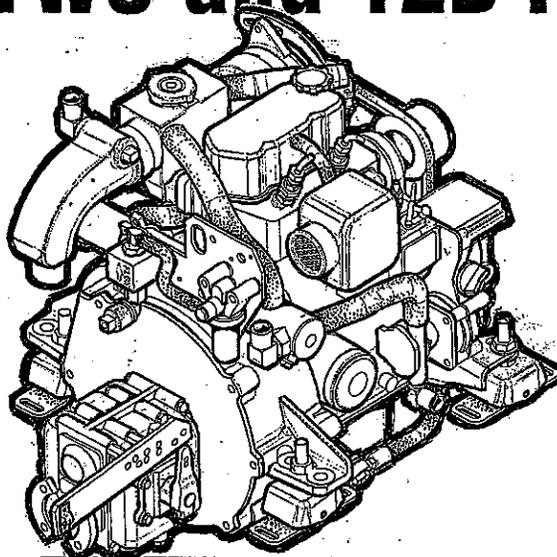




OPERATORS MANUAL

MARINE DIESEL ENGINES

12C-TWO and 12D-TWO



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 WESTERBEKE

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Member National Marine Manufacturers Association

⚠ WARNING

Exhaust gasses contain Carbon Monoxide, an odorless and colorless gas. Carbon Monoxide is poisonous and can cause unconsciousness and death. Symptoms of Carbon Monoxide exposure can include:

- Dizziness
- Nausea
- Headache
- Weakness and Sleepiness
- Throbbing in Temples
- Muscular Twitching
- Vomiting
- Inability to Think Coherently

IF YOU OR ANYONE ELSE EXPERIENCE ANY OF THESE SYMPTOMS, GET OUT INTO THE FRESH AIR IMMEDIATELY. If symptoms persist, seek medical attention. Shut down the unit and do not restart until it has been inspected and repaired.



A WARNING DECAL is provided by WESTERBEKE and should be fixed to a bulkhead near your engine or generator. WESTERBEKE also recommends installing CARBON MONOXIDE DETECTORS in the living/sleeping quarters of your vessel. They are inexpensive and easily obtainable at your local marine store.

**CALIFORNIA
PROPOSITION 65 WARNING**

Marine diesel and gasoline engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, and other reproductive harm.

SAFETY INSTRUCTIONS

INTRODUCTION

Read this safety manual carefully. Most accidents are caused by failure to follow fundamental rules and precautions. Know when dangerous conditions exist and take the necessary precautions to protect yourself, your personnel, and your machinery.

The following safety instructions are in compliance with the American Boat and Yacht Council (ABYC) standards.

PREVENT ELECTRIC SHOCK

⚠ WARNING: Do not touch AC electrical connections while engine is running, or when connected to shore power. Lethal voltage is present at these connections!

- Do not operate this machinery without electrical enclosures and covers in place.
- Shut off electrical power before accessing electrical equipment.
- Use insulated mats whenever working on electrical equipment.
- Make sure your clothing and skin are dry, not damp (particularly shoes) when handling electrical equipment.
- Remove wristwatch and all jewelry when working on electrical equipment.
- Do not connect utility shore power to vessels AC circuits, except through a ship-to-shore double throw transfer switch. Damage to vessels AC generator may result if this procedure is not followed.
- Electrical shock results from handling a charged capacitor. Discharge capacitor by shorting terminals together.

PREVENT BURNS — HOT ENGINE

⚠ WARNING: Do not touch hot engine parts or exhaust system components. A running engine gets very hot!

- Always check the engine coolant level at the coolant recovery tank.

⚠ WARNING: Steam can cause injury or death!

- In case of an engine overheat, allow the engine to cool before touching the engine or checking the coolant.

PREVENT BURNS — FIRE

⚠ WARNING: Fire can cause injury or death!

- Prevent flash fires. Do not smoke or permit flames or sparks to occur near the carburetor, fuel line, filter, fuel pump, or other potential sources of spilled fuel or fuel vapors. Use a suitable container to catch all fuel when removing the fuel line, carburetor, or fuel filters.
- Do not operate without a Coast Guard Approved flame arrester. Backfire can cause severe injury or death.
- Do not operate with the air cleaner/silencer removed. Backfire can cause severe injury or death.
- Do not smoke or permit flames or sparks to occur near the fuel system. Keep the compartment and the engine/generator clean and free of debris to minimize the chances of fire. Wipe up all spilled fuel and engine oil.
- Be aware — diesel fuel will burn.

PREVENT BURNS — EXPLOSION

⚠ WARNING: Explosions from fuel vapors can cause injury or death!

- Follow re-fueling safety instructions. Keep the vessels hatches closed when fueling. Open and ventilate cabin after fueling. Check below for fumes/vapor before running the blower. Run the blower for four minutes before starting your engine.
- All fuel vapors are highly explosive. Use extreme care when handling and storing fuels. Store fuel in a well-ventilated area away from spark-producing equipment and out of the reach of children.
- Do not fill the fuel tank(s) while the engine is running.
- Shut off the fuel service valve at the engine when servicing the fuel system. Take care in catching any fuel that might spill. DO NOT allow any smoking, open flames, or other sources of fire near the fuel system or engine when servicing. Ensure proper ventilation exists when servicing the fuel system.
- Do not alter or modify the fuel system.
- Be sure all fuel supplies have a positive shutoff valve.
- Be certain fuel line fittings are adequately tightened and free of leaks.
- Make sure a fire extinguisher is installed nearby and is properly maintained. Be familiar with its proper use. Extinguishers rated ABC by the NFPA are appropriate for all applications encountered in this environment.

SAFETY INSTRUCTIONS

ACCIDENTAL STARTING

⚠ WARNING: Accidental starting can cause injury or death!

- Disconnect the battery cables before servicing the engine/generator. Remove the negative lead first and reconnect it last.
- Make certain all personnel are clear of the engine before starting.
- Make certain all covers, guards, and hatches are re-installed before starting the engine.

BATTERY EXPLOSION

⚠ WARNING: Battery explosion can cause injury or death!

- Do not smoke or allow an open flame near the battery being serviced. Lead acid batteries emit hydrogen, a highly explosive gas, which can be ignited by electrical arcing or by lit tobacco products. Shut off all electrical equipment in the vicinity to prevent electrical arcing during servicing.
- Never connect the negative (-) battery cable to the positive (+) connection terminal of the starter solenoid. Do not test the battery condition by shorting the terminals together. Sparks could ignite battery gases or fuel vapors. Ventilate any compartment containing batteries to prevent accumulation of explosive gases. To avoid sparks, do not disturb the battery charger connections while the battery is being charged.
- Avoid contacting the terminals with tools, etc., to prevent burns or sparks that could cause an explosion. Remove wristwatch, rings, and any other jewelry before handling the battery.
- Always turn the battery charger off before disconnecting the battery connections. Remove the negative lead first and reconnect it last when servicing the battery.

BATTERY ACID

⚠ WARNING: Sulfuric acid in batteries can cause severe injury or death!

- When servicing the battery or checking the electrolyte level, wear rubber gloves, a rubber apron, and eye protection. Batteries contain sulfuric acid which is destructive. If it comes in contact with your skin, wash it off at once with water. Acid may splash on the skin or into the eyes inadvertently when removing electrolyte caps.

TOXIC EXHAUST GASES

⚠ WARNING: Carbon monoxide (CO) is a deadly gas!

- Ensure that the exhaust system is adequate to expel gases discharged from the engine. Check the exhaust system regularly for leaks and make sure the exhaust manifold/water-injected elbow is securely attached.
- Be sure the unit and its surroundings are well ventilated. Run blowers when running the generator set or engine.
- Don't run the generator set or engine unless the boat is equipped with a functioning marine carbon monoxide detector that complies with ABYCA-24. Consult your boat builder or dealer for installation of approved detectors.
- For additional information refer to ABYC T-22 (educational information on Carbon Monoxide).

⚠ WARNING: Carbon monoxide (CO) is an invisible odorless gas. Inhalation produces flu-like symptoms, nausea or death!

- Do not use copper tubing in diesel exhaust systems. Diesel fumes can rapidly destroy copper tubing in exhaust systems. Exhaust sulfur causes rapid deterioration of copper tubing resulting in exhaust/water leakage.
- Do not install exhaust outlet where exhaust can be drawn through portholes, vents, or air conditioners. If the engine exhaust discharge outlet is near the waterline, water could enter the exhaust discharge outlet and close or restrict the flow of exhaust. Avoid overloading the craft.
- Although diesel engine exhaust gases are not as toxic as exhaust fumes from gasoline engines, carbon monoxide gas is present in diesel exhaust fumes. Some of the symptoms or signs of carbon monoxide inhalation or poisoning are:

Vomiting	Inability to think coherently
Dizziness	Throbbing in temples
Headache	Muscular twitching
Nausea	Weakness and sleepiness

AVOID MOVING PARTS

⚠ WARNING: Rotating parts can cause injury or death!

- Do not service the engine while it is running. If a situation arises in which it is absolutely necessary to make operating adjustments, use extreme care to avoid touching moving parts and hot exhaust system components.

SAFETY INSTRUCTIONS

OPERATORS MANUAL

Many of the preceding safety tips and warnings are repeated in your Operators Manual along with other cautions and notes to highlight critical information. Read your manual carefully, maintain your equipment, and follow all safety procedures.

GASOLINE ENGINE AND GENERATOR INSTALLATIONS

Preparations to install a gasoline engine or generator should begin with a thorough examination of the American Boat and Yacht Council's (ABYC) standards. These standards are from a combination of sources including the USCG and the NFPA.

Sections of the ABYC standards of particular interest are:

H-2 Ventilation

H-24 Gasoline Fuel Systems

P-1 Exhaust Systems

P-4 Inboard Engines

E-9 DC Electrical Systems

All installations must comply with the Federal Code of Regulations (FCR).

ABYC, NFPA AND USCG PUBLICATIONS FOR INSTALLING DIESEL ENGINES

Read the following ABYC, NFPA and USCG publications for safety codes and standards. Follow their recommendations when installing your engine.

ABYC (American Boat and Yacht Council)
"Safety Standards for Small Craft"

Order from:

ABYC
3069 Solomon's Island Rd.
Edgewater, MD 21037

NFPA (National Fire Protection Association)
"Fire Protection Standard for Motor Craft"

Order from:

NFPA
11 Tracy Drive
Avon Industrial Park
Avon, MA 02322

USCG (United States Coast Guard)
"USCG 33CFR183"

Order from:

U.S. Government Printing Office
Washington, D.C. 20404

INSTALLATION

When installing WESTERBEKE engines and generators it is important that strict attention be paid to the following information:

CODES AND REGULATIONS

Strict federal regulations, ABYC guidelines, and safety codes must be complied with when installing engines and generators in a marine environment.

SIPHON-BREAK

For installations where the exhaust manifold/water injected exhaust elbow is close to or will be below the vessel's waterline, provisions must be made to install a siphon-break in the raw water supply hose to the exhaust elbow. This hose must be looped a minimum of 20" above the vessel's waterline. *Failure to use a siphon-break when the exhaust manifold injection port is at or below the waterline will result in raw water damage to the engine and possible flooding of the boat.*

If you have any doubt about the position of the water-injected exhaust elbow relative to the vessel's waterline under the vessel's various operating conditions, *install a siphon-break.*

NOTE: *A siphon-break requires periodic inspection and cleaning to ensure proper operation. Failure to properly maintain a siphon-break can result in catastrophic engine damage. Consult the siphon-break manufacturer for proper maintenance.*



AVAILABLE FROM
YOUR WESTERBEKE
DEALER

EXHAUST SYSTEM

The exhaust hose must be certified for marine use. The system must be designed to prevent water from entering the exhaust under any sea conditions and at any angle of the vessels hull.

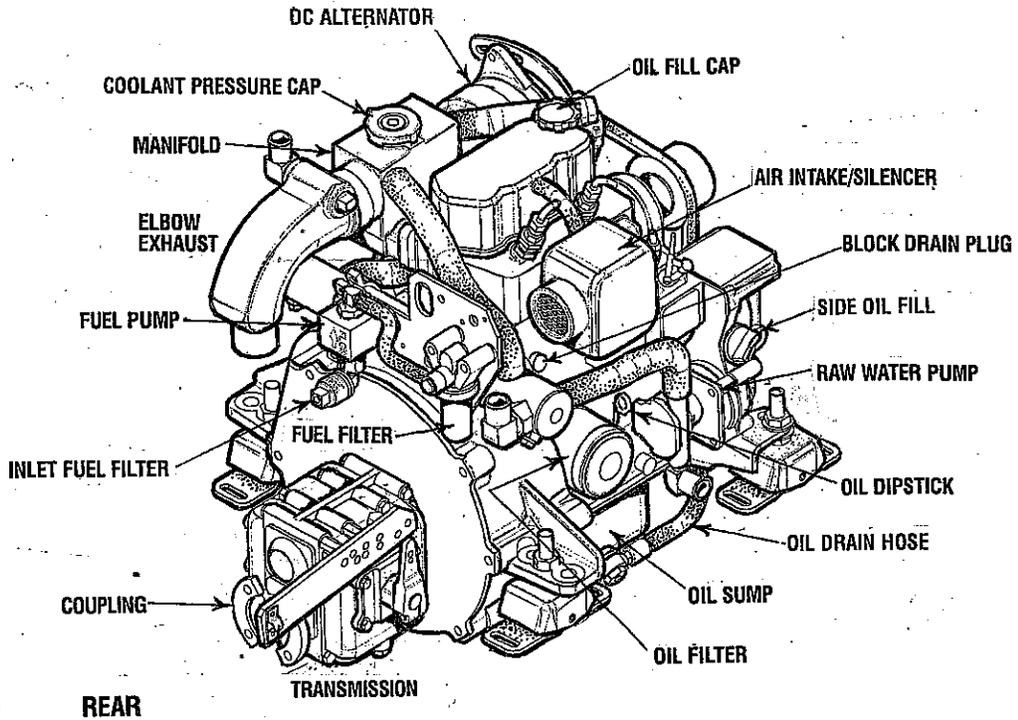
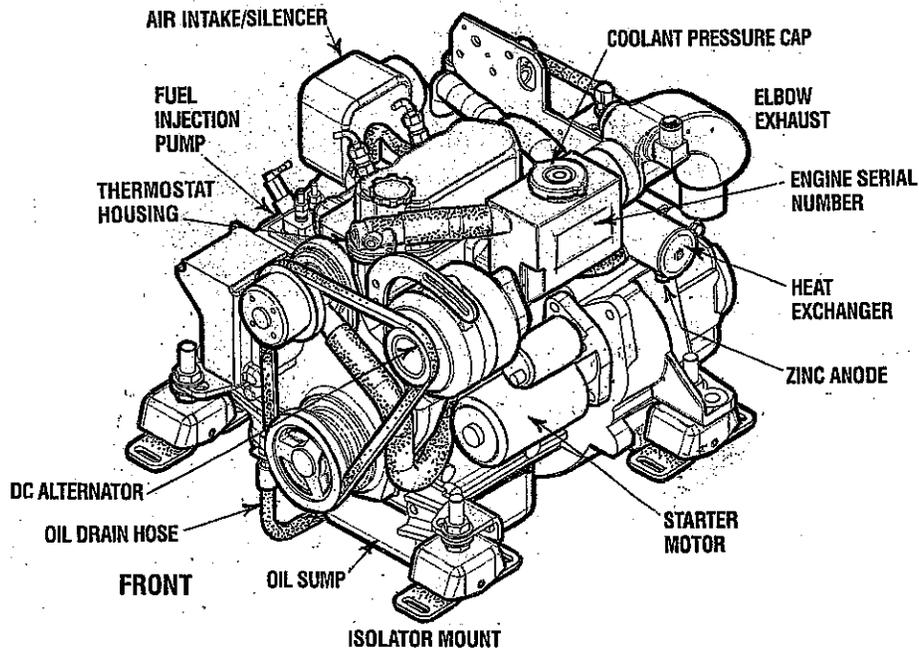
Carefully review the Marine Installation manual provided with your WESTERBEKE Engine or Generator.

Additional manuals are available from your WESTERBEKE dealer.

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PARTS IDENTIFICATION



INTRODUCTION

This WESTERBEKE Diesel Engine is a product of WESTERBEKE's long years of experience and advanced technology. We take great pride in the superior durability and dependable performance of our engines and generators. Thank you for selecting WESTERBEKE.

In order to get the full use and benefit from your generator it is important that you operate and maintain it correctly. This manual is designed to help you do this. Please, read this manual carefully and observe all the safety precautions throughout. Should your engine require servicing, contact your nearest WESTERBEKE dealer for assistance.

This is your operators manual. A parts catalog is also provided and a technical manual is available from your WESTERBEKE dealer. If you are planning to install this equipment contact your WESTERBEKE dealer for WESTERBEKE'S installation manual.

WARRANTY PROCEDURES

Your WESTERBEKE Warranty is included in a separate folder. If, after 60 days of submitting the Warranty Registry form you have not received a customer identification card registering your warranty, please contact the factory in writing with model information, including the unit's serial number and commission date.

Customer Identification Card



Customer Identification

MR. ENGINE OWNER

MAIN STREET

HOMETOWN, USA

Model

Ser. #

Expires

PRODUCT SOFTWARE

Product software, (tech data, parts lists, manuals, brochures and catalogs), provided from sources other than WESTERBEKE are not within WESTERBEKE's control.

WESTERBEKE CANNOT BE RESPONSIBLE FOR THE CONTENT OF SUCH SOFTWARE, MAKES NO WARRANTIES OR REPRESENTATIONS WITH RESPECT THERETO, INCLUDING ACCURACY, TIMELINESS OR COMPLETENESS THEREOF AND WILL IN NO EVENT BE LIABLE FOR ANY TYPE OF DAMAGE OR INJURY INCURRED IN CONNECTION WITH OR ARISING OUT OF THE FURNISHING OR USE OF SUCH SOFTWARE.

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NOTES, CAUTIONS AND WARNINGS

As this manual takes you through the operating procedures, maintenance schedules, and troubleshooting of your marine engine, critical information will be highlighted by NOTES, CAUTIONS, and WARNINGS. An explanation follows:

NOTE: *An operating procedure essential to note.*

CAUTION: *Procedures, which if not strictly observed, can result in the damage or destruction of your engine.*

WARNING: *Procedures, which if not properly followed, can result in personal injury or loss of life.*

INTRODUCTION

SERIAL NUMBER LOCATION

The engine's model and serial number are located on a nameplate mounted on the side of the engine's water jacketed exhaust manifold. The engine serial number is also stamped into the engine block on the flat surface out board of the injection pump. Take time to enter this important information on the illustration of the nameplate below, as this will provide a quick reference when seeking technical information and/or ordering parts.



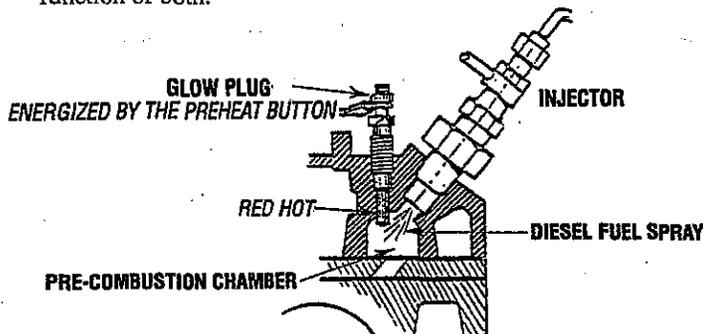
Fill in the information for your reference. 

UNDERSTANDING THE DIESEL ENGINE

The diesel engine closely resembles the gasoline engine, since the mechanism is essentially the same. The cylinders are arranged above a closed crankcase. The crankshaft is the same general type as a gasoline engine, and the diesel engine has the same types of valves, camshaft, pistons, connecting rods and lubricating system.

Therefore, to a great extent, a diesel engine requires the same preventive maintenance as a gasoline engine. The most important factors are proper ventilation and proper maintenance of the fuel, lubricating and cooling systems. Fuel and lubricating filter elements must be replaced at the time periods specified, and frequent checking for contamination (water, sediment, etc.) in the fuel system is also essential. Another important factor is the consistent use of the same brand of high detergent diesel lubrication oil designed specifically for diesel engines.

The diesel engine does differ from the gasoline engine, however, in its method of handling and firing of fuel. The carburetor and ignition systems are replaced by a single component – the fuel injection pump – which performs the function of both.



ORDERING PARTS

Whenever replacement parts are needed, always provide the engine model number and serial number as they appear on the silver and black name plate located on the manifold. You must provide us with this information so we may properly identify your engine. In addition, include a complete part description and part number for each part needed (see the separately furnished Parts List). Insist upon WESTERBEKE packaged parts because *will fit* or generic parts are frequently not made to the same specifications as original equipment.

SPARES AND ACCESSORIES

Certain spares will be needed to support and maintain your WESTERBEKE engine. Your local WESTERBEKE dealer will assist you in preparing an inventory of spare parts. See the *SPARE PARTS* page in this manual. For Engine Accessories, see *WESTERBEKE'S ACCESSORIES* brochure.

INSTALLATION MANUAL

Publication #43400 provides detailed information for installing engines.

PROTECTING YOUR INVESTMENT

Care at the factory during assembly and thorough testing have resulted in a WESTERBEKE engine capable of many thousands of hours of dependable service. However the manufacturer cannot control how or where the engine is installed in the vessel or the manner in which the unit is operated and serviced in the field. This is up to the buyer/owner-operator.

NOTE: Six important steps to ensure long engine life:

- *Proper engine installation and alignment.*
- *An efficient well-designed exhaust system that includes an anti-siphon break to prevent water from entering the engine.*
- *Changing the engine oil and oil filters every 100 operating hours.*
- *Proper maintenance of all engine and generator components according to the maintenance schedule in this manual.*
- *Use clean, filtered diesel fuel.*
- *Winterize your engine according to the "Lay-up and Recommissioning" section in this manual.*

DIESEL FUEL, ENGINE OIL AND ENGINE COOLANT

DIESEL FUEL

USE A DIESEL FUEL WITH A CETANE RATING OF #45 OR HIGHER.
(No. 2-D (SAE J313) diesel fuel according to ASTM D975).

Care Of The Fuel Supply

Use only clean diesel fuel! The clearance of the components in your fuel injection pump is very critical; invisible dirt particles which might pass through the filter can damage these finely finished parts. It is important to buy clean fuel, and keep it clean. The best fuel can be rendered unsatisfactory by careless handling or improper storage facilities. To assure that the fuel going into the tank for your engine's daily use is clean and pure, the following practice is advisable:

Purchase a well-known brand of fuel. Install and regularly service a good, visual-type fuel filter/water separator between the fuel tank and the engine. The Raycor 500 MA or 230 RMAM are good examples of such filters.

ENGINE OIL

Use a heavy duty engine oil with an API classification of CF, CG-4, CH-4 or CI-4. Change the engine oil and filter after an initial 50 hours of break-in operation. Then follow the oil and filter change intervals as specified in the **MAINTENANCE SCHEDULE** in this manual. Westerbeke Corporation does not approve or disapprove of the use of synthetic oils. If synthetic oils are used, engine break-in must be performed using conventional oil. Oil change intervals must be as in the **MAINTENANCE SCHEDULE**, not extended because synthetic oils are used.

SAE OIL VISCOSITY GRADES

For all temperatures use SAE 10W-30 or 15W-40.

CAUTION: Do not allow two or more brands of engine oil to mix. Each brand contains its own additives; additives of different brands could react in the mixture to produce properties harmful to your engine.

OIL PRESSURE

The engine's oil pressure, during operation, is indicated by the oil pressure gauge on the instrument panel. During normal operation, the oil pressure will range between 35 and 65 psi (2.5 and 3.9 kg/cm²).

NOTE: A newly started, cold engine can have an oil pressure reading upwards of 60 psi (4.2 kg/cm²). A warmed engine can have an oil pressure reading as low as 25 psi (1.8 kg/cm²). These readings will vary depending upon the temperature of the engine, the load placed on the engine, and the RPM's.

ENGINE COOLANT

WESTERBEKE recommends a mixture of 50% antifreeze and 50% distilled water. Distilled water is free from the chemicals that can corrode internal engine surfaces.

The antifreeze performs double duty. It allows the engine to run at proper temperatures by transferring heat away from the engine to the coolant, and lubricates and protects the cooling circuit from rust and corrosion. Look for a good quality antifreeze that contains Supplemental Cooling Additives (SCAs) that keep the antifreeze chemically balanced, crucial to long term protection.

The distilled water and antifreeze should be premixed before being poured into the cooling circuit.

PURCHASING ANTIFREEZE

Rather than preparing the mixture, WESTERBEKE recommends buying the premixed antifreeze so that when adding coolant the mixture will always be correct. There are two common types of antifreeze, Ethylene Glycol (green) and Propylene Glycol (red/purple), either can be used but do not mix the two and if changing from one to another, flush the engine thoroughly.

Premixed antifreeze for DIESEL Engines:
Specification #ASTM D53456.

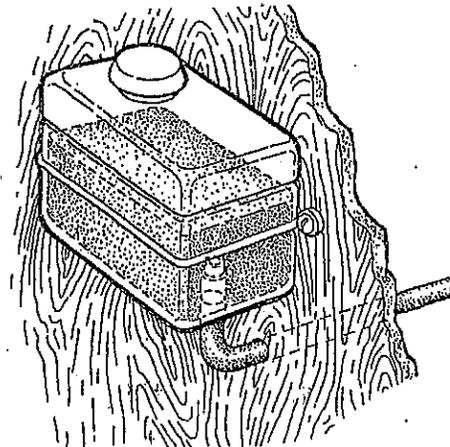
MAINTENANCE

Change the engine coolant every five years regardless of the number of operating hours as the chemical additives that protect and lubricate the engine have a limited life.

COOLANT RECOVERY TANK

A coolant recovery tank kit is supplied with each engine or generator. The purpose of this recovery tank is to allow for engine coolant expansion and contraction during engine operation, without the loss of coolant and without introducing air into the cooling system. This kit is provided and must be installed before operating the engine.

NOTE: This tank, with its short run of plastic hose, is best located at or above the level of the engine's manifold, but it can be located below the level of the engine's manifold if the particular installation makes this necessary.



ADMIRAL CONTROL PANEL

DESCRIPTION

This manually-operated control panel is equipped with a KEY switch and RPM gauge with an ELAPSED TIME meter which measures the engine's running time in hours and in 1/10 hours. The panel also includes a WATER TEMPERATURE gauge which indicates water temperature in degrees Fahrenheit, an OIL PRESSURE gauge which measures the engine's oil pressure in pounds per square inch, and a DC control circuit VOLTAGE gauge which measures the system's voltage. All gauges are illuminated when the key switch is turned on and remain illuminated while the engine is in operation. The panel also contains two rubber-booted pushbuttons, one for PREHEAT and one for START.

When the engine is shut down with the key switch turned off, the water temperature gauge will continue to register the last temperature reading indicated by the gauge before electrical power was turned off. The oil pressure gauge will fall to zero when the key switch is turned off. The temperature gauge will once again register the engine's true temperature when electrical power is restored to the gauge.

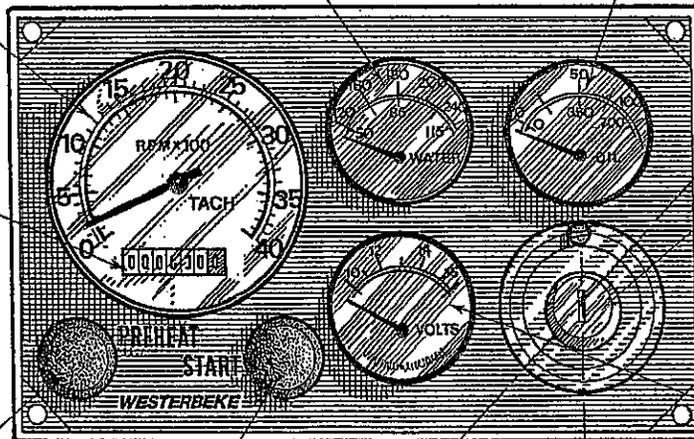
A separate alarm buzzer with harness is supplied with every Admiral Panel. The installer is responsible for electrically connecting the buzzer to the four-pin connection on the engine's electrical harness. The installer is also responsible for installing the buzzer in a location where it will be dry and where it will be audible to the operator should it sound while the engine is running. The buzzer will sound when the ignition key is turned on and should silence when the engine has started and the engine's oil pressure rises above 15 psi (1.1 kg/cm²).

WATER TEMPERATURE GAUGE: THIS GAUGE IS GRADUATED IN DEGREES FAHRENHEIT AND IS ILLUMINATED WHILE THE KEY SWITCH IS TURNED ON. THE ENGINE'S NORMAL OPERATING TEMPERATURE IS 170° - 190° F (77° - 88°C).

OIL PRESSURE GAUGE: THIS GAUGE IS GRADUATED IN POUNDS PER SQUARE INCH (PSI) AND IS ILLUMINATED WHILE THE KEY SWITCH IS TURNED ON. THE ENGINE'S NORMAL OPERATING OIL PRESSURE RANGES BETWEEN 30 - 60 psi (2.1 - 4.2 kg/cm²).

RPM GAUGE: REGISTERS REVOLUTIONS PER MINUTE OF THE ENGINE AND CAN BE RECALIBRATED FOR ACCURACY FROM THE REAR OF THE PANEL.

HOURMETER: REGISTERS ELAPSED TIME, AND SHOULD BE USED AS A GUIDE FOR THE MAINTENANCE SCHEDULE.

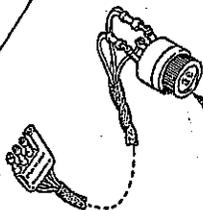


KEY SWITCH: PROVIDES POWER ONLY TO THE INSTRUMENT PANEL CLUSTER.

DC VOLTMETER: INDICATES THE AMOUNT THE BATTERY IS BEING CHARGED. SHOULD SHOW 13V TO 14V.

PREHEAT BUTTON: WHEN PRESSED, ENERGIZES THE ALTERNATOR'S EXCITER, THE FUEL LIFT PUMP, THE FUEL SOLENOID ON THE INJECTION PUMP, AND THE ENGINE'S GLOW PLUGS. IT BYPASSES THE ENGINE'S OIL PRESSURE ALARM SWITCH. IN ADDITION, THIS BUTTON ENERGIZES THE START BUTTON.

START BUTTON: WHEN PRESSED, ENERGIZES THE STARTER'S SOLENOID WHICH CRANKS THE ENGINE. THIS BUTTON WILL NOT OPERATE ELECTRICALLY UNLESS THE PREHEAT BUTTON IS PRESSED AND HELD AT THE SAME TIME.



AUTOMATIC ALARM SYSTEM

COOLANT TEMPERATURE ALARM: AN ALARM BUZZER HAS BEEN SUPPLIED WITH THE INSTRUMENT PANEL. IF THE ENGINE'S COOLANT REACHES 210° F (99°C), THIS SWITCH WILL CLOSE SOUNDING THE ALARM WHICH WILL EMIT A CONTINUOUS SIGNAL.

OIL PRESSURE ALARM: AN OIL PRESSURE ALARM SWITCH IS LOCATED OFF THE ENGINE'S OIL GALLERY. THIS SWITCH MONITORS THE ENGINE'S OIL PRESSURE. SHOULD THE ENGINE'S OIL PRESSURE FALL TO 5 - 10 psi (0.4 - 0.7 kg/cm²), THE SWITCH WILL OPEN SOUNDING THE ALARM. IN THIS EVENT, THE ALARM WILL EMIT A PULSATING SIGNAL.

CAPTAIN CONTROL PANEL

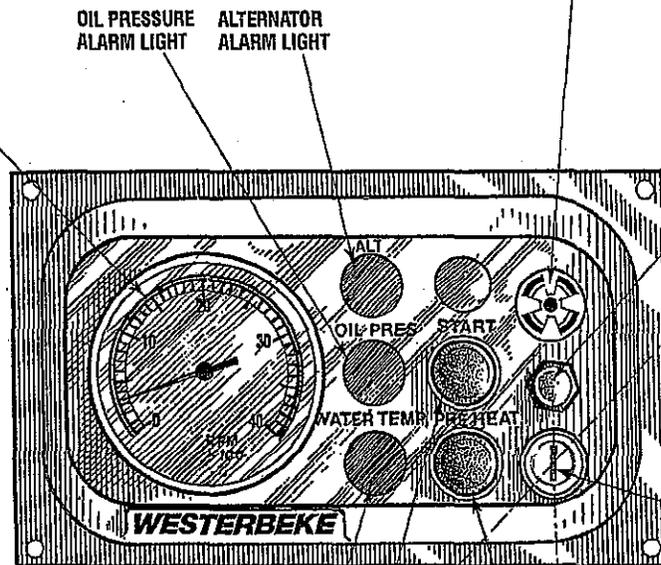
DESCRIPTION

This manually-operated control panel is equipped with a KEY switch, an RPM gauge, PREHEAT and START buttons, an INSTRUMENT TEST button and three indicator lamps, one for ALTERNATOR DISCHARGE, one for low OIL PRESSURE, and one for high ENGINE COOLANT TEMPERATURE.

The panel also includes an alarm buzzer for low OIL PRESSURE or high COOLANT TEMPERATURE. The RPM gauge is illuminated when the KEY switch is turned on and remains illuminated while the engine is in operation.

RPM GAUGE: REGISTERS REVOLUTIONS PER MINUTE OF THE ENGINE AND CAN BE RECALIBRATED FOR ACCURACY FROM THE REAR OF THE PANEL.

ALARM: THE ALARM WILL SOUND IF THE ENGINE'S OIL PRESSURE FALLS BELOW 5 - 10 psi (0.4 - 0.7 kg/cm²). IN THIS EVENT, THE ALARM WILL EMIT A PULSATING SIGNAL. THE ALARM WILL ALSO SOUND IF THE COOLANT TEMPERATURE IN THE FRESHWATER COOLING CIRCUIT RISES TO 210°F (99°C). IN THIS EVENT, THE ALARM WILL EMIT A CONTINUOUS SIGNAL. NOTE: THE ALARM WILL SOUND WHEN THE KEY SWITCH IS TURNED ON. THIS SOUNDING IS NORMAL. ONCE THE ENGINE STARTS AND THE ENGINE'S OIL PRESSURE REACHES 15 psi (1.1 kg/cm²), THE ALARM WILL SILENCE.



OIL PRESSURE
ALARM LIGHT ALTERNATOR
ALARM LIGHT

TEST BUTTON: WHEN PRESSED, TESTS THE ALTERNATOR, THE OIL PRESSURE, AND THE COOLANT TEMPERATURE CONTROL CIRCUITS. WHEN PRESSED, THE ALTERNATOR, THE OIL PRESSURE, AND THE WATER TEMPERATURE INDICATOR LIGHTS ILLUMINATE IN ADDITION TO SOUNDING THE ALARM BUZZER.

KEY SWITCH: PROVIDES POWER ONLY TO THE INSTRUMENT PANEL CLUSTER.

WATER TEMPERATURE
ALARM LIGHT

START BUTTON: WHEN PRESSED, ENERGIZES THE STARTER'S SOLENOID WHICH CRANKS THE ENGINE. THIS BUTTON WILL NOT OPERATE ELECTRICALLY UNLESS THE PREHEAT BUTTON IS PRESSED AND HELD AT THE SAME TIME.

PREHEAT BUTTON: WHEN PRESSED, ENERGIZES THE ALTERNATOR'S EXCITER, THE FUEL LIFT PUMP, THE FUEL SOLENOID ON THE INJECTION PUMP, AND THE ENGINE'S GLOW PLUGS, AND BYPASSES THE ENGINE'S OIL PRESSURE ALARM SWITCH. IN ADDITION, THIS BUTTON ENERGIZES THE START BUTTON.

PREPARATIONS FOR INITIAL START-UP

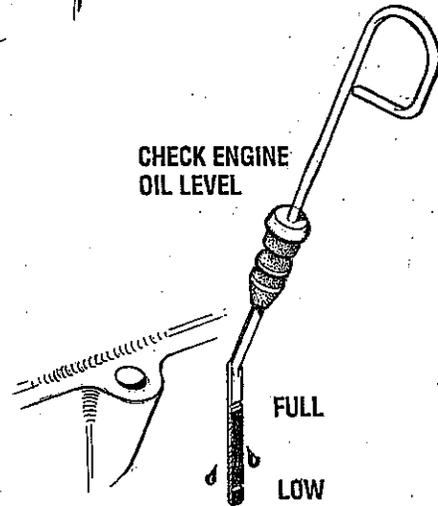
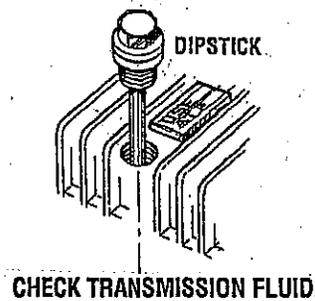
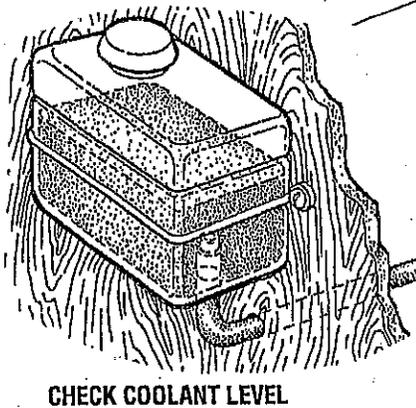
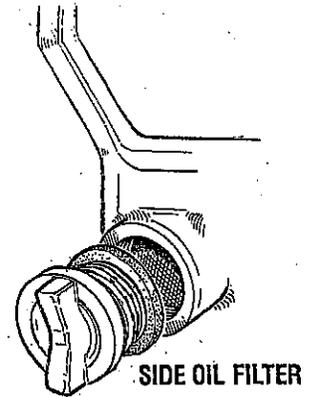
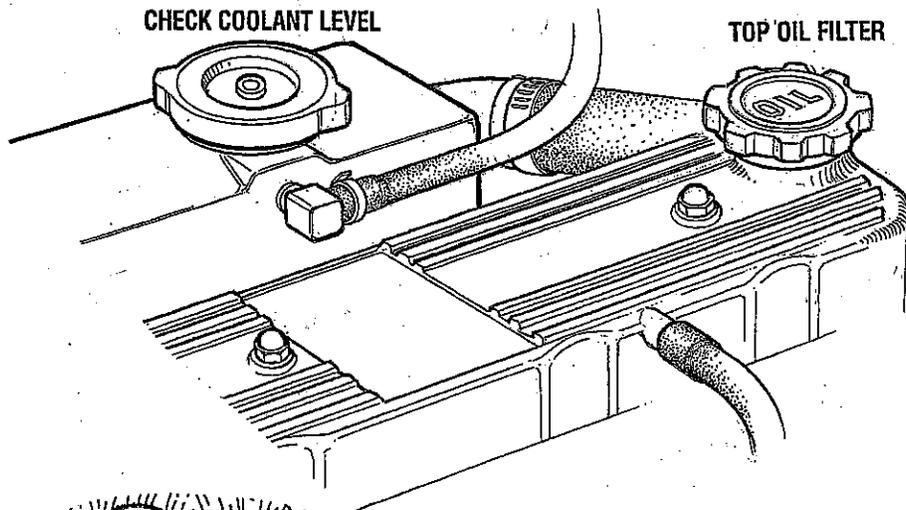
PRESTART INSPECTION

Before starting your engine for the first time or after a prolonged layoff, check the following items:

- Check the engine oil level. Add oil to maintain the level at the high mark on the dipstick.
- Turn on the fuel supply, then check the fuel supply and examine the fuel filter/water separator bowl for contaminants.
- Check the transmission fluid level.
- Check the DC electrical system. Inspect wire connections and battery cable connections. Make certain the positive (+) battery cable is connected to the starter solenoid and the negative (-) cable is connected to the engine ground stud (this location is tagged).
- Check the coolant level in both the plastic recovery tank and at the manifold.

NOTE: If the engine has not yet been filled with coolant, refer to the *COOLING SYSTEM* section of this manual.

- Visually examine the engine. Look for loose or missing parts, disconnected wires, and unattached hoses. Check the threaded connections and engine attachments.
- Make certain there is proper ventilation around the engine. An ample supply is necessary for proper engine performance.
- Make sure the mounting installation is secure.
- Ensure the propeller shaft is securely attached to the transmission.
- Open the thru-hull and make certain raw water is primed to the raw water strainer.



STARTING/STOPPING PROCEDURE

CHECK LIST

Follow this check list each day before starting your engine.

- Visually inspect the engine for fuel, oil, or water leaks.
- Check the oil level (dipstick).
- Check the coolant level in the coolant recovery tank. Periodically check the manifold coolant level.
- Check the transmission fluid level.
- Check your fuel supply.
- Look for clean fuel in the fuel filter/water separator transparent bowl.
- Check for loose wires at the alternator and make sure its mounting is secure.
- Check the starting batteries (weekly).
- Check drive belts for wear and proper tension (weekly).
- Check the raw water pump to make sure its mounting is secure.

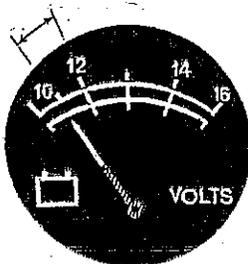
STARTING THE ENGINE

1. Put the transmission in neutral and advance the throttle.
2. Turn the KEY to the ON position (2 o'clock).
(The panel is energized, gauges are lit).
3. Depress the PREHEAT BUTTON, hold for 5 to 15 seconds depending on how cold it is.
(The fuel lift pump is priming the engine and the preheat is activated).
4. Continue pressing the PREHEAT BUTTON and press the START BUTTON.
(The start motor is cranking the engine).
5. Release the START BUTTON as the engine starts.
6. With the engine running, check the instruments for proper oil pressure and battery charging voltage. Also check for overboard discharge of exhaust water. The water temperature will rise slowly until the thermostat opens. Do not engage the gear shift until the temperature is close to normal.

NOTE: Never attempt to engage the starter while the engine is running.

It is important to closely monitor the panel gauges. become aware of the normal engine readings and take immediate action if these readings start to vary.

If a "smart" regulator is part of the charging system, allow about 50 seconds for the RPM gauge to activate.



NOTE: When starting:
A voltage drop will occur
when the preheat-switch
is depressed.

FAILURE TO START

If the engine fails to start when the start button is pressed for 5 seconds, wait for at least 30 seconds and repeat the starting procedure. Make certain the transmission control is in the neutral position.

Never run the starter motor for more than 30 seconds. If the engine fails to start, refer to the TROUBLESHOOTING CHART in this manual.

CAUTION: Prolonged cranking intervals without the engine starting can result in the engine exhaust system filling with raw water. This may happen because the pump is pumping raw water through the raw water cooling system during cranking. This raw water can enter the engine's cylinders by way of the exhaust manifold once the exhaust system fills. Prevent this from happening by closing the raw water supply through-hull shut-off; draining the exhaust muffler, and correcting the cause of the excessive engine cranking. Engine damage resulting from raw water entry is not a warrantable issue; the owner/operator should keep this in mind.

STOPPING PROCEDURES

To stop the engine, bring the throttle to an idle position and place the transmission in neutral. Allow the engine to idle for a few moments to stabilize the engine temperature. Then pull the shut-off tee/knob out and allow the engine to stop fully. Then push the shut-off tee/knob back in fully and shut-off with key.

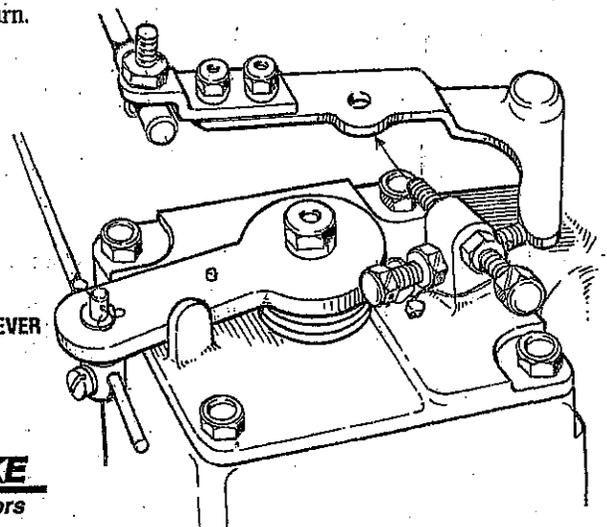
NOTE: Units with the Optional Electric Shut-Off, just turn off the key.

FAILURE TO STOP (Optional Electric Shut-Off)

In the unusual situation that the key switch fails to turn the engine off and it stays at a low idle, shut down can be accomplished by manually working the shut off lever located adjacent to the throttle lever by the injection pump.

NOTE: In such cases the electric fuel shut off solenoid may need to be threaded into the block an additional 1/4 - 1/2 turn.

ENGINE STOP LEVER



ENGINE BREAK-IN PROCEDURE

DESCRIPTION

Although your engine has experienced a minimum of one hour of test operations at the factory to make sure accurate assembly procedures were followed and that the engine operated properly, a break-in time is required. The service life of your engine is dependent upon how the engine is operated and serviced during its initial 50 hours of use.

Breaking-in a new engine basically involves seating the piston rings to the cylinder walls. Excessive oil consumption and smoky operation indicate that the cylinder walls are scored, which is caused by overloading the engine during the break-in period.

Your new engine requires approximately 50 hours of initial conditioning operation to break in each moving part in order to maximize the performance and service life of the engine. Perform this conditioning carefully, keeping in mind the following:

1. Start the engine according to the *STARTING PROCEDURE* section. Run the engine at fast idle while checking that all systems (raw water pump, oil pressure, battery charging) are functioning.
2. Allow the engine to warm up (preferably by running at fast idle) until the water temperature gauge moves into the 130 – 140°F (55 – 60°C) range.

3. While using the vessel, run the engine at various engine speeds for the first 25 hours. Avoid prolonged periods of idling.
4. Avoid rapid acceleration, especially with a *cold* engine.
5. Use caution not to overload the engine. The presence of a grey or black exhaust and the inability of the engine to reach its full rated speed are signs of an overload.
6. During the next 25 hours, the engine may be operated at varying engine speeds, with short runs at full rated rpm. Avoid prolonged idling during this break-in period.

CHECK LIST

- Monitor the control panel gauges.
- Check for leaks of fuel and engine oil.
- Check for abnormal noise such as knocking, friction, vibration and blow-back sounds.
- Confirm exhaust smoke:
 - When the engine is cold – white smoke.
 - When the engine is warm – almost smokeless.
 - When the engine is overloaded – some black smoke and soot.

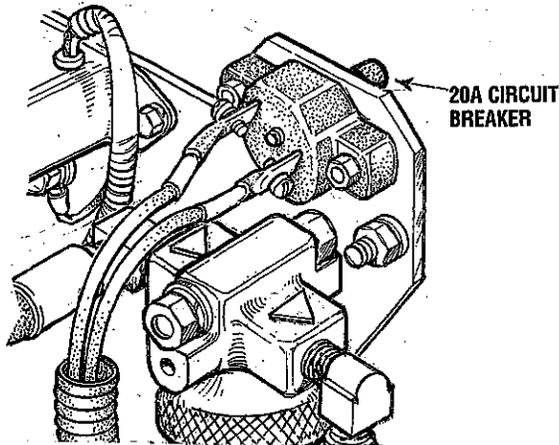
NOTE: See the *TRANSMISSION* section of this manual for break-in information on your transmission.

WARNING LIGHTS, ALARMS & CIRCUIT BREAKER

ALTERNATOR WARNINGS

The Captain Control Panel indicates alternator low discharge with a **red warning light**.

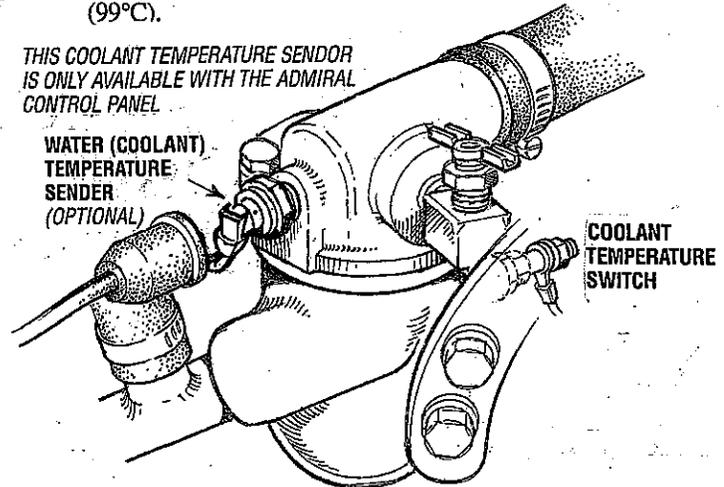
The Admiral Control Panel uses a **voltmeter** to monitor the performance of the alternator.



COOLANT TEMPERATURE SWITCH

A coolant temperature switch is located on the thermostat housing. This switch will activate a **continuous alarm** if the coolant's operating temperature reaches approximately 210°F (99°C).

THIS COOLANT TEMPERATURE SENSOR IS ONLY AVAILABLE WITH THE ADMIRAL CONTROL PANEL

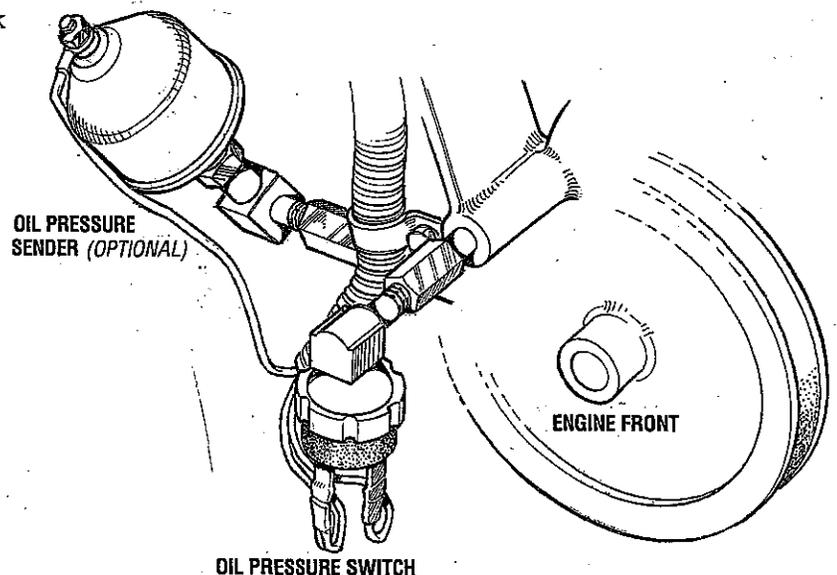


ENGINE CIRCUIT BREAKER

The DC harness on the engine is protected by an engine mounted manual reset circuit breaker (20 amps DC). Excessive current draw or electrical overload anywhere in the instrument panel wiring or engine wiring will cause the breaker to trip. In this event DC power to the electric fuel pump will terminate. As fuel is consumed and runs out, the engine will slow and stop. If this breaker should trip, check for the cause of high current draw and repair the problem. Reset the breaker and re-start the engine.

LOW OIL PRESSURE ALARM SWITCH

A low oil pressure alarm switch is located on the engine block. This switch's sensor monitors the engine's oil pressure. Should the engine's oil pressure fall to 5 - 10 psi (0.4-0.7 kg/cm²), this switch will activate a **pulsating alarm**.



MAINTENANCE SCHEDULE

In order to use this Maintenance Schedule, it will be necessary to log your engine hours. Use your engine hourmeter or record your engine hours by running time.

NOTE: Many of the following maintenance procedures are simple but others are more difficult and may require the expert knowledge of a service mechanic.

⚠ WARNING: Never attempt to perform any service while the engine is running. Wear the proper safety equipment such as goggles and gloves, and use the correct tools for each job. Disconnect the battery terminals when servicing any of the engine's DC electrical equipment.

SCHEDULED MAINTENANCE	CHECK EACH DAY	HOURS OF OPERATION							MAINTENANCE DESCRIPTION
		50	100	250	500	750	1000	1250	
Fuel Supply	<input type="checkbox"/>								Diesel No. 2 rating of 45 cetane or higher.
Filter/Water Separator	<input type="checkbox"/>								Check for water and dirt in fuel (drain/replace filter if necessary).
Engine Oil Level	<input type="checkbox"/>								Oil level should indicate between MAX. and LOW on dipstick.
Coolant Level	<input type="checkbox"/>								Check at recovery tank; if empty, check at manifold. Add coolant if needed.
Transmission Fluid Level	<input type="checkbox"/>								Fluid level should indicate between MAX and LOW on dipstick.
Drive Belts	<input type="checkbox"/> weekly								Inspect for proper tension (3/8" to 1/2" deflection) and adjust if needed. Check belt edges for wear.
Visual Inspection of Engine	<input type="checkbox"/>	NOTE: Keep engine surface clean. Dirt and oil will inhibit the engine's ability to remain cool.							Check for fuel, oil and water leaks. Inspect wiring and electrical connections. Keep bolts & nuts tight. Check for loose belt tension.
Fuel Filter		<input type="checkbox"/>		<input type="checkbox"/>	Change at 50 hours then every 250 hours.				
Starting Batteries (and House Batteries)	<input type="checkbox"/> weekly								Check electrolyte levels every 50 operating hours and make sure connections are very tight. Clean off excessive corrosion.
Engine Oil and Filter		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Initial engine oil & filter change at 50 hours, then change both every 100 hours.
Heat Exchanger Zinc Anode		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Inspect zinc anode, replace if needed. Clear the heat exchanger end of zinc anode debris.
Filter/Water Separator			<input type="checkbox"/>	Change filter every 200 hours.					
Exhaust System		<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>	Initial check at 50 hours, then every 250 hours. Inspect for leaks. Check anti-siphon valve operation. Check the exhaust elbow for carbon and/or corrosion buildup on inside passages; clean and replace as necessary. Check that all connections are tight. Check casting integrity.
Engine Hoses			<input type="checkbox"/>	Hose should be hard & tight. Replace if soft or spongy. Check and tighten all hose clamps.					
Throttle Transmission Shut-Off Cables		<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>	Check for loose fittings, cotter pins, etc. Lubricate with WD-40 or equivalent.
Adjust Engine Idle Speed		<input type="checkbox"/>							Adjust to 1000 - 1200 rpm
Raw Water Pump				<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>	Remove the pump cover and inspect the impeller, gasket, cam and cover for wear. Check the bearings and seals (the shaft can turn, but not wobble). Lubricate when reassembling.
Inlet Fuel Filter				<input type="checkbox"/>	Replace.				

MAINTENANCE SCHEDULE

NOTE: Use the engine hourmeter gauge to log your engine hours or record your engine hours by running time.

SCHEDULED MAINTENANCE	CHECK EACH DAY	HOURS OF OPERATION							MAINTENANCE DESCRIPTION
		50	100	250	500	750	1000	1250	
Raw Water Pump <i>At 750 operating hours, disassemble and inspect for overhaul.</i>						<input type="checkbox"/>			Remove the pump from the engine. Disassemble and inspect all components, replacing all worn components as needed. Inspect the drive gear slot for wear. Replace drive gear as needed.
Coolant System					<input type="checkbox"/>			<input type="checkbox"/>	Drain, flush, and refill cooling system with the appropriate antifreeze mix.
Electric Fuel Lift Pump		<input type="checkbox"/>		<input type="checkbox"/>	Periodically check the wiring connections and inspect the fuel line connections.				
*Fuel Injectors						<input type="checkbox"/>			Check and adjust injection opening pressure and spray condition. (see <i>ENGINE ADJUSTMENTS</i>).
*Starter Motor					<input type="checkbox"/>			<input type="checkbox"/>	Check solenoid and motor for corrosion. Remove and lubricate. Clean and lubricate the starter motor pinion drive.
*Preheat Circuit					<input type="checkbox"/>			<input type="checkbox"/>	Check operation of preheat solenoid. Remove and clean glow plugs, check resistance (4-6 ohms). Reinstall with anti-seize compound on threads.
*Engine Cylinder Compression					<input type="checkbox"/>			<input type="checkbox"/>	Check compression pressure and timing (see <i>ENGINE ADJUSTMENTS</i>).
*Adjust the Valve Clearances Re-torque Cylinder Head Bolts		<input type="checkbox"/>			<input type="checkbox"/>			<input type="checkbox"/>	Adjust Valve Clearances, re-torque cylinder head bolts. (see <i>ENGINE ADJUSTMENTS</i>).
*Heat Exchanger								<input type="checkbox"/>	Remove, have professionally cleaned and pressure tested.
*Water Injected Exhaust Elbow					<input type="checkbox"/>			<input type="checkbox"/>	Check casting integrity every 500 hours of operation. Clean internal passage. Replace as needed.
Engine Damper Plate								<input type="checkbox"/>	Chattering at idle/low rpm is an indication of damper plate spring wear. Inspect and replace as needed.
Lubricate Panel Key Switch with "Lockeze"		<input type="checkbox"/>							Lubricate at 50 hours, then at least once a season.
Transmission Fluid								<input type="checkbox"/>	Initial change at 25 hours, then at least once a season.

*WESTERBEKE recommends this service be performed by an authorized mechanic.

FUEL SYSTEM

DIESEL FUEL

USE A DIESEL FUEL WITH A CETANE RATING OF #45 OR HIGHER.
(No. 2-D (SAE J313) diesel fuel according to ASTM D975).

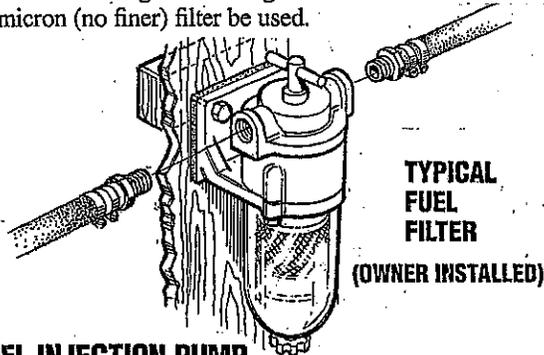
FUEL FILTERS

The fuel injection pump and the fuel injectors are precisely manufactured and they must receive clean diesel fuel, free from water and dirt. To ensure this flow of clean fuel, the fuel must pass through at least two fuel filters, a fuel water separator and the engine's spin-on fuel filter. Visually inspect, clean, and change these filters according to the maintenance schedule in this manual.

FUEL WATER SEPARATOR

A primary fuel filter of the water separating type must be installed between the fuel tank and the engine to remove water and other contaminants from the fuel before they can be carried to the fuel system on the engine.

The owner/operator is responsible for making certain the fuel reaching the engine's injection equipment is free of impurities. This process is accomplished by installing and maintaining a proper fuel filter/water separator between the fuel tank and the generator/engine. Westerbeke recommends a 10 micron (no finer) filter be used.



FUEL INJECTION PUMP

The fuel injection pump is the most important component of the diesel engine, requiring the utmost caution in handling. The fuel injection pump has been thoroughly bench-tested and the owner/operator is cautioned not to attempt to service it. If it requires servicing, remove it and take it to an authorized fuel injection pump service facility. Do not attempt to disassembly and repair it.

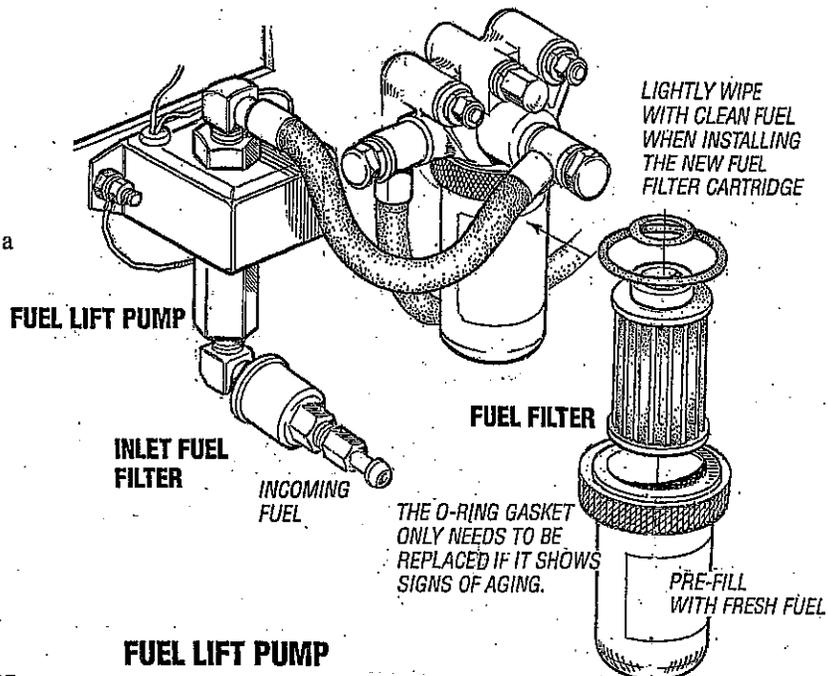
The only adjustment the servicing mechanic should make to the fuel injection pump is the adjustment for the engine idle speed (see *IDLE SPEED ADJUSTMENT* under *ENGINE ADJUSTMENTS*).

ENGINE FUEL FILTER

Periodically check the fuel connections and the bowl for leakage. Replace the filter element after the first 50 hours then follow the *MAINTENANCE SCHEDULE*.

Changing/cleaning the filter element

1. Shut off the fuel supply.
2. Unscrew the retainer ring that holds the filter bowl to the housing and allow the bowl to come away from the housing.
3. Remove and replace the filter element and clean the bowl.
4. Replace the sealing "O" ring and reassemble the bowl to the housing. Thread the retainer ring on carefully so as not to cross thread. When retainer contacts the "O" ring, tighten 1/4 - 1/2 turns by hand. Open the fuel supply and run the engine to inspect for leaks.



FUEL LIFT PUMP

Periodically check the fuel connections to and out of the pump and make sure that no leakage is present and that the fittings are tight and secure. The DC ground connection at one of the pump's mounting bolts should be clean and well secured by the mounting bolt to ensure proper pump operation.

When energized thru the preheat circuit, the fuel lift pump will purge air from the fuel system and provide a continuous flow of fuel as the engine is running.

INLET FUEL FILTER

To ensure clean fuel into the fuel pump, there is a small in-line fuel filter connected to the fuel lift pump elbow. This filter should be replaced every 250 hours of operation or once a season, whichever occurs first.

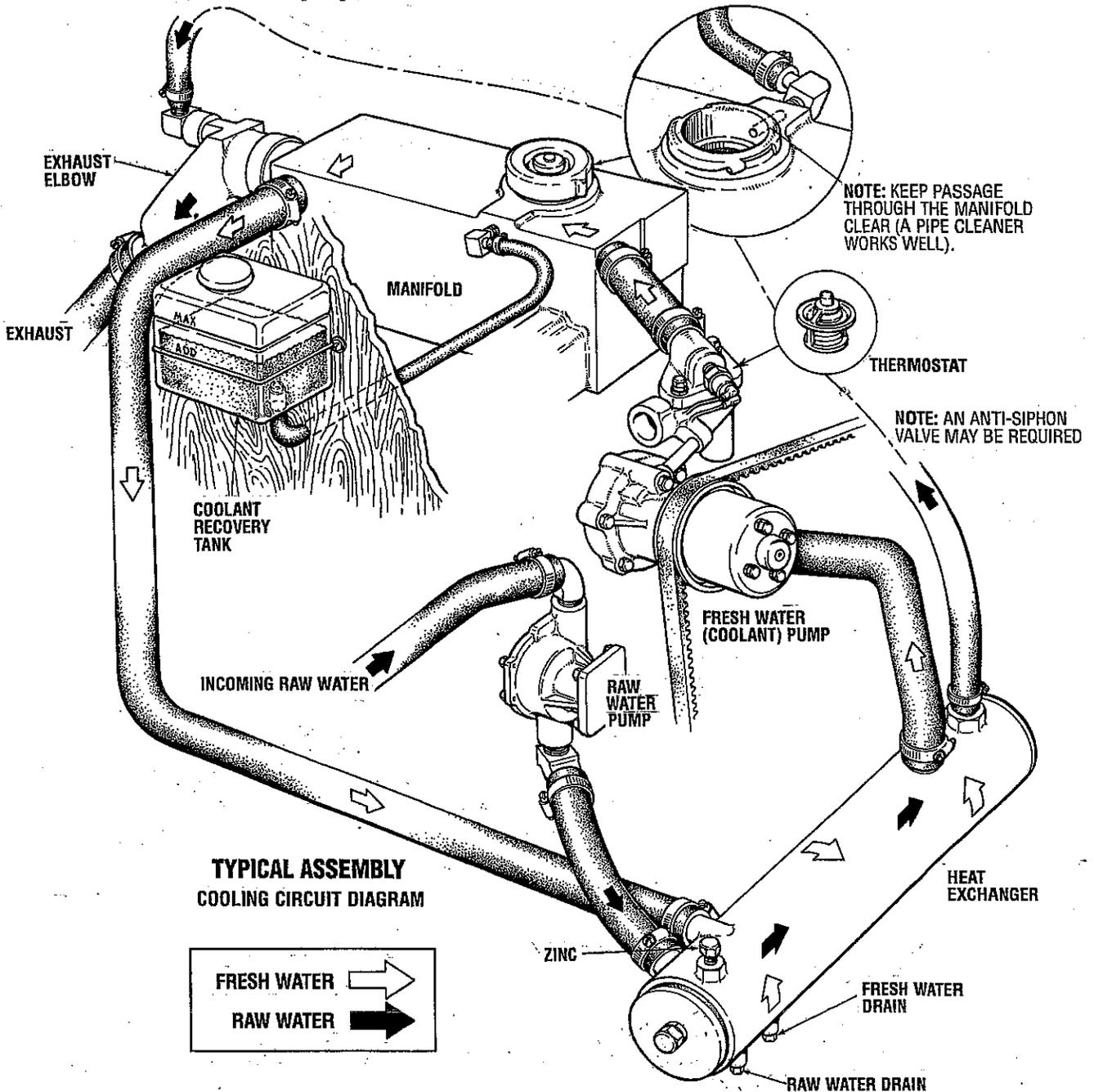
ENGINE COOLING CIRCUIT

DESCRIPTION

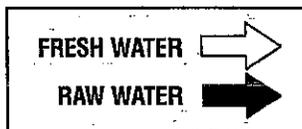
Westerbeke marine diesel generators are designed and equipped for fresh water cooling. Heat produced in the engine by combustion and friction is transferred to fresh water coolant which circulates throughout the engine. This circulating fresh water coolant cools the engine block and its internal moving parts. The heat is transferred externally from the fresh water coolant to raw water by means of a heat exchanger; similar in function to an automotive radiator. Raw water flows through the tubes of the heat exchanger while fresh water coolant flows around the tubes; engine heat transferred to the fresh water coolant is conducted through the tube walls to the raw water which is then pumped into the

exhaust system where finally it is discharged overboard. In other words, the engine is cooled by fresh water coolant, this coolant is cooled by raw water, and the raw water carries the transferred heat overboard through the exhaust system. The fresh water coolant and raw water circuits are independent of each other. Using only fresh water coolant within the engine allows the cooling water passages to stay clean and free from harmful deposits.

NOTE: Refer to ENGINE COOLANT paragraphs in this section for the recommended antifreeze and water mixture to be used as the fresh water coolant and for information on filling the fresh water system.



**TYPICAL ASSEMBLY
COOLING CIRCUIT DIAGRAM**



COOLING SYSTEM

FRESH WATER COOLING CIRCUIT

Fresh water coolant is pumped through the engine by a circulating pump, absorbing heat from the engine. The coolant then passes through the thermostat into the manifold, to the heat exchanger where it is cooled and returned to the engine block via the suction side of the circulating pump. When the engine is started cold, external coolant flow is prevented by the closed thermostat (although some coolant flow is bypassed around the thermostat to prevent the exhaust manifold from overheating). As the engine warms up, the thermostat gradually opens, allowing full flow of the engine's coolant to flow unrestricted to the external portion of the cooling system.

ENGINE COOLANT

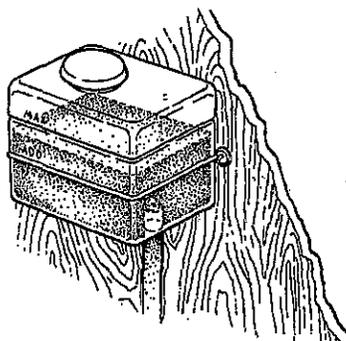
WESTERBEKE recommends a mixture of 50% antifreeze and 50% distilled water. Distilled water is free from the chemicals that can corrode internal engine surfaces.

The antifreeze performs a double duty. It allows the engine to run at proper temperatures by transferring heat away from the engine to the coolant and lubricates and protects the cooling circuit from rust and corrosion. Look for a good quality antifreeze that contains Supplemental Cooling Additives (SCAs) that keep the antifreeze chemically balanced, crucial to long term protection.

NOTE: Look for the new environmentally friendly long lasting antifreeze that is now available.

The recommended 50/50 mixture will protect the engine against the most extreme temperature. The antifreeze mixture will also retard rust within the engine and add to the life of the circulating pump impeller and seals.

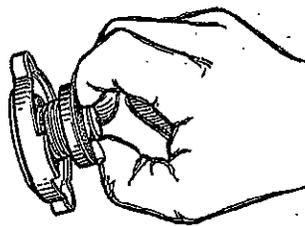
A proper 50/50 mixture as recommended will protect the engine coolant to temperatures of -40°F .



Coolant Recovery Tank

The coolant recovery tank allows for the expansion and contraction of the engine's coolant during engine operation without introducing air into the system. This recovery tank is provided with fresh water cooled models and with the fresh water coolant conversion kit and must be installed before operating the engine.

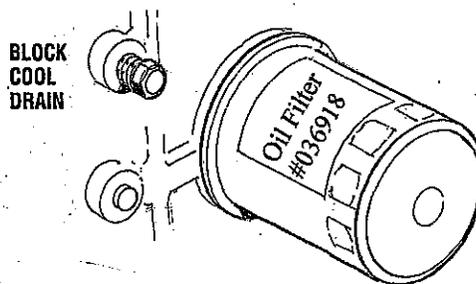
NOTE: This tank, with its short run of plastic hose, is best located at or above the level of the engine's manifold.



NOTE: Periodically check the condition of the pressure cap. Ensure that the upper and lower rubber seals are in good condition and check that the vacuum valve opens and closes tightly. Carry a spare cap.

CHANGING COOLANT

The engine's coolant must be changed according to the *MAINTENANCE SCHEDULE*. If the coolant is allowed to become contaminated, it can lead to overheating problems. Drain the engine coolant by removing the block drain adjacent to the oil filter, remove the in-board drain plug on the heat exchanger and remove the pressure cap from the water jacketed exhaust manifold.



Refilling the Coolant

After closing the engine drains, pour clean, premixed coolant into the manifold, start the engine and run it at a slow idle.

Monitor the coolant in the manifold and add as needed. Fill the manifold to the filler neck and when the coolant is flowing, install the pressure cap.

Remove the cap on the coolant recovery tank and fill with coolant mix to halfway between LOW and MAX and replace the cap. Run the engine and observe the coolant expansion flow into the recovery tank.

After checking for leaks, stop the engine and allow it to cool. Coolant should draw back into the cooling system as the engine cools down. Add coolant to the recovery tank if needed. Clean up any spilled coolant

CAUTION: The engine must be allowed to cool down before attempting these procedures. Not only is the surface of the engine hot but coolant temperatures can be at 190°F .

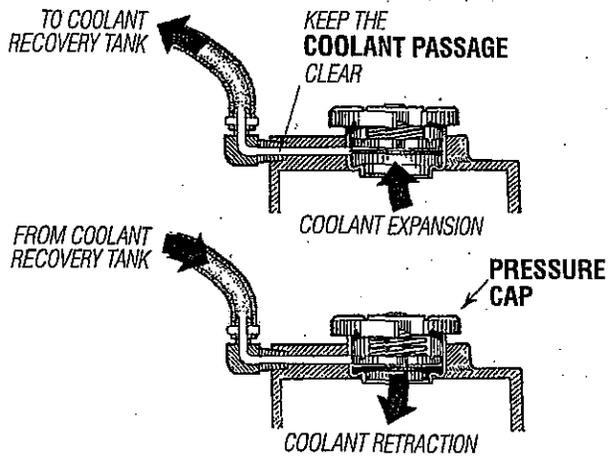
CAUTION: Proper cooling system maintenance is critical; a substantial number of engine failures can be traced back to cooling system corrosion.

COOLING SYSTEM

THERMOSTAT

A thermostat, located near the manifold at the front of the engine, controls the coolant temperature as the coolant continuously flows through the closed cooling circuit. When the engine is first started, the closed thermostat prevents coolant from flowing (some coolant is by-passed through a hole in the thermostat to prevent the exhaust manifold from overheating). As the engine warms up, the thermostat gradually opens. The thermostat is accessible and can be checked, cleaned, or replaced easily. Carry a spare thermostat and gasket

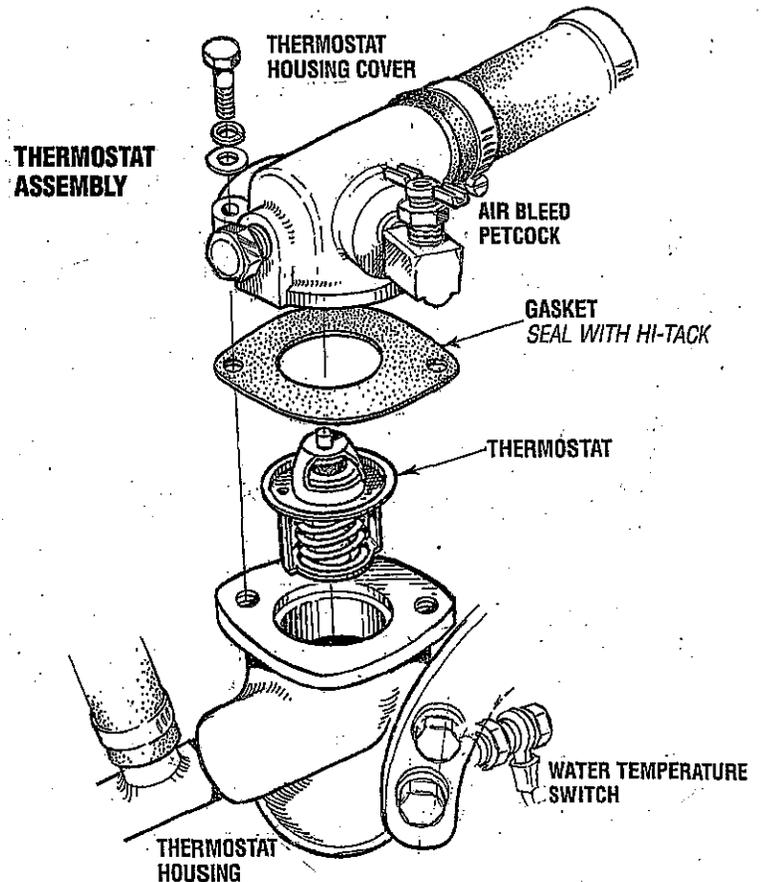
A coolant recovery tank allows for engine coolant expansion and contraction during engine operation, without any significant loss of coolant and without introducing air into the cooling system. This tank should be located at or above the engine manifold level and should be easily accessible.



Replacing the Thermostat

Remove the cap screws and disassemble the thermostat housing as shown. When installing the new thermostat and gasket, apply a thin coat of sealant on both sides of the gasket before pressing it into place. Do *not* over-tighten the cap screws.

Run the engine and check for normal temperatures and that there are no leaks at the thermostat housing.



CAUTION: *The engine must be allowed to cool down before attempting these procedures. Not only is the surface of the engine hot but coolant temperatures can be at 190° F.*

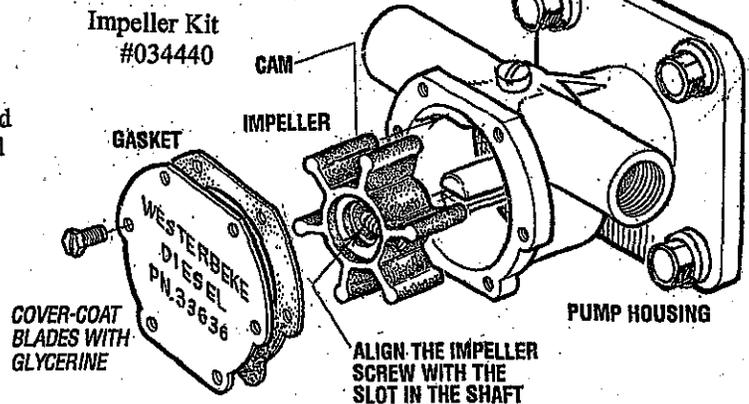
COOLING SYSTEM

RAW WATER PUMP

The raw water pump is a self-priming, rotary pump with a non-ferrous housing and a Neoprene impeller. The impeller has flexible blades which wipe against a curved cam plate within the impeller housing, producing the pumping action. **On no account should this pump be run dry.** There should always be a spare impeller and impeller cover gasket aboard (an impeller kit). Raw water pump impeller failures occur when lubricant (raw water) is not present during engine operation. Such failures are not warrantable, and operators are cautioned to make sure raw water flow is present at start-up. The raw water pump should be inspected periodically for broken or torn impeller blades. See **MAINTENANCE SCHEDULE**.

NOTE: Should a failure occur with the pumps internal parts (seals and bearings), it may be more cost efficient to purchase a new pump and rebuild the original pump as a spare.

RAW WATER PUMP (EARLY MODELS) SAME INSTRUCTIONS APPLY



NOTE: If any of the vanes have broken off the impeller they must be found to prevent blockage in the cooling circuit. They often can be found in the heat exchanger.

RAW WATER INTAKE STRAINER

A clean raw water intake strainer is a vital component of the engine's cooling system. Include a visual inspection of this strainer when making your periodic engine check. The water in the glass should be clear.

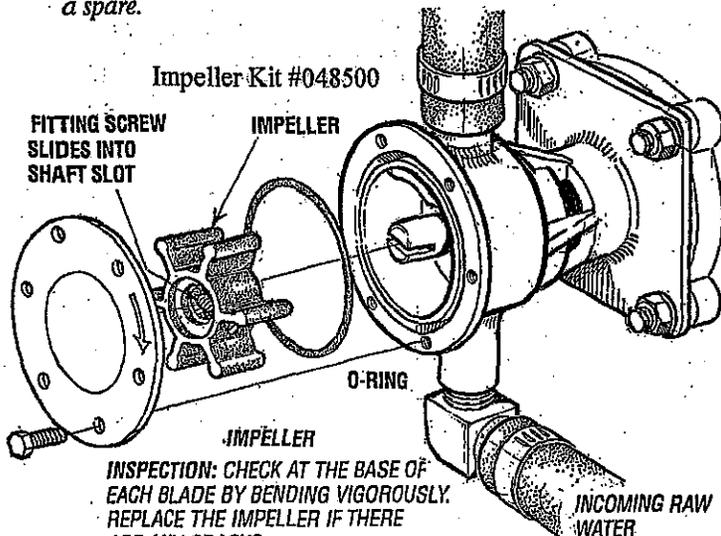
Perform the following maintenance after every 100 hours of operation:

1. Close the raw water seacock.
2. Remove and clean the strainer filter.
3. Clean the glass.
4. Replace the washer if necessary.
5. Reassemble and install the strainer.
6. Open the seacock.
7. Run the engine and check for leaks.

NOTE: Also follow the above procedure after having run hard aground.

If the engine temperature gauge ever shows a higher than normal reading, the cause may be that silt, leaves or grass may have been caught up in the strainer, slowing the flow of raw water through the cooling system.

NOTE: Always install the strainer at or below the waterline so the strainer will always be self-priming.



INSPECTION: CHECK AT THE BASE OF EACH BLADE BY BENDING VIGOROUSLY. REPLACE THE IMPELLER IF THERE ARE ANY CRACKS.

WHEN INSTALLING: TAKE CARE TO ALIGN THE IMPELLER KEYWAY WITH THE SHAFT KEY. FOLD THE IMPELLER BLADES IN EITHER DIRECTION (THEY WILL TURN IN THE CORRECT POSITION WHEN THE IMPELLER STARTS TO ROTATE).

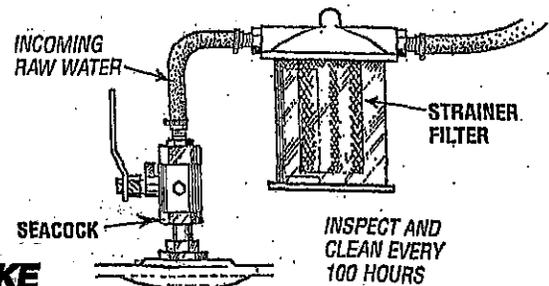
RAW WATER PUMP
#048080

CHANGING THE RAW WATER PUMP IMPELLER

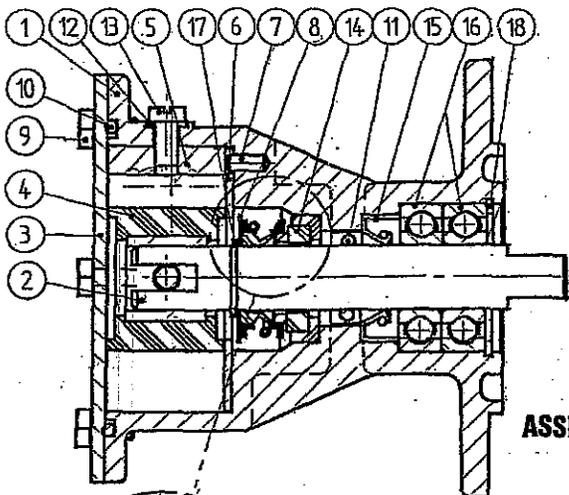
Close the raw water intake valve. Remove the pump cover and gasket or O-ring with the aid of two screwdrivers or pliers. Carefully pry/pull the impeller out of the pump. Lightly coat the inside of the pump housing with glycerine. Install the new impeller and cover with gasket, open the raw water intake valve.

NOTE: Never allow the pump to run dry. Even a short period of dry running may destroy the impeller.

TYPICAL RAW WATER INTAKE STRAINER (OWNER INSTALLED)



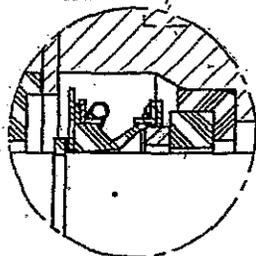
REPAIR PARTS ARE AVAILABLE
FROM YOUR WESTERBEKE DEALER



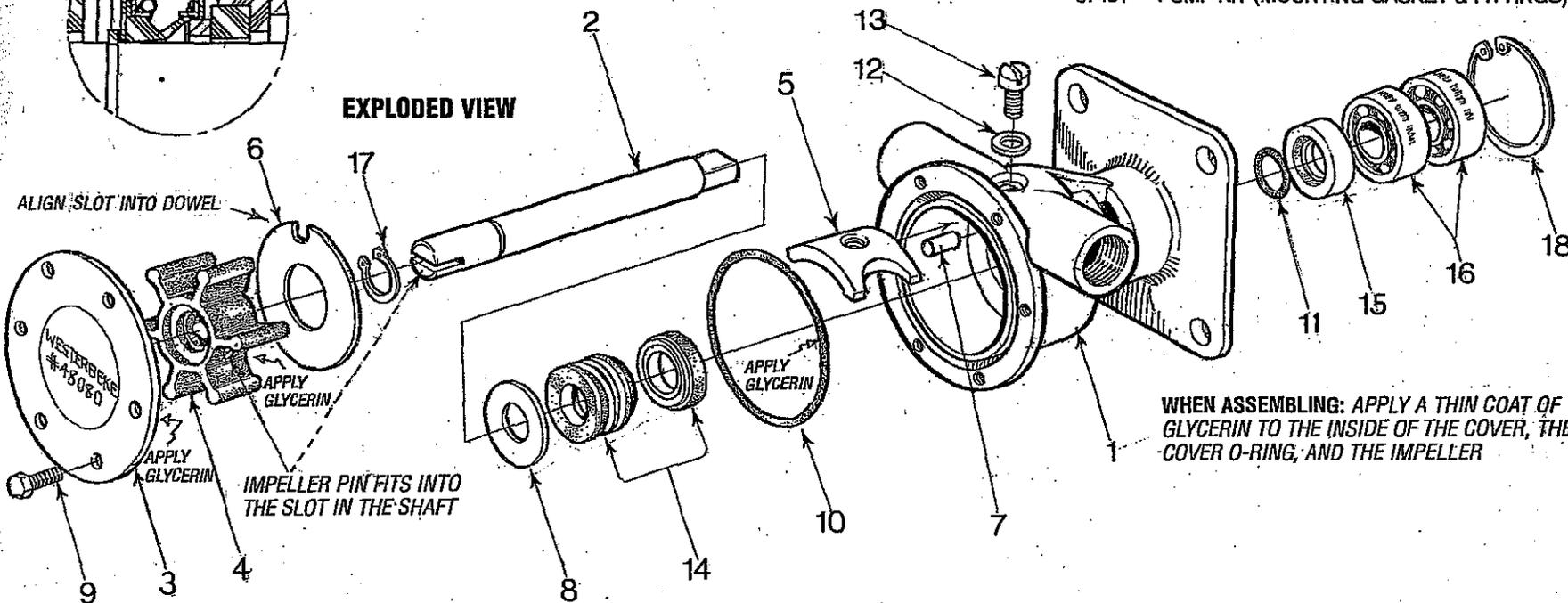
ASSEMBLED VIEW

NOTE
THE PUMP-REPAIR KIT (49000)
INCLUDES ALL THE LISTED
COMPONENTS EXCEPT ITEMS
1 AND 7. THE KIT ALSO INCLUDES
A PUMP MOUNTING GASKET.

KEY NO.	PART NUMBER AND PART NAME	QUANTITY
1	48080 RAW WATER PUMP	1
2	49172 SHAFT	1
3	49170 IMPELLER COVER	1
4	48500 IMPELLER KIT (O-RING & GLYCERIN)	1
5	34458 CAM	1
6	49171 WEAR PLATE	1
7	302575 DOWEL	1
8	48253 SPRING SEAL WASHER	1
9	34463 IMPELLER COVER SCREW	6
10	48359 IMPELLER COVER O-RING	1
11	33041 O-RING	1
12	33037 CAM WASHER	1
13	46662 CAM SCREW	1
14	48254 SPRING SEAL	1
15	49169 LIP SEAL	1
16	34464 BALL BEARING	2
17	33045 RETAINING INTERNAL RING	1
18	33044 RETAINING EXTERNAL RING	1
	49000 PUMP REPAIR KIT	1
	37431 PUMP KIT (MOUNTING GASKET & FITTINGS)	1



EXPLODED VIEW

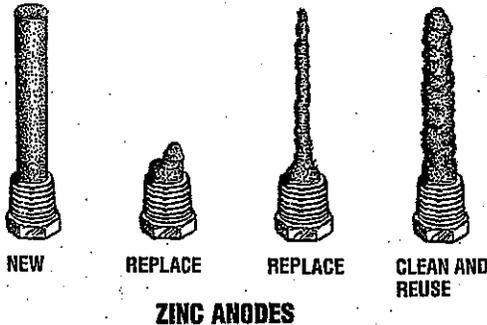


RAW WATER PUMP (PN. 48080)

COOLING SYSTEM

Zinc Anode #011885

A zinc anode, or *pencil*, is located in the raw water cooling circuit within the heat exchanger. The purpose of having the zinc anode is to sacrifice them to electrolysis action taking place in the raw water cooling circuit, thereby reducing the effects of electrolysis on other components of the system. The condition of the zinc anode should be checked monthly and the anode cleaned or replaced as required. Spare anodes should be carried on board.



If the zinc anodes need replacement, hold the hex boss into which the zinc anode is threaded with a wrench while loosening the anode with another wrench. This prevents the hex boss from possibly tearing off the exchanger shell. After removing the zinc, note the condition of it. If the zinc is in poor condition, there are probably a lot of zinc flakes within the exchanger. Remove the end of the heat exchanger and clean the inside of all zinc debris. Always have a spare heat exchanger end gasket in case the present one becomes damaged when removing the end cover. Replace the gasket (refer to your engine model's heat exchanger end gasket part number), O-ring and cover, and install a new zinc anode.

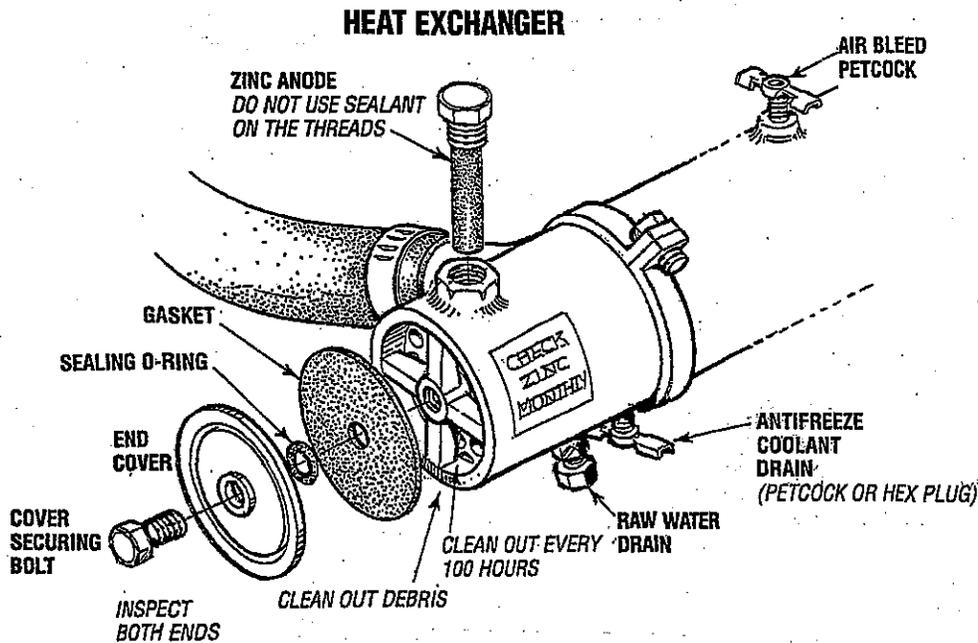
NOTE: The threads of the zinc anodes are pipe threads and do not require sealant. Sealant should not be used as it may insulate the zinc from the metal of the heat exchanger housing preventing electrolysis action on the zinc.

Heat Exchanger Service

After approximately 1000 hours of operation, remove, clean and pressure test the engine's heat exchanger. (A local automotive radiator shop should be able to clean and test the heat exchanger.)

NOTE: Operating in silty and/or tropical waters may require that a heat exchanger cleaning be performed more often than every 1000 hours.

NOTE: Electrolysis action is the result of each particular installation and vessel location; not that of the engine.

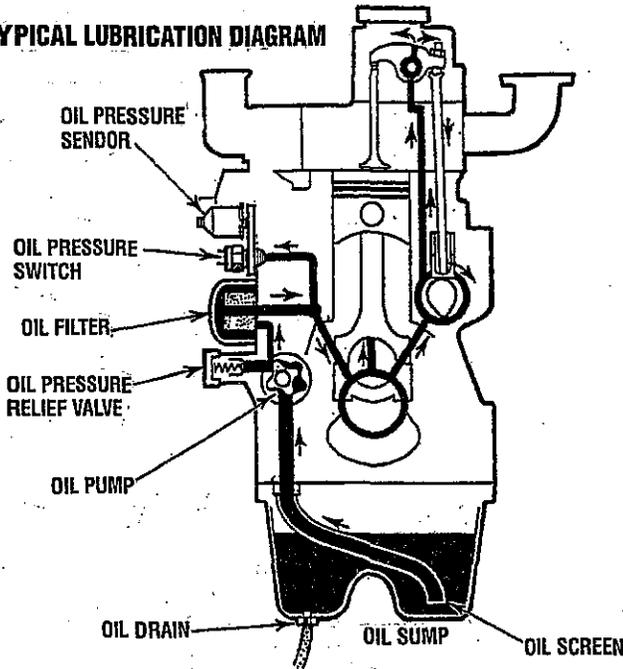


TYPICAL ASSEMBLY

NOTE: When installing the heat exchanger end covers. Be sure that the end cover securing bolt's sealing O-ring is installed. Failure to install this sealing O-ring can result in end plate failure/sea water leakage.

ENGINE LUBRICATING OIL

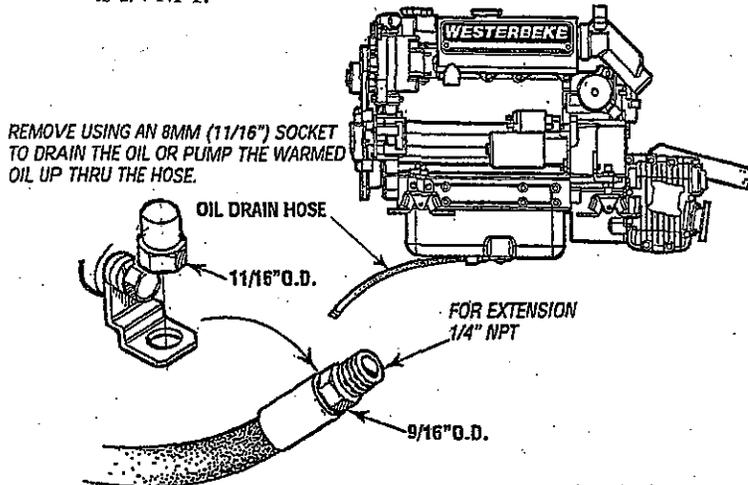
TYPICAL LUBRICATION DIAGRAM



ENGINE OIL CHANGE

1. **Draining the Oil Sump.** Discharge the used oil through the sump drain hose (attached to the front of the engine) while the engine is warm. Drain the used oil completely, replace the hose in its bracket, and replace the end cap securely.

NOTE: Thread size for the lube oil drain hose capped end is 1/4 NPT.

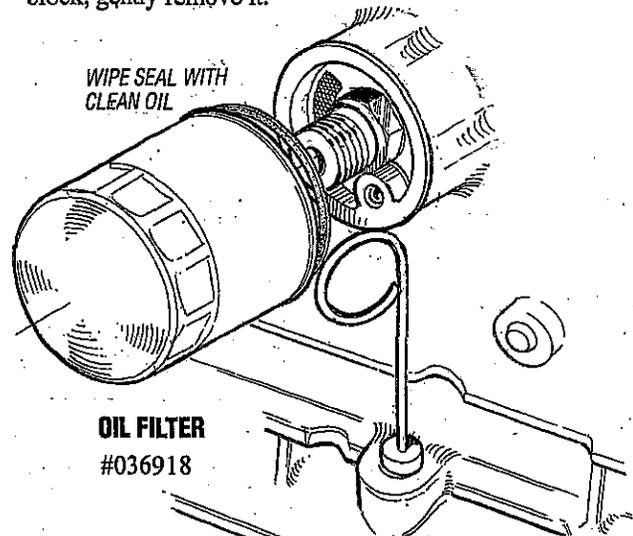


WARNING: Used engine oil contains harmful contaminants. Avoid prolonged skin contact. Clean skin and nails thoroughly using soap and water. Launder or discard clothing or rags containing used oil. Discard used oil properly.

2. **Replacing the Oil Filter.** When removing the used oil filter, you may find it helpful and cleaner to punch a hole in the upper and lower portion of the old filter to drain the oil from it into a container before removing it. This helps to lessen spillage. A small style automotive filter wrench should be helpful in removing the old oil filter.

NOTE: Do not punch this hole without first loosening the filter to make certain it can be removed!

Place some paper towels and a plastic bag around the filter when unscrewing it to catch any oil left in the filter. (Oil or any other fluid on the engine reduces the engine's cooling ability. Please keep your engine clean.) Inspect the old oil filter as it is removed to make sure that the rubber sealing gasket came off with the old oil filter. If this rubber sealing gasket remains sealed against the engine block, gently remove it.



When installing the new oil filter element, wipe the filter gasket's sealing surface on the engine block free of oil and apply a thin coat of clean engine oil to the rubber gasket on the new oil filter. Screw the filter onto the threaded oil filter nipple, and then tighten the filter firmly by hand.

NOTE: Generic filters are not recommended, as the material standards or diameters of important items on generic parts might be entirely different from genuine parts. Immediately after an oil filter change and oil fill, run the engine to make sure the oil pressure is normal and that there are no oil leaks around the new oil filter.

3. **Filling the Oil Sump.** Add new oil through the oil filler cap on the top of the engine. After refilling, run the engine for a few moments while checking the oil pressure. Make sure there is no leakage around the new oil filter or from the oil drain system, and stop the engine. Then check the quantity of oil with the lube oil dipstick. Fill to, but not over the high mark on the dipstick, should the engine require additional oil.

REMOTE OIL FILTER (OPTIONAL)

PN# 040078

INSTALLATION

This popular accessory is used to relocate the engine's oil filter from the engine to a more convenient location such as an engine room bulkhead.

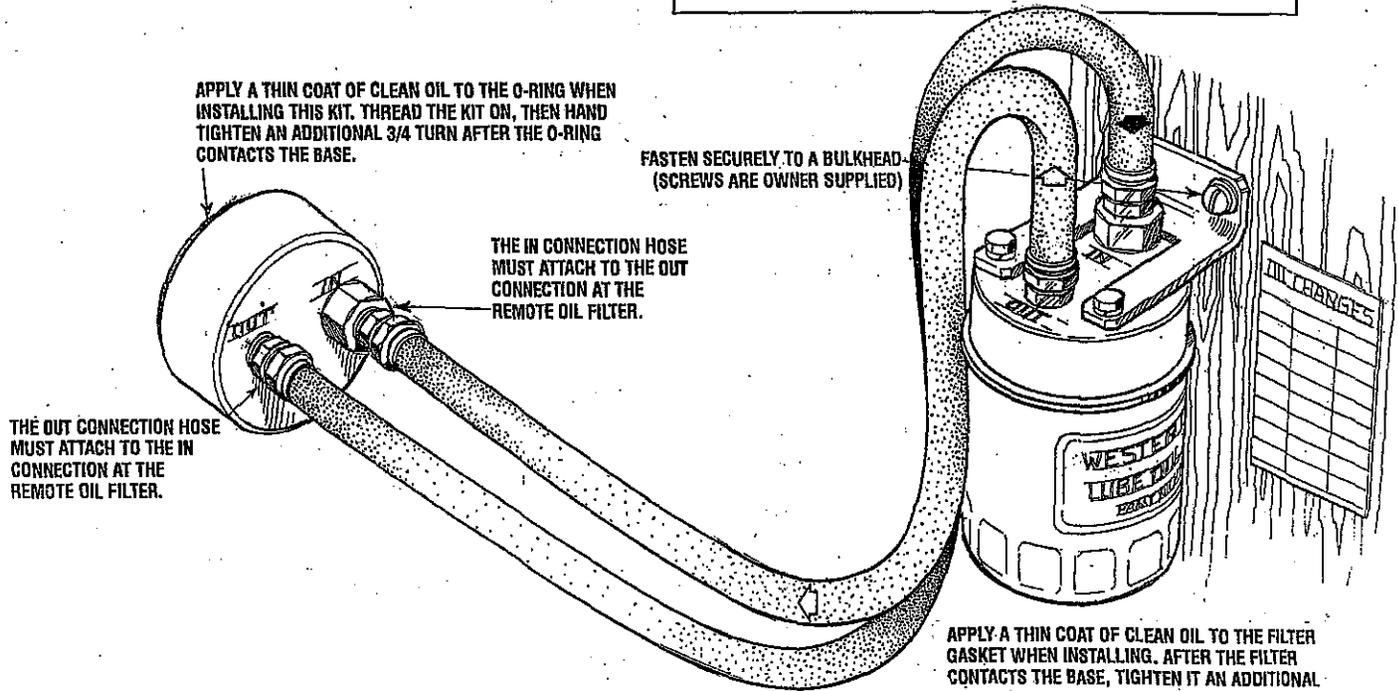
NOTE: Refer to *ENGINE OIL CHANGE* in this manual for instructions on removing the oil filter.

To install, simply remove the engine oil filter and thread on WESTERBEKE's remote oil filter kit as shown. Always install this kit with the oil filter facing down as illustrated.

Contact your WESTERBEKE dealer for more information.

NOTE: Westerbeke is not responsible for engine failure due to incorrect installation of the Remote Oil Filter.

CAUTION: It is vital to install the oil lines correctly. If the oil flows in the reverse direction, the by-pass valve in the filter assembly will prevent the oil from reaching the engine causing an internal engine failure. If there is no oil pressure reading, shutdown immediately and check the hose connections.



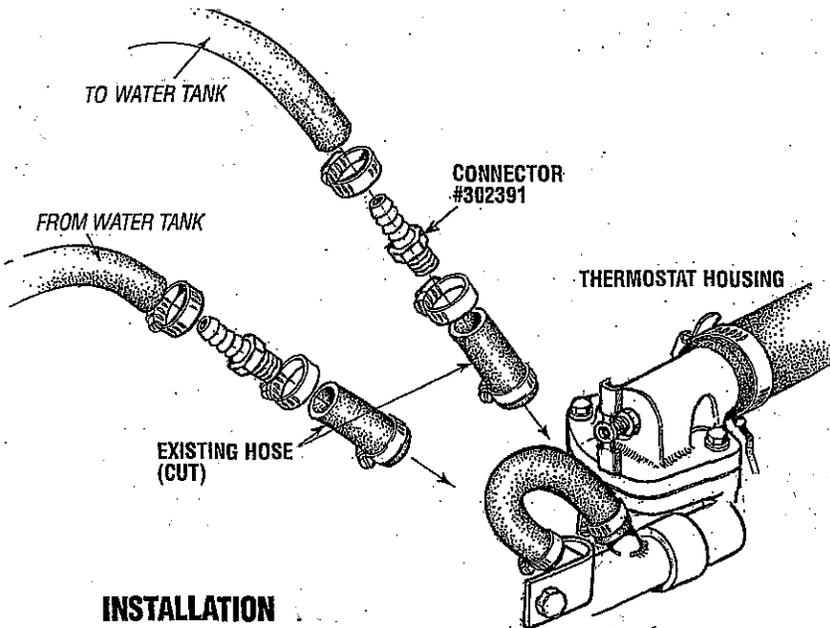
DOMESTIC HOT WATER TANK CONNECTIONS

DESCRIPTION

Both the two and three cylinder models are equipped with connections to send engine coolant to a domestic water heater. If the owner/operator wishes to connect a water heater, remove the bypass hose and connect a water heater as described in the instructions presented below.

CURRENT MODEL ENGINES

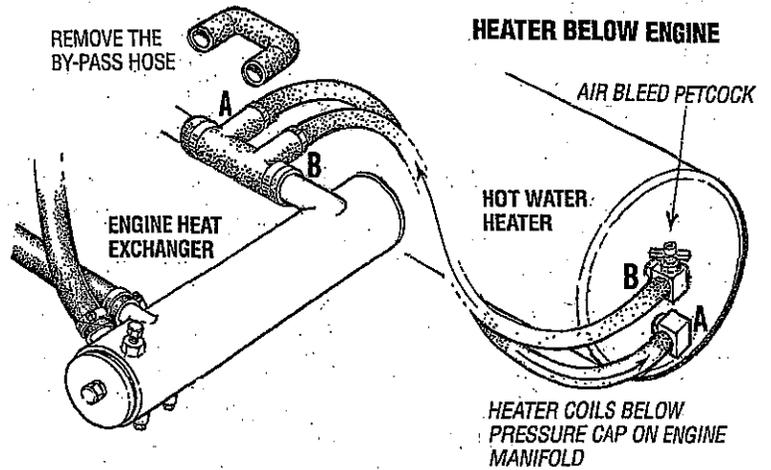
SIMPLY CUT INTO THE EXISTING HOSE AT THE THERMOSTAT HOUSING AND INSERT TWO CONNECTORS (PART #302391) INTO THE TWO PIECES OF HOSE. COUPLE THE HOSES FROM THE WATER TANK TO THE OTHER END OF THE CONNECTORS AND TIGHTEN THE HOSE CLAMPS. IT WILL NOT MATTER WHICH HOSES RUN TO AND FROM THE TANK.



INSTALLATION

The heater should be mounted conveniently either in a high or low position in relation to the engine, so that the connecting hoses from the heater to the engine can run in a reasonably direct line without any loops which might trap air.

PREVIOUS MODEL ENGINES



With the bypass hose removed, there remain two connecting points A and B for hoses to run to and from the water heater. These connections assure a flow of hot water through the heater at all times but do not restrict the engine's cooling water.

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 connection 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 is able to 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 the hose runs which will trap air.

(CONT.) HEATER ABOVE THE ENGINE

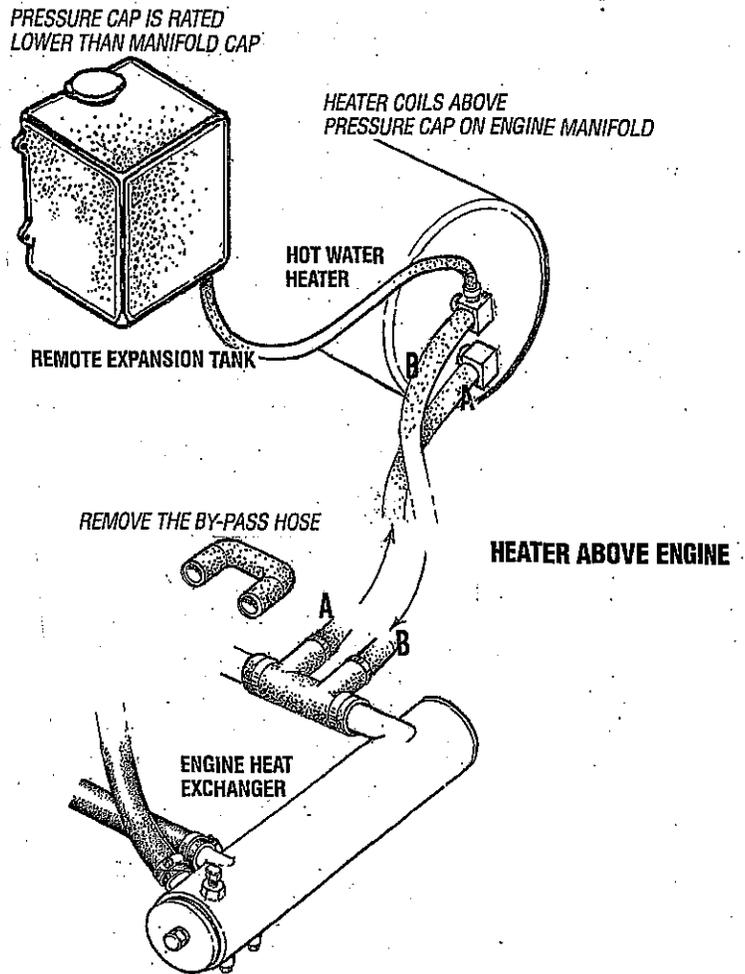
DOMESTIC HOT WATER TANK CONNECTIONS

HOT WATER HEATER ABOVE THE ENGINE

If any portion of the heating circuit rises above the engine's own pressure cap, the a pressurized (aluminum) remote expansion tank must be installed in the circuit to become the highest point. The remote expansion tanks part number is 24177. Tee the remote expansion tank into the heater circuit at the heater connection, choosing the higher of the two for the return. Tee right at the heater and plumb a single line up to the tanks location and the other back to the engine's flow control. Install the remote expansion tank in a convenient location such as in a sail locker so the fresh water coolant level can easily be checked. The remote expansion tank will now serve as a check and system fill point. The plastic coolant recovery tank is not used when the remote expansion tank kit is installed, since this tank serves the same function.

The pressure cap on the engine's manifold should be installed once the engine's cooling system is filled with coolant. Finish filling the cooling system from the remote tank once the system is filled and is free of air and exhibits good coolant circulation. During engine operation, checking the engine's coolant should be done at the remote tank and not at the engine manifold cap.

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.



TACHOMETER

TACHOMETER/HOUR METER

The tachometer/hour meter used in propulsion engine instrument panels contains two separate electrical circuits with a common ground. One circuit operates the hour meter and the other the tachometer. The hour meter circuit operates on 12 volts alternator charging voltage supplied to the (+) terminal on the back of the instrument.

The tachometer circuit operates on AC voltage 6-8 volts, fed from one of the diodes in the alternator and supplied to the tachometer input terminal while the engine is running, and the alternator producing battery charging voltage 13.0-14.8 volts DC.

The following are procedures to follow when troubleshooting a fault in either of the two circuits in a tachometer/hour meter.

Hour meter Inoperative

Check for the proper DC voltage between (+) and (-) terminals.

1. Voltage present - meter is defective - repair or replace.
2. Voltage not present - trace (+) and (-) electrical connections for fault. (Jump 12 volts DC to meter (+) terminal to verify the operation.)

Tachometer Inoperative

Check for the proper AC voltage between tachometer input terminal and (-) terminal with the engine running.

1. Voltage present - attempt adjusting meter through calibration access hole. No results, repair or replace meter.
2. AC voltage not present - check for proper alternator DC output voltage.
3. Check for AC voltage at tach terminal on alternator to ground.
4. Check electrical connections from tachometer input terminal to alternator connection.

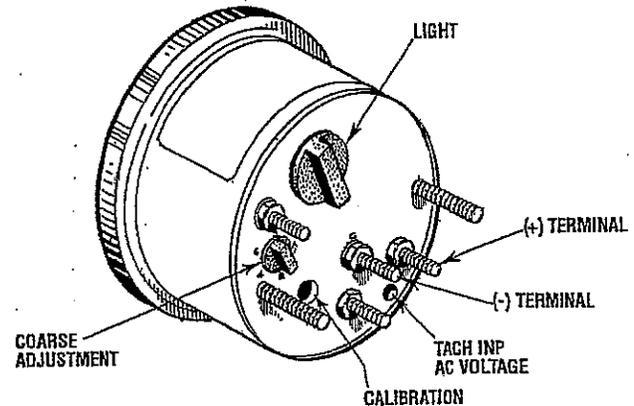
Tachometer Sticking

1. Check for proper AC voltage between "tach inp." terminal and (-) terminal.
2. Check for good ground connection between meter (-) terminal and alternator.
3. Check that alternator is well grounded to engine block at alternator pivot bolt.

Tachometer Inaccurate

- a. With a hand-held tach on the front of the crankshaft pulley retaining nut or with a strobe-type tach, read the front crankshaft pulley rpm at idle.
- b. Adjust the tachometer using a 5/64 or 2mm Allen wrench through the CAL. (calibration) access hole in the rear of the tachometer. Zero the tachometer and then adjust it to the rpm indicated by the strobe or hand tachometer. (Verify the rpm at idle and high rpm and adjust the tachometer as needed)

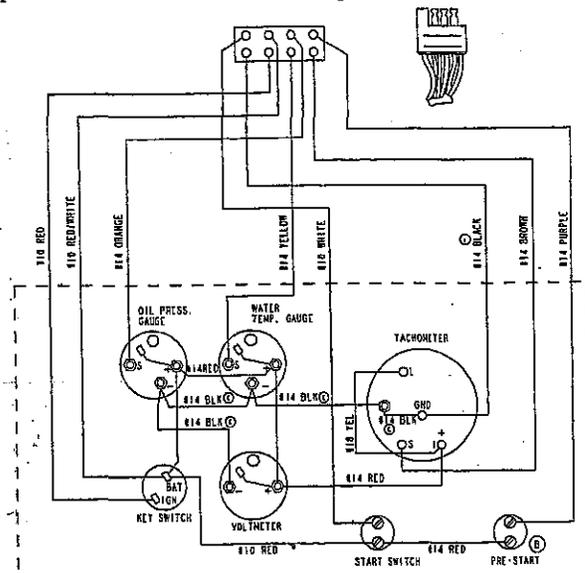
NOTE: Current model tachometers use a coarse adjustment dial to set the tachometer to the crankshaft pulley rpms. The calibrating screw is then used for fine tuning.



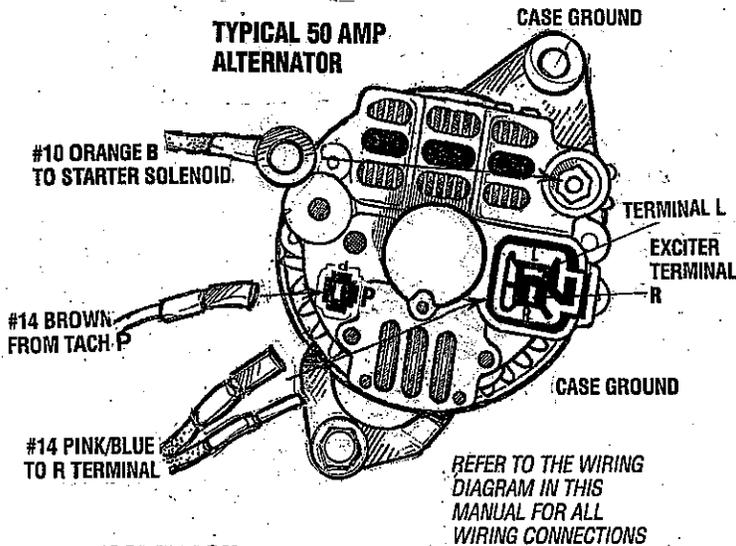
TACHOMETER CHECK (New Installation)

NOTE: In a new installation having new instrument panels, the tachometer may not always be correctly calibrated to the engine's rpm. This calibration should be checked in all new installations.

1. Warm up the engine to normal operating temperature. Remove any specks on the crankshaft pulley with a clean cloth and place a piece of suitable reflecting tape on the pulley to facilitate use of a photoelectric type tachometer.
2. Start and idle the engine.
3. Aim the light of the tachometer onto the reflecting tape to confirm the engine speed. Check the instrument panel tachometer reading. Adjust the tachometer in the panel by using the instrument coarse adjustment to calibrate the instrument reading to the closest R.P.M. that the photo tach is showing. Then use the fine calibration adjustment to bring the instrument to the exact reading as the photo tach.
4. Set the tachometer to the idle speed (the engine idle speed has been factory adjusted and the idle screws and high speed screws have been locked in place).



ALTERNATORS TESTING/TROUBLESHOOTING



DESCRIPTION

The following information applies to the standard alternators that are supplied with WESTERBEKE'S Engines and Generators.

ELECTRICAL CHARGING CIRCUIT

The charging system consists of an alternator with a voltage regulator, an engine DC wiring harness, a mounted DC circuit breaker and a battery with connecting cables. Because of the use of integrated circuits (IC's), the electronic voltage regulator is very compact and is mounted internally or on the back of the alternator.

It is desirable to test the charging system (alternator and voltage regulator) using the wiring harness and electrical loads that are a permanent part of the system and will then provide the technician with an operational test of the charging system as well as the major components of the electrical system.

ALTERNATOR DESCRIPTION

The stator is connected to a three-phase, full-wave bridge rectifier package which contains six diodes. The bridge converts the AC generated in the stator to a DC output for battery charging and accessories,

Power to the regulator and the field of the integral regulator alternator is provided by the field diode (or diode trio) package contained in the alternator.

These alternators produce a rated output of 50 or 51 amps. rated output is achieved at approximately 6000 alternator rpm at an ambient temperature of 75°F (23.8°C). The alternators are designed to operate in an ambient temperature range of -40° to 212°F (-40° to 100°C).

VOLTAGE REGULATOR

The integral voltage regulator is an electronic switching device which senses the system voltage level and switches the voltage applied to the field in order to maintain a proper system voltage.

The regulator design utilizes all-silicon semi conductors and thick-film assembly techniques. After the voltage has been adjusted to the proper regulating valve, the entire circuit is encapsulated to protect the circuit and the components from possible damage due to handling or vibration.

ALTERNATOR TROUBLESHOOTING

Use this troubleshooting section to determine if a problem exists with the charging circuit or with the alternator. If it is determined that the alternator or voltage regulator is faulty, have a qualified technician check it.

⚠ WARNING: A working alternator runs hot. A failed alternator can become very hot. Do not touch the alternator until it has cooled.

LOW BATTERY/FAULTY CIRCUIT

If the starter only moans or makes a clicking sound instead of spinning the engine to life it is likely a low battery or a faulty connection in the starting circuit and not an alternator problem.

PRELIMINARY INSPECTION

Before starting the actual alternator and voltage regulator, testing the following checks are recommended.

1. Make certain your alternator is securely mounted.
2. Check the drive belts for proper tension. Replace the belt if it is worn or glazed.
3. Check that all terminals, connectors and plugs are clean and tight. Loose or corroded connections cause high resistance and this could cause overcharging, undercharging or damage to the charging system. Badly corroded battery cables could prevent the battery from reaching a fully charged condition.
4. Check the condition of the battery and charge if necessary. A low or discharged battery may cause false or misleading readings in the tests.

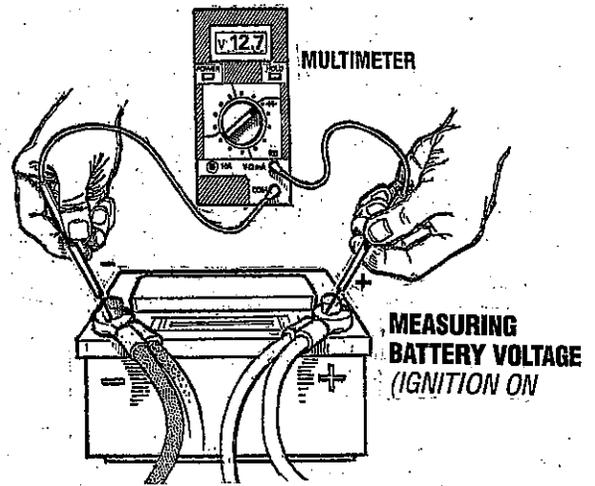
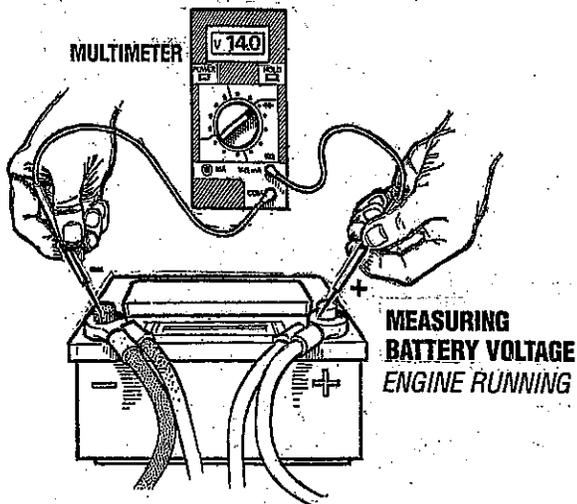
NOTE: An isolator with a diode, a solenoid, or a battery selector switch is usually mounted in the circuit to isolate the batteries so the starting battery is not discharged along with the house batteries. If the isolator is charging the starting battery but not the house battery, the alternator is OK and the problem is in the battery charging circuit.

ALTERNATORS TESTING/TROUBLESHOOTING

TESTING THE ALTERNATOR

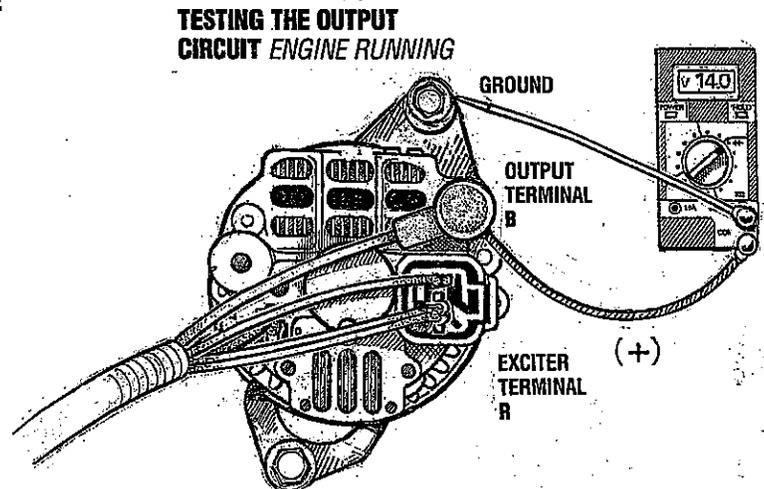
CAUTION: Before starting the engine make certain that everyone is clear of moving parts! Keep away from sheaves and belts during test procedures.

1. Start the engine.
2. After the engine has run for a few minutes, measure the starting battery voltage at the battery terminals using a multimeter set on DC volts.
 - a. If the voltage is increasing toward 14 volts, the alternator is working; omit Steps 3 through 8 and go directly to "Checking the Service Battery."
 - b. If the voltage remains around 12 volts, a problem exists with either the alternator or the charging circuit; continue with Steps 3 through 8.
3. Turn off the engine. Inspect all wiring and connections. Ensure that the battery terminals and the engine ground connections are tight and clean.
4. If a battery selector switch is in the charging circuit, ensure that it is on the correct setting.
5. Turn on the ignition switch, but do not start the engine.
6. Check the battery voltage. If the battery is in good condition, the reading should be 12 to 13 volts.



TESTING THE OUTPUT CIRCUIT

1. Connect the positive probe to the output terminal B and connect the negative probe to ground.
2. Wiggle the engine wiring harness while observing the voltmeter. The meter should indicate the approximate battery voltage, and should not vary. If no reading is obtained, or if the reading varies, check the alternator output circuit for loose or dirty connections or damaged wiring.
3. Start the engine.
4. Repeat the same measurement, the negative probe to ground, the positive probe to B with the engine running. The voltage reading should be between 13.5 and 14.5 volts. If your alternator is over or under-charging, have it repaired at a reliable service shop.
5. If the previous test reads only battery voltage at terminal B, use the meter to measure the DC excitation terminal. If 12 volts is not present at exciter terminal R, inspect the wiring for breaks and poor connections. Jump 12 volts from a 12 volt source (such as the battery) and operate the alternator. If the voltage output is 13-14 volts, then the alternator is OK.

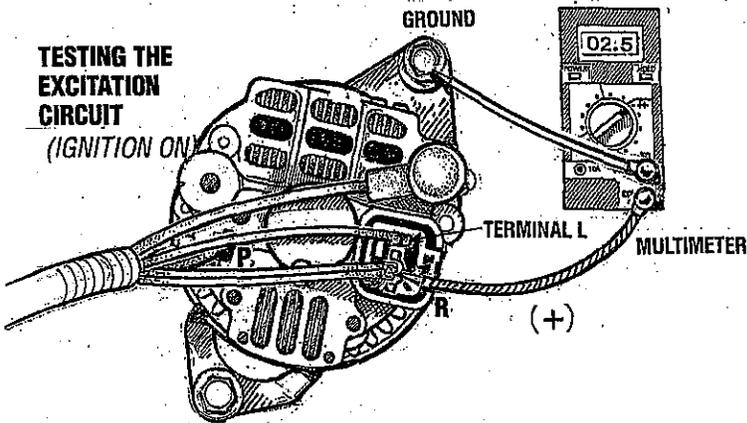


ALTERNATORS TESTING/TROUBLESHOOTING

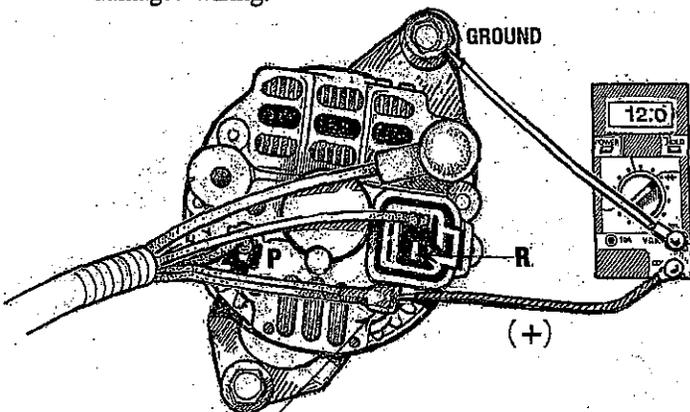
TESTING THE EXCITATION CIRCUIT

1. Connect the positive (+) multimeter probe to the excitation terminal R on the alternator and the negative (-) lead to ground.
2. Turn the battery switch to the on position and note the multimeter reading. The reading should be 1.3 to 2.5 volts (see illustration).

TESTING THE EXCITATION CIRCUIT (IGNITION ON)



3. If the reading is between .75 and 1.1 volts, the rotor field circuit probably is shorted or grounded.
4. If the reading is between 6.0 and 7.0 volts, the rotor field circuit probably is open.
5. If no reading is obtained, an open exists in the alternator-excitation lead or in the excitation circuit of the regulator. Disconnect the lead from exc. terminal R. Connect the positive multimeter probe to the excitation lead and the negative multimeter probe to ground. If the multimeter now indicates an approximate battery voltage, the voltage regulator is defective and must be replaced. If no voltage is indicated, check the excitation circuit for loose or dirty connections or damaged wiring.



REMOVE FROM
TERMINAL R

TESTING THE EXCITATION CIRCUIT (IGNITION ON)

CHECKING THE SERVICE BATTERY

Check the voltage of the service battery. This battery should have a voltage between 13 and 14 volts when the engine is running. If not, there is a problem in the service battery charging circuit. Troubleshoot the service battery charging circuit by checking the wiring and connections, the solenoid, isolator, battery switch, and the battery itself.

When the problem has been solved and before the alternator is back in operation, take the time to tighten and clean the terminal studs. Also clean the connecting terminals from the wiring harness.

ALTERNATOR REPAIR

If tests indicate a failed alternator, it will need to be disassembled and repaired. Any good alternator service shop can do the job.

NOTE: WESTERBEKE'S service Manual has detailed instructions for the disassembly and repair of their standard alternators.

BATTERY CARE

The minimum recommended capacity of the battery used in the engine's 12 volt DC control circuit is 600 - 900 Cold Cranking Amps (CCA).

Review the manufacturer's recommendations and then establish a systematic maintenance schedule for your engine's starting batteries and house batteries.

- Monitor your voltmeter for proper charging during engine operation.
- Check the electrolyte level and specific gravity with a hydrometer.
- Use only distilled water to bring electrolytes to a proper level.
- Make certain that battery cable connections are clean and tight to the battery posts (and to your engine).
- Keep your batteries clean and free of corrosion.

CAUTION: Before starting the engine make certain that everyone is clear of moving parts! Keep away from sheaves and belts during test procedures.

CAUTION: To avoid damage to the battery charging circuit, never shut off the engine battery switch when the engine is running!

GLOW PLUGS

DESCRIPTION

The glow plugs are wired through the preheat solenoid. When PREHEAT is pressed at the control panel this solenoid should "click" on and the glow plug should begin to get hot.

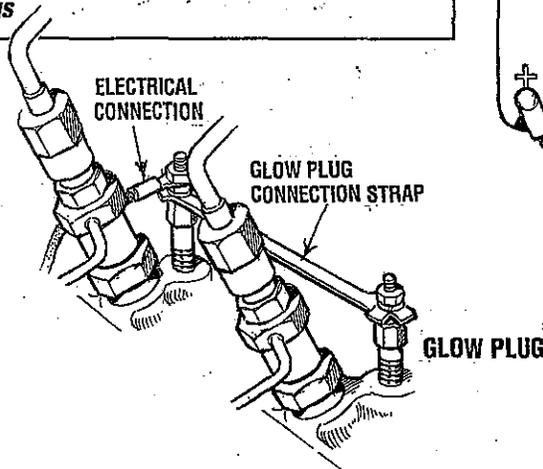
INSPECTION

To inspect the plug, remove the electrical terminal connections, then unscrew or unclamp each plug from the cylinder head. Thoroughly clean each plug's tip and threads with a soft brush and cleaning solution to remove all the carbon and oil deposits. While cleaning, examine the tip for wear and burn erosion; if it has eroded too much, replace the plug.

TESTING

An accurate way to test glow plugs is with an ohmmeter. Touch one prod to the glow plug's wire connection, and the other to the body of the glow plug, as shown. A good glow plug will have a 1.0- to 1.5-ohm resistance. This method can be used with the plug in or out of the engine. You can also use an ammeter to test the power drain (8 to 9 amps per plug).

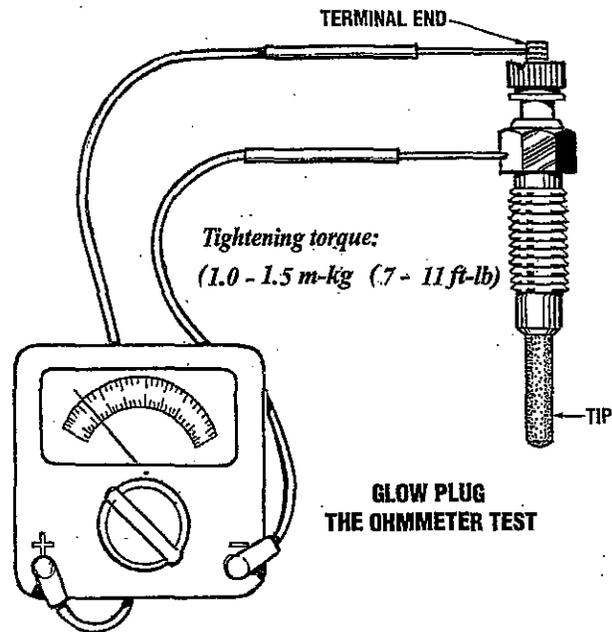
WARNING: These glow plugs will become very hot to the touch. Be careful not to burn your fingers when testing the plugs



Re-install the plugs in the engine and test them again. The plugs should get very hot (at the terminal end) within 20 to 25 seconds. If the plugs don't heat up quickly, check for a short circuit. When reinstalling the glow plugs, use anti-seize compound on the threads.

Glow Plug Tightening Torque 7 - 11 lb-ft (1.0 - 1.5 kg-m)

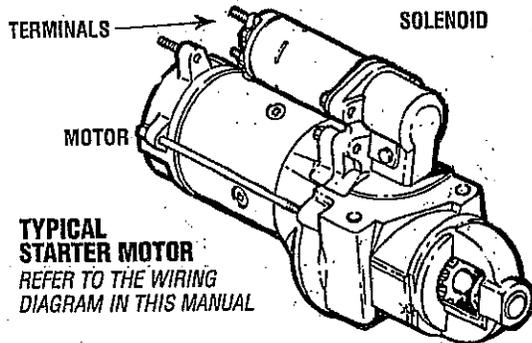
WARNING: Do not keep a glow plug on for more than 30 seconds



STARTER MOTOR

DESCRIPTION

The starter is a new type, small, light-weight and is called a high-speed internal-reduction starter. The pinion shaft is separate from the motor shaft; the pinion slides only on the pinion shaft. A reduction gear is installed between the motor shaft and a pinion shaft. The pinion sliding part is not exposed outside the starter so that the pinion may slide smoothly without becoming fouled with dust and grease. The motor shaft is supported at both ends on ball bearings. The lever mechanism, switch and overrunning clutch inner circuit are identical to conventional ones.



TROUBLESHOOTING

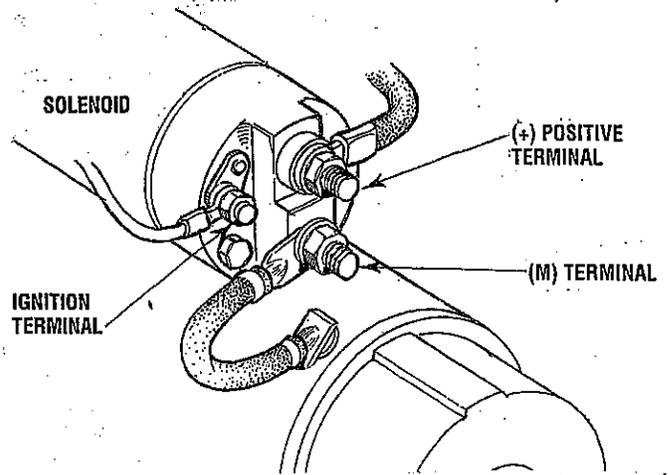
⚠ WARNING: *The following emergency starting procedures must not be used with gasoline engines. Sparks could cause an explosion and fire.*

Prior to testing, make certain the ship's batteries are at full charge and that the starting system wiring connections (terminals) are clean and tight. Pay particular attention to the ground wire connections on the engine block.

To check the wiring, try cranking the starter for a few seconds, never more than 10 seconds at a time, then run your hand along the wires and terminals looking for warm spots that indicate resistance. Repair or replace any trouble spots.

Using a multimeter, test the voltage between the positive terminal stud on the start solenoid and the engine block (ground).

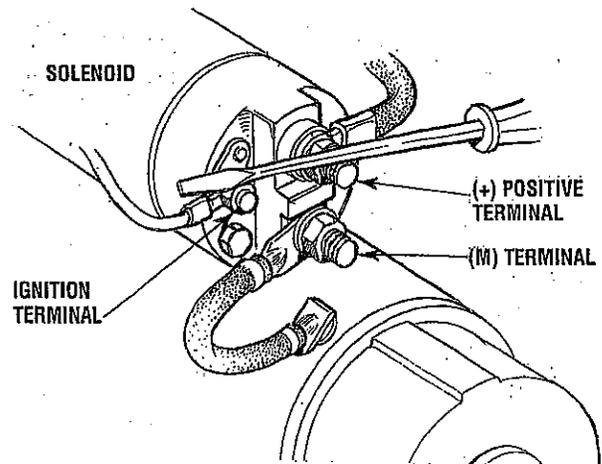
If you read 12 volts, the starter is faulty.



To test the ignition circuit, locate the ignition(s) terminal (it is one of the small terminal studs and is wired to the ignition circuit). Use a screwdriver, don't touch the blade, to jump from that ignition terminal to the positive battery connection terminal on the solenoid.

If the starter cranks, the fault lies with the ignition circuit.

If the solenoid clicks but nothing happens, the starter motor is probably faulty.

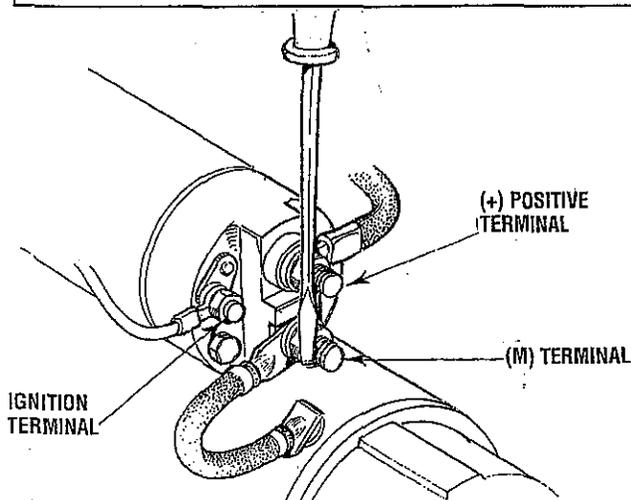


If nothing happens at all, the solenoid is not getting current. Check the battery isolation switch and inspect the wiring connections. It is also possible that the solenoid is defective.

⚠ WARNING: *There will be arcing and sparks will fly when jumping terminals. Be certain the engine space is free of potentially explosive fumes, especially gasoline, and that there are NO flammable solvents or materials stored nearby.*

STARTER MOTOR

⚠ WARNING: When performing these procedures, position yourself safely away from the moving parts of the engine in case the engine starts-up. Also warn other crew members of the danger.



Test again by jumping the two large terminal studs. Hold the screwdriver blade firmly between the studs. Do not allow the screwdriver blade to touch the solenoid or starter casing, this would cause a short.

⚠ WARNING: There will be arcing as the full starting current should be flowing thru the blade of the screwdriver.

If the starter spins, the solenoid is faulty.

If the starter fails to spin, the motor is probably faulty.

If no arcing occurred, there is no juice reaching the solenoid.

NOTE: Starter motors are either inertia type or pre-engaged. In the pre-engaged model, the solenoid also moves an arm that engages the starter motor to the flywheel of the engine. using a screwdriver to bypass the solenoid on such a starter will run the motor without engaging the flywheel. Turn the starter switch on to provide power to the solenoid. Hopefully it will create enough magnetic field for the arm to move even though the contacts inside the solenoid are bad.

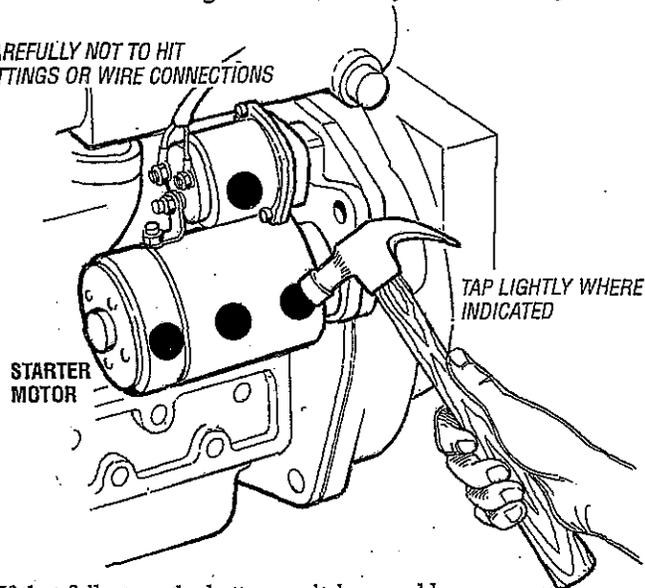
EMERGENCY START

Corrosion to the starter brushes and/or the solenoid contacts can cause the sporadic problem of the engine starting one time but not another. If corrosion is the problem, the starter will need to be rebuilt.

It is however, sometimes possible to get started by taping the starter lightly with a small hammer.

With the battery switch off and no ignition, tap lightly on the starter/solenoid casing as shown, then try to start the engine.

CAREFULLY NOT TO HIT FITTINGS OR WIRE CONNECTIONS



If that fails, turn the battery switch on and have a crew member turn the ignition on and off rapidly as you tap again with the hammer. This may loosen the brushes and allow contact to start the engine. When you reach a repair facility, the starter will need to be repaired.

SERVICE

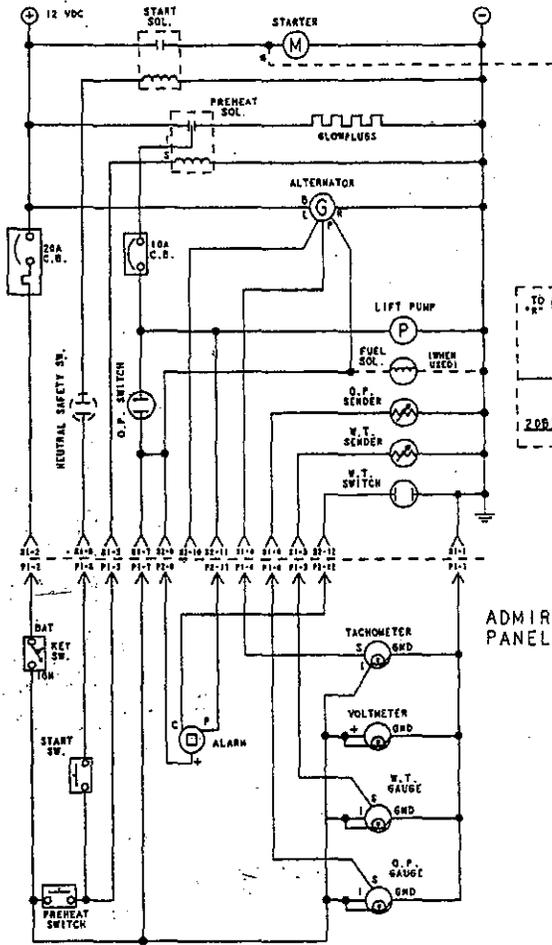
WESTERBEKE uses a standard starter motor which can be serviced or rebuilt at any starter motor automotive service center.

If replacing the starter motor, make certain the new motor is certified for marine use. Automotive starters do not meet USCG standards. If in doubt, contact your WESTERBEKE dealer.

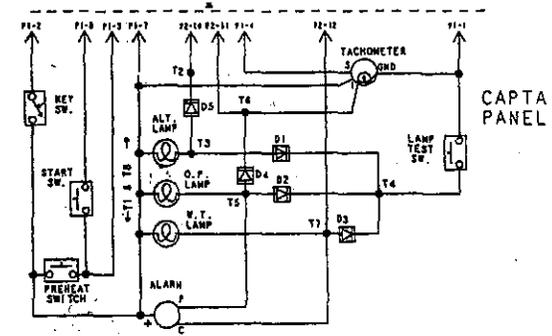
TO REMOVE FOR SERVICE

1. Disconnect the negative battery cable.
2. If necessary, remove any components to gain full access to the starter motor.
3. Label and disconnect the wiring from the starter. (Do not allow wires to touch, tape over the terminals).
4. Remove the starter mounting bolts.
5. Remove the starter from the engine. In some cases the starter will have to be turned to a different angle to clear obstructions.

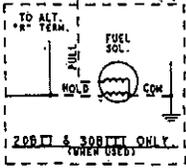
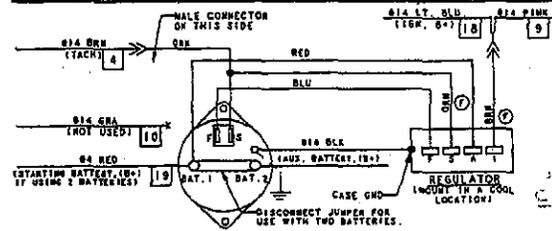
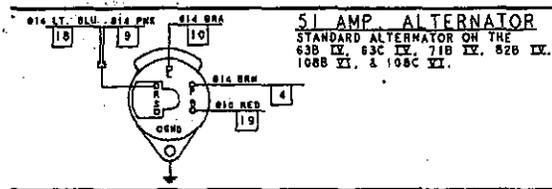
ENGINE WIRING SCHEMATIC (#39144)



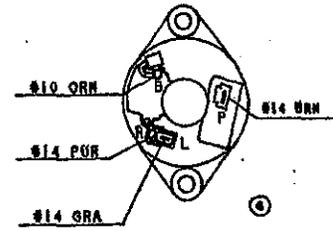
ADMIRAL PANEL



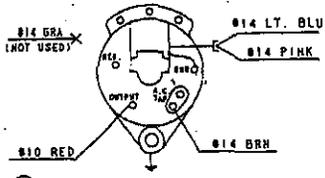
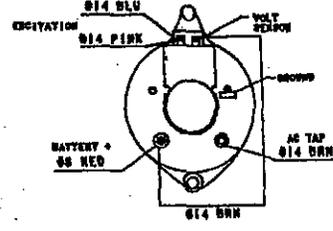
CAPTAIN PANEL



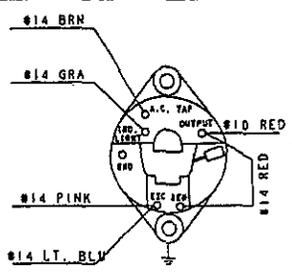
MITSUBISHI 50 AMP. ALT.



PRESTOLITEVEECE-NEVILLE 90 AMP. ALT.

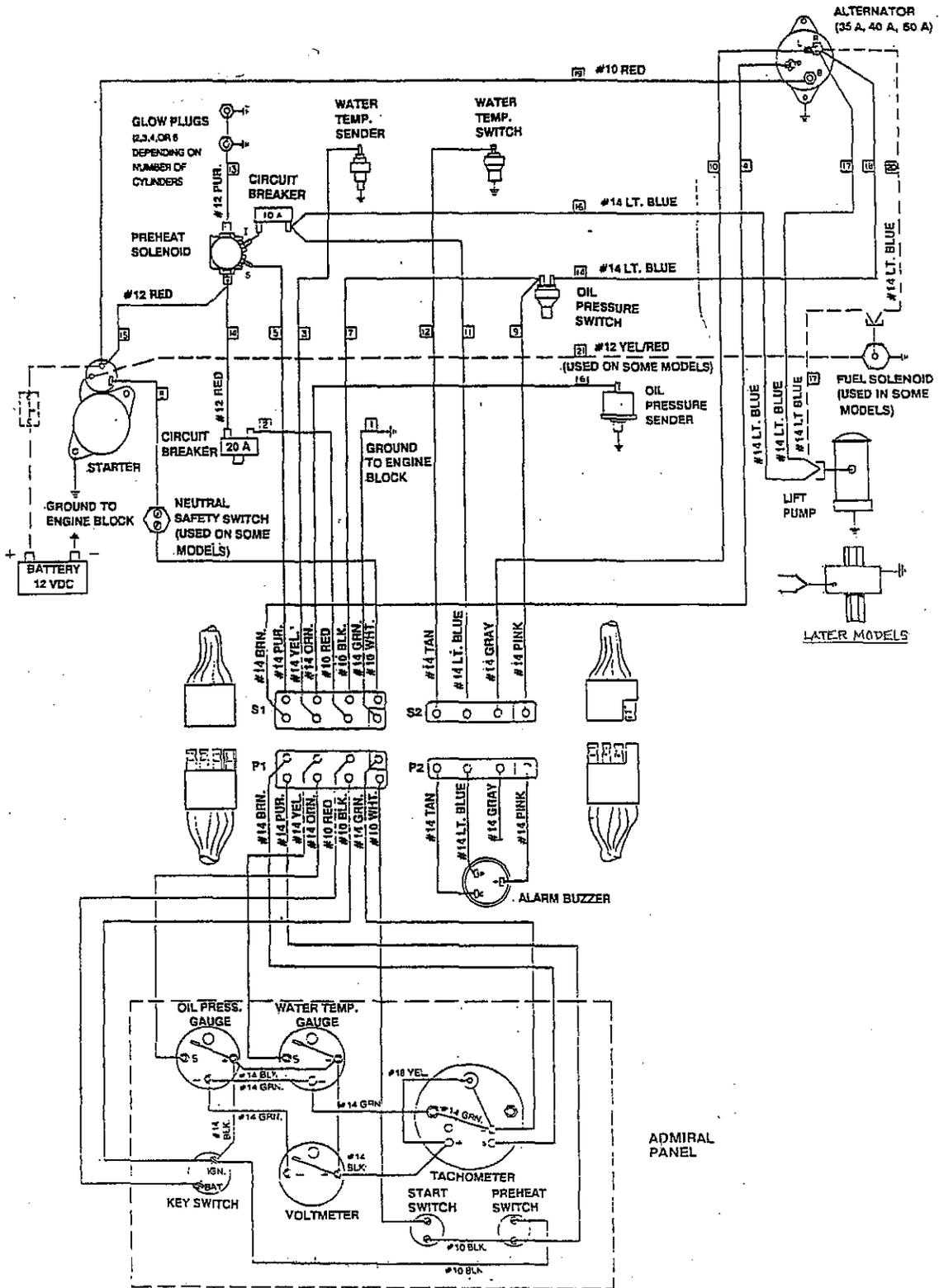


PRESTOLITE 72 AMP. ALT.



UNIVERSAL PROPULSION
PRESTOLITE 51 AMP. ALT.

ADMIRALS PANEL WIRING DIAGRAM (#36844)



ENGINE TROUBLESHOOTING

The following troubleshooting table describes certain problems relating to engine service, the probable causes of these problems, and the recommendations to overcome these problems.

NOTE: Fuel run/shut off solenoid (Optional).

NOTE: The engine's electrical system is protected by a 20 ampere manual reset circuit breaker located on a bracket at the back of the engine. The preheat solenoid is mounted on the same bracket.

Problem	Probable Cause	Verification/Remedy
No panel indications; fuel solenoid or fuel pump is not working (key switch is on and PREHEAT button is depressed).	<ol style="list-style-type: none"> 1. Battery switch not on. 2. 20-amp circuit breaker tripped. 3. 10-amp breaker tripped on preheat solenoid 4. Loose battery connections. 5. Preheat solenoid not operating. 	<ol style="list-style-type: none"> 1. Check switch and/or battery connections. 2. Reset breaker; if breaker trips again, check preheat solenoid circuit and check circuit for shorts to ground. 3. Check the voltage both at and after the breaker on the preheat solenoid. 4. Check (+) connection to starter solenoid and (-) connection to engine ground stud. Check battery cable connections. 5. Check solenoid "S" terminal for voltage.
START button is depressed, no starter engagement.	<ol style="list-style-type: none"> 1. Connection to solenoid faulty. 2. Gear shift not in neutral. 3. Faulty switch. 4. Faulty solenoid. 5. Loose battery connections. 6. Low battery. 	<ol style="list-style-type: none"> 1. Check connection. 2. Gear shift must be in neutral (see <i>NEUTRAL SWITCH</i> under <i>HURTH HSW TRANSMISSIONS</i>). 3. Check switch with ohmmeter. 4. Check that 12 volts are present at the solenoid connection. 5. Check battery connections. 6. Check battery charge state.
START button is depressed; panel indications OK; starter solenoid OK; fuel solenoid not functioning.	<ol style="list-style-type: none"> 1. Poor connections to fuel solenoid. 2. Defective fuel solenoid. 	<ol style="list-style-type: none"> 1. Check connections. 2. Check that 12 volts are present at the (+) connection on the fuel run solenoid.
Engine cranks, but does not start, fuel solenoid energized.	<ol style="list-style-type: none"> 1. Faulty fueling system. 2. Preheat solenoid faulty. 3. Low battery power. 	<ol style="list-style-type: none"> 1. Check that fuel valves are open. <ol style="list-style-type: none"> 1a. Check for air in fuel system. Bleed air from fuel system. 1b. Fuel filters clogged. Replace filters and bleed air from fuel system. 2. Check solenoid. 3. Switch to combine house and start batteries. <ol style="list-style-type: none"> 3a. Replace batteries.
Engine can't be stopped.	<ol style="list-style-type: none"> 1. Faulty DC alternator. 2. Disconnect fuel shut-off cable. 3. Fuel run solenoid will not de-energize. 	<ol style="list-style-type: none"> 1. Remove Exc. connection at alternator; repair alternator. 2. Check connection at shut-off lever. Pull lever back to close off the fuel 3. Manually shut the engine down using the shut off lever adjacent to the throttle lever on the engine.
Battery runs down.	<ol style="list-style-type: none"> 1. Oil pressure switch. 2. High resistance leak to ground. 3. Low resistance leak. 4. Poor battery connections. 5. DC alternator not charging (tachometer not operating). 	<ol style="list-style-type: none"> 1. Observe if gauges and panel lights are activated when engine is not running. Test the oil pressure switch. 2. Check wiring. Insert sensitive (0 - .25 amp) meter in battery lines. (Do not start engine.) Remove connections and replace after short is located. 3. Check all wires for temperature rise to locate the fault. 4. Check cable connections at battery for loose connections, corrosion 5. Check connections, check belt tension, test alternator. See <i>DC ELECTRICAL SYSTEM/ALTERNATOR</i>.
Battery not charging	<ol style="list-style-type: none"> 1. DC charge circuit faulty. 2. Alternator drive. 	<ol style="list-style-type: none"> 1. Perform DC voltage check of generator charging circuit. See <i>Testing the Battery Charging Circuit</i>. 2. Check drive belt tension; alternator should turn freely. Check for loose connections. Check output with voltmeter. Ensure 12 volts are present at the Exc. terminal.

(continued)

ENGINE TROUBLESHOOTING

Problem	Probable Cause	Verification/Remedy
Engine slows and stops.	<ol style="list-style-type: none"> 1. Fuel lift pump failure. 2. Switches and/or wiring loose or disconnected. 3. Fuel starvation. 4. 20 Amp circuit breaker tripping. 5. Exhaust system is restricted. 6. Water in fuel. 7. Air intake obstruction. 	<ol style="list-style-type: none"> 1. Fuel lift pump should make a distinct ticking sound. Replace pump with spare. 2. Inspect wiring for short circuits and loose connections. Inspect switches for proper operation. 3. Check fuel supply, fuel valves, fuel lift pump. 4. Check for high DC amperage draw during operation. Ensure breaker is not overly sensitive to heat which would cause tripping. 5. Check for blockage, collapsed hose, carbon buildup at exhaust elbow. 6. Pump water from fuel tank(s); change filters and bleed fuel system. 7. Check air intake
Engine overheats/shuts down.	<ol style="list-style-type: none"> 1. Raw water not circulating. 2. Coolant not circulating. 	<ol style="list-style-type: none"> 1. Raw water pump failure. Check impeller — replace. 2. Obstruction at raw water intake or raw water filter. <ol style="list-style-type: none"> 2a. Thermostat — remove and test in hot water. Replace thermostat. 2b. Loss of coolant — check hoses, hose clamps, drain plug, etc. for leaks. 2c. Broken or loose belts — tighten/replace. 2d. Air leak in system; run engine and open the pressure cap to bleed air. Add coolant as needed.
Engine alarm sound pulsates.	<ol style="list-style-type: none"> 1. Loss of oil. 2. Oil pressure switch. 	<ol style="list-style-type: none"> 1. Check dipstick, look for oil leaks at oil filter and at oil drain hose connection. 2. Replace oil pressure switch.
Engine alarm sounds continuously.	<ol style="list-style-type: none"> 1. Engine coolant. 2. High temperature switch opens at too low a temperature. 	<ol style="list-style-type: none"> 1. Check engine coolant level. 2. Check for satisfactory operation with switch bypassed, check with ohmmeter, replace if faulty.
Exhaust smoke problems	<ol style="list-style-type: none"> 1. Blue smoke. 2. White smoke. 3. Black smoke. 	<ol style="list-style-type: none"> 1. Incorrect grade of engine oil. <ol style="list-style-type: none"> 1a. Crankcase is overfilled with engine oil (oil is blowing out through the exhaust). 2. Engine is running cold. <ol style="list-style-type: none"> 2a. Faulty injector or incorrect injector timing. 3. Improper grade of fuel. <ol style="list-style-type: none"> 3a. Fuel burn incomplete due to high back-pressure in exhaust or insufficient air for proper combustion (check for restrictions in exhaust system; check air intake). 3b. Improperly timed injectors or valves, or poor compression. 3c. Lack of air — check air intake. Check for proper ventilation. 3d. Overload.

CONTROL PANEL TROUBLESHOOTING

MANUAL STARTER DISCONNECT (TOGGLE SWITCHES)

NOTE: The engine control system is protected by a 20 amp manual reset circuit breaker located on the engine as close as possible to the power source.

Problem	Probable Cause	Verification/Remedy
PREHEAT depressed, no panel indications fuel solenoid, electric fuel pump and preheat solenoid not energized.	<ol style="list-style-type: none"> 1. Oil Pressure switch. 2. 20 amp circuit breaker tripped. 	<ol style="list-style-type: none"> 1. Check switches and/or battery connections. 2. Reset breaker. If it opens again, check preheat solenoid circuit and run circuit for shorts to ground.
START SWITCH DEPRESSED, no starter engagement.	<ol style="list-style-type: none"> 1. Connection to solenoid faulty. 2. Faulty switch. 3. Faulty solenoid. 4. Loose battery connections. 5. Low battery. 	<ol style="list-style-type: none"> 1. Check connection. 2. Check switch with ohmmeter. 3. Check that 12 volts are present at the solenoid connection. 4. Check battery connections. 5. Check battery charge state.
NO IGNITION, cranks, does not start.	<ol style="list-style-type: none"> 1. Faulty fueling system. 2. Check for air in the fuel system. 3. Faulty fuel lift pump. 	<ol style="list-style-type: none"> 1. Check for fuel. 2. Allow system to bleed. 3. Replace fuel lift pump.
NOT CHARGING BATTERY	<ol style="list-style-type: none"> 1. Faulty alternator drive. 	<ol style="list-style-type: none"> 1. Check the drive belt and its tension. Be sure the alternator turns freely. Check for loose connections. Check the output with a voltmeter. Ensure 12V are present at the regulator terminal.
BATTERY RUNS DOWN	<ol style="list-style-type: none"> 1. Oil pressure switch. 2. High resistance leak to ground. 3. Low resistance leak to ground. 4. Faulty alternator. 	<ol style="list-style-type: none"> 1. Observe if the gauges and panel lights are activated when the engine is not running. Test the oil pressure switch. 2. Check the wiring. Insert sensitive (0-.25 amp) meter in battery lines (Do NOT start engine). Remove connections and replace after short is located. 3. Check all wires for temperature rise to locate the fault. 4. After a good battery charging, disconnect alternator at output. If leakage stops. Remove alternator and bench test. Repair or replace.

TROUBLESHOOTING WATER TEMPERATURE AND OIL PRESSURE GAUGES

If the gauge reading is other than what is normally indicated by the gauge when the instrument panel is energized, the first step is to check for 12 volts DC between the ignition (B+) and the Negative (B-) terminals of the gauge.

Assuming that there is 12 volts as required, leave the instrument panel energized and perform the following steps:

1. Disconnect the sender wire at the gauge and see if the gauge reads zero, which is the normal reading for this situation.
2. Remove the wire attached to the sender terminal at the gauge and connect it to ground. See if the gauge reads full scale, which is the normal reading for this situation.

If both of the above gauge tests are positive, the gauge is undoubtedly OK and the problem lies either with the conductor from the sender to the gauge or with the sender.

If either of the above gauge tests are negative, the gauge is probably defective and should be replaced.

Assuming the gauge is OK, check the conductor from the sender to the sender terminal at the gauge for continuity.

Check that the engine block is connected to the ground. Some starters have isolated ground terminals and if the battery is connected to the starter (both plus and minus terminals), the ground side will not necessarily be connected to the block.

ENGINE ADJUSTMENTS

NOTE: WESTERBEKE recommends that the following engine adjustments be performed by a competent engine mechanic. The information below is provided to assist the

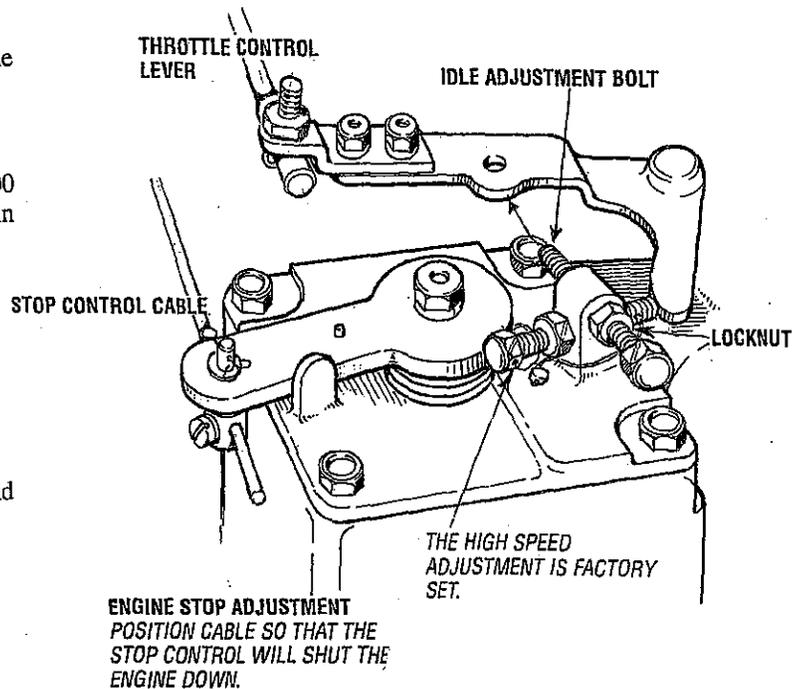
ENGINE IDLING SPEED

The engine idling speed is pre-set at the factory but once the boat is operating in the water other variables such as propeller size, shaft length, and the transmission can affect the idle speed.

The normal idle speed for these engine models is 1000-1200 rpm at normal engine operating temperatures. Where ever in this rpm range the engine operates the smoothest, does not stall when the throttle is restarted and no damper chatter is produces.

ADJUSTING THE IDLE SPEED

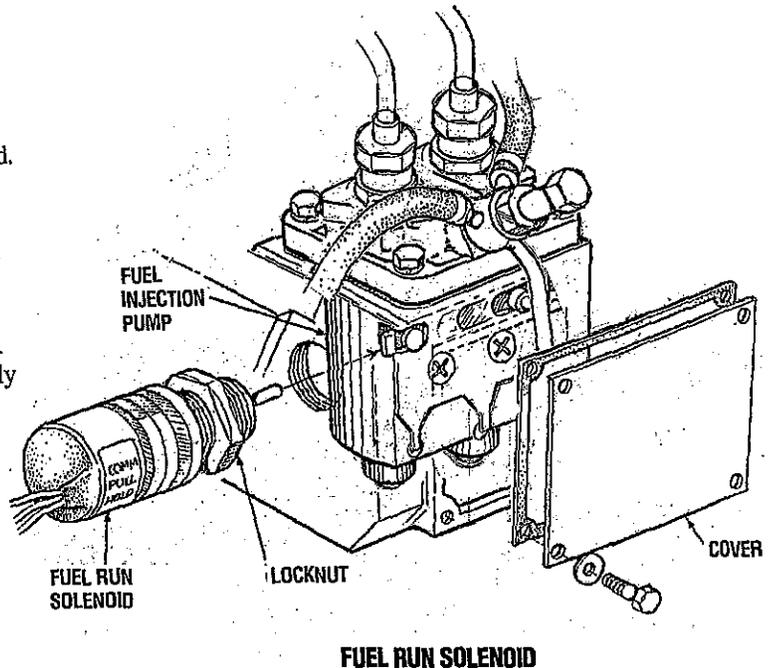
1. Loosen the locknut on the idle adjustment bolt on the fuel injection pump.
2. Adjust the bolt so that the throttle control lever will hold the engine at a quiet idle. (1000-12000 rpm)
3. Tighten the locknut.
4. Race the engine several times to ensure the idle speed remains as set.



OPTIONAL FUEL RUN/SHUT-OFF SOLENOID

The fuel run solenoid is mounted in a threaded hole on the engine's block just aft of and below the engine's injection pump. Proceed as follows when installing a replacement or new fuel run solenoid.

1. Visual access to the fuel injection pump's fuel rack is needed. To obtain this, remove the shut off lever and gasket just below the fuel injection pump.
2. Thread the locknut onto the solenoid and then apply a small amount of Teflon sealant to the threads on the solenoid.
3. Thread the solenoid into the hole on the engine and observe the solenoid plunger through the cover opening. Allow the plunger to contact the fuel rack and move fully into the injection pump. Do not thread further so as to push the plunger into the solenoid.
4. Back the solenoid out 1/4 - 1/2 of a turn and secure it in position with the locknut.
LOCKNUT TORQUE VALUE 28.9-36.2 FT-LB (4.0-5.0 M-KG)
5. Properly connect the three electrical leads from the solenoid. Two of the connections plug into the engine harness and the third grounds to the engine block at an adjacent inboard threaded hole with an 8mm bolt.
6. Re-assemble the shut-off lever with gasket and test run the unit. Make certain the unit stops when the solenoid is de-energized. If it does not and only goes to idle. Thread the solenoid in 1/8 - 1/4 turn till shut-off is obtained.



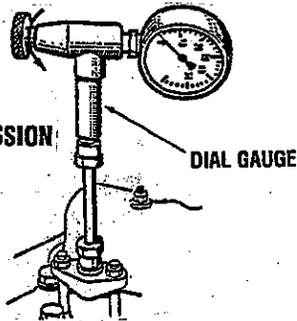
ENGINE ADJUSTMENTS

NOTE: WESTERBEKE recommends that the following engine adjustments be performed by a competent engine mechanic. The information below is provided to assist the mechanic.

ENGINE COMPRESSION

Check the engine's compression pressure at 500 and 1250 operating hours or whenever engine performance is reduced. Remove each glow plug and check each cylinder's compression pressure. The engine's cranking speed is at 280 rpm.

MEASURING COMPRESSION



Check the compression pressure. To do this warm the engine, remove all fuel injectors, or glow plugs, disconnect the fuel shut-off solenoid wire, and install a compression adapter in the injector hole or glow plug hole. Connect a compression tester on the adapter and crank the engine with the starter motor until the pressure reaches a maximum value. Repeat this process for each cylinder. Look for cylinders with dramatically (at least 20%) lower compression than the average of the others. Compression pressure should not differ by more than 35.5 psi (2.5 kg/cm²) at 280 rpm.

If a weak cylinder is flanked by healthy cylinder, the problem is either valve or piston related. Check the valve clearances for the weak cylinder, adjust as needed and test again. If the cylinder is still low, apply a small amount of oil into the cylinder to seal the rings and repeat the test. If compression comes up - the rings are faulty.

Abnormally high readings on all cylinders indicates heavy carbon accumulations, a condition that might be accompanied by high pressures and noise.

NOTE: In case of severe vibrations and detonation noise, the cause may be fuel injector problems, see FUEL INJECTORS. Poor fuel quality, contaminates and loss of positive fuel pressure to the injection pump will result in injector faults.

When re-installing the glow plugs use anti-seize compound.

COMPRESSION VALUES

STANDARD (AT 280 RPM) 398.16 PSI (28Kg/cm²)
MINIMUM (AT 280 RPM) 355.5 PSI (25Kg/cm²)

MAXIMUM ACCEPTABLE DIFFERENCE BETWEEN 35.5 PSI (2.5 Kg/cm²)

DRIVE BELT ADJUSTMENT

Excessive drive belt tension can cause rapid wear of the belt and reduce the service life of the fresh water pump's bearing. A slack belt or the presence of oil on the belt can cause belt slipping, resulting in high operating temperatures.

The drive belt is properly adjusted if the belt can be deflected no less than 3/8 inch (10mm) and no more than 1/2 inch (12mm) as the belt is depressed with the thumb at the midpoint between the two pulleys on the longest span of the belt. A spare belt or belts should always be carried on board.

WARNING: Never attempt to check or adjust the drive belt's tension while the engine is in operation.

Adjusting Belt Tension

1. Loosen the alternator pivot bolt.
2. Loosen the alternator adjusting bolt.
3. With the alternator loose, swing it outward until the drive belt is tensioned correctly.
4. Tighten both bolts.
5. Check the tension again after the engine has been in operation.

ENGINE ADJUSTMENTS

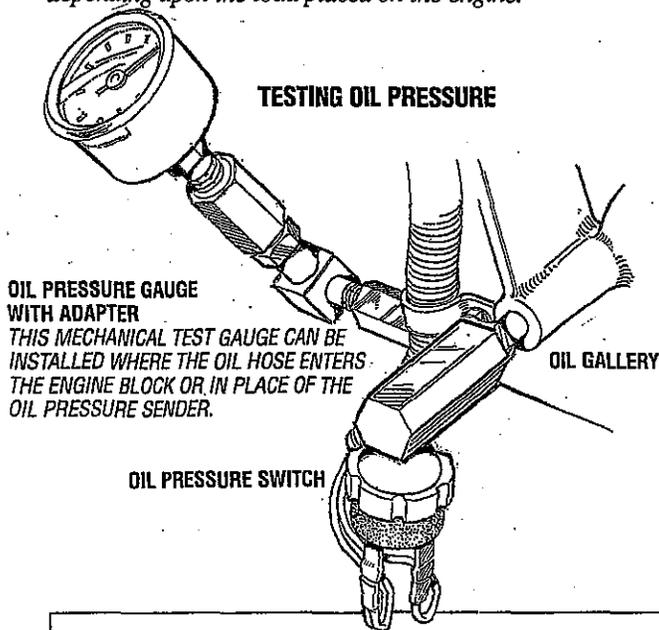
NOTE: WESTERBEKE recommends that the following engine adjustments be performed by a competent engine mechanic. The information below is provided to assist the mechanic.

TESTING OIL PRESSURE

To test oil pressure, remove the hex head plug from the oil gallery and install a mechanical oil pressure gauge in its place. After warming up the engine, read the oil pressure gauge.

OIL PRESSURE BETWEEN 35 AND 55 PSI

NOTE: A newly started, cold engine may have an oil pressure reading up to 70 or 80 psi. A warmed engine can have an oil pressure reading as low as 30 psi. Oil pressure will vary depending upon the load placed on the engine.



CAUTION: Be sure to stop the engine before checking the engine. Keep your hands away from rotating parts such as the cooling fan, v-belt, pulleys, and flywheel. Keep long hair away from rotating parts and do not wear music earphones.

LOW OIL PRESSURE

A gradual loss of oil pressure usually indicates a worn bearings. A rapid loss of oil pressure indicates a specific bearing failure. For additional information on low oil pressure readings, see the *ENGINE TROUBLESHOOTING* chart.

OIL PRESSURE RELIEF VALVE

The oil pressure relief valve is located in the front gear case cover just below the oil pressure senders location. It is held in place by a 22mm hexhead plug. This valve's cracking pressure is approximately 45 psi and operates to maintain the pressure in the engine's lubricating system.

OIL PRESSURE SWITCH

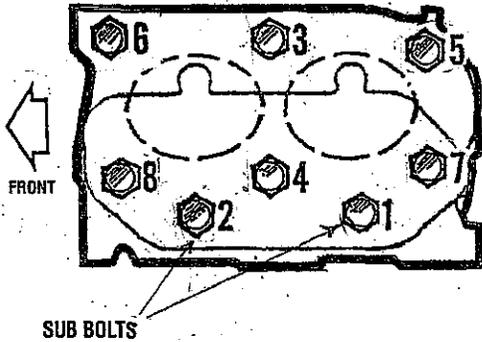
There is an oil pressure switch connected into the engine's oil gallery to monitor the engine oil pressure and to sound the panel alarm buzzer should a low oil pressure issue occur (5-10 psi). The engine alarm buzzer in such cases will sound continuously.

NOTE: This alarm will sound when starting the engine and will shut off once the oil pressure exceeds 5-10 psi.

ENGINE ADJUSTMENTS

NOTE: WESTERBEKE recommends that the following engine adjustments be performed by a competent engine mechanic. The information below is provided to assist the mechanic.

CYLINDER HEAD BOLT TIGHTENING SEQUENCE



Cylinder head bolts must be tightened before valve adjustment.

TORQUING THE CYLINDER HEAD BOLTS

After the initial break-in period (approximately 50 hours), the cylinder head bolts should be re-torques.

Loosen the cylinder head bolts one half turn in the order shown. (The engine should be cold). Then tighten the bolts in the sequence shown below. One bolt at a time. Tighten the rocker cover stud securely.

NOTE: The rocker shaft assembly should be removed for access to the cylinder head bolts.

TORQUE SPECIFICATIONS:

Bolts #1, #2 - 14.4 - 21.7 lb-ft (2.0 - 3.0 Kg-m)

Bolts #3, #4, #5, #6, #7, #8, - 54.2 - 61.4 lb-ft (7.5 - 8.5 Kg-m)

ROCKER SHAFT HOLD-DOWN BOLTS:

All main bolts are 14mm across the bolt head flats.

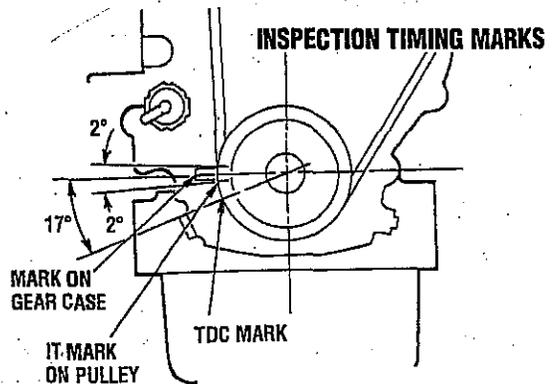
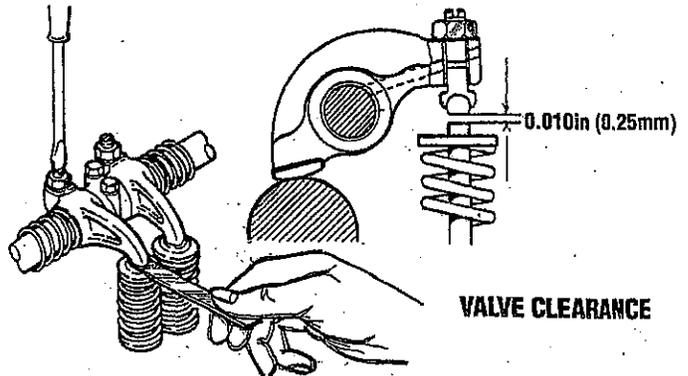
All sub bolts are 12mm across the bolt head flats.

Rocker shaft hold-down bolts are 12mm across the bolt head flats.

Rocker Cover Hold Down Cap Nuts - (10mm socket) (snug)

VALVE CLEARANCE ADJUSTMENT

The valve clearance must be adjusted every 500 operating hours or whenever the valve rocker is abnormally noisy. Valve adjustment should only be done when the engine is cold. Cold engine valve clearance is 0.010in (0.25mm).



1. Pull off the air breather pipe from the rocker cover and take off the rocker cover bolts. Adjust the valve clearances at TDC (Top Dead Center) for each cylinder when they are on their compression stroke.
2. Adjust all valve clearances at the Top Dead Center (TDC) of the compression stroke for each cylinder. Take care to align the TDC timing mark on the crankshaft pulley exactly with the indicator mark on the gear case, as shown on the illustration below. If these marks are not exactly aligned, the valves may be pushed up by the piston, depending on the position of the cam lobe.
3. Confirm that the valves do not move up or down when the crankshaft is turned slightly in either direction from the TDC mark.
4. Align the mark (as shown) for TDC for the No. 1 cylinder on its compression stroke and adjust the valve clearances for both intake and exhaust valves for the No.1 cylinder with the engine cold.

ENGINE ADJUSTMENTS

NOTE: WESTERBEKE recommends that the following engine adjustments be performed by a competent engine mechanic. The information below is provided to assist the mechanic.

VALVE CLEARANCE ADJUSTMENT (CONT.)

5. When setting TDC for the No.2 cylinder proceed as follows:
 - a. For the two engine (2 cylinder) from TDC for the No.1 cylinder, rotate the crankshaft 180° clockwise (as viewed from the front of the engine) and adjust the valve clearances for both the intake and exhaust valves for the No.2 cylinder.
Rotate the crankshaft another 240 clockwise to position the No.2 cylinder at TDC. Adjust the valve clearances for both the intake and exhaust valves for the No.2 cylinder.

Injection Pump Timing Adjustment (Spill Timing)

The shut-off lever (throttle) must be in the run position and the throttle fully open while making these adjustments or no fuel will flow to the injection pump.

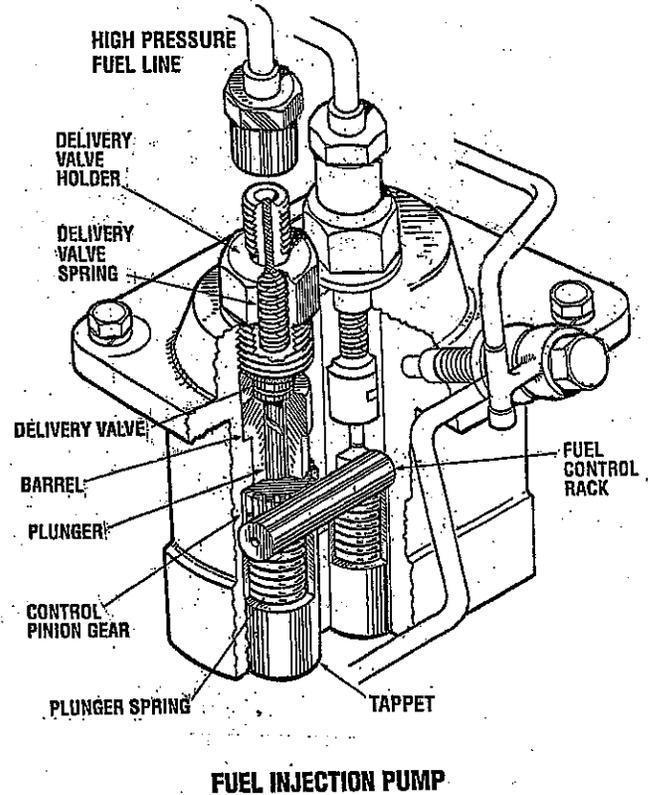
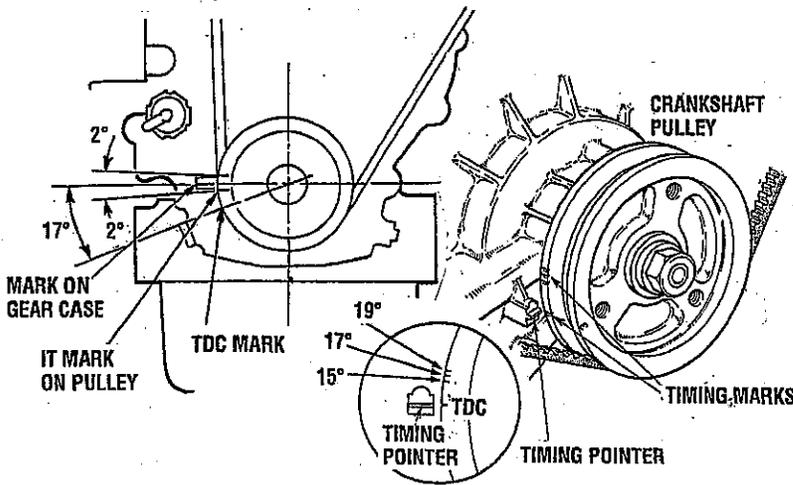
Remove the cylinder glow plugs to allow the engines crankshaft to be easily rotated.

1. Remove the high pressure fuel line from between the No.1 injector and the No.1 fuel delivery valve holder.
2. Remove the No.1 fuel delivery valve holder over the "O" ring and remove the delivery valve spring beneath the holder.
3. Reinstall only the delivery valve holder and re-attach the high pressure fuel line to the delivery holder. Attach it so that the end that would connect to the fuel injector is pointing away from the engine. Fuel will flow from this line during the timing check.

Rotate the engine's crankshaft in its normal direction of rotation to position piston No.1 at the beginning of its compression stroke.

Move the throttle lever to its full open position and operate the electric lift pump. Slowly rotate the crankshaft clockwise (as viewed from the front), catching the fuel from the No.1 fuel line, until the instant the fuel completely stops flowing (no drips). At this instant, the 19° BTDC timing mark on the crankshaft pulley should be directly aligned with the timing indicator on the front of the gear case $\pm .5$ degrees.

If the specified injection timing (19° BTDC) can not be attained, adjust the timing by increasing or decreasing the thickness of shim material under the injection pump's mounting flange to change the injection timing point. Changing the shim thickness by 0.004in (0.01mm) changes the injection timing by approximately one degree. To advance the timing, decrease the shim thickness, as required. To retard the timing, increase the shim thickness, as required.



ENGINE ADJUSTMENTS

NOTE: WESTERBEKE recommends that the following engine adjustments be performed by a competent engine mechanic. The information below is provided to assist the mechanic.

FUEL INJECTORS

NOTE: WESTERBEKE recommends that the following engine adjustments be performed by a competent engine mechanic. The information below is provided to assist the mechanic.

REMOVING FUEL INJECTORS

NOTE: Injector must be serviced in a "clean room" environment.

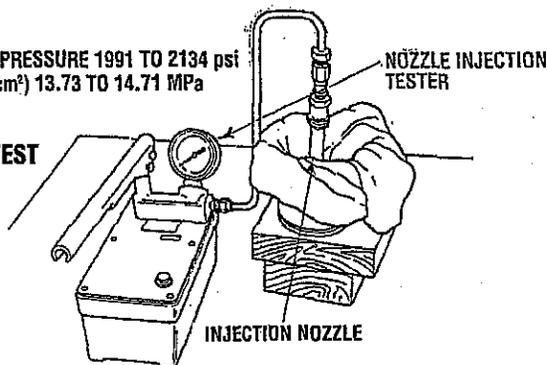
1. Disconnect the high pressure fuel lines from the injectors and loosen the lines at their attachment to the injection pump and move them out of the way of the injectors. Avoid bending the lines.
2. Using a 17mm long socket, remove the fuel return line in its entirety from the top of the injectors. Take care not to loose the two sealing washers and banjo bolt that attaches the fuel return line to each injector.

NOTE: Clean the area around the base of the injector prior to lifting it out of the cylinder head to help prevent any rust or debris from falling down into the injector hole. If the injector will not lift out easily and is held in by carbon build-up or the like, work the injector side-to-side with the aid of the socket wrench to free it, and then lift it out.

3. The injector seats in the cylinder head on a copper sealing washer. This washer should be removed with the injector and replaced with a new washer when the injector is reinstalled.

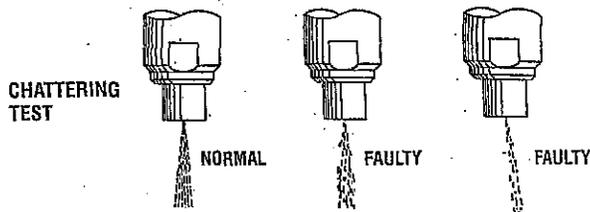
FUEL INJECTION PRESSURE 1991 TO 2134 psi
(140 TO 150 kg/cm²) 13.73 TO 14.71 MPa

INJECTION PRESSURE TEST



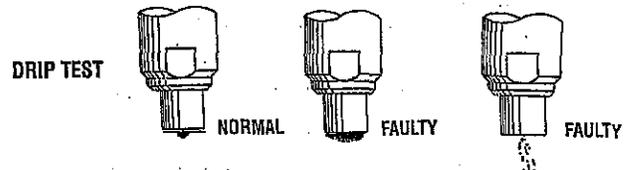
INJECTION TESTING

1. Using the nozzle tester, check the spray pattern and injection starting pressure of the nozzle. If it exceeds the limit, adjust or replace the nozzle. When using a nozzle tester, take the following precautions:



INSPECTING THE SPRAY PATTERN

1. Operate the hand lever of the nozzle tester at intervals of one stroke per second to check if the fuel is injected correctly in its axial direction. A nozzle is defective if it injects fuel in an oblique direction or in several separate strips. Also, a spray in the form of particles indicates a defect. These defects may sometimes be caused by clogging with dust and, therefore, all parts should be carefully cleaned before reassembly.



2. Apply the pressure of 1635 kg/cm² (115 lb/in²) to nozzle by operating the hand lever, and check the drips from the nozzle tip. If it drips or has a large accumulation of fuel on the bottom, it is considered defective and should be replaced. A very small amount of fuel may sometimes remain on the tip of the nozzle; however, this does not indicate a defect.

WARNING: The spray injected from the nozzle is of such velocity that it may penetrate deeply into the skin of fingers and hands, destroying tissue. If it enters the bloodstream,

INSTALLING

Install the nozzle and nozzle holder assembly in the reverse order of removal. When installing the nozzle and nozzle holder assembly, use a new copper washer.

JS AND BW TRANSMISSION

DESCRIPTION

The transmission's gear ratio is 2.47 to 1. This manual transmission rotates opposite to the engine when in forward gear. The JS transmits its power with case-hardened helical gears and, in reverse, an intermediate gear. The reversing process is carried out by a servo double disc system. For safety reasons, the transmission is **NOT** filled with lubricating for shipment. Before leaving the factory, each transmission is thoroughly tested with oil in the transmission. This testing, among other things, provides all internal parts with a coating of oil. This oil acts as a preservative, providing reliable protection against corrosion for at least one year if the transmission is properly stored.

The JS transmission is an immersion-lubricated type. Fill the transmission up to or near the top of the machined notch cut on the dipstick with SAE 20 W/20 or SAE 30 weight engine oil exclusively. Multigrade oils are not to be used in this transmission. **DO NOT** mix grades of oil! Lubricating oils may have an API specification of CF or CG-4.

LUBRICATION

The oil capacity for the JS transmission is approximately 1.0 quart (1.0 liter). Check the oil level daily after the engine has been warmed and stopped. The oil level should be maintained at the top of the machined flat on the dipstick when the dipstick is completely inserted into the transmission housing. Make sure that the two O-ring gaskets on the dipstick are in good shape. These O-rings will keep the dipstick in place.

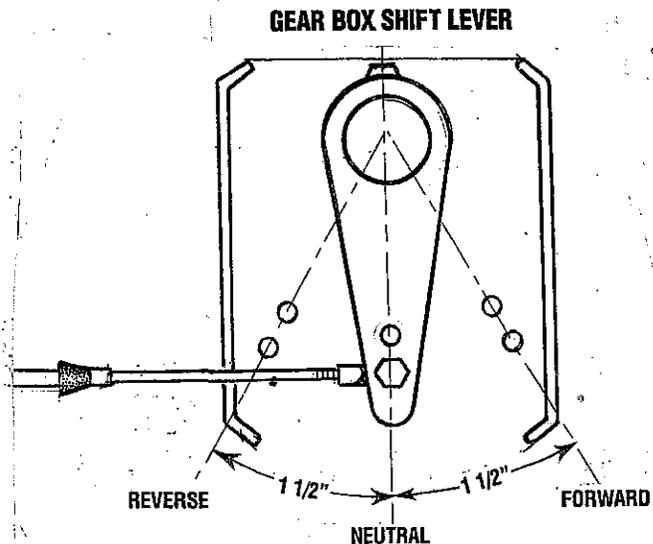
Change the transmission oil after the first 25 hours of engine operation and thereafter every 250 hours (or once per year, minimum). The JS has a 6 mm Allen Hex wrench drain plug for draining the oil. To make sure most of the oil will drain from the transmission, run the engine in **NEUTRAL** for approximately 10 to 15 minutes to warm oil. This oil may also be removed by inserting a pumps tube into the opening for the dipstick and extend it to the bottom of the case and then pump out the oil.

CONTROLS

The only controls required to operate the transmission is a single level remote controlled cable. The cable should be attached to the gear box lever using the cable bracket supplied with the unit. Both the gear box lever and the remote control lever must be in the **NEUTRAL** position when the cable is attached to the gear box lever. This allows the remote cable an equal throw distance to shift the gear box into **FORWARD** or into **REVERSE** from the **NEUTRAL** position without running out of cable. Allow approximately 1 1/2 inches of cable throw from the **NEUTRAL** position on the transmission's gear box lever to each of the two drive positions.

If the throw distance (or travel) of the remote cable is too short, the gear box lever cannot fully engage the transmission into **FORWARD** or **REVERSE**. In this situation, the transmission's internal clutches will wear prematurely and the transmission may over heat and eventually fail.

Excessive throw distance in the remote control level is not detrimental to the transmission. Note that the position of the remote control lever should align with the **NEUTRAL** marking on its bracket when the transmission is really in **NEUTRAL**.



SHIFTING

To shift the transmission from **NEUTRAL** into **FORWARD**, exert a *heavy push* to the remote control lever. A gentle throw may not carry enough force to actually shift the transmission's internal gears. A gentle throw is signalled by the transmission not engaging into the desired drive. Make sure the remote control lever is lubricated at least once each operating season. Shift the transmission while the engine is running at 1200 rpm or below.

⚠ CAUTION: NEVER remove or loosen the two-bolt gear box lever cover from transmission. The position of this plate and the actuating level inside of the transmission has been finely adjusted at the factory to ensure equal throw distance of internal mechanisms. Loosening of this cover's capscrews voids the transmission warranty.

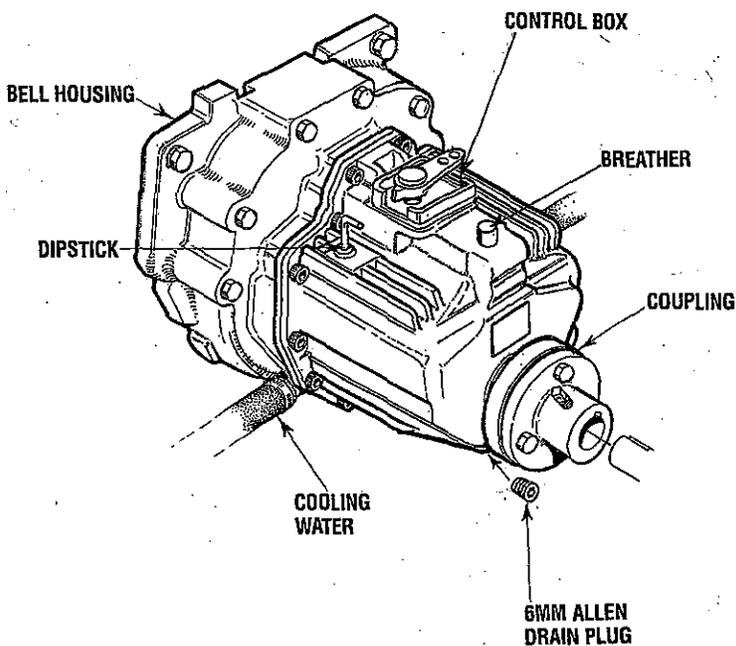
JS AND BW TRANSMISSION

SAILING OPERATION

The JS transmission should be left in its **NEUTRAL** position while sailing. Leaving the transmission in **NEUTRAL** while sailing alleviates unnecessary drag on the vessel because the propeller is able to freewheel (spin). However, if the transmission is left in its **FORWARD** gear while sailing, the transmission will not be damaged. (Leaving the transmission in **NEUTRAL** is just good sailing practice).

COOLING

The JS transmission is raw water-cooled. Raw water enters the transmission through a stainless steel inlet pipe located at the base of the bell housing. This water helps to cool the transmission's lubricating oil.



SERVICE

If any seal on the transmission shows signs of leaking, have the transmission looked at by a qualified WESTERBEKE dealer. This problem, especially concerning the rear seal, is often contributed to an improper alignment of the transmission's coupling and the propeller shaft's coupling. Disassembly of the transmission in the field is not recommended. If an overhaul or repair is needed, the work should be done by an authorized WESTERBEKE service center.

MAINTENANCE

Transmission maintenance is minimal. Keep the exterior housing clean, check the fluid level as part of your regular routine, and change the fluid every 300 operating hours.

Periodically inspect the transmission and the cooler for leaks and corrosion. Make certain the air vent is clear and when checking the fluid level look for signs of water contamination (fluid will appear as strawberry cream).

Lay-up/Winterize

Storage requires special care. Follow these procedures:

NOTE: This operation will usually occur when the engine raw water water cooling system is properly winterized.

- Clean up the transmission and touch-up any unpainted areas (use heat resistant paint).
- Fill the transmission with SAE 30 engine oil to prevent internal corrosion. (Extended storage only, 12 months or more).
- Loosen attaching hardware from the transmission output flange and propeller shaft coupling flange before removing the boat from the water. Separate the flanges and spray with lubricant.
- Inspect the gear shift cable, linkage, and attachments. Look for corrosion of the end fittings, cracks or cuts in the conduit, and bending of the actuator rods. Lubricate all moving parts.

NOTE: If the transmission is to be stored for a long time (twelve months or more), it should be topped off with oil to prevent internal corrosion. Reduce the oil level before putting the engine back into service.

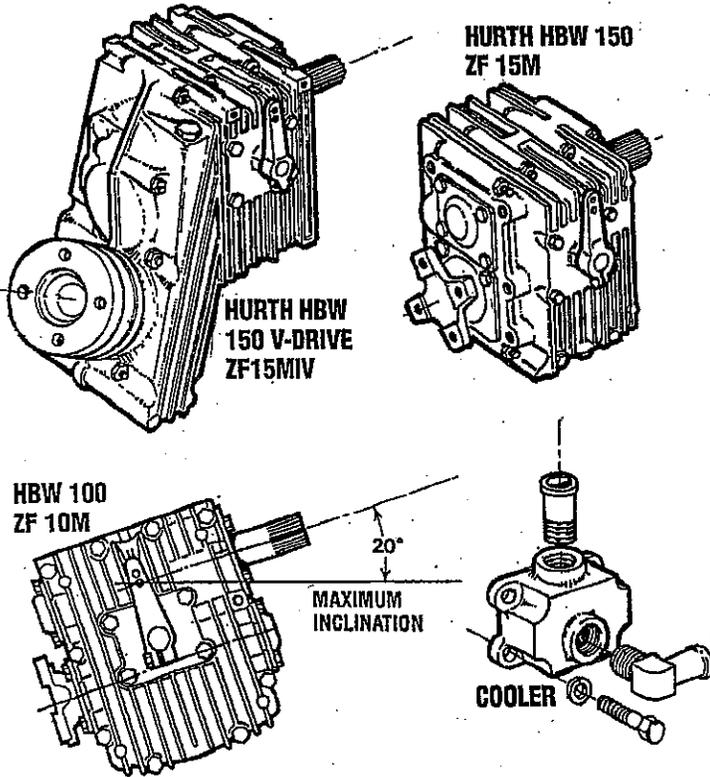
JS TRANSMISSIONS SPECIFICATIONS

General	Case-hardened helical gears with an intermediate reverse gear. Reversing out by servo double disc system
Gear Ratio (Standard)	2.47 : 1
Propeller Shaft (Direction of Rotation)	Right handed - standard transmission.
Propeller	See propeller recommendation chart
Lubricating Oil	SAE 20W/20 or SAE 30 exclusively (Do not mix grades of oil or use multi grades). API, CF, CG-4, or SJ.
Transmission Sump Capacity	1 qts (1 liters)
OIL TEMPERATURE	250 F (120 C) Maximum

HURTH HBW/ZF TRANSMISSIONS

DESCRIPTION

The information below is specific to the HBW Transmissions, the *TRANSMISSION TROUBLESHOOTING SECTION* applies to all models.



CAUTION: The position of the mechanism behind the actuating lever is factory-adjusted to ensure equal shift lever travel from neutral position A and B. If this mechanism is in any way tampered with, the transmission warranty will be void.

SHAFT COUPLINGS

WESTERBEKE recommends a flexible connection between the transmission and the propeller shaft if the engine is flexibly mounted, in order to compensate for angular deflections. The installation of a special propeller thrust bearing is not required, since the propeller thrust will be absorbed by the transmission bearing, provided the value specified under *SPECIFICATIONS* is not exceeded. However, the output shaft should be protected from additional loads. Special care should be taken to prevent torsional vibration. When using a universal joint shaft, make certain to observe the manufacturers instructions.

Even with the engine solidly mounted, the use of flexible coupling or "DRIVESAVER" will reduce stress in the gear-box bearings caused by hull distortions, especially in wooden boats or where the distance between transmission output flange and stern gland is less than about 800mm.

"Drivesaver" is a product of Globe Marine Rockland, MA.

NOTE: When installing the transmission, make certain that shifting is not impeded by restricted movability of the cable or rod linkage, by unsuitably positioned guide sheaves, too small a bending radius or other restrictions. In order to mount a support for shift control cable connections, use the two threaded holes located above the cable bracket mounted on the gear housing. Refer to the WESTERBEKE parts list.

SHIFT LEVER

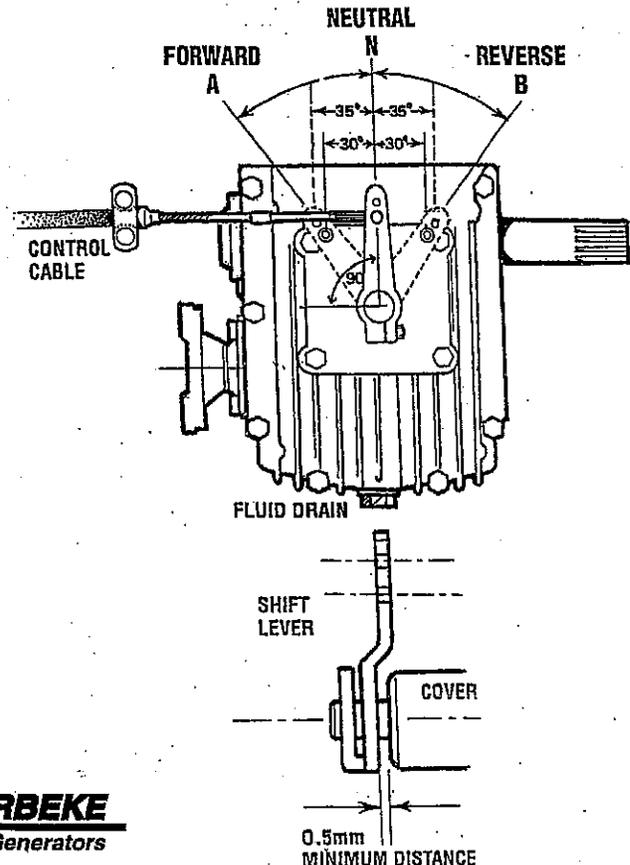
The transmission is suitable for single lever remote control. Upon loosening the retaining screw, the actuating lever can be moved to any position required for the control elements (cable or rod linkage). Make certain that the shift lever does not contact the actuating lever cover plate: the minimum distance between lever and cover should be 0.5mm.

The control cable or rod should be arranged at right angle to the actuating shift lever when in the neutral position. The neutral position of the operating lever on the control console should coincide with the neutral position of this lever.

The shifting travel, as measured at the pivot point of the actuating lever, between the neutral position and end positions A and B should be at least 35mm for the outer and 30mm for the inner pivot point.

A greater amount of shift lever travel is in no way detrimental and is recommended. However, if the lever travel is shorter, proper clutch engagement might be impeded which, in turn, would mean premature wear, excessive heat generation and clutch plate failure. This would be indicated by slow clutch engagement or no engagement at all.

NOTE Check for proper lever travel at least each season.

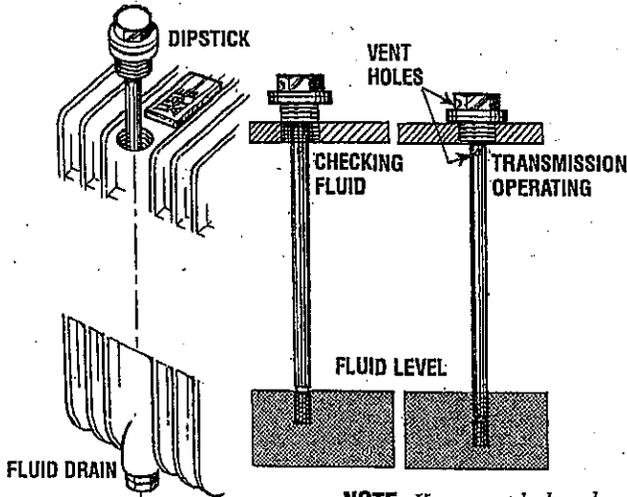


HURTH HBW/ZF TRANSMISSIONS

INITIAL OPERATION

All HBW/ZF marine transmissions are test-run on a test stand with the engine at the factory prior to delivery. For safety reasons the fluid is drained before shipment.

Fill the gearbox with Automatic Transmission Fluid (DEXRON II or DEXTRON III). The fluid level should be up to the index mark on the dipstick. To check the fluid level, just insert the dipstick, do not screw it in. Screw the dipstick into the case after the fluid level is checked and tighten. Do not forget the sealing ring under the hexhead of the dipstick. Check for leaks and change the fluid after the first 25 hours, also make a visual inspection of the coupling, oil cooler and hoses, and shift cables.



FLUID CHANGE

Change the fluid for the first time after about 25 hours of operation, then every 250 operating hours or at least once a year or when you change engine oil.

Removing the fluid

Push a suction pump hose down through the dipstick hole to the bottom of the housing and suck out the fluid. (If space allows, use the transmission drain). Remove the drain plug from the bottom of the transmission and allow the fluid to drain into a container, then reinstall the plug with its sealing washer. Wipe down the transmission and properly dispose of the used fluid. After running the engine, shut down and recheck the fluid level.

Drain plug torque 20 - 25 ft/lbs

NOTE: When changing the fluid, take care not to lose the drain plug sealing washer. The drain plug will leak without this sealing washer.

WARNING: Never pull out the dipstick while the engine is running. Hot fluid will splash from the dipstick hole. This could cause severe burns.

LOCKING THE PROPELLER

Locking of the propeller shaft by an additional brake is not required: use the gear shift lever position opposite your direction of travel for this purpose. Never put the gear shift in the position corresponding to the direction of travel of the boat.

WHEN UNDER SAIL OR BEING TOWED

Rotation of the propeller without load (in neutral), such as when the boat is being sailed, being towed, or anchored in a river, as well as operation of the engine with the propeller stopped (for charging the battery), will have no detrimental effects on the transmission

DAILY OPERATION

- Check the transmission fluid.
- Visually check the gear shift linkage and transmission.
- Start the engine in neutral, allowing a few minutes at idle to warm the fluid.
- Shift into gear.

NOTE: Too low an idle speed will produce a chattering noise from the transmission gear and damper plate. In such cases the idle speed should be increased

For additional information refer to the following text in this Transmission Section: *SHAFT COUPLINGS, MAINTENANCE AND TRANSMISSION TROUBLESHOOTING.*

HBW/ZF TRANSMISSIONS SPECIFICATIONS

General	(Hurth/ZF Standard Transmission) Case-hardened helical gears, with a servo-operated multiple disc clutch.
Gear ratio (optional)	HBW 50/ZF 5M (2.05 : 1) HBW 100/ZF 10M (1.79 : 1) HBW 150V/ZF 15MIV (2.13 : 1) HBW 150A/ZF 15MA (1.88 : 1)
Lubricating Fluid	ATF - or Dextron - II or III
Transmission Sump Capacity	HBW 50/ZF 5M 0.63pts (0.3L) HBW 100/ZF 10M 0.74pts (0.35L) HBW 150V/ZF 15MIV 2.1pts (1.0L) HBW 150A/ZF 15MA 1.0pts (0.47L)
Propeller Rotation	Transmissions turn Right Hand propellers

HURTH HBW/ZF TRANSMISSIONS

OPERATING TEMPERATURE

⚠ WARNING: *If the transmission fluid temperature is too high, stop the engine immediately and check the transmission fluid.*

Normal operating temperature of the transmission fluid should be in the range of 122°F (50°C) to 212°F (100°C). A maximum temperature of 266°F (130°C) may be only reached for a short time.

Make certain there is enough space around the transmission to provide good ventilation and cooling.

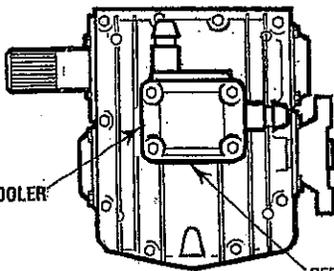
TRANSMISSION COOLER

Some *WESTERBEKE* model's transmissions are equipped with an externally attached convection type transmission cooler.

The cooler is a separate part of the transmission which prevents any possibilities of coolant diluting the transmission fluid. However, the continued flow of coolant thru the cooler will, in time, erode the inside of the cooler causing external leaks.

A transmission cooler may last ten years or more but, in some circumstances, depending on operating hours, tropical waters, maintenance, etc. it might only last half that time.

WESTERBEKE recommends having a spare cooler aboard.



PERIODICALLY INSPECT FOR
EROSION AND LEAKAGE

MAINTENANCE

Transmission maintenance is minimal. Keep the exterior housing clean, check the fluid level as part of your regular routine, and change the fluid every 300 operating hours.

Periodically inspect the transmission and the cooler for leaks and corrosion. Lubricate the cable connections.

Lay-up/Winterize

Storage requires special care. Follow these procedures:

- Drain water from the transmission oil cooler and replace with a proper mixture of antifreeze coolant.

NOTE: *This operation will normally occur when the engine raw water cooling system is properly winterized.*

- Clean up the transmission and touch up unpainted areas (use heat resistant paint).
- Fill the transmission with *Dextron III ATF* fluid to prevent internal corrosion (extended storage only, twelve months or more).
- Loosen attaching hardware from the transmission output flange and propeller shaft coupling flange before removing the boat from the water. Separate the flanges and spray with lubricant.
- Inspect the gear shift cable, linkage, and attachments. Look for corrosion of the end fittings, cracks or cuts in the conduit, and bending of the actuator rods. Lubricate all moving parts.

NOTE: *If the transmission is to be stored for a long time (twelve months or more), it should be topped off with fluid to prevent internal corrosion. Reduce the fluid level before putting the engine back into service.*

For additional information contact:

HURTH MARINE GEAR
ZF Industries
Marine US Headquarters
3131 SW 42nd Street
Fort Lauderdale, FL 33312
Tel.: (954) 581-4040
Fax: (954) 581-4077
www.ZF-Marine.com

HURTH HBW/ZF TRANSMISSION TROUBLESHOOTING

CONTROL CABLES

The majority of transmission difficulties arise as a result of improper clutch adjustments (manual transmissions) or problems with control cables (hydraulic transmissions) rather than from problems with the transmission itself.

HURTH/ZF clutches, in particular, are very sensitive to improper cable adjustments.

If you experience operating problems with the transmission, shut the engine down. First check the transmission-fluid level, then have a helper move the cockpit shift lever through the full range — from neutral to full forward, back to neutral, into full reverse, and back to neutral — while you observe the actuating lever on the transmission. If the remote is stiff to operate, break the cable loose at the transmission and try again. If it is still stiff, check the cable for kinks or excessively tight bends, and check any linkage for binding.

A new cable and perhaps a new linkage mechanism may be needed. While the cable is loose, shift the transmission in and out of gear using the lever on the side of the transmission to make sure there's no binding inside the case.

If the transmission passes these tests, crank the engine and have a helper put it in forward and reverse while you observe the propeller shaft; if the shaft isn't turning, the transmission needs professional attention. If it does turn but there's no thrust, check to see you still have a propeller on the end of the shaft or, if you have a folding or feathering propeller, that it isn't stuck in the "no pitch" position.

NOTE: *If you suspect a major problem in your transmission, immediately contact your WESTERBEKE dealer or an authorized marine transmission facility.*

Problem	Probable Cause	Verification/Remedy
Transmission gears cannot be shifted. Fails to move into gear.	<ol style="list-style-type: none"> 1. Actuating lever is loose. 2. Shifting cable is broken, bent or unattached. Cable radius is too severe. 3. Shift lever is binding against cover plate. 	<ol style="list-style-type: none"> 1. Tighten damping bolt on shifting lever. 2. Check the cable, reattach or replace. 3. Detach the shift cable and operate the lever by hand. Clearance should be 0.02 in (0.5mm).
Transmission shifts into gear, but fails to propel the boat.	<ol style="list-style-type: none"> 1. Output coupling is not turning. 2. Propeller shaft is not turning. Output coupling is turning. 3. Output coupling and propeller shaft are turning. 	<ol style="list-style-type: none"> 1. Transmission needs professional attention. 2. The coupling bolts are sheared or the coupling is slipping on the propeller shaft. Tighten or replace set screws, keys, pins and coupling bolts as necessary. 3. Inspect the propeller. It may be missing or damaged. A folding propeller may be jammed. A variable pitch propeller may be in "no pitch" position.
Delay of gear engagement or engages only after an increase in speed.	<ol style="list-style-type: none"> 1. Lever travel N to B not equal to N to A. Refer to diagram. 2. Shift level travel is insufficient. 3. Shift lever is binding against cover plate. 	<ol style="list-style-type: none"> 1. Adjust cover plate until the lever is exact mid-position. Refer to <i>SHIFT LEVER TEXT AND DIAGRAM</i>. 2. Check shift lever cable length. See <i>SHIFT LEVER DIAGRAM</i>. 3. Check clearance, adjust if necessary.
Transmission noise becomes louder.	<ol style="list-style-type: none"> 1. Damage starting on flexible coupling due to wear or fatigue, possibly due to misalignment between engine and driveshaft. 2. Beginning damage of bearings in transmission due to torsional vibrations, running without fluid, overload, wrong alignment of transmission, or excessive engine output. 	<ol style="list-style-type: none"> 1. Check alignment, inspect flexible coupling. If noise persists, inspect the damper plate between the transmission and the engine. Replace if necessary. 2. Transmission needs professional attention.
Chattering transmission noise, mainly at low engine speed.	<ol style="list-style-type: none"> 1. The engine or propeller generates torsional vibrations in the drive unit which produces a "chattering" noise in the transmission. 	<ol style="list-style-type: none"> 1. Mount a flexible coupling with another stiffness factor between the transmission coupling with and the driveshaft. A higher stiffness factor might be sufficient. 2. Inspect the damper plate between the engine and the transmission. Replace if necessary.
Boat fails to attain specified max. speed.	<ol style="list-style-type: none"> 1. Operating temperature is high. 2. Operating without cooling. 	<ol style="list-style-type: none"> 1. Wrong type of fluid. Use ATF. Check fluid level. 2. Check cooler. Inspect coolant hoses and coolant flow.
Oil Leakage.	<ol style="list-style-type: none"> 1. Corrosion at radial sealing ring and shaft. Damaged sealing ring. 2. Misalignment of output flanges. 	<ol style="list-style-type: none"> 1. Transmission needs professional attention. 2. Check alignment. Must be within 0.003 in (0.08mm).

NOTE: *If you suspect a major problem in your transmission, immediately contact your WESTERBEKE dealer or an authorized marine transmission facility.*

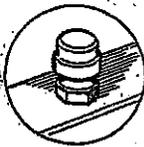
HURTH HBW/ZF TRANSMISSION TROUBLESHOOTING

Problem	Probable Cause	Verification/Remedy
High fluid temperature.	<ol style="list-style-type: none"> 1. Fluid level high during operation. 2. Fluid level low. 3. Plugged or restricted fluid cooler. 4. No water in cooling system. 5. Filter clogged (if applicable). 	<ol style="list-style-type: none"> 1. Pump out fluid to the maximum and mark on dipstick. 2. Add fluid. 3. Replace cooler and flush water system. 4. Check cooling system and repair. 5. Replace element.
Fluid on transmission housing.	<ol style="list-style-type: none"> 1. Loose screws. 2. Loose screw connections. 3. Loose dipstick. 4. Loose fluid filter. 5. Fluid level high during operation. 	<ol style="list-style-type: none"> 1. Tighten to specification. 2. Tighten, replace. 3. Tighten, replace. 4. Tighten, replace. 5. Pump out fluid to the maximum and mark on dipstick.
Fluid and water mixed; shifts hard.	<ol style="list-style-type: none"> 1. Damage to fluid cooler. 2. Selector control linkage. 	<ol style="list-style-type: none"> 1. Replace cooler and flush transmission and hoses. 2. Refer this manual.
Slow engagement.	<ol style="list-style-type: none"> 1. Selector control. 2. Low fluid level. 3. Linkage. 	<ol style="list-style-type: none"> 1. Refer this manual. 2. Add fluid. 3. Adjust (refer this manual).
No movement of the boat.	<ol style="list-style-type: none"> 1. Selector control. 2. Improper selector position. 3. Low fluid level. 4. Propeller missing. 5. Propeller shaft broken. 6. Transmission malfunction. 7. Engine malfunction. 	<ol style="list-style-type: none"> 1. Consult service station. 2. Adjust (see this manual). 3. Add fluid. 4. Replace. 5. Contact marine repair. 6. Contact manufacturer. 7. Contact marine repair.

NOTE: If you suspect a major problem in your transmission, immediately contact your WESTERBEKE dealer or an authorized marine transmission facility.

PRM NEWAGE TRANSMISSIONS MODELS 80 AND 120

THE MODEL 120 HAS A BREATHER FITTING ON THE TOP OF THE CASE



NOTE: When changing the fluid, take care not to lose the drain plug sealing washer. The drain plug will leak without this sealing washer.

WARNING: Never pull out the dipstick while the engine is running. Hot fluid will splash from the dipstick hole. This could cause severe burns.

DAILY OPERATION

- Check the transmission fluid.
- Visually check the gear shift linkage and transmission.
- Start the engine in neutral, allowing a few minutes at idle to warm the fluid.
- Shift into gear.

NOTE: Too low an idle speed will produce a chattering noise from the transmission gear and damper plate. In such cases the idle speed should be increased.

GEAR SHIFTING

The engine must be at idle. Pause in neutral before selecting ahead or astern. Transmission models PRM 80 and 120 are ideal for single lever controls, controlling both the throttle and the gear shift at one time.

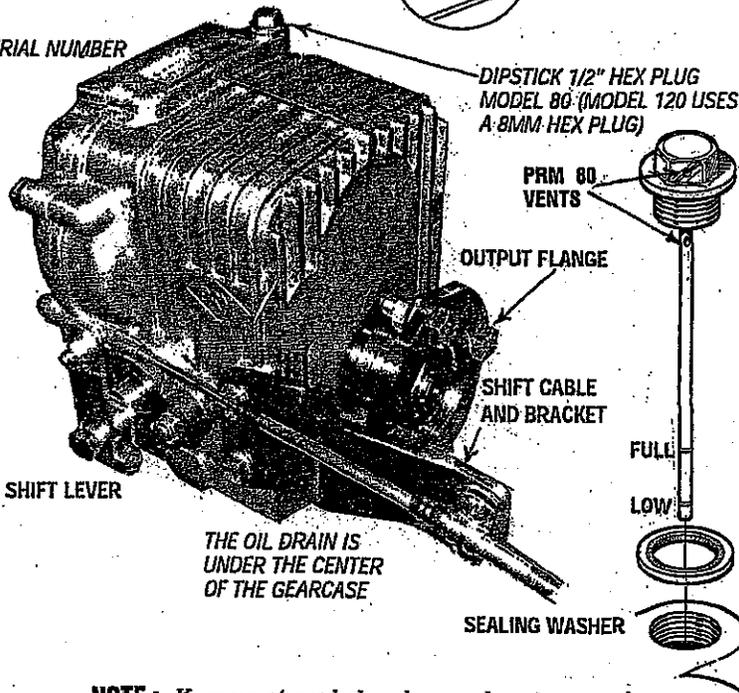
WARNING: When shifting gears, bring the engine throttle to idle and pause in neutral before shifting ahead or astern.

LOCKING THE PROPELLER

Locking of the propeller shaft by an additional brake is not required. Use the gear shift lever position opposite your direction of travel for this purpose. Never put the gear shift in the position corresponding to the direction of travel of the boat.

WHEN UNDER SAIL OR BEING TOWED

Rotation of the propeller without a load, such as when the boat is being sailed, being towed or anchored in a river, as well as operation of the engine with the propeller stopped (for charging the battery), will have no detrimental effects on the transmission.



NOTE: Keep vent/vent holes clear and unobstructed.

INITIAL OPERATION

Before starting the engine, remove the dipstick and fill the transmission with automatic transmission fluid (ATE) Dextron 11 or Dextron 111. Fill to the mark on the dipstick. Do not overfill.

Run the engine to warm up the fluid and after shutting down the engine, re-check the fluid level.

Model PRM 80-1.0 U.S. pints (0.6L)
Model PRM 120-1.4 U.S. pints (0.8L)

NOTE: Always clean the area around the dipstick plug before filling with fluid. Replace the dipstick by screwing it down

CHECKING THE FLUID LEVEL

Thread the dipstick fully into the case, then unscrew it and observe the fluid level.

CHANGING THE TRANSMISSION FLUID

Change the fluid for the first time after about 25 hours of operation, then every 250 operating hours or at least once a year or when you change engine fluid. Check for leaks and make a visual inspection of the shift cables and shaft coupling. Push a suction pump hose down through the dipstick hole to the bottom of the housing and suck out the fluid. (If space allows, use the transmission drain). Remove the drain plug from the bottom of the transmission (1" with sealing washer) and allow the fluid to drain into a container, then reinstall the plug with its sealing washer. Wipe down the transmission and properly dispose of the used fluid. After running the engine, shut down and recheck the fluid level.

PRM NEWAGE TRANSMISSIONS

MODELS 80 AND 120

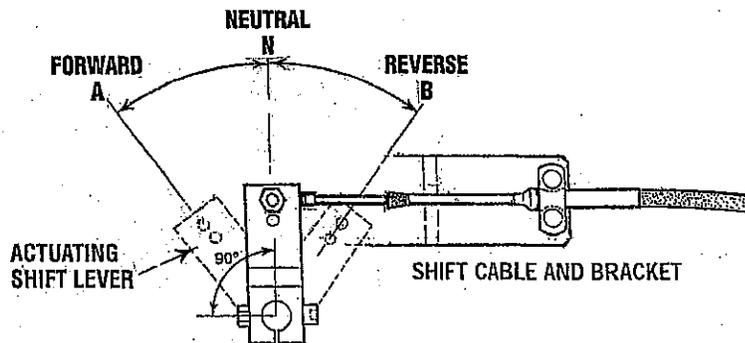
CONTROL CABLES

The control cable or rod should be arranged at a right angle to the actuating shift lever with the lever in the neutral position. The neutral position of the operating lever in the cockpit must coincide with the neutral position of this lever.

The shift level travel **must** be such that the lever just strikes the internal stops for the lever when shifted into forward or reverse. Those stops can be determined by manually moving the shift lever with the cable disconnected. This is an important adjustment for proper engagement of the gear.

A greater amount of shift lever travel is in no way detrimental and is recommended. However, if the lever travel is shorter, proper clutch engagement might be impeded which, in turn, would mean premature wear, excessive heat generation and clutch plate failure. This would be indicated by slow clutch engagement or no engagement at all.

NOTE: Check for proper lever travel and the security of the cable to the lever bracket at least each season.



MAINTENANCE/SERVICE

Make certain the transmission fluid is changed annually. If the fluid should become contaminated by water or the gearbox suffers major mechanical damage, the gearbox must be thoroughly flushed out and re-filled with fresh fluid to the correct specifications.

NEWAGE TRANSMISSIONS LTD. has distributors around the world. Listed here are those in the United States.

Atlantis Marine Gear Supply Inc.
418 Boston Street
Topshfield, MA 01933
Tel: 978-887-0001
Fax: 978-887-5599

Harbor Marine Transmission
1402 West marineview Drive
Everett, WA 98021
Tel: 425-259-3285

Transmission Marine
223 Southwest 33 Court
P.O. Box 21086
Ft. Lauderdale, FL 33335-1086
Tel: 954-467-1540
Fax: 954-467-1525

Newage Transmissions, Limited.
Website: www.Newage-PRM.co.uk

If a major problem should occur, contact your **WESTERBEKE** dealer or a **NEWAGE** distributor. To avoid prejudicing warranty rights, do not undertake repair work on the gearbox without first contacting **NEWAGE TRANSMISSIONS LTD.** or a **NEWAGE** distributor (listed above) or your **WESTERBEKE** dealer.

WARRANTY

NEWAGE TRANSMISSIONS LTD. warrants that all PRM Newage Transmissions will be free from defects in material and workmanship under normal use and service for a period of 24 months.

All PRM transmissions must be correctly installed, aligned, and maintained.

TROUBLESHOOTING

See the following page.

PRM NEWAGE TRANSMISSIONS TROUBLESHOOTING

Problem	Probable Cause	Verification/Remedy
Excessive noise at low speeds.	1. Engine idle speed too low.	1. Increase idling speed.
Excessive noise at all speeds.	1. Defective coupling. 2. Shaft misalignment. 3. Prop out of balance.	1. Inspect/replace coupling if necessary. 2. Check alignment with feeler gauge. 3. Remove, check pitch, balance and weight.
Fluid needs constant topping off.	1. Power too high. 2. Fluid leak.	1. Compare engine and transmission data. 2. Inspect seals, O-rings, drain plug, check for fluid leaks.
Difficulty in moving lever control.	1. Poor installation of cable. 2. Faulty cable.	1. Check installation, remove sharp bends and turns. 2. Replace.
Escape of pressure from gearbox when dipstick is removed.	1. Defective breather causing leaks past oil seals.	1. Remove dipstick/clean vent holes - PRM80. 2. Unscrew vent assembly from top of transmission and clean with solvent - PRM120.
No drive ahead or astern.	1. Mechanical-damper plate problem.	1. Replace damper plate.
Propeller speed does not increase with engine speed ahead and astern.	1. Shift cable.	1. Remove control cable or linkage not allowing F-N-R to move correct distance. Remove cable and operate lever by hand to check movement. Adjust cable if necessary
Propeller speed does not increase with engine speed in one direction only.	1. Cone/clutch cable slippage. Damaged. clutch plates or clutch cones.	1. Remove and examine clutch/clutch cone on appropriate shaft and replace if necessary.
Excessive noise from gearbox at low speeds.	1. Engine idle speed set too low. Faulty adjustment.	1. Increase idling speed. If not cured by increasing idling speed, refer to engine supplier. Remove, examine and replace coupling if necessary.
Excessive noise throughout operating range.	1. Defective input coupling. Input coupling worn/damaged. Propeller shaft misalignment, faulty installation or hull flexing. 2. Propeller out of balance, damaged prop, poorly matched. 3. Defective bearing/bearing. Worn or damaged.	1. Check the alignment of the propeller shaft coupling. If necessary, rectify by adjusting the shims under the engine mounts or adjust the engine mounts themselves. 2. Remove the propeller and check that the pitch, weight, diameter and balance of all the blades are equal and rectify if necessary. 3. Isolate defective bearing, remove and replace.
Difficulty in moving single lever control.	1. Operating control cable.	1. Check the installation and eliminate all tight bends in the cable.

12C AND 12D TWO ENGINE SPECIFICATIONS

SPECIFICATIONS

Engine Type	Diesel, four-cycle, two-cylinder, fresh water-cooled, vertical in-line. 12 Hp @ 3000 rpm maximum
Governor	Mechanical, centrifugal weight type
Valve Mechanism	Overhead
Combustion Chamber	Swirl chamber type
Bore & Stroke	2.99 x 2.76 inches (76 x 70 mm)
Piston Displacement	38.75 cubic inches (0.635 liters)
Firing Order	1 - 2
Direction of Rotation	Clockwise, when viewed from the front.
Maximum Torque	30 lb-ft (4.15 kg-m) at 2200 rpm
Compression Ratio	23:1
Compression Pressure	398 psi (28 kg/cm ²) at 280 rpm
Valve Seat Angle	Intake 45° Exhaust 45°
Valve Clearance (engine cold)	Intake 0.010 inches (0.25) Exhaust 0.010 inches (0.25)
Dimensions	Height: 19.75 (501.65) Width: 17.22 inches (437.3) Length: 25 inches (635)
Inclination	Continuous 14° Temporary 25° (not to exceed 30 min.)
Dry Weight	228 lbs (103.4 kgs)
Fuel Consumption	1.1 US gph (4.1 lph) at 3600 rpm (approximate)
Idle Speed	1000 - 1200 rpm
Cruise Speed	2000 - 2500 rpm

ELECTRICAL SYSTEM

Starting Battery	12 Volt, (-) negative ground
Battery Capacity	600 - 800 CCA (Cold Cranking Amps)
Starting Aid	Glow plugs, sheathed type
Starter Motor	12 Volt, 1.2 Kw, solenoid, actuator shift
DC No-Load Current	100 Amps at 11.5 Volts (3000 rpm, min)
Cold Cranking Current	125 Amps at 10 Volts (805 rpm, min)
Alternator	12 Volt DC, 50 Amps
Regulator	Internal regulator, built into alternator

LUBRICATION SYSTEM

General	Pressure type by Trochoid pump, gear-driven, with external pressure valve relief
Operating Oil Pressure (engine hot)	15 - 45 psi (1.0 - 3.1 kg/cm ²)
Oil Grade	API Specification CF, CF-4, CG-4, CH-4 or CI-4 SAE 15W-40 (all season)
Oil Filter (Pn. #036920)	Full flow, paper element, spin on
Sump Capacity (including filter)	3.0 U.S. qts (2.8 liters)

FUEL SYSTEM

General	Open flow, self-bleeding
Fuel	No. 2 diesel (cetane rating of 45 or higher)
Injection Pump	In-line plunger type (BOSCH)
Engine Timing (Spill Timing)	19° ± 1° BTDC Static
Injection Pressure	1991 psi (140 kg/cm ²)
Nozzle	Throttle type
Air cleaner	Metal screen type-cleanable
Air Flow (engine combustion)	34 cfm (0.96 cmm)
Lift Pump (PN #039275)	12 volt DC lift capacity of 5' (1.5 mm) wet

COOLING SYSTEM

General	Fresh water-cooled block, thermostatically-controlled with heat exchanger
Operating Temperature	170 - 190° F (77 - 88° C)
Fresh Water Pump (PN# 037015)	Centrifugal type, metal impeller, belt-driven
Raw Water Pump (PN# 033636)	Positive displacement, rubber impeller, mechanically-driven
Raw Water Flow (measured before discharge into exhaust elbow)	11.1 US gmp (42 lpm) at 3000 rpm-approx.
System Capacity (Fresh Water)	2.9 US qts (2.7 liters)

TRANSMISSIONS

JS Model	2.47:1 reduction (See Transmission pages)
PRM 80	2.50:1 reduction
BW7	2.47:1 reduction
Propeller Rotation	Right hand turning - Standard Transmission
Propeller Shaft	3/4" diameter (minimum)

LAY-UP & RECOMMISSIONING

GENERAL

Many owners rely on their boatyards to prepare their craft, including engines and generators, for lay-up during the off-season or for long periods of inactivity. Others prefer to accomplish lay-up preparation themselves.

The procedures which follow will allow you to perform your own lay-up and recommissioning, or you may use them as a check list if others do the procedures.

These procedures should afford your engine protection during a lay-up and also help familiarize you with the maintenance needs of your engine.

If you have any questions regarding lay-up procedures, call your local servicing dealer; he will be more than willing to provide assistance.

PROPELLER SHAFT COUPLING

The transmission and propeller half couplings should always be opened up and the bolts removed when the boat is hauled out of the water or moved from land to water, and during storage in the cradle. The flexibility of the boat often puts a severe strain on the propeller shaft or coupling or both, while the boat is taken out or put in the water. In some cases, the shaft has actually been bent by these strains. This does not apply to small boats that are hauled out of the water when not in use, unless they have been dry for a considerable period of time.

FRESH WATER COOLING CIRCUIT

A 50-50 solution of antifreeze and distilled water is recommended for use in the coolant system at all times. This solution may require a higher concentration of antifreeze, depending on the area's winter climate. Check the solution to make sure the antifreeze protection is adequate.

Should more antifreeze be needed, drain an appropriate amount from the engine block and add a more concentrated mixture. Operate the engine to ensure a complete circulation and mixture of the antifreeze concentration throughout the cooling system. Now recheck the antifreeze solution's strength.

LUBRICATION SYSTEM

With the engine warm, drain all the lubricating oil from the oil sump. Remove and replace the oil filter (Place some paper towels and a plastic bag around the filter to catch the oil during its removal).

When installing the new oil filter, be sure to apply a small amount of oil on the rubber sealing gasket at the base of the filter. Fill the sump with the correct amount of oil for your engine. (Refer to the SPECIFICATIONS section of this manual). Use an oil with an API specification of CF or CG-4. Run the engine and check for proper oil pressure and make sure there are no leaks.

CAUTION: Do not leave the engine's old engine oil in the sump over the lay-up period. Lubricating oil and combustion deposits combine to produce harmful chemicals which can reduce the life of your engine's internal parts.

FUEL SYSTEM

Top off your fuel tanks with No. 2 Diesel fuel. Fuel additives such as *BioBor* and *Diesel Kleen + Cetane Boost* should be added at this time to control bacterial growth and to condition the fuel. Care should be taken that the additives used are compatible with the primary fuel filter/water separator used in the system. Change the element in your primary filter and clean the separator sediment bowl.

Change the fuel filter elements on the engine and bleed the fuel system, as needed. Start the engine and allow it to run for 5 – 10 minutes to make sure no air is left in the fuel system. Check for any leaks that may have been created in the fuel system during this servicing, correcting them as needed. Operating the engine for 5 – 10 minutes will help allow movement of the treated fuel through the injection equipment on the engine.

RAW WATER COOLING CIRCUIT

Close the through-hull seacock. Remove the raw water intake hose from the seacock. Place the end of this hose into a five gallon bucket of clean fresh water. Before starting the engine, check the zinc anode found in the primary heat exchanger on the engine and clean or replace it as required, and also clean any zinc debris from inside the heat exchanger where the zinc anode is located. Clean the raw water strainer.

Start the engine and allow the raw water pump to draw the fresh water through the system. When the bucket is empty, stop the engine and refill the bucket with an antifreeze solution slightly stronger than needed for winter freeze protection in your area.

Start the engine and allow all of this mixture to be drawn through the raw water system. Once the bucket is empty, stop the engine. This antifreeze mixture should protect the raw water circuit from freezing during the winter lay-up, as well as providing corrosion protection.

Remove the impeller from your raw water pump (some antifreeze mixture will accompany it, so catch it in a bucket). Examine the impeller. Acquire a replacement, if needed, and a cover gasket. Do not replace the impeller (into the pump) until recommissioning, but replace the cover and gasket.

INTAKE MANIFOLD AND THRU-HULL EXHAUST

Place a clean cloth, lightly soaked in lubricating oil, in the opening of the intake manifold to block the opening. Do not shove the cloth out of sight. (If it is not visible at recommissioning, and an attempt is made to start the engine, you may need assistance of the servicing dealer). Make a note to remove the cloth prior to start-up. The thru-hull exhaust port can be blocked in the same manner.

LAY-UP & RECOMMISSIONING

Starter Motor

Lubrication and cleaning of the starter drive pinion is advisable, if access to the starter permits its easy removal. Make sure the battery connections are shut off before attempting to remove the starter. Take care in properly replacing any electrical connections removed from the starter.

Cylinder Lubrication [Diesel]

If you anticipate a long lay-up period (12 months or more) WESTERBEKE recommends you coat the engine cylinders with SAE #40 oil. To do this, either remove the glow plug for each cylinder or the fuel injector, which ever is easiest. Squirt a good quantity of oil into each cylinder. Then rotate the engine crankshaft by hand slowly two revolutions. Re-install the glow plugs or injectors. Make sure you have available any sealing washers that may be needed for the injectors return line.

Intake Manifold [Gasoline]

Clean the filter screen in the flame arrester, and place a clean cloth lightly soaked in lube oil around the flame arrester to block any opening. Also place an oil-soaked cloth in the through-hull exhaust port. Make a note to remove cloths prior to start-up!

Cylinder Lubrication [Gasoline]

With the engine running, spray the fogging oil into the open intake, stalling the engine. This will lubricate the valves and cylinders.

NOTE: At spring commissioning, remove and clean the spark plugs and rotate the engine by hand two complete revolutions. Re-install the spark plugs, tighten properly and reconnect the high tension leads fully onto each spark plug.

Batteries

If batteries are to be left on board during the lay-up period, make sure that they are fully charged, and will remain that way, to prevent them from freezing. If there is any doubt that the batteries will not remain fully charged, or that they will be subjected to severe environmental conditions, remove the batteries and store them in a warmer, more compatible environment.

⚠ WARNING: Lead acid batteries emit hydrogen, a highly-explosive gas, which can be ignited by electrical arcing or a lighted cigarette, cigar, or pipe. Do not smoke or allow an open flame near the battery being serviced. Shut off all electrical equipment in the vicinity to prevent electrical arcing during servicing.

Transmission [Propulsion Engine]

Check or change the fluid in the transmission as required. Wipe off grime and grease and touch up any unpainted areas. Protect the coupling and the output flange with an anti-corrosion coating. Check that the transmission vent is open. For additional information, refer to the *TRANSMISSION SECTION*.

Spare Parts

Lay-up time provides a good opportunity to inspect your Westerbeke engine to see if external items such as drive belts or coolant hoses need replacement. Check your basic spares kit and order items not on hand, or replace those items used during the lay-up, such as filters and zinc anodes. Refer to the *SPARE PARTS* section of this manual.

Recommissioning

The recommissioning of your Westerbeke engine after a seasonal lay-up generally follows the same procedures as those described in the *PREPARATIONS FOR STARTING* section regarding preparation for starting and normal starts. However, some of the lay-up procedures will need to be counteracted before starting the engine.

1. Remove the oil-soaked cloths from the intake manifold.
2. Remove the raw water pump cover and gasket and discard the old gasket. Install the raw water pump impeller removed during lay-up (or a replacement, if required). Install the raw water pump cover with a new cover gasket.
3. Reinstall the batteries that were removed during the lay-up, and reconnect the battery cables, making sure the terminals are clean and that the connections are tight. Check to make sure that the batteries are fully charged.

⚠ CAUTION: Wear rubber gloves, a rubber apron, and eye protection when servicing batteries. Lead acid batteries emit hydrogen, a highly explosive gas, which can be ignited by electrical arcing or a lighted cigarette, cigar, or pipe. Do not smoke or allow an open flame near the battery being serviced. Shut off all electrical equipment in the vicinity to prevent electrical arcing during servicing.

4. Remove the spark plugs, wipe clean, re-gap, and install to proper tightness [gasoline].
5. Check the condition of the zinc anode in the raw water circuit and clean or replace the anode as needed. Note that it is not necessary to flush the antifreeze/fresh water solution from the raw water coolant system. When the engine is put into operation, the system will self-flush in a short period of time with no adverse affects. It is advisable, as either an end of season or recommissioning service, to inspect the area where the zinc is located in the heat exchanger and clear any and all zinc debris from that area.
6. Start the engine in accordance with procedures described in the *PREPARATIONS FOR STARTING* section of this manual.

TORQUE SPECIFICATIONS

COMPONENT	FT-LB (M-KG)	COMPONENT	FT-LB (M-KG)
Alternator Bracket	27 - 38 (3.8 - 5.3)	Injection Pump Hollow Screw	
Back Plate	24 - 35 (3.3 - 4.8)	M10 (14)	7.2 - 10.8 (1.0 - 1.5)
Connecting Rod Cap M8 (14)	23 - 28.2 (3.2 - 3.5)	Injectors	36 - 38 (5.0 - 6.0)
Coolant Pump	12 - 17 (1.6 - 2.4)	Intake Manifold	12 - 17 (1.6 - 2.4)
Coolant Pump Pulley.....	12 - 17 (1.6 - 2.4)	Main Bearing Cap	36 - 38 (5.0 - 5.5)
Coolant Temperature Sender	9 - 13 (1.2 - 1.8)	Nozzle Holder (fitting to engine),	
Coolant Temperature Switch.....	9 - 13 (1.2 - 1.8)	M20 (21)	36.1 - 43.3 (5.0 - 6.0)
Crankshaft Pulley Nut, M16 (24) ..	72 - 86 (10 - 12)	Nozzle Retaining Nut,	
*Cylinder Head Bolts (wet)		M16 (21)	25.3 - 28.9 (3.5 - 4.0)
M8 (12) Bolts 1, 2, 3	14 - 21 (2.0 - 3.0)	Nozzle Union Color Fixing Nut,	
M10 (14) Bolts 4 - 11	54 - 61 (7.8 - 8.5)	M12 (17)	18.0 - 21.6 (2.5 - 3.0)
Cylinder Head Cover	2 - 3 (0.3 - 0.45)	Oil Drain Hose Plug M18 (19)	36.1 - 43.3 (5.0 - 6.0)
Engine Mounts	23 - 34 (3.2 - 4.7)	Oil Filter	
Exhaust Manifold.....	20 - 24 (2.7 - 3.3)	M20 (17)	7.9 - 9.4 (1.1 - 1.3)
Fuel Solenoid Locknut		Oil Pan Bolts	12 - 17 (1.6 - 2.3)
M30 (36).....	28.9 - 36.2 (4.0 - 5.0)	Oil Pressure Sender	9 - 13 (1.2 - 1.8)
Flywheel bolt M10 (17)	61 - 68 (8.5 - 9.5)	Oil Pressure Switch.....	9 - 13 (1.2 - 1.8)
Glow Plug, M10 (12).....	11 - 14.5 (1.5 - 2.0)	Oil Relief Plug	28.9 - 36.1 (4.0 - 5.0)
Glow Plug Lead Wire Fitting Nut,		Rear Oil Seal Cap.....	11 - 14 (1.5 - 2.0)
M4 (7)	0.7 - 1.0 (0.1 - 0.15)	Rocker Arm Assembly	11 - 15 (1.5 - 2.2)
Governor Assembly		Rocker Arm Cover.....	1.8 - 2.9 (0.25 - 0.40)
Relief Plunger Assembly	28.9 - 36.2 (4.0 - 5.0)	Rocker Cover Nut, M6 (10)	3.6 - 5.0 (0.5 - 0.7)
Taper Plug.....	11 - 23 (1.5 - 2.2)	Rocker Shaft Hold-down Bolt,	
Idle Gear Thrust Plate	15 - 23 (2.2 - 3.2)	M8 (12)	10.8 - 15.9 (1.5 - 2.2)
Injection Nozzle to Body	25.3 - 36.2 (3.5 - 4.0)	Thermostat Housing	6 - 8 (0.8 - 1.1)
Injection Pipe Flare Nut.....	18 - 22 (2.5 - 3.0)	Timing Gear Case	12 - 17 (1.6 - 2.4)
Injection Pipe Nut, M12 (17)	18 - 25 (2.5 - 3.5)	Torque Spring Set Locknut	6 - 9 (0.8 - 1.2)
Injection Pump Delivery Valve Holder		Water Temperature Gauge Joint	
M16 (17).....	25.3 - 28.2 (3.5 - 3.9)	M16 (17).....	14.4 - 21.6 (4.0 - 5.0)
Injection Pump Drive Gear			
Lock Nut	29 - 51 (4.0 - 7.0)		

NOTE: Hardware listed is metric, with values given as follows:

Flywheel Bolt, M10 (17)

M10 indicates Metric, 10mm thread diameter;

(17) indicates 17mm across the flats of the bolt head.

*(wet) indicates that the bolts (if removed) are to have a thin oil film wiped on them before they are retorqued. If the bolts have not been removed and need only to be retorqued, then no oil is needed.

DECIMAL TO METRIC EQUIVALENT CHART

Fractions of an inch	Decimal (in.)	Metric (mm)	Fractions of an inch	Decimal (in.)	Metric (mm)
1/64	0.015625	0.39688	33/64	0.515625	13.09687
1/32	0.03125	0.79375	17/32	0.53125	13.49375
3/64	0.046875	1.19062	35/64	0.546875	13.89062
1/16	0.0625	1.58750	9/16	0.5625	14.28750
5/64	0.078125	1.98437	37/64	0.578125	14.68437
3/32	0.09375	2.38125	19/32	0.59375	15.08125
7/64	0.109375	2.77812	39/64	0.609375	15.47812
1/8	0.125	3.175	5/8	0.625	15.87500
9/64	0.140625	3.57187	41/64	0.640625	16.27187
5/32	0.15625	3.96875	21/32	0.65625	16.66875
11/64	0.171875	4.36562	43/64	0.671875	17.06562
3/16	0.1875	4.76250	11/16	0.6875	17.46250
13/64	0.203125	5.15937	45/64	0.703125	17.85937
7/32	0.21875	5.55625	23/32	0.71875	18.25625
15/64	0.234375	5.95312	47/64	0.734375	18.65312
1/4	0.250	6.35000	3/4	0.750	19.05000
17/64	0.265625	6.74687	49/64	0.765625	19.44687
9/32	0.28125	7.14375	25/32	0.78125	19.84375
19/64	0.296875	7.54062	51/64	0.796875	20.24062
5/16	0.3125	7.93750	13/16	0.8125	20.63750
21/64	0.328125	8.33437	53/64	0.828125	21.03437
11/32	0.34375	8.73125	27/32	0.84375	21.43125
23/64	0.359375	9.12812	55/64	0.859375	21.82812
3/8	0.375	9.52500	7/8	0.875	22.22500
25/64	0.390625	9.92187	57/64	0.890625	22.62187
13/32	0.40625	10.31875	29/32	0.90625	23.01875
27/64	0.421875	10.71562	59/64	0.921875	23.41562
7/16	0.4375	11.11250	15/16	0.9375	23.81250
29/64	0.453125	11.50937	61/64	0.953125	24.20937
15/32	0.46875	11.90625	31/32	0.96875	24.60625
31/64	0.484375	12.30312	63/64	0.984375	25.00312
1/2	0.500	12.70000	1	1.00	25.40000

STANDARD AND METRIC CONVERSION DATA

LENGTH-DISTANCE

Inches (in) x 25.4 = Millimeters (mm) x .0394 = Inches
Feet (ft) x .305 = Meters (m) x 3.281 = Feet
Miles x 1.609 = Kilometers (km) x .0621 = Miles

VOLUME

Cubic Inches (in³) x 16.387 = Cubic Centimeters x .061 = in³
Imperial Pints (IMP pt) x .568 = Liters (L) x 1.76 = IMP pt
Imperial Quarts (IMP qt) x 1.137 = Liters (L) x .88 = IMP qt
Imperial Gallons (IMP gal) x 4.546 = Liters (L) x .22 = IMP gal
Imperial Quarts (IMP qt) x 1.201 = US Quarts (US qt) x .833 = IMP qt
Imperial Gallons (IMP gal) x 1.201 = US Gallons (US gal) x .833 = IMP gal
Fluid Ounces x 29.573 = Milliliters x .034 = Ounces
US Pints (US pt) x .473 = Liters (L) x 2.113 = Pints
US Quarts (US qt) x .946 = Liters (L) x 1.057 = Quarts
US Gallons (US gal) x 3.785 = Liters (L) x .264 = Gallons

MASS-WEIGHT

Ounces (oz) x 28.35 = Grams (g) x .035 = Ounces
Pounds (lb) x .454 = Kilograms (kg) x 2.205 = Pounds

PRESSURE

Pounds Per Sq In (psi) x 6.895 = Kilopascals (kPa) x .145 = psi
Inches of Mercury (Hg) x .4912 = psi x 2.036 = Hg
Inches of Mercury (Hg) x 3.377 = Kilopascals (kPa) x .2961 = Hg
Inches of Water (H₂O) x .07355 = Inches of Mercury x 13.783 = H₂O
Inches of Water (H₂O) x .03613 = psi x 27.684 = H₂O
Inches of Water (H₂O) x .248 = Kilopascals (kPa) x 4.026 = H₂O

TORQUE

Pounds-Force Inches (in-lb) x .113 = Newton Meters (Nm) x 8.85 = in-lb
Pounds-Force Feet (ft-lb) x 1.356 = Newton Meters (Nm) x .738 = ft-lb

VELOCITY

Miles Per Hour (MPH) x 1.609 = Kilometers Per Hour (KPH) x .621 = MPH

POWER

Horsepower (Hp) x .745 = Kilowatts (Kw) x 1.34 = MPH

FUEL CONSUMPTION

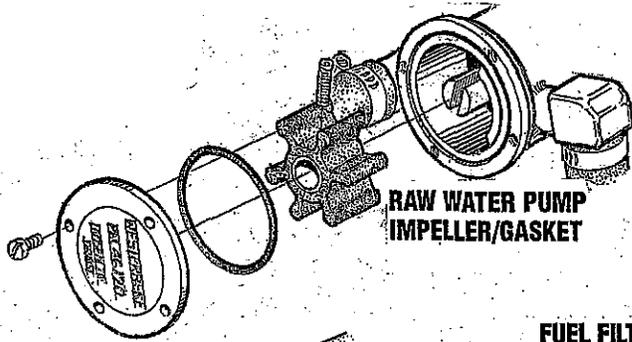
Miles Per Hour IMP (MPG) x .354 = Kilometers Per Liter (Km/L)
Kilometers Per Liter (Km/L) x 2.352 = IMP MPG
Miles Per Gallons US (MPG) x .425 = Kilometers Per Liter (Km/L)
Kilometers Per Liter (Km/L) x 2.352 = US MPG

TEMPERATURE

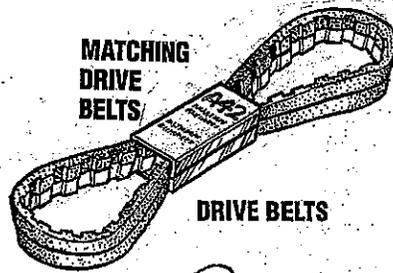
Degree Fahrenheit (°F) = (°C X 1.8) + 32
Degree Celsius (°C) = (°F - 32) x .56

SUGGESTED SPARE PARTS

Carry Only Genuine Westerbeke Spare Parts

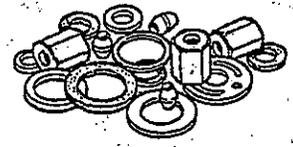


RAW WATER PUMP
IMPELLER/GASKET



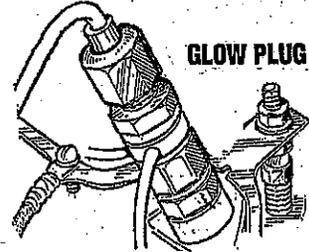
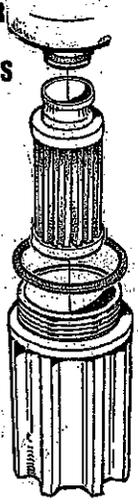
MATCHING
DRIVE
BELTS

DRIVE BELTS



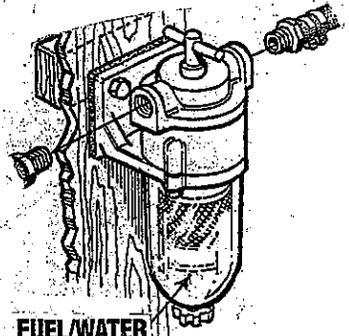
HARDWARE KIT

FUEL FILTER
CARTRIDGE
AND O-RINGS



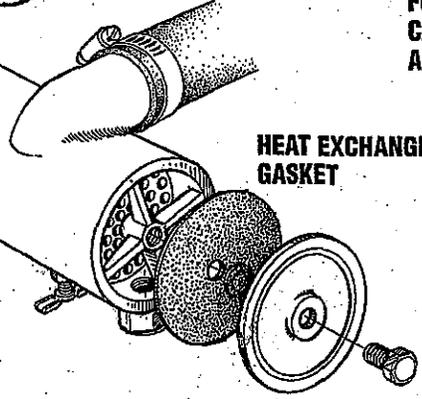
GLOW PLUG

INJECTOR



FUEL/WATER
FILTERS

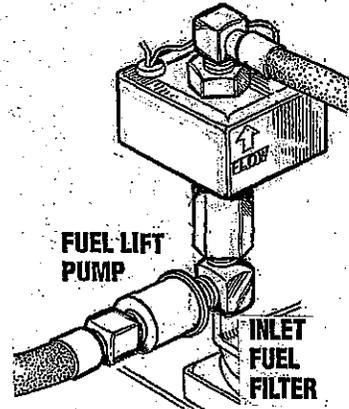
HEAT EXCHANGER
GASKET



ZINC
ANODE

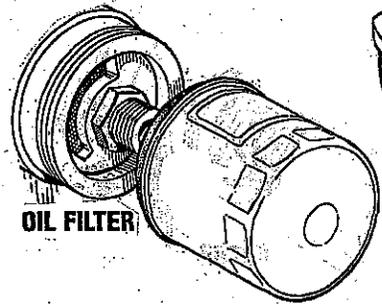


GASKET &
THERMOSTAT



FUEL-LIFT
PUMP

INLET
FUEL
FILTER



OIL FILTER



MOLDED
HOSE KIT
IN A CANVAS
CARRYING BAG



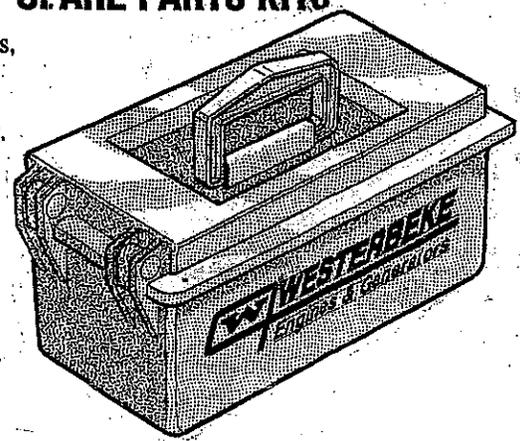
WESTERBEKE RECOMMENDS CARRYING ENOUGH SPARE ENGINE OIL (YOUR BRAND) FOR AN OIL CHANGE (5 QTS.) AND A GALLON OF PREMIXED COOLANT.

SPARE PARTS KITS

WESTERBEKE also offers two Spare Parts Kits, each packaged in a rugged hinged toolbox. Kit "A" includes the basic spares. Kit "B" is for more extensive off-shore cruising.

A Kit

- Impeller Kit
- Heat Exchanger Gasket
- Fuel Filter with Gasket
- Oil Filter
- Drive Belt
- Zinc Anodes



B Kit

- Impeller Kit
- Water Pump Repair Kit
- Thermostat Kit
- Zinc Anodes
- Complete Gasket Kit
- Heat Exchanger Gasket
- Injector
- Fuel Filter with Gasket
- Oil Filter
- Drive Belt



