WESTERBEKE

MARINE DIESEL GENERATOR

4.0KW BCD/4.0KW BCDA 612-60HZ

OPERATORS MANUAL

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WESTERBEKE

member NMMA

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CALIFORNIA
PROPOSITION 65 WARNING

Diesel engine exhaust 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.

This 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.

SAFETY INSTRUCTIONS

INTRODUCTION

Read this safety manual carefully. Most accidents are caused by failure to follow fundamental rules and precautions. Know when dangerous conditions exist and take the necessary precautions to protect yourself, your personnel, and your machinery.
The following safety instructions are in compliance with the American Boat and Yacht Council (ABYC) standards.

PREVENT ELECTRIC SHOCK

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

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

PREVENT BURNS — HOT ENGINE

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

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

> ⚠ **WARNING:** ***Steam can cause injury or death!***

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

PREVENT BURNS — FIRE

> ⚠ **WARNING:** ***Fire can cause injury or death!***

- Prevent flash fires. Do not smoke or permit flames or sparks to occur near the carburetor, fuel line, filter, fuel pump, or other potential sources of spilled fuel or fuel vapors. Use a suitable container to catch all fuel when removing the fuel line, carburetor, or fuel filters.
- Do not operate with a Coast Guard Approved flame arrester removed. Backfire can cause severe injury or death.
- Do not operate with the air cleaner/silencer removed. Backfire can cause severe injury or death.
- Do not smoke or permit flames or sparks to occur near the fuel system. Keep the compartment and the engine/generator clean and free of debris to minimize the chances of fire. Wipe up all spilled fuel and engine oil.
- Be aware — diesel fuel will burn.

PREVENT BURNS — EXPLOSION

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

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

SAFETY INSTRUCTIONS

ACCIDENTAL STARTING

⚠ WARNING: ***Accidental starting can cause injury or death!***

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

BATTERY EXPLOSION

⚠ WARNING: ***Battery explosion can cause injury or death!***

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

BATTERY ACID

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

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

TOXIC EXHAUST GASES

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

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

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

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

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

AVOID MOVING PARTS

⚠ WARNING: ***Rotating parts can cause injury or death!***

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

SAFETY INSTRUCTIONS

- Do not wear loose clothing or jewelry when servicing equipment; tie back long hair and 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.
- Do not run engines for long periods with their enclosures open.

⚠ 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.

ENGINE 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-2 Ventilation
P-1 Exhaust systems
P-4 Inboard engines
E-9 DC Electrical systems

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

ABYC, NFPA AND USCG PUBLICATIONS FOR INSTALLING DIESEL ENGINES

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

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

Order from:

ABYC
15 East 26th Street
New York, NY 10010

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

Order from:

National Fire Protection Association
11 Tracy Drive
Avon Industrial Park
Avon, MA 02322

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

Order from:

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

INSTALLATION

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

CODES AND REGULATIONS

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

SIPHON-BREAK

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

EXHAUST SYSTEM

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

A detailed 40 page Marine Installation Manual covering gasoline and diesel, engines and generators, is available from your WESTERBEKE dealer.

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INTRODUCTION

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

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

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

WARRANTY PROCEDURES

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

Customer Identification Card

WESTERBEKE

Customer Identification
MR. GENERATOR OWNER
MAIN STREET
HOMETOWN, USA
Model 4.0 BCD Ser. #U0000-D702
Expires 4/4/03

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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

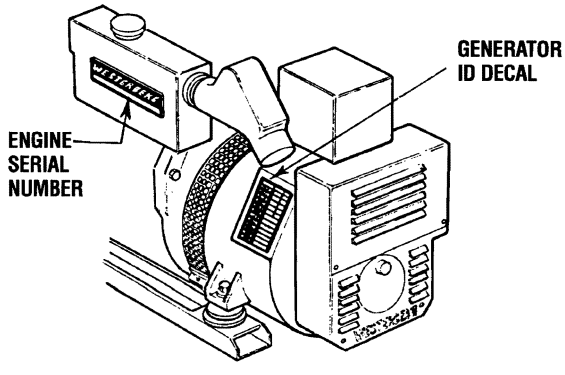
SERIAL NUMBER LOCATION

The engine and generator serial numbers and model numbers are located on a decal on the generator housing. Take the time to enter the information on the blank decal provided below as this will provide a quick reference when seeking technical information and/or ordering repair parts.

SPECIFICATION	50 HZ.	60 HZ.
MODEL		
RPM		
KW		
KVA		
VOLTS		
AMPS		
ENG. HP		
ENG. SER. NO.		
GEN. SER. NO.		
PF/PHASE	/	
WIRES		
RATING		
INSUL. CLASS		
TEMP. RISE		
BATTERY		
C.I.D.		

The engine serial number can also be found stamped into the engine block just above the injection pump. The generator serial number is stamped into the generator housing on the flat surface on the left side of the generator.

An identification plate on the engine manifold also displays the engine model and serial number.



NOTE: *A carbon monoxide warning decal has been provided by WESTERBEKE. Affix this decal in a visible position in the engine room.*

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 of the same general type as that of 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. Replacement of fuel and lubricating filter elements at the time periods specified is a must, and frequent checking for contamination (that is, water, sediment, etc.) in the fuel system is also essential. Another important factor is the 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 done away with and in their place is a single component – the fuel injection pump which performs the function of both.

ORDERING PARTS

Whenever replacement parts are needed, always provide the generator model number, engine serial number, and generator serial number as they appear on the silver and black name plate located on the generator end. You must provide us with this information so we may properly identify your generator set. In addition, include a complete part description and part number for each part needed (see the separately furnished Parts List). Also 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

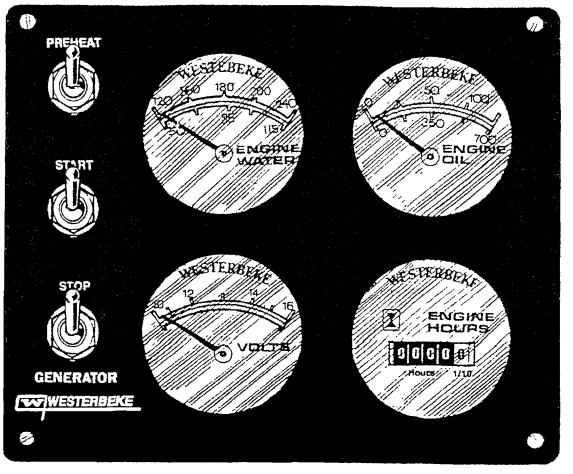
Certain spares will be needed to support and maintain your WESTERBEKE generator. Your local WESTERBEKE dealer will assist you in preparing an inventory of spare parts. See the *SPARE PARTS* page in this manual. For Engine and Generator Accessories, see the *ACCESSORIES* brochure.

GENERATOR CONTROL PANELS

DESCRIPTION OF SWITCHES

This manually controlled series of WESTERBEKE marine diesel generators is equipped with toggle switches on the engine control panel and, optionally, at remote panels.

All three switches are momentary contact type and serve the following functions:



PREHEAT: The PREHEAT toggle switch serves two purposes: preheating the engine for easy starting and defeating of bypassing the engine oil pressure switch. The defeat function turns on the fuel solenoid, instrument power and alternator excitation.

When the PREHEAT switch is depressed, the voltmeter, panel lights, gauges and meters and fuel solenoid will activate.

START: The START toggle switch closes the K1 relay that energizes the starter solenoid and activates the starter..

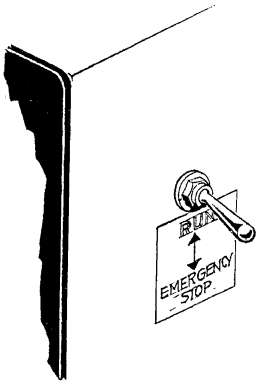
While the PREHEAT switch is still depressed, depressing the START switch engages the start solenoid. When the engine begins to fire, the START switch should be released. The PREHEAT switch should not be released until the oil pressure reaches 5 - 10 psi.

STOP: The STOP toggle switch is a normally closed switch. providing power to the fuel solenoid, instrument cluster and alternator excitation, after the oil pressure switch has closed upon starting. Opening of this switch opens the power circuit to the fuel solenoid, stopping the flow of fuel to the engine and shuts down the engine.

To stop the engine, depress the STOP switch. When the STOP switch is depressed, the power feed to the fuel solenoid is opened, and the fuel flow to the engine is stopped. The STOP switch should be depressed until the generator stops rotating.

NOTE: *When the engine is shut down, the water temperature gauge and the oil pressure gauge will continue to register the last temperature and oil pressure readings displayed. They will return to zero once electrical power is restored.*

EMERGENCY STOP: The EMERGENCY stop switch on the rear of the control box is normally closed. When depressed, it will open the DC circuit to the control panel and shut the engine down. As the switch is not toggled it can be used when performing maintenance.



DESCRIPTION OF GAUGES

Coolant Temperature

Engine coolant (water) temperature should normally indicate 175° to 195° F (80° to 90° C).

Engine Oil Pressure

Oil pressure (psi) may fluctuate depending on the generator load but should range between between 30 to 60 psi.

DC Voltmeter

Indicates the amount the battery is being charged should show 13V to 14V.

Hourmeter

Registers elapsed time and is used as a guide for when to perform scheduled maintenance.

REMOTE PANEL

For remote operation of the generator system, the same three switches are used. The PREHEAT and START switches are connected in parallel with the gauge panel's switches and serve the same functions as in the gauge panel. The STOP switch is in series with the gauge panel's STOP switch and serves the same function. There is a REMOTE START/STOP WIRING DIAGRAM in this manual.

NOTE: *For additional information on Control Panels. Refer to: STARTING/STOPPING PROCEDURE, DC WIRING DIAGRAMS and TROUBLESHOOTING GAUGES.*

DIESEL FUEL, ENGINE OIL AND ENGINE COOLANT

DIESEL FUEL

Use fuel that meets the requirements or specification of Class 2-D (ASTM), and has a cetane rating of #45 or better.

Care Of The Fuel Supply

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

Purchase a well-known brand of fuel.

Install and regularly service a good, visual-type fuel filter/water separator between the fuel tank and the engine. The *Raycor 225 or 500MA* are good examples of such filters.

ENGINE OIL

Use a heavy duty engine oil with an API classification of CF or CG-4 or better. Change the engine oil after an initial 50 hours of break-in operation, and every 100 hours of operation thereafter. For recommended oil viscosity, see the following chart:

Operating Temperature	Oil Viscosity
Above 68°F (20°C)	SAE 30, 10W-30 or 15W-40
41° – 68°F (5 – 20°C)	SAE 20, 10W-30 or 15W-40
Below 41°F (5°C)	SAE 10W-30 or 15W-40

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

OIL PRESSURE

The engine's oil pressure, during operation, is indicated by the oil pressure gauge on the instrument panel. During normal operation, the oil pressure will range between 35 and 55 psi (2.5 and 3.9 kg/cm²).

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

ENGINE COOLANT

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

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

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

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

Antifreeze mixtures will protect against an unexpected freeze and they are beneficial to the engine's cooling system. They retard rust and add to the life of the circulating pump seal.

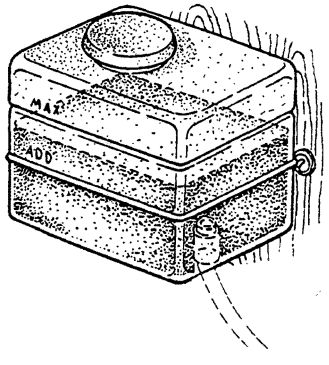
ANTIFREEZE PROTECTION

Antifreeze Concentration	23%	30%	35%	50%
Freezing Temperature	14°F (–10°C)	8°F (–13°C)	–4°F (–20°C)	–40°F (–40°C)

COOLANT RECOVERY TANK

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

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



PREPARATIONS FOR INITIAL START-UP

PRESTART INSPECTION

This section of the manual provides the operator with preparation, initial starting, break-in, starting (warm or cold) and stopping procedures. Follow the procedures as presented for the conditions indicated and your WESTERBEKE generator set will give reliable performance and long service life.

Before starting your generator set 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.
- ☐ Check the fuel supply and examine the fuel filter/separator bowls for contaminants.
- ☐ Check the DC electrical system. Inspect wire connections and battery cable connections.
- ☐ Check the coolant level in both the plastic recovery tank and at the manifold.
- ☐ Visually examine the unit. Look for loose or missing parts, disconnected wires, unattached hoses, and check threaded connections.
- ☐ Check load leads for correct connection as specified in the wiring diagrams.
- ☐ Examine air inlet and outlet for air flow obstructions.
- ☐ Be sure no other generator or utility power is connected to load lines.
- ☐ Be sure that in power systems with a neutral line that the neutral is properly grounded (or ungrounded) as the system requires, and that the generator neutral is properly connected to the load neutral. In single phase and some 3-phase systems an incomplete or open neutral can supply the wrong line-to-neutral voltage on unbalanced loads.
- ☐ Make sure the mounting installation is secure.
- ☐ Make sure that the generator is properly grounded.

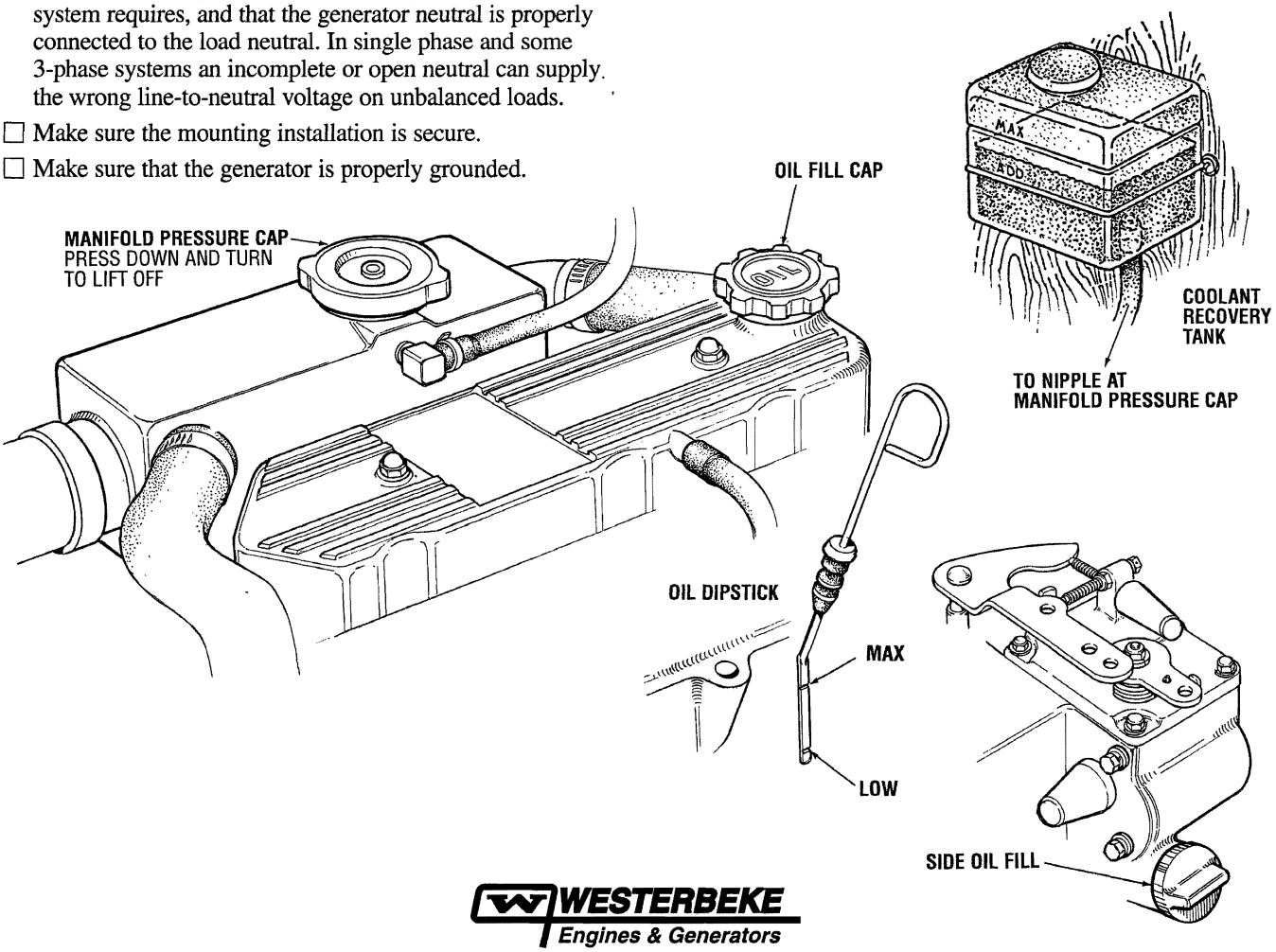
⚠ CAUTION: ***When starting the generator, it is recommended that all AC loads, especially large motors, be switched OFF until the engine has come up to speed and, in cold climates, starts to warm up. This precaution will prevent damage caused by unanticipated operation of the AC machinery and will prevent a cold engine from stalling.***

GENERATOR VOLTAGE

The speed of the generator engine is adjusted at the factory, however, it is advisable to verify.

To supply 60 Hertz, the speed should be 1800 RPM at no load, and should not fall below 1800 RPM by more than 5 percent (3 Hz) at full load.

Generator voltage should build to its rated value within 5 seconds after rated speed is attained. Record or observe voltage of generator at no load and at full load (hot). The voltages are easily adjusted to optimum values no load and full load (refer to *VOLTAGE ADJUSTMENT* in this manual). If possible, apply actual service load or test load of the same power factor as the load to be used in service. If voltage cannot be adjusted to suitable values and some fault seems evident, contact your authorized WESTERBEKE service dealer.



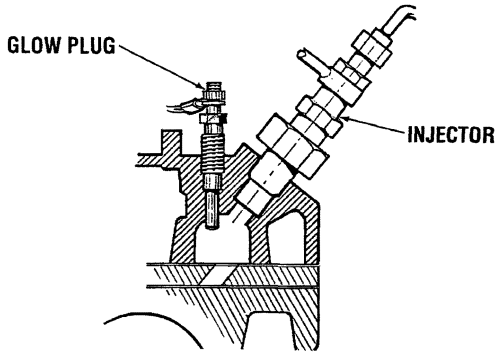
STARTING/STOPPING PROCEDURE

THE STARTING SYSTEM

Westerbeke diesel generators use electric starters assisted by glow plugs for both normal and cold weather starting. The illustration below shows a cross-sectional view of one cylinder. The glow plug is located in the combustion chamber so that its tip is in the injector nozzle's spray path. When the glow plug is energized by the PREHEAT button, the plug glows red at the tip and assists in igniting the fuel. The result is a rapid start with less wear on the starter.

This system is common to WESTERBEKE diesels. The start circuitry is designed so that the PREHEAT button must be depressed for the time specified in the preheat chart. Then, while keeping the PREHEAT button engaged, the START button is depressed to crank the engine.

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



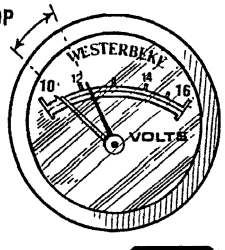
PREHEAT: Depress the PREHEAT switch. The voltmeter and panel lights, gauges and meters will be activated. The PREHEAT switch should be depressed in accordance with the following chart:

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

START: While still depressing the PREHEAT switch, depress the START switch. This will engage the starter solenoid. Upon engine starting, release the START switch. Do not release the PREHEAT switch until the oil pressure reaches 15 psi. Then as long as the high water temperature and low oil pressure protective circuits do not activate, the engine will remain energized and continue to run.

VOLTAGE DROP



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

Should the engine not start when the START switch is depressed for 10 to 20 seconds, release both switches and wait 30 seconds; repeat the procedure above and preheat longer. **Never run the starter for more than 30 seconds.**

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

Remote Starting Procedure

The remote start panel is the same as the engine-mounted start panel except that it has a green LED light and no gauges. When starting at a remote location, the green LED lights when the generator is running at approximately 600 rpm. This indicates when the START switch can be released since the starting of the generator may not be audible.

A. When the PREHEAT switch is depressed at the remote start/stop panel the LED light will illuminate. When the START switch is depressed and the starter cranks the engine this LED light will dim. When the engine starts the LED light will brighten signaling to release the START switch. Continue to hold the PREHEAT depressed for a few seconds to allow oil pressure to build up which closes the oil pressure safety switch that is in the series path for 12V B+ to the fuel run solenoid.

B. After the generator is started and the START switch is released, the generator's starter will not crank unless the PREHEAT switch is operated first because this switch supplies voltage to the START switch.

Once the engine starts, check the engine's instruments for proper oil pressure and battery charging voltage. Apply a light load to the generator and allow the engine's operating temperature to come up to 140-150° (60-66° C) before applying heavy loads.

NOTE: *Some unstable running may occur in a cold engine. Depressing the PREHEAT switch for 10-15 second intervals will help stabilize the engine RPM until the operating temperature reaches the 140 - 150° F and a load is applied to the engine.*

STARTING/STOPPING PROCEDURE

STARTING UNDER COLD CONDITIONS

Make sure the lubricating oil conforms with the ratings for the prevailing temperature. Check the table in the *ENGINE OIL* section in this manual.

The battery should be fully charged to minimize voltage drop.

Use a sufficient amount of preheat to aid in starting. See the *Temperature/Preheat* chart elsewhere in this section.

STOPPING PROCEDURE

1. Remove the AC electrical load from the generator and allow the generator to run for three to five minutes to stabilize its operating temperatures.
2. Depress the STOP switch and hold it until the generator is completely stopped.
3. Now release the STOP switch.

Remote Stopping Procedure

To stop the generator, depress the STOP switch which opens the normally closed B+ path for voltage to the engine's run circuit. The STOP switch must be held open until the generator comes to a complete stop.

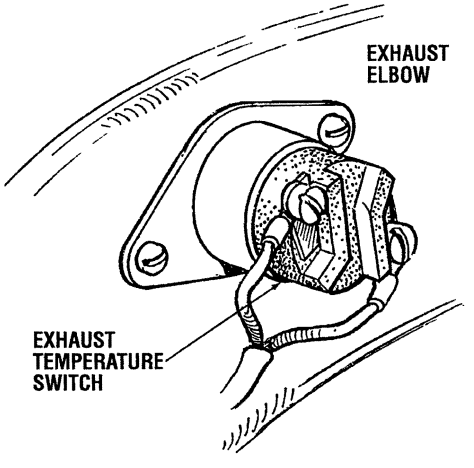
SAFETY SHUTDOWN SWITCHES

The engine is protected by three automatic shutdown switches. Should shutdown occur, ***do not attempt to restart without finding and correcting the cause. Refer to the heading "Engine Stops" in the*** **TROUBLESHOOTING** ***section of this manual.***

The following is a description of these automatic shutdown switches:

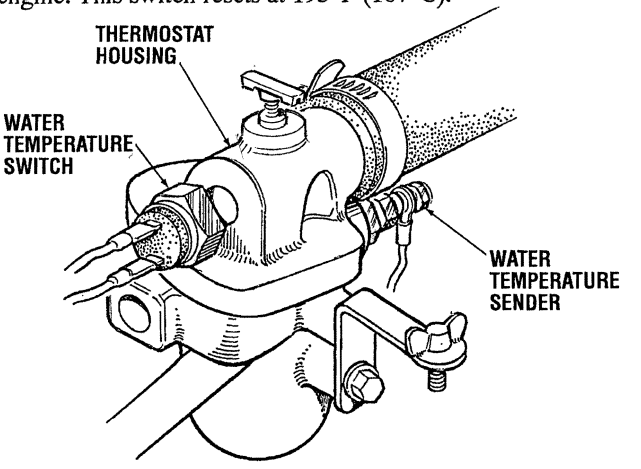
High Exhaust Temperature Switch

An exhaust temperature switch is located on the exhaust elbow. Normally closed, this switch will open and interrupt the DC voltage to the fuel solenoid on the injection pump (shutting OFF the engine) should the switch's sensor indicate an excessive exhaust temperature (an inadequate supply of raw water causes high exhaust temperatures). This switch opens at 260-270°F (127-132°C). This switch resets at approximately 225°F (107°C).



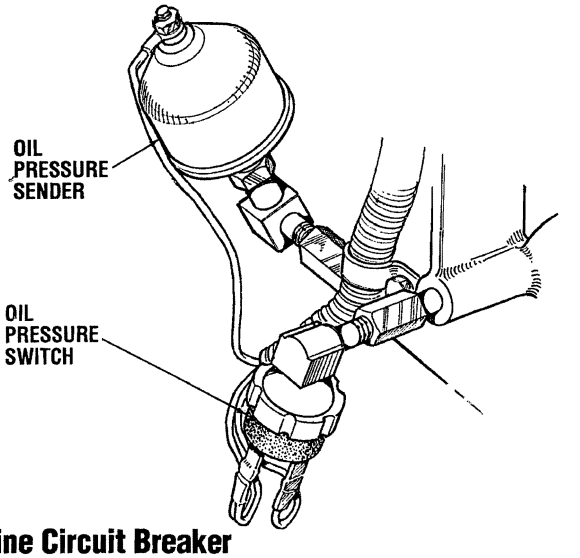
High Water Temperature Switch

A high water temperature switch is located on the thermostat housing. Normally closed, this switch, should the fresh water coolant's operating temperature reach approximately 210°F (99°C), will open and interrupt the DC voltage to the fuel solenoid on the injection pump, thereby shutting off the engine. This switch resets at 195°F (107°C).



Low Oil Pressure Switch

A low oil pressure shutdown switch is located off the engine's oil gallery. Normally open in a static state, this switch's sensor monitors the engine's oil pressure. Should the engine's oil pressure fall to 5-10 psi, this switch will open interrupting the DC voltage to the fuel solenoid on the injection pump, thereby shutting off the engine.



Engine Circuit Breaker

The generator's 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 generators 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 generator.

GENERATOR 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 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 generator 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:

Start the engine according to the *STARTING PROCEDURE* section. Run the engine while checking that all systems (raw water pump, oil pressure, battery charging) are functioning.

AFTER START-UP

Once the generator has been started, check for proper operation and then encourage a fast warm-up. Run the generator between 20% and 60% of full load for the first 10 hours.

> ⚠ **CAUTION:** ***Do not attempt to break-in your generator by running without a load.***

After the first 10 hours of the generator's operation, the load can be increased to the full-load rated output, then periodically vary the load.

Avoid overload at all times. An overload is signaled by smoky exhaust with reduced output voltage and frequency. Monitor the current being drawn from the generator and keep it within the generator's rating. Since the generator operates at 1800 RPM to produce 60 hertz , control of the generator's break-in is governed by the current drawn from the generator.

CHECK THE FOLLOWING

☐ 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.

To protect against unintentional overloading of the generator, the generator's output leads should be routed through a circuit breaker that is rated at the rated output of the generator.

NOTE: *Be aware of motor starting loads and the high current draw required for starting motors. This starting amperage draw can be 3 to 5 times normal running amperage. See* GENERATOR INFORMATION *in this manual.*

GENERATOR ADJUSTMENTS

Once the generator has been placed in operation, there may be adjustments required for engine speed (hertz) during the engine's break-in period (first 50 hours) or after this period. A no-load voltage adjustment may also be required in conjunction with the engine's speed adjustment. See *GENERATOR INFORMATION* in this manual.

THE DAILY ROUTINE

CHECK LIST

Each day before starting your generator, take a few moments to run this check list:

- ☐ Record the hourmeter reading in your log (engine hours relate to the maintenance schedule.)
- ☐ Visually inspect the generator for fuel, oil, or water leaks.
- ☐ Check the oil level (dipstick).
- ☐ Check the coolant level in the coolant recovery tank.
- ☐ Check your diesel fuel supply.
- ☐ Look for clean fuel in the fuel/separator transparent bowl.
- ☐ Check for loose wires at the alternator.
- ☐ Check the starting batteries (weekly).
- ☐ Check drive belts for wear and proper tension (weekly).

START THE GENERATOR

(See *STARTING PROCEDURES* on previous pages). Allow the engine to warm up for 5 to 10 minutes to reach operating temperatures of 140° to 150°F (60°-66°C) before applying AC loads, apply loads systematically allowing the generator to adjust to each load before applying the next. Check the gauges for proper oil pressure, operating temperature, and DC voltage.

NOTE: *Some unstable running may occur in a cold engine. This condition should abate as normal operating temperature is reached and loads are applied.*

> ⚠ **CAUTION:** ***Do not operate the generator for long periods of time without a load being placed on the generator.***

STOPPING THE GENERATOR

Remove the major AC loads from the generator one at a time. Allow the generator to run for a few minutes to stabilize the operating temperature and depress the stop switch. (See *STOPPING PROCEDURES* on previous pages.)

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. Disconnect the battery terminals when servicing any of the engine's DC electrical equipment.***

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

SCHEDULED MAINTENANCE	CHECK EACH DAY	HOURS OF OPERATION							EXPLANATION OF SCHEDULED MAINTENANCE
		50	100	250	500	750	1000	1250	
Fuel Supply	☐								Diesel No. 2 rating of 45 cetane or higher.
Fuel/Water Separator	☐								Check for water and dirt in fuel (drain/replace filter if necessary).
Engine Oil Level	☐								Oil level should indicate between MAX. and LOW on dipstick.
Coolant Level	☐								Check at recovery tank; if empty, check at manifold. Add coolant if needed.
Drive Belts	☐ weekly								Inspect for proper tension (3/8" to 1/2" depression) and adjust if needed. Check belt edges for wear.
Visual Inspection of Engine	☐	**NOTE:** *Please keep engine surface clean. Dirt and oil will inhibit the engine's ability to remain cool.*							Check for fuel, oil and water leaks. Inspect wiring and electrical connections. Keep bolts & nuts tight. Check for loose belt tension.
Fuel Filter		☐		☐	☐	☐	☐	☐	Initial change at 50 hrs., then change every 250 hrs.
Starting Batteries (and House Batteries)	☐ weekly								Every 50 operating hours, check electrolyte levels and make sure connections are very tight. Clean off excessive corrosion.
Engine Oil (and filter)		☐		☐		☐		☐	Change initial engine oil and filter at 50 hours, then change both every 100 hours.
Generator		☐	☐	☐	☐	☐	☐	☐	Check that AC connections are clean and secure with no chafing. See *GENERATOR MAINTENANCE* for additional information.
Heat Exchanger Zinc Anode		☐	☐	☐	☐	☐	☐	☐	Inspect zinc anode, replace if needed, clear the heat exchanger end of zinc anode debris.
Fuel/Water Separator			☐	☐	☐	☐	☐	☐	Change every 200 hours.
Exhaust System		☐		☐		☐		☐	Initial check at 50 hours, then every 250 hours. Inspect for leaks. Check anti-siphon valve operation. Check the exhaust elbow for carbon and/or corrosion buildup on inside passages; clean and replace as necessary. Check that all connections are tight.
Engine Hoses			☐	☐	☐	☐	☐	☐	Hose should be hard & tight. Replace if soft or spongy. Check and tighten all hose clamps.
Raw Water Pump			**NOTE:** *At 800 operating hours disassemble and inspect for overhaul.*					☐	Remove the pump cover and inspect impeller, cam and cover for wear. Check the shaft bearings and seals (shaft should not wobble). Lubricate when reassembling.
Coolant System					☐			☐	Drain, flush, and refill cooling system with appropriate antifreeze mix.
Fuel Injectors						☐			Check and adjust injection opening pressure and spray condition (see *ENGINE ADJUSTMENTS*).

MAINTENANCE SCHEDULE

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

SCHEDULED MAINTENANCE	CHECK EACH DAY	HOURS OF OPERATION							EXPLANATION OF SCHEDULED MAINTENANCE
		50	100	250	500	750	1000	1250	
***Starter Motor**					☐			☐	Check solenoid and motor for corrosion. Remove and lubricate. Clean and lubricate the starter motor pinion drive.
***Preheat Circuit**					☐			☐	Check operation of preheat solenoid. Remove and clean glow plugs; check resistance (4-6 ohms). Reinstall with anti seize compound on threads.
***Engine Cylinder Compression**					☐			☐	Check compression pressure and timing (see *Engine Adjustments*).
***Torque Cylinder Head Hold-down bolts**		☐			☐		☐		At first 50 hours, then every 500 hours (see *ENGINE ADJUSTMENTS*).
***Adjust the Valve Clearances**		☐			☐		☐		Adjust Valve Clearances (see *ENGINE ADJUSTMENTS*).
***Heat Exchanger**							☐		Remove, have professionally cleaned and pressure tested.

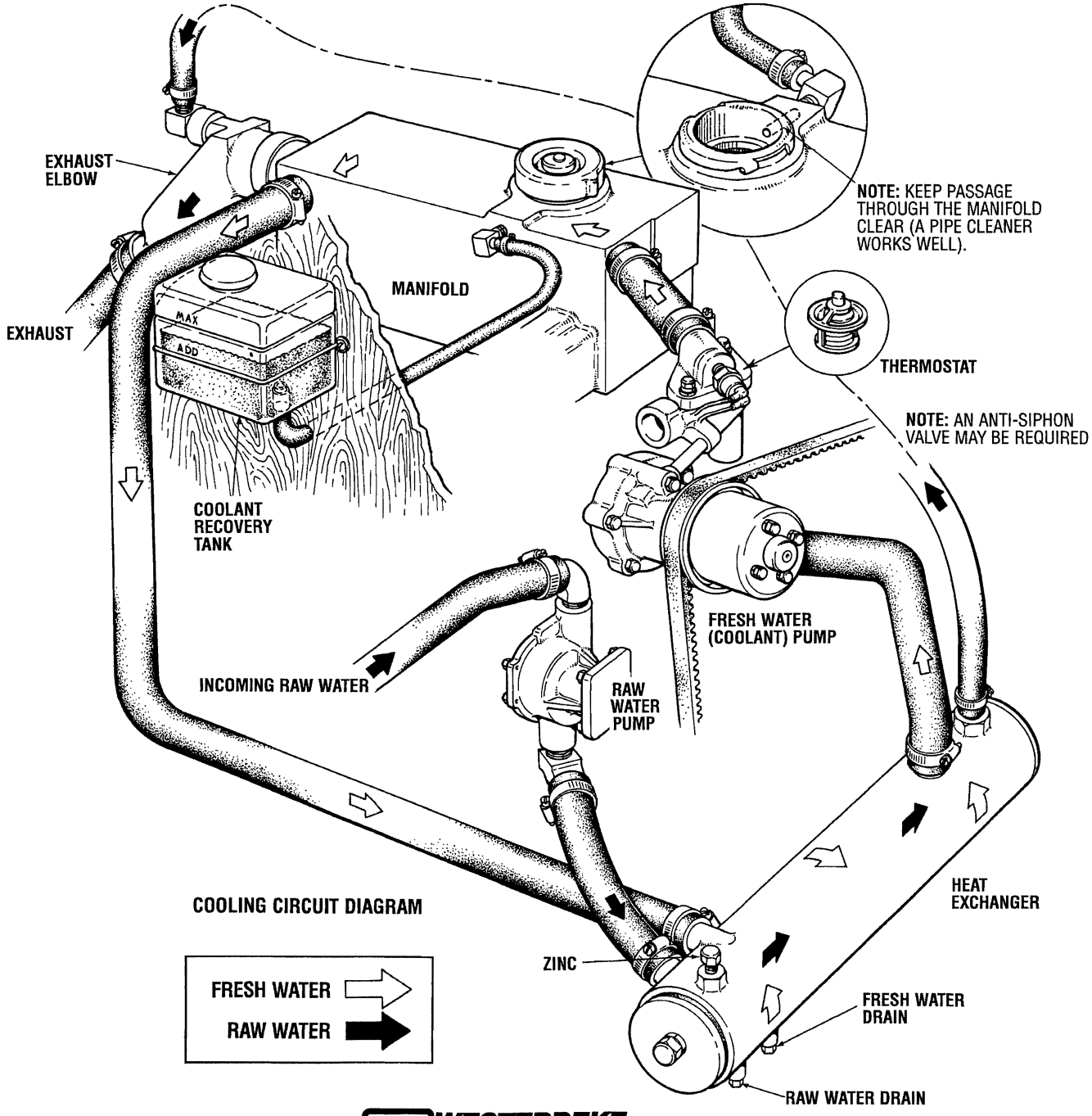
*WESTERBEKE recommends this service be performed by an authorized mechanic.

ENGINE COOLING CIRCUIT

DESCRIPTION

Westerbeke marine diesel generators are designed and equipped for fresh water cooling. Heat produced in the engine by combustion and friction is transferred to fresh water coolant which circulates throughout the engine. This circulating fresh water coolant cools the engine block and its internal moving parts. The heat is transferred externally from the fresh water coolant to raw water by means of a heat exchanger; similar in function to an automotive radiator. Raw water flows through the tubes of the heat exchanger while fresh water coolant flows around the tubes; engine heat transferred to the fresh water coolant is conducted through the tube walls to the raw water which is then pumped into the exhaust system where finally it is discharged overboard. In other words, the engine is cooled by fresh water coolant, this coolant is cooled by raw water, and the raw water carries the transferred heat overboard through the exhaust system. The fresh water coolant and raw water circuits are independent of each other. Using only fresh water coolant within the engine allows the cooling water passages to stay clean and free from harmful deposits.

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



ENGINE COOLING CIRCUIT

Fresh Water Circuit

Fresh water coolant is pumped through the engine by a belt-driven circulating pump, absorbing heat from the engine. The fresh water coolant circulates through the engine's block absorbing heat, then passes through the thermostat into the exhaust manifold, to the heat exchanger where it is cooled, and then is returned to the engine block through the suction side of the fresh water 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.

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 under the manifold and opening the manifold pressure cap. Flush the system with fresh water, then start the refill process.

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

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

To Refill With Coolant

After replacing the manifold drain plug, run the engine at idle and slowly pour clean, premixed coolant into the manifold.

NOTE: *When a steady flow of coolant appears at the heat exchanger drain plug opening, close the drain plug and fill the system until the manifold remains full.*

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. Clean up any spilled coolant.

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. Use a pipe cleaner to keep the passageway clear from the filler cap to the recovery tank hose.*

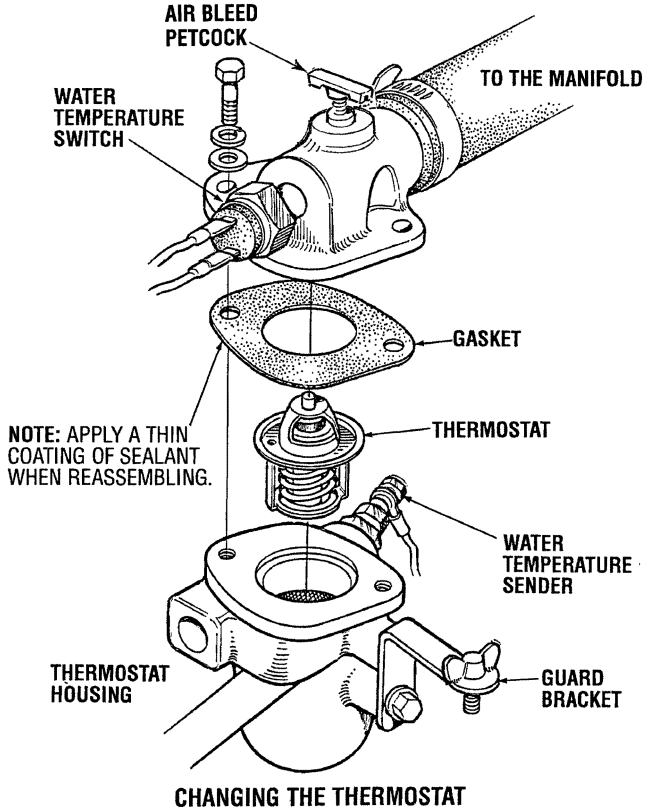
THERMOSTAT

A thermostat, located near the manifold at the front of the engine, controls the coolant temperature, as it 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.

To Replace the Thermostat

Remove the two 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.



CHANGING THE THERMOSTAT

ENGINE COOLING CIRCUIT

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 through a hose to the water strainer. The raw water passes from the strainer through the heat exchanger (through the heat exchanger tubes) where it cools the engine 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 pushed overboard.

Raw Water Pump

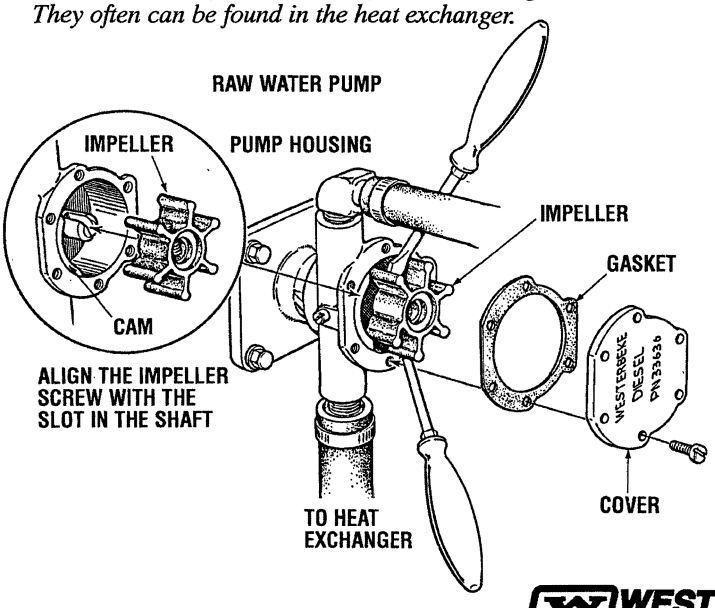
The raw water pump is a self-priming, rotary pump with a non-ferrous housing and a neoprene impeller. The impeller has flexible vanes which wipe against a curved cam plate within the impeller housing, producing the pumping action. On no account should this pump be run dry as water acts as a lubricant for the impeller. 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.

NOTE: *Should a failure occur with the pump's 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

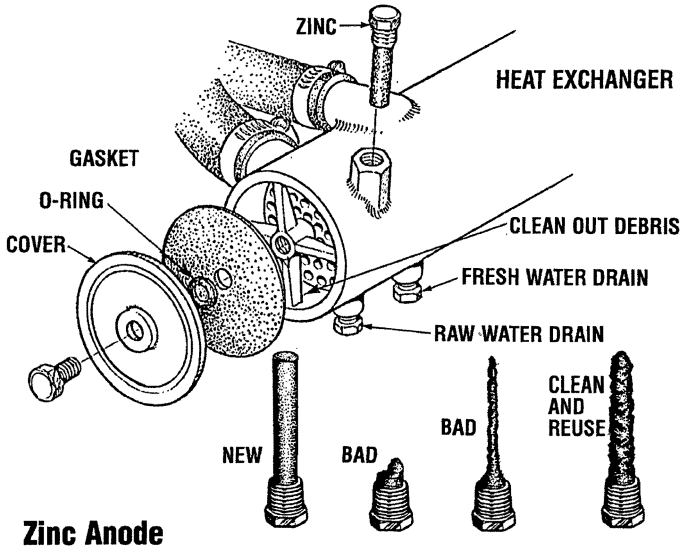
Close the raw water intake valve. Remove the impeller with the aid of two small screwdrivers, as illustrated, and carefully pry the impeller out of the pump. Install the new impeller and gasket by positioning the hub pin to align with the slot in the drive shaft. Move the blades to conform to the curved cam plate and push the impeller into the pump's housing. When assembling, apply a thin coating of lubricant to the impeller and gasket. Open the raw water intake valve before starting the engine.

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



Heat Exchanger

The heat exchanger is a copper tube which encloses a number of small copper tubes. Raw water is pumped through the small copper tubes and the freshwater coolant from the engine is circulated around the copper tubes. The raw water removes heat from the freshwater coolant.



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 action is the result of each particular installation and vessel location; not that of the generator.*

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 a lot of zinc flakes within the exchanger. Remove the end of the heat exchanger and clean the inside of all zinc debris. Always have a spare heat exchanger end gasket in case the present one becomes damaged when removing the end cover. Replace the gasket (refer to your engine model's heat exchanger end gasket part number), o-ring, cover, and install a new zinc pencil.

Heat Exchanger Service

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

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

FUEL SYSTEM

DIESEL FUEL

Use No. 2 diesel fuel with a cetane rating of 45 or higher. Do not use kerosene or home heating fuel.

FUEL WATER SEPARATOR

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

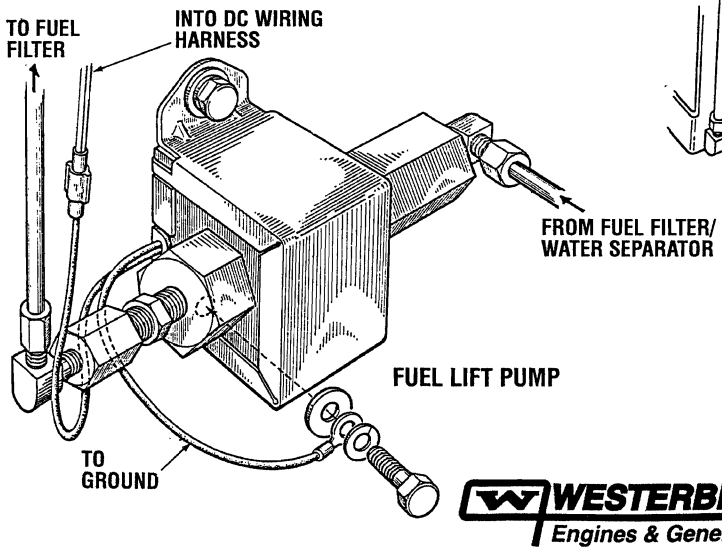
Most installers include a filter/water separator with the installation package as they are aware of the problems that contaminants in the fuel can cause.

A typical fuel filter/water separator is illustrated in this diagram. 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 filtration/separation system.

FUEL LIFT PUMP

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

> ⚠ **WARNING:** ***Fuel leakage at the fuel pump or its connections is a fire hazard and should be corrected. Make sure proper ventilation exists whenever servicing fuel system components.***

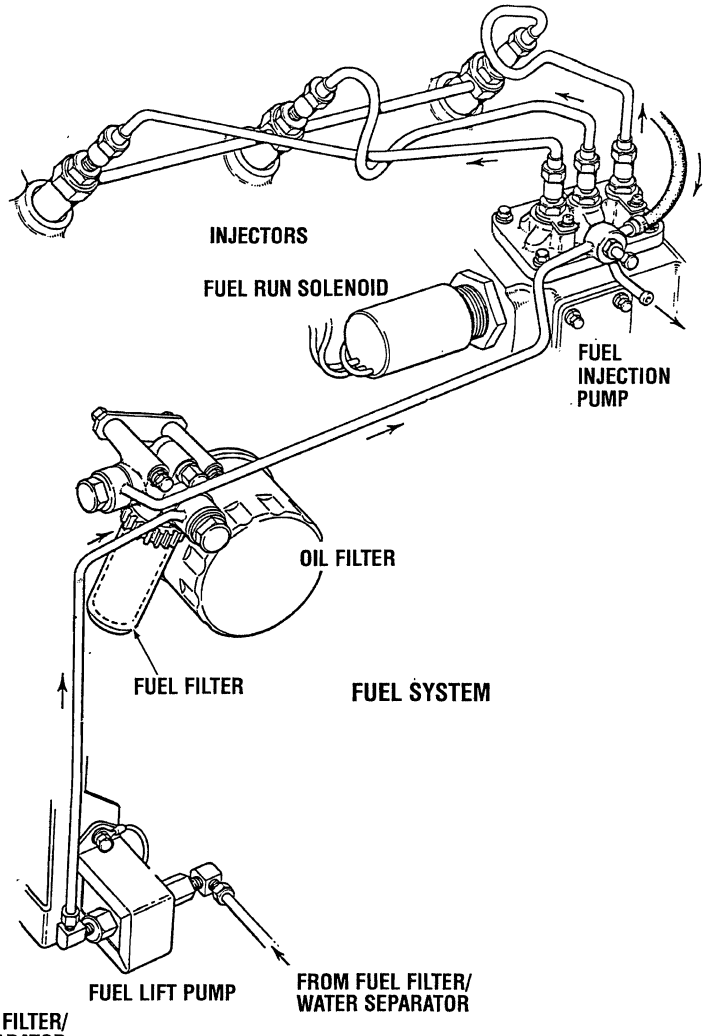


FUEL INJECTION PUMP

The fuel injection pump is the most important component of the diesel engine and, therefore, calls for the utmost caution in handling. The fuel injection pump has been thoroughly bench-tested and should not be tampered with.

Speed (hertz) and timing are the only adjustments the servicing dealer can perform on the injection pump. See the *ENGINE ADJUSTMENT* section in this manual. Other types of adjustments or repairs must be performed by a qualified injection service shop.

NOTE: *When servicing the injection pump, the service shop must be advised that the pump is being used in a generator application.*



FUEL SYSTEM

FUEL FILTERS

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

Changing the Fuel Filter

> ⚠ **WARNING:** ***Shut off the fuel valve at the tank when servicing the fuel system. Take care in catching any fuel that may spill. DO NOT allow any smoking, open flames or other sources of fire near the fuel system when servicing. Ensure proper ventilation exists when servicing the fuel system.***

1. Shut the fuel supply off.
2. Remove the fuel filter retaining ring by turning it counter clockwise and discard the filter element.

NOTE: *This element contains fuel. Take care not to spill it during disassembly and discard the used element properly.*

3. Wipe clean the sealing face on the housing so the new filter will seat properly.
4. Lightly oil the sealing o-rings on the new filter and assemble the element and its retaining ring.
5. Turn on the fuel and start the engine. The normal preheat function should quickly prime the system and the engine should start.
6. Wipe down the fuel filter assembly to make certain there are no leaks.

NOTE: *When using the preheat function to bleed air from the filter assembly, keep in mind that the preheat elements (glow plugs) are being energized. Take care not to overheat them.*

7. Should the engine fail to start when the start switch is depressed for 10 or 20 seconds, release and wait 30 seconds. Repeat the procedure and preheat for a longer period. **Never run the starter for more than 30 seconds.**

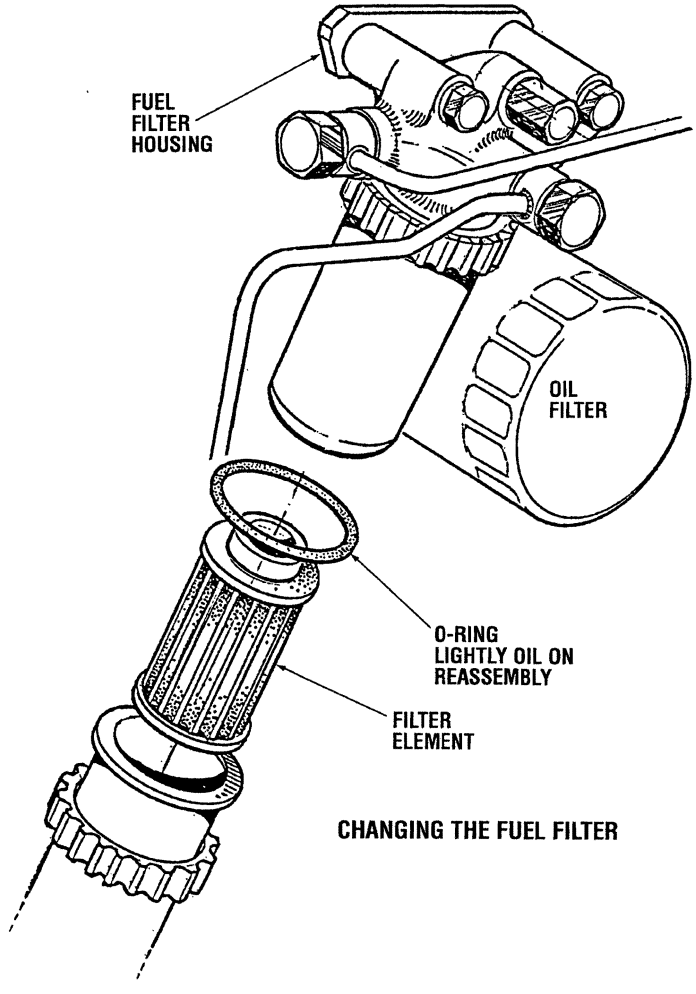
> ⚠ **WARNING:** ***Do not allow smoking or open flames near the fuel system when servicing. Also provide proper ventilation.***

Fuel Additives

If fungus or bacteria is causing fuel problems you should have an authorized dealer correct these problems. Then use a diesel fuel biocide to sterilize the fuel (follow the manufacturers instructions).

Spares

While the likelihood of having to service the system at sea is slim, the possibility does exist. Therefore, we recommend that banjo washers, injector seat washers, and a fuel filter be carried on board at all times. Purchase needed spares from your local WESTERBEKE dealer or distributor. If a leak should develop at a banjo washer that cannot be corrected by a simple tightening of the fitting, replace the sealing washer with a replacement found in the hardware kit for your model.



CHANGING THE FUEL FILTER

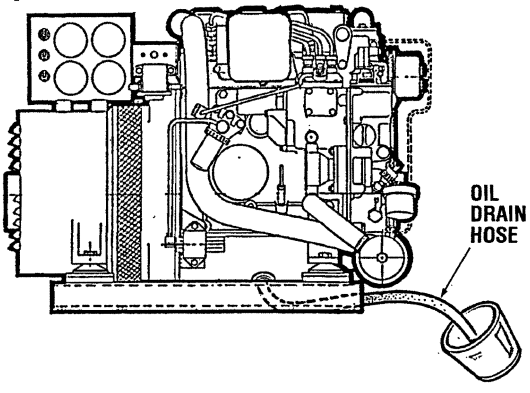
ENGINE OIL CHANGE

Engine Oil Change

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

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

Always observe the used 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 should water be present in the oil. Raw water present in the oil can be the result of a fault in the exhaust system attached to the engine and/or a siphoning of raw water through the raw water cooling circuit into the exhaust, filling the engine. This problem is often caused by the poor location of or the lack of an anti-siphon valve.

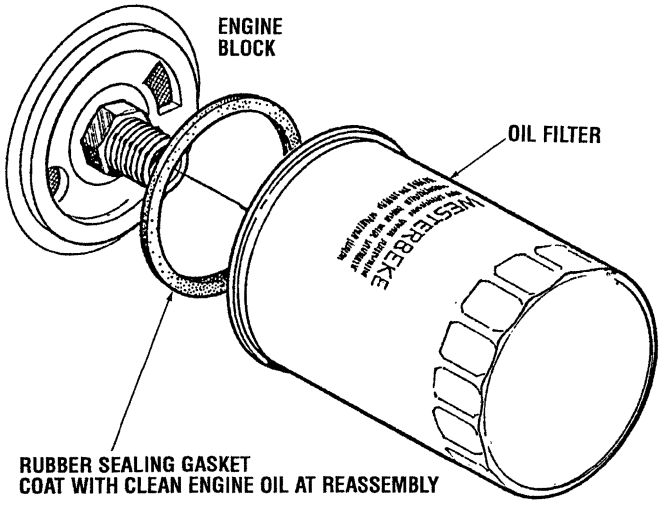


2. **Replacement of the Oil Filter.** When removing the used oil filter, you may find it helpful and cleaner to punch a hole in the upper and lower portion of the old filter to drain the oil from it into a container before removing it. This helps to lessen spillage. A small style automotive filter wrench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

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

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

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



CHANGING THE ENGINE OIL FILTER

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

3. **Filling the Oil Sump.** Add new oil through the oil filler cap on the top of the engine or through the side oil fill. After refilling, run the generator 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 stop the generator. Then check the quantity of oil with the lube oil dipstick. Fill to, but not over the high mark on the dipstick, should the engine require additional oil.

> ⚠ **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.***

Oil Pressure

The engine's oil pressure, during operation, is indicated by the oil pressure gauge on the instrument panel. During normal operation, the oil pressure will range between 35 and 55 psi.

NOTE: *A newly started, cold engine can have an oil pressure reading upwards of 60 psi. A warmed engine can have an oil pressure reading as low as 35 psi. These readings will vary depending upon the temperature of the engine and the load placed on the generator.*

REMOTE OIL FILTER (OPTIONAL)

INSTALLATION

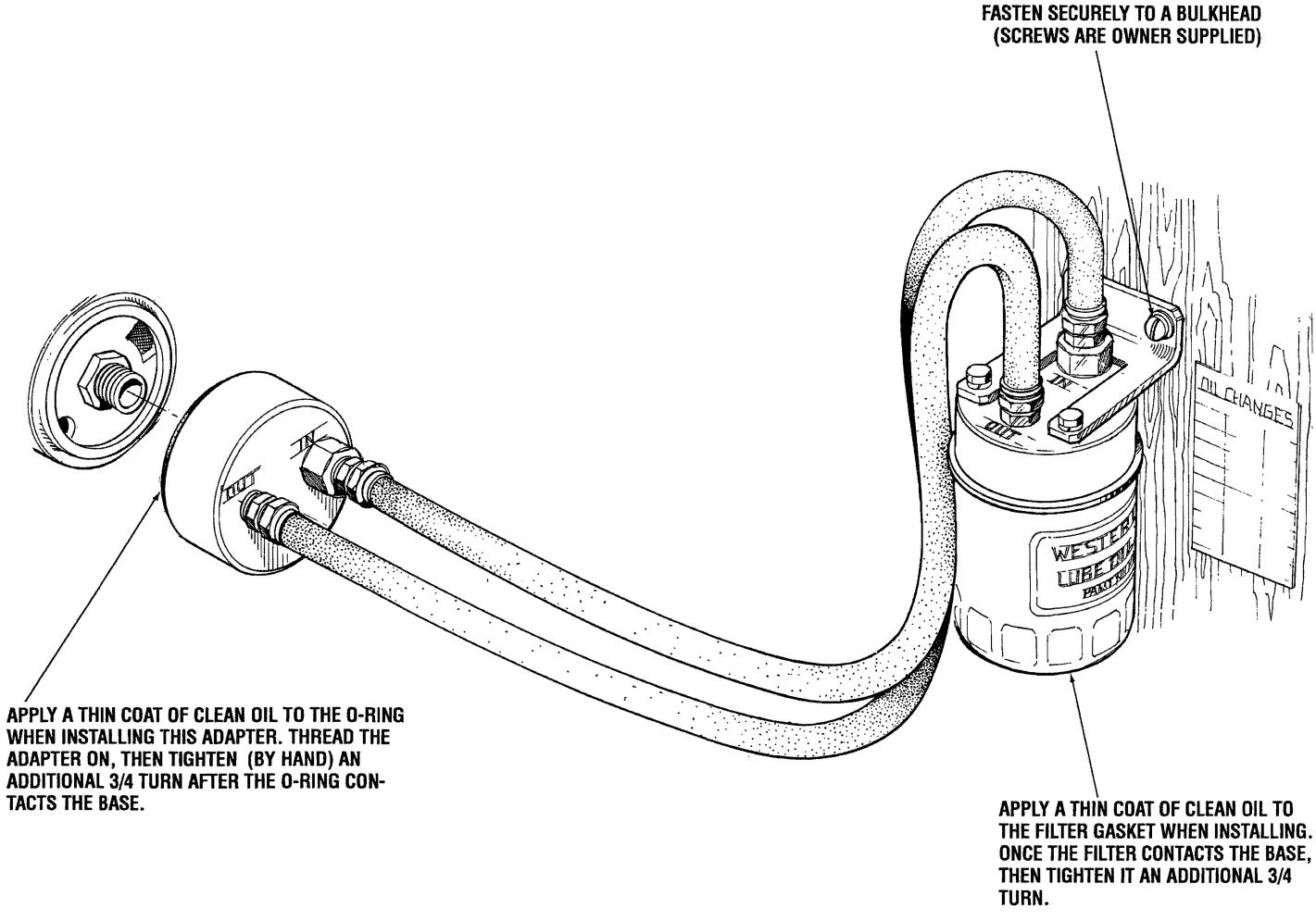
This popular accessory is used to relocate the engine's oil filter from the engine to a more convenient location such as an engine room bulkhead.

NOTE: *Refer to the* ENGINE OIL CHANGE *page 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.*



DC ELECTRICAL SYSTEM

DESCRIPTION

The DC Circuit on the 4.0 KW BCD functions to start, operate and stop the generator engine. The circuit is best understood by reviewing the DC WIRING SCHEMATICS. The engine's DC wiring is designed with three simple basic circuits: preheat, start, and stop.

Engine 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 on the engine.

> ⚠ **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 Specification

The minimum recommended capacity of the battery used in the engine's 12-volt DC control circuit is 300-600 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

The glow plug is a small heater installed in each pre-combustion chamber. They run off the engine starting battery and become red hot when activated.

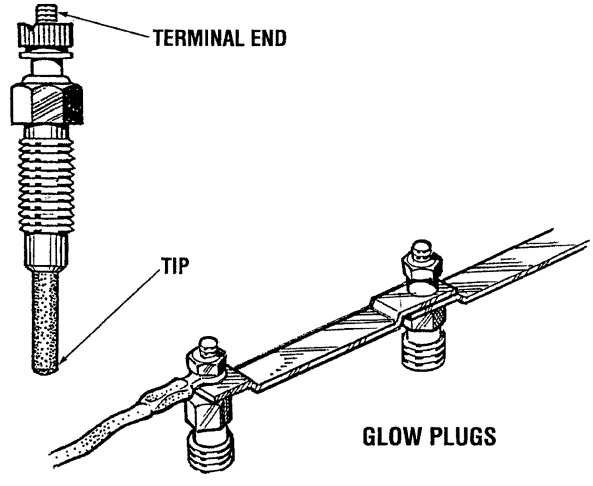
The glow plugs are wired through the preheat solenoid. When PREHEAT is pressed at the control panel this solenoid should "click" on and the glow plug should begin to get hot.

Glow plugs can be checked by unscrewing and holding them against a good ground (engine block) and turning them on. The tip should glow red hot. You can also use an ammeter to test the power drain (8 to 9 amps per plug), or an ohmmeter to test resistance (1.1 to 1.2 ohms).

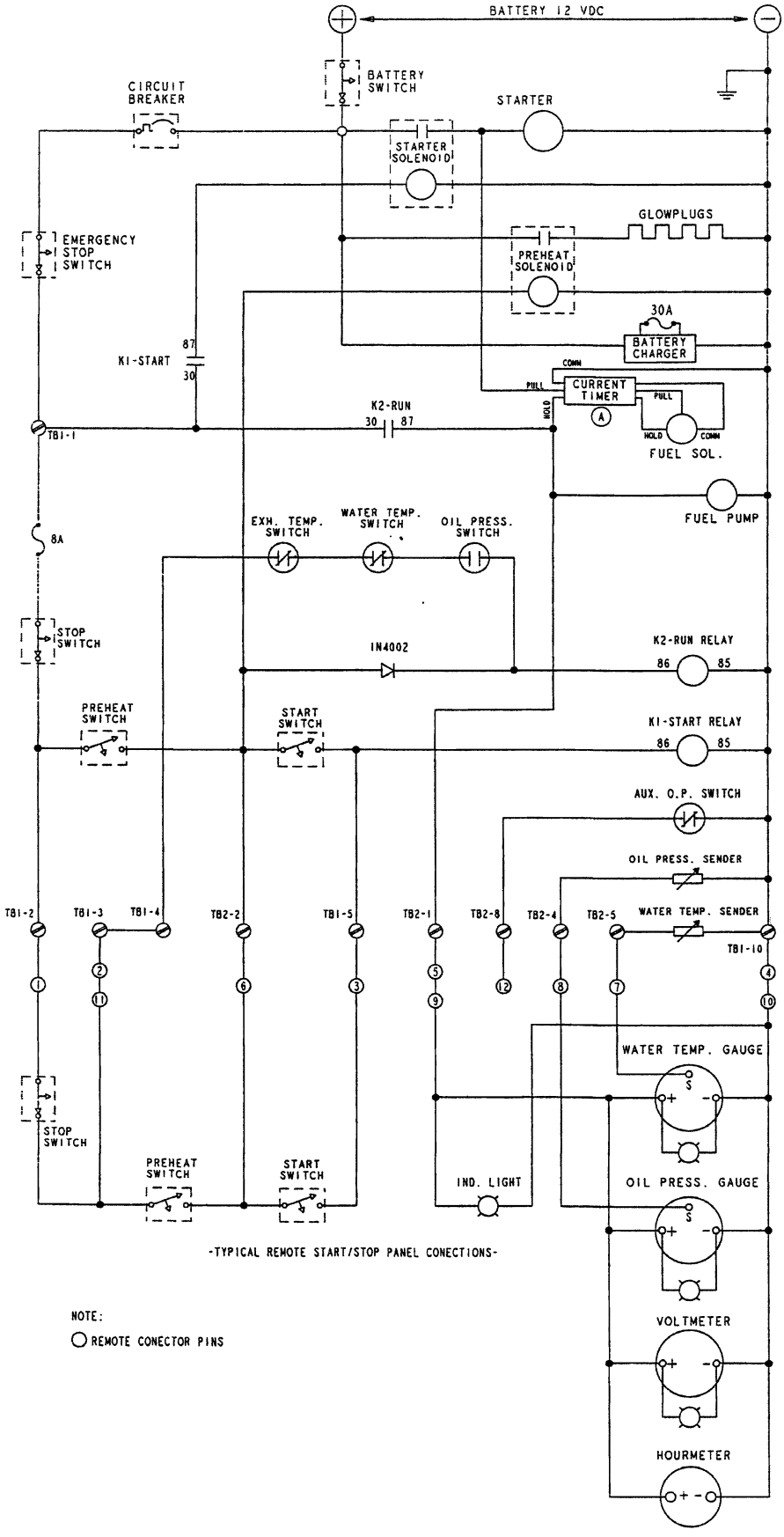
> ⚠ **WARNING:** ***These glow plugs will become very hot to the touch. Be careful not to burn your fingers when testing plugs.***

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

> ⚠ **CAUTION:** ***Do not keep glow plug on for more than 30 seconds.***



4.0 KW BCD WIRING SCHEMATIC #44732

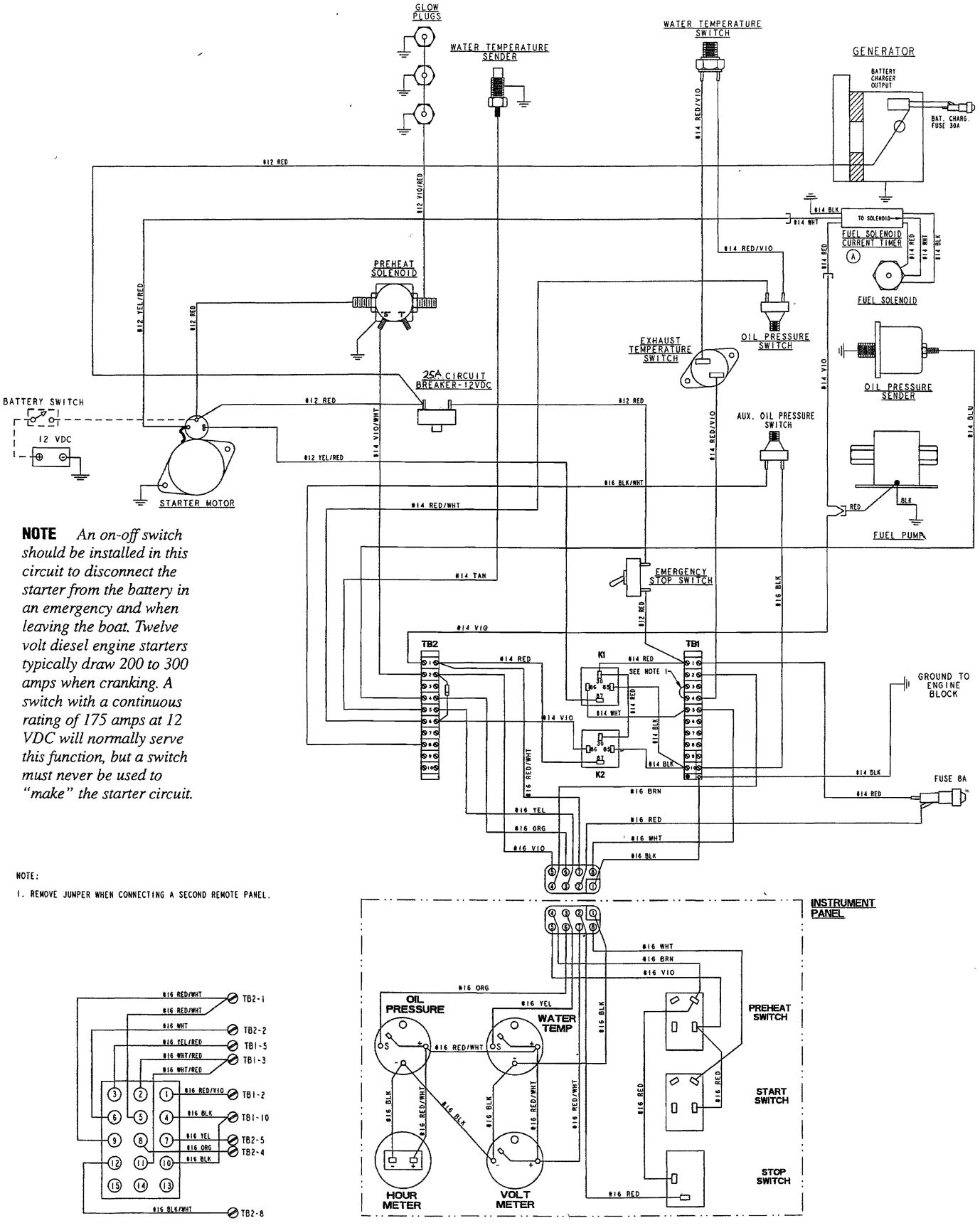


-TYPICAL REMOTE START/STOP PANEL CONECTIONS-

NOTE:

○ REMOTE CONECTOR PINS

4.0 KW BCD WIRING DIAGRAM #44732



NOTE *An on-off switch should be installed in this circuit to disconnect the starter from the battery in an emergency and when leaving the boat. Twelve volt diesel engine starters typically draw 200 to 300 amps when cranking. A switch with a continuous rating of 175 amps at 12 VDC will normally serve this function, but a switch must never be used to "make" the starter circuit.*

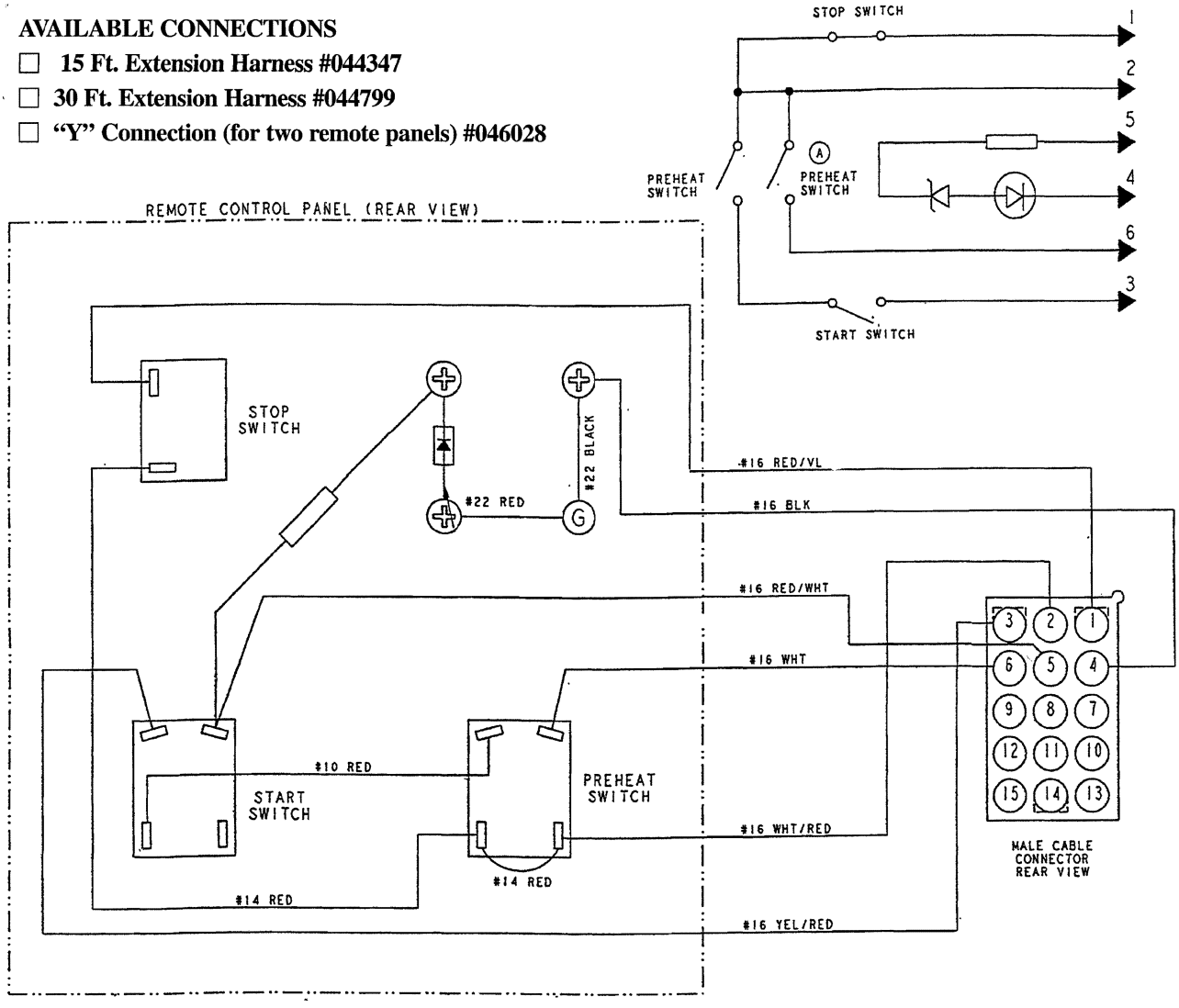
NOTE:

1. REMOVE JUMPER WHEN CONNECTING A SECOND REMOTE PANEL.

REMOTE INSTRUMENT PANEL
SCHEMATIC #44329

AVAILABLE CONNECTIONS

- ☐ **15 Ft. Extension Harness #044347**
- ☐ **30 Ft. Extension Harness #044799**
- ☐ **"Y" Connection (for two remote panels) #046028**



STARTER MOTOR

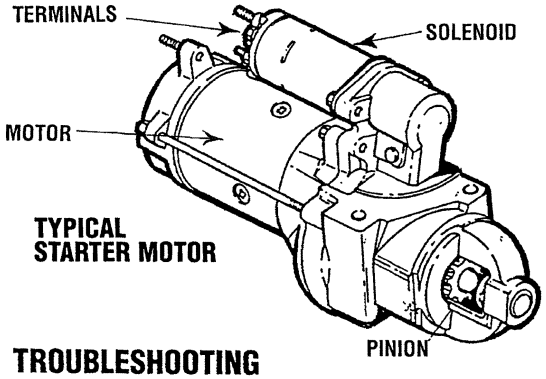
DESCRIPTION

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

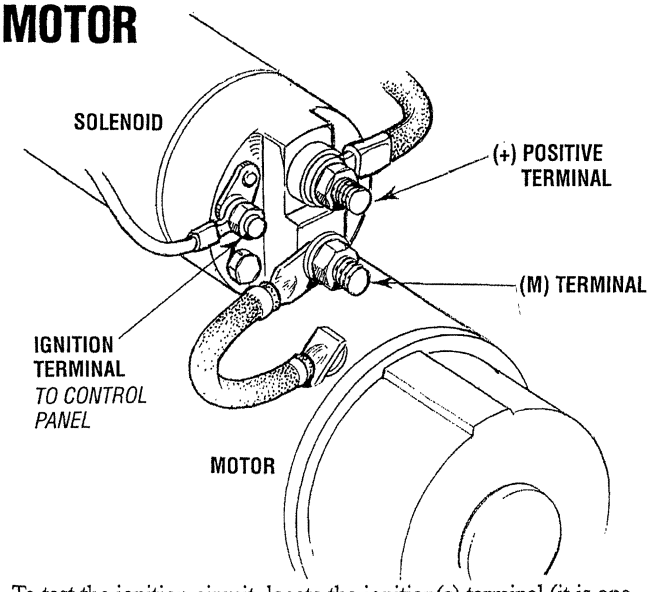
TROUBLESHOOTING

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).

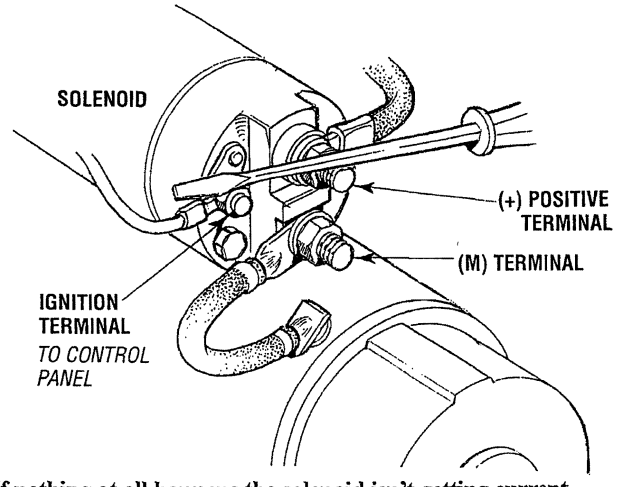
If you read 12 volts, the starter is faulty.



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.

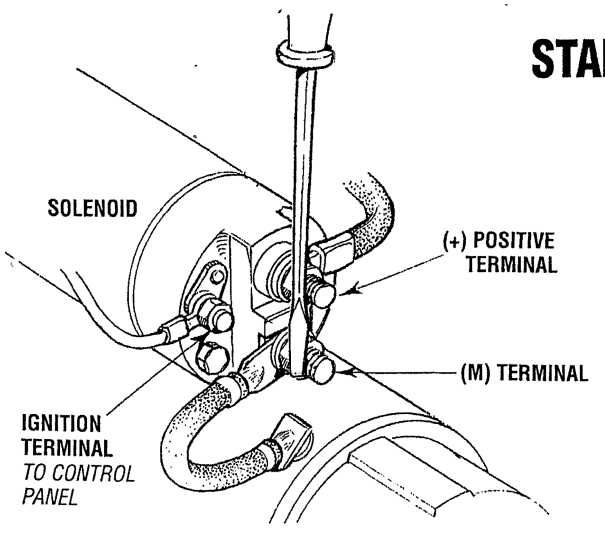
If the solenoid clicks but nothing else happens, the starter motor is probably faulty.



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.

ENGINE TROUBLESHOOTING

The tables which follow indicate troubleshooting procedures based upon certain problem indicators, the probable causes of the problems, and the recommendations to overcome these problems.

Note: *The engine's electrical system is protected by a 25 amp manual reset circuit breaker located on a bracket at the rear of the engine. The preheat solenoid is close by, as is the emergency* STOP *switch, which may be mounted on the same bracket or on the back of the instrument panel, depending upon the generator model.*

Problem	Probable Cause	Verification/Remedy
Key switch on, PREHEAT switch depressed: no panel indications; fuel solenoid or electrical fuel pump	**1.** Battery Switch not on.	**1.** Check switch and/or battery connections.
	2. Emergency stop switch off.	**2.** Check emergency stop switch position.
	2. 25-Amp circuit breaker tripped.	**2.** Reset breaker; if breaker trips again, check preheat solenoid circuit and check circuit for shorts to ground.
	3. 10-Amp breaker tripped on preheat solenoid.	**3.** Check voltage at and after breaker on preheat solenoid.
	4. Loose battery connections.	**4.** Check (+) connection to starter solenoid and (-) connection to engine ground stud. Check battery cable connections.
	5. Preheat solenoid not operating.	**5.** Check solenoid "S" terminal for voltage.
START SWITCH DEPRESSED, no starter engagement.	**1.** Connection to solenoid faulty.	**1.** Check connection.
	2. Faulty switch.	**2.** Check switch with ohmmeter.
	3. Faulty solenoid.	**3.** Check that 12 volts are present at the solenoid connection.
	4. Loose battery connections.	**4.** Check battery connections.
	5. Low battery.	**5.** Check battery charge state.
START switch 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.
Generator engine cranks, but does not start, fuel solenoid energized.	**1.** Faulty fueling system.	**1.** Check that fuel valves are open.
		1a. Switch to combine house and start batteries.
		1b. Replace batteries.
		2c. Check fuel lift pump.
	2. Preheat solenoid faulty.	**2.** Check solenoid.
Engine can't be stopped.	**1.** Faulty DC alternator.	**1.** Remove "R" connection at alternator, repair alternator.
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
Battery not charging	**1.** DC charge circuit faulty.	**1.** Perform D.C. voltage check of generator charging circuit. See *Testing the Battery Charging Circuit* in this manual.
Generator engine stops.	**1.** Fuel lift pump failure.	**1.** Fuel lift pump should make a distinct ticking sound. Replace pump with spare.
	2. Switches and/or wiring loose or disconnected.	**2.** Inspect wiring for short circuits and loose connections. Inspect switches for proper operation.
	3. Fuel starvation.	**3.** Check fuel supply, fuel valves, fuel lift pump.
	4. 25 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 buildup at exhaust elbow.
	6. Water in fuel.	**6.** Pump water from fuel tank(s); change filters and bleed fuel system.

ENGINE TROUBLESHOOTING

Problem	Probable Cause	Verification/Remedy
Generator engine overheats/shuts down.	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.
Generator engine shuts down, Low oil pressure.	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.
Generator engine shuts down, High exhaust temperature.	1. Exhaust too hot.	1. Check raw water injection flow, look for exhaust obstruction.
	2. High temperature switch opens at . too low a temperature.	2. Check for satisfactory operation with switch bypassed, check with ohmmeter, replace if faulty.
Exhaust smoking 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 WATER TEMPERATURE AND OIL PRESSURE GAUGES

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

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

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

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

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

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

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

ENGINE ADJUSTMENTS

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

GENERATOR FREQUENCY ADJUSTMENT (HERTZ)

Once the diesel generator set has been placed in operation, there may be adjustments required for engine speed (Hertz) during the engine's break-in period (first 50 hours) or after this period. A no-load voltage adjustment may also be required in conjunction with the engine's speed adjustment. These are not warrantable adjustments as they relate to normal break-in and maintenance.

Frequency is a direct result of engine/generator speed, as indicated by the following:

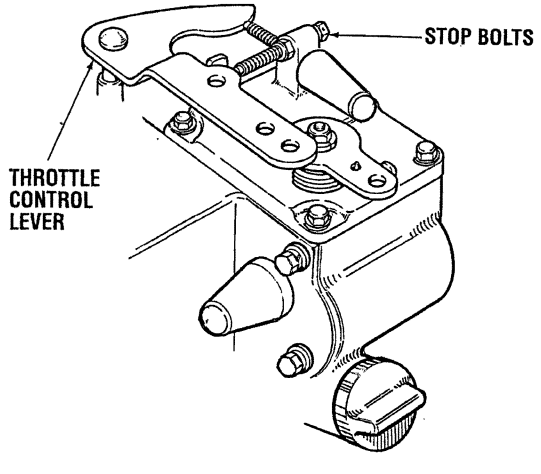
When the generator is run at 1800 rpm, the AC voltage output frequency is 60 Hertz.

Therefore, to change the generator's frequency, the engine speed *must* be changed. To accomplish the frequency change, perform the following:

1. With the engine stopped, make certain the AC output leads to the AC terminal block in accordance with the AC voltage connections diagram are specified for your generator set. These connections are shown in the *BC GENERATOR* section of this manual.

> ⚠ **WARNING:** ***Before starting the engine make certain that everyone is clear of moving parts! Keep away from pulleys and belts during test procedures.***

2. Start the engine and adjust the engine's speed by adjusting the stop bolts and positioning the throttle arm against these stop bolts to either increase or decrease engine no-load speed to adjust the Hertz produced.

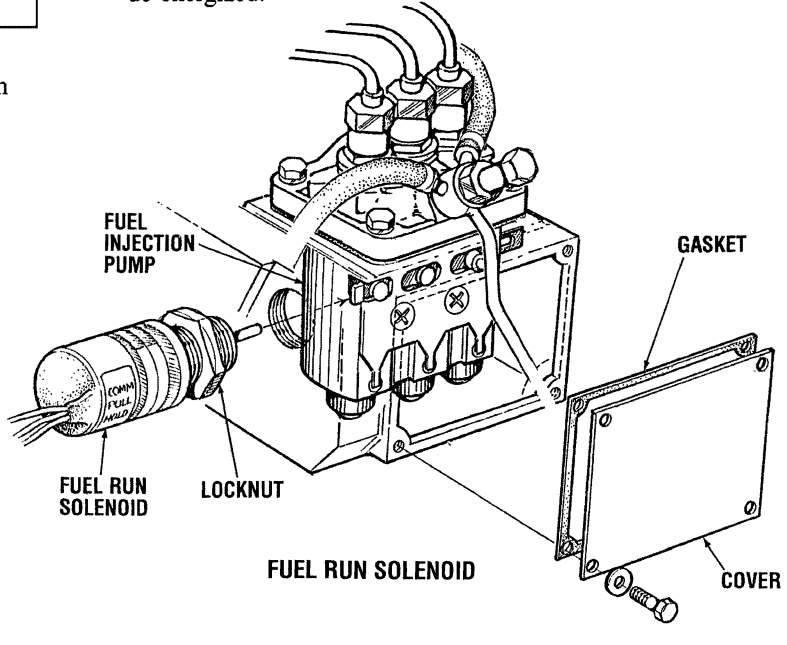


3. To arrive at the appropriate frequency, either monitor the speed of the engine/generator with a tachometer, or monitor the frequency with a frequency meter, the latter method being the more precise of the two.

FUEL RUN SOLENOID

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

1. Visual access to the fuel injection pump's fuel rack is needed. To obtain this, remove the small square side cover and gasket just below the fuel injection pump.
2. Thread the locknut onto the solenoid and then apply a small amount of Teflon sealant to the threads on the solenoid.
3. Thread the solenoid into the hole on the engine and observe the solenoid plunger through the cover opening. Allow the plunger to contact the fuel rack and move fully into the injection pump. Do not thread further so as to push the plunger into the solenoid.
4. Back the solenoid out 1/4 - 1/2 of a turn and secure it in position with the locknut.
5. Properly connect the three electrical leads from the solenoid. Two of the connections plug into the engine harness and the third grounds to the engine block at an adjacent inboard threaded hole with a 8mm bolt.
6. Reassemble the cover and gasket and test run the unit. Make certain that the unit stops when the solenoid is de-energized.



FUEL RUN SOLENOID

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

For your safety, WESTERBEKE generator models come equipped with belt guards that cover over the belt(s) on the front of the engine. ("Out of sight - out of mind." The belt guard is NOT installed for that purpose.) Operators are advised that proper inspection, service, and maintenance is required.

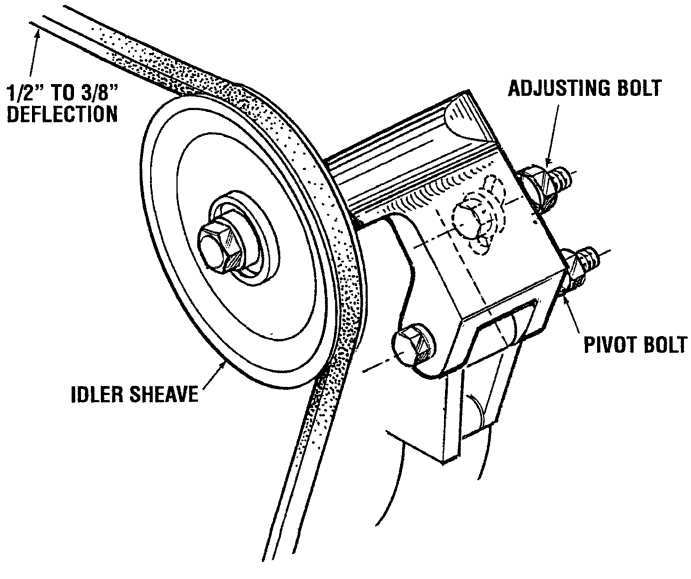
Excessive drive belt tension can cause rapid wear of the belt and reduce the service life of the fresh water pump's bearing. A slack belt or the presence of oil on the belt can cause belt slipping, resulting in high operating temperatures.

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

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

Adjusting Belt Tension

1. Remove the belt guard.
2. Loosen the pivot belt that holds the idler sheave and loosen the adjusting bolt.
3. With the belt loose, inspect for wear, cracks and frayed edges.
4. Pivot the idler sheave to the left or right as required, to loosen or tighten.
5. Tighten the pivot bolt and the adjusting bolt.
6. Replace the guard. Operate the generator for about 5 minutes and then shut the generator down.
7. Remove the guard and recheck the belt tension.
8. Replace the guard.

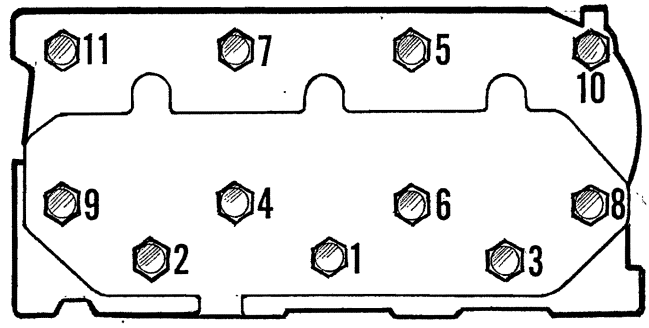


TORQUING THE CYLINDER HEAD BOLTS

After the initial break-in period (approximately 50 hours) and every 500 hours thereafter, the cylinder head bolts should be re-torqued.

Tighten the cylinder head bolts according to the sequence shown. Make sure the engine is cold when this is done. Before applying the specified torque to the bolt, loosen it 1/4 to 1/2 of a turn and then apply the torque. Follow this procedure according to the numbered sequence shown in the illustration to the right.

Bolts #1, 2, and 3, (12mm socket) 2.0 ~ 3.0 kg-m (14 ~ 22 ft-lb). Bolts #4, 5, 6, 7, 8, 9, 10, and 11 (14mm socket) 7.5 ~ 8.5 kg-m (54 ~ 61 ft-lb) (Rockershaft Hold Down Bolts - 12mm socket - 1.5 ~ 2.2 kg-mm (11 ~ 16 ft-lb).



CYLINDER HEAD BOLT PATTERN

ENGINE COMPRESSION

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

Compression values:

Standard	Minimum
397.6 psi (28 kg/cm²)	312.4 psi (22 kg/cm²)

The maximum acceptable difference between cylinders is 35.5 psi (3.5 kg/cm²).

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.*

Injection Pump Timing Adjustment (Spill Timing)

If your engine's fuel injection timing is not properly adjusted, the engine will not operate properly, and may be difficult to start. Have the injection pump delivery rate checked by a well-established fuel injection shop. Adjust the injection as follows:

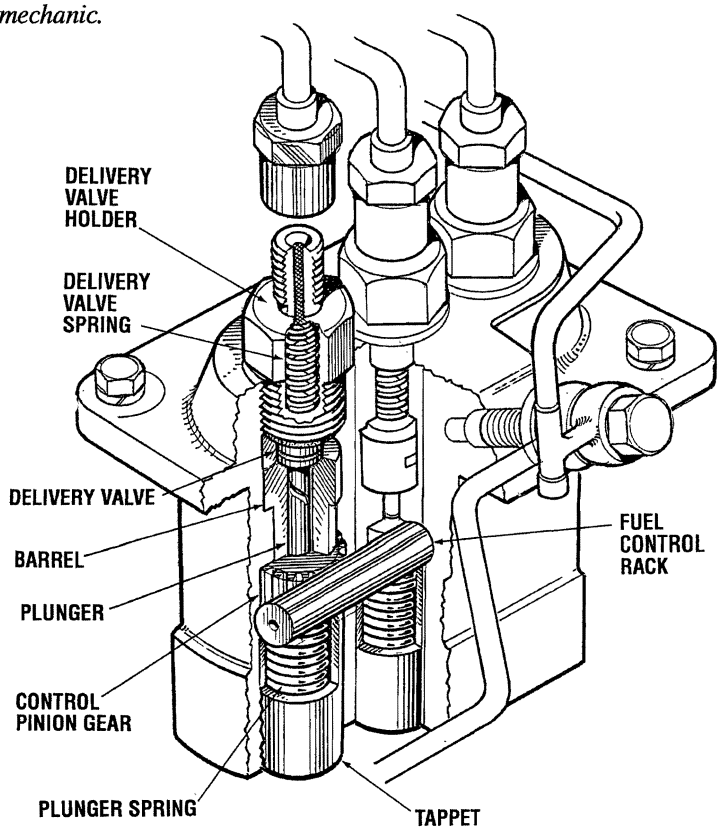
NOTE: *The fuel shut-off lever* ***must be*** *in the* **RUN** *position while making the adjustment or no fuel will flow from the fuel injection pump.*

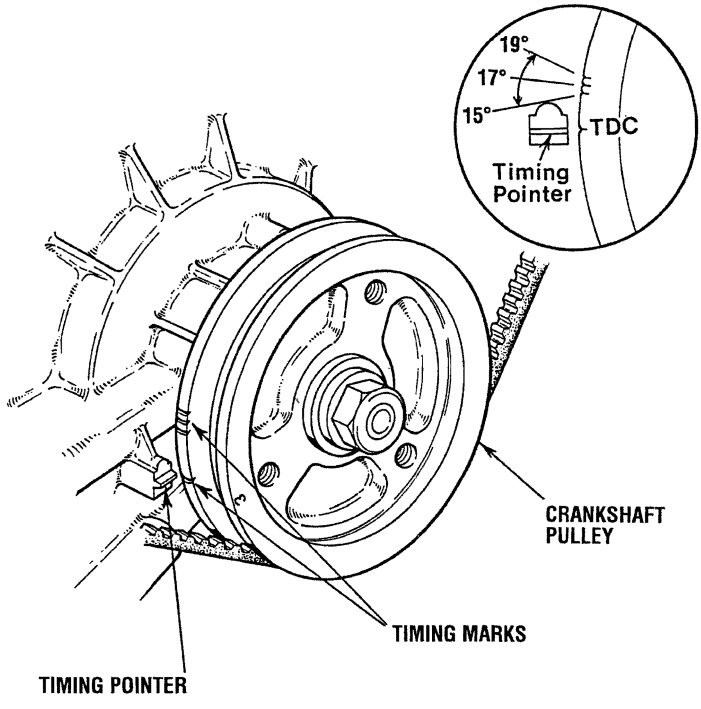
1. Remove the high pressure fuel line from between the No. 1 injector and the No. 1 fuel delivery valve holder.
2. Remove the No. 1 fuel delivery valve holder over "O" ring and remove the delivery valve spring beneath the holder.
3. Reinstall only the delivery valve holder and reattach the high pressure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

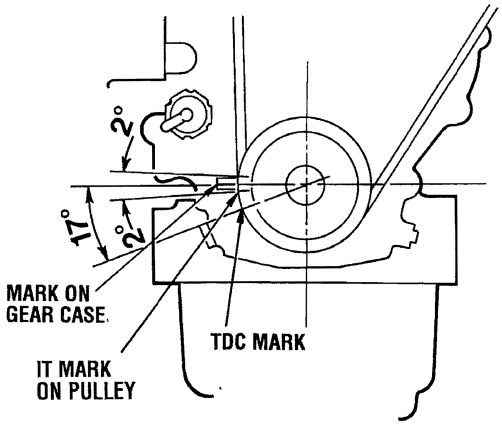
Rotate the engine's crankshaft in its normal direction of rotation to position piston the No. 1 at the beginning of its compression stroke.

Move the throttle lever to its full open position and operate the electric lift pump. Slowly rotate the crankshaft clockwise (as viewed from the front), catching the fuel from the No. 1 fuel line, until the instant the fuel completely stops flowing (no drips). At this instant, the 16° BTDC timing mark on the crankshaft pulley should be directly aligned with the timing indicator on the front of the gear case ± .5 degrees.

If the specified injection timing (16° BTDC) cannot be attained, adjust the timing by increasing or decreasing the thickness of shim material under the injection pump's mounting flange to change the injection timing point. Changing the shim thickness by 0.004 inch (0.01mm) changes the injection timing by approximately one degree. To advance the timing, decrease the shim thickness, as required. To retard the timing, increase the shim thickness, as required. Refer to your generator's Parts List for shim part numbers.







ENGINE ADJUSTMENTS

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

VALVE CLEARANCE ADJUSTMENT

NOTE: *Retorque the cylinder head bolts before adjusting the engine's valves. See* TORQUING THE CYLINDER HEAD BOLTS.

> ⚠ **WARNING:** ***Adjust the valve clearance when the engine is cold. Valves are adjusted by cylinder in the firing order of the engine. Tighten the cylinder head bolts to the specified torque before adjusting the valves.***

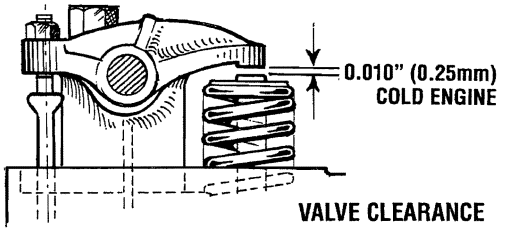
Pull off the air breather pipe from the rocker cover, and take off the rocker cover bolts and the rocker cover to expose the rocker shaft and valve assembly.

Remove the glow plugs from each of the cylinders to enable the engine to be easily rotated by hand to position each cylinder for valve adjustment.

Valves are adjusted with the piston in the cylinder being adjusted at TDC (top dead center) of its compression stroke. Each cylinder is adjusted following the engine's firing order. 1-3-2 for WESTERBEKE's three cylinder engines.

Valve adjustment beginning with cylinder #1. Rotate the crankshaft slowly and observe the operation of the valves for cylinder #1. Watch for the intake valve to open indicating the piston is on it's intake stroke (the piston is moving down in the cylinder). Continue to rotate the crankshaft slowly and look for the intake valve to close. This indicates the piston is now starting it's compression stroke (the piston is moving up in the cylinder towards TDC).

Align the TDC mark on the crankshaft front pulley with the timing marker on the front gear case cover when positioning the #1 Piston at TDC of it's compression stroke. Confirm this by rotating the crankshaft approximately 20 degrees before and after this point and the two valves for the #1 cylinder should not move.



Adjust the valves in #1 cylinder for both intake and exhaust.

Proceed to the next cylinder in the firing order.

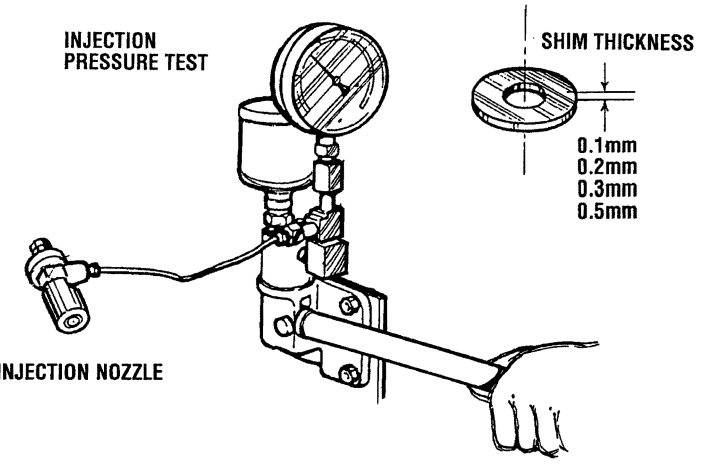
Rotate the crankshaft 240 degrees in normal direction of rotation and adjust the next cylinder's valves in the firing order. Rotate the crankshaft another 240 degrees and adjust the next cylinders valves in the firing order.

Adjust each valve's clearance by inserting a 0.010 inch (0.25mm) feeler gauge between the rocker arm and the valve stem. Make sure to adjust all valves while the engine is cold.

Re-install the glow plugs (use anti-seize compound on the threads) and assemble the rocker cover and rocker cover belts. See the TIGHTENING TORQUE SCHEDULE in this manual.

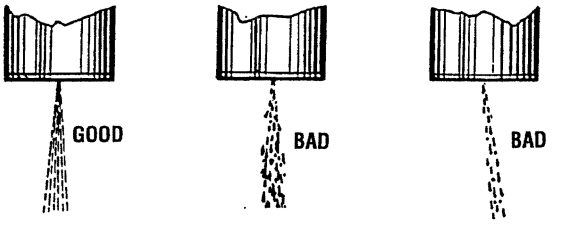
TESTING FUEL INJECTORS

Remove and check fuel injectors. The injector spray pressure should be 1988 psi ± 142 psi (140 kg/cm² ±10 kg/cm²). Undesirable injector conditions, to include after dripping, should be eliminated.



CHATTERING TEST

For the chattering test, operate the tester level slowly. If the nozzle sprays sharply and intermittently, the nozzle is considered good. The nozzle should spray fuel straight in its axial direction. A nozzle is defective if it sprays fuel in a wrong direction, in several separate strips, or in the form of particles. These defects may sometimes be caused by clogging with dust, therefore all parts should be cleaned carefully before reassembly.



GENERATOR INFORMATION

USE OF ELECTRIC MOTORS

The power required to start an electric motor is considerably more than is required to keep it running after it is started. Some motors require much more current to start them than others. Split-phase (AC) motors require more current to start, under similar circumstances, than other types. They are commonly used on easy-starting loads, such as washing machines, or where loads are applied after the motor is started, such as small power tools. Because they require 5 to 7 times as much current to start as to run, their use should be avoided, whenever possible, if the electric motor is to be driven by a small generator. Capacitor and repulsion-induction motors require from 2 to 4 times as much current to start as to run. The current required to start any motor varies with the load connected to it. An electric motor connected to an air compressor, for example, will require more current than a motor to which no load is connected.

In general, the current required to start 115-Volt motors connected to medium starting loads will be approximately as follows:

MOTOR SIZE (HP)	AMPS FOR RUNNING (AMPERES)	AMPS FOR STARTING (AMPERES)
1/6	3.2	6.4 to 22.4*
1/4	4.6	9.2 to 32.2*
1/3	5.2	10.4 to 72.8*
1/2	7.2	14.4 to 29.2*
3/4	10.2	20.4 to 40.8*
1	13	26 to 52

***NOTE:** *In the above table the maximum* Amps for Starting *is more for some small motors than for larger ones. The reason for this is that the hardest starting types (split-phase) are not made in larger sizes.*

Because the heavy surge of current needed for starting motors is required for only an instant, the generator will not be damaged if it can bring the motor up to speed in a few seconds. If difficulty is experienced in starting motors, turn off all other electrical loads and, if possible, reduce the load on the electric motor.

REQUIRED OPERATING SPEED

Run the generator first with no load applied, then at half the generator's capacity, and finally loaded to its full capacity as indicted on the generator's data plate. The output voltage should be checked periodically to ensure proper operation of the generating plant and the appliances it supplies. If an AC voltmeter or ampere meter is not installed to monitor voltage and load, check it with a portable meter and amp probe.

NOTE: *When the vessel in which the generator is installed contains AC equipment of 120 volts only, it is recommended that the generator's AC terminal block be configured to provide one 120 volt AC hot leg for the vessel's distribution panel. This will ensure good motor starting response from the generator.*

GENERATOR FREQUENCY ADJUSTMENT

Frequency is a direct result of engine speed. The engine has been factory set to run at 1800 rpm to produce a frequency of 60 Hz. Refer to *GENERATOR FREQUENCY ADJUSTMENT (HERTZ)* in this manual if an adjustment is necessary.

Generator Maintenance

- Maintaining reasonable cleanliness is important. Connections of terminal boards and rectifiers may become corroded, and insulation surfaces may start conducting if salts, dust, engine exhaust, carbon, etc. are allowed to build up. Clogged ventilation openings may cause excessive heating and reduced life of windings.
- For unusually severe conditions, thin rust-inhibiting petroleum-base coatings, should be sprayed or brushed over all surfaces to reduce rusting and corrosion.
- In addition to periodic cleaning, the generator should be inspected for (a) tightness of all connections, (b) evidence of overheated terminals and (c) loose or damaged wires.
- The drive discs on single bearing generators should be checked periodically if possible for tightness of screws and for any evidence of incipient cracking failure. Discs should not be allowed to become rusty because rust may accelerate cracking. The bolts which fasten the drive disc to the generator shaft must be hardened steel SAE grade 8, identified by 6 radial marks, one at each of the 6 corners of the head.
- The rear armature bearing is lubricated and sealed; no maintenance is required. However, if the bearing becomes noisy or rough-sounding, have it replaced.
- Examine bearing at periodic intervals. No side movement of shaft should be detected when force is applied. if side motion is detectable, bearings are wearing or wear on shaft of bearing socket outside bearing has occurred. Repair must be made quickly or major components will rub and cause major damage to generator.

Carbon Monoxide Detector

WESTERBEKE recommends mounting a carbon monoxide detector in the vessels living quarters. **Carbon monoxide, even in small amounts, is deadly.**

The presence of carbon monoxide indicates an exhaust leak from the engine or generator or from the exhaust elbow/exhaust hose, or that fumes from a nearby vessel are entering your boat.

If carbon monoxide is present, ventilate the area with clean air and correct the problem immediately!

BC GENERATOR SINGLE PHASE

NOTE: *WESTERBEKE recommends that the following generator tests and adjustments be performed by a qualified technician.*

DESCRIPTION

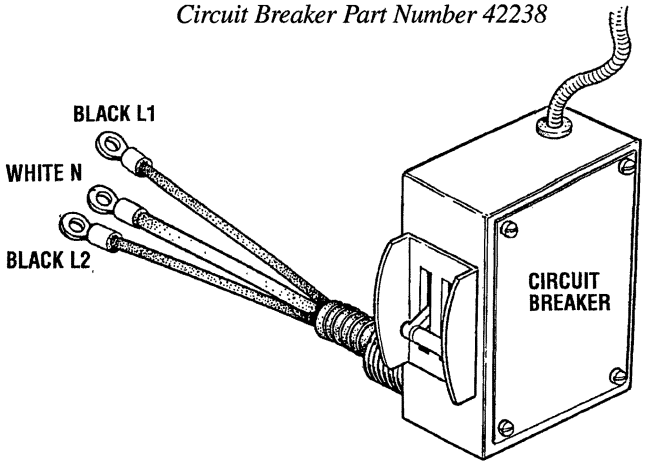
The BC generator is a brushless, self-excited generator which requires only the driving force of the engine to produce an AC output. The stator houses two sets of windings; the main stator windings and the exciter windings. When the generator is started, residual magnetism in the four rotating poles induces a current in the stator which then generates an even larger current in the exciter windings. This mutual build up of current in the four rotating poles and in the exciter windings quickly reaches the saturation point of the capacitor(s) and a regulated energy field is then maintained in the stator. At the same time, this regulated field produces a steady voltage in the stator windings which can then be drawn off the generator's AC terminals to operate AC equipment. The generator is a single-phase, reconnectable 120 volt AC two-wire or 120/240 volt AC three-wire, at 60 hertz. Refer to the SPECIFICATIONS section of this manual for generator ratings. The generator's data plate gives the voltage, current and frequency rating of the generator. An AC wiring decal is affixed to the inside of the louvered cover at the generator end. A diagram of the various AC voltage connections is provided on the decal. An Integral Controller (IC) is mounted inside the generator and supplies a continuous DC charge to the generators starting battery when the generator is running. For more information see the INTEGRAL CONTROLLER DC CHARGER section in this manual.

Circuit Breaker

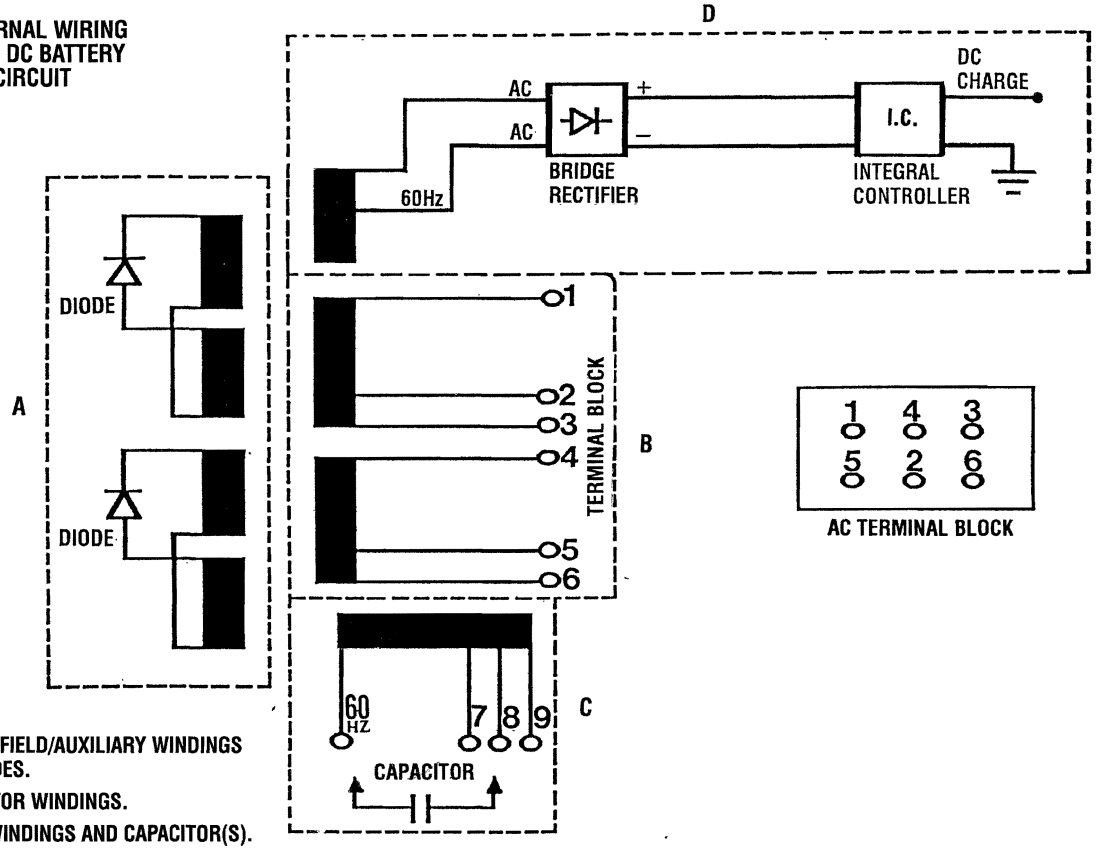
A circuit breaker is installed on all single phase WESTERBEKE generators. This circuit breaker will automatically disconnect generator power in case of an electrical overload. The circuit breaker can be manually shut off when servicing the generator to ensure that no power is coming into the boat.

NOTE: *This circuit breaker is available as a* WESTERBEKE *add-on kit for earlier model generators; contact your* WESTERBEKE *dealer.*

Circuit Breaker Part Number 42238



GENERATOR INTERNAL WIRING SCHEMATIC WITH DC BATTERY CHARGING CIRCUIT



A. ROTATING FIELD/AUXILIARY WINDINGS WITH DIODES.

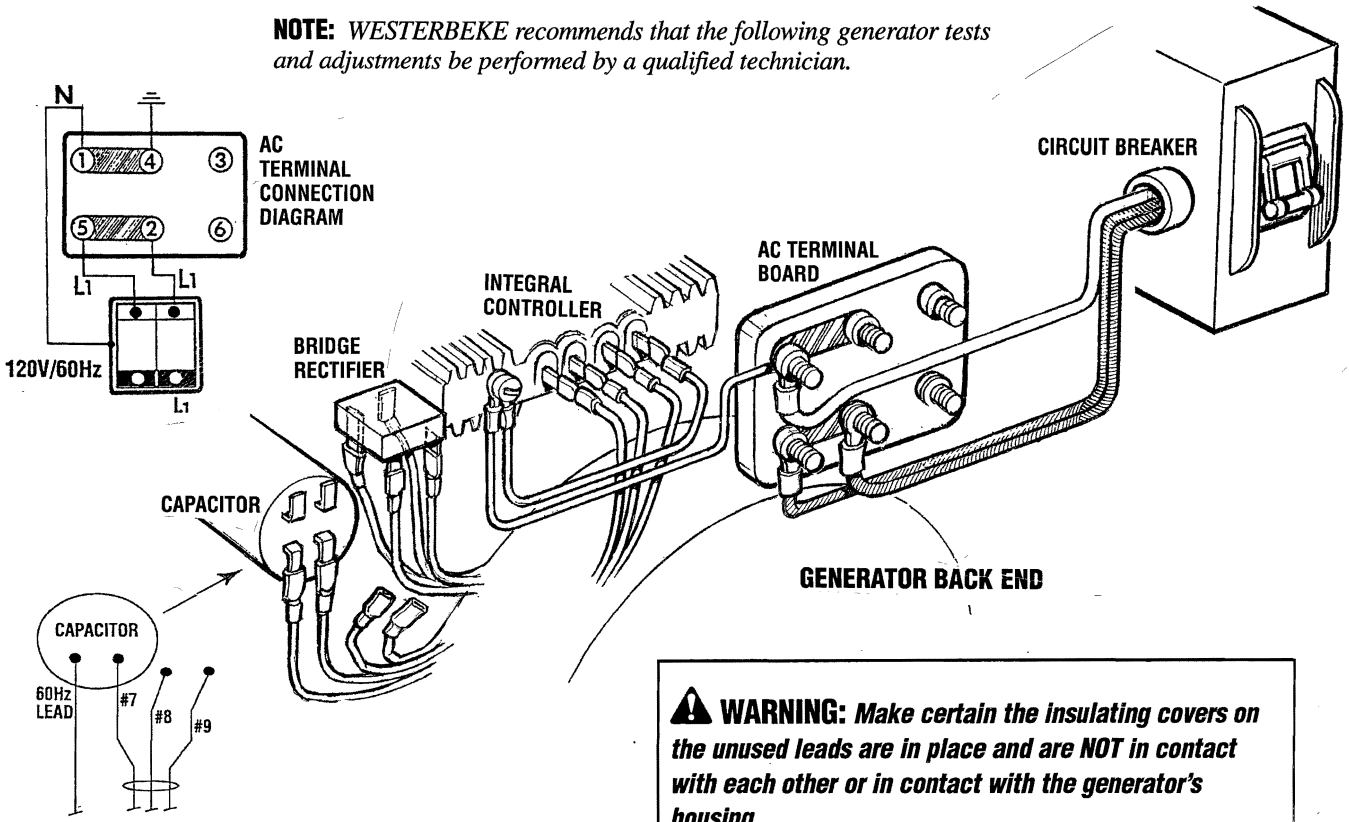
B. MAIN STATOR WINDINGS.

C. EXCITER WINDINGS AND CAPACITOR(S).

D. DC BATTERY CHARGING CIRCUIT WITH BRIDGE RECTIFIER AND INTEGRAL CONTROLLER.

BC GENERATOR SINGLE PHASE

NOTE: *WESTERBEKE recommends that the following generator tests and adjustments be performed by a qualified technician.*



⚠ WARNING: ***Make certain the insulating covers on the unused leads are in place and are NOT in contact with each other or in contact with the generator's housing.***

SINGLE EXCITER NO-LOAD VOLTAGE ADJUSTMENT

1. Remove the louvered metal plate, at the back of the generator, covering the AC terminal connections and the capacitor(s).
2. Start the generator and allow it to run for approximately five minutes so the engine can warm up. Make sure the generator is operating without any equipment drawing AC current from the generator (that is, shut off all electrical appliances). Make sure the engine's speed (Hertz) is correct. Adjust the governor as needed to obtain the correct engine speed before proceeding.
3. Refer to the AC load connections diagram for the correct configuration then check the generator's no-load voltage by measuring the voltage across the neutral lead and the hot lead with a volt meter. Make sure you record this reading. The generator's no-load voltage is 115 - 124 volts at 60.5 - 61.5 Hertz. If the voltage output is higher or lower than specified, proceed.
4. *Shut off* the generator. Make sure the 60Hz Hertz lead is plugged into the capacitor.

⚠ WARNING: ***Capacitors must be discharged before handling as they store electricity and can pack a potentially lethal charge even when disconnected from their power source.***

NOTE: *Simply cross the capacitor's two terminals with an insulated (plastic handle) screwdriver. This will discharge any excess electricity.*

⚠ WARNING: ***Do not attempt to make a no-load voltage adjustment while the generator is operating. The capacitor can produce a 400-500 volt charge. Touching any wiring can produce a severe electrical shock. In addition, attempting to make a no-load voltage adjustment while the generator is operating could cause your fingers to be caught in the generator's rotor.***

5. There are three plugs grouped for the right capacitor terminal, #7, #8, and #9. If the generator's no-load voltage is low, then disconnect the lower numbered plug and connect the plug with the next higher number. If the generator's no-load voltage is high, then disconnect the higher numbered plug and connect the plug with the next lower number. Note that the plug presently connected to this terminal may be any one of the three plugs available.
6. If the generator's no-load voltage cannot be adjusted because the voltage needs to be increased and the highest numbered plug is already connected to the right terminal, or the voltage needs to be lowered and the lowest numbered plug is connected, refer to the WESTERBEKE BC Generator Troubleshooting Guide).

BC GENERATOR SINGLE PHASE

NOTE: *WESTERBEKE recommends that the following generator tests and adjustments be performed by a qualified technician.*

INTEGRAL CONTROLLER (I.C.)

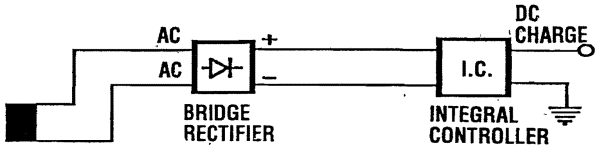
The Integral Controller (I.C.) is an encapsulated, solid-state unit that supplies a DC charging voltage to the generator's starting battery while the generator is opening.

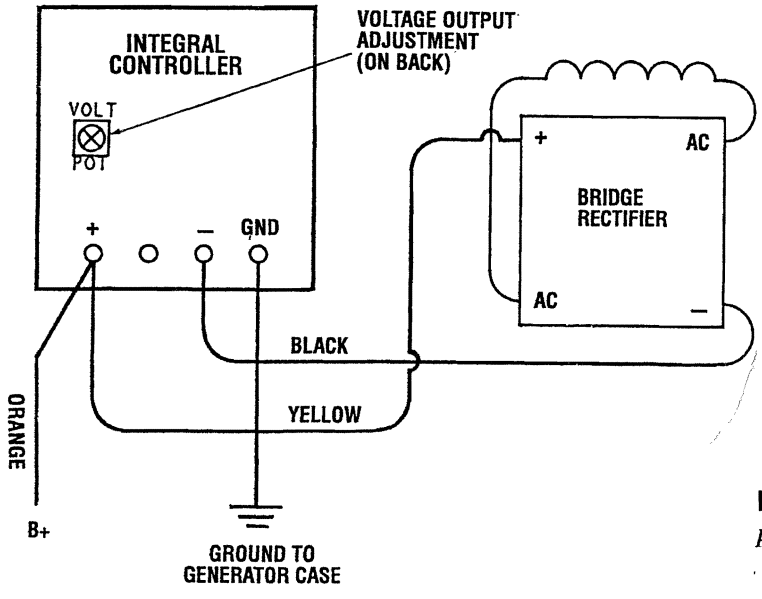
Charging Voltage: 13.0 - 14.0 volts DC
Charging Amperage: 0 - 10- amps DC

A separate group of stator windings supplies AC voltage to a bridge rectifier which converts the AC current to supply the I.C. unit. The I.C. unit senses the needs of the starting battery and supplies a DC charge when one is needed. If you suspect that the I.C. unit is faulty (that is, if the battery's charge is low), check the charging circuit and it's components as described in the following steps. Check all connections for cleanliness and tightness including the ground before replacing the I.C. unit.

NOTE: *When the generator is first started, the I.C. unit will produce a low charging rate. This charging rate will rise as the generator is operated.*

The Integral Controller is mounted inside the generator housing in the 12:00 position. There is a voltage output adjustment on the controller that will allow a DC voltage output adjustment of ± 2 volts.





Testing the Battery Charging Circuit

1. **Bridge Rectifier**

   Normal AC voltage running to the rectifier (while the engine is operating at 1800 rpm) is measured across the two AC connections on the bridge rectifier. (As illustrated).

   AC voltage running to the bridge rectifier (approximate):

No-load off the generator	**16.0 volts AC**
Full-load off the generator	**17.5 volts AC**

   Normal DC voltage running out of the rectifier (in volts DC) is measured across the two DC connections of the bridge rectifier; that is + and –.

   DC voltage running from the bridge rectifier (approximate):

No-load off the generator	**17.0 volts DC**
Full-load off the generator	**18.5 volts DC**

2. **AC winding: 0.14 ohm**

   Lift the two AC wire leads off the bridge rectifier and measure, the resistance between these two leads with an ohmmeter. It should measure 0.14 ohm. No continuity should exist between these two leads and the ground or the main AC stator windings.

3. **Testing the Bridge Rectifier** (meter used - Simpson 260)

   A. Set your ohmmeter's scale on RX1 (+ DC) and set the needle to zero.

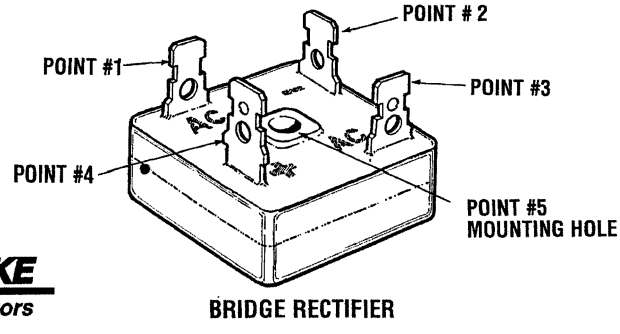
   B. Connect the (+) positive lead from the ohmmeter to point #4. Taking the ohmmeter's negative (–) lead, momentarily touch points #1, #2, #3, and #5. The ohmmeter should register no deflection for any of the points touched.

   C. Remove the positive (+) lead from point #4 and connect the negative (–) lead; momentarily touch points #1, #2, and #3. The ohmmeter's needle should deflect when each point is touched.

   D. Leaving the negative ohmmeter (–) lead on point #4, touch point #5 with the positive lead. No deflection should take place.

   E. Place the positive (+) lead on point #1 and the negative (–) lead on point #3. The ohmmeter again should not register any deflection (no deflection indicated infinite resistance). Reverse these connections and the ohmmeter should again register no deflection. If the rectifier fails any of the previous tests (A-E), replace the rectifier because it is defective.

NOTE: *Different types and/or brands of test meters may produce opposite test results.*



BRIDGE RECTIFIER

LAY-UP AND 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 to use 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.

Fresh Water Cooling System

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

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

Lubrication System

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

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

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

Fuel System

Top off your fuel tanks with No. 2 diesel fuel. Fuel additives such as BioBor and Sta-Bil should be added at this time to control algae and condition the fuel. Care should be taken that the additives used are compatible with the primary filter/water separator used in the system. Change the element in your primary fuel filter/water separator, if the fuel system contains one, 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 Circuit

Close the through-hull sea cock. Remove the raw water intake hose from the sea cock. Place the end of this hose into a 5-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, if one is installed, in the inside of the hull.

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

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

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

Intake Manifold and Through-hull Exhaust

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

LAY-UP AND RECOMMISSIONING

Generator End

Remove the louvered cover on the generator end. Check all wire connections on the AC terminal block and those running to the bridge rectifier making sure they are secure. Should these connections appear corroded, they should be removed, cleaned, and reconnected. Make sure all AC leads are properly cleaned and reconnected. Make sure all AC leads are properly supported and not chafing as they exit the generator housing.

Starter Motor

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

Cylinder Lubrication

It is not necessary to remove the fuel injectors from the cylinder head to squirt light lubricating oil into the cylinders for the few months of normal lay-up. However, if you anticipate a longer lay-up period (12 months or more), we recommended that this procedure be performed. The light oil in the cylinders will prevent the piston rings from sticking to the cylinder walls. Make sure you have replacements for the injector and return line sealing washers.

Spares

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.

Batteries

If batteries are to be left on board during the lay-up period, make sure they are fully charged, and will remain that way, to prevent them from freezing. If there exists 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.

Recommissioning

The recommissioning of your Westerbeke engine after a seasonal lay-up generally follows the same procedures as those presented 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 replacement, if required). Install the raw water pump cover with a new cover gasket.

> ⚠ **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.***

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 to, as either an end of season or recommissioning service to inspect the area that the zinc is located at in the heat exchanger and clear any and all zinc debris from that area.
5. Start the engine in accordance with procedures in the *PREPARATIONS FOR STARTING* section of this manual.

SPECIFICATIONS 4.0 KW BC GENERATORS

ENGINE SPECIFICATIONS

Engine Type	Diesel, four-cycle, three-cylinder, fresh water-cooled, vertical in-line overhead valve mechanism, naturally aspirated.
Combustion Chamber	Swirl type
Bore & Stroke **BCD** **BCDA**	 2.76 x 2.76 inches (70 x 70 mm) 2.99 x 2.76 inches (76 x x70mm)
Piston Displacement **BCD** **BCDA**	 49.31 cubic inches (0.808 liters) 59.09 cubic inches (0.952 liters)
Firing Order	1 - 3 - 2
Direction of Rotation	Clockwise, when viewed from the front
Maximum Torque (at 1800 rpm)	40 lb-ft (5.1 kg-m)
Compression Ratio	23:1
Valve Seat Angle	Intake 45° Exhaust 45°
Fuel Transfer Pump	Electric
Dimensions	Height: 19.9 inches (504.5 mm) Width: 16.0 inches (406.4 mm) Length: 27.2 inches (690.6 mm)
Weight	336 lbs (152.4 kgs)
Governor	Mechanical, centrifugal weight type
Fuel Consumption (approximate)	0.54 gph (2.0 lph) at 1800 rpm
Inclination	Continuous 14° Temporary 25° (not to exceed 30 min.)

TUNE-UP SPECIFICATIONS

Injector Pressure	1988 ±142 psi (140 ±10 kg/cm²)
Engine Timing	16°±1° BTDC Static
Compression Pressure Minimum	398 psi (28 kg/cm²) at 280 rpm limit
Valve Clearance (engine cold)	Intake 0.098 inches (0.25 mm) Exhaust 0.098 inches (0.25 mm)
Valve Seat Angle	Intake/Exhaust 45°
Engine Speed	1800 rpm @ 60Hz
Engine Timing (Spill) **BCD** **BCDA**	 11° ± 1° BTDC 15° ± 1° BTDC

EXHAUST EMISSIONS SYSTEMS

Emission Control Systems	Smoke Puffer Limiter

LUBRICATION SYSTEM

General	Forced lubrication by geared pump.
Oil Filter	Full flow, spin-on replaceable type
Sump Capacity (not including filter)	3.2 U.S. qts (3.03 liters)
Operating Oil Pressure (engine hot)	35 - 55 psi (2.5 - 3.8 kg/cm²)
Oil Grade	API Specification CF or CG-4, SAE 30, 10W-30, 15W-40

FUEL SYSTEM

General	Open flow, self bleeding, self priming
Fuel	No. 2 diesel oil (cetane rating of 45 or higher)
Fuel Injection Pump	In-line plunger type (Bosch type)
Nozzle	Throttle type
Fuel Filter	Cartridge Type
Air cleaner	Plastic intake silencer - cleanable
Air Flow (engine combustion)	31.2 cfm (0.5787 cmm)
Fuel Lift Pump	12 Volt DC lift capacity 5' (1.5m)

COOLING SYSTEM

General	Fresh water-cooled block, thermostatically-controlled with heat exchanger.
Operating Temperature	170 - 190° F (77 - 88° C)
Fresh Water Pump	Centrifugal type, metal impeller, belt-driven
Raw Water Pump	Positive displacement, rubber impeller, gear-driven.
Raw Water Flow, at 1800 rpm	6.5 - 7.0 US gpm (24.6 - 26.5 lpm) (measured before discharging into exhaust elbow).
System Capacity (fresh water)	4.0 qts (3.79 liters)

ELECTRICAL SYSTEM

Starting Battery	12-Volt, (-) negative ground
Battery Capacity	600 - 900 Cold Cranking Amps (CCA)
Starter	12-Volt, reduction
Starting Aid	Glow plugs, sheathed type
DC No-Load Current	90 Amps max. at 11.5 volts
DC Cranking Current	175-200 Amps (engine cold)
DC Charging	17 Amp IC 13 - 14 volts DC (in generator)

SPECIFICATIONS 4.0 KW BCD GENERATORS

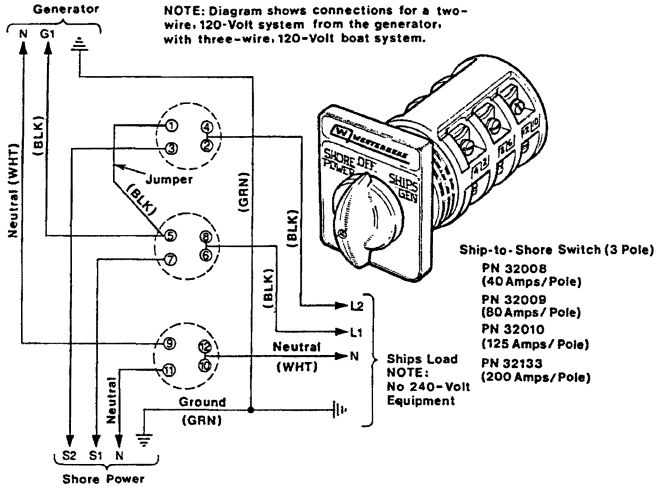
AC GENERATOR (Single Phase)	
Single Phase	Brushless, four-pole, revolving field. Self-exciting, capacitor saturated field excitation. Pre-lubricated, single-bearing design. 120 volts, single phase
Voltage	120 Volts - 60 Hertz
Voltage regulation:	±5% no load to full load.
Frequency regulation:	±3 Hertz (5%) no load to full load.
Rating (Volts AC)	60 Hertz (1800 rpm) 120 Volts/41.6 Amps
Generator Cooling Air Requirements (60 Hertz) at 1800 rpm	175 - 200 cfm (4.95 - 5.66 cmm)
Generator Compartment Ambient Temperature Recommendations	104°F (40°C) maximum **NOTE:** *Forced ventilation should be provided to maintain generator compartment temperatures below 104°F (40°C).*
Cooling	Cast centrifugal blower, direct connected.
Electromagnetic Interference level	Exceeds requirements for most marine radio telephones and standard televisions. Meets CE (Certified Europe) requirements.

DESCRIPTION

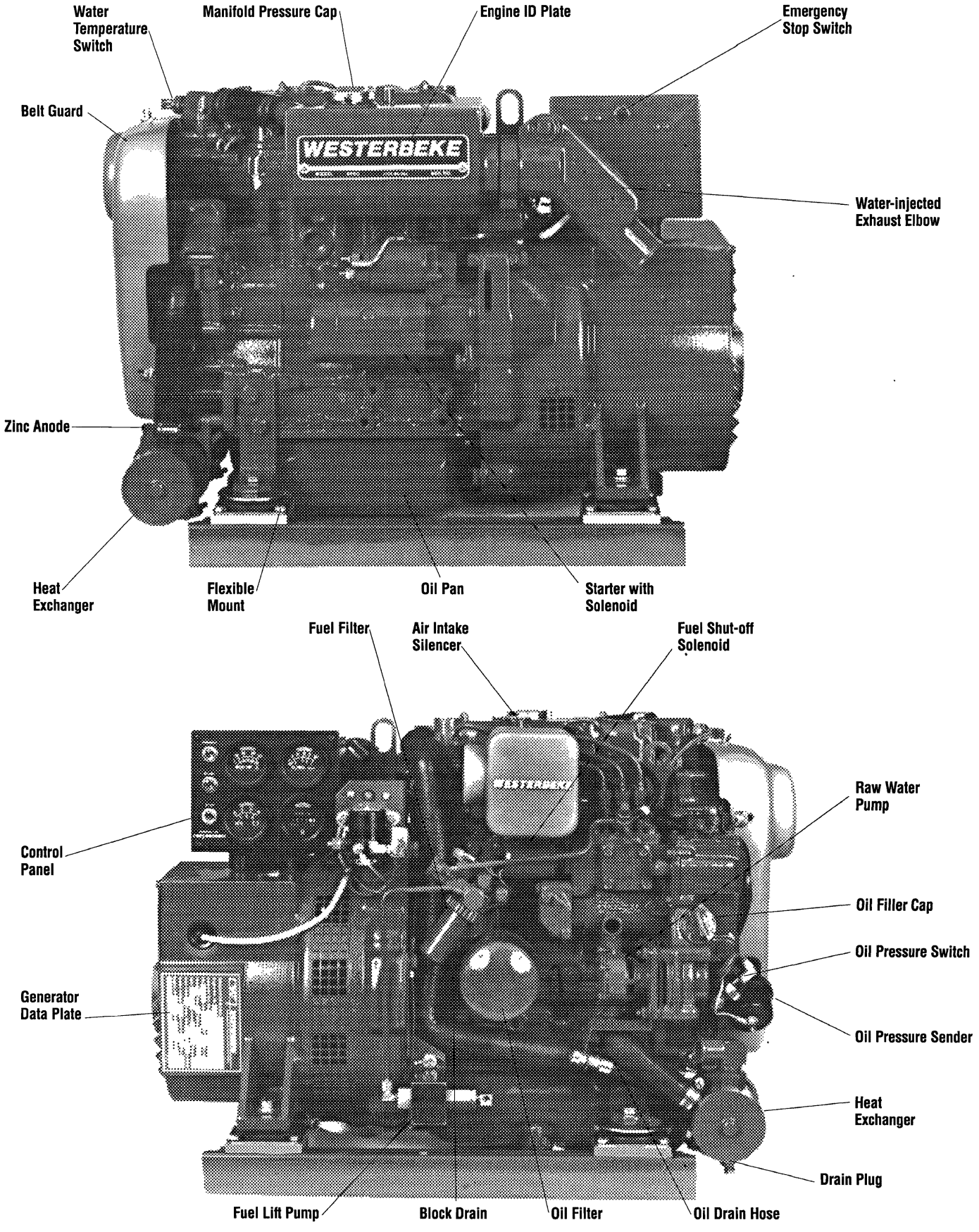
If the installer connects shore power to the vessel's AC circuit, this must be done by means of the Shore Power Transfer Switch. Set the transfer switch shown in the diagrams to the OFF position. This switch prevents simultaneous connection of shore power to generator output.

> ⚠ **CAUTION:** ***Damage to the generator can result if utility shore power and generator power are connected at the same time. This type of generator damage is not covered under the warranty; it is the installer's responsibility to make sure all AC connections are correct.***

120 Volt/60 Hertz Three Wire Configuration



WESTERBEKE 4.0 KW BCD PARTS IDENTIFICATION



STANDARD HARDWARE TORQUES

NOTE: *Unless stated otherwise for a specific assembly, use the following torque values when tightening standard hardware.*

Grade 4	Pitch	lb-ft	kg-m
6mm bolt head/nut	1	2.9-5.1	0.4-0.7
8mm bolt head/nut	1.25	7.2-11.6	1.0-1.6
10mm bolt head/nut	1.25	13.7-22.4	1.9-3.1
10mm bolt head/nut	1.5	13.0-21.7	1.8-3.0
12mm bolt head/nut	1.25 (ISO)	25.3-39.8	3.5-5.5
12mm bolt head/nut	1.5	25.3-39.8	3.5-5.5
12mm bolt head/nut	1.75	21.7-36.2	3.0-5.0
13mm bolt head/nut	1.5	32.5-50.6	4.5-7.0
14mm bolt head/nut	1.5	36.2-57.9	5.0-8.0
14mm bolt head/nut	2	34.0-55.7	4.7-7.7
16mm bolt head/nut	1.5	54.2-79.6	7.5-11.0
16mm bolt head/nut	2	51.4-76.7	7.1-10.6
Grade 6T			
6mm bolt head/nut	1	4.3-6.5	0.6-0.9
8mm bolt head/nut	1.25	10.8-15.9	1.5-2.2
10mm bolt head/nut	1.25	21.7-32.5	3.0-4.5
10mm bolt head/nut	1.5	19.5-30.4	2.7-4.2
12mm bolt head/nut	1.25 (ISO)	36.2-57.9	5.0-8.0
12mm bolt head/nut	1.5	36.2-50.6	5.0-7.0
12mm bolt head/nut	1.75	34.7-49.2	4.8-6.8

Grade 7T, 8T and 8.8	Pitch	lb-ft	kg-m
6mm bolt head/nut	1	5.8-8.7	0.8-1.2
8mm bolt head/nut	1.25	14.5-21.7	2.0-3.0
10mm bolt head/nut	1.25	28.9-39.8	4.0-5.5
10mm bolt head/nut	1.5	26.8-37.6	3.7-5.2
12mm bolt head/nut	1.25 (ISO)	54.2-75.9	7.5-10.5
12mm bolt head/nut	1.5	50.6-65.1	7.0-9.0
12mm bolt head/nut	1.75	43.4-61.5	6.0-8.5
13mm bolt head/nut	1.5	57.9-86.8	8.0-12.0
14mm bolt head/nut	1.5	72.3-108.5	10.0-15.0
14mm bolt head/nut	2	68.7-101.3	9.5-14.0
16mm bolt head/nut	1.5	108.5-166.4	15.0-23.0
16mm bolt head/nut	2	101.3-159.1	14.0-22.0
Grade 5 Cap Screw			
1/4 UNC		9-11	1.2-1.5
1/4 UNF		11-13	1.5-1.8
5/16 UNC		18-20	2.5-2.8
5/16 UNF		21-23	2.9-3.2
3/8 UNC		28-33	3.7-4.6
3/8 UNF		30-35	4.1-4.8
7/16 UNC		44-49	6.1-6.8
7/16 UNF		50-55	6.9-7.6
1/2 UNC		68-73	9.4-10.1
1/2 UNF		73-80	10.1-11.1

4.0 KW BCD GENERATOR TIGHTENING TORQUE TABLE

	Socket Size	Ft-lb	Kg-m
Cylinder head	M10 (14mm)	54 - 61	7.5 - 8.5
Cylinder head cover	M8 (12mm)	2 - 3	0.3 - 0.45
Connecting rod cap		50 - 54	6.9 - 7.5
Main bearing cap		80 - 85	11.0 - 11.7
Camshaft thrust plate		12 -17	1.6 - 2.4
Camshaft gear		45 - 51	6.2 - 7.0
Idle gear		17 - 23	2.3 - 3.2
Injection pump drive gear		29 - 51	4.0 - 7.0
Rocker arm assembly		80 - 85	11.0 - 11.7
Timing gear case		12 -17	1.6 - 2.4
Timing gear cover		12 -17	1.6 - 2.4
Rear oil seal cap		11 - 15	1.5 - 2.0
Oil Pan Drain Plug	M18	36.2 - 43.4	5.0 - 6.0
Oil pipe (oil pump)		6 - 9	0.8 - 1.2
Oil filter		8.0 - 9.4 (or tighten firmly by hand)	1.1 - 1.3

	Socket Size	Ft-lb	Kg-m
Water pump		12 -17	1.6 - 2.4
Crankshaft pulley nut	M16 (24mm)	72.3 - 86.7	10.0 - 12.0
Temperature gauge unit		9 - 13	1.2 - 1.8
Oil pressure switch		9 - 13	1.2 - 1.8
Glow plug	M10 (12mm)	10.8 - 14.5	1.5 - 2.0
Injection nozzle		12 -17	1.6 - 2.4
Injection pipe flare unit		18 - 22	2.5 - 3.0
Intake manifold		12 -17	1.6 - 2.4
Exhaust manifold		12 -17	1.6 - 2.4
Exhaust elbow (to exhaust manifold)			
Back plate		24 - 35	24 - 35.0
Injector spray pressure		1990 ± 140.0 psi 140 ± 10 kg/cm²	
Cylinder compression pressure		398 psi (280 rpm) 28 kg/cm² (280 rpm)	

STANDARD AND METRIC CONVERSION DATA

LENGTH-DISTANCE

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

VOLUME

Cubic Inches (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

METRIC CONVERSIONS

INCHES TO MILLIMETERS / MILLIMETERS TO INCHES

Inches	mm	Inches	mm	mm	Inches	mm	Inches
1	25.40	15	381.00	1	0.0394	15	0.5906
2	50.80	20	508.00	2	0.0787	20	0.7874
3	76.20	25	635.00	3	0.1181	25	0.9843
4	101.60	30	762.00	4	0.1575	30	1.1811
5	127.00	35	889.00	5	0.1969	35	1.3780
10	254.00	40	1016.00	10	0.3937	40	1.5748

10 MILLIMETERS = 1 CENTIMETER, 100 CENTIMETERS = 1 METER = 39.37 INCHES (3.3 FEET)

INCHES TO METERS / METERS TO INCHES

Inches	Meters	Inches	Meters	Meters	Inches	Meters	Inches
1	0.0254	7	0.1778	0.1	3.937	0.7	27.559
2	0.0508	8	0.2032	0.2	7.874	0.8	31.496
3	0.0762	9	0.2286	0.3	11.811	0.9	35.433
4	0.1016	10	0.2540	0.4	15.748	1.0	39.370
5	0.1270	11	0.2794	0.5	19.685	1.1	43.307
6	0.1524	12	0.3048	0.6	23.622	1.2	47.244

TO CONVERT METERS TO CENTIMETERS, MOVE DECIMAL POINT TWO PLACES TO THE RIGHT

YARDS TO METERS / METERS TO YARDS

Yards	Meters	Yards	Meters	Meters	Yards	Meters	Yards
1	0.91440	6	5.48640	1	1.09361	6	6.56168
2	1.82880	7	6.40080	2	2.18723	7	7.65529
3	2.74320	8	7.31520	3	3.28084	8	8.74891
4	3.65760	9	8.22960	4	4.37445	9	9.84252
5	4.57200	10	9.14400	5	5.46807	10	10.93614

MOVE DECIMAL POINT FOR HIGHER VALUES — e.g. 6,000 METERS = 6,561.68 YARDS

POUNDS TO KILOGRAMS / KILOGRAMS TO POUNDS

lb	kg	lb	kg	kg	lb	kg	lb
1	0.454	6	2.722	1	2.205	6	13.228
2	0.907	7	3.175	2	4.409	7	15.432
3	1.361	8	3.629	3	6.614	8	17.637
4	1.814	9	4.082	4	8.818	9	19.842
5	2.268	10	4.536	5	11.023	10	22.046

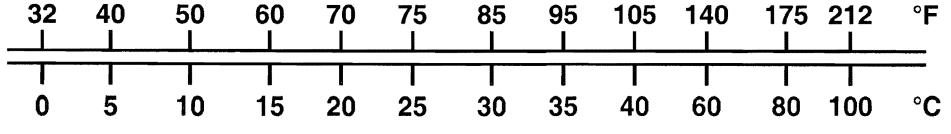
GALLONS TO LITERS / LITERS TO GALLONS

Gallons	Liters	Gallons	Liters	Liters	Gallons	Liters	Gallons
1	3.79	10	37.86	1	0.26	60	15.66
2	7.57	20	75.71	2	0.53	90	23.77
3	11.36	30	113.57	5	1.32	120	31.32
4	15.14	40	151.42	10	2.64	150	39.62
5	18.93	50	189.28	20	5.28	180	47.54

PINTS TO LITERS / LITERS TO PINTS

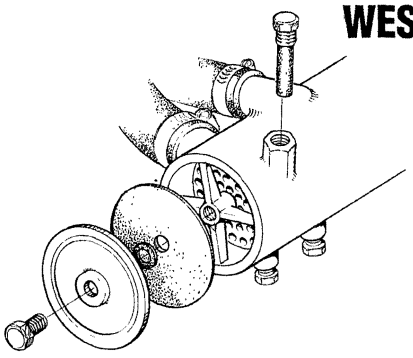
Pints	Liters	Pints	Liters	Liters	Pints	Liters	Pints
1	0.47	6	2.84	1	2.11	6	12.68
2	0.95	7	3.31	2	4.23	7	14.79
3	1.42	8	3.79	3	6.34	8	16.91
4	1.89	9	4.26	4	8.45	9	19.02
5	2.37	10	4.73	5	10.57	10	21.13

TEMPERATURE



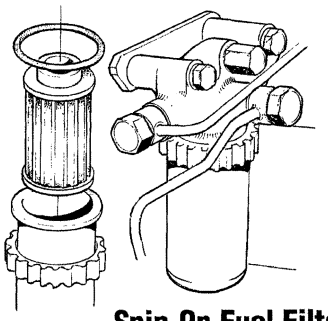
SUGGESTED SPARE PARTS

WESTERBEKE MARINE DIESEL GENERATORS

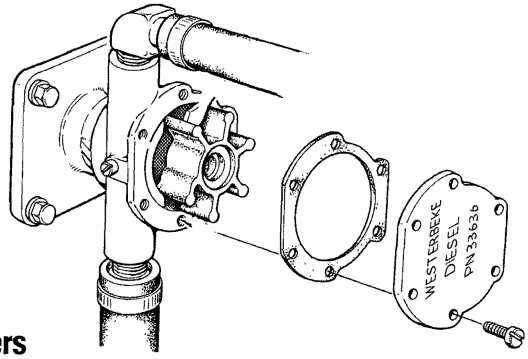


Heat Exchanger and Gasket
Check annually.

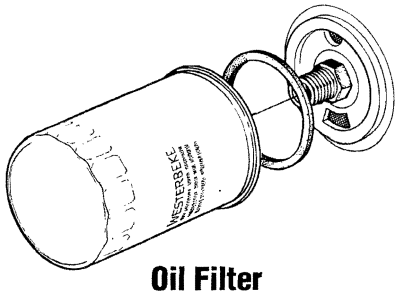
Zinc Anodes
Carry several.



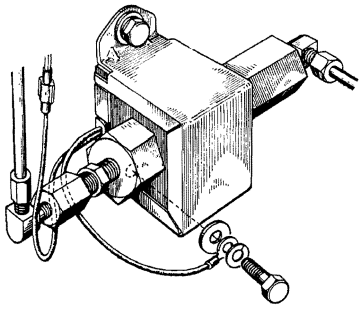
Spin-On Fuel Filters
Always carry a spare.



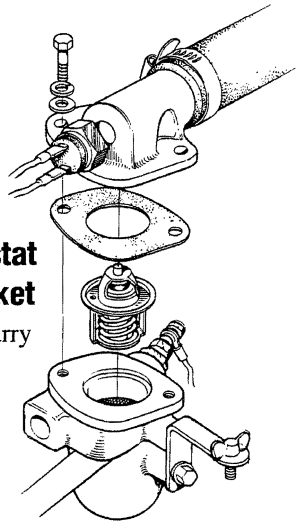
Raw Water Impeller and Gasket
Check annually.



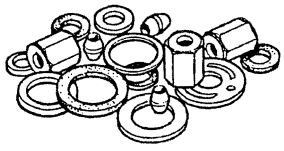
Oil Filter
Have several aboard
Change every 100 hours.



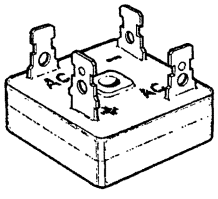
Fuel Lift Pumps
Solid State Model have a spare on board.



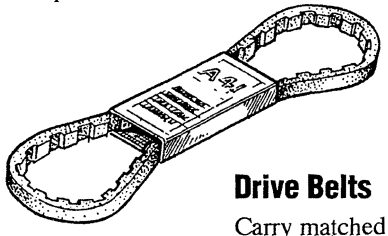
Thermostat and Gasket
Always carry a spare aboard.



Fuel Hardware Kits
Fuel line banjo fittings and washers.



Bridge Rectifier



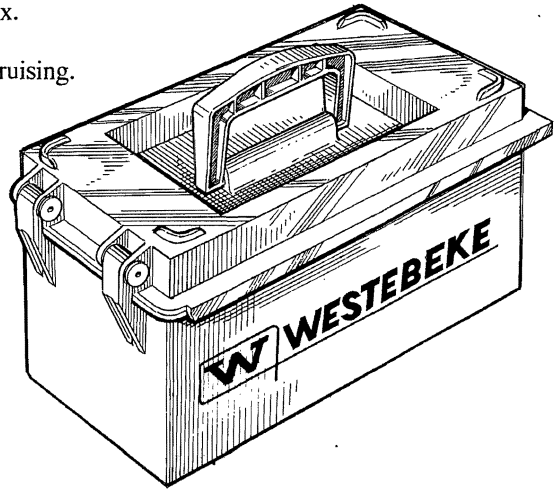
Drive Belts
Carry matched pairs.
Inspect every 100 hours.

SPARE PARTS KITS

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

A Kit

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



B Kit

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


WESTERBEKE
Engines & Generators