OPERATOR'S MANUAL

for

WESTERBEKE 46 MARINE ENGINE

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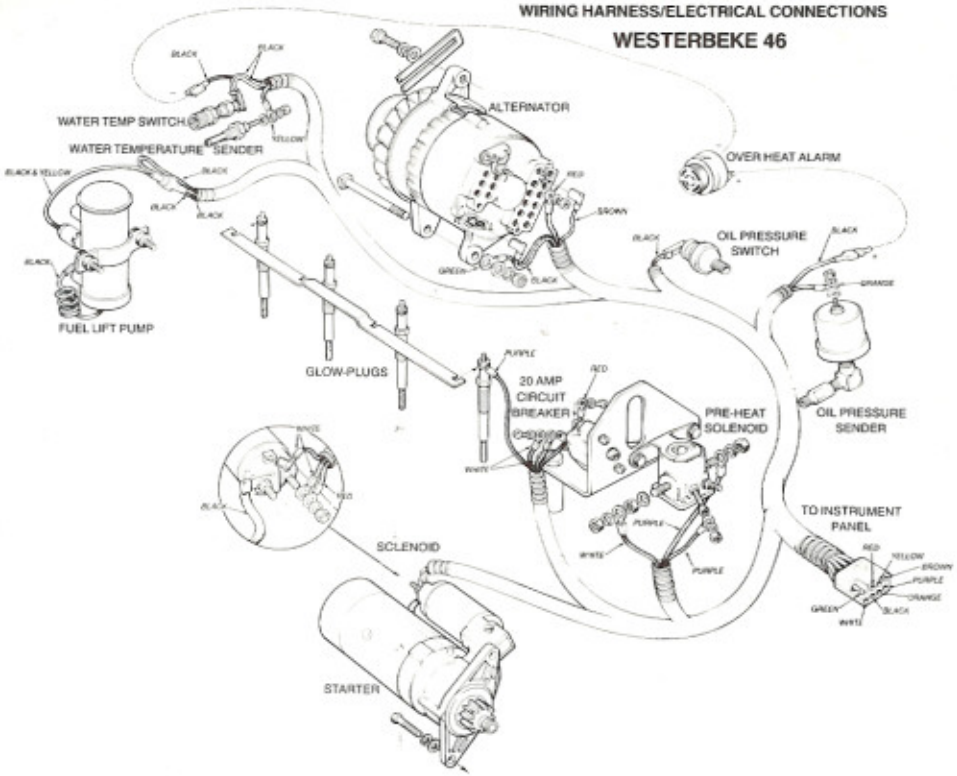
CABLE: WESTCORP, AVON · TELEX: 92-4444

WIRING HARNESS/ELECTRICAL CONNECTIONS

WESTERBEKE 46



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 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 the receipt of your engine, you have not received a Customer Identification Card (see below) registering your warranty, please contact the factory.

We look forward to your continued patronage.

from: J.H. Westerbeke Corp.
Avon Industrial Park
Avon, MA 02322

Mail To:

J. H. WESTERBEKE CORP.
AVON INDUSTRIAL PARK, AVON, MASS. 02322

CUSTOMER IDENTIFICATION
W-46 1234C408 Pleasure Craft
expires 9/15/85

Adam Smith
85 Maple Street
Alden, IN 12234

PN

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GENERAL SPECIFICATIONS

Model	Westerbeke 46
Type	4-cycle, fresh water cooled diesel engine with raw water pump and heat exchanger
# & Arrangement of Cylinders	4, in-line
Bore X Stroke	84 X 90mm (3.30 X 3.70 in.)
Total Piston Displacement	2084cc (127 cu. in.)
Compression Ratio	21 : 1
Firing Order	1 - 3 - 4 - 2
Rotational Direction	Clockwise as viewed from timing gear case
Fuel	# 2 fuel oil (cetane number 45 or more)
Lubricating Oil	Mineral oil, heavy duty, grade CC or CD
Maximum Power	64 horsepower at 3800 RPM
Intermittent Power	47.5 horsepower at 3000 RPM
Westerbeke Rating	46 horsepower at 3000 RPM
Continuous Power	43 horsepower at 3000 RPM
Dry Weight	242kg (535 lbs.)
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 thermostat
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

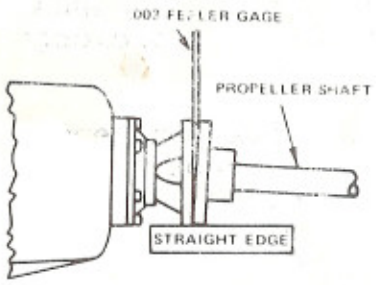
INSTALLATION, PREPARATION AND SUPPLY CAUTIONS

* 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 lubricating oil to full mark on dipstick (Select readily available lubricating oil of grade CC or CD).

* Fill water with suitable mixture of water and antifreeze to suit your temperature zone. See page 16.

* 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.

* Inspect and adjust parts of the engine only after it is stopped.

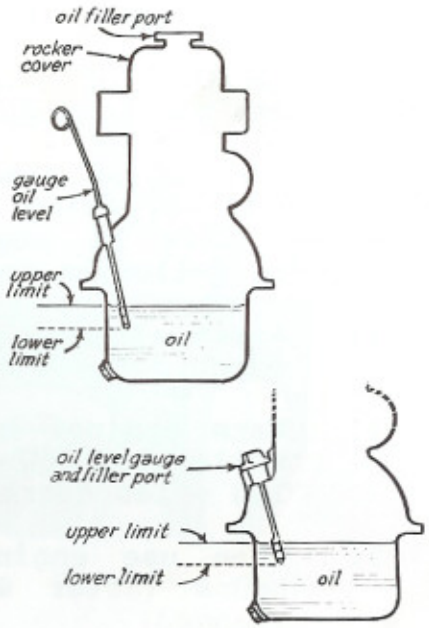
* Check and refill engine oil, cooling water and fuel after the engine is brought to a stop.

* 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 5.

* 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.

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



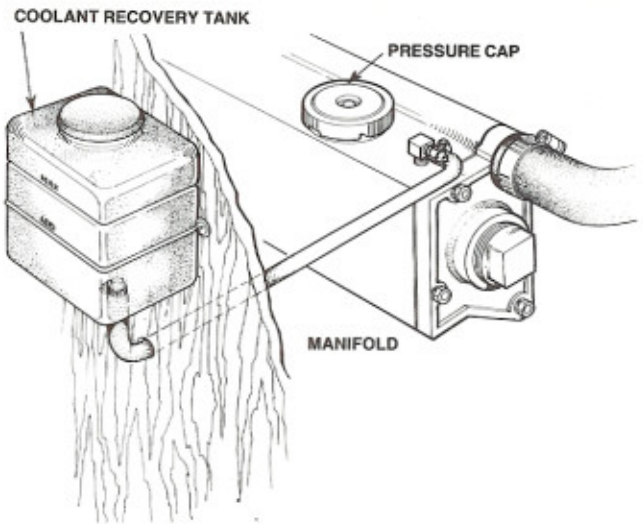
1. Fill your engine with oil up to or near the upper limit on the dipstick. Use a good grade of oil with API specification of CC or better. For quantity of oil, you may refer to the General Specifications page. However, it is best always to be guided by dipstick measurement as angle of installation has some effect.

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 level line. Need for adding coolant is indicated when a cold engine has coolant level below the bottom level line.

   c) In winter add antifreeze as described on page 16. Antifreeze may be used year round if changed annually.



3. Fill the fuel tank with #2 Diesel fuel with 45 Cetane rating. 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 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 hours of operation.

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

1. Start engine, run 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 (60% $\pm$) for first five hours (after which the lube oil filter element should be changed).

4. Avoid rapid acceleration.

5. Use caution not to overload engine. Grey or black smoke is a sign of overload.

6. Next fifteen hours may be run at 70 - 75% load.

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, nor by varying loads with intervals of fast acceleration and/or excessive speed.

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

As indicated above, use a short warm up at idle and put engine under moderate load and speed for the first five hours of operation. For the next fifteen hours, use approximately 70% load. This kind of careful operation will result in best results from your engine.

DESCRIPTION OF STARTING SYSTEM

Model W-46 uses an electric starter assisted by glow plugs for both normal and cold weather starting. Figure 1 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.

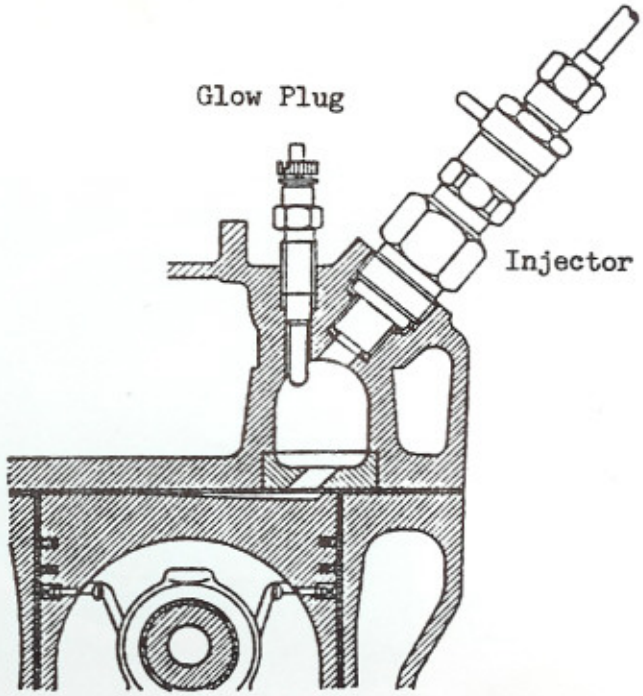


Fig. 1 Combustion chamber

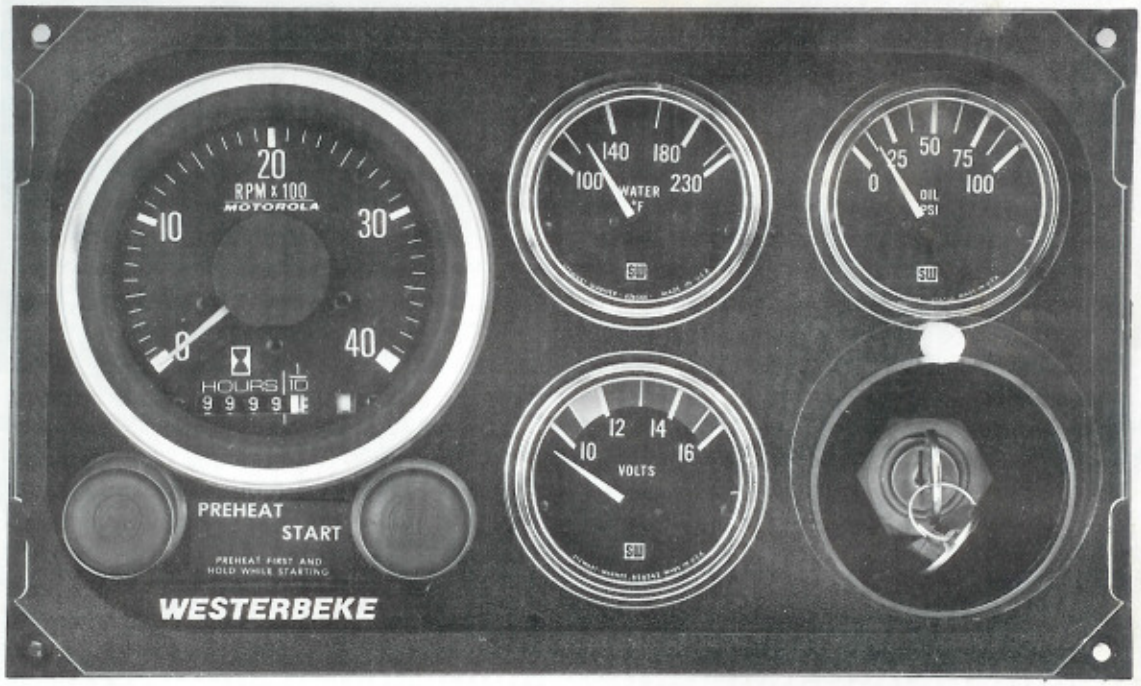
After which, and while keeping the preheat button engaged, the start button is depressed to crank the engine.

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 8 and 9.

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.

STARTING PROCEDURES

1. Advance throttle to full, pressPreheat button and hold for the number of seconds indicated on Page 7 in "Glow Plug Use Data".

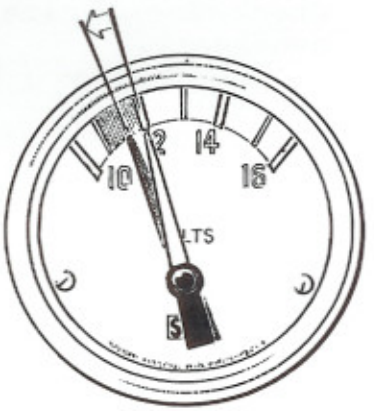
2. While still engaging Preheat button, press start button.

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 moderate speed.

5. Should the engine NOT start even though cranking for 10 seconds, release the start button for 30 seconds and repeat the sequence by preheating 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 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.

8. During engine operation, do NOT press the Start button. This may damage the starter motor.

9. To warm up engine, run a few minutes at idle to make checks in '7' above. Then operate under reduced load (50 to 60 percent) until water temperature rises into the 140° range.

STOPPING PROCEDURES

1. Model W-46 has manual shut-off. A 'T' handle or knob is pulled to shut off fuel. Simply pull the shut-off and hold out until the engine stops completely. Then, PUSH THE STOP CONTROL BACK TO THE RUN POSITION.

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.

3. While an engine alarm buzzer is provided to warn the operator if this happens, the best precaution is always to remove the key.

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.
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 12.)

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 normal 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.

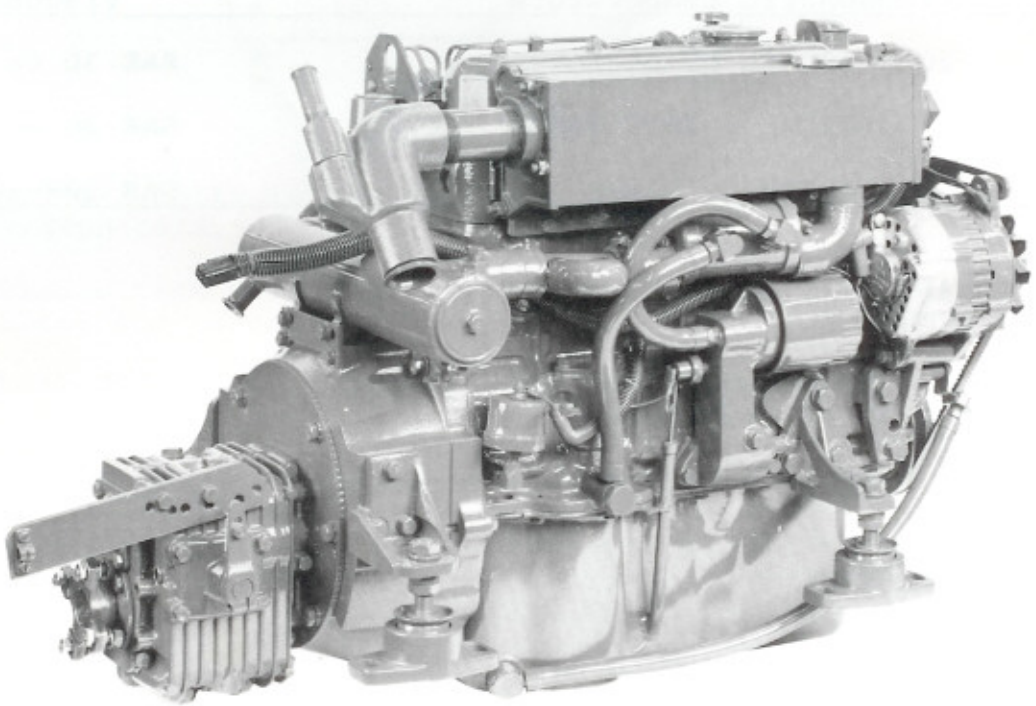


Photo above is right hand side of the W46 with Hurth 2:1 reverse and reduction gear.

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. Do not alternate brands.

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 50 and 70 PSI.

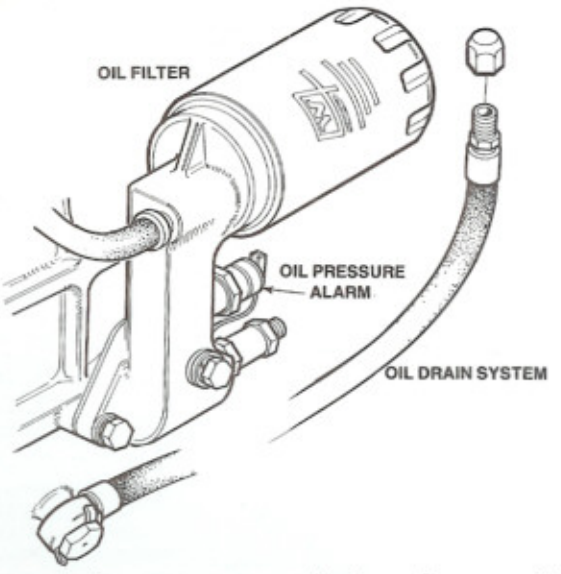
At idle speed.....20 PSI.

At the time of cranking.....Pressure will rise proportionately with speed.

4. Engine oil change

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.

5. 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 fill, run engine to ensure that oil pressure is normal and that there are no oil leaks.

FUEL SYSTEM

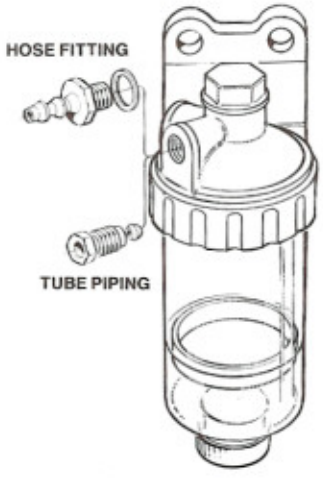
1. Diesel fuel

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.



INSTR. #33009

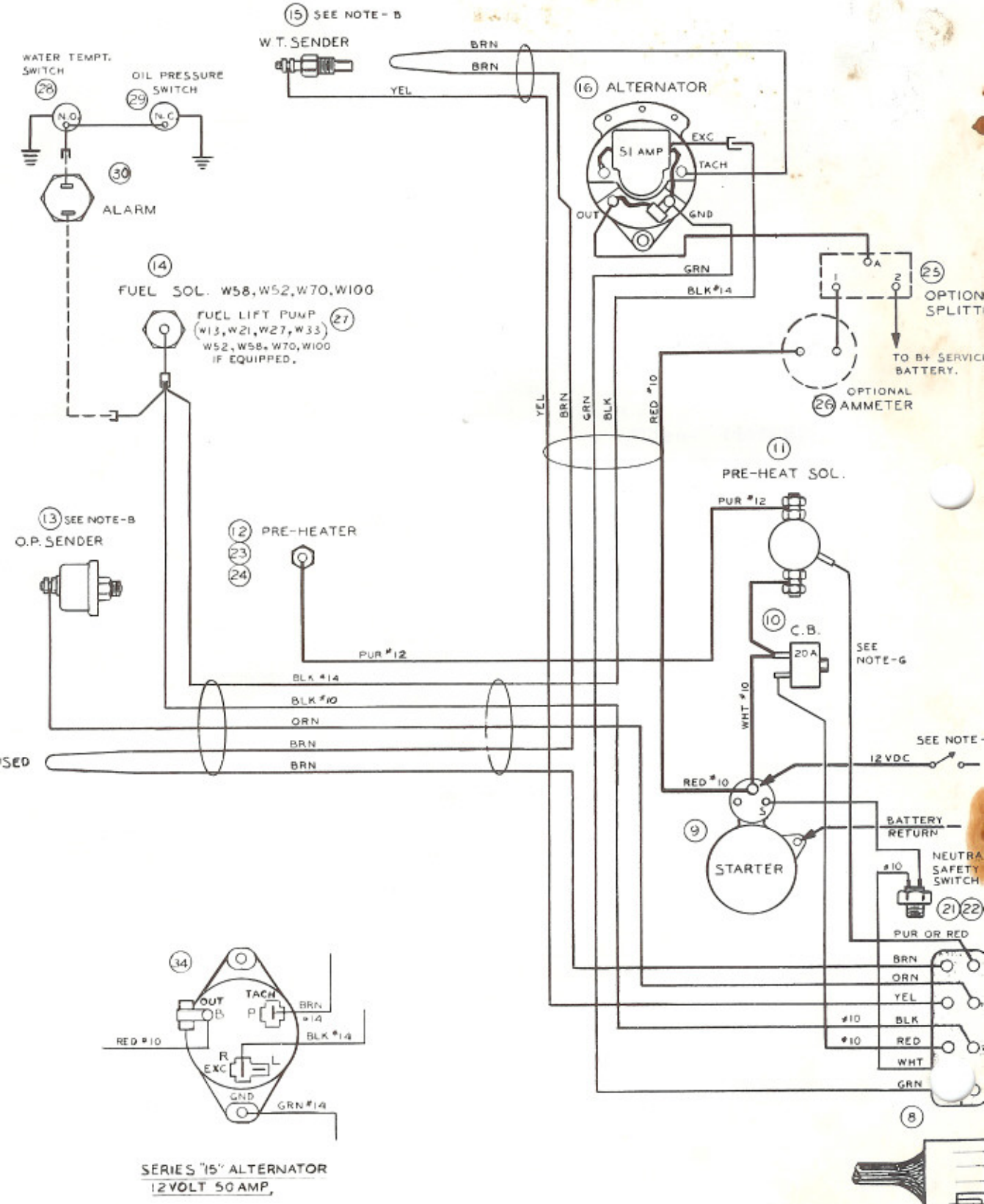
SEDIMENTER/WATER TRAP #32974

Installation Instructions

1. Bolt Sedimenter/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 Sedimenter. 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.

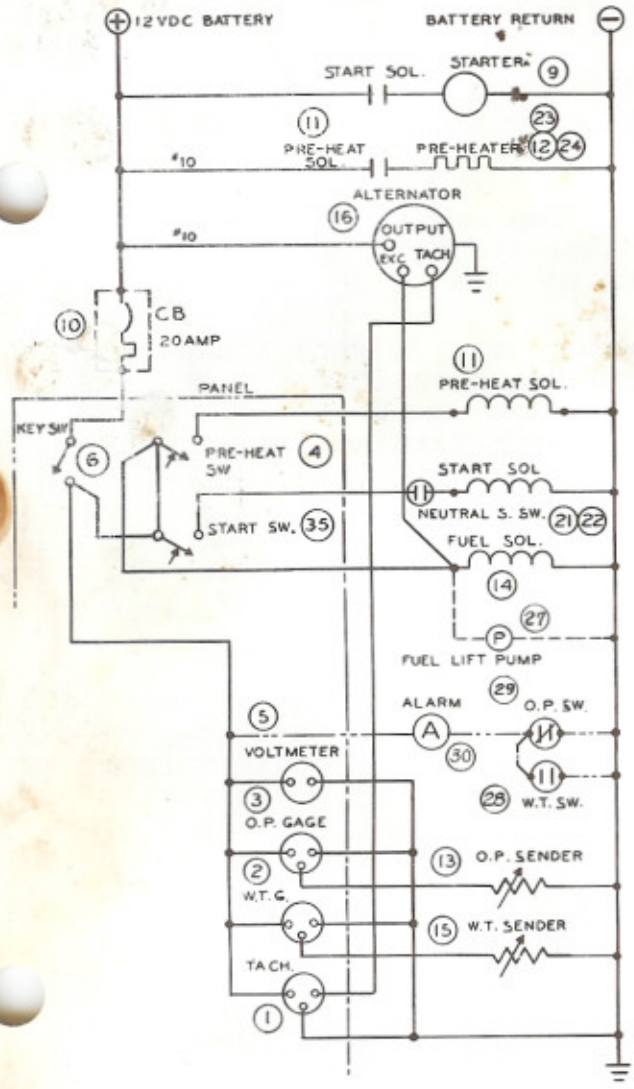
MARINE ENG. WIRING DIAGRAM FOR VOLTMETER, KEY SWITCH AND 2 PUSHBUTTONS

W/D No. 33685



SERIES "15" ALTERNATOR
12 VOLT 50 AMP.

SCHEMATIC DIAGRAM.



NOTES:

NOTES ON BUILDER/OWNERS RESPONSIBILITY.

Ⓐ 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. 12 VOLT 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 12 VDC WILL NORMALLY SERVE THESE FUNCTIONS, BUT SUCH A SWITCH MUST NEVER BE USED TO "MAKE" THE STARTER CIRCUIT.

OTHER NOTES:

Ⓑ WARNING; SENDER CONNECTION: CONTACT WITH B+ MAY DAMAGE SENDER.

Ⓒ ALL RETURNS ARE THROUGH ENGINE BLOCK.

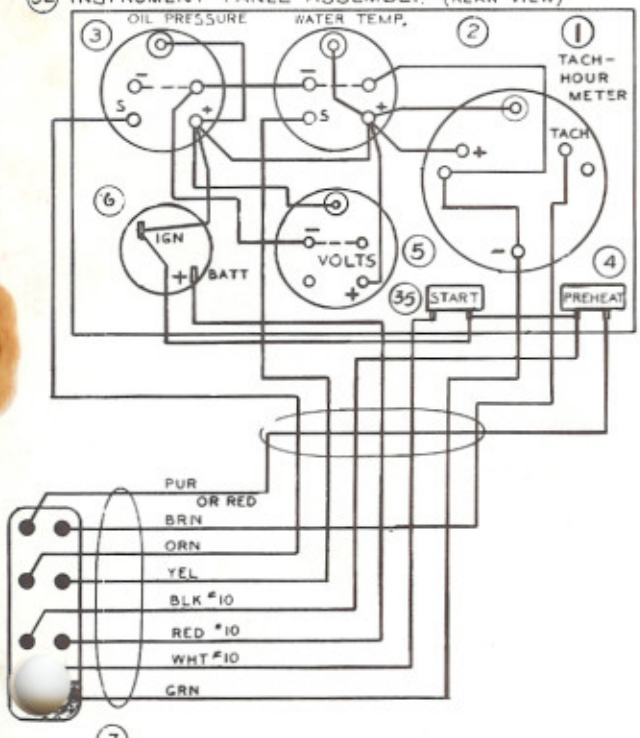
Ⓓ FOR WIRING OF AUXILLARY ALTERNATORS SEE THE FOLLOWING DIAGRAMS.
MOTOROLA 85 AMP, 11232
MOTOROLA 120 AMP, 11231
LEECE-NEVILLE 53 AMP, 16535
LEECE-NEVILLE 105 AMP, 16614

Ⓔ IF ADDITIONAL PRESSURE SWITCHES ARE REQ'D TO START BOAT ACCESSORES, A FLEXIBLE HOSE MUST BE RUN FROM THE OIL PRESSURE MANIFOLD TO A NEARBY BULKHEAD AND ALL PRESSURE SWITCHES MOUNTED AT THE BULKHEAD.

Ⓕ APPLY SILASTIC OR TIGHT WOUND PLASTIC/SPLICE ELECTRICAL TAPE AROUND CONNECTORS CONNECTED.

Ⓖ 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.

(32) INSTRUMENT PANEL ASSEMBLY. (REAR VIEW)



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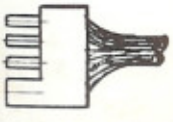


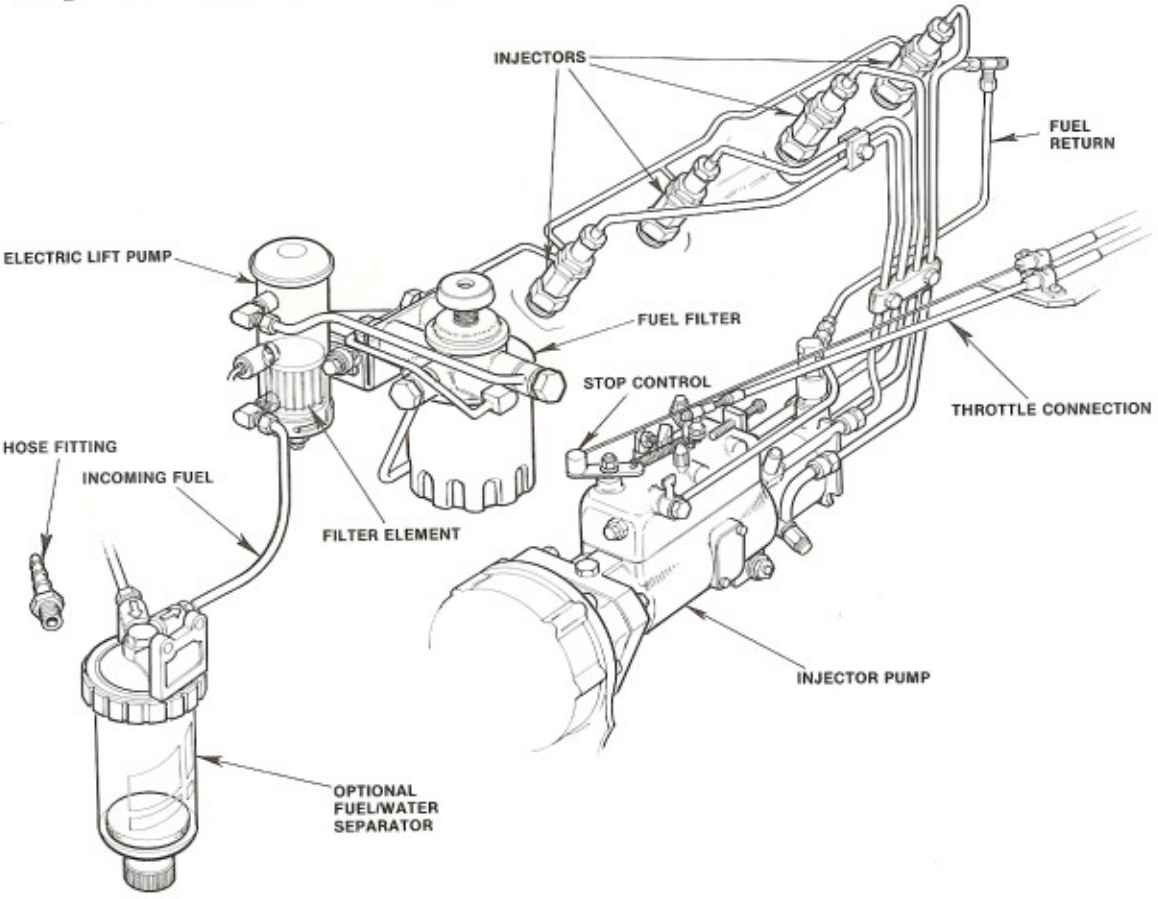
ITEM	DESCRIPTION	QTY	ASSY	OPTION ASSY
35	SWITCH, START.	1		
34	ALTERNATOR, 12V. 50A.	1		
33	PANEL, LESS INSTRUMENTS	1		
32	PANEL, COMPLETE		1	
31		1		
30	ALARM			1
29	OIL PRESS. SW. N.C.			1
28	WATER TEMPT. SW. N.O.			1
27	FUEL LIFT PUMP	1		
26	AMMETER (OPTIONAL)			1
25	SPLITTER (OPTIONAL)			1
24	GLOW PLUGS W30 & W60	4 EACH		
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 20 AMP.	1		
9	STARTER, MARINE ENGINE	1		
8	HARNESS, ENGINE		1	
7	HARNESS, PANEL		1	
6	KEYSWITCH, IGNITION.	1		
5	VOLTMETER	1		
4	SWITCH, PRE-HEAT	1		
3	OIL PRESSURE GAUGE	1		
2	WATER TEMP. GAUGE	1		
1	TACHOMETER	1		

If a water trap type filter (see page 13) 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.



3. Notes on fuel system

See on facing 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 25 and purchase spares from your local Westerbeke Dealer or Distributor. For example, hardware kit #33441 will supply fuel system washers for Model W46.

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 the steps described on pages 8 and 9. 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. Re-install new filter.

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

After the first 50 hour change, the change period may be increased to 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 adjustment, whenever necessary, should be performed at an authorized service station, as a precision pump tester and skills 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.

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, and never use it mixed with antifreeze of a different brand.

*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.

ANTIFREEZE ADDITION DATA

Antifreeze Concentration %		13	23	30	35	45	50	60
Freezing temperature	°C	-5	-10	-15	-20	-30	-40	-50
	(°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

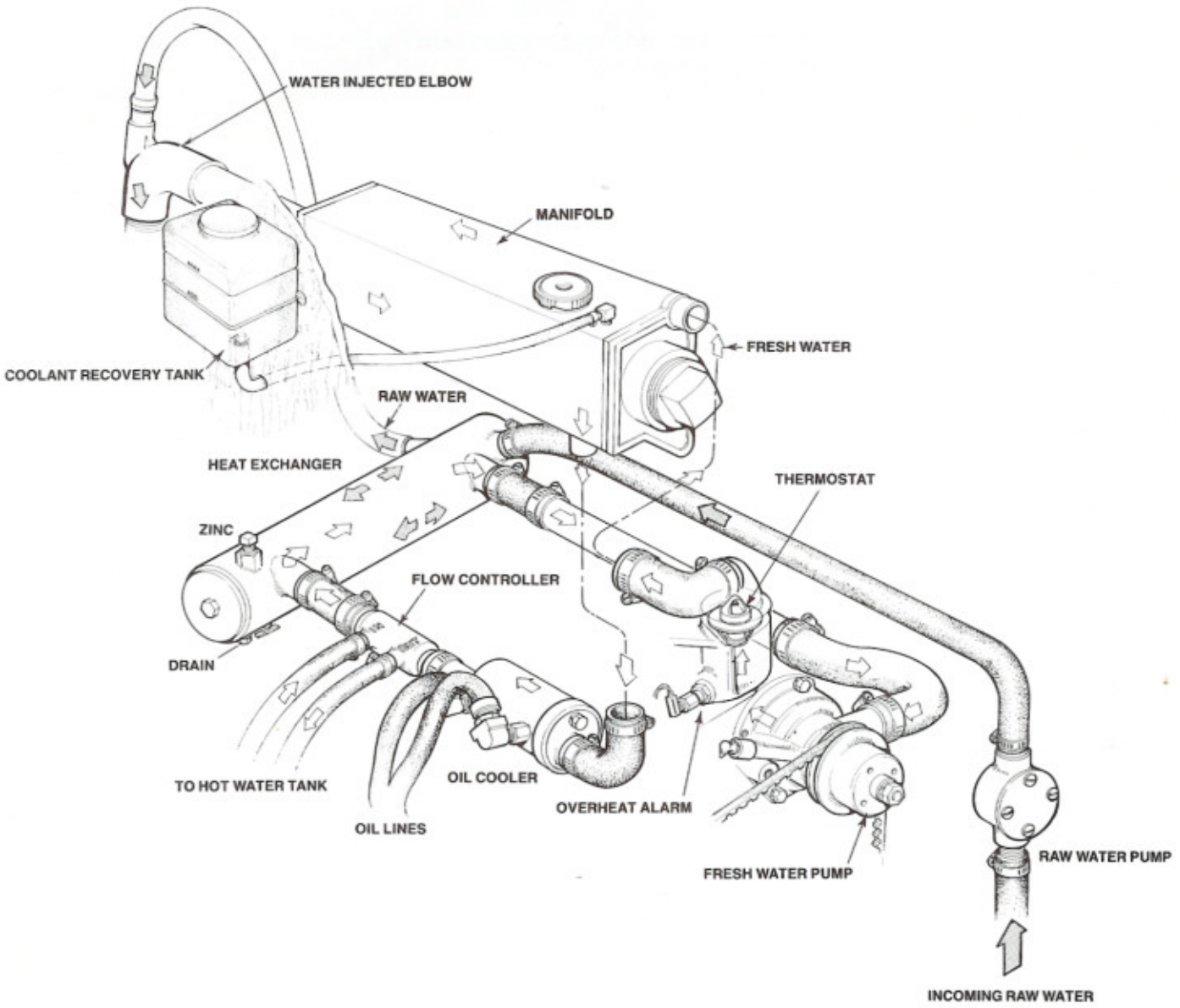
The system consists of a sea water pump which pumps raw sea water through a heat exchanger to remove heat from the coolant. The raw water is discharged overboard through the exhaust line.

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.

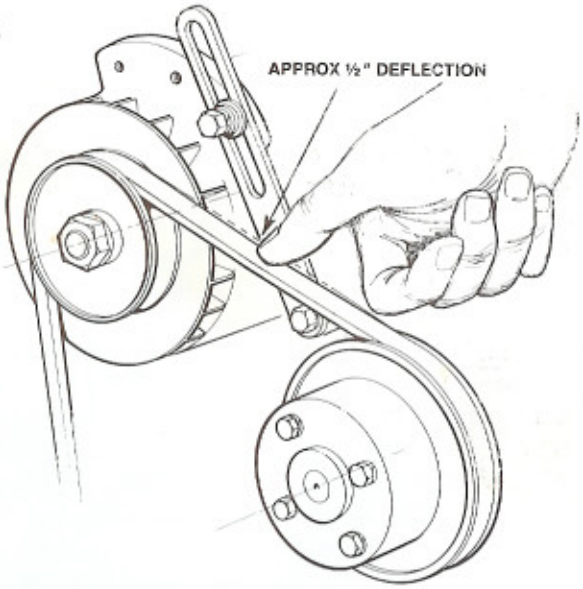
The total system is very reliable and requires only a daily check of the water level in the system plus routine check of hose clamps and fittings.

It is likely that zinc electrodes will waste away from contact with sea water. 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.

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 25.



Alternator belt and water pump tension



The belts are properly tense if they deflect 10 to 12 mm (0.39 to 0.47 in) as they are depressed with a finger between the pulley and pulley of the long distance side. 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 and insufficient charging due to a slipping belt.

CAUTION:

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

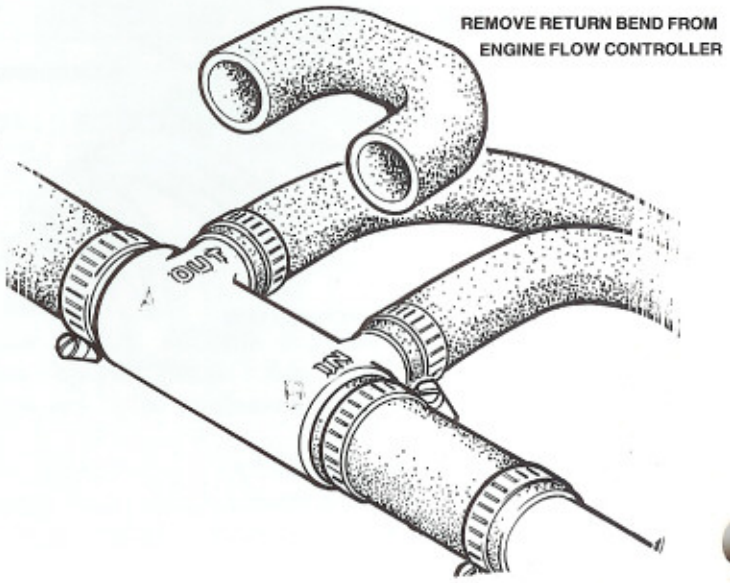
WIRING DIAGRAM

Your engine is of 12V system and its electric circuitry is as shown in diagram #33685 in centerfold of this manual.

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.

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 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 two connections on the water heater while the upper connection on the heater returns to B, nearest the heat exchanger.

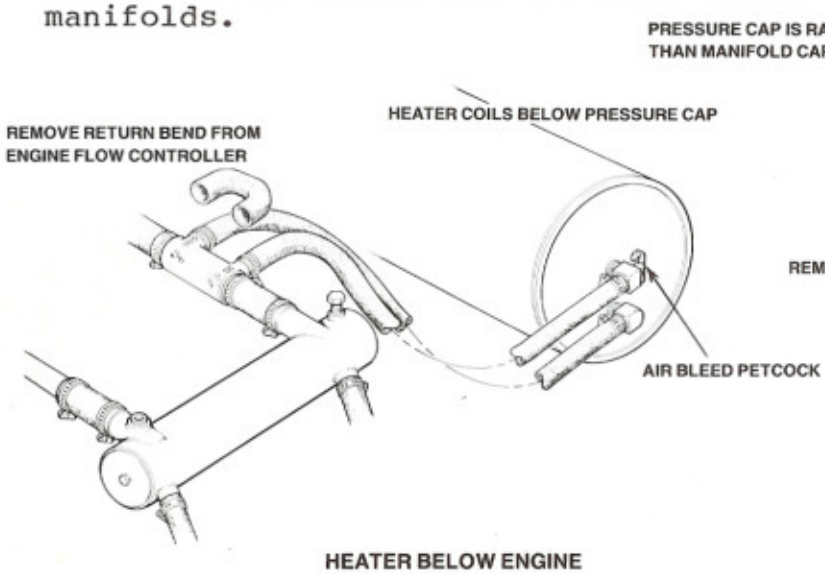
Hoses should rise continuously from their low point at the heater to the engine so that trapped air will rise naturally from the heater to the engine. If trapped air can rise to the heater, then an air bleed petcock must be installed at the higher fitting on the heater for bleeding air while filling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

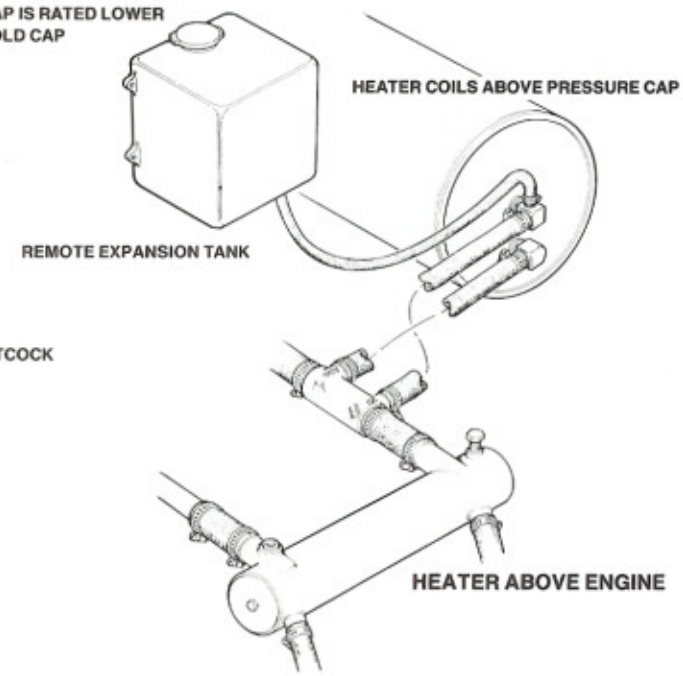
If any portion of the engine cooling water circuit to or from the heater rises above the engine's own pressure cap, then the pressurized remote expansion tank must be installed in the circuit to become the highest point. The tank kit Part Number is 24177. Install the remote expansion tank in a convenient 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.

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





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. Checkup of engine oil level 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 reading.

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

   F. Checkup for abnormality with exhaust gas, noise and vibration

2. Servicing following initial 50 hours of operation

   A. Renewal of engine oil

   B. Replacement of lube and fuel filters

   *C. Adjustment of valve clearance Intake & Exhaust - .025"

   *D. Tightening of bolts and nuts

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 400 hours of operation

A. Adjustment of engine idle, if necessary

*B. Adjustment of valve clearance

*C. Checkup of starter motor, alternator and regulator

Check the brush and surface of commutator for the degree of wear. Replace the brush if it is worn beyond the limits of wear.

*D. Checkup of glow plugs

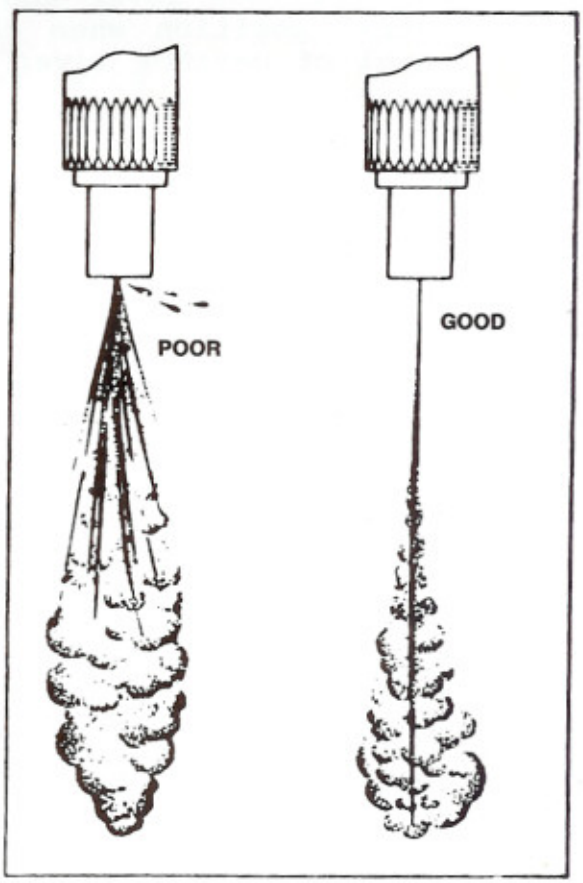
Check the glow plugs for blow-out.

E. Removal of cooling water and flushing is suggested.

6. Servicing at every 800 hours of operation

*A. Checkup of nozzles

Set the injection starting pressure to 1706 $^{+142}_{-0}$ psi and eliminate undesirable injection conditions including "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 kg/cm^2 (42.7 psi) between cylinders or if the cylinder pressure is less than 30 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

5. Servicing at every 400 hours of operation

A. Adjustment of engine idle, if necessary

*B. Adjustment of valve clearance

*C. Checkup of starter motor, alternator and regulator

Check the brush and surface of commutator for the degree of wear. Replace the brush if it is worn beyond the limits of wear.

*D. Checkup of glow plugs

Check the glow plugs for blow-out.

E. Removal of cooling water and flushing is suggested.

6. Servicing at every 800 hours of operation

*A. Checkup of nozzles

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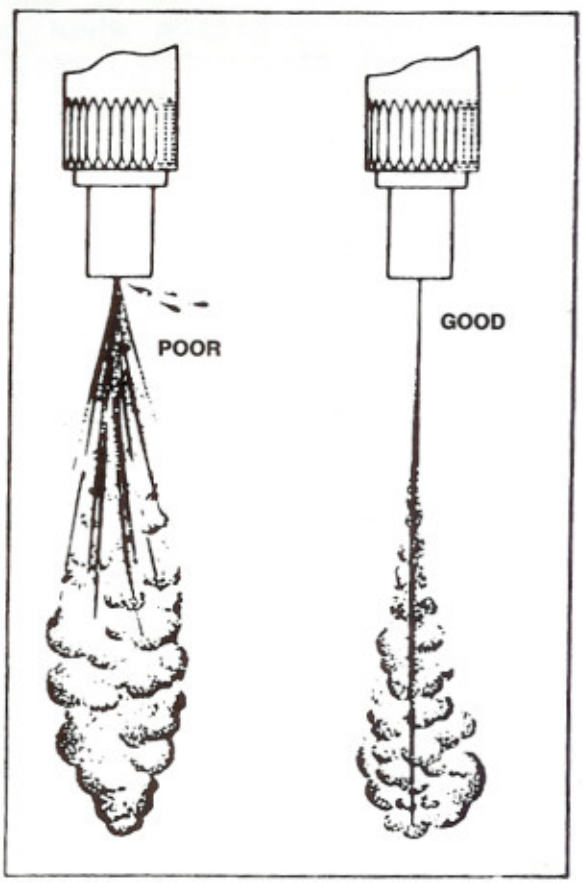

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*C. Fuel injection adjustment

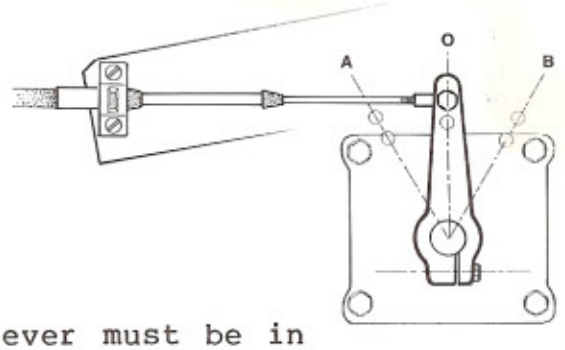
In case of severe vibration during idling, have it repaired at an authorized distributor or dealer which is equipped with a pump tester.

*D. Check tightness of nuts and bolts

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.

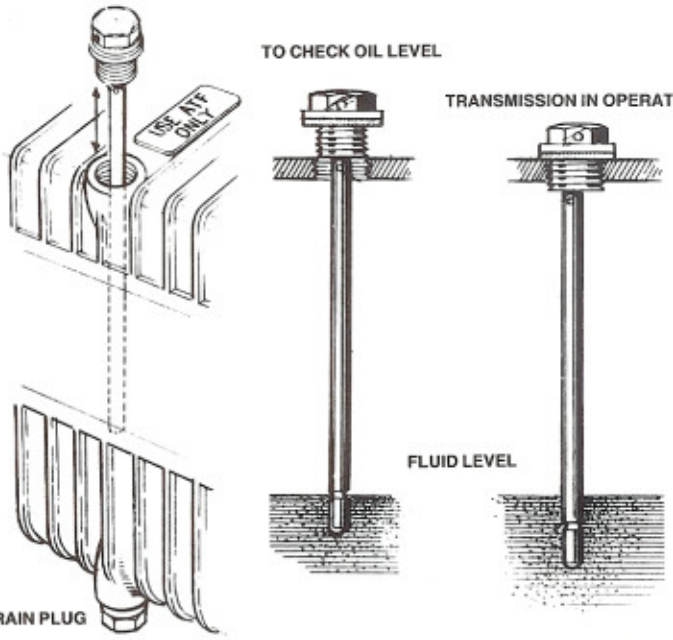
4. Check that actuating lever hub does not touch cover plate hub. Maintain at least 0.5 mm (0.002") clearance.

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 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 <u>not</u> screw in.



PROBLEM	REMEDY
1. ENGINE DOES NOT START	
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
2. ENGINE STALLS WHILE IN OPERATION	
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
3. IMPROPER OIL PRESSURE	
a. Oil shortage	Refill
b. Oil leak through connections	Repair
c. Oil pressure switch defective	Replace
4. ENGINE OVERHEATING	
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
5. BATTERY IS UNDERCHARGED	
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

TIGHTENING TORQUE

Important bolts and nuts

kg-m (lb-ft)

Secured part or component	Threads Diameter – Pitch	Tightening torque
Cylinder head	12 – 1.75	12 (86)
Main bearing cap	12 – 1.75	8.5 (61)
Connecting rod bearing cap	10 – 1.0	5.5 (40)
Flywheel	12 – 1.25	8.5 (61)
Camshaft thrust plate	8 – 1.25	1.8 (13)
Front plate.	8 – 1.25	1.0 (7)
Timing gear case	8 – 1.25	1.0 (7)
Crankshaft pulley	24 – 1.5	40 (288)
Rear plate	10 – 1.25	3.5 (25)
Idler thrust plate	10 – 1.25	3.5 (25)
Rear oil seal	6 – 1.0	0.4 (3)
Oil pan	8 – 1.25	0.7 (5)
Oil pan drain plug	18 – 1.5	10.0 (72)
Rocker shaft bracket	8 – 1.25	1.5 (11)
Injection pump delivery valve holders		3.0 (22)
Nozzle holder retaining nuts		5.0 (36)

General bolts and nuts

Screw thread		Tightening torque			
		With spring washer		Without spring washer	
dia.	pitch	kg-m	lb-ft	kg-m	lb-ft
8	1.0	1.8	13	2.2	16
	1.25	1.8	13	2.1	15
10	1.25	3.6	26	4.2	30
	1.5	3.4	25	4.0	29
12	1.25	6.5	47	7.6	55
	1.75	6.0	43	7.1	51
14	1.5	10.4	75	12.2	88
	2.0	9.8	71	11.5	83
16	1.5	15.8	114	18.6	135
	2.0	15.0	108	17.6	127
18	1.5	22.9	166	26.9	195
	2.5	20.7	150	24.4	176

COMMON PARTS BY NUMBER

DESCRIPTION	PART NUMBER	NUMBER REQU PER ENGI
Fuel Hardware Kit, including banjo washers, injector seat washers	33441	1
Lift Pump Filter & Gasket	30548	1
Fuel Filter	24363	1
Lube Oil Filter	30233	1
Glow Plugs	34380	4
Raw Water Pump	16423	1
Raw Water Pump Mounting Gasket	11143	1
Raw Water Pump Repair Kit	18172	1
Raw Water Pump Impeller & Gasket Kit	33104	1
Alternator Belt	30475	1
Thermostat	24688	1
Thermostat Housing Gasket	33966	2
Oil Pressure Alarm Switch	30944	1
Injector	34376	4
Zinc Plugs	11885	1

WESTERBEKE LIMITED WARRANTY

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.

3. Notification

If you encounter a problem with your Westerbeke engine or generator set within the warranty period 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.
AVON INDUSTRIAL PARK, AVON, MASS. 02322 (617) 588 7700
CABLE: WESTCORP, AVON TELEX: 92 4444

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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

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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;
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SUPPLEMENTARY INFORMATION JUNE 6, 1985

WESTERBEKE W-46

CYLINDER HEAD MAINTENANCE INFORMATION

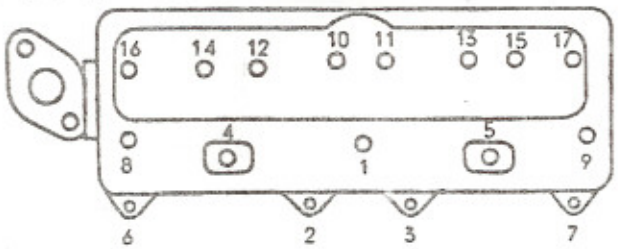
A. Cylinder Head Bolt Torque

12.0 Kg-m (86.0 lb.-ft.) Bolts on Exhaust side of head.

10.5 Kg-m (76.0 lb.-ft.) Bolts on Intake side of head.

NOTE: Bolts No. 4 and 5 are located under the intake manifold where it is attached to the head.)

FRONT



Intake Side

Tighten bolts in the sequence shown above with the engine cold.

Loosen each bolt 1/8-1/4 turn before applying the specified torque.

Rocker Shaft Bracket Bolt 1.5 Kg-m (11 lb.-ft.)

B. Valve Clearance Adjustment

Valve Clearance (Cold) .2-.3 mm (.009-.012 inch)

VALVE ADJUSTMENT PROCEDURE:

A. Rotate the crankshaft slowly in the normal direction of rotation to bring the piston of No. 1 cylinder to T.D.C. of its compression stroke. (Observe when this is done that the valves of No. 4 cylinder are in the position of valve overlap, i.e., the period between the opening of the inlet valve and the closing of the exhaust valve.)

In this condition, adjust valve clearance in the conventional manner of the intake and exhaust valve of No. 1 cylinder, the intake valve of No. 2 cylinder, and the exhaust valve of No. 3 cylinder.

Westerbeke W-46

Cylinder Head Maintenance Information

B. Rotate the crankshaft in the normal direction of rotation (360°), and stop. Adjust the valve clearance of the intake and exhaust valve of No. 4 cylinder, the exhaust valve of No. 2 cylinder, and the intake valve of No. 3 cylinder.

VALVE AND CYLINDER ARRANGEMENT