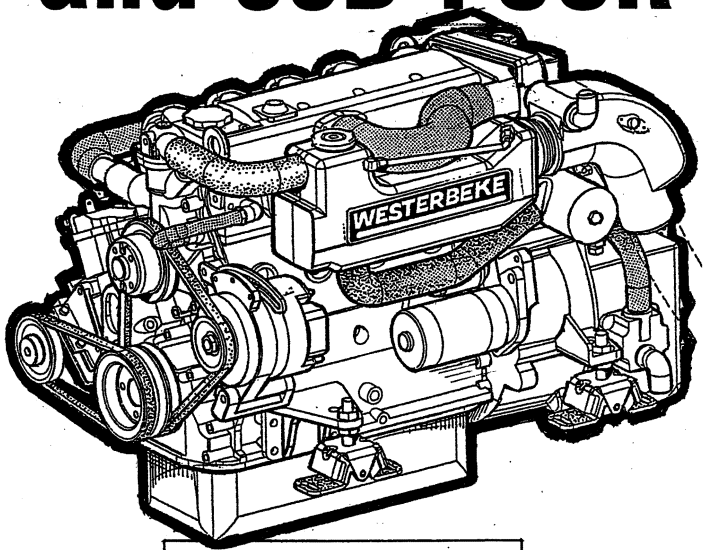
OPERATORS MANUAL
MARINE DIESEL ENGINES

55B-FOUR 55C-FOUR and 55D-FOUR



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WESTERBEKE

member NMMA

WESTERBEKE CORPORATION • 150 JOHN HANCOCK ROAD
MYLES STANDISH INDUSTRIAL PARK • TAUNTON MA 02780
WEBSITE: WWW.WESTERBEKE.COM

CALIFORNIA PROPOSITION 65 WARNING

Exhaust gas from diesel and gasoline engines (and some of its constituents) are known to the State of California to cause cancer, birth defects, and other reproductive harm.

⚠ 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.

WESTERBEKE
Engines & Generators

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. 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.

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 fuel injector, 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 lines or fuel filters.
- 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 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 vessel's hatches closed when fueling. Open and ventilate the cabin after fueling. Check below for fumes/vapor before running the blower. Run the blower per 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 while it 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!***

- To prevent accidential starting of the propulsion engine when servicing, turn the battery selector switch to the OFF position.
- 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 disconnecting 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 manifolds are securely attached and no warping exists. Pay close attention to the manifold, water injection elbow, and exhaust pipe nipple.
- In addition to routine inspection of the exhaust system, install a **carbon monoxide detector**. Consult your boat builder or dealer for installation of approved detectors.
- For additional information, refer to ABYC H-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

  Dizziness

  Throbbing in temples

  Muscular twitching

  Intense headache

  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

- Do not wear loose clothing or jewelry when servicing equipment; avoid wearing loose jackets, shirts, sleeves, rings, necklaces or bracelets that could be caught in moving parts.
- Make sure all attaching hardware is properly tightened. Keep protective shields and guards in their respective places at all times.
- Do not check fluid levels or the drive belt's tension while the engine is operating.
- Stay clear of the drive shaft and the transmission coupling when the engine is running; hair and clothing can easily be caught in these rotating parts.

HAZARDOUS NOISE

⚠ WARNING: ***High noise levels can cause hearing loss!***

- Never operate an engine without its muffler installed.
- Do not run an engine with the air intake (silencer) removed.

⚠ WARNING: ***Do not work on machinery when you are mentally or physically incapacitated by fatigue!***

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 an engine should begin with a thorough examination of the American Boat and Yacht Council's (ABYC) standards. These standards are a combination of sources including the USCG and the NFPA.

Sections of the ABYC standards of particular interest are:

H-32 Ventilation for boats using diesel fuel
H-33 Diesel Fuel Systems
P-1 Installatiion of Exhaust Systems for Propulsion and Auxilliary Engines
P-4 Marine Inboard Engines and Transmissions
E-11 AC & DC Electrical Systems on Boats
TA Batteries and Battery Chargers

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

ABYC, NFPA AND USCG PUBLICATIONS FOR INSTALLING MARINE ENGINES AND GENERATORS

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
613 Third Dtreet, Suite 10
Annapolis, MD 21403
(410) 990-4460
www.abycinc.org

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

Order From:

NFPA
1 Batterymarch Park
P.O. Box 9101
Quincy, MA 02269-9101

USCG (United States Coast Guard)
"CFR 33 AND CFR46"
Code of Federal Regulations

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

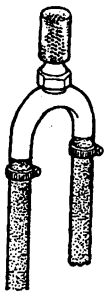
Strict federal regulations, ABYC guidelines, and safety codes must be complied with when installing engines and generators in a marine environment.

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/water injected exhaust elbow is near or below the loaded water line of the vessel will result in raw water damage to the engine and possible flooding of the vessel.***

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

SIPHON-BREAK WITH STAINLESS LOOP FOR 1" HOSE
PART NO. 044010

EXHAUST SYSTEM

The exhaust system's hose MUST be certified for marine use. Corrugated Marine Exhaust Hose is recommended. The use of this type of hose allows for extreme bends and turns without the need of additiinal fitting and clamps to accomplish these bends and turns .In this regard, a single length of corrugated exhaust hose can be used. The system MUST be designed to prevent the entry of water into the exhaust system under any sea conditions and at any angle of vessels heal.

A detailed Marine Installation Manual covering gasoline and diesel engines and generators is supplied with every unit sold. This manual is also available in pdf format on our website to download

Website: www.westerbeke.com

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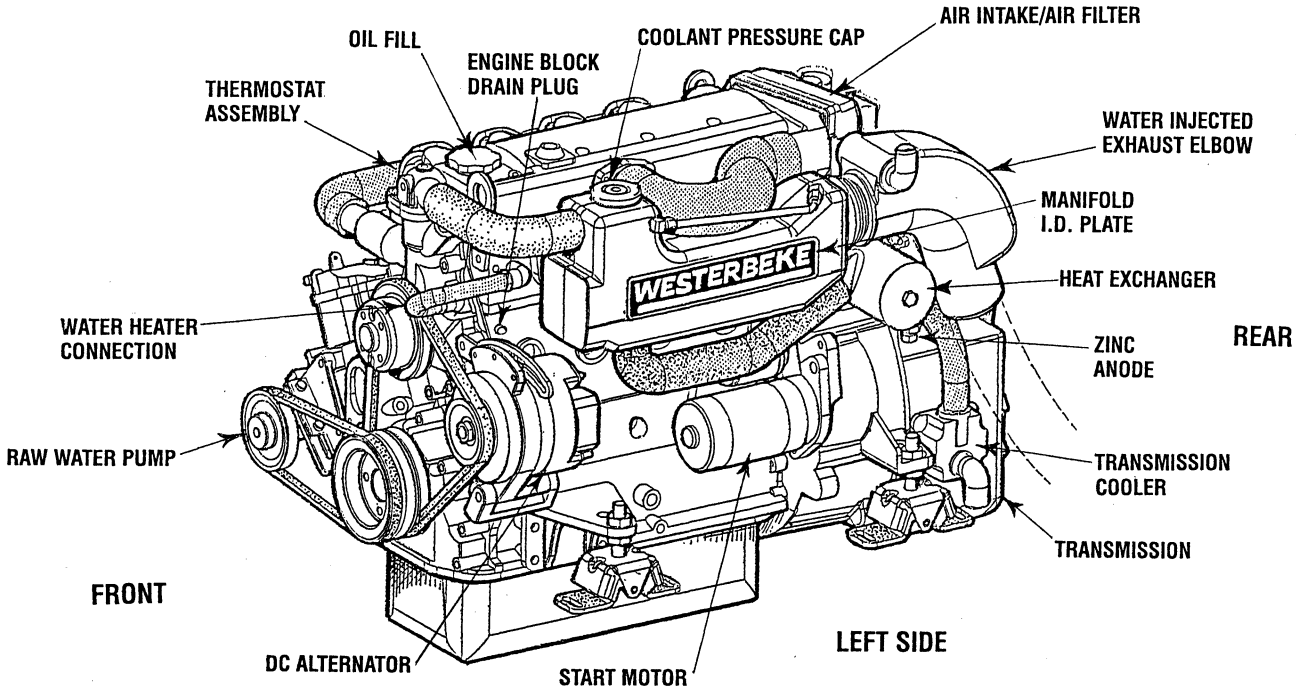
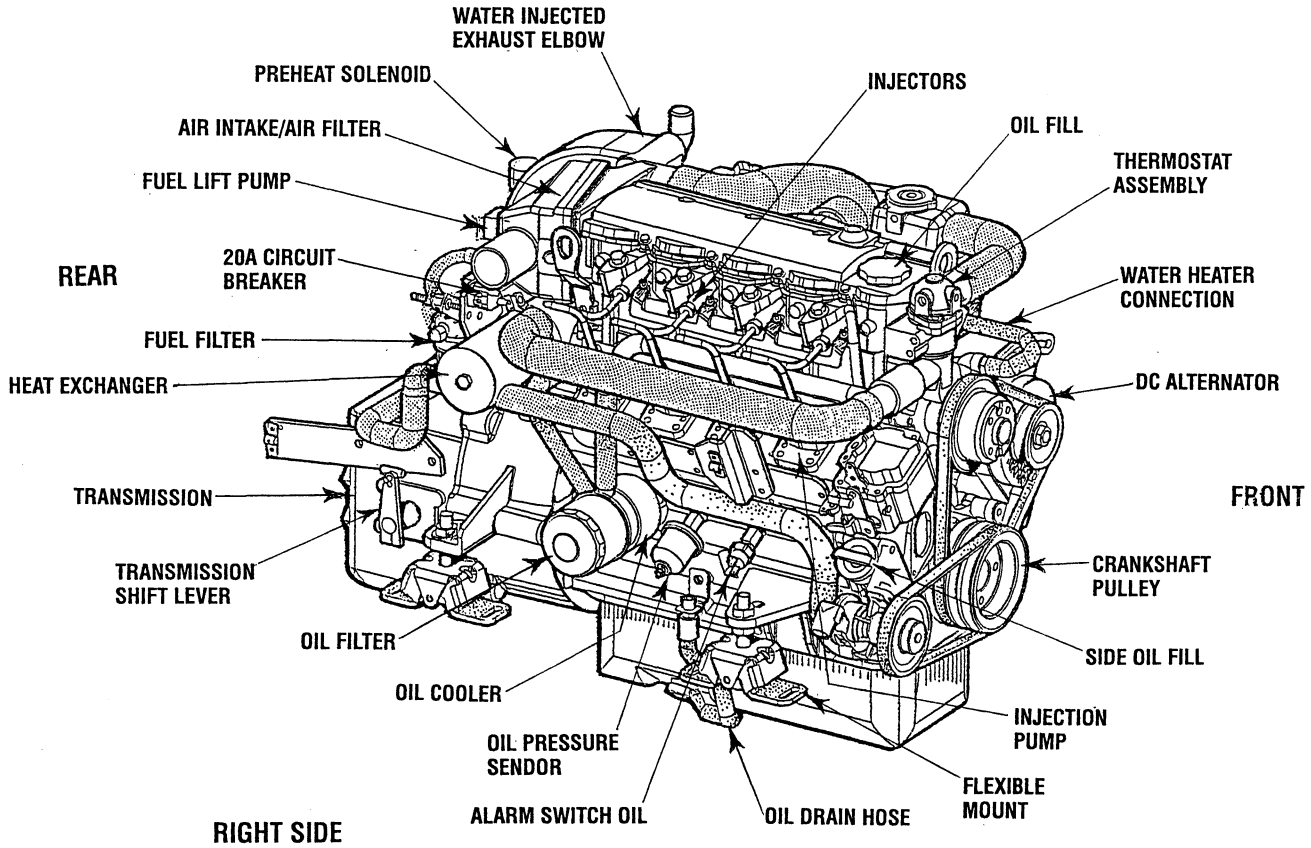
PARTS IDENTIFICATION





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 engine, 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 Drawing is also provided and a Service Manual is available from your WESTERBEKE dealer. If you are planning to install this equipment yourself, 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 engine's serial number and commission date.

Customer Identification Card

WESTERBEKE

Customer Identification
MR. ENGINE OWNER _____
MAIN STREET _____
HOMETOWN, USA _____
Model _____ Ser. #_____
Expires _____

PRODUCT SOFTWARE

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

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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 number and serial number are located on a nameplate mounted on the side of the engine's manifold. The engine's serial number can also be found stamped into the engine block on the flat surface of the block just forward of the number one cylinders injection pump. Take the time to enter this information on the illustration of the nameplate shown below, as this will provide a quick reference when seeking technical information and/or ordering repair parts.

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 type 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 contaminant's (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 nameplate 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.

RAW WATER COOLING SYSTEM

Siphon-Break

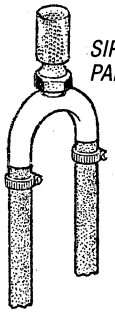
For installations where the water injected exhaust elbow is close to or will be below the vessels waterline, provisions **must** be made to install a siphon-break in the raw water supply hose to the water injected exhaust elbow. The siphon-break provides an air vent in the raw water cooling system to prevent raw water from filling the exhaust system and the engine's cylinders when the engine is shutdown.

> ⚠ **CAUTION:** ***Failure to use a siphon-break when the exhaust manifold injection port is at or below the load 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 vessels waterline under the vessels various operating conditions, ***install a siphon-break.*** This precaution is necessary to protect your engine.

The siphon-break must be installed in the highest point of a hose that is looped a minimum of 20 inches (51cm) above the vessels waterline. This siphon-break **must always** be above the waterline during all angles of vessel operation to prevent siphoning.

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.*



SIPHON-BREAK
PART NO. 033327

SIPHON-BREAK WITH STAINLESS LOOP FOR 1" HOSE
PART NO. 044010

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.

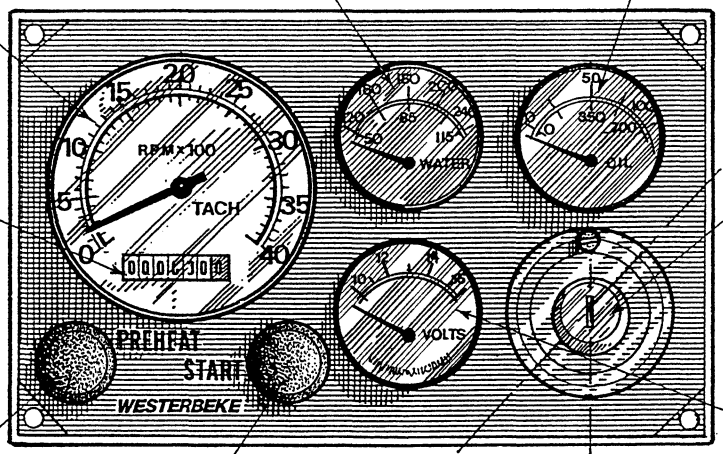
When the engine is shut down with the key switch turned off, the water temperature gauge will continue to register the last temperature reading indicated by the gauge before electrical power was turned ***off***. The oil pressure gauge will fall to zero when the key switch is turned ***off***. The temperature 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: TURN THE KEY SWITCH ON. SUPPLIES DC POWER TO THE INSTRUMENT CLUSTER IN THE PANEL. POWER TO THE PREHEAT BUTTON. DC POWER TO THE EXC TERMINAL ON THE DC ALTERNATOR. DC POWER TO THE ALARM BUZZER AND IT WILL EMIT A PULSING SOUND. DC POWER TO THE FUEL SHUT-OFF SOLENOID ENERGIZING IT TO ALLOW FUEL DELIVERY TO THE INJECTORS.

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

PREHEAT BUTTON: WHEN DEPRESSED, IT SUPPLIES DC POWER TO THE START BUTTON. ENERGIZES THE PREHEAT SOLENOID TO SEND DC POWER TO THE GLOW PLUGS, FUEL PUMP AND ALARM BUZZER **P** TERMINAL.

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.

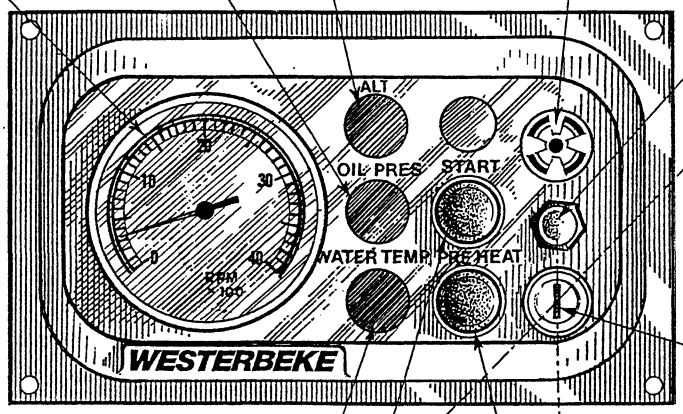
The panel also includes an alarm buzzer for low OIL PRESSURE or high COOLANT TEMPERATURE. The RPM gauge is illuminated when the KEY switch is turned **on** and remains illuminated while the engine is in operation.

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.

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

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: TURN THE KEY SWITCH ON. SUPPLIES DC POWER TO THE INSTRUMENT CLUSTER IN THE PANEL. POWER TO THE PREHEAT BUTTON. DC POWER TO THE EXC TERMINAL ON THE DC ALTERNATOR. DC POWER TO THE ALARM BUZZER AND IT WILL EMIT A PULSING SOUND. DC POWER TO THE FUEL SHUT-OFF SOLENOID ENERGIZING IT TO ALLOW FUEL DELIVERY TO THE INJECTORS.

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 DEPRESSED, IT SUPPLIES DC POWER TO THE START BUTTON. ENERGIZES THE PREHEAT SOLENOID TO SEND DC POWER TO THE GLOW PLUGS, FUEL PUMP AND ALARM BUZZER **P** TERMINAL.

DIESEL FUEL, ENGINE OIL AND ENGINE COOLANT

DIESEL FUEL

Use a diesel fuel that meets the requirements of No. 2-D SAE J 313 and has a Cetane rating of #45 or higher grade of diesel fuel according to ASTM D975.

Care Of The Fuel Supply

Use only clean diesel fuel! The clearance of the components in your engines fuel injection pump is very critical; invisible dirt particles which might pass through the primary and secondary filters can damage these finely machined 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. The use of additives to combat BACTERIAL growth on the fuel tank is recommended such as Bio-Bor and an additive such as Diesel Kleen + Centane Boost to help restore lubricity back into the diesel fuel when an Ultra Low Sulfur diesel is being used.

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. A 10 micron filter element is recommended.

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 engine 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 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 listed in the **MAINTENANCE SCHEDULE** section of this manual and not be extended if synthetic oils are used.

NOTE: *The information above supersedes all previous statements regarding synthetic oil.*

SAE OIL VISCOSITY GRADE

For all temperature ranges: SAE 15W-40 or SAE 10W-40.

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.

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

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 deom one to another-flush the engine thoroughly.

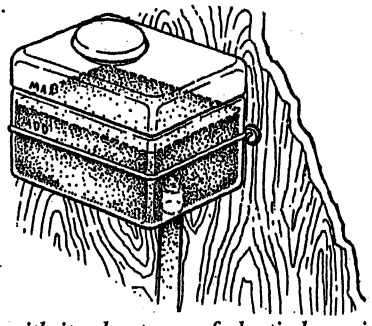
Premixed Antifreeze for Diesel Engines:
Specifications ASTM D53456
Prestone pre-mixed is a well known brand and is recommended.

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

The coolant recovery allows for the expansion and contraction of the engines 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 exhaust manifold.*

PREPARATIONS FOR INITIAL START-UP

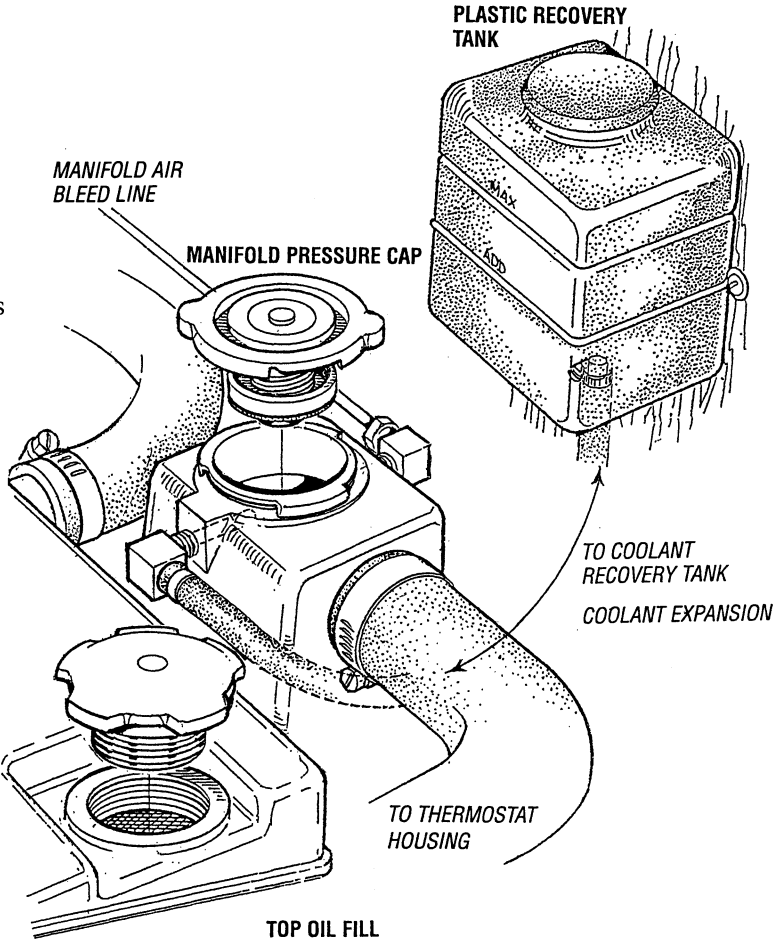
PRESTART INSPECTION

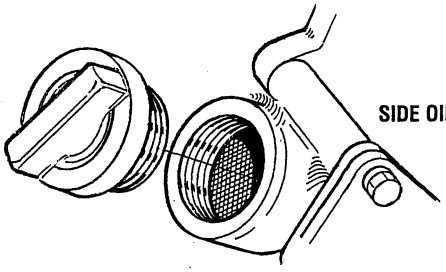
Before starting your engine for the first time or after a prolonged layoff, check the following items:

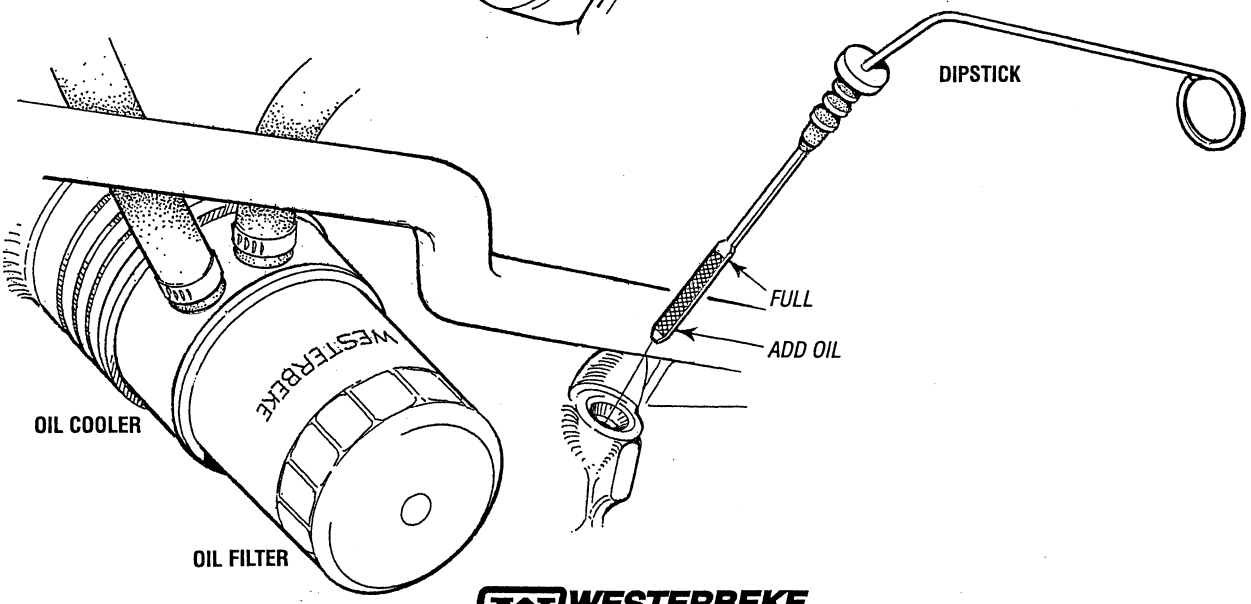
- ☐ Check the engine oil level. Add oil to maintain the level at the high mark on the dipstick.
- ☐ Turn on the fuel supply, then check the fuel supply and examine the fuel filter/water separator bowl for contaminants.
- ☐ Check the transmission fluid level.
- ☐ Check the DC electrical system. Inspect 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

STARTING PROCEDURE

1. Place the transmission in neutral and advance the throttle control to slightly open.
2. Turn the KEY SWITCH to the ON position (2 o'clock). (If the panel is energized, the gauges are on.)
3. Depress the PREHEAT BUTTON, and hold for 5 - 10 seconds.
4. Continue to hold the PREHEAT BUTTON and depress the START BUTTON.
5. Release the START BUTTON and PREHEAT BUTTON once the engine starts.
6. With the engine running, check the instruments for proper oil pressure and battery charging voltage. The water temperature will rise slowly and then stabilize when the thermostat opens.

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.

Temperature/Preheat

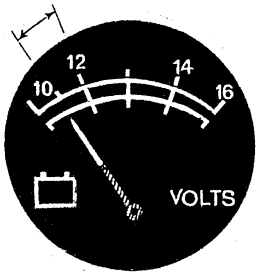
Atmospheric Temperature	Preheating Time
41°F(5°C) or higher	Approx. 10 seconds
41°F(5°C) to 23°F (–5°C)	Approx. 15 seconds
23°F(–5°C) or lower	Approx. 20 seconds
Limit of continuous use	30 seconds before cranking

NOTE: *The START button will not energize unless the PREHEAT button is depressed. Depressing the PREHEAT button activates the glow plugs in the cylinder head so use the PREHEAT intermittently to avoid overheating the glow plugs..*

Starting Under Cold Conditions

Make certain the lubricating oil is appropriate for the prevailing temperature. Use oil as specified in the SPECIFICATIONS section of this manual.

NOTE: *When starting: A voltage drop will occur when the preheat button 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 as some engines have a neutral safety switch to prevent starting in gear.

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

⚠ 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 shutoff, 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.***

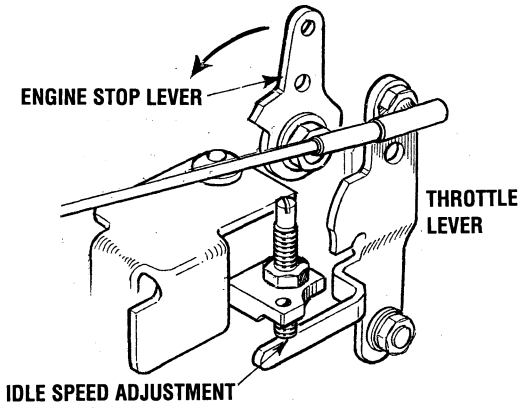
STOPPING PROCEDURE

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 temperatures, then shut the engine down by turning off the key switch.

NOTE: *Make certain this key switch is in the OFF position (12 o'clock). If the key switch is left ON, the alarm will sound, warning you the key is in the ON position.*

FAILURE TO STOP

In the unusual situation that the key switch fails to turn the engine off, shutdown can be accomplished by pressing back the mechanical stop lever. This stop lever is located next to the throttle lever on the engine.



NOTE: *Once the engine is shutdown, investigate why the key switch failed to properly shutdown the engine when turned in the off position.*

WARNING LIGHTS, ALARMS & CIRCUIT BREAKER

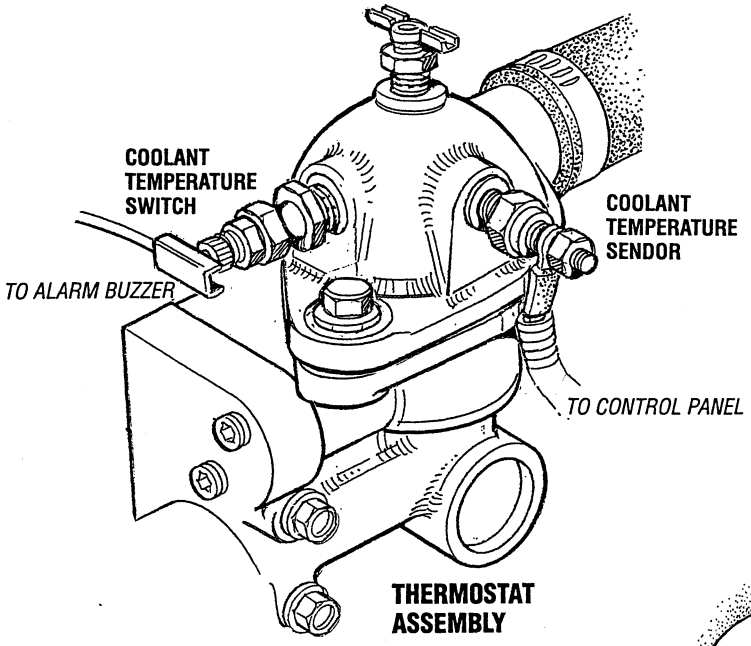
ALTERNATOR WARNINGS

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.

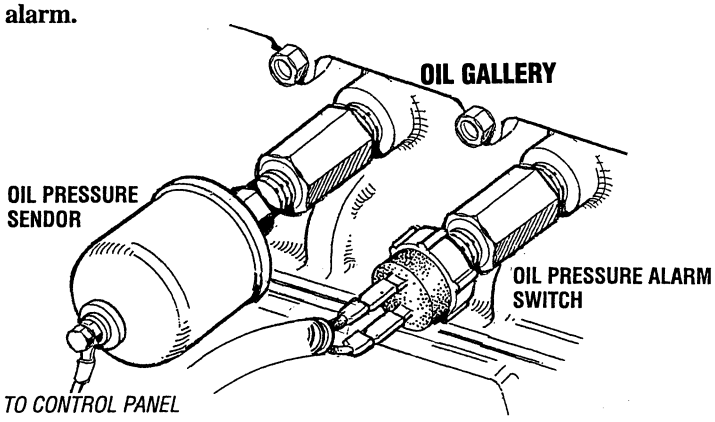
COOLANT TEMPERATURE SWITCH

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).



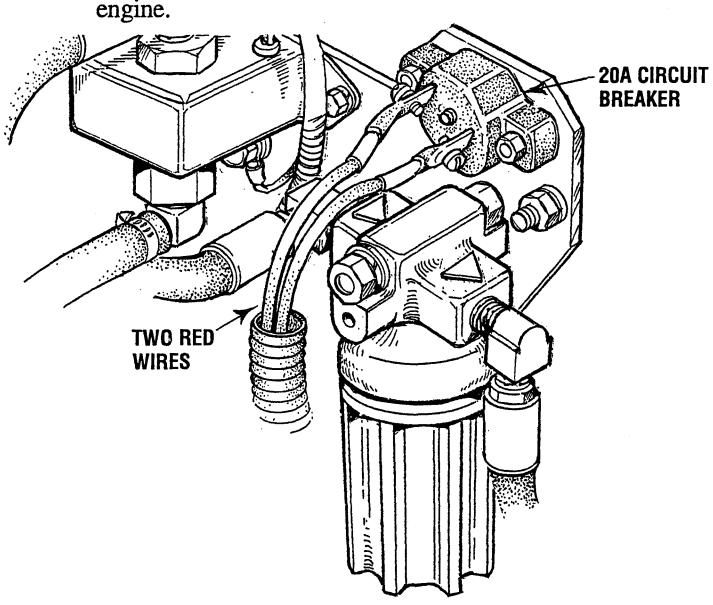
LOW OIL PRESSURE ALARM SWITCH

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.**



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 most engines will shut down because the opened breaker disconnects the fuel supply. If this should occur, check and repair the source of the problem. After repairing the fault, reset the breaker and restart the engine.



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.

RECOMMENDED RPM RANGES

Cruise RPM

Models 55B/Four and 55C/Four	2000-2500 rpm
Model 55D/Four	1800 - 2200 rpm

Maximum RPM (propeller loaded)

Models 55B/Four and 55C/Four	2950-3000 rpm
Model 55D/Four	2550-2600 rpm

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.*

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).
- ☐ Visually inspect the raw water pump for leakage.

STARTING THE ENGINE

NOTE: *See STARTING/STOPPING PROCEDURE in this manual for more detailed instructions.*

1. Put the transmission in neutral, throttle advanced.

   NOTE: *Hydraulically operated transmissions have a neutral safety switch through which the starter solenoid energizing circuit passes. This switch is open when the transmission is in gear so the starter solenoid will not energize.*

2. Turn the KEY SWITCH to the ON position (2 o'clock). (If the panel is energized, the gauges are on.)
3. Depress the PREHEAT BUTTON, and hold for 5 - 10 seconds.
4. Continue to hold the PREHEAT BUTTON and depress the START BUTTON.
5. Release the START BUTTON and PREHEAT BUTTON once the engine starts.
6. With the engine running, check the instruments for proper oil pressure and battery charging voltage. The water temperature will rise slowly and then stabilize when the thermostat opens.

   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.

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 as some engines have a neutral safety switch to prevent starting in gear.

Never run the starter 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 sytem fills. Prevent this from happening by closing the raw water supply through-hull shutoff, 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 Procedure

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 temperatures. Then shut the engine down by turning off the key switch.

NOTE: Make certain the key switch is in the OFF position(12 o'clock). If the key is left ON, the alarm will sound signaling the operate it has been left ON.

MAINTENANCE SCHEDULE

⚠ 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. When servicing/replacing DC components, ensure the key switch in the instrument panel is in the OFF position or turn OFF the DC starting battery.***

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

INSPECTION AND PREPARATION FOR INITIAL START-UP (Also refer to the PREPARATIONS for START-UP in this manual)

Coolant Level	Check at recovery tank, if empty, check at manifold. Add coolant if needed.
Engine Oil Level	Oil level should indicate between MAX and LOW on dipstick. Do not overfill!
Fuel/Water Separator (owner installed)	The fuel in the filter should be clean and the valves open. Replace filter every 250 operating hours or once a year.
Fuel Supply	Fuel tank must have the proper amount of clean diesel fuel and the fuel valve must be open.
***Visual Inspection of Engine**	Check for fuel, oil and water and exhaust leaks. Check that the water injected exhaust elbow securing v-clamp is tight. No exhaust leaks around the elbow. Inspect wiring and electrical connections. Look for loose bolts/hardware and hardware.
Transmission Fluid Level	Fluid level should be at the top mark on the dipstick.
Drive Belts	Inspect for proper tension (3/8" to 1/2" deflection) and adjust if needed.

ENGINE'S TRANSMISSION IS POSITIONED IN NEUTRAL.

AFTER THE FIRST 50 HOURS OF OPERATION

***Inlet Fuel Filter**	Initial change, then every 250 hours or once a year.
***Fuel Filter and "O" Rings**	Initial change, then every 250 hours or once a year.
Engine Oil and Filter	Initial engine oil and filter change at 50 hours, then change both every 250 hours.
***Exhaust System**	Initial check at 50 hours, then every 250 hours or once a year. Carefully inspect for leaks. Check that the exhaust hoses are properly attached and that the securing clamps are tight. Check for integrity/mounting security of the water injected exhaust elbow.
Engines Idle Speed	Engine should idle at 950 to 1000 rpm. Adjust if necessary.
Transmission Fluid	Initial change, then at 300 hours or once a season.
Heat Exchanger	Open end caps and clean out debris. Change zinc anode if necessary.

EVERY 50 OPERATING HOURS OR MONTHLY

***Drive Belts (Fresh Water/Raw Water Pumps)**	Inspect for proper tension (3/8" to 1/2" deflection) and adjust if needed. Check belt for slipping, cracking and wear. Adjust tension or replace as needed. Replace cover.
Starting Batteries	Check electrolyte levels Make sure cables and connections are in good order. Clean off corrosion if needed. Apply petroleum jelly to terminals for corrosion protection.
Electric Fuel Pump	Inspect for leaks, ensure fuel and electrical connections are clean and tight.
Raw Water Pump	Inspect impeller and check the shaft and security of the pulley. Inspect that there is no water seal leak.

EVERY 100 OPERATING HOURS OR YEARLY

Air Intake Filter	Remove and clean filter, replace if contaminated.
Heat Exchanger	Inspect and clean zinc anode. Note the condition, then determine your own schedule. If zinc needs replacing, you should remove the end cap and clean out the debris. Replace zinc if necessary.
Key Switch	Lubricate with "lockeze".
***Drive Belts (Fresh Water/Raw Water Pumps)**	Inspect for proper tension (3/8" to 1/2" deflection) and adjust if needed. Check belt for slipping, cracking and wear. Adjust tension or replace as needed. Replace cover.
Starting Batteries	Check electrolyte levels Make sure cables and connections are in good order. Clean off corrosion if needed. Apply petroleum jelly to terminals for corrosion protection.
Electric Fuel Pump	Inspect for leaks, ensure fuel and electrical connections are clean and tight.
Raw Water Pump	Inspect impeller and check the shaft and security of the pulley. Inspect that there is no water seal leak.

NOTE: *Keep the engine surface clean. Dirt and oil will inhibit the engine's ability to remain cool.*

MAINTENANCE SCHEDULE

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

EVERY 250 OPERATING HOURS OR YEARLY

Transmission	Change fluid at 300 operating hours. Lubricate control cable and check attachment.
Engine Oil	Change engine oil and oil filter (always together).
Fuel Filter and "O" Rings	Remove and replace fuel filter and all sealing "O" rings.
Inlet Fuel Valve	Remove and replace inlet fuel valve.
Air Intake Filter	Remove and clean, replace if contaminated.
DC Alternator	Check mounting bracket, tighten electrical connections.
Electric Fuel Pump	Inspect for leaks, ensure fuel and electrical connections are clean and tight.
***Vibration Isolators/Engine Mounts**	Check vibration isolators, brackets and mounting hardware. Replace as needed.
Heat Exchanger	Inspect zinc anode, replace if necessary.
***Exhaust Elbow/Exhaust System**	Check the structual integrity of the water injected exhaust elbow casting. Check the integrity of the exhaust system attached to the elbow. All hose connections should be secure. No chaffing. No exhaust leaks. Hoses and muffler are in good serviceable condition. **NOTE:** *An exhaust leak will cause exposure to diesel exhaust!*

EVERY 500 OPERATING HOURS OR YEARLY

***Fuel Injectors**	Check and adjust injection opening pressure and spray conditions.
Coolant System	Drain, flush and re-fill the cooling system with appropriate antifreeze mix. Replace the thermostat and cooling pressure cap
***Valve Clearances**	Adjust valves. (Incorrect valve clearance will result in poor engine performance.)
***Starter Motor**	Check solenoid and motor for corrosion. Remove and lubricate. Clean and lubricate the starter motor pinion drive
Raw Water Pump	Remove from engine, remove cover and inspect cam and wear plates. Replace any components showing wear. If needed, replace the impeller and gasket. Lubricate when reassembling.
***Preheat Circuit**	Check operation of the pre-heat. Remove and clean the glow plugs. Re-install with anti-seize compound on threads.
***Engine/Shaft Alignment**	Check security of the shaft coupling and check shaft alignment.

EVERY 1000 OPERATING HOURS OR OR EVERY FIVE YEARS

***Heat Exchanger**	Remove the heat exchanger for professional cleaning and pressure testing. Change the antifreeze and flush the system.
***Engine Cylinder Compression Test**	Check compression pressure
***Adjusting the Valve Clearances**	Adjust the valves.
***Positive Crankcase Ventilation Valve**	Disassemble and clean. Replace as needed (PN. 047448).
***Fuel Injectors**	Pressure test injectors / re-build at 1500 hours.
***Transmission Oil Cooler**	Remove and have professionally tested and cleaned.
***Starter Motor**	Remove, clean and lubricate the drive.
***Transmission Damper Plate**	Inspect the damper plate, replace if necessary (damper plate chatter at idle speed is an indication of damper spring wear).

⚠ **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. When servicing/replacing DC components, ensure the key switch in the instrument panel is in the OFF position or turn OFF the DC starting battery.***

NOTE: *Keep the engine surface clean. Dirt and oil will inhibit the engine's ability to remain cool.*

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

FUEL SYSTEM

DIESEL FUEL

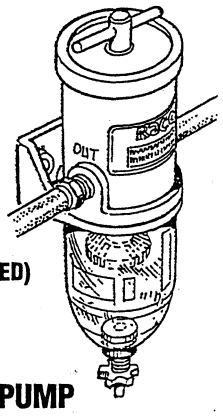
Use a diesel fuel that meets the requirements of No. 2-D SAE J 313 and has a Cetane rating of #45 or higher grade of diesel fuel according to ASTM D975.

FUEL FILTER/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 contaminant's from the fuel before they can be carried to the fuel system on the engine.

Most installers include a fuel filter/water separator with the installation package as they are aware of the problems that contaminant's in the fuel can cause.

A typical fuel filter/water separator is illustrated below. This is the *Raycor Model 500 MA*. Keep in mind that if a water separator type filter is not installed between the fuel supply tank and engine-mounted fuel system, any water in the fuel will affect the fuel pump, engine filter, and injection equipment. 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.



TYPICAL FUEL FILTER (OWNER INSTALLED)

FUEL INJECTION PUMP

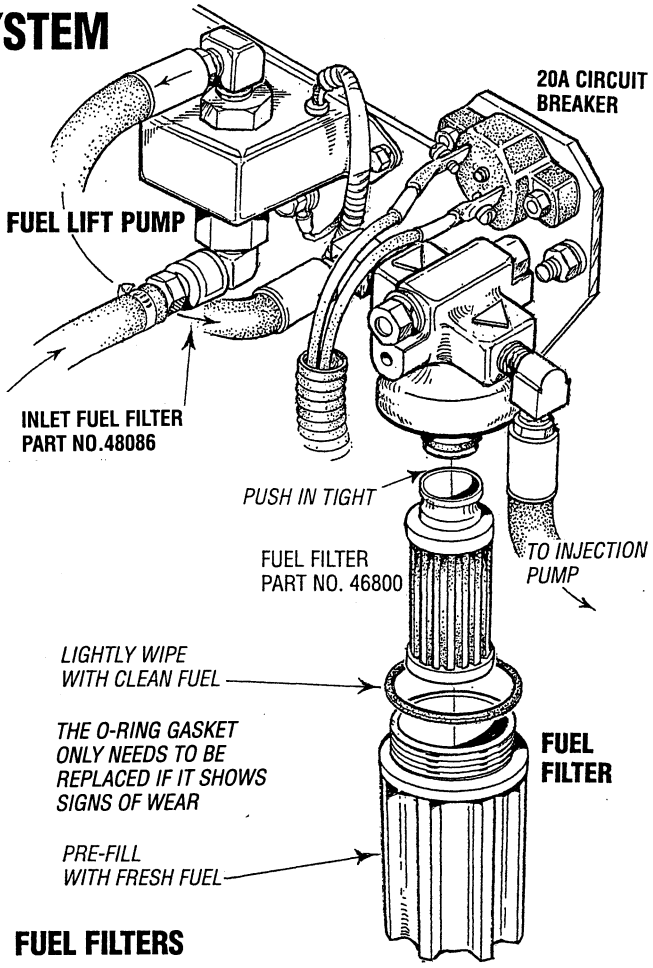
The fuel injection pump is a very important component of the diesel engine, requiring the utmost care in handling. The fuel injection pump has been thoroughly bench-tested and the owner-operator is cautioned not to attempt to service it. If it requires servicing, remove it and take it to an authorized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

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 pumps mounting bolts should be clean and well secured by the mounting bolt to ensure proper pump operations.

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.

A small fuel filter has been added to the incoming fuel line to ensure that filtered fuel enters the fuel lift pump.



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 filter/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.

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 the Fuel Filter Element

Refer to the illustration above.

1. Shut off the fuel supply.
2. Turn the fuel filter bowl counterclockwise to remove.
3. Pull the filter element straight down and off.
4. Inspect both O-rings and replace if worn.
5. Wipe the O-rings with clean fuel and snap the new filter up into place over the small O-ring.
6. Clean off the filter bowl and threads. (The bowl can be pre-filled with fuel). Screw the bowl into place when the O-ring contacts the housing. Tighten the bowl firmly by hand.
7. The key-on preheat sequence will allow the lift pump to fill the fuel filter.
8. Run the engines and inspect for leaks.

COOLING SYSTEM

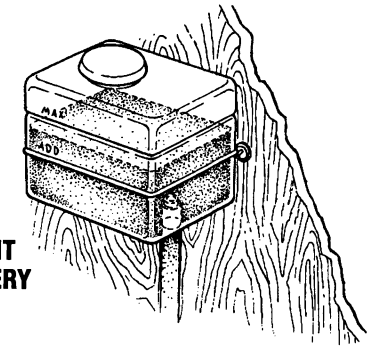
FRESH WATER COOLING CIRCUIT

NOTE: *Refer to the* ENGINE COOLANT *page for the recommended antifreeze and water mixture to be used as the fresh water coolant.*

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.

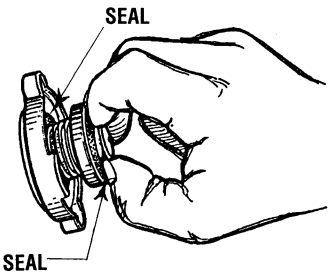
Coolant Recovery Tank

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.



COOLANT RECOVERY TANK

NOTE: *Periodically check the condition of the manifold 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.*



CHECKING THE PRESSURE 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.

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

Drain the engine coolant by removing the drain plug on the engine block and opening the manifold pressure cap. Flush the system with fresh water, then reinstall the drain and start the refill process. Refer to the illustration below.

NOTE: *The drain petcock on the heat exchanger can also be used to help drain engine coolant.*

> ⚠ **WARNING:** ***Beware of the hot engine coolant. Wear protective gloves.***

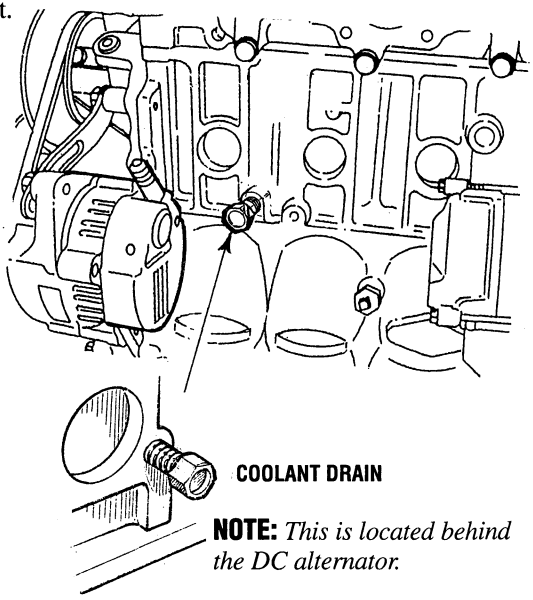
Refilling the Coolant

After replacing the engine block drain plug, close the heat exchanger's coolant petcock. Then run the engine at idle and slowly poor clean, premixed coolant into the manifold.

Monitor the coolant in the manifold and add as needed. Fill the manifold to the filler neck and install the manifold 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 and check the coolant in the manifold. Clean up any spilled coolant.



COOLANT DRAIN

NOTE: *This is located behind the DC alternator.*

COOLING SYSTEM

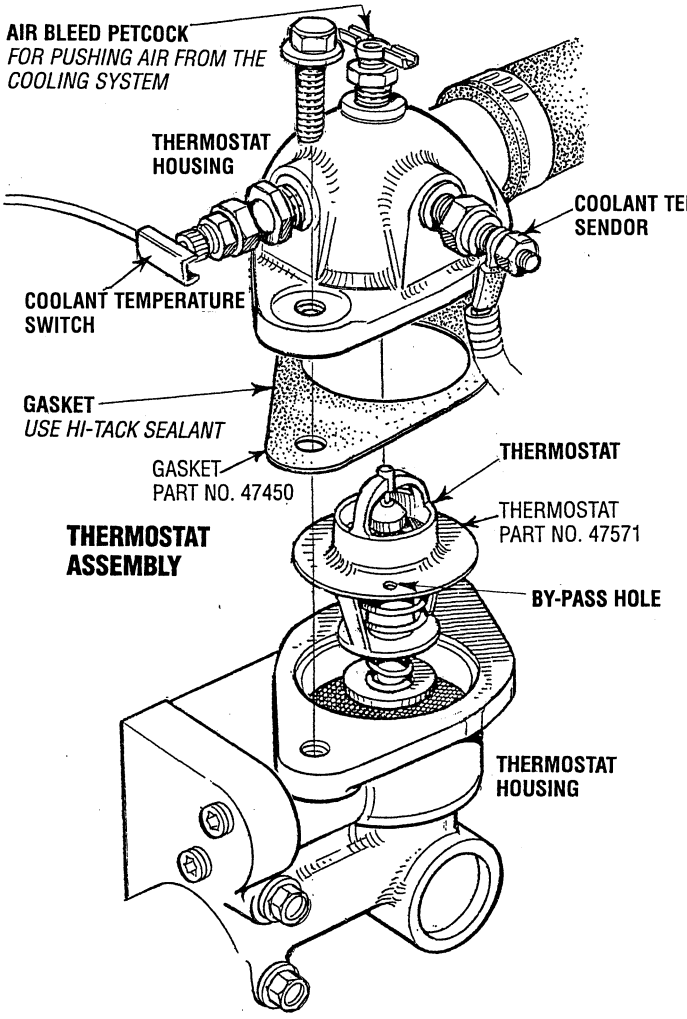
THERMOSTAT

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

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.



RAW WATER INTAKE STRAINER

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

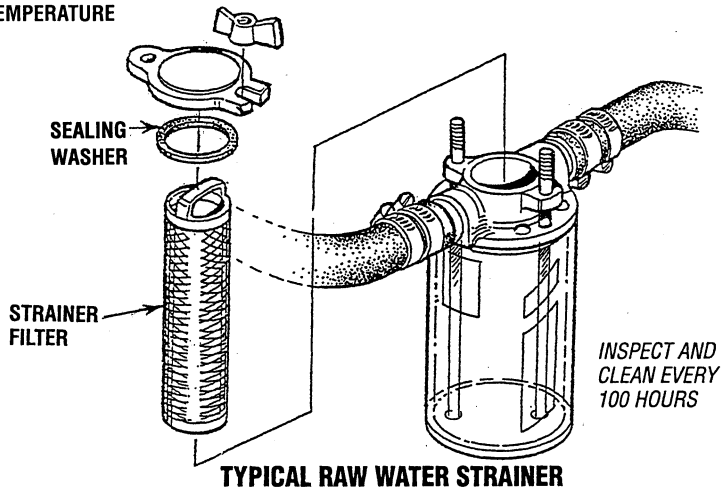
A clean raw water intake strainer is a vital component of the engine's cooling system. Include a visual inspection of this strainer when making your periodic engine check. The water in the glass should be clear.

Perform the following maintenance after every 100 hours of operation:

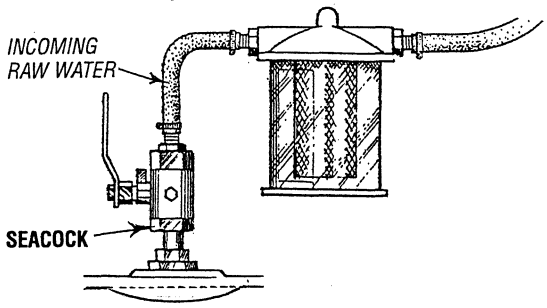
1. **Close the raw water seacock.**
2. Remove and clean the strainer filter.
3. Clean the glass.
4. Replace the sealing washer if necessary.
5. Reassemble and install the strainer.
6. **Open the seacock.**
7. Run the engine and check for leaks.

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.



TYPICAL RAW WATER STRAINER (OWNER INSTALLED)



COOLING SYSTEM

RAW WATER COOLING CIRCUIT

The raw water flow is created by a positive displacement impeller pump. This pump draws water directly from the ocean, lake, or river from a thru-hull opening through a hose to the water strainer. The raw water passes from the strainer through the pump to the heat exchanger (through the heat exchanger tubes) where it cools the engine's circulating fresh water coolant. The raw water is then discharged into the water-injected exhaust elbow, mixing with, and cooling the exhaust gasses. This mixture of exhaust gas and raw water is driven through the stern tube and overboard.

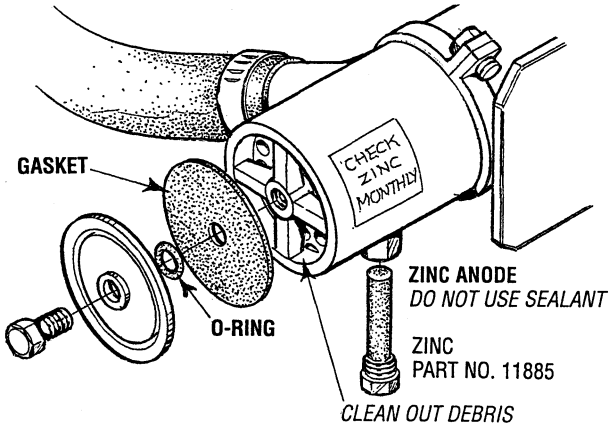
HEAT EXCHANGER

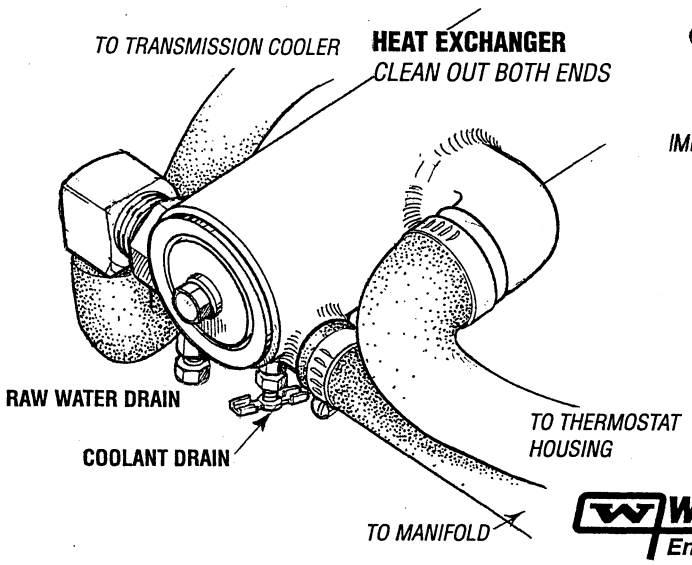
Cool raw water flows through the inner tubes of the heat exchanger. As the engine coolant passes around these tubes, the heat of the internal engine is conducted to the raw water which is then pumped into the exhaust system and discharged. The engine coolant (now cooled) flows back through the engine and the circuit repeats itself.

The engine coolant and raw water are independent of each other; this keeps the engine's water passages clean from the harmful deposits found in raw water.

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.)





RAW WATER PUMP

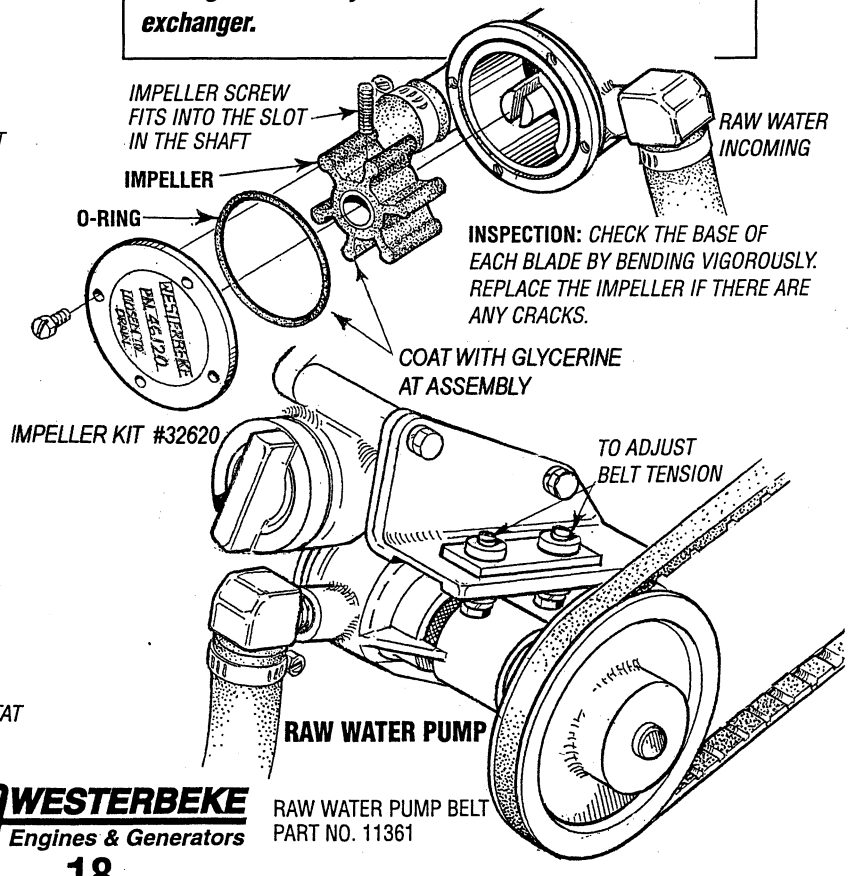
The raw water pump is a self-priming, rotary pump with a non-ferrous housing and a Neoprene impeller. The impeller has flexible blades which wipe against a curved cam plate within the impeller housing, producing the pumping action. **On no account should this pump be run dry.** There should always be 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.*

Changing the Raw Water Pump Impeller

Close the raw water intake valve. Remove the pump cover and, using an impeller puller, screw drivers, or pliers, carefully pry the impeller out of the pump. Install the new impeller and gasket. Move the blades to conform to the curved cam plate and push the impeller into the pumps housing. When assembling, apply a thin coating of lubricant to the impeller and gasket. Open the raw water intake valve.

> ⚠ **CAUTION:** ***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.***

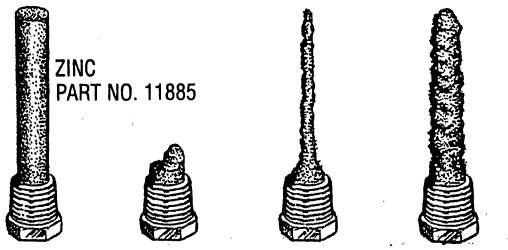


COOLING SYSTEM

ZINC ANODE

A zinc anode, or pencil, is located in the raw water cooling circuit within the heat exchanger. The purpose of the zinc anode is to sacrifice itself 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.

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



ZINC ANODES

If the zinc pencil needs replacement, hold the hex boss into which the zinc pencil 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 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, 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.*

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

NOTE: It is difficult to give specifics as to the service life of a zinc anode. This varies from one operating area to another. Monitor your units zinc on a monthly basis and determine the period of time for replacement.

AIR INTAKE / SILENCER

Description

A marine diesel engine running at high speed will typically consume more than 6,000 cubic feet of air per hour. Not only must the engine room be well ventilated, the air flow into the engine must be unrestricted.

Air Filter

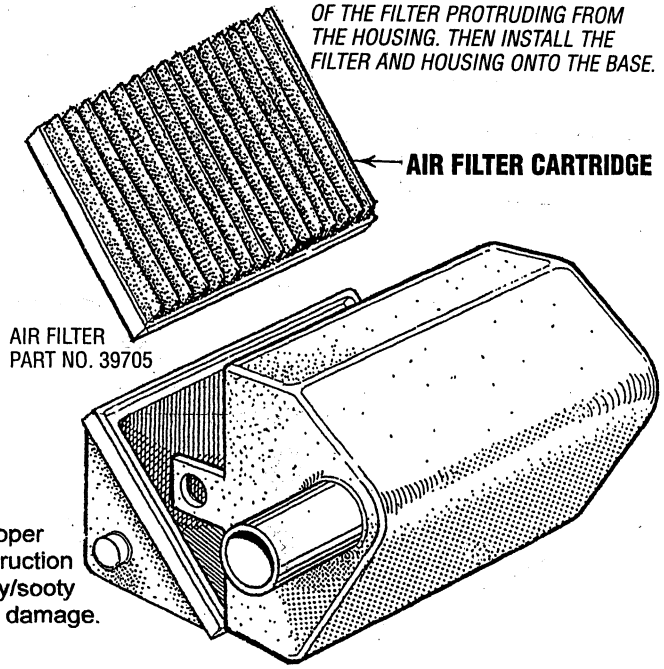
The filter cartridge prevents engine room dust and dirt and other contaminants from entering the engine with the air. It helps extend engine life and quiets the engine.

Maintenance

The filter should be cleaned every 100 operating hours. Tap the cartridge on a flat surface to dislodge dirt or clean off with compressed air. If the cartridge is badly contaminated or oily, replace it.

CAUTION: Regular inlet filter cartridge maintenance is vital for proper engine operation. Failure to maintain this filter will result in air obstruction into the engine. This will result in poor fuel combustion and smokey/sooty exhaust discharge. Filter deterioration can result in internal engine damage.

INSTALL THE FILTER CARTRIDGE INTO THE HOUSING WITH THE SCREEN SIDE OF THE FILTER FACING OUT OF THE HOUSING. PRESS THE CARTRIDGE INTO THE HOUSING LEAVING APPROX. 1/8" OF THE FILTER PROTRUDING FROM THE HOUSING. THEN INSTALL THE FILTER AND HOUSING ONTO THE BASE.



ENGINE LUBRICATING OIL

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 engine break-in operation. Then follow the oil and filter change intervals as specified in the **MAINTENANCE SCHEDULE** in this manual.

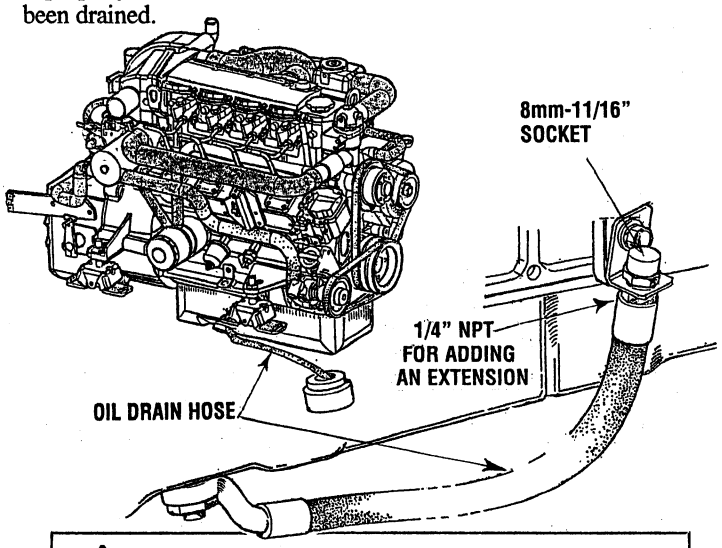
An oil viscosity of SAE 10W-40 or 15W-40 is recommended in all conditions and all seasons.

Westerbeke Corporation does not approve or disapprove 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 listed in the **MAINTENANCE SCHEDULE** section of this manual and not be extended if synthetic oils are used.

NOTE: *The information above supersedes all previous statements regarding synthetic oil.*

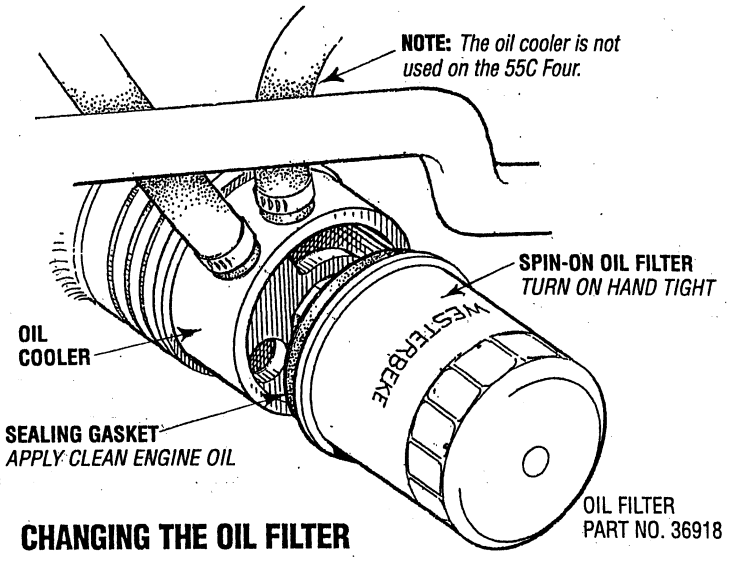
CHANGING THE ENGINE OIL

The engine oil should be warm. Remove the oil drain hose from its attachment bracket and lower it into a container and allow the oil to drain, or attach a pump to the end of the drain hose and pump the old oil out. Make sure the oil drain hose is properly secured in its holder after all of the old oil has been drained.



⚠ 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.***

Always observe the old oil as it is removed. A yellow/gray emulsion indicates the presence of water in the oil. Although this condition is rare, it does require prompt attention to prevent serious damage. Call a competent mechanic if water is present in the oil. Water present in the oil can be the result of a fault in the exhaust system attached to the engine and/or a siphoning through the water cooling circuit into the exhaust, filling it up into the engine.



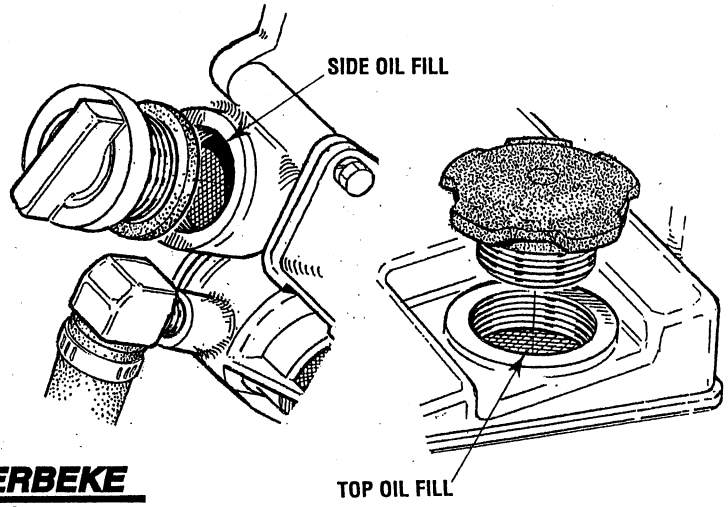
CHANGING THE OIL FILTER

When removing the used oil filter, you may find it helpful to punch a hole in the upper and lower portion of the old filter to drain the oil into a container before removing it. This helps to lessen spillage. An automotive filter wrench should be helpful in removing the old oil filter. Place some paper towels and a plastic bag around the filter when unscrewing it to catch any oil that's in the filter. Inspect the old oil filter as it is removed to make sure that the rubber sealing gasket comes off with the old oil filter. If this rubber sealing gasket remains sealed against the oil filter adapter, gently remove it. When installing the new oil filter element, wipe the filter gasket's sealing surface on the oil filter adapter free of oil and apply a thin coat of clean engine oil to the rubber sealing gasket on the oil filter. Screw the filter onto the threaded oil filter stub, and tighten the filter firmly by hand.

NOTE: *Use genuine WESTERBEKE oil filters. Generic filters are not recommended.*

REFILLING THE OIL SUMP

Add fresh oil through the valve cover. After refilling the oil, run the engine for a few moments while checking the engine's oil pressure. Make sure there is no leakage around the new oil filter or from the oil drain system, and then stop the engine. Then check the quantity of oil with the lube oil dipstick. Fill to the FULL mark on the dipstick.



REMOTE OIL FILTER (OPTIONAL)
PN. 040076

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.

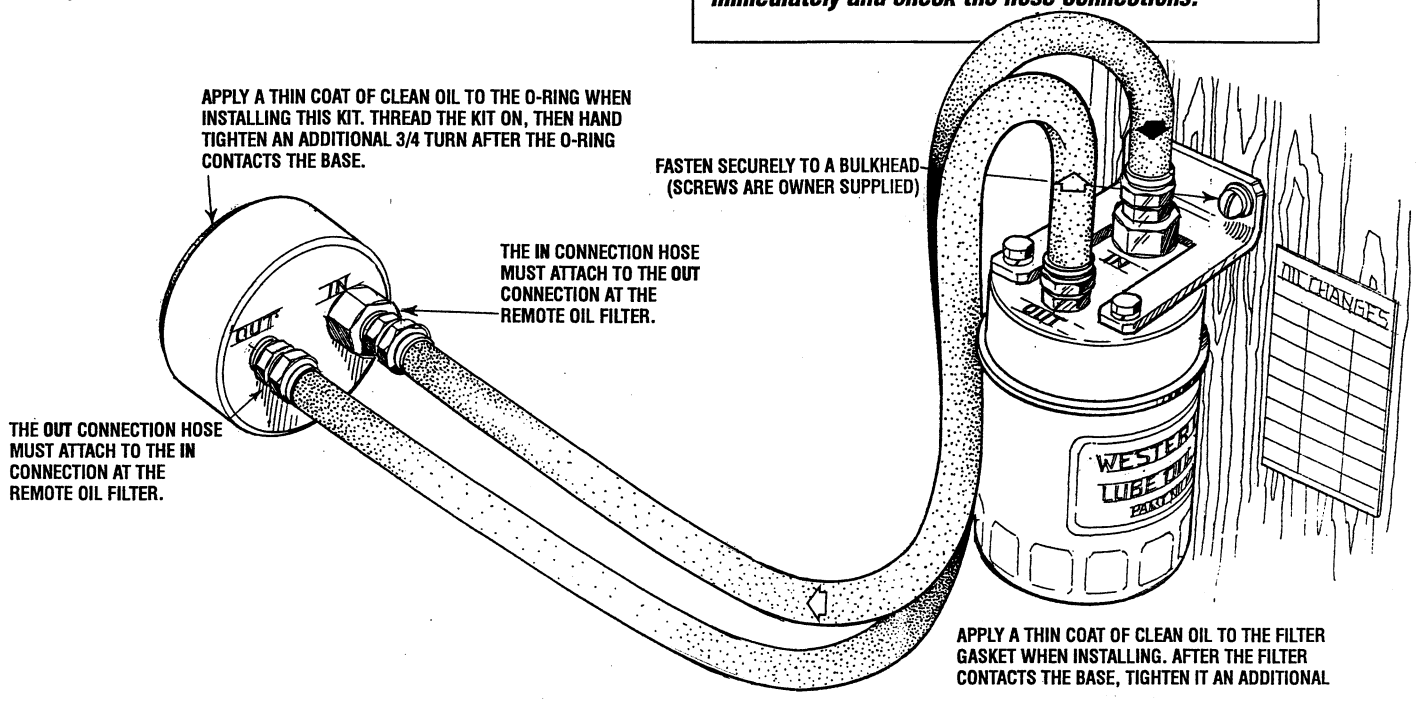
NOTE: *Refer to ENGINE OIL CHANGE in this manual for instructions on removing the oil filter.*

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 bypass 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.***



WATER HEATER

WATER HEATER INSTALLATIONS

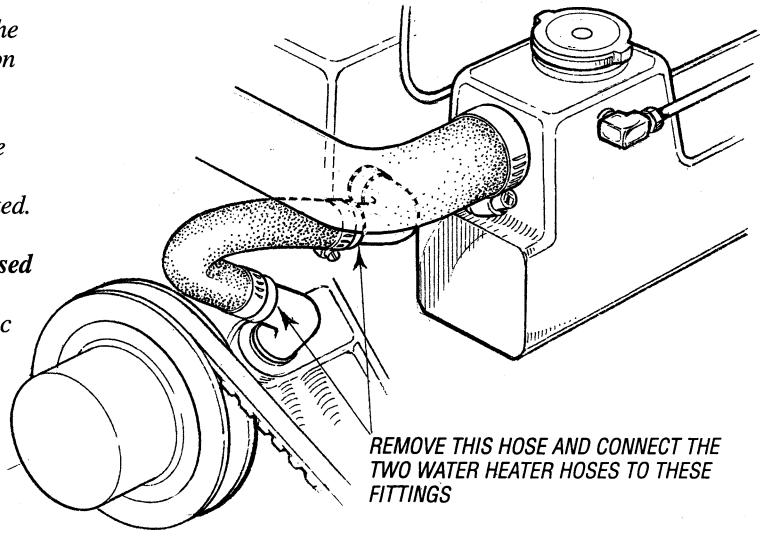
These engines are equipped with connections for the plumbing of engine coolant to transfer heat to an on-board water heater. The water heater should be mounted in a convenient location either in a high or low position in relation to the engine, so that the connecting hoses from the heater to the engine can run in a reasonably direct line without any loops which might trap air.

Hoses should rise continuously from their low point at the heater to the engine so that 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.

NOTE: *If any portion of the heating circuit rises above the engine's own pressure cap, then a pressurized (aluminum) remote expansion tank (Kit #024177)* ***must*** *be installed in the circuit to become the highest point. Tee the remote expansion tank into the heater circuit, choosing the higher of the two connections for the return. Tee at the heater, and plumb a single line up to the tanks location and the other back to the engine's return. Install the remote expansion tank in a convenient location so the 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.*** *Remove and store the plastic recovery tank if it has been already installed.*

The pressure cap on the engine's manifold should be installed after the engine's cooling system is filled with coolant. Finish filling the cooling system from the remote tank after 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 it rises continuously from the heater to the tank, enabling any air in the system to rise up to the tank and out of the system.

NOTE: *An air bleed petcock is located on the engine's heat exchanger. Open this petcock when filling the engine's coolant system to allow air in the exchanger to escape. Close tightly after all the air is removed.*



HOT WATER CONNECTIONS

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

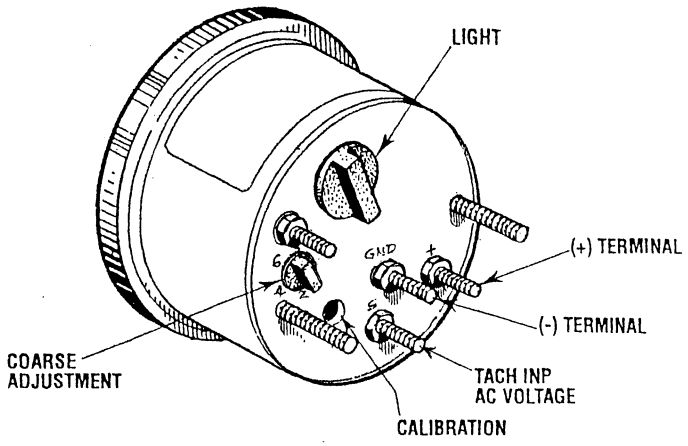
1. Check for proper AC voltage between "tach inp." terminal and (-) terminal.
2. Check for good ground connection between meter (-) terminal and alternator.
3. Check that alternator is well grounded to engine block at alternator pivot bolt.

Tachometer Inaccurate

a. Using a hand held strobe tachometer reading front crank shaft pulley speed. Adjust the engine speed to 1/2 rated engine rpm..

b. Using the coars adjustment, select A, B, 4, 6, or 8 that puts the panel tachometer rpm reading the closest to the strobes tachometers rpm reading.

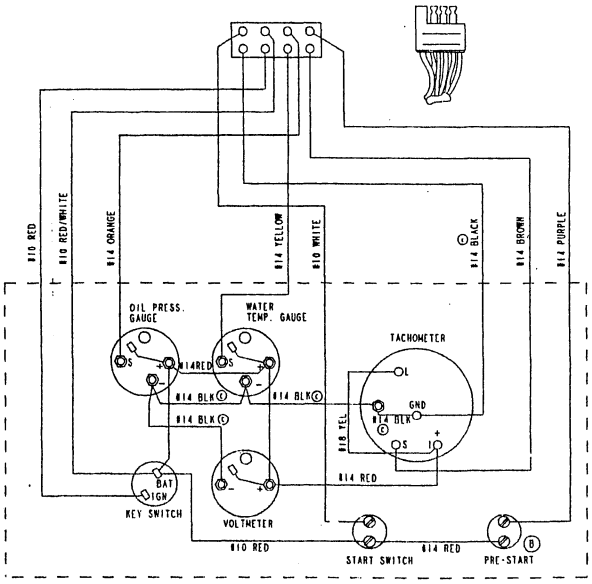
c. Using a 5/64 (2mm) allen wrench, adjust the calibration pod on the panel tachometer to read the same as the strobe tachometers rpm.



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.*

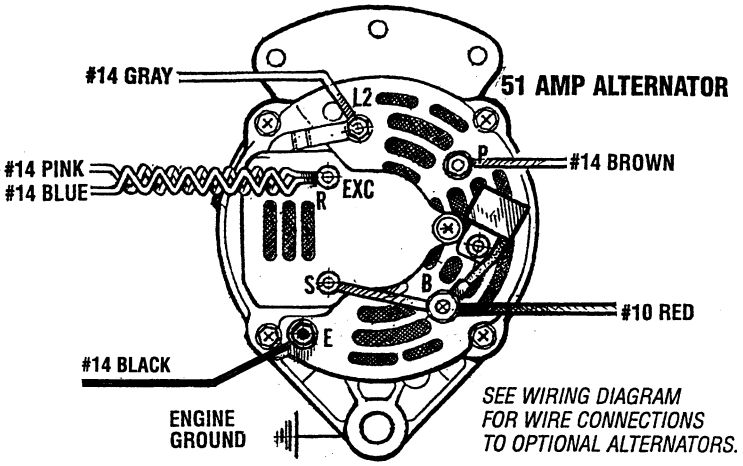
1. Warm up the engine to normal operating temperature. Remove any specks on the crankshaft pulley with a clean cloth and place a piece of suitable reflecting tape on the pulley to facilitate use of a photoelectric type tachometer.
2. Start and idle the engine.
3. Aim the light of the tachometer onto 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 rpm 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).



DC ELECTRICAL SYSTEM

ALTERNATOR

The charging system consists of a DC belt driven 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.



ALTERNATOR TROUBLESHOOTING

> ⚠ **WARNING:** ***A failed alternator can become very hot. Do not touch until the alternator has cooled down.***

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.

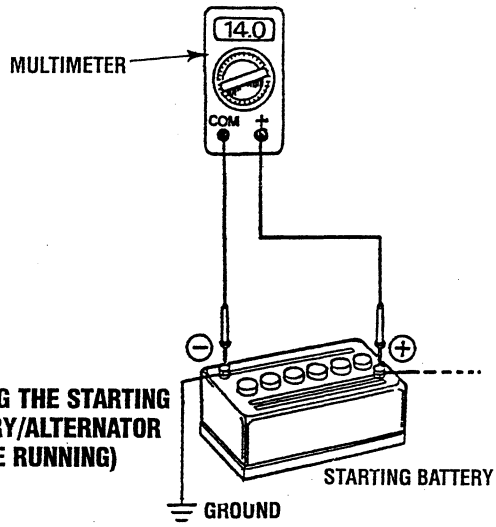
The alternator charging circuit charges the starting battery and the service battery. An isolator with a diode, a solenoid or a battery selector switch is usually mounted in the circuit to isolate the batteries so the starting battery is not discharged along with the service battery. If the alternator is charging the starting battery but not the service battery, the problem is in the service battery's charging circuit and not with the alternator.

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.***

> ⚠ **WARNING:** ***When testing with a multimeter: DC and AC circuits are often mixed together in marine applications. Always disconnect a shore power cord, isolate DC and AC converters, and shut down the engine before performing DC testing. No AC tests should be made without a proper knowledge of AC circuits.***

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" on the next page.
   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.

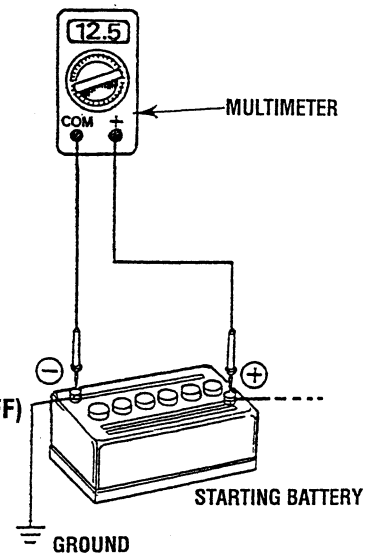


TESTING THE STARTING BATTERY/ALTERNATOR (ENGINE RUNNING)

3. Turn off the engine. Inspect all wiring and connections. Ensure that the battery terminals and the engine ground connections are tight and clean.

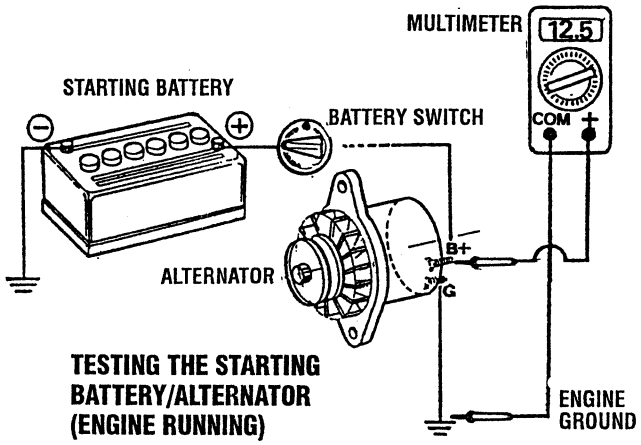
> ⚠ **CAUTION:** ***To avoid damage to the battery charging circuit, never shut off the engine battery switch when the engine is running!***

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 ALTERNATOR VOLTAGE (IGNITION ON - ENGINE OFF)

7. Now check the voltage between the alternator output terminal (B+) and ground. If the circuit is good, the voltage at the alternator will be the same as the battery, or if an isolator is in the circuit the alternator voltage will be zero. If neither of the above is true, a problem exists in the circuit between the alternator and the battery. Check all the connections — look for an opening in the charging circuit.



TESTING THE STARTING BATTERY/ALTERNATOR (ENGINE RUNNING)

8. Start the engine again. Check the voltage between the alternator output and ground.

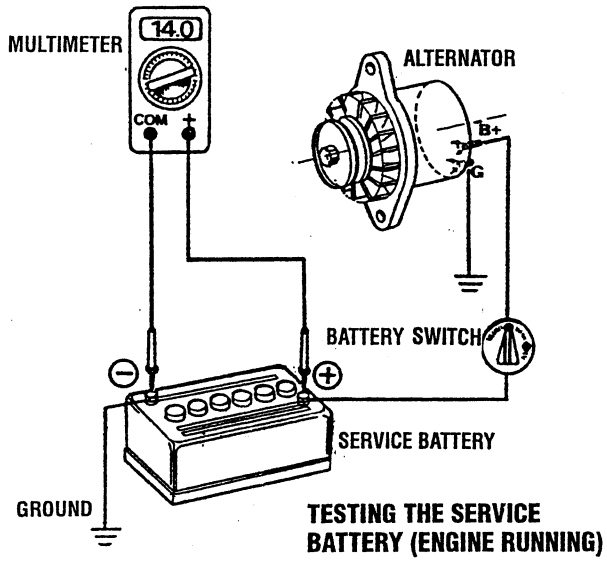
   The voltage reading for a properly operating alternator should be between 13.5 and 14.5 volts. If your alternator is over- or under-charging, have it repaired at a reliable service facility.

   NOTE: *Before removing the alternator for repair, use a voltmeter to ensure that 12 volts DC excitation is present at the EXC terminal if the previous test showed only battery voltage at the B output terminal.*

   If 12 volts is not present at the EXC terminal, trace the wiring and look for breaks and poor connections.

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.



TESTING THE SERVICE BATTERY (ENGINE RUNNING)

> ⚠ **CAUTION:** ***To avoid damaging the alternator diodes, do not use a high voltage tester (i.e. a megger) when performing tests on the alternator charging circuit.***

12 VOLT DC CONTROL CIRCUIT

The engine has a 12 volt DC electrical control circuit that is shown on the wiring diagrams that follow. Refer to these diagrams when troubleshooting or when servicing the DC electrical system.

> ⚠ **CAUTION:** ***To avoid damage to the battery charging circuit, never shut off the engine battery switch while the engine is running. Shut off the engine battery switch, however, to avoid electrical shorts when working on the engine's electrical circuit.***

BATTERY

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

Battery Care

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.

> ⚠ **WARNING:** ***Sulfuric acid in lead batteries can cause severe burns on skin and damage clothing. Wear protective gear.***

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.

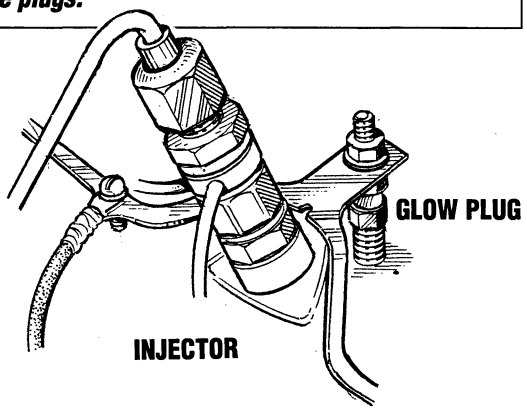
INSPECTION

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 - 1.5 ohm resistance. This method can be used with the plug in or out of the engine. You can also use an multimeter to test the power drain (8 - 9 amps per plug).

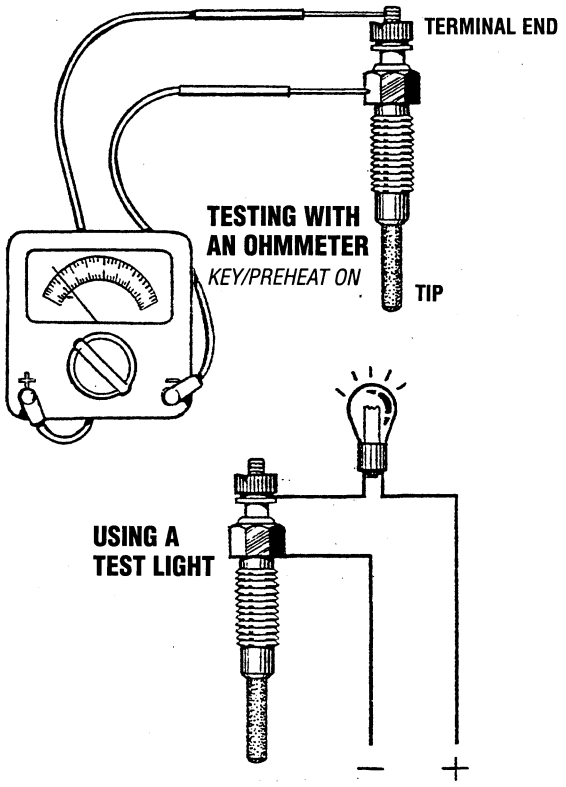
⚠ WARNING: ***These glow plugs will become very hot to the touch. Be careful not to burn your fingers when testing the plugs.***



Re-install the plugs in the engine and test them again. The plugs should get very hot (at the terminal end) within 7 to 15 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.

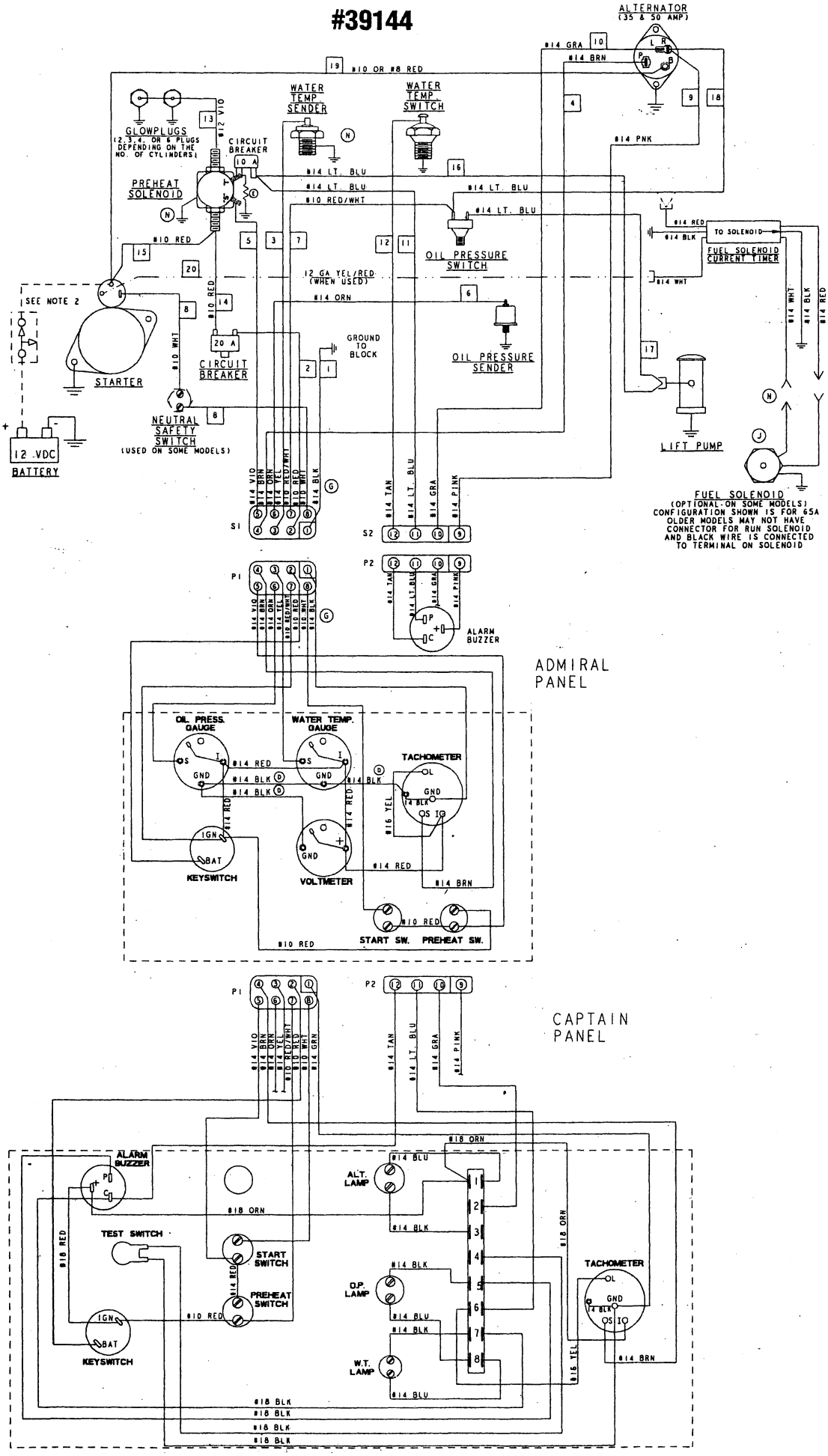
⚠ WARNING: ***Do not keep a glow plug on for more than 30 seconds.***

GLOW PLUG TIGHTENING TORQUE
1.0 - 1.5 M-KG (7 -11 FT-LB)



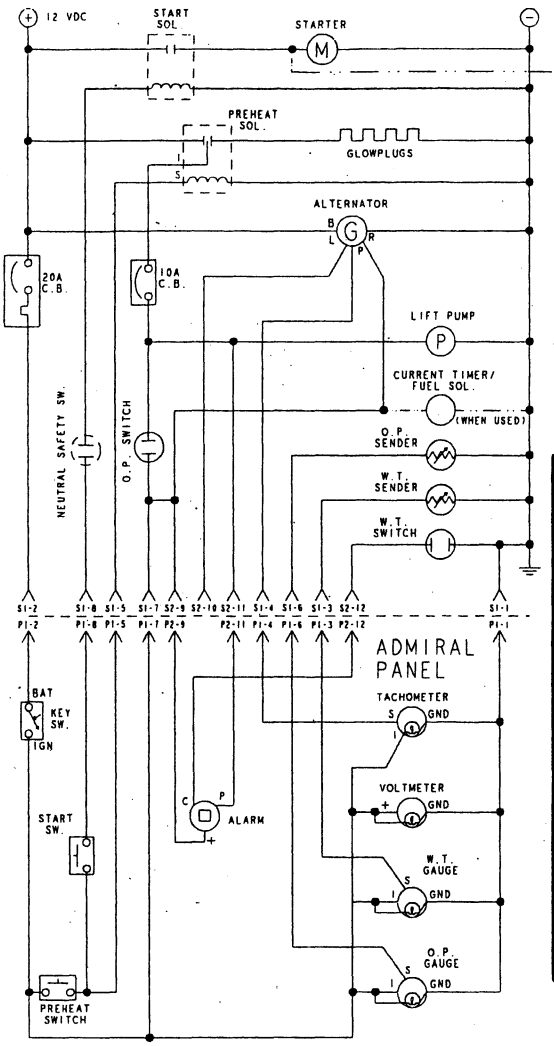
WIRING DIAGRAM

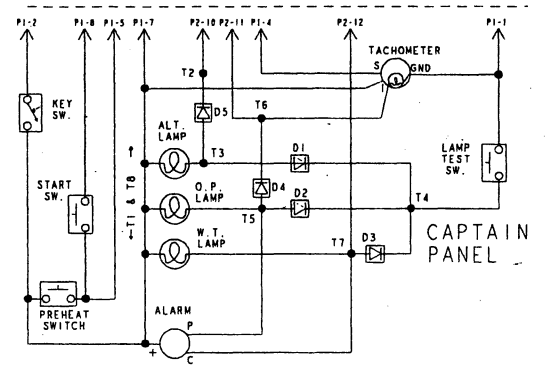
#39144

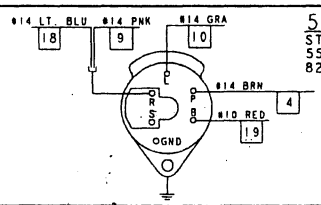


WIRING SCHEMATIC

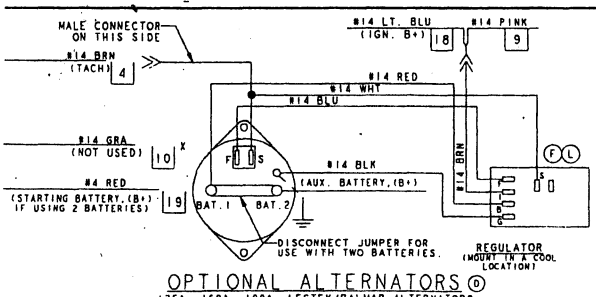
#39144



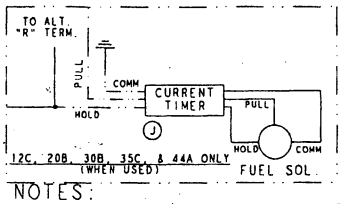




51 AMP. ALTERNATOR
STANDARD ALTERNATOR ON THE 55C, 63B, 63C, 64A, 71B, 82B, 108B, & 108C.

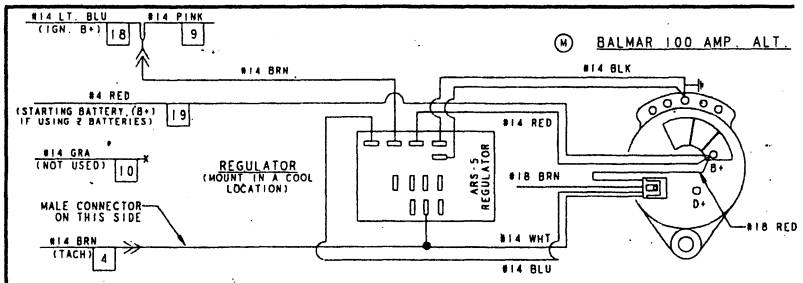


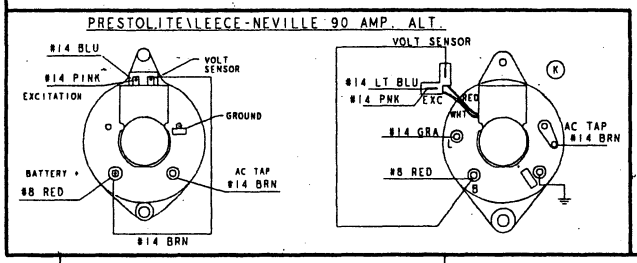
OPTIONAL ALTERNATORS (D)
135A, 160A, 190A, LESTEK/BALMAR ALTERNATORS
AVAILABLE ON THE M50B, 55C, 63B, 63C, 64A, 71B, 82B, 108B, & 108C ONLY.
(H)

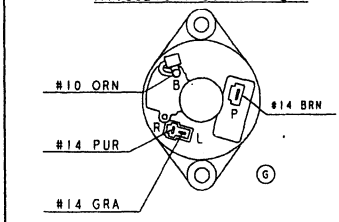


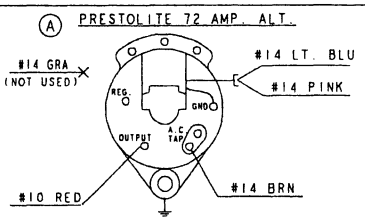
NOTES:

1. THIS PRODUCT IS PROTECTED BY A MANUAL RESET CIRCUIT BREAKER LOCATED NEAR THE STARTER. EXCESSIVE CURRENT WILL CAUSE THE BREAKER TO TRIP AND THE ENGINE WILL SHUT DOWN. THE BUILDER/OWNER MUST BE SURE THAT THE INSTRUMENT PANEL, WIRING, AND ENGINE ARE INSTALLED TO PREVENT CONTACT BETWEEN ELECTRICAL DEVICES AND SEAWATER.
2. AN ON-OFF SWITCH SHOULD BE INSTALLED BETWEEN THE BATTERY AND STARTER TO DISCONNECT THE BATTERY IN AN EMERGENCY AND WHEN LEAVING THE BOAT. A SWITCH WITH A CONTINUOUS RATING OF ITS AMPS AT 12 VDC WILL SERVE THIS FUNCTION. THIS SWITCH SHOULD NOT BE USED TO MAKE OR BREAK THE CIRCUIT.
3. THE PINK WIRE AT PLUG 2 IS UNUSED AND SHOULD BE INSULATED, CAPTAIN PANEL ONLY.
4. THE GRAY WIRE AT PLUG 2 IS UNUSED AND SHOULD BE INSULATED, ADMIRAL PANEL ONLY.

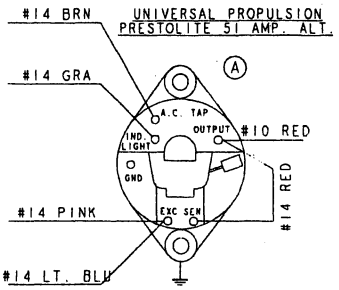


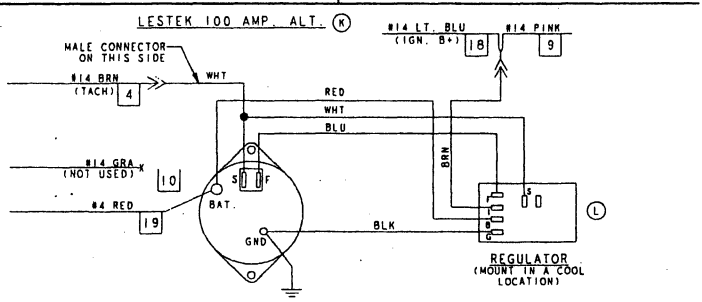






NOTE:
WIRE FOR BATTERY ATTATCHMENT WILL NEED TO BE UPGRADED TO AN 8 GAUGE FROM 10 GAUGE





STARTER MOTOR

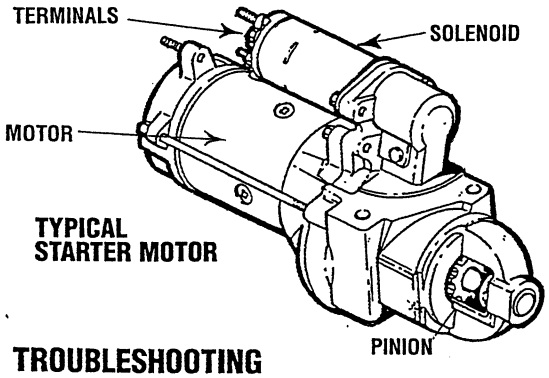
DESCRIPTION

The starting system includes the battery, starter motor, solenoid, and starter button.

When the starter button on the instrument panel is depressed, current flows and energizes the starter's solenoid coil. The energized coil becomes an electromagnet, which pulls the plunger into the coil, and closes a set of contacts which allow high current to reach the starter motor. At the same time, the plunger also serves to push that starter pinion to mesh with the teeth on the flywheel.

To prevent damage to the starter motor when the engine starts, the pinion gear incorporates an over-running (one-way) clutch which is splined to the starter armature shaft. The rotation of the running engine may speed the rotation of the pinion but not the starter motor itself.

Once the started button is released, the current flow ceases, stopping the activation of the solenoid. The plunger is pulled out of contact with the battery-to-start cables by a coil spring, and the flow of electricity is interrupted to the starter. This weakens the magnetic fields and the starter ceases its rotation. As the solenoid plunger is released, its movement also pulls the starter drive gear from its engagement with the engine flywheel.



TYPICAL STARTER MOTOR

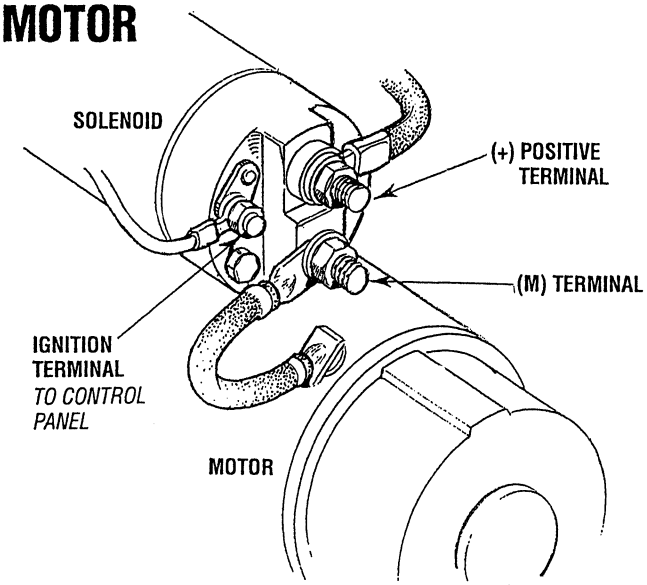
TROUBLESHOOTING

Prior to testing, make certain the ships 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).

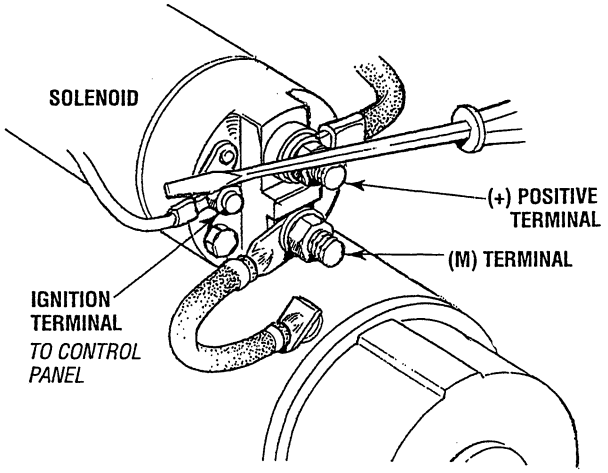
If you read 12 volts, the starter is faulty.



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.

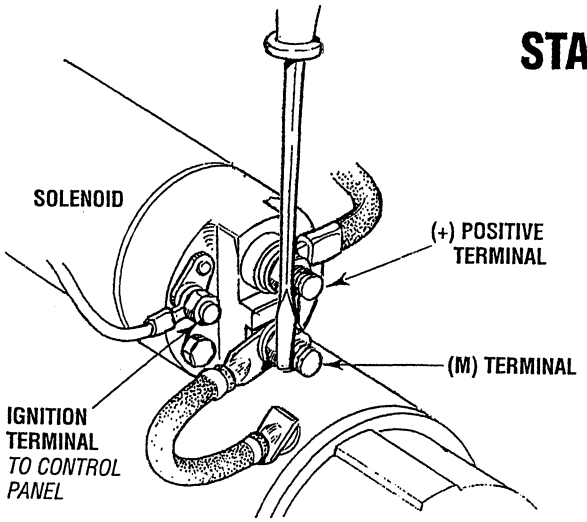
If the solenoid clicks but nothing else happens, the starter motor is probably faulty.



If nothing at all happens the solenoid isn't 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 arching and sparks will fly when jumping terminals. Be certain the engine space is free of potentially explosive fumes, especially gasoline.***

STARTER MOTOR



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 arching 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 arching 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 the 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.*

SERVICE

Westerbeke uses a standard marine 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.

DUAL OUTPUT ALTERNATORS

DESCRIPTION

Dual output and high output alternators are available as optional equipment on most WESTERBEKE engines. These alternators can be installed during factory assembly or as add-on equipment at anytime.

Dual alternators can be configured to charge two banks of batteries at the same time or, using a battery selector switch, charge each set of batteries separately.

INSTALLATION

If an optional dual alternator has already been factory installed, simply follow the WESTERBEKE wiring diagram and the engine installation instructions.

If the new dual alternator is being added to an existing "in-the-boat" engine, carefully follow the alternator installation instructions below:

1. Disconnect the alternators negative cable from the battery.
2. Remove the alternator and disconnect or tape off the output [positive] cable. Do not reuse.
3. Install the new alternator.
4. Attach a new heavy gauge output cable[s] from the alternator's output terminal [s]. Using the cable sizes indicated.

LENGTH REQUIRED		
	UP TO 6'	#4 WIRE
	UP TO 12'	#2 WIRE
	UP TO 20'	#0 WIRE

[ALWAYS USE FINE STRAND CABLE]

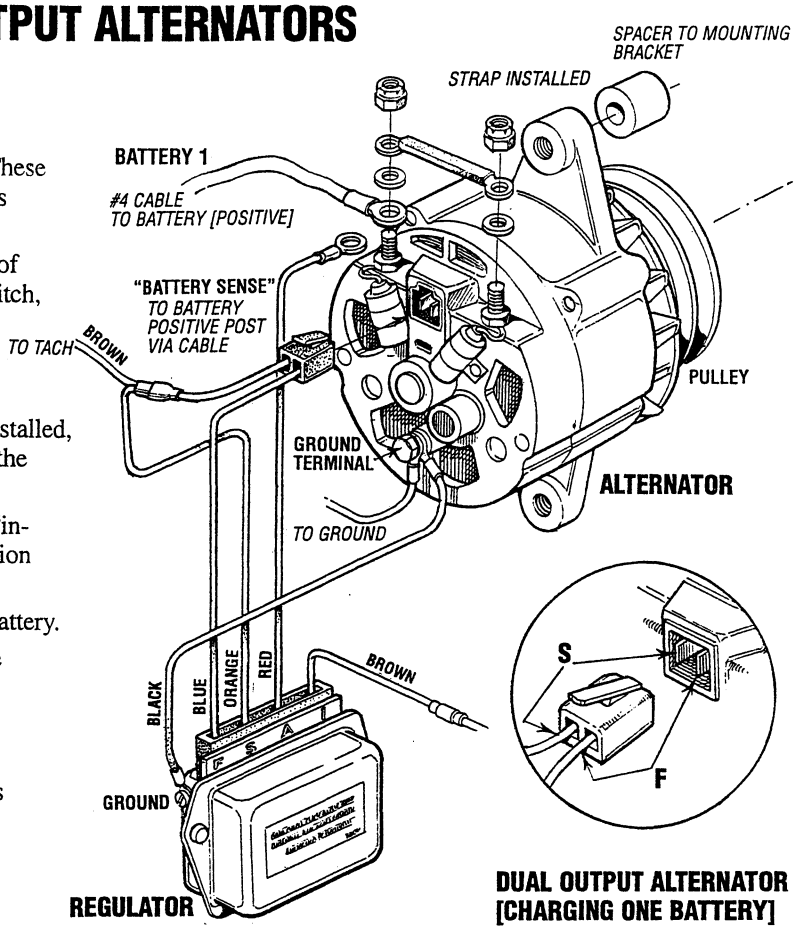
5. Make certain that the batteries negative post ground cable to the engine block is the same heavy gauge as the positive cable.
6. Mount the regulator to a flat surface in a cool dry location.
   a. Connect the black wire to the ground terminal on the alternator.

> **⚠ CAUTION:** ***Do not connect any power source without first grounding the regulator.***

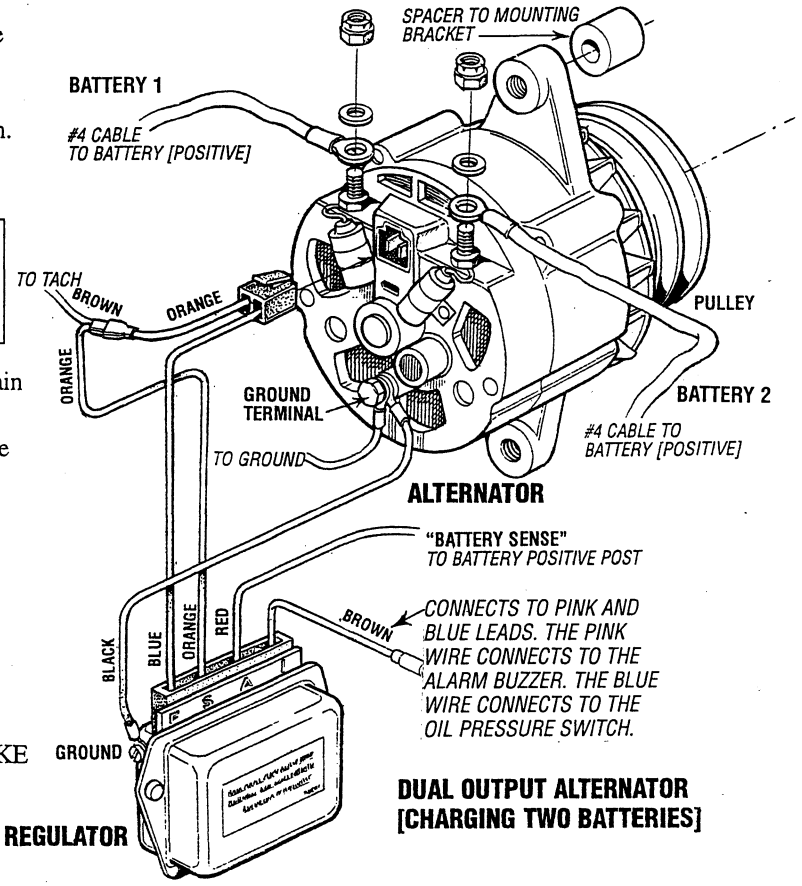
   b. Plug the 2-pin connector into the alternator, make certain it is firmly seated.
   c. The red "battery sense" wire should be connected to the batteries positive [+] post [or the positive cable].
   d. The brown wire "keyed ignition" is the key circuit which actuates the regulator, this wire must connect to a switched [+] 12 volt source. Refer to the *WESTERBEKE WIRING DIAGRAM* for the proper connection.

Dual Pulleys

A variety of accessory pulleys for high powered and dual charging alternators are available from your WESTERBEKE dealer.



DUAL OUTPUT ALTERNATOR [CHARGING ONE BATTERY]



DUAL OUTPUT ALTERNATOR [CHARGING TWO BATTERIES]

DUAL OUTPUT ALTERNATORS

TROUBLESHOOTING

NOTE: *Before troubleshooting, make certain that the drive belts are tight and the batteries are in good condition.*

Regulator Testing

The red "battery sensing" **wire A** connects to the battery, it must always read battery voltage. If battery voltage is not present, trace the wire for a bad connection.

The orange **wire S** should read 0 volts with the key off, 12 volts [approximately] with the key on. If the readings are incorrect, trace the wire for a bad connection.

The blue **wire F** supplies current to the alternator fields, its voltage will vary depending on the battery charge or actual load/rpm. The readings can vary from 4 to 12 volts with the key on, 0 volts with the key off.

KEY ON - NO VOLTAGE REGULATOR IS DEFECTIVE
KEY OFF - BATTERY VOLTAGE REGULATOR IS DEFECTIVE

REGULATOR TEST POINTS AND PROPER VOLTAGE

Terminal/Color	Ignition Off	Ignition On	Engine Running
I Brown	0 volts	2 -12 volts	14.2 volts
A Red	12.6 volts	12 volts	14.2 volts
S Orange	0 volts	0 volts	6 - 8 volts
F Blue	0 volts	10 - 11 volts	4 - 12 volts
Alt. Output	12.6 volts	12 volts	14.2 volts

Alternator Testing

The regulator is functioning properly and the batteries are in good condition.

1. Test the voltage at the alternator plug with the **engine off-key on**. The voltage at the alternator terminal F and the voltage in the plug [blue wire F] from the regulator should read the same.
2. Hold a screw driver close [1/2"] to the alternator pulley. If voltage is present you should feel the magnetic field. If not, the problem may be the brushes [worn] or the rotor [open circuit].
3. Start the engine, at fast idle the output terminals should indicate 14.2 volts [no load]. A reading of 12.6 would indicate the alternator is not performing properly.

   Apply a load such as an electric bilge pump, the voltage should maintain at least 13.8 volts. 13 volts or less indicates the alternator is faulty.

NOTES:

- ☐ *When the engine is first started, it takes a few moments for the alternator to "kick in" and take the load. There is a noticeable change in the sound of the engine and the RPM gauge will excite.*
- ☐ *A slight whine is normal when running with a full load on the alternator.*
- ☐ *When the alternator is producing high amperage, it will become very hot.*
- ☐ *When replacing the alternator drive belts, always purchase and replace dual belts in matched pairs.*

DUAL OUTPUT ALTERNATORS
BALMAR REGULATOR

DESCRIPTION

Dual output and high output alternators are available as optional equipment on most WESTERBEKE engines. These alternators can be installed during factory assembly or as add-on equipment at anytime.

Dual alternators can be configured to charge two banks of batteries at the same time or, using a battery selector switch, charge each set of batteries separately.

INSTALLATION

If an optional dual alternator has already been factory installed, simply follow the WESTERBEKE wiring diagram and the engine installation instructions.

If the new dual alternator is being added to an existing "in-the-boat" engine, carefully follow the alternator and regulator instructions below:

1. Disconnect the alternators negative cable from the battery.
2. Remove the alternator and disconnect or tape off the output [positive] cable. Do not reuse.
3. Install the new alternator.
4. Attach a new heavy gauge output cable[s] from the alternator's output terminal [s]. Using the cable sizes indicated.

LENGTH REQUIRED		
	UP TO 6'	#4 WIRE
	UP TO 12'	#2 WIRE
	UP TO 20'	#0 WIRE

[ALWAYS USE FINE STRAND CABLE]

5. Make certain that the batteries negative post ground cable to the engine block is the same heavy gauge as the positive cable.
6. Mount the regulator to a flat surface in a cool dry location.

   a. Connect the black wires to the mounting bolt on the alternator (ground)

> ⚠ **CAUTION:** ***Do not connect any power source without first grounding the regulator.***

   b. Plug the 2-pin connector into the alternator connection and make certain it is firmly seated.

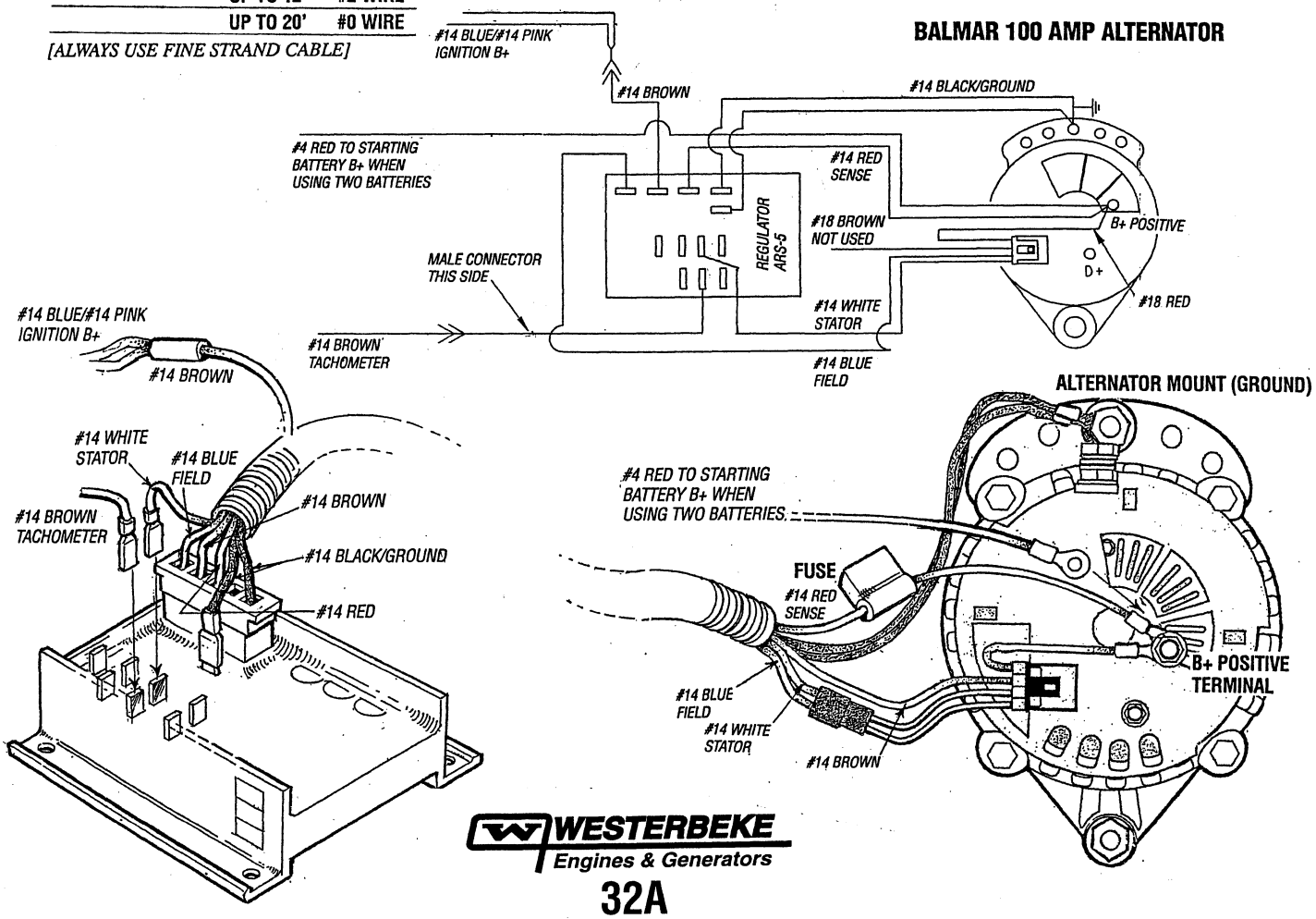
   c. The red "battery sense" wire should be connected to the batteries positive [+] post [or the positive cable].

   d. The brown wire "keyed ignition" is the key circuit which actuates the regulator, this wire must connect to a switched [+] 12 volt source. Such as the oil pressure switch.

   e. A brown wire from the electric tachometer connects to the regulator.

Dual Pulleys

A variety of accessory pulleys for high powered and dual charging alternators are available from your WESTERBEKE dealer.



DUAL OUTPUT ALTERNATORS
BALMAR REGULATOR

TROUBLESHOOTING

NOTE: *Before troubleshooting, make certain that the drive belts are tight and the batteries are in good condition.*

Regulator Testing

The red "battery sensing" wire **A** connects to the battery, it must always read battery voltage. If battery voltage is not present, trace the wire for a bad connection.

The white wire **S** should read 0 volts with the key off, 12 volts [approximately] with the key on. If the readings are incorrect, trace the wire for a bad connection.

The blue wire **F** supplies current to the alternator fields, its voltage will vary depending on the battery charge or actual load/rpm. The readings can vary from 4 to 12 volts with the key on, 0 volts with the key off.

KEY ON - NO VOLTAGE REGULATOR IS DEFECTIVE
KEY OFF - BATTERY VOLTAGE REGULATOR IS DEFECTIVE

REGULATOR TEST POINTS AND PROPER VOLTAGE

Terminal/Color	Ignition Off	Ignition On	Engine Running
I Brown	0 volts	2 -12 volts	14.2 volts
A Red	12.6 volts	12 volts	14.2 volts
S White	0 volts	0 volts	6 - 8 volts
F Blue	0 volts	10 - 11 volts	4 - 12 volts
Alt. Output	12.6 volts	12 volts	14.2 volts

Alternator Testing

The regulator is functioning properly and the batteries are in good condition.

1. Test the voltage at the alternator plug with the **engine off-key on**. The voltage at the alternator terminal **F** and the voltage in the plug [blue wire F] from the regulator should read the same.
2. Hold a screw driver close [1/2"] to the alternator pulley. If voltage is present you should feel the magnetic field. If not, the problem may be the brushes [worn] or the rotor [open circuit].
3. Start the engine, at fast idle the output terminals should indicate 14.2 volts [no load]. A reading of 12.6 would indicate the alternator is not performing properly.

   Apply a load such as an electric bilge pump, the voltage should maintain at least 13.8 volts. 13 volts or less indicates the alternator is faulty.

NOTES:

- ☐ *When the engine is first started, it takes a few moments for the alternator to "kick in" and take the load [a noticeable change in the sound of the engine].*
- ☐ *A slight whine from the alternator when the load is normal.*
- ☐ *When the alternator is producing high amperage, it will become very hot.*
- ☐ *When replacing the alternator drive belts, always purchase and replace dual belts in matched pairs.*

NOTE: *For additional information on regulators and alternators, contact WWW.BALMAR.COM.*

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: *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).	1. Battery switch not on.	1. Check switch and/or battery connections.
	2. 20-amp circuit breaker tripped.	2. Reset breaker; if breaker trips again, check preheat solenoid circuit and check circuit for shorts to ground.
	3. Loose battery connections.	3. Check (+) connection to starter solenoid and (–) connection to engine ground stud. Check battery cable connections.
START button is depressed, no starter engagement.	1. Connection to solenoid faulty.	1. Check connection.
	2. Gear shift not in neutral.	2. Gear shift must be in neutral (see *NEUTRAL SWITCH* under *HURTH HSW TRANSMISSIONS*).
	3. Faulty switch.	3. Check switch with ohmmeter.
	4. Faulty solenoid.	4. Check that 12 volts are present at the solenoid connection.
	5. Loose battery connections.	5. Check battery connections.
	6. Low battery.	6. Check battery charge state.
START button is depressed; panel indications OK; starter solenoid OK; fuel solenoid not functioning.	1. Poor connections to fuel solenoid.	1. Check connections.
	2. Defective fuel solenoid.	2. Check that 12 volts are present at the (+) connection on the fuel run solenoid.
	3. Faulty current limiter	3. Check continuity through limitor connections.
Engine cranks, but does not start, fuel solenoid energized.	1. Faulty fueling system.	1. Check that fuel valves are open.
		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. Preheat solenoid faulty.	2. Check solenoid.
Engine can't be stopped.	1. Faulty DC alternator.	1. Remove Exc. connection to alternator, repair alternator.
	2. Fuel run solenoid will not de-energize.	2. Manually disconnect the 12 volt connection to the fuel run solenoid.
Battery runs down.	1. Oil pressure switch.	1. Observe if gauges and panel lights are activated when engine is not running. Test the oil pressure switch.
	2. High resistance leak to ground.	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. Low resistance leak.	3. Check all wires for temperature rise to locate the fault.
	4. Poor battery connections.	4. Check cable connections at battery for loose connections, corrosion
	5. DC alternator not charging (tachometer not operating).	5. Check connections, check belt tension, test alternator. See *ALTERNATOR TESTING.*
Engine starts, runs but does not come up to speed.	1. Fuel line restriction.	1. Inspect all fuel lines.
	2. Throttle plate binding.	2. Adjust linkage.
	3. Faulty fuel lift pump.	3. Lift pump should "tick". Check connections, test for 12 volts.
	4. Faulty wire connection.	4. Inspect wires.
	5. High exhaust back pressure.	5. Inspect exhaust elbow for corrosion. Check exhaust elbow hose. Test back pressure.
Battery not charging	1. DC charge circuit faulty.	1. Perform DC voltage check of generator charging circuit. See *Testing the Battery Charging Circuit.*
	2. Alternator drive.	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.

ENGINE TROUBLESHOOTING

Problem	Probable Cause	Verification/Remedy
Engine slows and stops.	1. Fuel lift pump failure.	1. Fuel lift pump should make a distinct ticking sound. Replace pump with spare.
	2. Oil pressure switch.	2. Inspect switch for proper operation. Closed contacts with engine operating.
	3. Fuel starvation.	3. Check fuel supply, fuel valves and fuel filters.
	4. 20 Amp circuit breaker tripping.	4. Check for high DC amperage draw during operation. Ensure breaker is not overly sensitive to heat which would cause tripping.
	5. Exhaust system is restricted.	5. Check for blockage, collapsed hose, carbon build-up at exhaust elbow.
	6. Water in fuel.	6. Pump water from fuel tank(s), change filters and bleed fuel system.
	7. Air intake obstruction	7. Check air intake filter cartridge.
Engine overheats/alarm sounds steady.	1. Raw water not circulating.	1. Raw water pump failure. Check impeller — replace.
	2. Coolant not circulating.	2. Obstruction at raw water intake or raw water filter.
		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.	1. Loss of oil..	1. Check dipstick, look for oil leaks at oil filter and at oil drain hose connection.
	2. Oil pressure switch.	2. Replace oil pressure switch.
	3. Alarm circuit resistor faulty.	3. Check resistor at pre-heat solenoid. Resistor value 1,000 Ohm.
	4. Faulty electric fuel pump.	4. Check fuel pump winding. Ohm value 31.8 Ohm.
Exhaust smoke problems	1. Blue smoke.	1. Incorrect grade of engine oil.
		1a. Crankcase is overfilled with engine oil (oil is blowing out through the exhaust).
	2. White smoke.	2. Engine is running cold.
		2a. Faulty injector or incorrect injector timing.
	3. Black smoke.	3. Improper grade of fuel.
		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 and air filter. Check for proper ventilation.
		3d. Overload.

TROUBLESHOOTING COOLANT 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 sender 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 mechanic.*

DRIVE BELT ADJUSTMENT

Proper inspection, service and maintenance of the drive belts is important for the efficient operation of your engine (see *Drive Belts* under *MAINTENANCE SCHEDULE*).

Drive belts must be properly tensioned. Loose drive belts will not provide proper alternator charging and will eventually damage the alternator. Drive belts that are too tight will pull the alternator out of alignment and/or cause the alternator to wear out prematurely. Excessive drive belt tension can also cause rapid wear of the belt and reduce the service life of the coolant pumps bearing. A slack belt or the presence of oil on the belt can cause belt slipping, resulting in high operating temperatures and tachometer variations.

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 mid-point 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 adjusting strap bolt and the base mounting bolt.
2. With the belt loose, inspect for wear, cracks and frayed edges.
3. Pivot the alternator on the base mounting bolt to the left or right as required, to loosen or tighten.
4. Tighten the base mounting bolt and the adjusting strap bolt.
5. Run the engine for about 5 minutes, then shut down and recheck the belt tensions.

RAW WATER PUMP

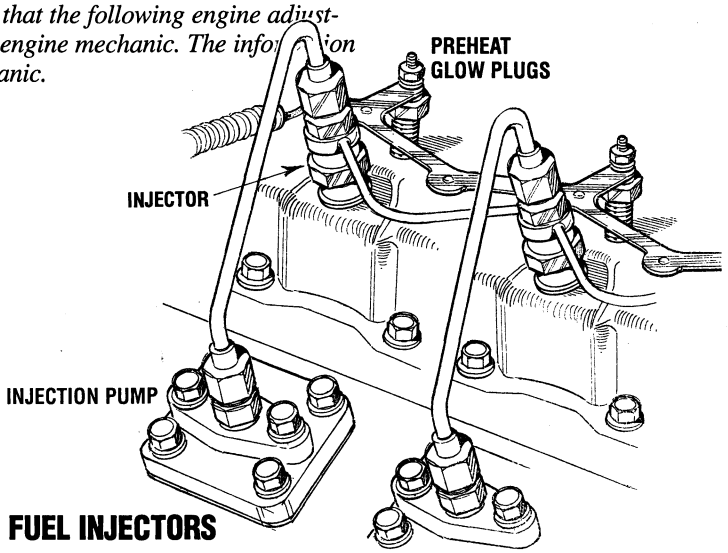
The tension of the raw water pump belt is adjusted by releasing the pumps fasteners and sliding the pump back and forth. The water pump belt should be firmly tight and checked often.

STARTER AND DC ALTERNATOR SERVICE

The starter and the DC charging alternator should be maintained following the maintenance schedule in this manual.

Major service/overhaul of the starter or DC charging alternator should be undertaken as needed.

Refer to your *WESTERBEKE SERVICE MANUAL.*



FUEL INJECTORS

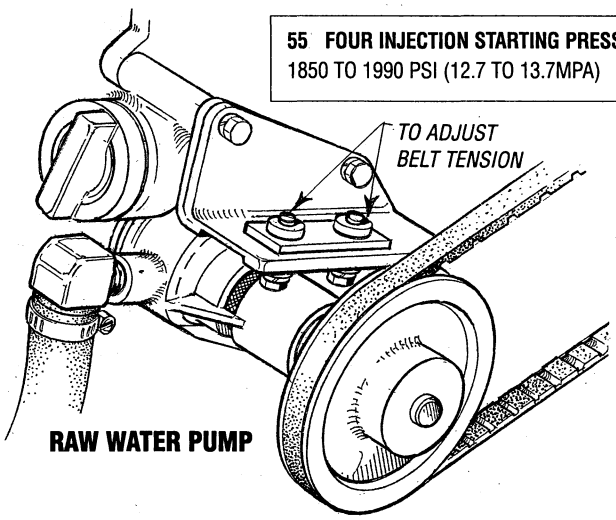
In case of severe vibrations and detonation noise, have the injectors checked and overhauled by an authorized fuel injection service center. Poor fuel quality, contaminant's and loss of positive fuel pressure to the injection pump can result in injector faults. Since fuel injectors must be serviced in a clean room environment, it is best to carry at least one extra injector as a spare should a problem occur.

Before removing the old injector, clean the area around the base of the injector 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.

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 new injector is installed.

The fuel injectors should be tested and rebuilt according to the MAINTENANCE SCHEDULE in this manual.

55 FOUR INJECTION STARTING PRESSURE
1850 TO 1990 PSI (12.7 TO 13.7MPA)



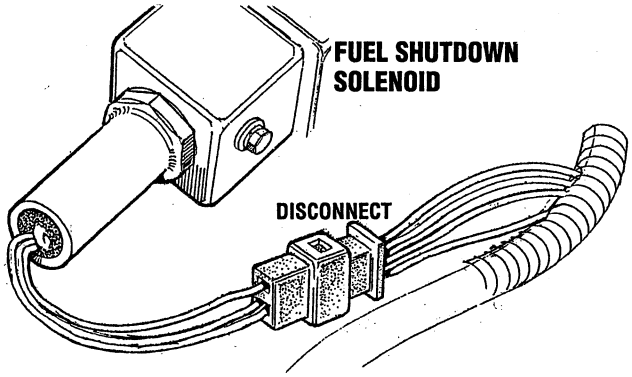
ENGINE ADJUSTMENTS

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 ENGINE COMPRESSION

Make certain the oil level (dipstick) is at the correct level and the air intake filter is clean. The battery and starter motor must also be in good condition.

1. Warm the engine to normal operating temperature.
2. Disconnect the wire to the fuel shutdown solenoid.
3. Remove all the glow plugs from the engine and install the compression gauge/adapter combination to the cylinder on which the compression is to be measured.



4. Close the raw water seacock (thru-hull).
5. Crank the engine and allow the gauge to reach a maximum reading, then record that reading.
6. Repeat this process for each cylinder.

NOTE: *If the readings are below the limit, the engine needs an overhaul.*

55' FOUR COMPRESSION PRESSURE
441 PSI (3.04 MPa) NORMAL AT CRANKING SPEED OF 250 RPM.
44.1 PSI BETWEEN CYLINDERS

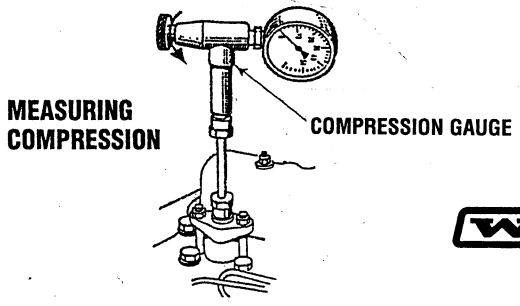
7. Re-install the glow plugs (use anti-seize compound on the threads) and reset the fuel shut-off to the run position.
8. **Open the raw water seacock (thru-hull).**

Low Compression

When low compression is found, determine the cause by applying a small amount of oil in the cylinder thru the glow plug hole. Allow the oil to settle.

Install the pressure gauge and repeat the above test. If the compression reading rises dramatically, the fault is with the rings. If the compression valve does not rise, the problem is with the valves.

A slight rise in compression would indicate a problem with both the rings and the valves.



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 40 and 85 psi.

NOTE: *A newly started, cold engine can have an oil pressure reading up to 85 psi. A warmed engine can have an oil pressure reading as low as 25 psi. These readings will vary depending upon the temperature of the engine and the rpms.*

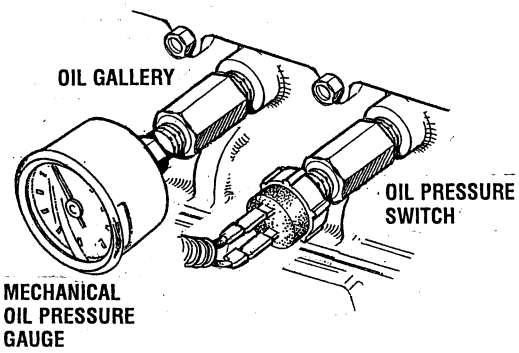
Low Oil Pressure

The specified safe minimum oil pressure is 5 - 10 psi. A gradual loss of oil pressure usually indicates worn bearings. For additional information on low oil pressure readings, see the *ENGINE TROUBLESHOOTING* chart.

Testing Oil Pressure

To test oil pressure, remove the oil pressure sender then install a mechanical oil pressure gauge in its place. After warming up the engine, set the engine speed at idle and read the oil pressure gauge.

55' FOUR OIL PRESSURE
43 TO 85 PSI (290 TO 590 KPa) NORMAL

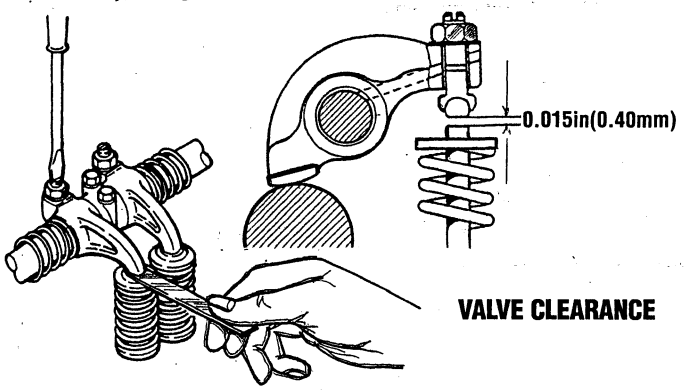


ENGINE ADJUSTMENTS

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

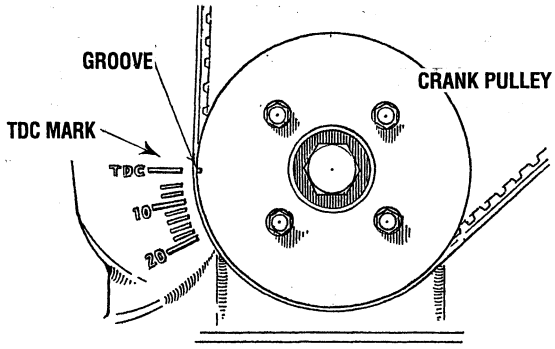
VALVE CLEARANCE ADJUSTMENT

The valve clearance must be adjusted every 1000 operating hours or whenever the valve rocker is abnormally noisy. Valve adjustment should only be done when the engine is cold. A cold engine valve clearance is 0.015in (0.40mm).

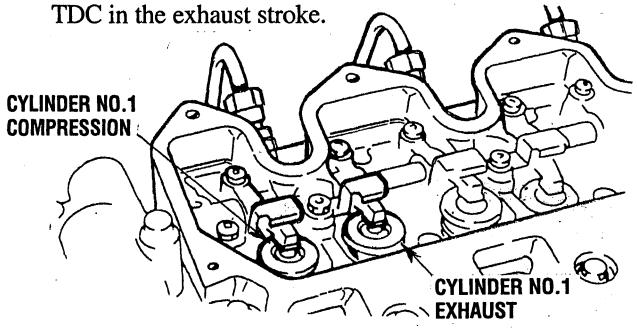


NOTE: *The cylinder head bolts have been tightened with the "Angular Tightening Method". Therefore, it is not necessary to retighten the cylinder head bolts before adjusting the valve clearances.*

ADJUSTMENT PROCEDURE



1. Turn the crankshaft clockwise so that the mark groove on the crank pulley is aligned with the TDC mark (cast out) on the timing gear case cover.
2. Remove the cylinder head cover and check to see if cylinder No.1 is at TDC in the compression stroke or at TDC in the exhaust stroke. When the intake and exhaust valves are closed, the cylinder is at TDC in the compression stroke, and when only the exhaust valve is open, it is at TDC in the exhaust stroke.



3. In accordance with the conditions of cylinder No.1, measure and adjust if required the clearance of the valves marked with either ◎ or ● in the table below.

Cylinder No.	1		2		3		4	
Valve arrangement	I	E	I	E	I	E	I	E
When No. 1 cylinder is at TDC in the compression stroke	●	●	●			●		
When No. 4 cylinder is at TDC in the compression stroke				◎	◎		◎	◎

I: Inlet E: Exhaust

4. On completion of the valve clearance alignment make a mark alignment as in **1** by giving a turn to the crankshaft in the normal direction. Then measure and adjust the clearance of the other valves.

> ⚠ **CAUTION:** ***The rocker arm is made of die-cast aluminum. Therefore, be careful not to tighten the adjusting screw to excess.***

Adjustment of Injection Timing

The injection timing may not be re-adjusted. Take care not to forget to insert a shim in the mounting surface when reassembling the injection pump after disassembly.

IDLE SPEED (OPERATING RPMS)

Engine idles speed 950 - 1000 rpm
(All models in this manual)
Idle speed should be adjusted with the engine in its normal operating temperature range.

Cruise RPM
Models 55B/Four and 55C/Four 2000-2500 rpm
Model 55D/Four 1800 - 2200 rpm

Maximum RPM (propeller loaded)
Models 55B/Four and 55C/Four 2950-3000 rpm
Model 55D/Four 2550-2600 rpm

ZF MARINE TRANSMISSIONS

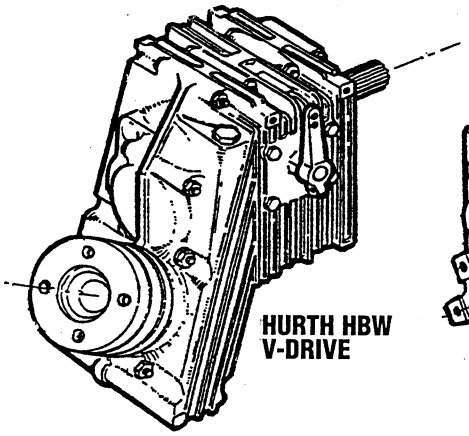
DESCRIPTION

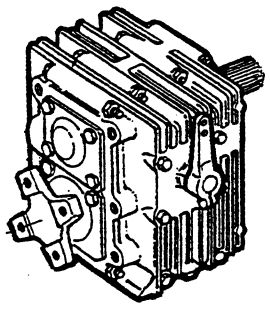
The information below is specific to the HBW Transmissions, the *TRANSMISSION TROUBLESHOOTING SECTION* applies to all models.

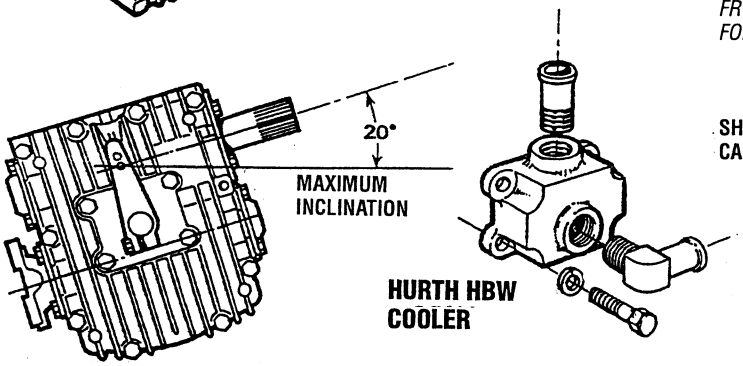
CONNECTION OF GEAR BOX WITH PROPELLER

HBW recommend a flexible connection between the transmission gearbox 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 taken 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 a flexible coupling or "DRIVESAVER" will reduce stress in the gearbox bearings caused by hull distortions, especially in wooden boats or where the distance between transmission output flange and stern gland is less than about 32 in (812 mm).







⚠ 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.***

*"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 Bowden cable or rod linkage, by unsuitably positioned guide sheaves, too small a bending radius, etc. In order to mount a support for shift control cable connections, use the two threaded holes located above the shift cover on top of the gear housing. Refer to the WESTERBEKE parts list.*

CONTROL CABLES

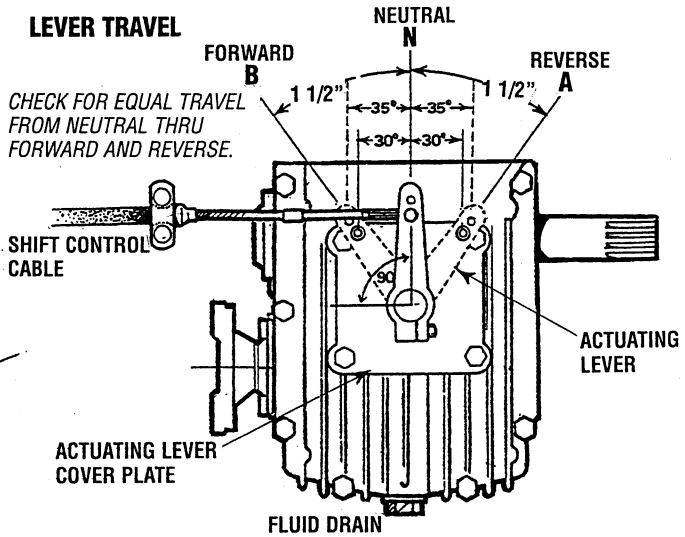
The transmission is suitable for single lever remote control. Upon loosening the retaining screw, the actuating lever can be moved to any position required for the shift control elements (cable or rod linkage). Make certain that the actuating lever does not contact the actuating lever cover plate: the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

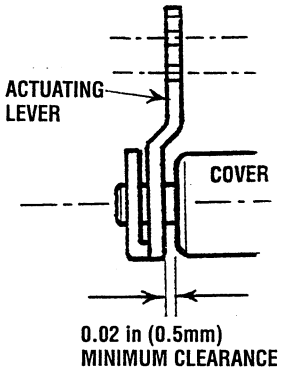
The control cable should be arranged at a right angle to the actuating lever when in the neutral position. The neutral position of the shift operating lever on the control console should coincide with the neutral position of the actuating lever.

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 pivot point 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 actuating lever travel at least each season.*



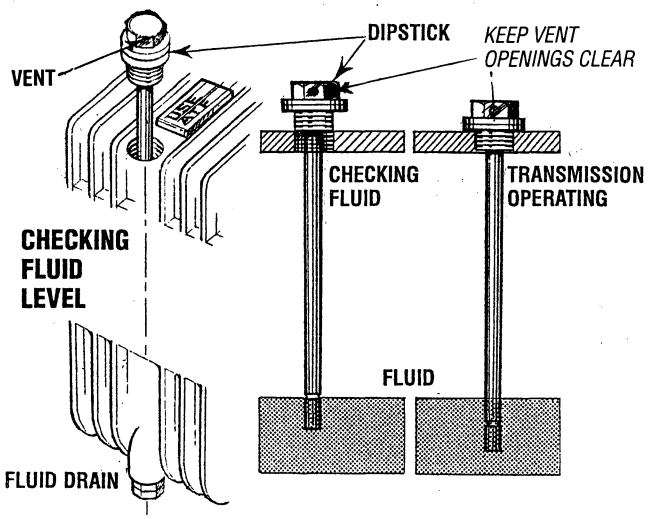


ZF MARINE TRANSMISSIONS

INITIAL OPERATION

All HDW/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.***

OPERATING TEMPERATURE

The maximum permissible ATF temperature should not exceed 230° (110°). This temperature can only be reached for a short time.

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

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, 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.*

ZF TRANSMISSIONS SPECIFICATIONS

General	(ZF Standard Transmission) Case hardened helical gears, with a servo-operated multiple disc clutch
Gear Ratio (optional) **Note:** There are a variety of gear ratios available. Only a few are listed.	ZF 15MA (1.88:1 or 2.13:1) ZF 12MA (2.13:1) ZF 15MIV (2.13:1 or 2.72:1) ZF 25A (1.9:1 or 2.4:1) ZF 25MA (2.2:1 or 2.7:1)
Lubricating Fluid	ATF - Type A or Dextron - II or III
Propeller Shaft Direction of Rotation	Right-hand rotation for above models listed.

ZF MARINE TRANSMISSIONS

OPERATING TEMPERATURE

> ⚠ **CAUTION:** ***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.

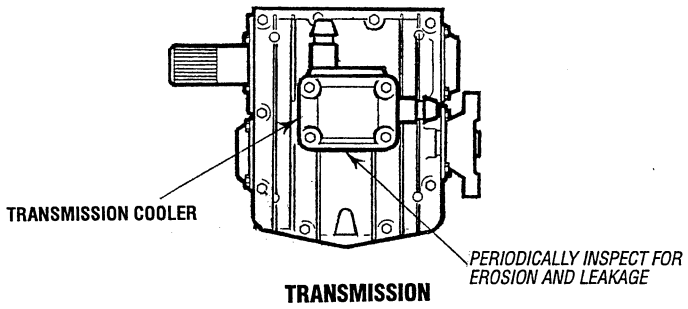
TRANSMISSION COOLER

Transmission coolers are standard on ZF10M(HBW100), ZF12M(HBW124), ZF15M(HBW150), ZF15MA(HBW150A), ZF15MIV(HBW150V) and the ZF25M(HBW250). No cooler is needed for the ZF35 or the ZF50.

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.



MAINTENANCE

Transmission maintenance is minimal. Keep the exterior housing clean, check the fluid level as part of your regular routine per operational checks. Change the fluid after initial 25 hour break-in and then at 300 hours of operation or at least once a season.

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:

☐ 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:

ZF Industries
3131 SW 42nd Street
Fort Lauderdale, FL 33312
Tel.: (954) 581-4040

TRANSMISSION TROUBLESHOOTING [ZF]

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 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.*

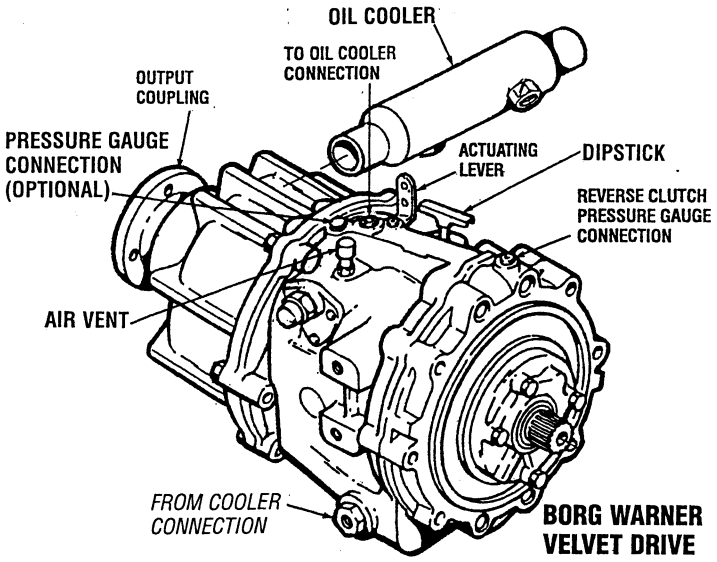
Problem	Probable Cause	Verification/Remedy
Transmission gears cannot be shifted. Fails to move into gear.	1. Actuating lever is loose.	1. Tighten damping bolt on actuating lever.
	2. Shifting cable is broken, bent or unattached. Cable radius is too severe.	2. Check the cable, reattach or replace.
	3. Actuating lever is binding against the. cover plate.	3. Detach the shift cable and operate the actuating lever by hand. Clearance should be0.02 in (0.5mm).
Transmission shifts into gear, but fails to propel the boat.	1. Output coupling is not turning.	1. Transmission needs professional attention.
	2. Propeller shaft is not turning. Output coupling is turning.	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. Output coupling and propeller shaft are turning.	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.	1. Actuating lever travel **N** to **B** not . equal to **N** to **A**.	1. Adjust cover plate until is in exact mid-position. This adjustment MUST be performed only by an authorized ZF facility.
	2. Actuating lever travel is insufficient.	2. Check shift lever cable length. See *ACTUATING LEVER DIAGRAM.*
	3. Actuating lever is binding against cover plate.	3. Check clearance, adjust if necessary.
Transmission noise becomes louder.	1. Damage starting on flexible coupling due to wear or fatigue, possibly due to misalignment between engine and transmission.	1. Check alignment, inspect flexible coupling. If noise persists, inspect the damper plate between the transmission and the engine. Replace if necessary.
	2. Beginning damage of bearings in transmission due to torsional vibrations, running without fluid, overload, wrong alignment of transmission, or excessive engine output.	2. Transmission needs professional attention.
Chattering transmission noise, mainly at low engine speed.	1. The engine or propeller generates torsional vibrations in the drive unit which produces a "chattering" noise in the transmission.	1. Mount a flexible coupling with another stiffness factor between the engine and transmission; a coupling with 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.	1. Operating temperature is high.	1. Wrong type of fluid. Use ATF Dextron III, check fluid level.
	2. Operating without cooling.	2. Check cooler. Inspect coolant hoses and coolant flow.
Oil Leakage.	1. Corrosion at radial sealing ring and shaft. Damage sealing ring.	1. Transmission needs professional attention.
	2. Misalignment of output flanges.	2. Check alignment. Must be within 0.003 in (0.08mm).

TRANSMISSION TROUBLESHOOTING [ZF]

Problem	Probable Cause	Verification/Remedy
Chattering transmission noise, mainly at low engine speed.	**1.** The engine or propeller generates torsional vibrations in the drive unit which produces a "chattering" noise in the transmission. **2.** Damper plate chatter.	**1.** Mount a flexible coupling with another stiffness factor between the engine and transmission; a coupling with a higher stiffness factor might be sufficient. **2.** Advance throttle slightly, if chatter stops the idle speed should be adjusted. **2a.** If chatter continues, inspect the damper plate.
Transmission shifts into gear, but fails to propel the boat.	**1.** Output coupling is not turning. **2.** Propeller shaft is not turning. Output coupling is turning. **3.** Output coupling and propeller shaft are turning.	**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. Variable pitch propeller may be in "no pitch" position.

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

BORG WARNER VELVET DRIVE TRANSMISSION
OPTIONAL TRANSMISSION



SHIPMENT

For safety reasons, the transmission is ***not*** filled with transmission fluid during shipment and the selector lever is temporarily attached to the actuating shaft.

Before leaving the WESTERBEKE plant, each transmission undergoes a test run, with *Dextron III ATF* transmission fluid. The residual fluid remaining in the transmission after draining acts as a preservative and provides protection against corrosion for at least one year if properly stored.

TRANSMISSION FLUID

Check the transmission fluid level on the dipstick. If the transmission has not been filled, fill with *Dextron III* and continue to use this fluid. During the first 25 hours of operation, keep a lookout for any leakage at the bell housing, output shaft and transmission cooler. This fluid should be changed after the first 25 hours and approximately every 300 operating hours thereafter and/or at winter lay-up.

> ⚠ **CAUTION:** ***Be certain the transmission is filled and the correct size cooler is properly installed before starting the engine.***

SHIFT LEVER POSITION

The gear shift control mechanism and linkage must position the actuating lever on the transmission exactly in Forward (**F**), Neutral (**N**), and Reverse (**R**) shifting positions. A detent ball located behind the transmission lever must work freely to center the lever in each position. The gear shift positions at the helm must be coordinated with those of the Velvet Drive actuating lever through shift mechanism adjustments. An improperly adjusted shift mechanism can cause damage to the transmission. The shifting mechanism and transmission actuating lever should be free of dirt and well lubricated to ensure proper operation.

Shifting Into Gear

Place the gear shift in Neutral before starting the engine. Shifting from one selector position to another selector position may be made at any time below 1000 rpm and in any order. Shifts should be made at the lowest *practical* engine speed. Start the engine and set the throttle at idle speed; allow the transmission fluid to warm up for a few minutes.

Neutral

Move the gear shift lever to the middle position. You should feel the detent. This centers the actuating lever on the transmission. With the control in this position, hydraulic power is completely interrupted and the output shaft of the transmission does not turn.

NOTE: *Some transmissions are equipped with a neutral safety switch. Unless the transmission actuating lever is perfectly aligned in neutral, the engine starter will not activate.*

Forward

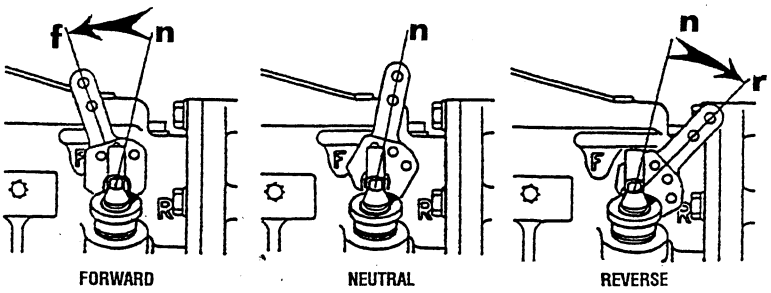
Move the gear shift lever to the forward position. You should feel the detent. The actuating lever on the transmission is in the forward position. The output shaft and the propeller shaft move the boat in a forward direction.

Reverse

Move the gear shift lever to the reverse position. You should feel the detent. The actuating lever on the transmission is in the reverse position. The output shaft and the propeller should move the boat in a reverse direction (astern).

NOTE: *Moving the transmission actuating lever from Neutral Position to Forward is always toward the engine. Reverse is always away from the engine. If boat moves backwards with the gear shift control in the forward position, shut off the engine! This problem may be a result of incorrect movement of the actuating lever by the gear shift lever.*

BORG WARNER VELVET DRIVE TRANSMISSION



TRANSMISSION ACTUATING LEVER POSITIONS

DAILY OPERATION

- ☐ Check the transmission fluid.
- ☐ Visually check the gear shift linkage and transmission.
- ☐ Start the engine in neutral. Allow a few minutes at idle for the fluid to warm.

  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.*

- ☐ Shift into gear.

> ⚠ **CAUTION:** ***Shifting gears above 1000 rpm can cause damage to the engine damper plate. Pulling the throttle back to idle when shifting gears will save wear on the transmission and the damper plate.***

INSPECTION

- ☐ Visually check for oil leaks at the hydraulic connections. Check for wear on the hydraulic lines and replace if worn.
- ☐ Lubricate the detent ball and shift cable attachments.
- ☐ Inspect the shift linkage.
- ☐ Inspect the transmission bolts; retorque if necessary.

> ⚠ **CAUTION:** ***Clutch failure will occur if the transmission shift lever does not fully engage the detent ball positions.***

CHANGING THE TRANSMISSION FLUID

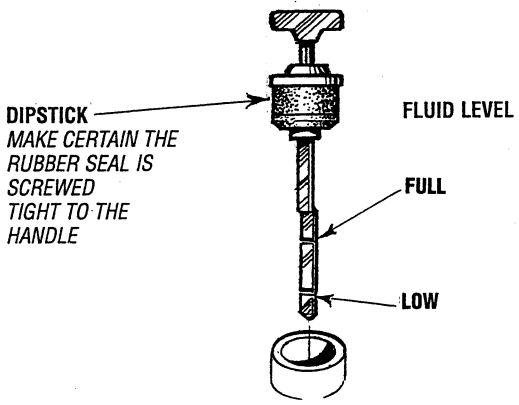
After the initial 50 hour change, the transmission fluid should be changed at every 300 operating hours thereafter or at winter haul-out. However, the fluid must be changed whenever it becomes contaminated, changes color, or smells rancid.

- ☐ Remove the oil filler cap and dipstick.
- ☐ Remove the oil cooler return line and allow the oil to drain into a container.
- ☐ Reconnect the oil cooler return line.
- ☐ Use a suction pump to remove the transmission oil through the filler cap/dipstick hole.
- ☐ Clean off the transmission and properly dispose of the used fluid.
- ☐ Refill the transmission with *DEXTRON III ATF*. The quantity will vary depending on the transmission model and the installation angle. Fill through the dipstick hole.
- ☐ Check the dipstick for the proper fluid level.
- ☐ Replace the oil filler cap and dipstick. (Press the dipstick into place and turn clockwise until finger-tight.)
- ☐ Run the engine, shutdown and recheck the fluid level.

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

Oil Capacity

Approximately 2.5 quarts (2.36 liters) will fill most transmissions to the oil level fill mark on the dipstick. Many variables have a direct relationship to the oil capacity. Additional oil will be required to fill the oil cooler and the cooler lines. The angle of installation will make a difference in the quantity of oil required to fill the transmission.



Oil Temperature

A maximum oil temperature of 190°F (88°C) is recommended. Discontinue operation anytime sump oil temperature exceeds 230°F (110°C).

PRESSURE GAUGE

An optional mechanical pressure gauge can be installed at the control panel to constantly monitor the pressure of the transmission fluid. A normal reading at 2000 rpm in forward gear should indicate 95 – 120 lb-in² (6.7 – 8.4 kg-cm²) and be constant.

BORG WARNER VELVET DRIVE TRANSMISSION

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:

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

NOTE: *This operation will usually 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, 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 fluid to prevent internal corrosion. Reduce the fluid level before putting the engine back into service.*

WARRANTY NOTES

Service manuals are available from your *BORG WARNER* dealer. **For assistance, contact:**

Velvet Drive Transmissions
1208 Old Norris Road
Liberty, SC 29657
Tel.: (800) 583-4327
www.VelvetDrive.com

BORG WARNER is aware of the shock loads that can be placed on its gears as the result of mechanical propeller operation or fully reversing of the propeller blades while shifting. Therefore torque loads and directional changes should be made at low engine speeds. If it is found that a failure was caused by a shock load, any warranty claim will be denied.

> ⚠ **CAUTION:** ***System-related noises or vibrations can occur at low engine speeds which can cause gear rattle resulting in damage to the engine and/or transmission. BORG WARNER is not responsible for total system-related torsional vibration of this type.***

If any problems occur with the transmission, see *TRANSMISSION TROUBLESHOOTING* in this manual.

OIL COOLERS

The continued flow of raw water through the cooler will, in time, erode the inside of the cooler causing cross leaks to occur. These internal cooler leaks will cause one of the following two problems:

1. Transmission fluid will leak into the flow of raw water and be discharged overboard through the engine exhaust. *A loss of transmission fluid will cause the transmission to fail.*
2. The raw water will leak into the transmission fluid causing an increase in transmission fluid. This contaminated fluid will appear as strawberry cream. *The transmission will eventually fail.*

Either case requires an immediate response:

1. Install a new oil cooler.
2. Refill the transmission with *DEXTRON III ATF.*

If water has contaminated the fluid, the transmission fluid needs to be cleaned out and replaced with fresh fluid. It will take several fluid changes to get rid of the contamination. Check your dipstick each time until it appears as pure transmission fluid. Change the transmission filter and clean out the fluid lines that connect to the cooler.

If the transmission fails to shift properly, it will most likely need the attention of a qualified transmission service facility.

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.

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 engine oil from the oil sump. Remove and replace the oil filter and fill the sump with new oil. Use the correct grade of oil. Refer to the *ENGINE LUBRICATING OIL* pages in this manual for the oil changing procedure. 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. 2D diesel fuel. Fuel additives should be added prior to topping off to ensure they mix with the fuel being added and fuel still in the tank. Additives such as Bio-bor and Diesel Kleen + Cetane Boost should be added at this time to control bacteria growth and 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 fuel filter/water separator 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.

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.

LAY-UP & RECOMMISSIONING

Cylinder Lubrication

If you anticipate a long lay-up period (12 months or more) WESTERBEKE recommends removing the glow plugs from the cylinder head (injectors if engine does not have glow plugs) and squirt light lubricating oil into each cylinder. Rotate the engine by hand 1-2 revolutions and re-install the glow plugs or injectors.

Be sure to have a hardware kit for your engine to ensure you will have any needed sealing washers.

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.

> ⚠ **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.***

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.
4. 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.
5. Start the engine in accordance with procedures described in the *PREPARATIONS FOR STARTING* section of this manual.

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

DISTANCE EQUIVALENTS

1 Degree of Latitude = 60 Nm = 111.120 km
1 Minute of Latitude = 1 Nm = 1.852 km

VOLUME

Cubic Inches (in^3) x 16.387 = Cubic Centimeters x .061 = in^3
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 (H_2O) x .07355 = Inches of Mercury x 13.783 = H_2O
Inches of Water (H_2O) x .03613 = psi x 27.684 = H_2O
Inches of Water (H_2O) x .248 = Kilopascals (kPa) x 4.026 = H_2O

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

LIQUID WEIGHTS

Diesel Oil = 1 US gallon = 7.13 lbs
Fresh Water = 1 US gallon = 8.33 lbs
Gasoline = 1 US gallon = 6.1 lbs
Salt Water = 1 US gallon = 8.56 lbs

SPECIFICATIONS 55B AND 55C ENGINE

SPECIFICATIONS

Engine Type	Diesel, water cooled, four cycle, four cylinder, in-line overhead valve type
Displacement	133 cubic inches (2.179 liter)
Combustion Type	In-direct injection
Combustion System	Swirl chamber
Bore & Stroke	3.35 x 3.78 inches (85 x 96 mm)
Max. Angle of Installation	Not to exceed 14°
Max. Angle of Rotation	Not to exceed 30° for 30 minutes
Firing Order	1 - 3 - 4 - 2
Direction of Rotation	Counterclockwise, when viewed from flywheel
Propeller Shaft	Right hand direction of rotation
Compression Ratio	21:5:1
Aspiration	Naturally Aspirated
Engine Speed	Idle speed: 950-1000 RPM Cruising Speed: 2000-2500 RPM No load speed: 3200 RPM (neutral)
Fuel Consumption	1.5 U.S. gph running at 2500 RPM (approx.) when the propeller used allows the engine to turn at 3000 RPM at full open throttle underway in forward
Dimensions - inches (mm) Engine Only	Height: 23.3 inches (592 mm) Width: 18.6 inches (472 mm) Length: 27.0 inches (687 mm)
Weight	448 lbs (203.2 kgs)
Air Flow	Engine Combustion: 116 cfm (3.3 cmn) Engine Cooling: 100 cfm (2.8 cmm)

TUNE-UP SPECIFICATIONS

Compression Pressure	441 psi (3.04 MPa)
Valve Timing Intake Opens Intake Closes	 Open at 15° BTDC - Close 29° ABDC Open at 40° BTDC - Close 16° ATDC
Injection Timing	16° BTDC - **55-B** 13° BTDC - **55 C**
Nozzle Injector Pressure	1920 psi (13.2 MPa)
Valve Clearance (engine cold)	0.0157 inches (0.4 mm)

ELECTRICAL SYSTEM

Starting Battery	12 Volt, (–) negative ground
Battery Capacity	400 - 600 CCA (min.)
DC Charging Alternator	50 Amp rated, belt-driven - 12V
Starting Aid	Glow plugs, 12V sheathed
Starter	12 Volt, 1.8 KW with solenoid
Cold Cranking Amps	175 - 200 Amps
Alternator Regulator	Internal regulator, built into alternator

EXHAUST SYSTEM

Exhaust Elbow	45° elbow
Exhaust Hose Size	3.0" I.D. hose
Exhaust Gas Flow	265 cfm at 3000 RPM
Muffler Size (min.)	14" x 14"

FUEL SYSTEM

General	Self bleeding
Fuel	Diesel fuel ASTM D975 No.2D
Fuel Injection Pump	BOSCH, PFR type
Injectors	Throttle type
Fuel Filter	Primary, full flow, spin-on element
Air cleaner	Replaceable paper cartridge.
Fuel Lift Pump	Solid state with external filter

COOLING SYSTEM

General	Fresh water-cooled with tube and shell type heat exchanger.
Operating Temperature	170 – 190° F (77 – 88° C)
Fresh Water Pump	Centrifugal metal impeller type belt-driven.
Raw Water Pump	Positive displacement, rubber impeller, belt-driven.
System Capacity	7.25 US qts (6.86 liters)
Sea Water Flow at 3000 rpm	8.0 - 8.5 gpm (30.2 - 32.1 lpm) (measured before discharging into water injected exhaust elbow)

LUBRICATION SYSTEM

General	Forced lubrication by Trochoid type pump
Oil Filter	Full flow spin-on
Sump Capacity (not including filter)	8 U.S. qts (7.6 liters)
Operating Oil Pressure (engine hot)	43 – 85 psi (290 – 590 KPa)
Oil Grade	API Service Category CF, CF-4, CG-4, CH-4 or CI-4. SAE 10W-40 or 15W-40
Oil Cooler	Fresh water cooled

TRANSMISSION

General	ZF Marine Transmission, case hardened, helical gears, with a servo-operated multiple disc clutch
Gear Ratio (standard)	1:88:1 (ZF25M)
Propeller Recommendations	18 x 13P-2blade (RH) or 18 x 11P 3 blade (RH) (Propeller used should allow the engine to reach its full rated RPM (3000 + 000 -100) at full open throttle while underway in forward gear)
Lubricating Fluid	Automatic transmission fluid, type Dexron II or III
Transmission Sump Capacity	0.75 U.S. qts. (0.79 liters)

SPECIFICATIONS 55D ENGINE

SPECIFICATIONS

Engine Type	Diesel, water cooled, four cycle, four cylinder, in-line overhead valve type
Displacement	133 cubic inches (2.179 liter)
Combustion Type	In-direct injection
Combustion System	Swirl chamber
Bore & Stroke	3.35 x 3.78 inches (85 x 96 mm)
Max. Angle of Installation	Not to exceed 14°
Max. Angle of Rotation	Not to exceed 30° for 30 minutes
Firing Order	1 - 3 - 4 - 2
Direction of Rotation	Counterclockwise, when viewed from flywheel
Propeller Shaft	Right hand direction of rotation
Compression Ratio	21:5:1
Aspiration	Naturally Aspirated
Engine Speed	Idle speed: 950-1000 RPM Cruising Speed: 1800-2200 RPM No load speed: 2700 RPM (+ or -)
Fuel Consumption	**1.6 U.S. gph running at 2200 RPM (approx.) when the propeller used allows the engine to turn at 2600 RPM at full open throttle underway in forward**
Dimensions - inches (mm) Engine Only	Height: 23.9 inches (592 mm) Width: 21.0 inches (472 mm) Length: 35.4 inches (687 mm)
Weight	448 lbs (203.2 kgs)
Air Flow	Engine Combustion: 100 cfm (2.8 cmn) Engine Cooling: 100 cfm (2.8 cmm)

TUNE-UP SPECIFICATIONS

Compression Pressure	441 psi (3.04 MPa)
Valve Timing Intake Opens Intake Closes	 Open at 15° BTDC - Close 29° ABDC Open at 40° BTDC - Close 16° ATDC
Injection Timing	13° BTDC
Nozzle Injector Pressure	1920 psi (13.2 MPa)
Valve Clearance (engine cold)	0.0157 inches (0.4 mm)

ELECTRICAL SYSTEM

Starting Battery	12 Volt, (–) negative ground
Battery Capacity	400 - 600 CCA (min.)
DC Charging Alternator	50 Amp rated, belt-driven - 12V
Starting Aid	Glow plugs, 12V sheathed
Starter	**12 Volt, 1.8 KW with solenoid**
Cold Cranking Amps	260 – 285 amps
Alternator Regulator	Internal regulator, built into alternator

EXHAUST SYSTEM

Exhaust Elbow	45° elbow
Exhaust Hose Size	3.0" I.D. hose
Exhaust Gas Flow	**230 cfm at 2600 rpm**
Muffler Size (min.)	14" x 14"

FUEL SYSTEM

General	Self bleeding
Fuel	Diesel fuel ASTM D975 No.2D
Fuel Injection Pump	BOSCH, PFR type
Injectors	Throttle type
Fuel Filter	Primary, full flow, spin-on element
Air cleaner	Replaceable paper cartridge.
Fuel Lift Pump	Solid state with external filter

COOLING SYSTEM

General	Fresh water-cooled with tube and shell type heat exchanger.
Operating Temperature	170 – 190° F (77 – 88° C)
Fresh Water Pump	Centrifugal metal impeller type belt-driven.
Raw Water Pump	Positive displacement, rubber impeller, belt-driven.
System Capacity	7.25 US qts (6.86 liters)
Sea Water Flow at 2600 rpm	7.0 - 7.3 gpm (26.5 - 27.6 lpm) (measured before discharging into water injected exhaust elbow)

LUBRICATION SYSTEM

General	Forced lubrication by Trochoid type pump
Oil Filter	Full flow spin-on
Sump Capacity (not including filter)	8.9 U.S. qts (8.4 liters)
Operating Oil Pressure (engine hot)	43 – 85 psi (290 – 590 KPa)
Oil Grade	API Service Category CF, CF-4, CG-4, CH-4 or CI-4. SAE 10W-40 or 15W-40
Oil Cooler	Fresh water cooled

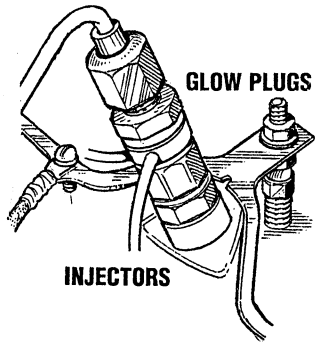
TRANSMISSION

General	ZF Marine Transmission, case hardened, helical gears, with a servo-operated multiple disc clutch
Gear Ratio (standard)	1:88:1 (ZF25M)
Propeller Recommendations	**18 x 12P-2blade (RH) or 18 x 10P 3 blade (RH) (Propeller used should allow the engine to reach its full rated RPM (2600 + 000 -100) at full open throttle while underway in forward gear)**
Lubricating Fluid	Automatic transmission fluid, type Dexron II or III
Transmission Sump Capacity	0.75 U.S. qts. (0.79 liters)

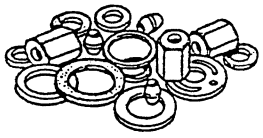
SUGGESTED SPARE PARTS

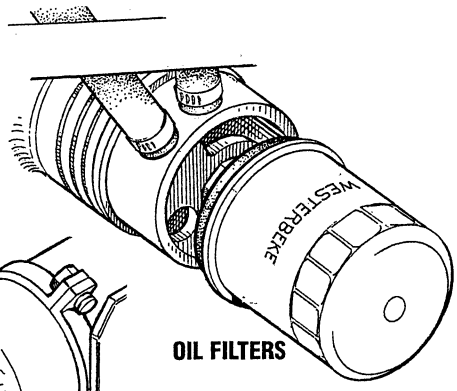
WESTERBEKE MARINE DIESEL ENGINES

CONTACT YOUR WESTERBEKE DEALER FOR SUGGESTIONS AND ADDITIONAL INFORMATION

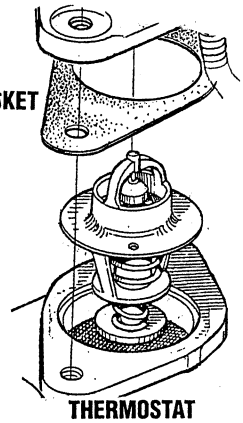

GLOW PLUGS

INJECTORS

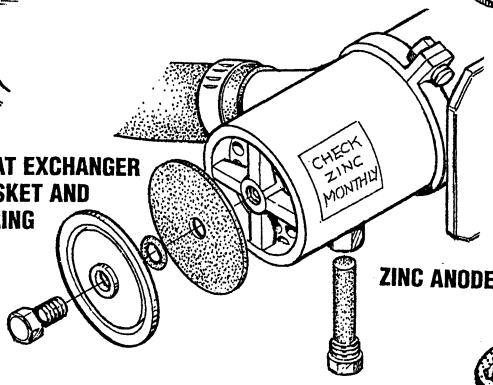

HARDWARE KIT



OIL FILTERS

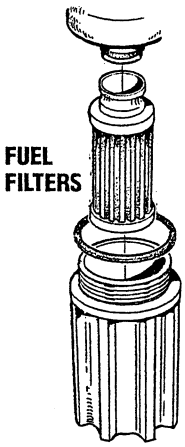

GASKET

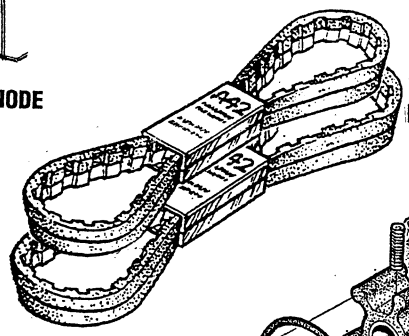
THERMOSTAT

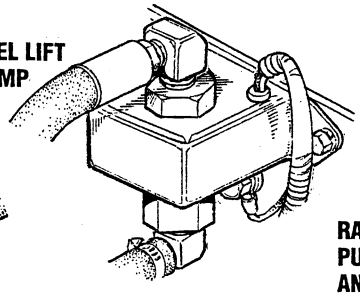


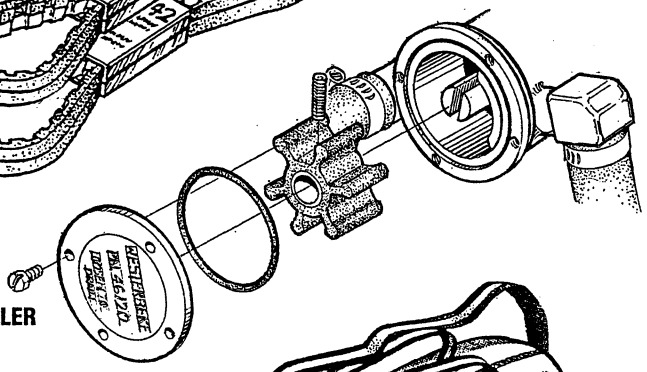
HEAT EXCHANGER GASKET AND O-RING

ZINC ANODE

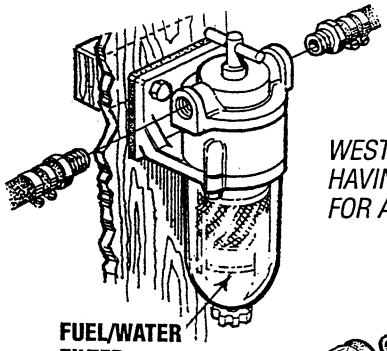

FUEL FILTERS


ENGINE BELTS

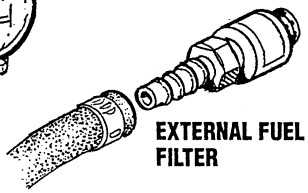

FUEL LIFT PUMP

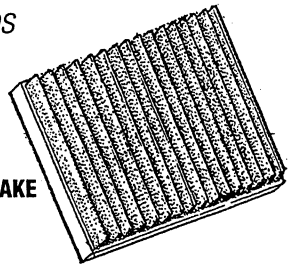


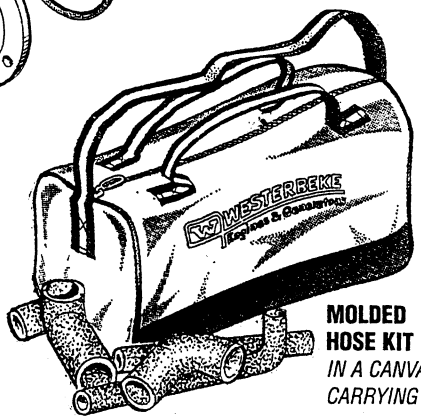
RAW WATER PUMP IMPELLER AND O-RING


FUEL/WATER FILTER CARTRIDGES

WESTERBEKE ALSO RECOMMENDS HAVING ENOUGH OIL ON-BOARD FOR AT LEAST ONE OIL CHANGE


EXTERNAL FUEL FILTER

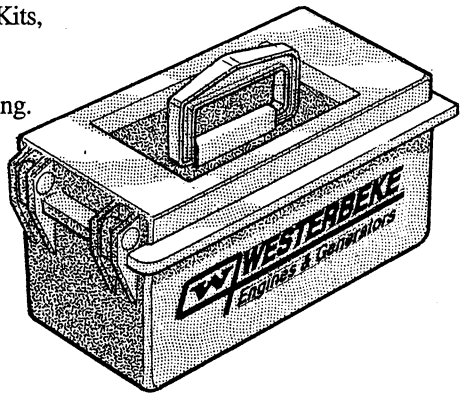

AIR INTAKE FILTER



MOLDED HOSE KIT *IN A CANVAS CARRYING BAG*

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.



KIT A

- ZINC ANODES
- DRIVE BELTS
- OIL FILTER
- FUEL FILTER
- HEAT EXCHANGER GASKET
- IMPELLER KIT
- FUEL SYSTEM HARDWARE KIT
- FUEL PUMP INLET FILTER

KIT B

- ZINC ANODES
- DRIVE BELTS
- OIL FILTER
- FUEL FILTER
- HEAT EXCHANGER GASKET
- IMPELLER KIT
- INJECTOR
- OVERHAUL GASKET KIT
- AIR FILTER
- GLOW PLUG
- FUEL SYSTEM HARDWARE KIT
- FUEL PUMP INLET FILTER

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