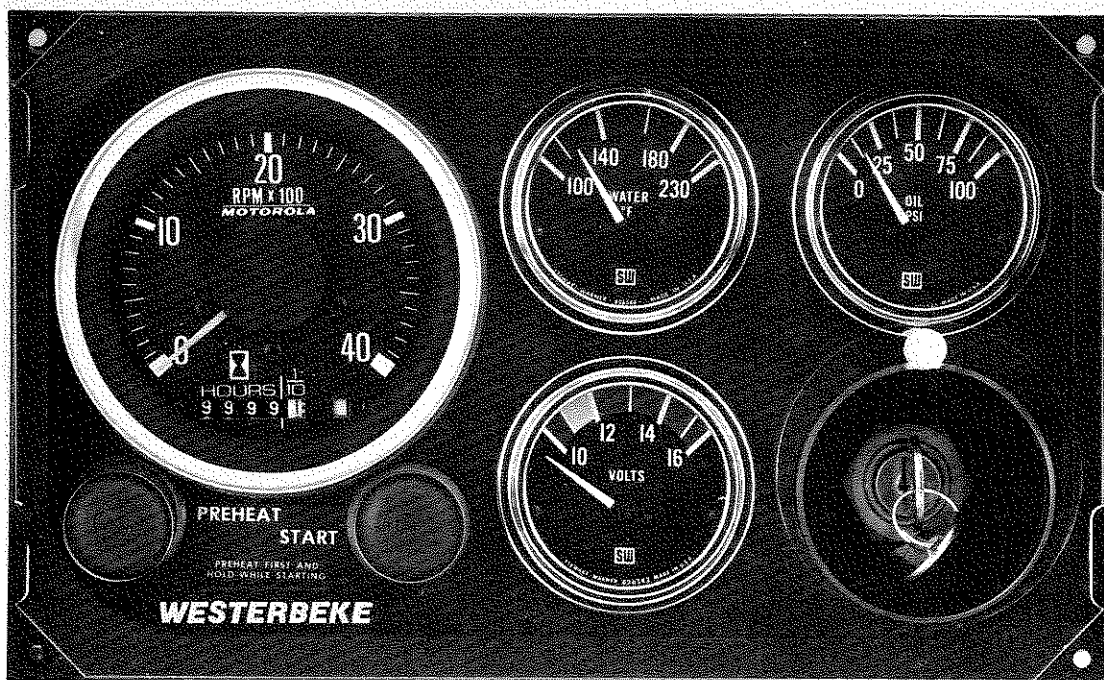
After which, and while keeping the preheat button engaged, the start button is depressed to crank the engine.

Glow Plug Use Data

Atmospheric temperature	Preheating time
+5°C (+41°F) or higher	Approx. 10 sec.
+5°C (+41°F) to -5°C (+23°F)	Approx. 20 sec.
-5°C (+23°F) or lower	Approx. 30 sec.
Limit of continuous use	1 minute

For complete starting and stopping procedures, see pages 10 and 11.

INSTRUMENT PANEL Description and use of:



- Note 1: When engine is stopped after use, the water temperature and oil pressure gauges may stay at their running readings.
- Note 2: When engine is next to be used, turn keyswitch ON. The temperature and pressure gauges will "ZERO" and the voltmeter will register battery voltage. The electric fuel pump, mounted on the engine, will also begin to operate, purging any air accumulated in the system.
- Note 3: The engine is now prepared for starting.
- Note 4: For INITIAL STARTS:  
The self-priming feature of the W-46 is different from other models in that it requires longer time. Two circuits are required to bleed both fuel filter and injection pump. Therefore, when priming the W-46 for the first time or when the system has been worked on or has been run out of fuel, allow the electric fuel pump to operate for 2 to 3 minutes before the first cranking effort. Simply turn the ignition key ON to activate the electric fuel pump.

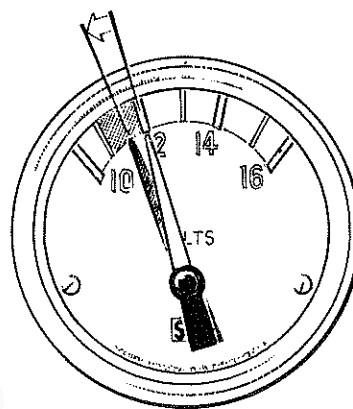
STARTING PROCEDURES

1. Advance throttle to full, press Preheat button and hold for the number of seconds indicated on Page 8 in "Glow Plug Use Data".
2. While still engaging Preheat button, press Start button.

Note: Failure to engage the Preheat button will not allow the Starter button to energize the starter.

3. The starter will crank the engine which should start in 10 seconds or less.
4. As soon as the engine starts, release buttons and throttle back to a moderate idle warm up of 80 - 1000 RPM.
5. Should the engine NOT start even though cranking for 10 seconds, release the buttons for 30 seconds and repeat the sequence by pre-heating the glow plugs sufficiently. The starter motor should never be run more than 30 seconds at a time.

6. Proper glow plug function is indicated by voltmeter drop when the Preheat button is depressed. This drop will be slight but discernible. If no voltage drop is noted, it may indicate defective glow plugs or a faulty preheat circuit. (Check for loose connection).



7. As soon as the engine has started, release both Start and Preheat buttons. Check that with engine running, oil pressure and battery charge voltage are registering and that raw water is discharging with the exhaust.

Note: An alarm buzzer is supplied with every unit. It is the responsibility of the installer to electrically connect the alarm buzzer to the two marked terminal connections on the engine electrical harness and install the buzzer in a dry location so that it will be audible to the operator should it sound during engine operation. This buzzer will sound when the ignition key is turned on and should silence when the engine is started and oil pressure rises above 15 lbs.

8. To warm up engine, run a few minutes at idle to make checks in '7' above. Then operate under reduced RPM until water temperature rises into the 140° range. Then operate under moderate power until normal operating temperature is reached.

## STOPPING PROCEDURES

1. Model W-46, early models were supplied with a manual shut-off. A 'T' handle or knob is pulled to shut off fuel, stopping the engine.

Later Models June 1985 (C506) on, were supplied with an electric shut-off operated by the key switch and having the manual shutoff as an installer's option.

2. With the engine stopped, it is necessary to turn off the key-switch. If you fail to do this, the panel remains energized and the electric fuel pump continues to run. This oversight results in a dead battery. With the alarm buzzer installed and functioning, it will sound when the engine is shut down manually and the keyswitch left ON signaling to turn the key off.

## CAUTIONS ON STARTING AND OPERATION

1. Normal starting

Follow the procedures below for routine starting of your engine.

- 1) Check the engine and transmission oil levels and refill if necessary.
- 2) Insure that you have sufficient fuel. Keep tank as full as possible.
- 3) Check cooling water level, and refill if necessary.  
Note: Check for leaks of water or oil, particularly when signs of such leak are found on the bottom of the engine or in the drip tray when provided.
- 4) Start the engine in accordance with the procedures given on the preceding pages.
- 5) Allow the engine to warm up to 140°-150° F before placing the engine under heavy load.

2. Starting under cold conditions

The following three adverse conditions concur as the atmospheric temperature drops exceedingly, and the engine must, under such conditions, be started by taking steps described below:

LUBRICATING OIL TURNS VISCOUS - Make certain that viscosity is proper for the prevailing atmospheric temperature. Check the oil also for deterioration. (Study page 13.)

VOLTAGE ACROSS BATTERY TERMINALS DROPS - Check that the battery is fully charged.

THE TEMPERATURE OF INTAKE AIR IS LOW AND COMPRESSION TEMPERATURE DOES NOT RISE ENOUGH - Allow the glow plug to operate sufficiently to aid starting. See table on page 8.

3. Cautions during operation

Confirm that the oil pressure is normal during operation.

Confirm that exhaust gas is as follows:

- \* While engine is cold.....White smoke
- \* When the engine grows warm.....Almost smokeless
- \* When the engine is overloaded.....Some black smoke

Check for abnormal noise such as knocking, friction or leaking sounds, and vibration and blow-back sounds.

Check for leaks of fuel and engine oil.

A knocking sound is normal while the engine is cold, during quick acceleration and at idle. Confirm that no knocking sound is heard in other cases.

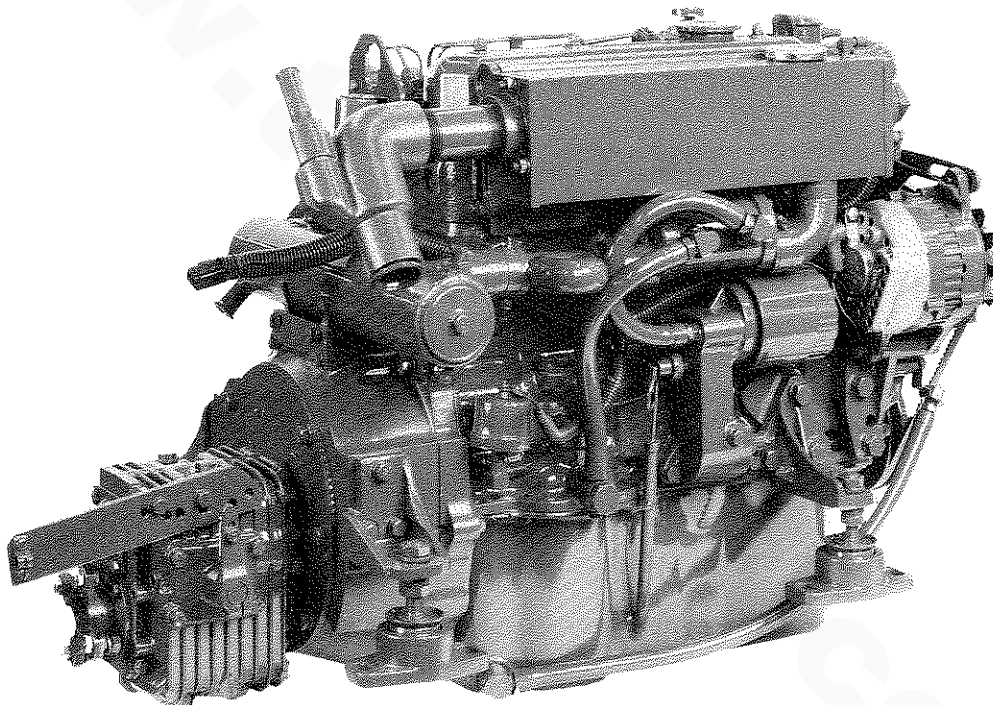


Photo above is right hand side of the W46 with Hurth 2:1 reverse and reduction gear.

REQUIREMENTS FOR PROPER OPERATION

LUBRICATION SYSTEM

1. Engine oil

For engine lubrication, use diesel engine oil. Diesel engine oils are classified according to the API Specifications into grades CA, CB, CC and CD. Any one of them is usable, but use of CC or higher grades prepared by well-known makers is recommended. The oil selected should be used thereafter.

2. Engine oil viscosity

Use oil having viscosity best suited to the atmospheric temperature. Use of an all-season oil SAE10W-30 with minimum viscosity change under different temperatures is suggested.

Atmospheric temperature	Viscosity
20°C (68°F) or higher	SAE 30 or 10W-30
5°C (41°F) - 20°C (68°F)	SAE 20 or 10W-30
5°C (41°F) or lower	SAE 10W-30

3. Oil pressure

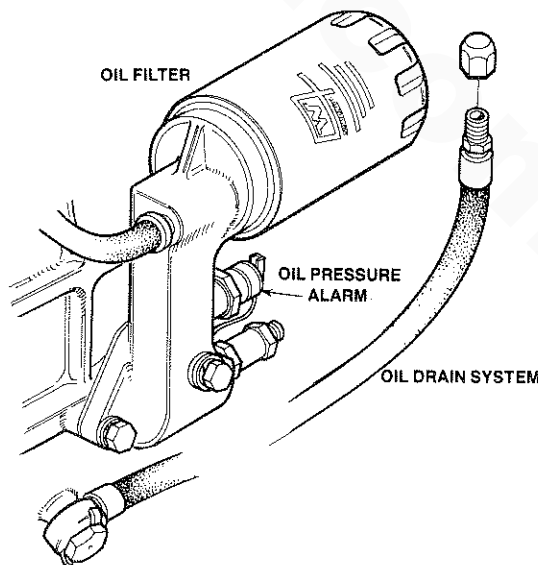
The oil pressure during operation of the engine is indicated by the oil pressure gauge.

During normal operation.....Oil pressure will range between (Under Power) 30 and 60 PSI. (2.10 - 4.21 kg/cm<sup>2</sup>)  
 At idle speed.....20 - 30 P.S.I. (1.75 - 2.10 kg/cm<sup>2</sup>)  
 At the time of cranking.....Pressure will rise proportionately with speed.

4. Replacement of oil filter

Being a replaceable cartridge type, the oil filter requires no cleaning inside. In installing the oil filter element, apply engine oil thinly on to the O-ring, and then tighten it by hand firmly.

When removing the used filter, cover over with a plastic bag. This will allow both filter element and spilled oil to be collected cleanly without spilling oil in the bilge.



Note A: After-market filters are not recommended since the material standard or diameters of important items might be entirely different from genuine parts.

Note B: Immediately after filter change and oil filler, run engine to ensure that oil pressure is normal and that there are no oil leaks.

5. Engine oil change: Initially at 50 hours then every 100 hours of (including filter) operation

To renew engine oil, discharge old oil through the sump drain hose attached at front of engine while engine is still warm. Drain old oil completely, replace the hose, plug the end securely and add fresh oil through the oil fill cap on the valve cover. After refilling oil, idle the engine for several minutes and stop. Then check the quantity of oil by the oil level gauge. Fill to but not over the high mark on the dipstick. Always observe old oil as it is removed. A yellow/grey emulsion indicates presence of water in the oil. While this condition is rare, it does require prompt attention to prevent serious damage. Call a competent mechanic.

## FUEL SYSTEM

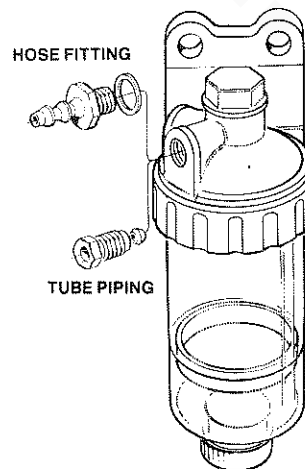
1. Diesel fuel

USE #2 DIESEL FUEL. NEVER USE KEROSENE OR HEAVY OIL.

In cold weather particularly, water vapor is produced by condensation when air is present in the fuel tank. The tank, therefore, should be kept full as much as possible.

The fuel tank, furthermore, needs to be kept completely free of dirt and water.

2. It is required that a primary fuel filter of the water entrapment type be installed between the fuel tank and the engine. Such a filter, shown here, is available under Part #32974 from your local Westerbeke representative or your boat builder. This filter, adapted for boat builder use, comes complete with fittings for either hose or metal tubing. Mount in an accessible place, inspect often and drain off water accumulation frequently.



SEDIMENT/WATER TRAP #32974

### Installation Instructions

1. Bolt Sediment/Water Trap securely to an accessible structure so positioned that a receptacle to catch drainage can be placed under.
2. If fuel is to be piped with copper or bundy tubing, use nuts and ferrules provided. Be sure the tubing projects 1/4 inch through the ferrule before tightening the nut.
3. If fuel is to be piped with hose, use the two brass barbed fittings and washers supplied. Be certain that the hose selected has diagonal braid inserted (to cling on the barb), that it is neoprene lined and that it is USCG approved.
4. If water is present in the fuel, it will collect slowly in the bottom of the Sediment. When the red float ring reaches the drain line on the plastic bowl, loosen the bottom drain plug until all water runs out.
5. Tighten drain plug securely so no air can enter system.
6. Energize fuel pump to refill bowl.

INSTR. #33009



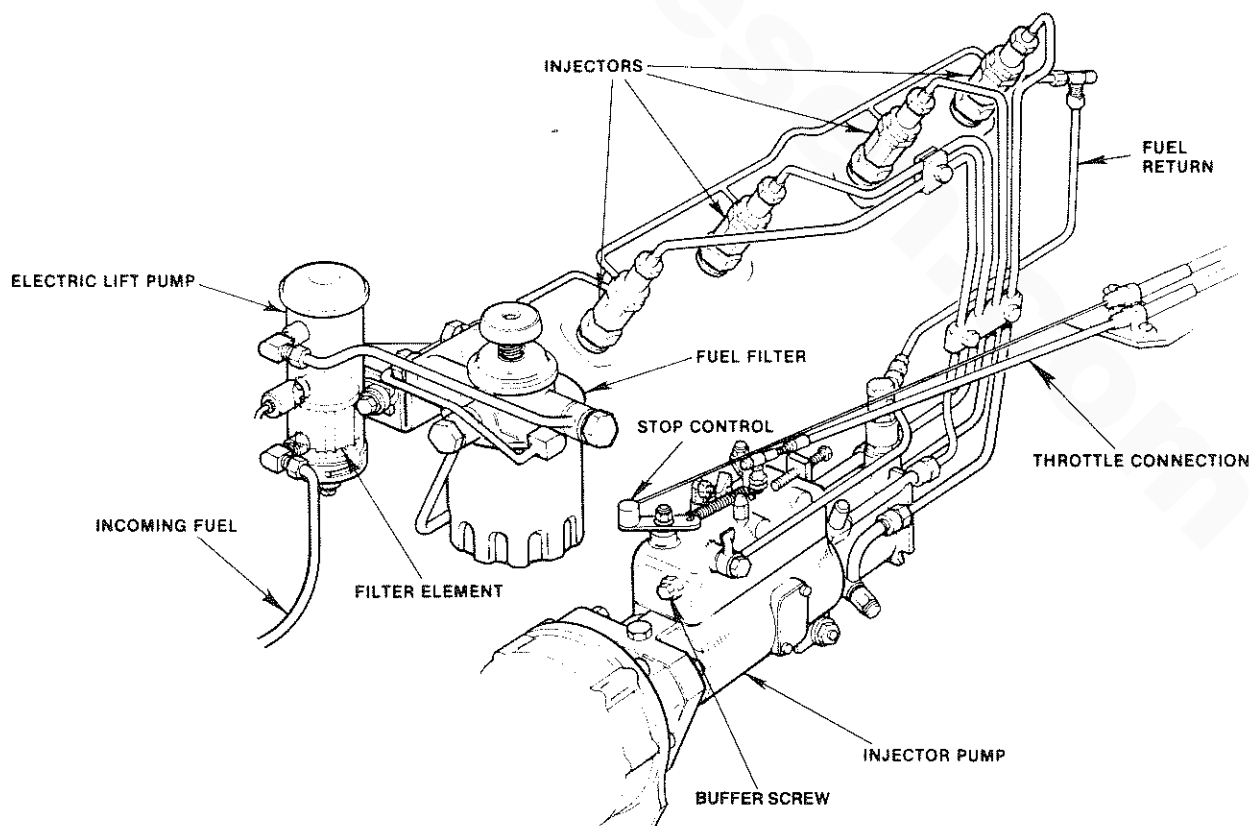
If a water trap type filter is not interposed between the fuel tank and engine lift pump, any entrained water will tend to lay in the bottom of the electric lift pump. Internal metal parts of the lift pump will rust. Particles will pass on to filters and eventually to injection pump and injectors with damaging and expensive results. IT IS WELL TO REMEMBER THAT WATER DAMAGE TO THE FUEL SYSTEM IS NOT COVERED BY WARRANTY!

While many boat builders do supply a water trap filter, there are some who do not. It is to prevent such omission that Westerbeke offers a sedimenter/water trap filter as a desirable optional extra at moderate cost. It is supplied with fittings for either hose piping or metal tube piping.

Priming and self bleeding. All engines covered by this manual have a fuel filter with hand priming pump in the head casting for emergency use. The main priming source is the electric lift pump mounted on the cylinder head front.

The Westerbeke self-bleeding fuel system on Model W-46 is semi-automatic. If you run out of fuel, perform a filter change or any disassembly of the fuel system, the system will then contain air which may prevent the engine from starting. In such event, turn the keyswitch on, allow electric pump to run for two minutes, and crank engine for approximately seven seconds. If the engine has not started, wait for approximately thirty seconds more of electric pump action and crank engine again. These time periods may vary from engine to engine.

Note: The self bleeding feature on the W-46 relates to the engines's fuel system only.



3. Notes on fuel system

See on prior page a typical exploded view of a fuel system for this engine. It is also illustrative of the self-bleeding and priming system used by Westerbeke.

The Westerbeke self-bleeding fuel system is semi-automatic in operation. While it is unlikely that the operator will be forced to service the system at sea, the possibility does exist. Therefore, it is recommended that banjo washers, injector seat washers, lift pump filter and gasket, fuel filter and gasket be carried on board at all times. Select the parts for your engine on page 43 and purchase spares from your local Westerbeke Dealer or Distributor. For example, hardware kit #34441 will supply fuel system washers for the Model 46.

If a leak should develop at a banjo or washer that cannot be remedied by a simple tightening of the screw, renew the washers.

The engine can be started by taking steps described on pages 9 and 10. In cases where the engine cannot be started easily, loosen two injection nuts on the nozzle side, turn the speed control lever to "full open" position, turn the starter motor and then tighten the nuts firmly.

4. Replacing filter elements

After the first 50 hours of operation, unscrew and discard fuel filter element. Install a new filter.

This same treatment is required of the filter element in the fuel lift pump. Similarly, replace with a new filter element using a new gasket.

After the first 50 hours change, the change period may be increased at 200 hours or once per season.

5. Fuel injection pump

The fuel injection pump is one of the most important components of the diesel engine and thus it calls for the utmost caution in handling. Furthermore, the fuel injection pump has been thoroughly shop-adjusted and should never be readjusted carelessly.

Such adjustments, whenever necessary, should be performed at an authorized service station, as a precision pump tester skill are required.

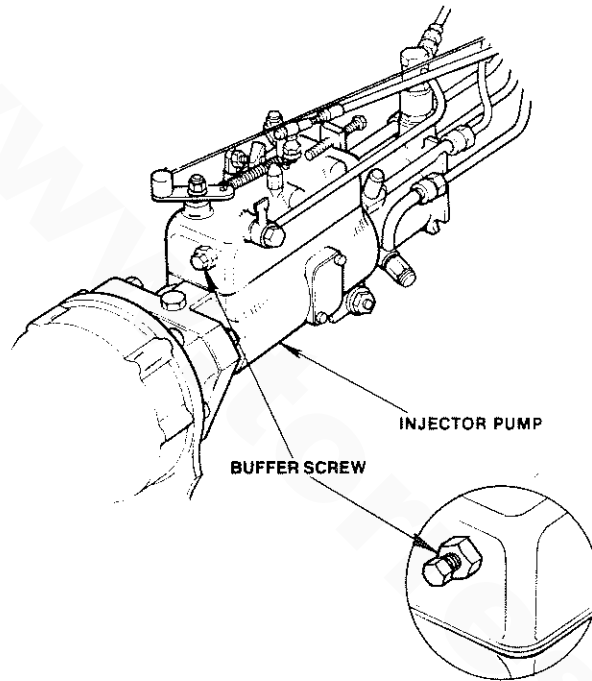
To obtain long and satisfactory use of your injection pump:

Always use fuel which is free from impurities.  
Clean and renew the fuel filters periodically.  
Inspect water entrapment filter regularly.

On the forward control housing of the injection pump is a buffer screw. This buffer screw has all the visual characteristics of a bleed screw, but it is not. The adjustment of this screw should not be tampered with, or disturbed.

Disturbing the adjustment of this buffer screw can shut off the delivery of fuel from the injection pump to the injectors and prevent the engine from starting.

**DO NOT TAMPER WITH THIS BUFFER SCREW ADJUSTMENT!**



COOLING SYSTEM

1. Cooling water

As cooling water, use soft water with least impurity content such as tap water (potable water) or rainwater, and never use hard water or foul water. Use of hard water or water containing much impurity will lead to collection of scale in the engine and heat exchanger with resultant decline in cooling effects.

2. Antifreeze

In cold districts, care should be taken to prevent cooling water from freezing. Cooling water, when frozen, expands to break the heat exchanger and the cylinder block, and it is essential that antifreeze be added to cooling water in a quantity proportional to the lowest temperature of the district. It is recommended that the antifreeze mixture be used throughout the year.

\*Antifreeze of poor quality or without rust inhibitor will cause corrosion of the cooling system. Always use antifreeze prepared by a reliable maker.

\*Make sure that the cooling system of the engine is cleaned well before adding antifreeze.

\*Recommended antifreeze for year round use is ZEREX or PRESTONE with rust inhibitor.

\*Thoroughly mix the antifreeze and water before adding to the cooling system.

ANTIFREEZE ADDITION DATA

Antifreeze Concentration %	13	23	30	35	45	50	60
Freezing °C	-5	-10	-15	-20	-30	-40	-50
temperature (°F)	(23)	(14)	(5)	(-4)	(-22)	(-40)	(-58)

Note: It is advisable that antifreeze concentration be selected on the basis of a temperature which is about 5°C (10°F) lower than the actual atmospheric temperature expected.

3. Fresh water cooling system

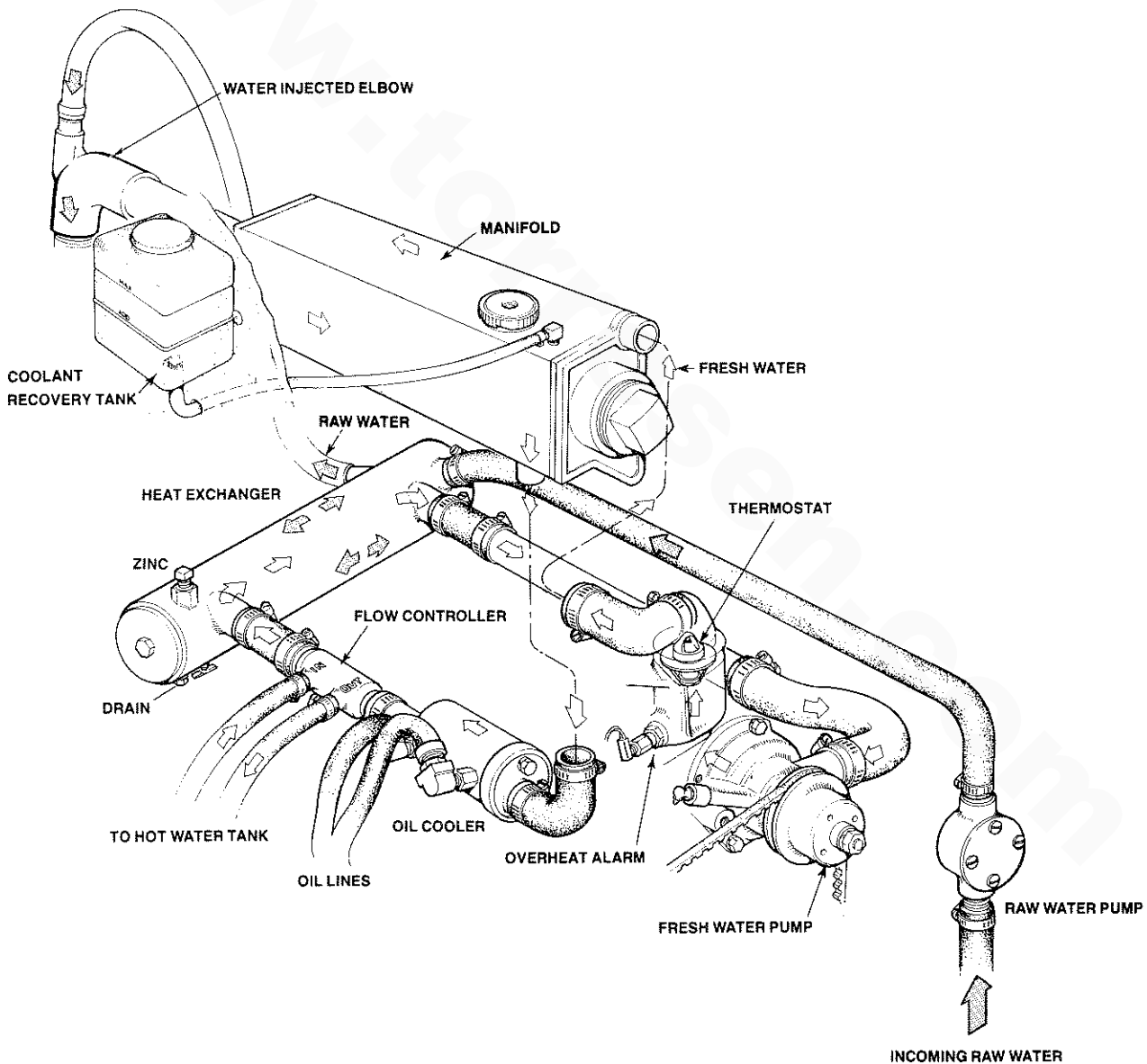
The system consists of a sea water pump which pumps raw sea water through a heat exchanger to remove heat from the coolant. The raw water is discharged overboard through the exhaust line.

The engine coolant (fresh water with or without antifreeze) is circulated by the fresh water pump in continuous circuit, pumped through the cylinder block, cylinder head, heat exchanger and back to the fresh water pump.

The total system is very reliable and requires only a daily check of the water level in the system plus routine checks of hose clamps and fittings .

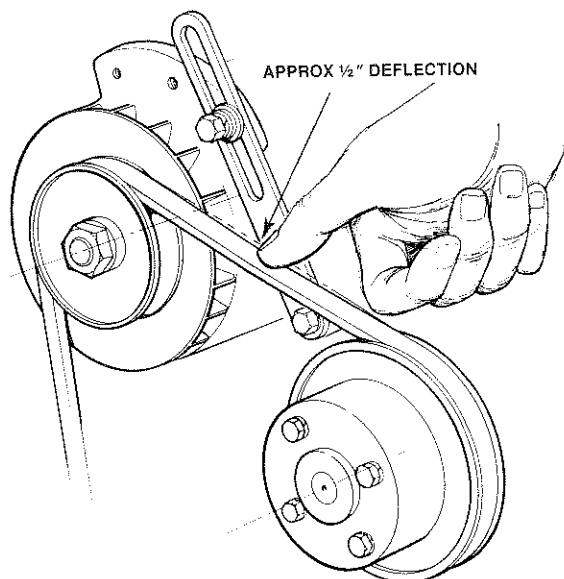
It is likely that zinc electrodes will waste away from electrolysis action in the sea water circuit. They should be checked monthly. It is also possible for the raw water pump impeller to fail due to lack of sea water or deterioration. An early sign of impeller failure is less water and more steam at the exhaust through hull fitting and higher engine operating temperature.

It is recommended, therefore, that zinc electrodes, water pump belt, alternator belt, sea water pump assembly and sea water impeller kit be carried onboard at all times. These parts should be ordered from your nearest stocking dealer and used as inspection dictates. The part numbers for these may be taken from the parts list on page 43.



## BELT TENSION

The belts are properly tensioned when they deflect 10 to 12 mm (0.39 to 0.47 in) as they are depressed with a finger between the alternator pulley and fresh water pump pulley. Excessive tension can cause quick wear of the belt and bearings of the water pump and the alternator. Excessive slackness or presence of oil on the belt, on the other hand, can lead to engine overheating, insufficient charging due to a slipping alternator belt and rapid wear of the belt.



### CAUTION:

Never attempt to adjust tension of any drive belt while the engine is in operation.

## WIRING DIAGRAM

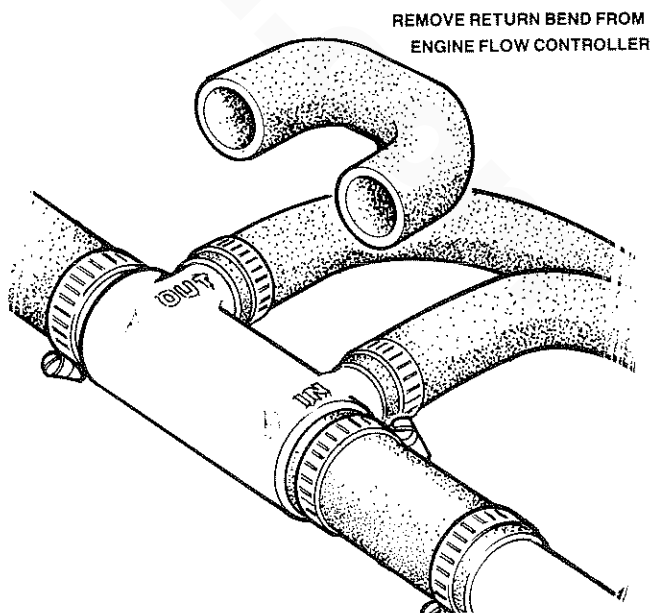
Your engine has a 12 volt DC start/run circuit. A pictorial schematic of this is illustrated on Page 22. Study it and learn to understand how the system functions.

For installing electrical parts, connect them correctly by referring to the diagram and at the same time check for damaged wire sheathing and confirm that grounding is provided properly. Care must always be taken while working on the electrical system.

NEVER SHUT THE ENGINE BATTERY SWITCH OFF WHILE THE ENGINE IS RUNNING. DAMAGE TO THE BATTERY CHARGING ALTERNATOR WILL RESULT SHOULD THIS BE DONE.

## DOMESTIC HOT WATER

Sketch at right shows Model W-46 complete with Flow Control mechanism and its bypass connection for normal use. If it is desired to connect a hot water heater, remove the bypass hose altogether and connect the heater as instructed on the following page. Study the instructions carefully.



Model W 46 comes complete with a Flow Control which, when properly connected to a heater tank, produces domestic hot water from waste engine heat.

Principle: With the bypass hose #30962 removed, there remain 2 connecting points A and B for hose to and from the water heater. These connections assure a flow of hot water through the heater at all times and yet preclude excessive restriction of engine cooling water flow caused by the heater - all simply and automatically.

Installation: The heater should be mounted conveniently either in high or low position, so that connecting hoses from heater to engine can run in reasonably direct line without loops which might entrap air. Connection Point A on the Flow Control housing should connect to the lower of the two connections on the water heater while the upper connection on the heater returns to B, nearest the heat exchanger.

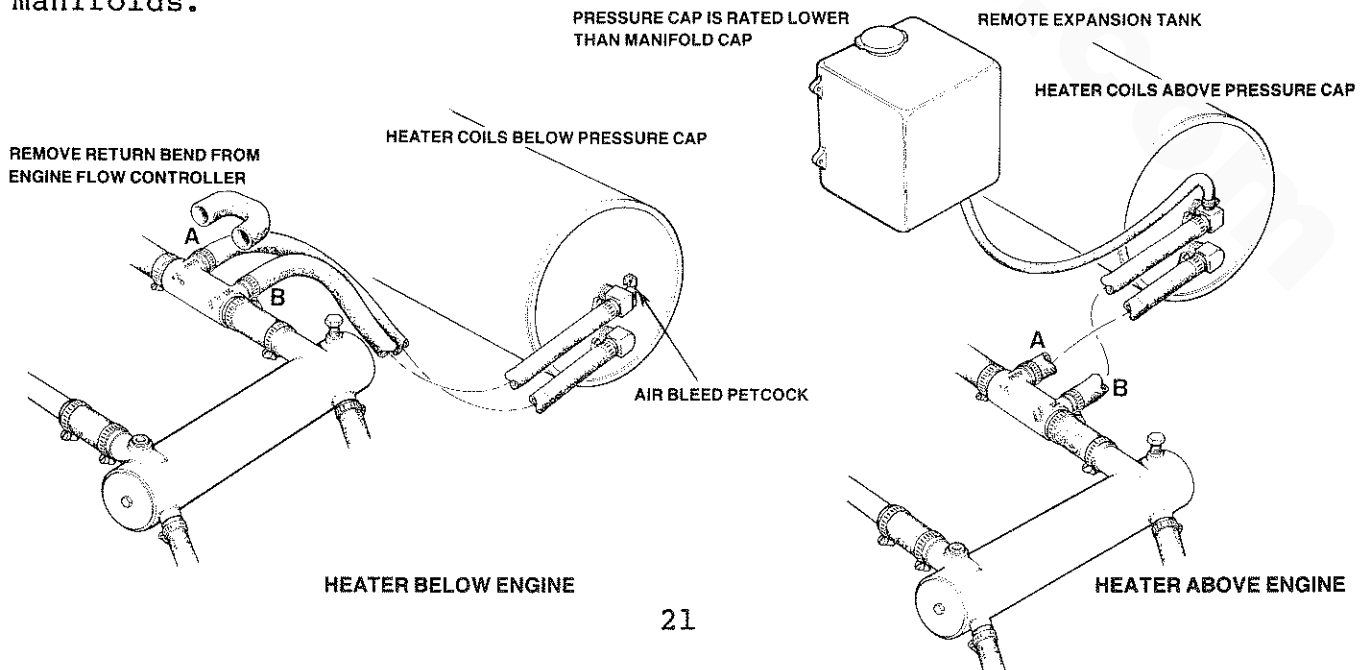
Hoses should rise continuously from their low point at the heater to the engine so that trapped air will rise naturally from the heater to the engine. If trapped air can rise to the heater, then an air bleed petcock must be installed at the higher fitting on the heater for bleeding air while filling the system. Avoid loops in hose runs which will trap air.

If any portion of the engine cooling water circuit to or from the heater rises above the engine's own pressure cap, then the pressurized remote expansion tank must be installed in the circuit to become the highest point. The tank kit part number is 24177. Install the remote expansion tank in a convenient location such as a sail locker for ease of checking fresh water coolant level.

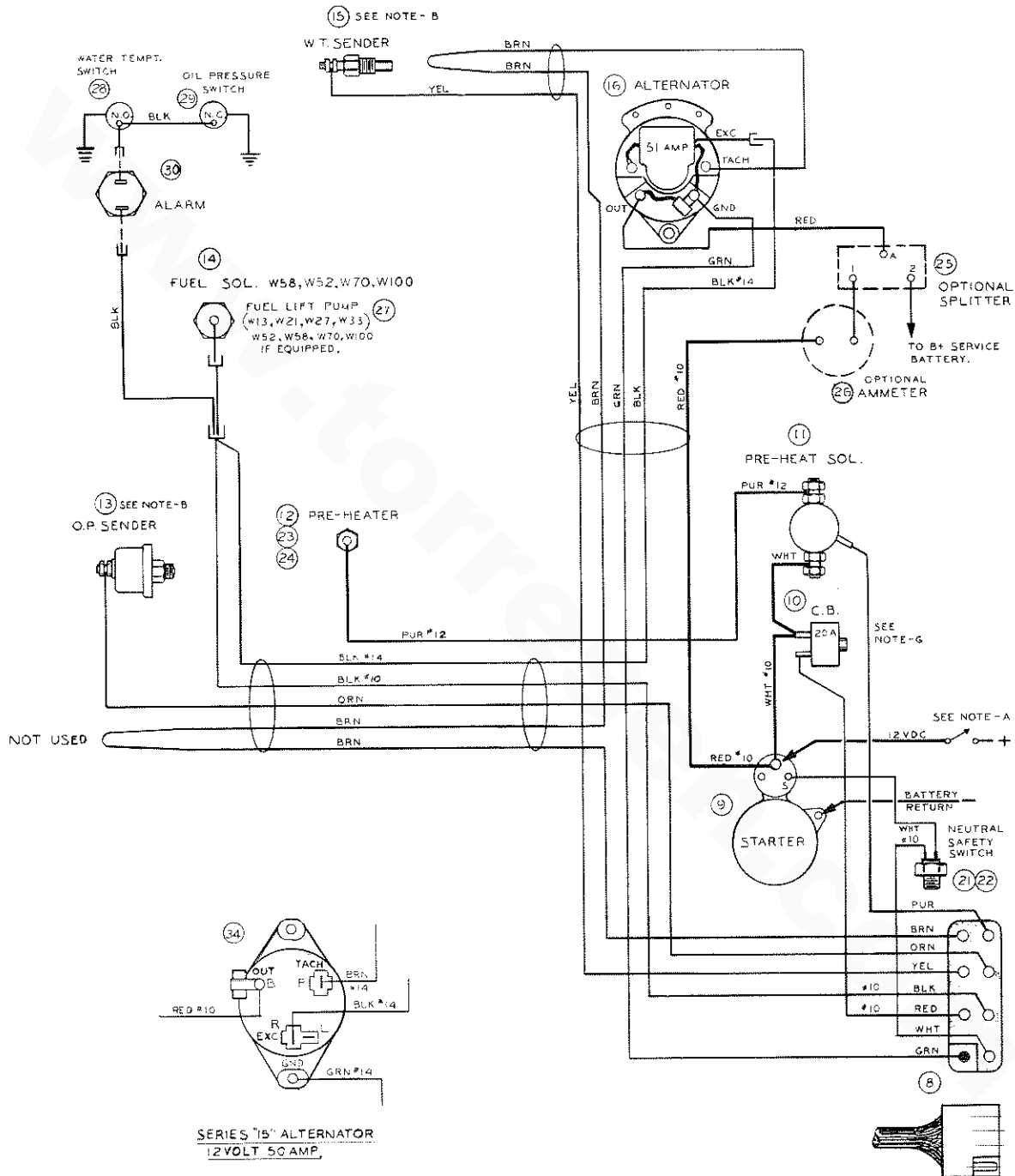
The cap on the engine mounted expansion tank/manifold should not be opened once the remote system is installed and filled.

The hose connection from the heater to the remote expansion tank should be routed and supported so as to rise continuously from the heater to the tank enabling any air in the system to rise.

Illustration below are of Flow Control adapted to our single pass manifolds.

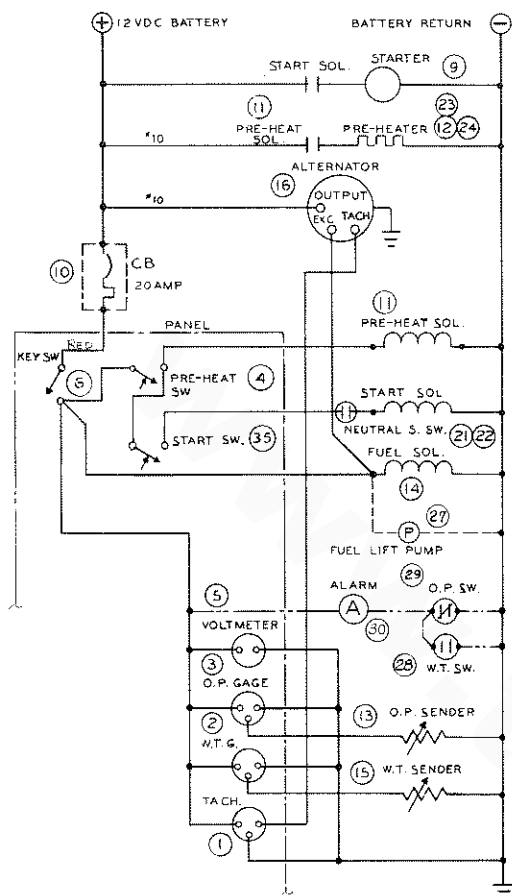


WIRING DIAGRAM.





SCHEMATIC DIAGRAM.



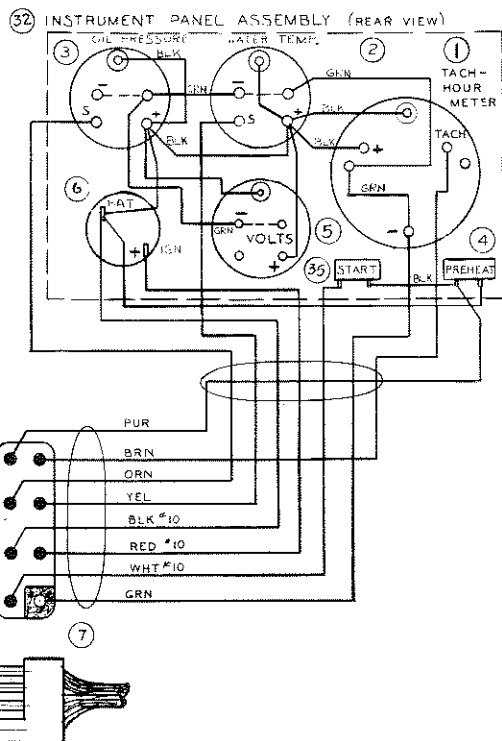
NOTES:

NOTES ON BUILDER/OWNERS RESPONSIBILITY.

- (A) AN ON-OFF SWITCH MUST BE INSTALLED IN THIS LINE TO DISCONNECT THE STARTER CIRCUIT FROM THE BATTERY IN AN EMERGENCY & WHEN LEAVING THE BOAT. 12VOLT DIESEL ENGINE STARTERS TYPICALLY DRAW 200 TO 300 AMPS WHEN CRANKING. THE DURATION OF INDIVIDUAL CRANKING CYCLES SHOULD NOT EXCEED 30 SECONDS. A SWITCH WITH CONTINUOUS RATING OF 175 AMPS AT 12VDC WILL NORMALLY SERVE THESE FUNCTIONS, BUT SUCH A SWITCH MUST NEVER BE USED TO "MAKE" THE STARTER CIRCUIT.

OTHER NOTES:

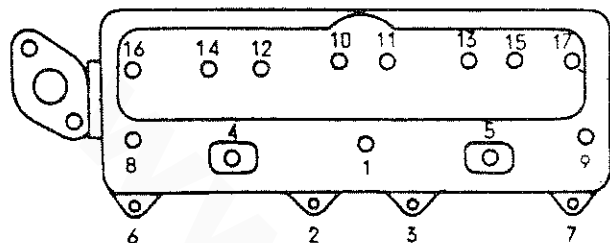
- (B) WARNING ; SENDER CONNECTION:  
CONTACT WITH B+ MAY DAMAGE SENDER.
- (C) ALL RETURNS ARE THROUGH ENGINE BLOCK.
- (D) FOR WIRING OF AUXILIARY ALTERNATORS SEE THE FOLLOWING DIAGRAMS.  
MOTOROLA 63 AMP, 11232  
MOTOROLA 120 AMP, 11231  
LEECE-NEVILLE 53 AMP, 16535  
LEECE-NEVILLE 105 AMP, 16614
- (E) IF ADDITIONAL PRESSURE SWITCHES ARE REQ'D TO START BOAT ACCESSORIES, A FLEXIBLE HOSE MUST BE RUN FROM THE OIL PRESSURE MANIFOLD TO A NEARBY BULKHEAD AND ALL PRESSURE SWITCHES MOUNTED AT THE BULKHEAD.
- (F) APPLY SILASTIC OR TIGHT WOUND PLASTIC/SPICE ELECTRICAL TAPE AROUND CONNECTORS CONNECTED.
- (G) CAUTION:  
THIS PRODUCT IS PROTECTED BY A MANUAL RESET CIRCUIT BREAKER LOCATED NEAR THE STARTER AND AS CLOSE TO THE SOURCE OF CURRENT AS POSSIBLE. EXCESSIVE CURRENT DRAIN ANYWHERE IN THE INSTRUMENT PANEL, WIRING, OR ENGINE WILL CAUSE THE BREAKER TO TRIP. IN THIS EVENT, MOST ENGINE MODELS WILL SHUT DOWN BECAUSE THE OPENED BREAKER DISCONNECTS THEIR FUEL SUPPLY. THEREFORE THE BUILDER/OWNER MUST BE SURE THAT THE INSTRUMENT PANEL, WIRING AND ENGINE ARE INSTALLED TO PREVENT CONTACT BETWEEN ELECTRICAL DEVICES AND SALT WATER.



35	SWITCH, START.	1		
34	ALTERNATOR, 12V. 50A.	1		
33	PANEL, LESS INSTRUMENTS	1		
32	PANEL, COMPLETE		1	
31		1		
30	ALARM			1
29	OIL PRESS. SW. N.C.			1
28	WATER TEMPT. SW. N.O.			1
27	FUEL LIFT PUMP	1		
26	AMMETER (OPTIONAL)			1
25	SPLITTER (OPTIONAL)			1
24	GLOW PLUGS W30E W40 4EACH			
23	GLOW PLUGS W40	1		
22	NEUTRAL SAFETY SW. PARAGON	1		
21	NEUTRAL SAFETY SW. WARNER	1		
20	PANEL, LESS INSTRUMENTS	1		
19	PANEL, COMPLETE		1	
18	SUPPRESSION KIT. ALT.	1		
17	TACH. KIT. ALTERNATOR	1		
16	ALTERNATOR, 51 A.	1		
15	SENDER, WATER TEMP.	1		
14	SOLENOID, FUEL	1		
13	SENDER, OIL PRESSURE	1		
12	PRE-HEATER (W58)	4		
11	SOLENOID, PRE-HEAT	1		
10	CIRCUIT BREAKER 20AMP	1		
9	STARTER, MARINE ENGINE	1		
8	HARNES, ENGINE		1	
7	HARNES, PANEL		1	
6	KEY SWITCH, IGNITION.	1		
5	VOLTMETER	1		
4	SWITCH, PRE-HEAT	1		
3	OIL PRESSURE GAUGE	1		
2	WATER TEMP. GAUGE	1		
1	TACHOMETER	1		
ITEM	DESCRIPTION	QTY	ASSY	OPTION
	J.H. WESTERBEKE CORP.			
	AVON, MA. 02322			
	SCALE NONE			
	DESIGNED BY J. Spaulding			
	DRAWN BY J. Spaulding			
	DATE 2-22-84			
	PLATE NO. 33685			

CYLINDER HEAD AND VALVES

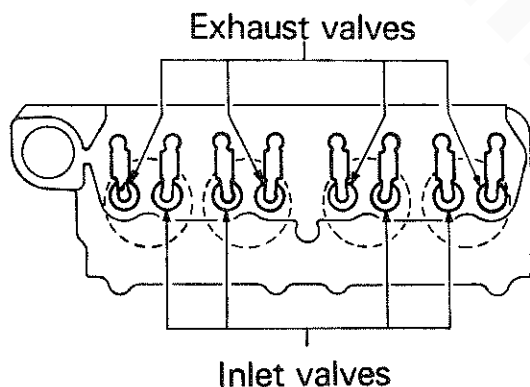
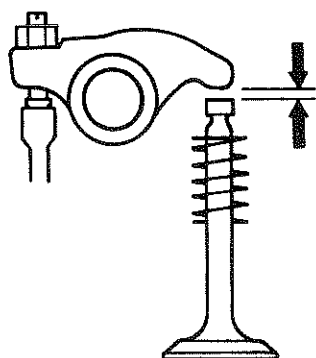
1. Tighten cylinder head bolts in the sequence shown. The engine should be cold. Loosen each bolt one-eighth to one-quarter turn when tightening in the sequence shown. Note that bolt #4 and 5 are located under the intake manifold where it is attached to the head.



Head Bolt Tightening Torque:

Exhaust Side  
12.0 kg/m (86 lb/ft)  
Intake side  
10.5 kg/m (76 lb/ft)

2. Tighten rocker shaft bracket bolts to 1.5 kg/m (11 lb/ft).
3. Adjust valve clearance with the engine cold following retorquing of cylinder head bolts according to the following procedure. The valve clearance is 0.2 - 0.3 mm (0.009 - 0.012 inch).
  - A. Rotate the crankshaft slowly in the normal direction of rotation to bring the piston of the number 1 cylinder (front of engine) to T.D.C. of it's compression stroke. (Observe when this is done that the valves of the number 4 cylinder are in a position of valve overlap, ie., the period between the opening of the inlet valve and the closing of the exhaust valve.)
  - B. In this position adjust the valve clearance in the conventional manner of the intake and exhaust valve of the number 1 cylinder, the intake valve of the number 2 cylinder and the exhaust valve of the number 3 cylinder.
  - C. Rotate the crankshaft in the normal direction of rotation one full turn (360°) and stop.
  - D. In this position adjust the valve clearance of the intake and exhaust valve of the number 4 cylinder, the exhaust valve of the number 2 cylinder and the intake valve of the number 3 cylinder.



RECOMMENDED MAINTENANCE SERVICE

Check and service your engine at specified intervals to maintain it in its best conditions and permit it to perform as it should. As for those asterisked items, it is suggested that you have them performed by an authorized distributor or dealer.

1. Daily inspection before use.

- A. Check up of engine oil lever and refilling.

No refill is required if the level is near the upper limit line of the gauge.

- B. Checkup of cooling water and refilling.

Refill up to the ADD line on coolant recovery tank.

- C. Check your fuel supply.

- D. Checkup of gauges and meters.

After starting your engine, check oil pressure, water temperature and voltage readings.

- E. Check for loose parts (fan belt or bolt, etc.), damage and leaks.

- F. Check for abnormality with exhaust gas, noise and vibration.

2. Servicing following initial 50 hours of operation.

- A. 1. Renewal of engine lube oil and filter  
2. Renewal of transmission lubricant  
(HBW units 25 hours).

- B. Replacement of fuel filters.

1. Secondary spin-on.  
2. Electric fuel pump filter.

- \*C. Tightening of bolts and nuts.

- \*D. Adjustment of valve clearance Intake & Exhaust - 0.2 - 0.3mm  
(.009 - .012 inches).

- E. Check security of all electrical connections.

- F. Adjust belt tensions.

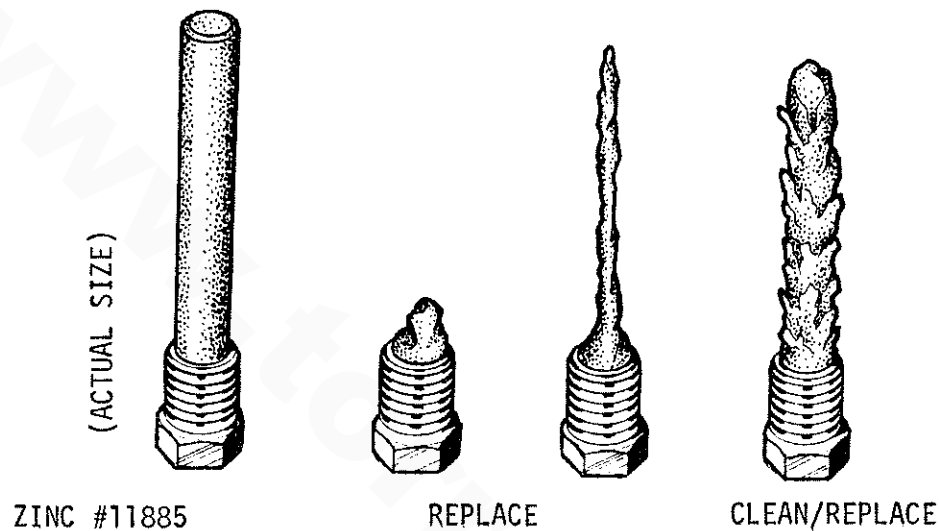
- G. Check security of propeller shaft coupling, both to transmission flange and shaft to couplings.

- H. Adjust engine idle speed, if needed.

I. Check condition of zinc anode in heat exchanger.

Should material be flaking off the zinc, it should be scraped clean, or be replaced by a good solid zinc pencil.

If it appears that a lot of material has been flaking off the zinc, then it is advised that the end cap of the exchanger be removed, and the flaked material be cleaned from that area of the exchanger. A new end cap gasket should be on hand in case it is needed when replacing the end cap.



\*J. Check for proper movement and security of throttle and shift linkage.

3. Servicing at every 100 hours of operation.

- A. Renewal of engine oil.
- B. Replacement of oil filter.

4. Servicing at every 200 hours of operation.

- A. Replacement of engine mounted fuel filter elements.
- B. Replacement of fuel filter (cartridge type).

5. Servicing at every 500 hours of operation.

- A. Adjustment of engine idle, if necessary.

\*B. Tightening of bolts and nuts.

\*C. Adjustment of valve clearance.

\*D. Checkup of glow plugs.

Check glow plugs for blow out. Do resistance check.

E. Removal of cooling water and flushing is suggested.

F. Lubricate fresh water pump  
(Grease fitting - refill capacity 1.2 cu. in.)

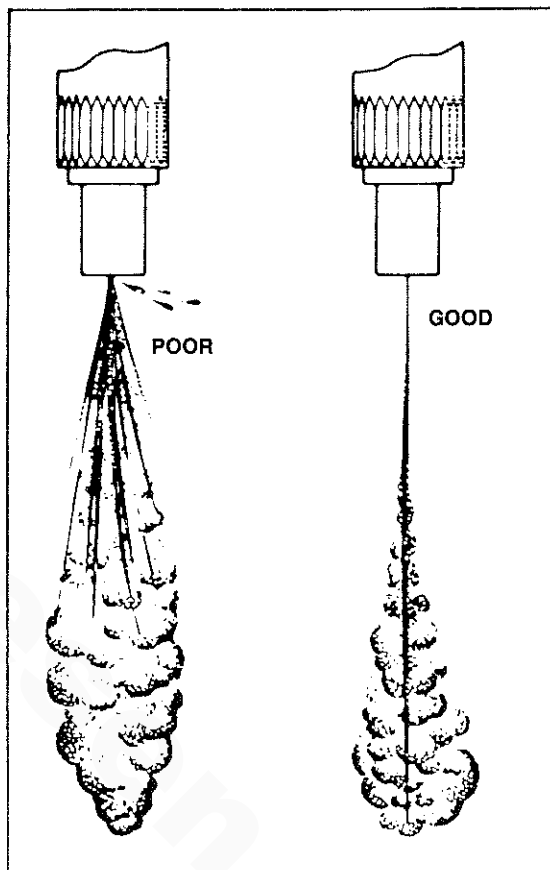
6. Servicing at ever 800 hours of operation.

\*A. Checkup of nozzles.

Set the injection starting  
+142  
pressure to 1706 -0 psi  
and eliminate undesirable  
injection conditions in-  
cluding "after dripping".

\*B. Check Compression pressure

Remove each glow plug and  
check cylinders, one by  
one, using a compression  
pressure gauge. If the  
pressure differs by more  
than  $3.0\text{kg/cm}^2$  (42.7 psi)  
between cylinders or if  
the cylinder pressure is  
less than  $30\text{kg/cm}^2$   
(427.0 psi) at 200 RPM,  
correct it.



\*C. Fuel injection adjustment.

In case of severe vibration during idling, have it repaired  
at an authorized distributor or dealer which is equipped with  
a pump tester.

\*D. Check tightness of nuts and bolts.

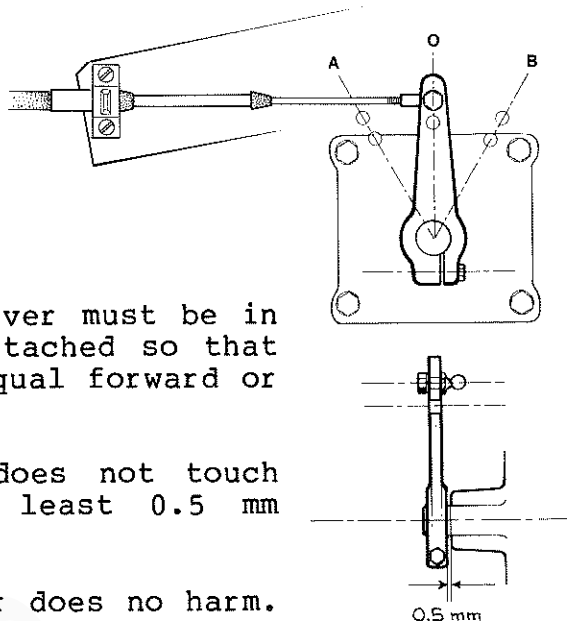
\*E. Check up of starter motor and alternator.

HBW TRANSMISSIONS

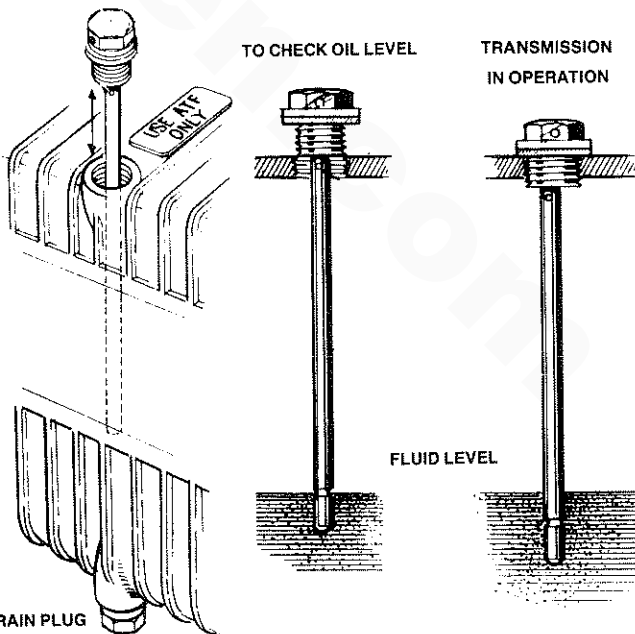
All HBW models turn right hand propellers.  
 All HBW models have their own oil sumps and dipsticks.  
 All HBW models use ATF lubricant.  
 All HBW models should be shifted into gear in one swift motion - not allowed to slip in slowly.

Control of gearbox -

1. The gearbox is suitable for single lever remote control using 33C cable.
2. The cable should attach at right angles to the actuating lever using the cable bracket supplied.
3. Both gear box lever and remote lever must be in neutral position when cable is attached so that travel of gearbox lever will be equal forward or reverse.
4. Check that actuating lever hub does not touch cover plate hub. Maintain at least 0.5 mm (0.002") clearance.

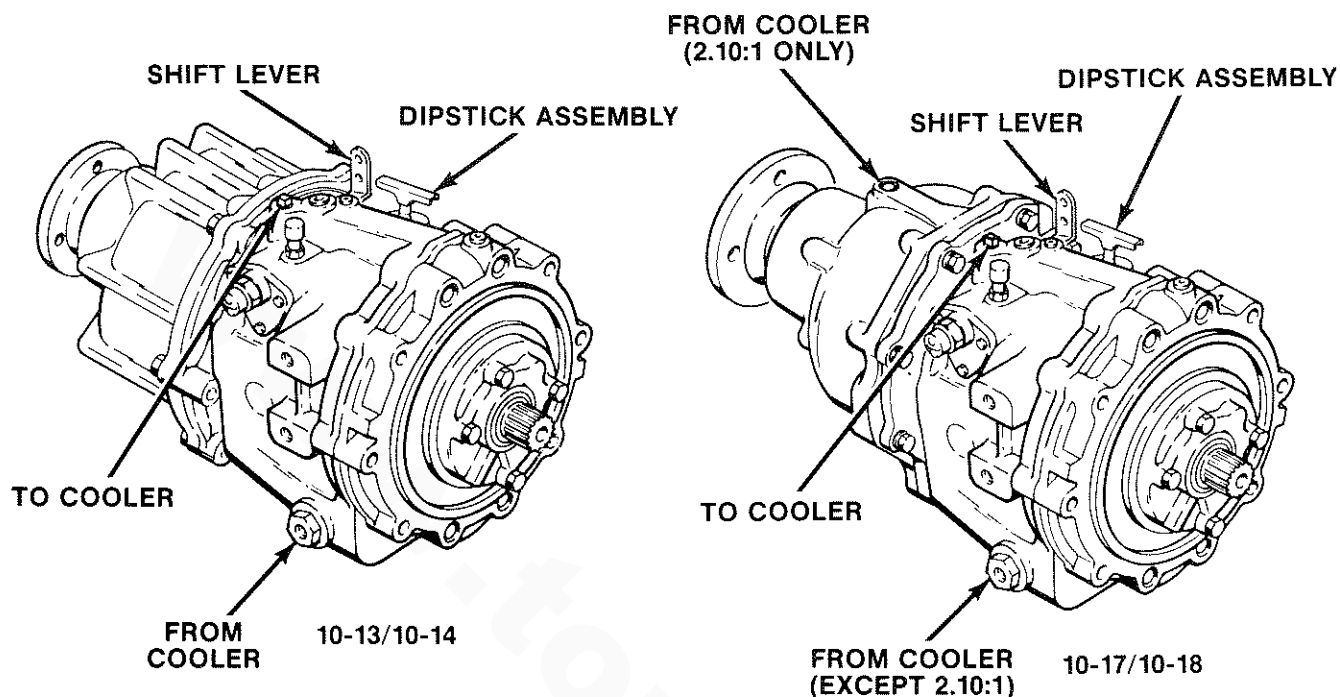


5. Over travel of the actuating lever does no harm. However, if the travel is too short to give full engagement, premature wear, excessive heat generation and gear failure may result.
6. The position of the cover plate underneath the actuating lever is factory adjusted to ensure equal lever travel from neutral to A and B. DO NOT LOOSEN THE CAPSCREWS HOLDING THIS ASSEMBLY. Doing this voids transmission warranty.



7. Fill gearbox with automatic transmission fluid to the level indicated by the dipstick mark. (Study illustrations adjacent.)
8. Note that to check oil level, the dipstick drops on the housing. It does not screw in.

WARNER HYDRAULIC TRANSMISSIONS



1. CONTROL LEVER POSITION

The position of the control lever on transmission when in forward should be shifted to the point where it covers the letter "F" on the case casting, and is located in its proper position by the poppet ball. The Warranty is cancelled if the shift lever poppet spring and/or ball is permanently removed, or if the the control lever is changed in any manner, or repositioned, or if linkage between remote control and transmission shift lever does not have sufficient travel in both directions. This does not apply to transmissions equipped with Warner Gear electrical shift control.

2. LUBRICATION

The properties of the oil used in the transmission are extremely important to the proper function of the hydraulic system. Therefore, it is extremely important that the recommended oil, automatic transmission fluid (ATF), Type A or Dexron II be used.

NOTE: Be sure the cooler is properly installed and the transmission contains oil before cranking or starting the engine.

### 3. FILLING AND CHECKING THE HYDRAULIC SYSTEM

The oil level should be maintained at the full mark on the dipstick. Check oil level prior to starting engine. Check daily before starting engine. The hydraulic circuit includes the transmission, oil cooler, cooler lines and any gauge lines connected to the circuit. The complete hydraulic circuit must be filled when filling the transmission and this requires purging the system of air before the oil level check can be made. The air will be purged from the system if the oil level is maintained above the pump suction opening while the engine is running at approximately 1500 RPM. The presence of air bubbles on the dipstick indicates that the system has not been purged of air.

New applications or a problem installation should be checked to insure that the oil does not drain back into the transmission from the cooler and cooler lines. Check the oil level for this drain back check only, immediately after the engine has been shut off and again after the engine has been stopped for more than one hour (overnight is excellent). A noticeable increase in the oil level after this waiting period indicates that the oil is draining from the cooler and cooler lines. The external plumbing should be changed to prevent any drain back.

### 4. STARTING ENGINE

Move the shift lever to the center position where the spring-loaded ball enters the chamfered hole in the side of the shift lever and properly locates lever in neutral position before starting engine.

### 5. SHIFTING

Shifts from any selector position to any other selector position may be made at any time and in any order if the engine speed is below 1000 RPM; however, it is recommended that all shifts be made at the lowest feasible engine speed. Move the shift lever to the extreme forward position where the spring loaded ball enters the chamfered hole in the side of the shift lever and properly locates lever in forward position.

Move transmission shift lever to the extreme rearward position where the spring-loaded ball enters the chamfered hole in the side of the shift lever and properly locates it in the reverse position.

### 6. FREEWHEELING

Under sail with the propeller turning, or at trolling speeds with one of two engines shut down, the design of the gear maintains adequate cooling and lubrication.



## 7. COOLING PROBLEMS

Water passages inside of the cooler will sometimes become clogged, and this will reduce cooling capacity and cause overpressuring. Back flushing of the cooler will sometimes help to flush the foreign material from the cooler passages. The cooler and hose should be thoroughly flushed or replaced in the event a failure has occurred. Metallic particles from the failure tend to collect in the case of the cooler and gradually flow back into the lube system. Replace oil cooler to prevent contamination of the new transmission.

Water hoses may collapse and reduce or completely shut off all flow to the cooler. Collapsed hoses are usually caused by aging of the hoses or improper hose installation. Hose installation should be made with no sharp bends. Hoses should be routed so there is no possibility for engine shifting to cause hoses to pull loose or become pinched. A visual inspection of hoses while under way will sometimes allow detection of faulty hoses.

Reduction or complete loss of water flow can be caused by a faulty water pump. A rubber water pump impeller will sometimes fail and after such a failure the cooler passages may be restricted by the particles of rubber from the failed impeller. Water pump cavitation may be caused by improper or faulty plumbing or an air leak on the inlet side of the pump. The water pump may not prime itself or may lose its prime when inlet plumbing is not properly installed.

It is possible for cross leaks to occur inside the cooler, permitting oil to flow into the water or water flow into the oil.

## ROUTINE CHECKS AND MAINTENANCE

### ANNUAL CHECKS

1. PROPELLER AND OUTPUT SHAFT ALIGNMENT: This check should also be made any time the propeller strikes a heavy object and after any accident where the boat is stopped suddenly. Shaft alignment should also be checked after the boat has been lifted by a hoist or moved on a trailer.
2. SHIFT LEVER POSITIONING: The selector controls must position the shift lever exactly in F, N and R selection positions with the ball poppet centered in the shift lever hole for each position.
3. BOLT TORQUE: Check all bolts for tightness.
4. COOLER CONNECTIONS: Check water lines, oil lines and connections for leakage. Make sure lines are securely fastened to prevent shifting.
5. CHANGING OIL: A seasonal oil change is recommended in pleasure boats. Work boats require more frequent changes. Change oil any time the oil becomes contaminated, changes color or becomes rancid smelling. Automatic transmission fluids (ATF), Type A is recommended for use.

### DAILY CHECKS

1. Check transmission oil level.
2. Check for any signs of oil leakage in the bellhousing, at gasket sealing surfaces or at the output shaft oil seal.
3. A quick visual check of the general condition of the equipment may cause faulty equipment to be detected.
4. Listen for any unusual noises and investigate to determine the cause of any such noises.

### WINTER STORAGE

1. Drain water from transmission oil cooler. This will prevent freezing in cooler climates, and prevent harmful deposits from collecting.

### GENERAL CHECKS

1. Check coupling alignment each time a transmission is replaced in the boat.
2. Check shift linkage adjustment to insure that the transmission

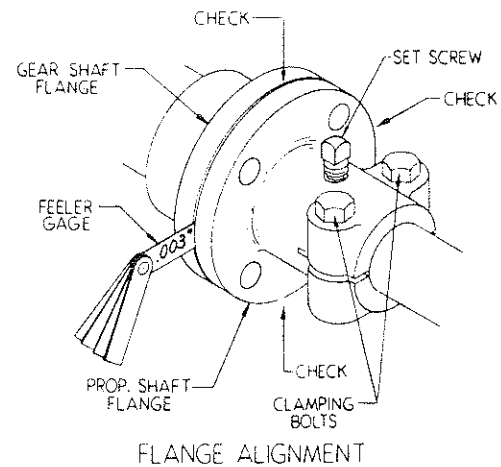
shift lever is positioned so that the spring loaded ball enters the chamfered hole in the side of the shift lever.

3. Connect an oil cooler into the cooler circuit before cranking or starting the engine. Various cooler circuits have been used and the correct cooler connections should be found from service literature prior to making the cooler installation.
4. Use a cooler of sufficient size to insure proper cooling.
5. Check engine rotation and transmission pump setting and the propeller rotation prior to assembling the transmission to engine.
6. Check oil pressure and temperature when transmission function indicates that a problem exists.
7. Use the recommended fluid for filling the transmission.
8. Fill the transmission prior to starting the engine.
9. Check oil level immediately after the engine has been shut off.
10. Use a clean container for handling transmission fluid.
11. Replace cooler line after a transmission failure, prior to installing a new or rebuilt transmission.
12. Check fluid level at operating temperature.

## WALTER V-DRIVES

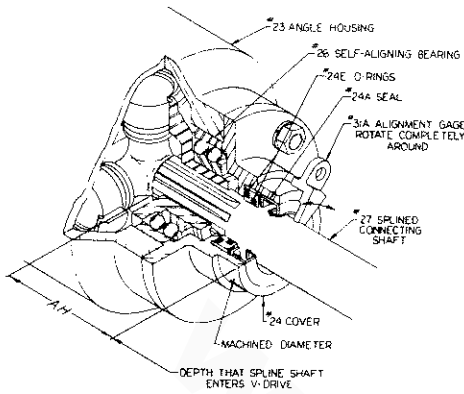
## FLANGE ALIGNMENT - DIRECT COUPLED MODELS

Install the propeller shaft flange on to the propeller shaft and tighten the two clamping bolts on the split hub (none on RV-10D). A self-locking set screw is provided for the propeller shaft flange. Spot drill the propeller shaft and then securely tighten the set screw. Many good installations are ruined by improper shaft flange alignment. Accurate alignment will ensure a smooth operating drive train and eliminate many problems that arise due to misalignment. Final alignment should not be attempted until the boat has been allowed to "settle" in the water. After the engine has been installed, adjust the mounts per manufacturer's instructions until the pilot diameters of the gear shaft flange and the propeller shaft flange engage freely. Butt the flange faces together. Without rotating either flange, check with a feeler gauge in at least four places as shown in the illustration. If the maximum feeler gauge that can slip between the flange faces at any point is .003", the unit is properly aligned. If a thicker gauge can be inserted at any point, the engine must be readjusted until proper alignment is obtained. Turn the propeller shaft flange 1/4 of a turn without moving the gear shaft change. Try inserting the .003" feeler gauge as described above. The gap will not change if the propeller shaft is straight. If it increases, the shaft or flange is bent and must be removed and straightened. Rotate the propeller shaft flange in two more 1/4 turn increments and repeat the procedure. The pilot diameters must be rechecked to ensure that they still engage freely. Secure the two flanges together with the heat treated bolts and special high collared lockwashers supplied.



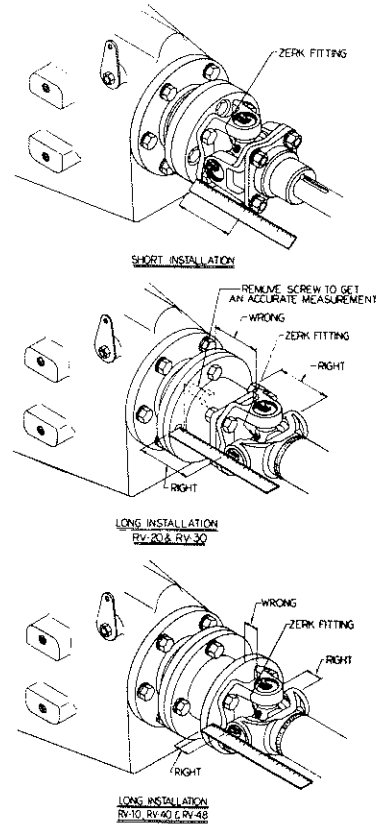
## ENGINE ALIGNMENT - INDEPENDENT MODELS

The engine must be adjusted so that the alignment of the flexible joint is within 3°. An accurate steel rule should be used for this purpose as shown in the illustration. On short installations using a flexible joint assembly, the faces of the flexible joint must be parallel within 1/8". Measure this in at least four places around the diameter without rotating the assembly. With long installations using the #36 tubular drive shaft (also on all RV-10D's) the distance from the #33A spool adapter to the bores in the universal joint which is welded to the tubular shaft must be measured on both sides of the joint. Rotate the shaft exactly 1/4 of a turn and measure to the same joint. The four distances must be equal within 1/8". (Do not measure



to the joint end that is on the spool adapter. This distance will not vary with misalignment since the joint is bolted and cannot move.) Put the #31A alignment gauge on the machined diameter of the #24 cover and slide it completely around. It will indicate how the engine must be moved to center the spline shaft in the oil seal. Re-measure the joints to see if

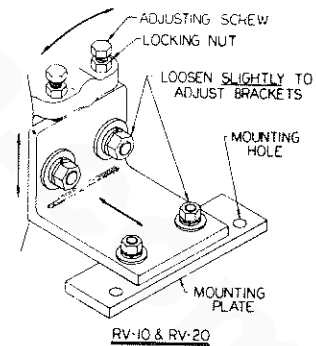
they are still parallel within 1/8". It is important that both alignments be checked thoroughly. It is possible for the spline shaft to be perfectly centered and the flexible joint to be out more than 3". Premature failure of the #26 self-aligning bearing and seals may occur due to misalignment. The zerk fitting (located on the cross of the universal joint) should be greased with a light alemite lubricant. The above procedure should be repeated after the boat has been placed in operation. It is possible for the engine to slightly shift and settle, especially if it has rubber mounts.



**FLANGE ALIGNMENT - INDEPENDENT MODELS**

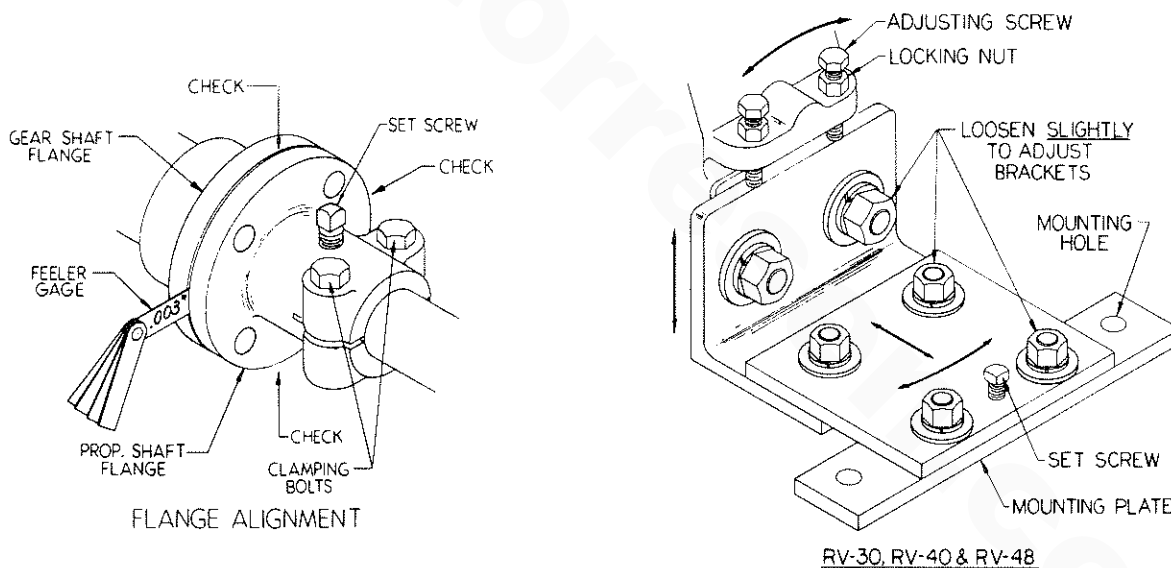
Install the propeller shaft flange on to the propeller shaft and tighten the two clamping bolts on the split hub (none on RV-10). A self-locking set screw is provided for the propeller shaft flange. Spot drill the propeller shaft and securely tighten the set screws.

All V-drives are supplied with 3-way adjustable mounting brackets (2-way on the RV-10 and RV-20) as standard equipment. The brackets must face downward as shown in the illustration to properly absorb propeller thrust. The mounting plates can be removed and reversed to fit wider engine bed centers. Before installing the V-drive, loosen all the nuts on the mounting brackets and check to see that the studs are in the center of the slots. Re-tighten the nuts. Place the V-drive on the engine bed, lining it up "by eye" to the propeller shaft flange as closely as possible. Firmly bolt it down through the holes provided in the mounting plates. Loosen the locking nuts on the adjusting screws. Slightly loosen the nuts on the mounting brackets just enough to be able to move the V-drive.



Many good installations are ruined by improper propeller shaft flange alignment. Accurate alignment will ensure a smooth operating

drive train and eliminate many problems that arise due to misalignment. Final alignment should not be attempted until the boat has been allowed to "settle" in the water. Adjust the V-drive until the pilot diameters of the gear shaft flange and the propeller shaft flange engage freely. Butt the flange faces together. Without rotating either flange, check with a feeler gauge in at least four places as shown in the illustration. If the maximum feeler gauge that can slip between the flange faces at any point is .003", the unit is properly aligned. If a thicker gauge can be inserted at any point, the V-drive must be readjusted until proper alignment is obtained. Turn the propeller shaft flange 1/4 of a turn without moving the gear shaft flange. Try inserting the .003" feeler gauge as described above. The gap will not change if the propeller shaft is straight. If it increases, the shaft or flange is bent and must be removed and straightened. Rotate the propeller shaft flange in two more 1/4 turn increments and repeat the procedure. The pilot diameters must be rechecked to ensure that they still engage freely. Tighten the nuts on the mounting brackets and the locking nuts on the adjusting screws. Remove the set screws from the brackets (none on RV-10 or RV-20), spot drill and securely tighten. Recheck the flange alignment to make sure the V-drive did not move out of alignment. Secure the two flanges together with the heat treated bolts and special high collared lock-washers supplied.



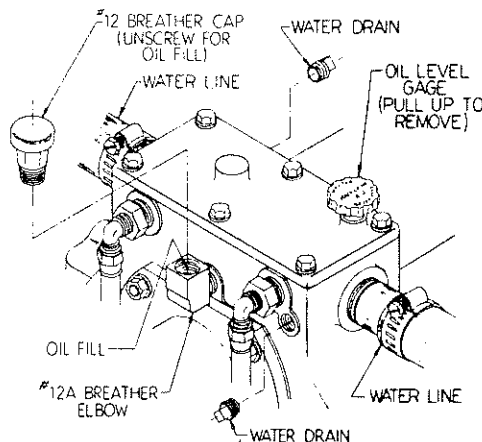
#### WATER AND SWITCH CONNECTIONS

Hook up the water lines to the two pipe connections on the V-drive (intake and exhaust lines are interchangeable). Generally, one line from the seacock to the V-drive and another from the V-drive to the intake of the engine water circulating pump are utilized. In some cases, scuppers through the hull are connected to and from the V-drive to provide independent water-cooling and are actuated by the movement of the water. With closed cooling systems, the V-drive should be incorporated into the system between the cooler and the suction side of the water pump. Proper operating temperatures are from 140° to

180°F, although safe operating temperatures may be as high as 210°F. On the models equipped with an oil circulating pump, the #49 oil pressure drop switch and the 12 volt #49A warning light should be hooked up per the wiring diagram. The switch may be grounded to any part of the V-drive or engine (either terminal may be used for the ground).

**OIL FILL**

Pull out the #21 oil level gauge. Unscrew the #12 breather cap and fill the V-drive with SAE #30 motor oil through the #12A breather elbow. On the RV-10 only, the oil may be added by removing the plug in the #6D top cover. See table below for approximate oil capacities. The amount varies with the angle of installation. The oil level should be checked with the oil level gauge fully inserted in the unit. The proper level is between the "H" and "L" marks on the gauge. Add a 2 ounce tube of Molykote (molybdenum disulfide), which is supplied with each V-drive for extra lubrication and break-in. It provides protection against scoring or galling of gears, bearings and other moving parts. Additional Molykote after break-in is not required. Reinstall the breather cap. The oil level should be rechecked after the unit has been run and allowed to sit for about a minute. Add oil if necessary.



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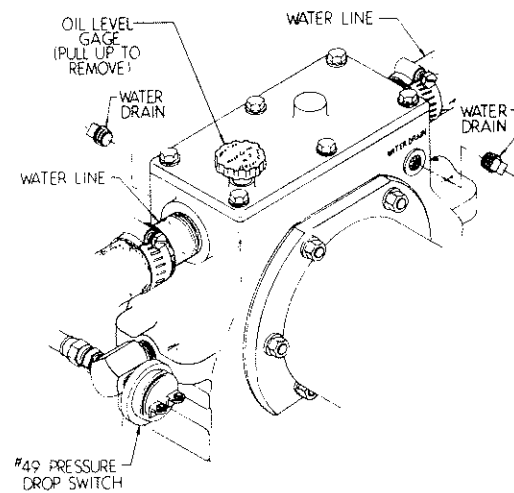
	RV-10	RV-20	RV-30	RV-40	RV-48
Oil capacity (Approx.)	1 pint	2 pints	3 pints	4 pints	4 pints

**DEALER PREPARATION**

The propeller shaft and engine alignment must be checked and corrected, if necessary, before the boat is delivered. Final alignment should not be attempted until the boat is allowed to "settle" in the water. The oil level must be checked and oil added if required. While the boat is being run, the water connections should be checked for leaks. The oil pressure drop switch and warning light (if the V drive is equipped with an oil circulating pump) should be checked for proper operation. Do not transport the boat with the propeller shaft coupling connected. Damage to the shaft, shaft log and V-drive can result.

## OPERATION

A pressure drop warning light is mounted on the instrument panel on V-drives equipped with an oil circulating pump. The warning light will stay on until the boat gets under way and the engine speed increases to sufficient RPM for the pump to maintain pressure. This normally occurs at approximately 1200 RPM, but the actual speed may vary by as much as 400 RPM. Extended cruising at low RPM, such as when trolling, is not harmful to the V-drive, even though the warning light may stay lit. Normal operation is between 6 to 12 PSI. The light will go on when the oil pressure drops below 2 PSI. Loss of oil and/or insufficient oil level are the major causes of pressure drop. The oil level should immediately be restored, and while running the boat, the unit should be checked for leaks. If the oil level is normal and the light stays lit when the boat reaches normal cruising speed, the wiring should be checked for loose and/or corroded connections. If the wiring is correct and the light remains lit, the #49 pressure drop switch, which is mounted on the side of the V-drive (see illustration), should be checked for proper operation. The switch can easily be removed and an accurate oil pressure gauge installed in its place. If the pressure is normal, the switch should be replaced. If the pressure is below normal, the oil lines should be checked for blockage. The pump should be inspected and replaced if necessary. The pump is standard on the RV-48 and an optional feature on other models (not available on the RV-10).



The oil level should be checked several times during the season, especially on V-drives without pumps (see OIL FILL).

A clatter or rattle in the V-drive at low RPM is due to the over-riding of the propeller during the compression stroke of the engine. Although annoying, it is not harmful. It may be reduced by adjusting the idle speed and/or tuning up the engine for smoother operation.

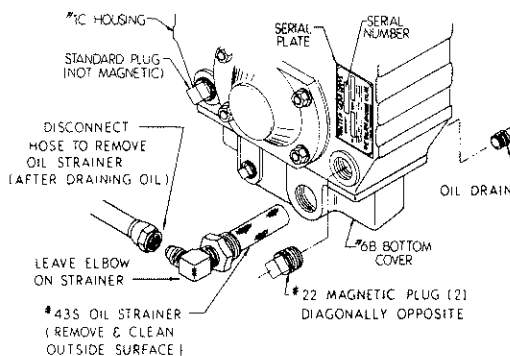
## MAINTENANCE

### 1. OIL CHANGE AND JOINT LUBE

After the first 100 hours of operation and every season and/or 500 hours thereafter, the oil should be changed. Run the boat to warm up the V-drive to operating temperature. Turn off the engine. Remove the plug in the #6B bottom cover that is opposite the #43S oil strainer. Reinstall after draining. Disconnect the oil hose leading from the #43S strainer (leave the elbow on the strainer). Unscrew the strainer and clean the outside surface. Reinstall the strainer and reconnect the oil hose. Unscrew the two #22 magnetic plugs that are located on diagonally opposite corners of the #1C main housing.



The plugs can be checked to see if they are magnetic only after removal. Touch the inside face with a metallic object, such as a screwdriver. Clean them and reinstall. Usually, there are four plugs in the bottom part of the main housing. Only two of these are magnetic. The other two need not be removed (see illustration). Refill with SAE 30 motor oil to the proper level (see INSTALLATION - OIL FILL). The Zerk fitting on the external universal joint should be greased with a light alemite lubricant (see ENGINE ALIGNMENT).



## 2. WATER DRAIN

For protection from freezing during winter lay-up, remove the small pipe plugs (located diagonally opposite) on the front and back of the housing marked "Water Drain" (see illustration). On the RV-10 only, one of the water lines going into the #6 water-cooled bottom cover must be disconnected to drain the water.

## 3. FLANGE AND ENGINE REALIGNMENT

When the boat is launched after being in drydock, the line-up of the V-drive to the propeller shaft flange and the engine to the V-drive should be rechecked and corrected if necessary. Some engines with rubber mounts may sag and must be raised with adjustments or shims for proper alignment (see "Flange Alignment" and "Engine Alignment").

ENGINE TROUBLESHOOTING

PROBLEM	REMEDY
<b>1. ENGINE DOES NOT START</b>	
a. Starting switch is defective	Correct connections and contacts
b. Deficient drive torque of the starter motor	The battery is exhausted, trouble with the starter motor, or dirty or loose wiring
c. Improper viscosity of engine oil	Check the viscosity and renew oil if necessary
d. Engine too cold	Use glowplug starting aid
e. Seizure of moving parts	Rectify
f. Air present in fuel system	Purge thoroughly with electric fuel pump
g. No fuel in fuel tank	Refill
h. Fuel filter clogged	Clean or renew
i. 20 Amp circuit breaker tripped	Manually reset
<b>2. ENGINE STALLS WHILE IN OPERATION</b>	
a. Fuel tank is empty	Refill
b. Fuel filter clogged	Clean or renew
c. Air present in fuel system	Retighten fuel line connections and allow electric fuel pump to run long enough to purge air thoroughly
<b>3. IMPROPER OIL PRESSURE</b>	
a. Oil shortage	Refill
b. Oil leak through connections	Repair
c. Oil pressure sender defective	Replace
d. Oil filter clogged	Replace
<b>4. ENGINE OVERHEATING</b>	
a. Cooling water shortage	Refill
b. Water leaks	Repair
c. Belt loose or smeared with oil	Clean or renew
d. Raw water pump defective	Repair or renew
e. Thermostat defective	Replace
<b>5. BATTERY IS UNDERCHARGED</b>	
a. Belt tension improper	Rectify
b. Faulty wiring circuit	Rectify
c. Alternator not functioning (observe voltmeter)	Replace
d. Battery faulty	Replace
e. Faulty voltage regulator	Repair or renew

TORQUE SPECIFICATIONS

	<u>Kg-m</u>	<u>lb-ft</u>
Cylinder head bolts		
Exhaust side	11.5 - 12.5	83.2 - 90.5
Intake side	10.0 - 11.0	72.4 - 79.6
Main bearing cap	8.0 - 9.0	57.9 - 65.2
Connecting rod bearing caps	5.0 - 6.0	36.2 - 43.4
Rocker shaft bracket	1.0 - 2.0	7.2 - 14.5
Front plate bolts	.7 - 1.5	5.1 - 10.8
Timing gear cover	.7 - 1.5	5.1 - 10.8
Camshaft thrust plate	1.5 - 2.3	10.8 - 16.6
Idle thrust plate	3.0 - 4.0	21.7 - 28.9
Crankshaft pulley	39.5 - 40.5	285.7 - 292.9
Backplate to block	3.0 - 3.5	21.7 - 25.3
Rear oil seal	0.4	2.9
Flywheel bolts	8.0 - 9.0	57.9 - 65.2
Oil pan bolts	0.7	5.1
Banjo bolt - oil drain hose	9.5 - 10.5	68.7 - 75.9
Injector retaining nut	4.5 - 5.5	32.5 - 39.8
Injection pump delivery valve holder	2.5 - 3.5	18.1 - 25.3

UNLESS OTHERWISE INDICATED

	<u>Pitch</u>	<u>kg-m</u>	<u>lb-ft.</u>
<b>Grade 4T</b>			
6mm bolt/nut	1	0.4 - 0.7	2.9 - 5.1
8mm bolt/nut	1.25	1.0 - 1.6	7.2 - 11.6
10mm bolt/nut	1.25	1.9 - 3.1	13.7 - 22.4
10mm bolt/nut	1.5	1.8 - 3.0	13.0 - 21.7
12mm bolt/nut	1.25 (ISO)	3.5 - 5.5	25.3 - 39.8
12mm bolt/nut	1.5	3.5 - 5.5	25.3 - 39.8
12mm bolt/nut	1.75	3.0 - 5.0	21.7 - 36.2
13mm bolt/nut	1.5	4.5 - 7.1	32.5 - 50.6
14mm bolt/nut	1.5	5.0 - 8.0	36.2 - 57.9
14mm bolt/nut	2	4.7 - 7.7	34.0 - 55.7
16mm bolt/nut	1.5	7.5 - 11.2	54.2 - 79.6
16mm bolt/nut	2	7.1 - 10.6	51.4 - 76.7
<b>Grade 6T</b>			
6mm bolt/nut	1	0.6 - 0.9	4.3 - 6.5
8mm bolt/nut	1.25	1.5 - 2.2	10.8 - 15.9
10mm bolt/nut	1.25	3.0 - 4.5	21.7 - 32.5
10mm bolt/nut	1.5	2.7 - 4.2	19.5 - 30.4
12mm bolt/nut	1.25 (ISO)	5.0 - 8.0	36.2 - 57.9
12mm bolt/nut	1.5	5.0 - 7.0	36.2 - 50.6
12mm bolt/nut	1.75	4.8 - 6.8	34.7 - 49.2
<b>Grade 7T, 8T and 8.8</b>			
6mm bolt/nut	1	0.8 - 1.2	5.8 - 8.7
8mm bolt/nut	1.25	2.0 - 3.0	14.5 - 21.7
10mm bolt/nut	1.25	4.0 - 5.5	28.9 - 39.8
10mm bolt/nut	1.5	3.7 - 5.2	26.8 - 37.6
12mm bolt/nut	1.25 (ISO)	7.5 - 10.5	54.2 - 75.9
12mm bolt/nut	1.5	7.0 - 9.0	50.6 - 65.1
12mm bolt/nut	1.75	6.0 - 8.5	43.4 - 61.5
13mm bolt/nut	1.5	8.0 - 12.0	57.9 - 86.8
14mm bolt/nut	1.5	10.0 - 15.0	72.3 - 108.5
14mm bolt/nut	2	9.5 - 14.0	68.7 - 101.3
16mm bolt/nut	1.5	15.0 - 23.0	108.5 - 166.4
16mm bolt/nut	2	14.0 - 22.0	101.3 - 159.1
<b>Grade 5 capscrew</b>			
1/4 UNC		1.2 - 1.5	9 - 11
1/4 UNF		1.5 - 1.8	11 - 13
5/16 UNC		2.5 - 2.8	18 - 20
5/16 UNF		2.9 - 3.2	21 - 23
3/8 UNC		3.7 - 4.6	28 - 33
3/8 UNF		4.1 - 4.8	30 - 35
7/16 UNC		6.1 - 6.8	44 - 49
7/16 UNF		6.9 - 7.6	50 - 55
1/2 UNC		9.4 - 10.1	68 - 73
1/2 UNF		10.1 - 11.1	73 - 80

COMMON PARTS BY NUMBER

DESCRIPTION	PART NUMBER	NUMBER REQUIRED PER ENGINE
Fuel Hardware Kit, including banjo washers, injector seat washers	34441	1
Lift Pump Filter & Gasket	30548	1
Fuel Filter	24363	1
Lube Oil Filter	35828	1
Glow Plugs	34380	4
Sea Water Pump	16423	1
Sea Water Pump Mounting Gasket	11143	1
Sea Water Pump Repair Kit	18172	1
Sea Water Pump Impeller & Gasket Kit	33104	1
Alternator Belt	30475	1
Thermostat	24688	1
Thermostat Housing Gasket	33966	2
Oil Pressure Alarm Switch	34761	1
Injector	34376	4
Zinc Plugs	11885	1
Spare parts Kit A	34444	1
Spare parts Kit B (extended cruising)	34445	1

**1. Warranty Obligation and Duration**

Westerbeke warrants to the original consumer purchaser that all standard Westerbeke marine engines and generator sets manufactured or supplied by us will be free from defects in material and workmanship for a period of one year: from date of commission, or date of purchase on repower, OR fifteen hundred (1500) hours on Commercial Generators, only (whichever occurs first).

**2. Remedy**

Westerbeke will elect to repair or replace free of charge to you any product or part returned to our factory transportation costs prepaid which we adjudge defective in materials or workmanship. Alternatively, we may reimburse at our discretion a portion of labor costs incurred to repair defective parts or products on site. If you request shipment of replacement parts to you prior to our determination of cause of failure, such shipment will be sent C.O.D.

**3. Notification**

If you encounter a problem with your Westerbeke engine or generator set within the warranty period as stated above, contact your nearest authorized Westerbeke Master Distributor directly, by telephone or letter.

Be prepared to furnish the following information:

- a. number of hours on unit
- b. date of commission, date of purchase
- c. owner's office and home telephone
- d. model number, serial number
- e. name of vessel
- f. present location of vessel or product
- g. name and address of builder
- h. boat model name
- i. who performed prior servicing, installation
- j. description of current problem
- k. any service outlet consulted and their diagnosis

**4. Exclusions**

This warranty shall not apply to:

- a) failures due to wear and tear, misuse, accident or negligence, including but not limited to improper storage or installation, inadequate maintenance, overloading and insufficient lubrication;
- b) consequential harm caused by overheating of engine cooling water or loss of engine lubricating pressure (these conditions should be constantly monitored by engine instruments and/or alarms);
- c) consequential harm caused by improper installation or failure of accessories attached to our product, such as water heaters and refrigeration compressors;
- d) products altered or modified in a manner not authorized in writing by Westerbeke;
- e) products damaged in transit;
- f) replacement of engine fluids, filter elements or vee belts, engine tune-up, valve adjustment, oil and water leaks, or any other normal service items;
- g) specially manufactured products provided to customer specifications;
- h) fuel systems, cooling systems, exhaust systems, electrical systems and cable control systems beyond the connection points on the product.

**5. Application of Warranty**

THIS WARRANTY IS IN LIEU OF ALL OTHER EXPRESS WARRANTIES. ANY WARRANTY IMPLIED BY LAW, INCLUDING WARRANTIES OF MERCHANTABILITY OR FITNESS, IS IN EFFECT ONLY FOR THE DURATION OF THE EXPRESS WARRANTY SET FORTH IN THE FIRST PARAGRAPH ABOVE. NO REPRESENTATIVE OR PERSON IS AUTHORIZED TO GIVE ANY OTHER WARRANTY OR TO ASSUME FOR WESTERBEKE ANY OTHER LIABILITY IN CONNECTION WITH THE SALE OF ITS PRODUCTS. WESTERBEKE WILL NOT BE LIABLE FOR ANY CONSEQUENTIAL DAMAGES RESULTING FROM THE USE OR INSTALLATION OF ITS PRODUCTS.

SOME STATES DO NOT ALLOW LIMITATIONS ON HOW LONG AN IMPLIED WARRANTY LASTS OR THE EXCLUSIONS OR LIMITATION OF INCIDENTAL OR CONSEQUENTIAL DAMAGES, SO THE ABOVE LIMITATIONS AND EXCLUSION MAY NOT APPLY TO YOU. THIS WARRANTY GIVES YOU SPECIFIC LEGAL RIGHTS, AND YOU MAY ALSO HAVE OTHER RIGHTS WHICH VARY FROM STATE TO STATE.

P/N 21479

6/1/83



**J. H. WESTERBEKE CORP.**

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CABLE WESTCORP, AVON-TELEX: 92 4444

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