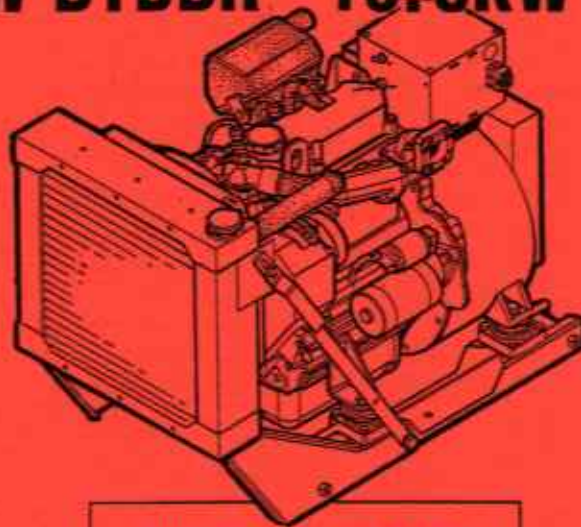




OPERATORS MANUAL MOBILE and INDUSTRIAL GENERATORS

**8.0KW BT DAR 10.0KW BT DAR
12.5KW BT DBR 15.0KW BT DCR**



**PUBLICATION NO.49120
FIRST EDITION
AUGUST 2003**

 WESTERBEKE

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

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

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



A WARNING DECAL is provided by WESTERBEKE and should be fixed to a bulkhead near your engine or generator.

WESTERBEKE also recommends installing CARBON MONOXIDE DETECTORS. They are inexpensive and easily obtainable at your local marine or hardware store.

**CALIFORNIA
PROPOSITION 65 WARNING**

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

SAFETY INSTRUCTIONS

INTRODUCTION

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

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

PREVENT ELECTRIC SHOCK

⚠ WARNING: Do not touch AC electrical connections while engine is running. 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.
- 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 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!

- 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.

ACCIDENTAL STARTING

⚠ WARNING: Accidental starting can cause injury or death!

- To prevent accidental starting when servicing the generator, remove the 8 amp fuse from the control panel.
- 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.

SAFETY INSTRUCTIONS

BATTERY EXPLOSION

⚠ WARNING: Battery explosion can cause injury or death!

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

BATTERY ACID

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

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

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

- Ensure that the exhaust system is adequate to expel gases discharged from the engine. Check the exhaust system regularly for leaks and make sure the exhaust manifolds are securely attached and no warping exists. Pay close attention to the manifold and exhaust.
- Be sure the unit and its surroundings are well ventilated.
- In addition to routine inspection of the exhaust system, install a **carbon monoxide detector**. Consult your dealer for installation of approved detectors.

⚠ 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 vents, or air conditioners.
- Although diesel engine exhaust gases are not as toxic as exhaust fumes from gasoline engines, carbon monoxide gas is present in diesel exhaust fumes. Some of the symptoms or signs of carbon monoxide inhalation or poisoning are:
 - Vomiting
 - Dizziness
 - Throbbing in temples
 - Muscular twitching
 - Intense headache
 - Weakness and sleepiness

AVOID MOVING PARTS

⚠ WARNING: Rotating parts can cause injury or death!

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

HAZARDOUS NOISE

⚠ WARNING: High noise levels can cause hearing loss!

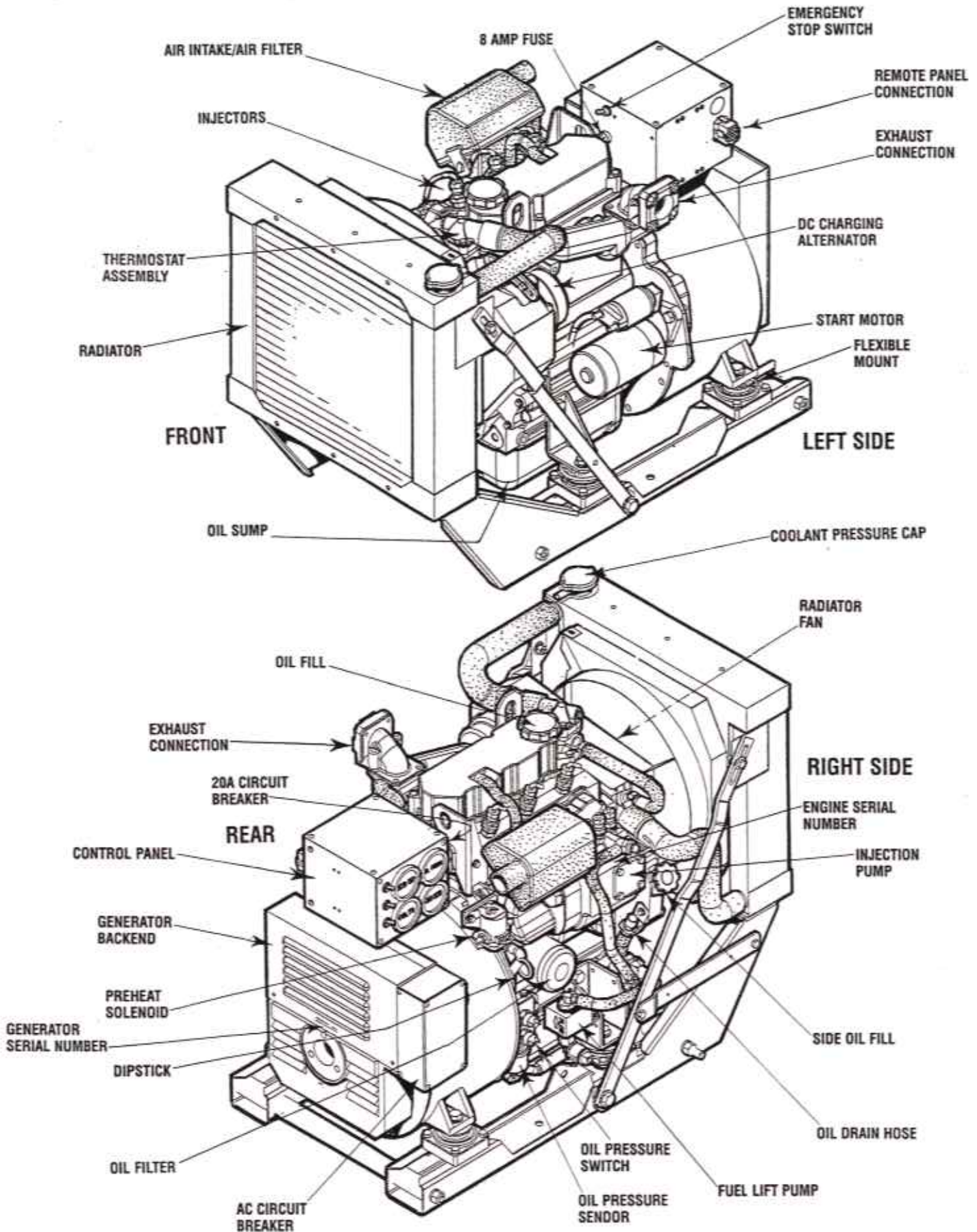
- Never operate an engine without its muffler installed.
- Do not run an engine with the air intake (silencer) removed.
- Do not run engines for long periods with their enclosures open.

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

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PARTS IDENTIFICATION



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



Customer Identification

MR. GENERATOR OWNER

MAIN STREET

HOMETOWN, USA

Model 15BTDAR Ser. #U0000-E302

Expires 7/20/2004

PRODUCT SOFTWARE

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

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NOTES, CAUTIONS AND WARNINGS

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

NOTE: *An operating procedure essential to note.*

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

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

INTRODUCTION

SERIAL NUMBER LOCATION

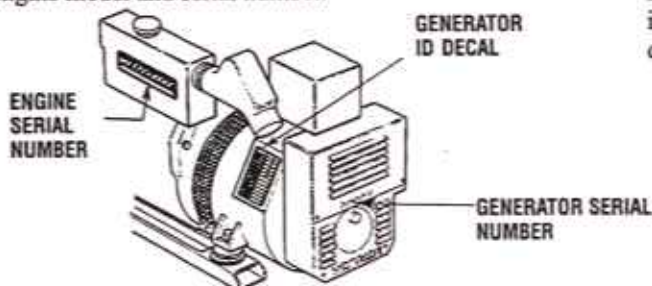
The engine and generator serial numbers and model numbers are located on a decal on the generator housing. Take the time to enter this information on the illustration of the nameplate shown below, as this will provide a quick reference when seeking technical information and/or ordering repair parts.

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 replaced by a single component – the fuel injection pump – which performs the function of both.

ORDERING PARTS

Whenever replacement parts are needed, always provide the generator model number, engine serial number, and generator serial number as they appear on the silver and black nameplate 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). Insist upon WESTERBEKE packaged parts because *will fit* or generic parts are frequently not made to the same specifications as original equipment.

SPARES AND ACCESSORIES

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

INSTALLATION MANUAL

Publication #43400 provides detailed information for installing generators and is available at your WESTERBEKE dealer.



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.

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 75 psi (241.3 and 517.1 Kpa).

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

ENGINE COOLANT

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

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

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

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.

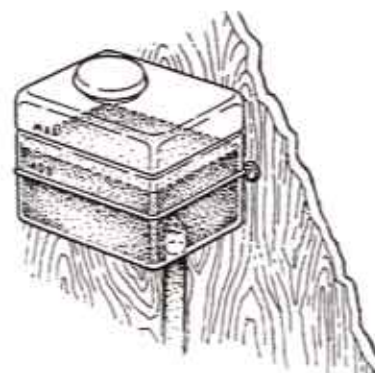
ANTIFREEZE PROTECTION

Antifreeze concentration	23%	30%	35%	50%
Freezing Temperature	14°F (-5°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.



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 serves two purposes: preheating the engine for easy starting and bypassing the engine oil pressure switch. The PREHEAT function closes the K2 relay, as well as supplies current to the fuel solenoid pull coil.

When the PREHEAT switch is depressed, the voltmeter, panel lights, gauges and meters and the hold coil of the fuel solenoid.

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 K2 relay. 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 side 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 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.

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. Make certain the (+) battery cable is connected to the starter solenoid and the negative (-) cable is connected to the engine ground stud (this location is tagged).
- Check the coolant level in both the plastic recovery tank and at the manifold.
- 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.

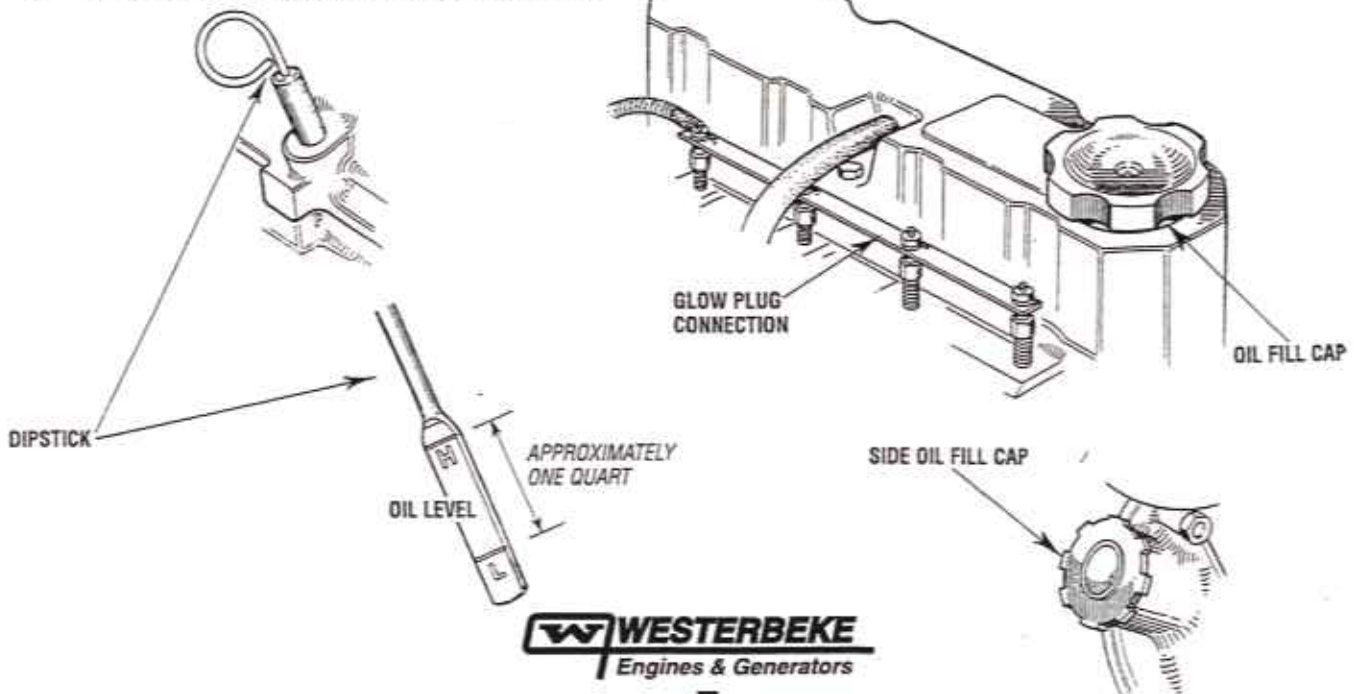
GENERATOR VOLTAGE

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

60 Hz The engine no-load speed is set at 61.5 - 62 Hz. At rated amperage hertz output may decrease to 48.6 - 59.0 Hz.

50 Hz The engine no-load speed is set at 61.5 Hz. At rated amperage hertz output may decrease to 48.5 - 49.0 Hz.

The speed of the generator engine is adjusted at the factory, however it is advisable to verify. 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 or test load of the same power factor as the load to be used in service. If the voltage cannot be adjusted to suitable values and fault seems evident, contact your authorized WESTERBEKE service dealer.



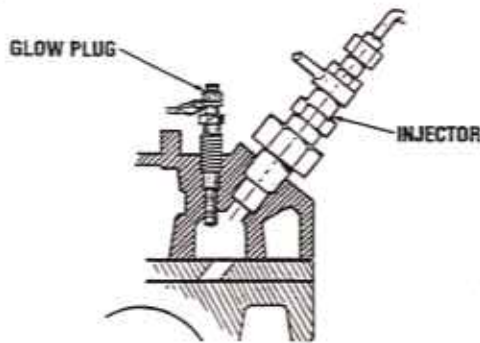
STARTING/STOPPING PROCEDURE

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.



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.*

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.

- 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. The green LED will remain brightly illuminated while the engine is running.
- 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°F (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 and the green LED light goes out.

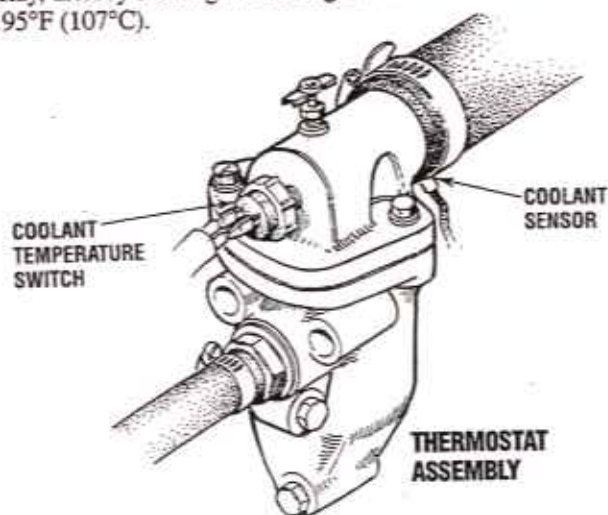
SAFETY SHUTDOWN SWITCHES

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:

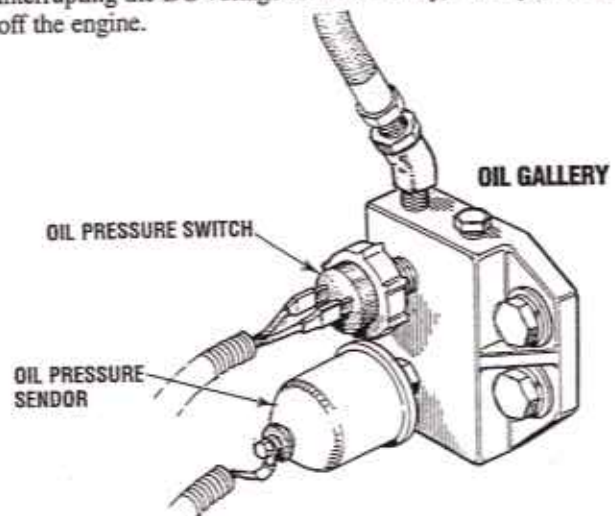
Coolant Temperature Switch

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 K2 relay, 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 K2 relay, 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 the generator will shut down and the voltage to the K2 relay is terminated. 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 (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.

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 OPERATION

CHECK LIST

Follow this check list each day before starting your generator.

- 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/radiator.
- 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 an operating temperature 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 lessen 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 manuals).

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	<input type="checkbox"/>								Diesel No. 2 rating of 45 cetane or higher.
Fuel/Water Separator	<input type="checkbox"/>								Check for water and dirt in fuel (drain/replace filter if necessary).
Engine Oil Level	<input type="checkbox"/>								Oil level should indicate between MAX. and LOW on dipstick.
Coolant Level	<input type="checkbox"/>								Check at recovery tank; if empty, check at manifold and radiator. Add coolant if needed.
Drive Belts	<input type="checkbox"/> weekly								Inspect for proper tension (3/8" to 1/2" deflection) and adjust if needed. Check belt edges for wear.
Visual Inspection of Engine	<input type="checkbox"/>	NOTE: <i>Please keep engine surface clean. Dirt and oil will inhibit the engine's ability to remain cool.</i>							Check for fuel, oil and water leaks. Inspect wiring and electrical connections. Keep bolts & nuts tight. Check for loose belt tension.
Fuel Filter		<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Initial change at 50 hrs, then change every 250 hrs.
Starting Batteries	<input type="checkbox"/> weekly								Every 50 operating hours check electrolyte levels and make sure connections are very tight. Clean off excessive corrosion.
Engine Oil (and filter)		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Initial engine oil & filter change at 50 hrs., then change both every 100 hours.
Generator		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Check that AC connections are clean and secure with no chafing. See <i>GENERATOR SECTION</i> for additional information.
Fuel/Water Separator			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Change every 200 hours.
Electronic Governor Control (if applicable)		<input type="checkbox"/>				<input type="checkbox"/>			Check and or adjust the no-load speed in the panel, required (hertz) and the regulator board adjustment as needed. NOTE: <i>These adjustment are not a warrantable adjustment during or after the unit's break-in.</i>
Exhaust System		<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>	Initial check at 50 hrs., then every 250 hrs. Inspect for leaks. 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			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Hose should be hard & tight. Replace if soft or spongy. Check and tighten all hose clamps.

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	
Coolant System					<input type="checkbox"/>			<input type="checkbox"/>	Drain, flush, and refill cooling system with appropriate antifreeze mix.
Air Intake Filter			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Clean every 100 hours. Replace as needed.
Electric Fuel Lift Pump		<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Periodically check the wiring connections..
DC Alternator				<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>	Check DC charge from alternator. Check mounting bracket; tighten electrical connections.
*Fuel Injectors						<input type="checkbox"/>			Check and adjust injection opening pressure and spray condition (see <i>ENGINE ADJUSTMENTS</i>).
*Starter Motor					<input type="checkbox"/>			<input type="checkbox"/>	Check solenoid and motor for corrosion. Remove and lubricate. Clean and lubricate the starter motor pinion drive.
*Preheat Circuit					<input type="checkbox"/>			<input type="checkbox"/>	Check operation of preheat solenoid. Remove and clean glow plugs; check resistance (4-6 ohms). Reinstall with anti-seize compound on threads.
*Engine Cylinder Compression					<input type="checkbox"/>			<input type="checkbox"/>	Check compression pressure and timing (see <i>ENGINE ADJUSTMENTS</i>).
*Torque Cylinder Head Hold-down bolts		<input type="checkbox"/>			<input type="checkbox"/>			<input type="checkbox"/>	At first 50 hours, then every 500 hours (see <i>ENGINE ADJUSTMENTS</i>).
*Adjust the Valve Clearances		<input type="checkbox"/>			<input type="checkbox"/>			<input type="checkbox"/>	Adjust Valve Clearances (see <i>ENGINE ADJUSTMENTS</i>).
*Radiator								<input type="checkbox"/>	Remove, have professionally cleaned and pressure tested.

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

COOLING SYSTEM

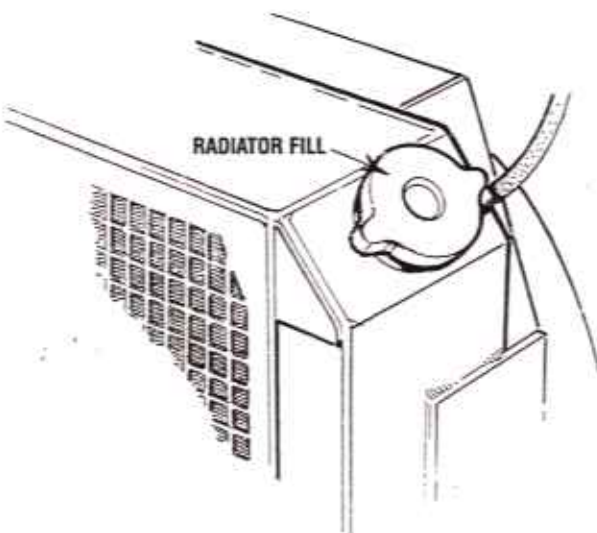
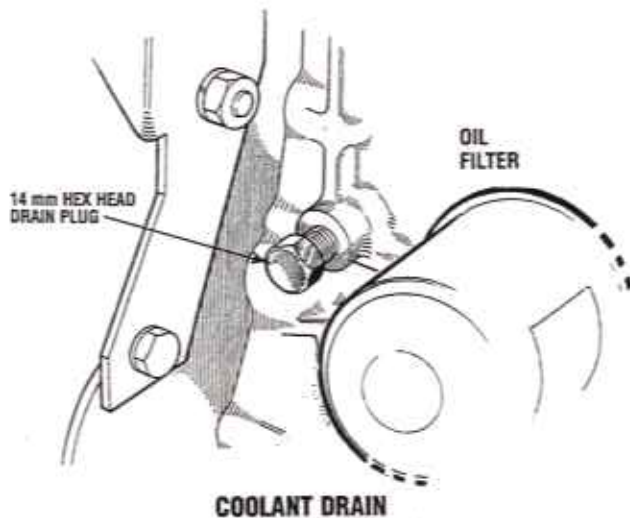
DESCRIPTION

Westerbeke diesel engines 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 and the engine oil.

Fresh water coolant is pumped through the engine by a circulating pump, absorbing heat from the engine. The coolant then passes through the thermostat into the manifold, to the radiator where it is cooled, and returned to the engine block via the suction side of the circulating pump.

FRESH WATER COOLING CIRCUIT

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



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 engine 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

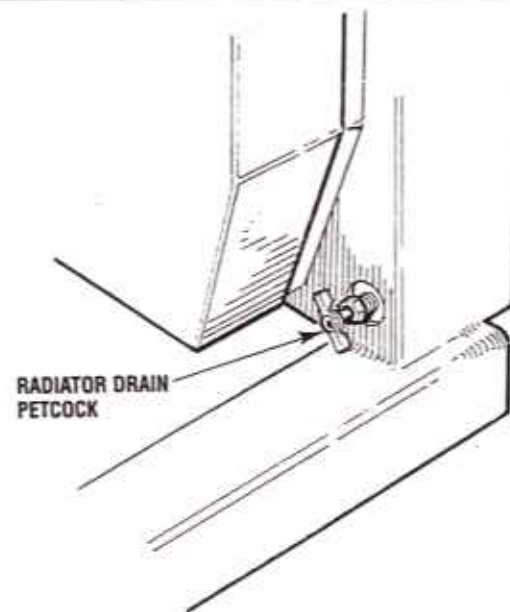
The engine's coolant must be changed according to the MAINTENANCE SCHEDULE. If the coolant is allowed to become contaminated, it can lead to overheating problems.

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 loosening the drain plug on the engine block and opening the radiator pressure cap. Flush the system with fresh water, then start the refill process.

NOTE: The petcock on the radiator can also be used to drain engine coolant.

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



COOLING SYSTEM

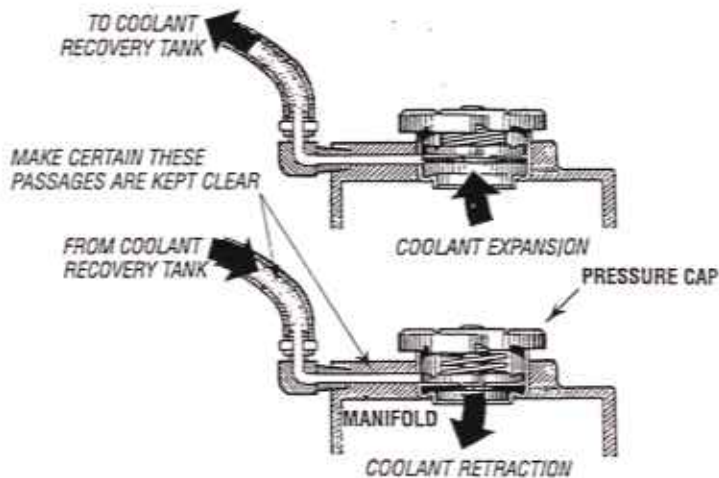
Refilling the Coolant

After replacing the engine block drain plug, close the radiator coolant petcock, then pour clean, premixed coolant into the radiator and when the coolant is visible, start the engine.

Monitor the coolant in the radiator and add as needed. Fill the radiator to the filler neck and install the pressure cap.

Remove the cap on the coolant recovery tank and fill with coolant mix to halfway between LOW and MAX and replace the cap. Run the engine, 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 radiator 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.



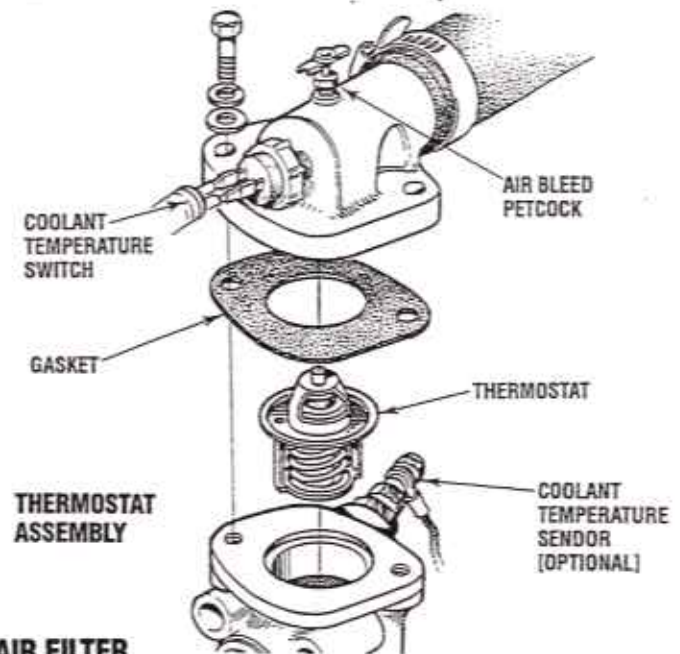
THERMOSTAT

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

Replacing the Thermostat

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

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

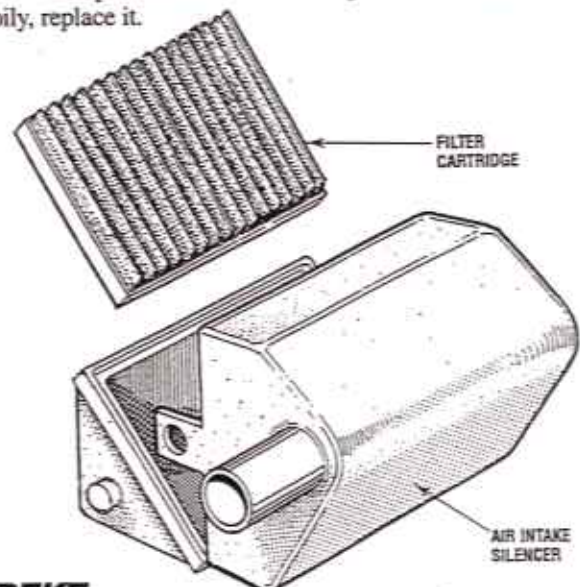


AIR FILTER

The air filter cartridge prevents engine room dust and dirt from entering the engine, it also extends engine life, and quiets the engine.

MAINTENANCE

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



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 FILTER/WATER SEPARATOR

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

The owner/operator is responsible for making certain the fuel reaching the engine's injection equipment is free of impurities. This process is accomplished by installing and maintaining a proper fuel filter/water separator between the fuel tank and the generator/engine. Westerbeke recommends a 10 micron filter be used.

FUEL INJECTION PUMP

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

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

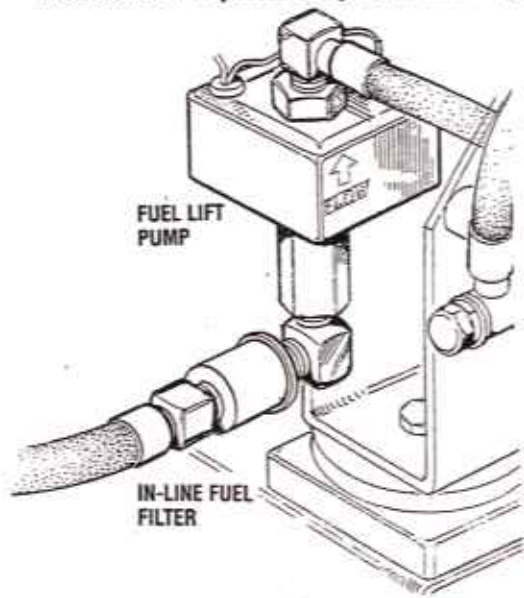
FUEL LIFT PUMP

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

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

FUEL LIFT PUMP FILTER

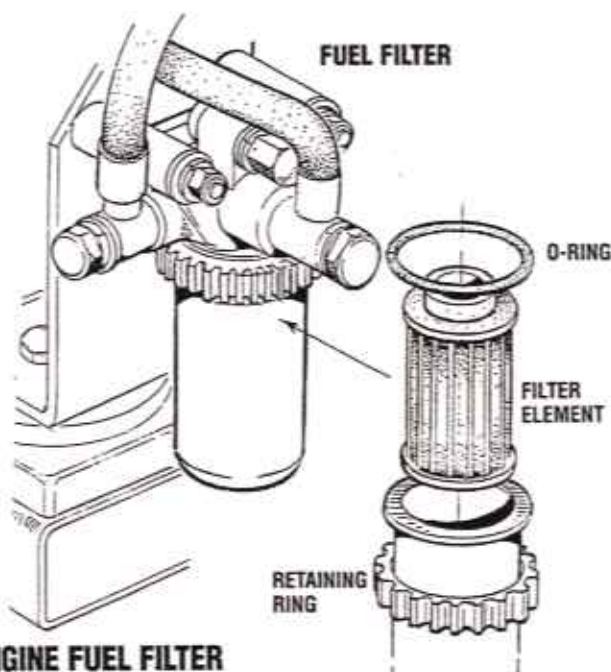
To ensure clean fuel into the fuel lift pump, there is a small in-line fuel filter connected to the fuel lift pump elbow. This filter should be replaced every 200 hours of operation.



FUEL FILTERS

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

⚠ 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.



ENGINE FUEL FILTER

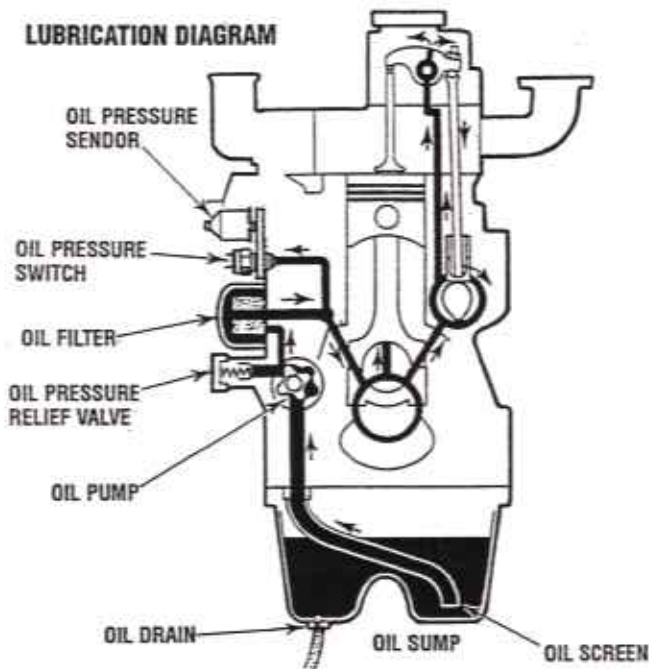
Periodically check the fuel connections and the bowl for leakage. Replace the filter element after the first 50 hours then follow the *MAINTENANCE SCHEDULE*.

Changing/cleaning the filter element

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

ENGINE LUBRICATING OIL

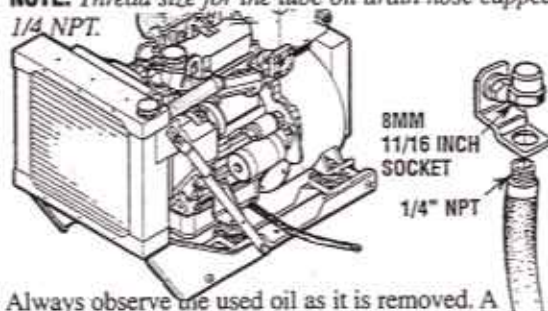
LUBRICATION DIAGRAM



ENGINE OIL CHANGE

1. **Draining the Oil Sump.** Discharge the used oil through the sump drain hose (attached to the front of the engine) while the engine is still 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.

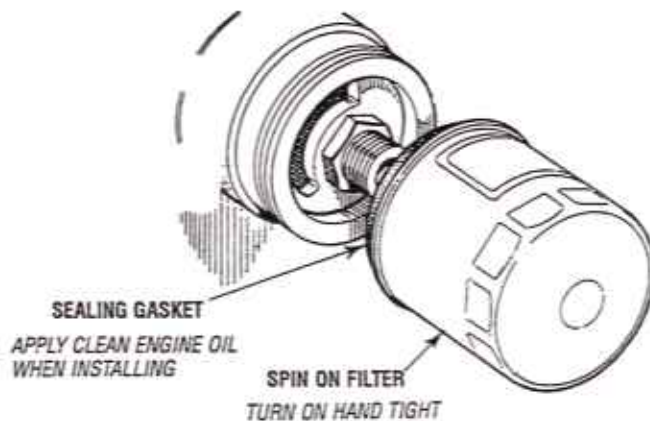


Always observe the used oil as it is removed. A yellow/gray emulsion indicates the presence of water in the oil. Although this condition is rare, it does require prompt attention to prevent serious damage. Call a qualified mechanic should water be present in the oil. exhaust, filling the engine.

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

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

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



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

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

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

REMOTE OIL FILTER (OPTIONAL)

INSTALLATION

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

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

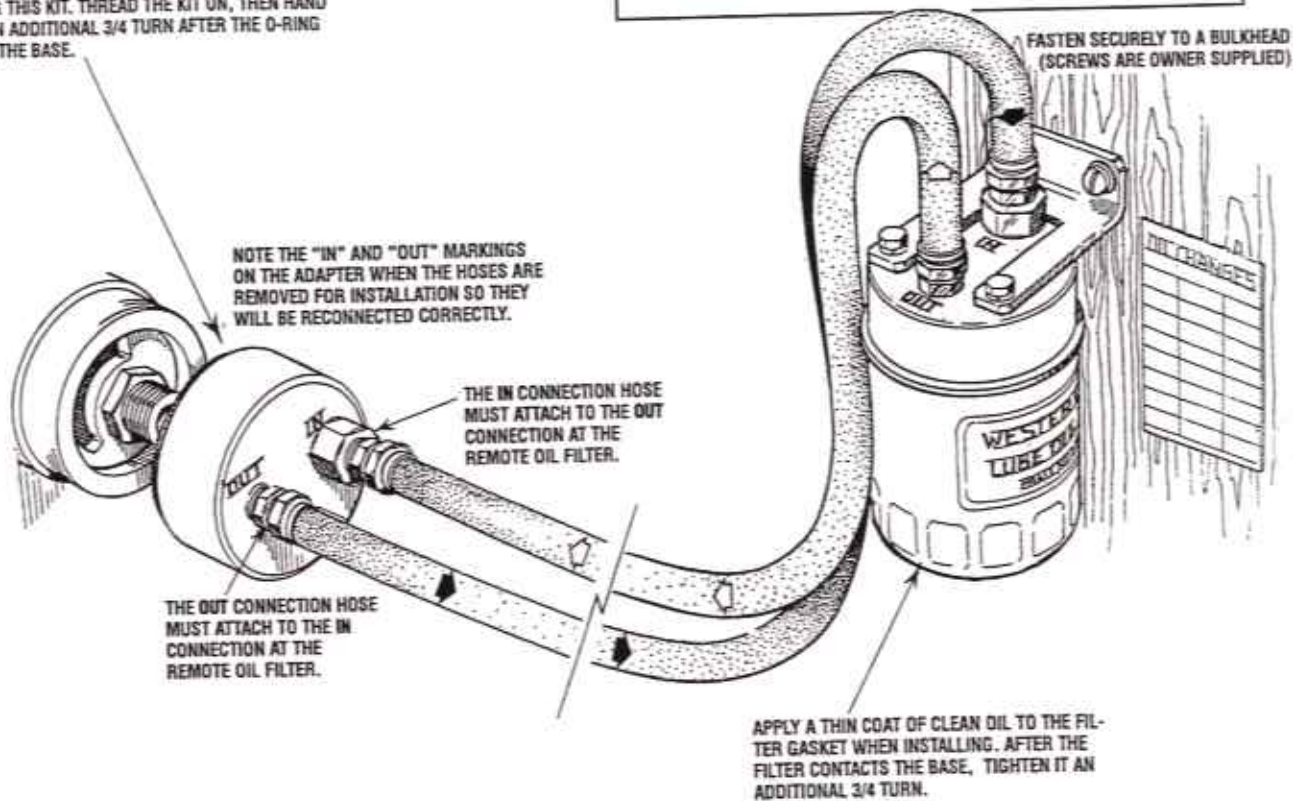
To install, simply remove the engine oil filter and thread on WESTERBEKE'S remote oil filter kit as shown. Always install this kit with the oil filter facing down as illustrated.

Contact your WESTERBEKE dealer for more information.

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

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

APPLY A THIN COAT OF CLEAN OIL TO THE O-RING WHEN INSTALLING THIS KIT. THREAD THE KIT ON, THEN HAND TIGHTEN AN ADDITIONAL 3/4 TURN AFTER THE O-RING CONTACTS THE BASE.



OIL PRESSURE

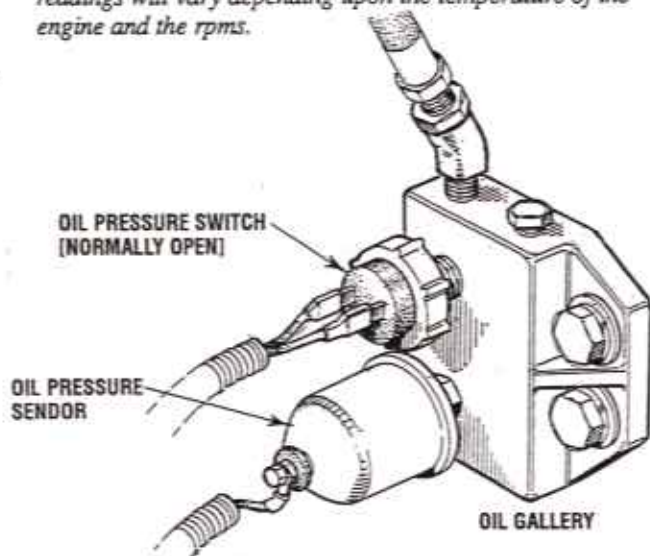
DESCRIPTION

The lubricating system is a pressure feeding system using an oil pump. The engine oil is drawn from the oil sump by the oil pump, which drives the oil, under pressure, through the oil filter, oil cooler and various lubricating points in the engine. The oil then returns to the oil sump to repeat the continuous cycle. When the oil pressure exceeds the specified pressure, the oil pushes open the relief valve in the oil pump and returns to the oil sump, keeping the oil pressure within its specified range.

OIL PRESSURE

The engine's oil pressure, during operation, is indicated by the oil pressure gauge on the instrument panel. During normal operation, the oil pressure will range between 40 and 60 psi (2.8 and 4.2 kg/cm²).

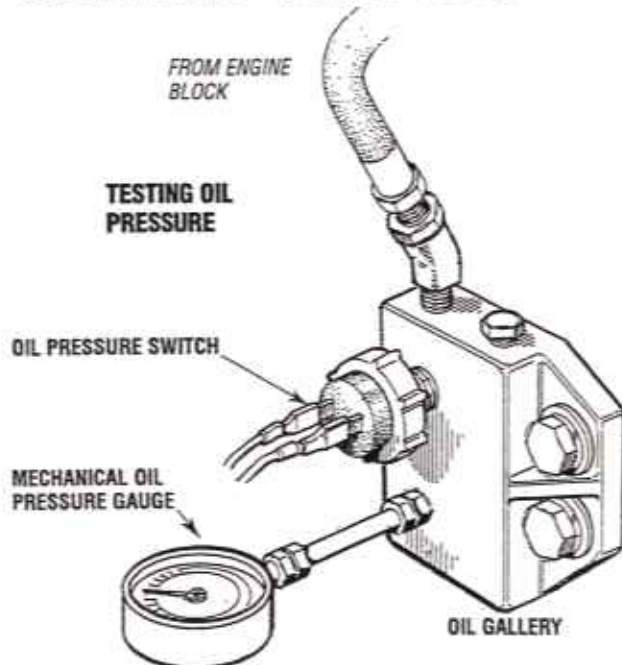
NOTE: A newly started, cold engine can have an oil pressure reading up to 60 psi (4.2 kg/cm²). A warmed engine can have an oil pressure reading as low as 35 psi (2.5 kg/cm²). These readings will vary depending upon the temperature of the engine and the rpms.



TESTING OIL PRESSURE

To test the oil pressure, remove the oil pressure sender, then install a mechanical oil pressure gauge in its place. After warming up the engine, set the engine speed at 1800 rpm and read the oil pressure gauge.

Oil Pressure 35.0 lb/in² (3.8 kg/cm²) or more at 1800 rpm.
Sender and Switch Torque 9 - 13 ft-lb (1.2 - 1.8 m - kg).



LOW OIL PRESSURE

The specified safe minimum oil pressure is 4.3 + 1.4 psi (0.3 + 0.1 kg/cm²). A gradual loss of oil pressure usually indicates a worn bearings. For additional information on low oil pressure readings, see the *ENGINE TROUBLESHOOTING* chart.

OIL PRESSURE RELIEF VALVE

An oil pressure relief valve is located on the engine block just below the injection pump. This valve opens at approximately 50 psi [343 kpa] and maintains that pressure.

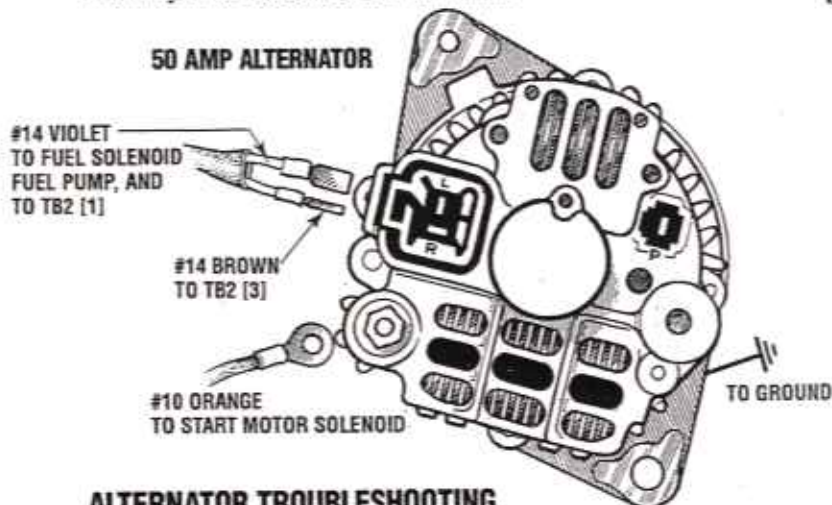
LOCATED JUST UNDER THE FUEL INJECTION PUMP ON THE ENGINE BLOCK.



DC ELECTRICAL SYSTEM

ALTERNATOR

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



ALTERNATOR TROUBLESHOOTING

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

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

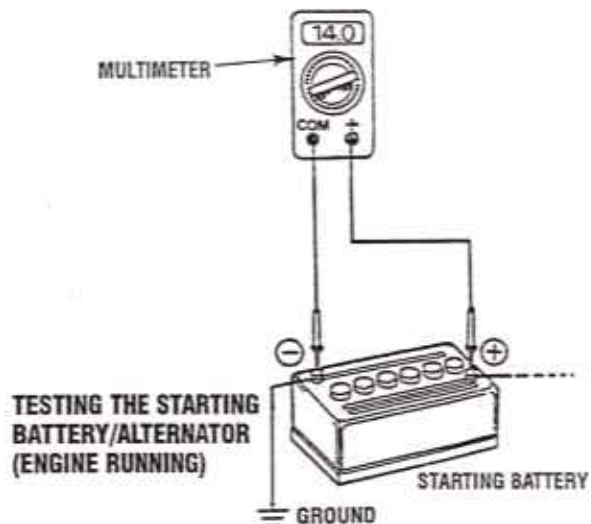
The alternator charging circuit charges the starting battery and any accessory battery. An isolator with a diode, a solenoid or a battery selector switch is usually mounted in the circuit to isolate the batteries so the starting battery is not discharged along with the accessory battery. If the alternator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

Testing the Alternator

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

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

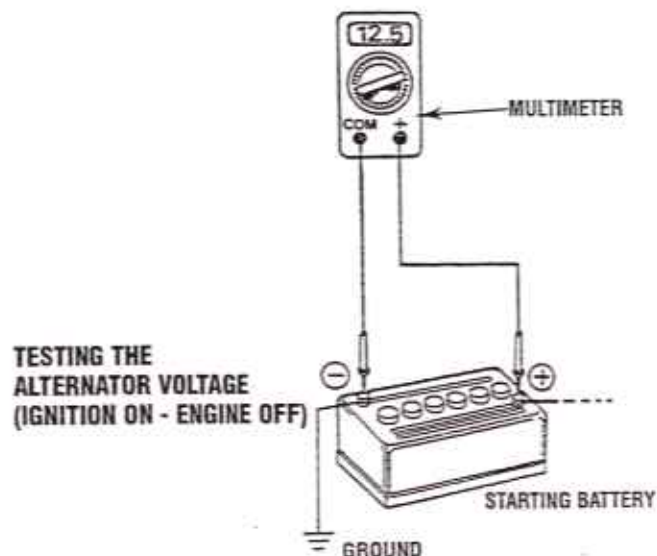
1. Start the engine.
2. After the engine has run for a few minutes, measure the starting battery voltage at the battery terminals using a multimeter set on DC volts.
 - a. If the voltage is increasing toward 14 volts, the alternator is working.
 - b. If the voltage remains around 12 volts, a problem exists with either the alternator or the charging circuit; continue with Steps 3 through 8.



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

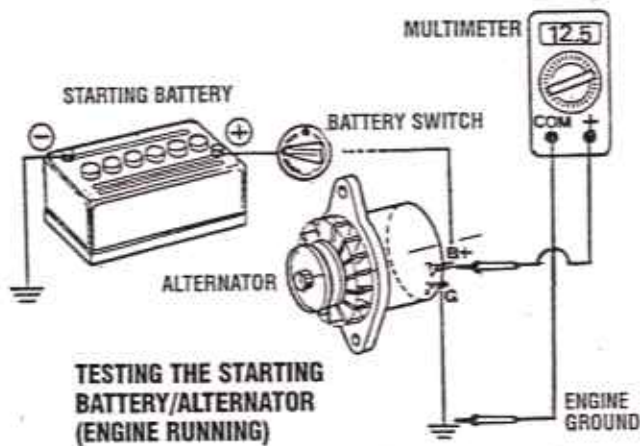
⚠ CAUTION: To avoid damage to the DC charging alternator, never shut off the engine battery switch when the engine is running!

4. Turn on the ignition switch, but do not start the engine.
5. Check the battery voltage. If the battery is in good condition, the reading should be 12 to 13 volts.



DC ELECTRICAL SYSTEM

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



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

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

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

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

12 VOLT DC CONTROL CIRCUIT

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

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

BATTERY

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

Battery Care

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

- 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.

STARTER MOTOR

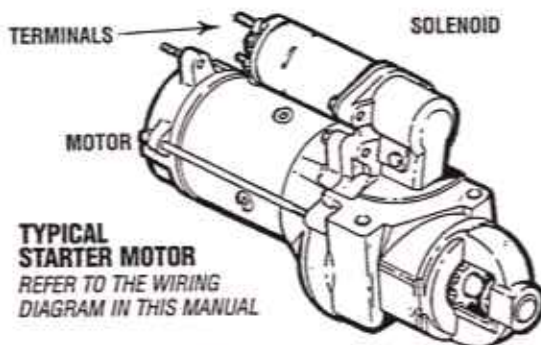
DESCRIPTION

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
REFER TO THE WIRING DIAGRAM IN THIS MANUAL

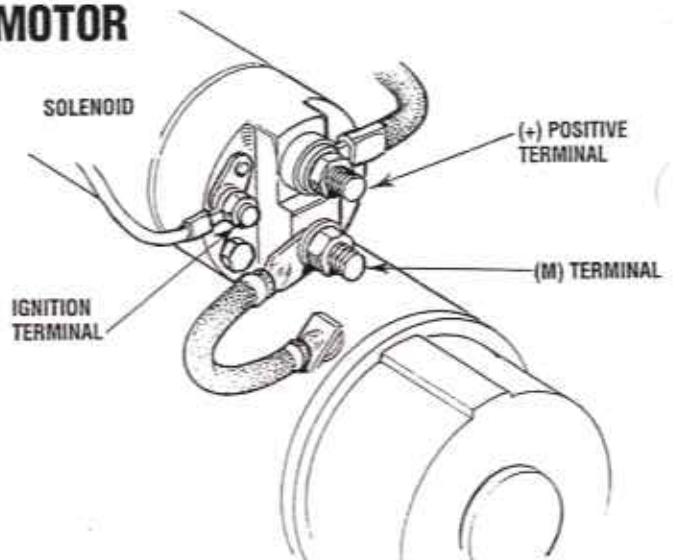
TROUBLESHOOTING

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

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

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

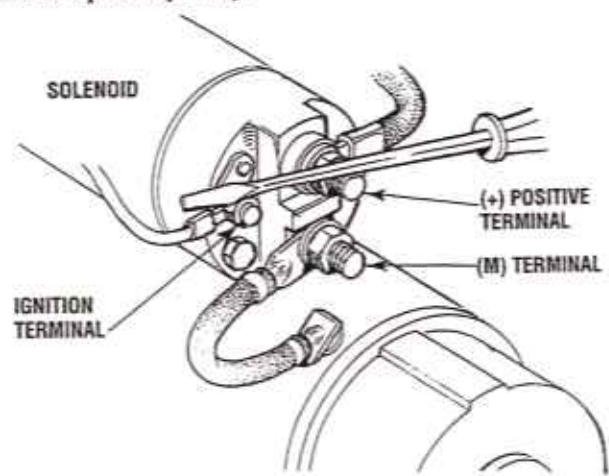
If you read 12 volts, the starter is faulty.



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

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

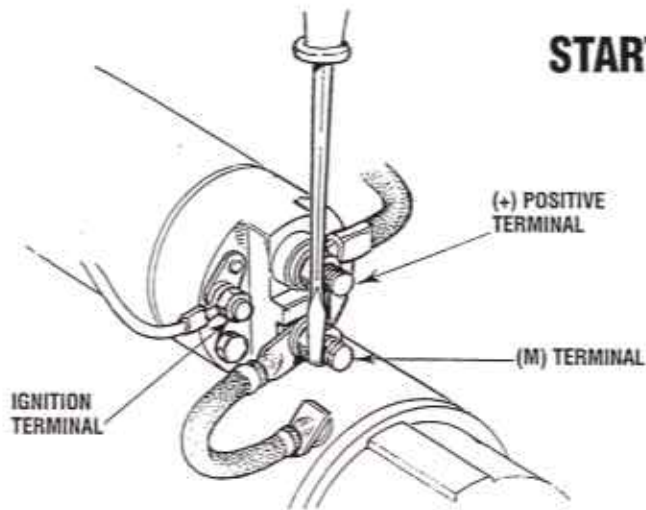
If the solenoid clicks but nothing else happens, the starter motor is probably faulty.



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 arcing 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 arcing as the full starting current should be flowing thru the blade of the screwdriver.*

If the starter spins, the solenoid is faulty.

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

If no arcing occurred. There is no juice reaching the solenoid.

NOTE: *Starter motors are either inertia type or pre-engaged. In the pre-engaged model, the solenoid also moves an arm that engages the starter motor to the flywheel of the engine. Using a screwdriver to bypass the solenoid on such a starter will run the motor without engaging the flywheel. Turn the starter switch on to provide 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.

GLOW PLUGS

DESCRIPTION

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

INSPECTION

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

TESTING

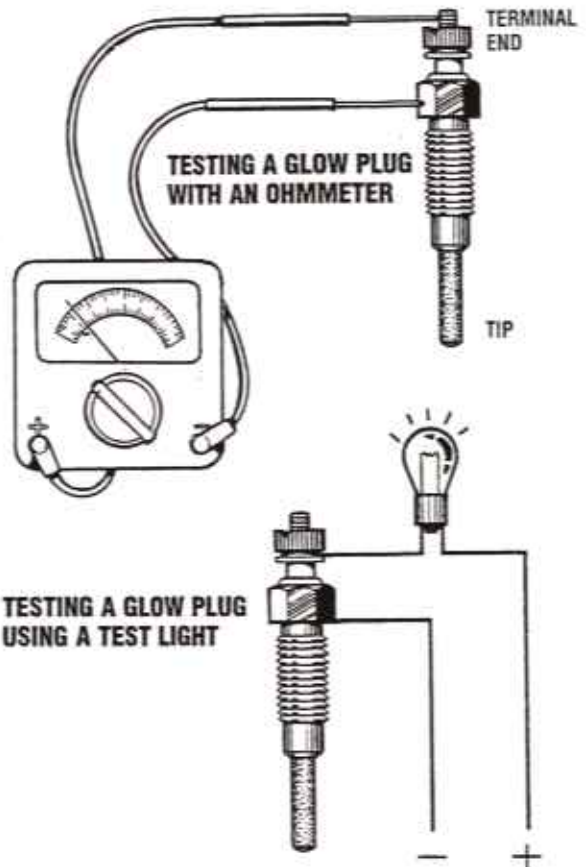
An accurate way to test glow plugs is with an ohmmeter. Touch one prod to the glow plug's wire connection, and the other to the body of the glow plug, as shown. A good glow plug will have a 0.4 - 0.6 ohm resistance. This method can be used with the plug in or out of the engine. You can also use an ammeter to test the power drain (5 - 6 amps per plug).

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

Re-install the plugs in the engine and test them again. The plugs should get very hot (at the terminal end) within 7 to 15 seconds. If the plugs don't heat up quickly, check for a short circuit. When reinstalling the glow plugs, use anti-seize compound on the threads.

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

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

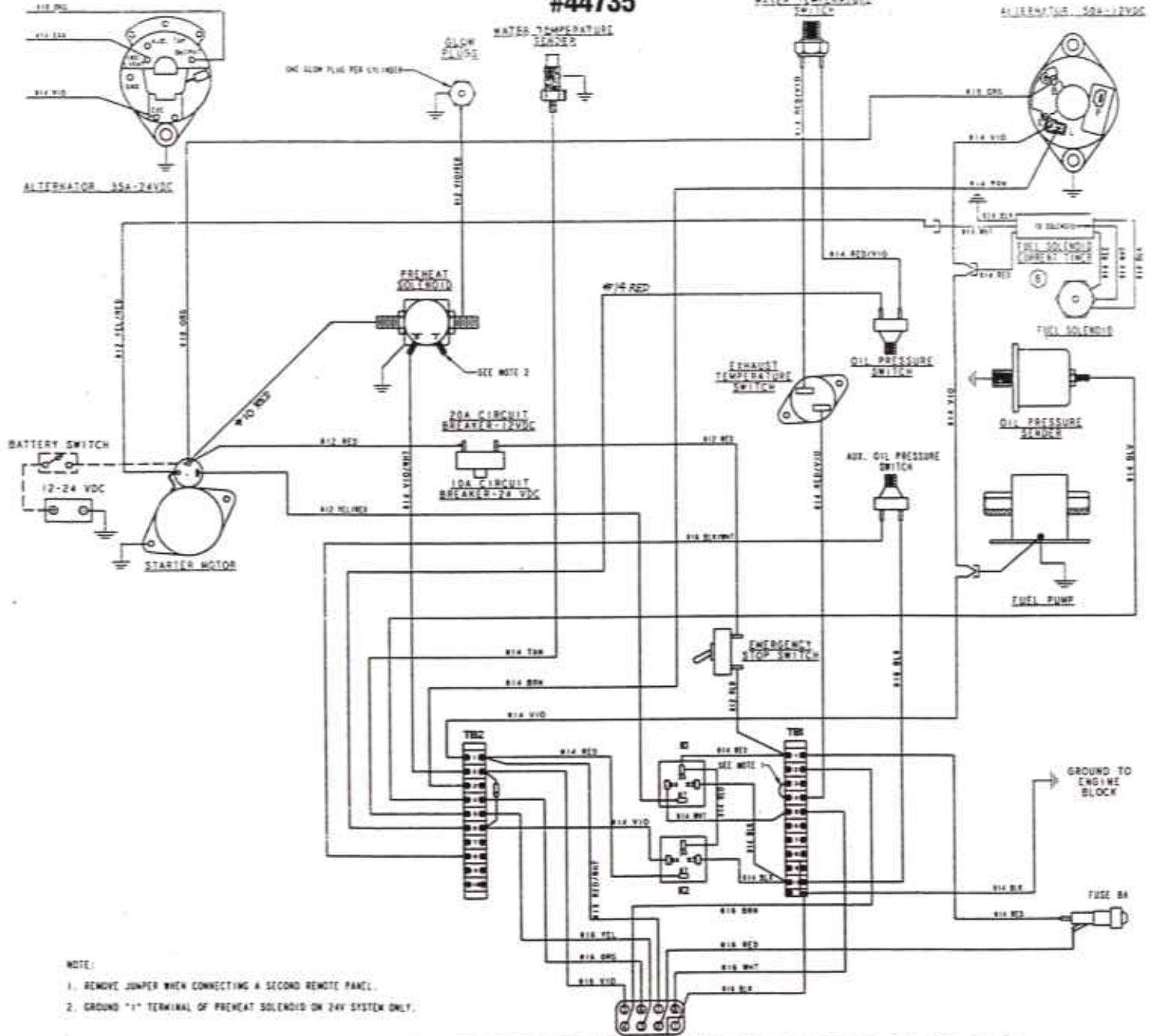


GENERATOR WIRING DIAGRAM

#44735

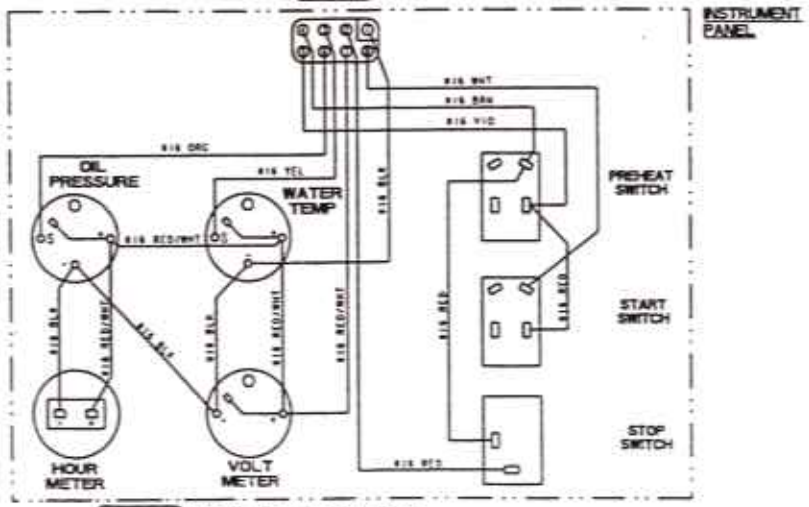
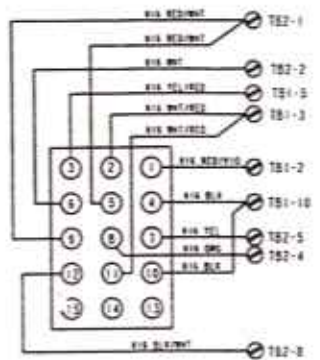
WATER TEMPERATURE SWITCH

ALTERNATOR 35A-24VDC

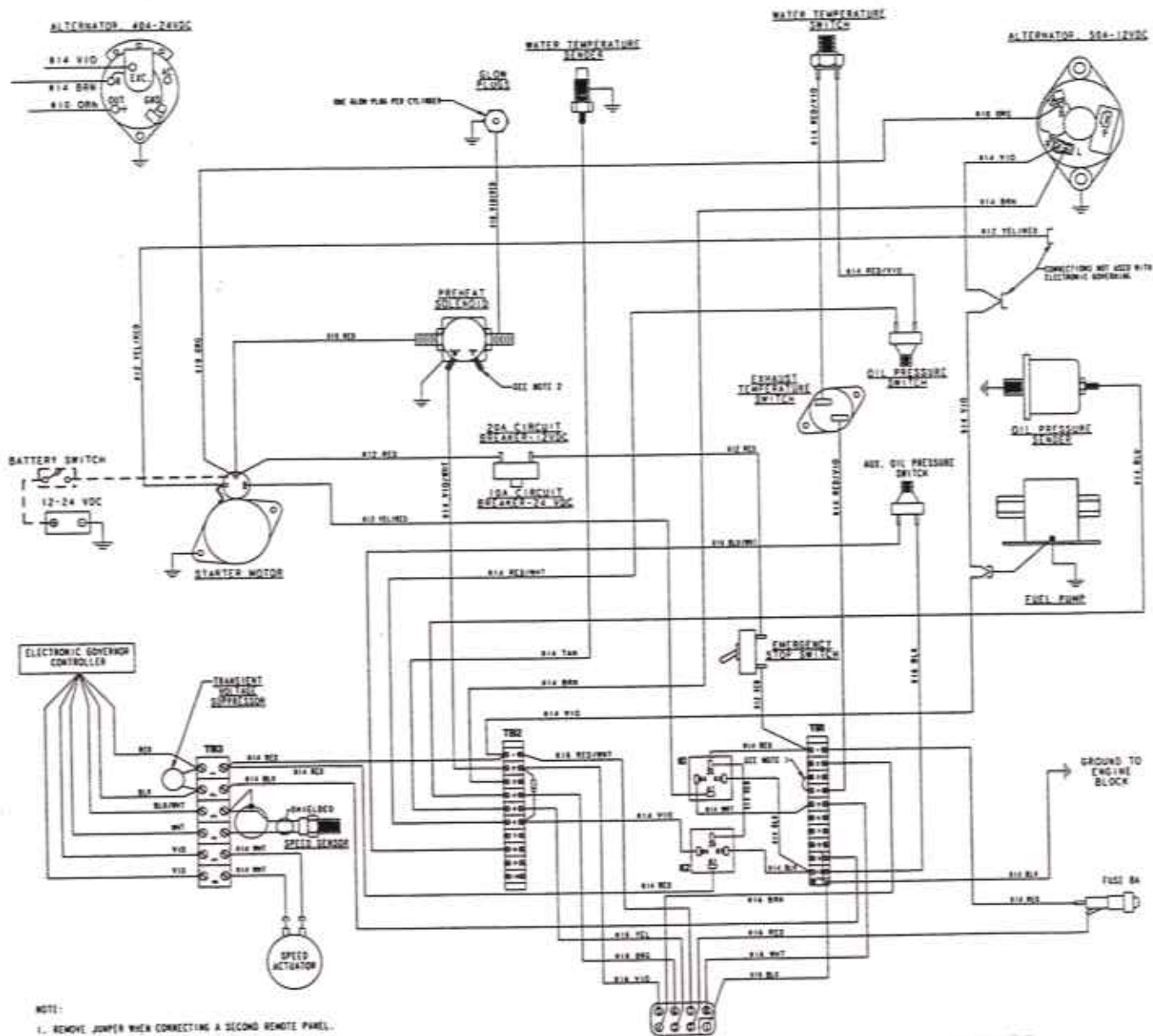


NOTE:

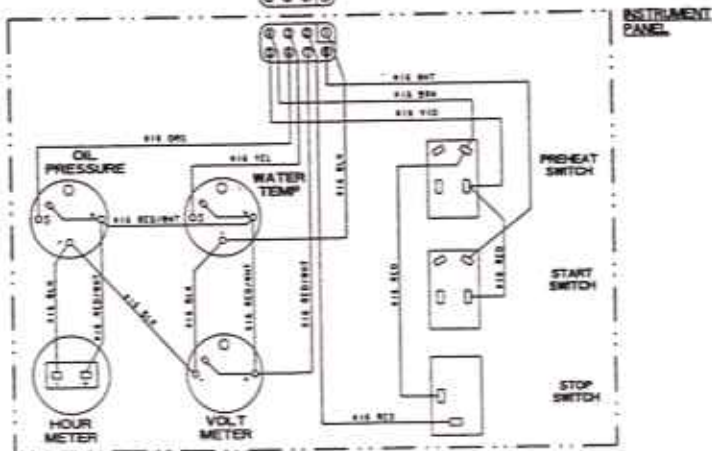
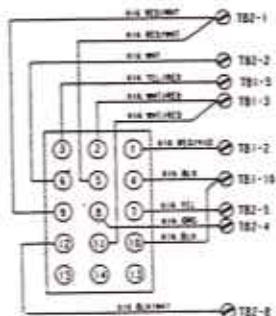
1. REMOVE JUMPER WHEN CONNECTING A SECOND REMOTE PANEL.
2. GROUND "1" TERMINAL OF PREHEAT SOLENOID ON 24V SYSTEM ONLY.



GENERATOR WIRING DIAGRAM #044927 (OPTIONAL ELECTRONIC GOVERNING)

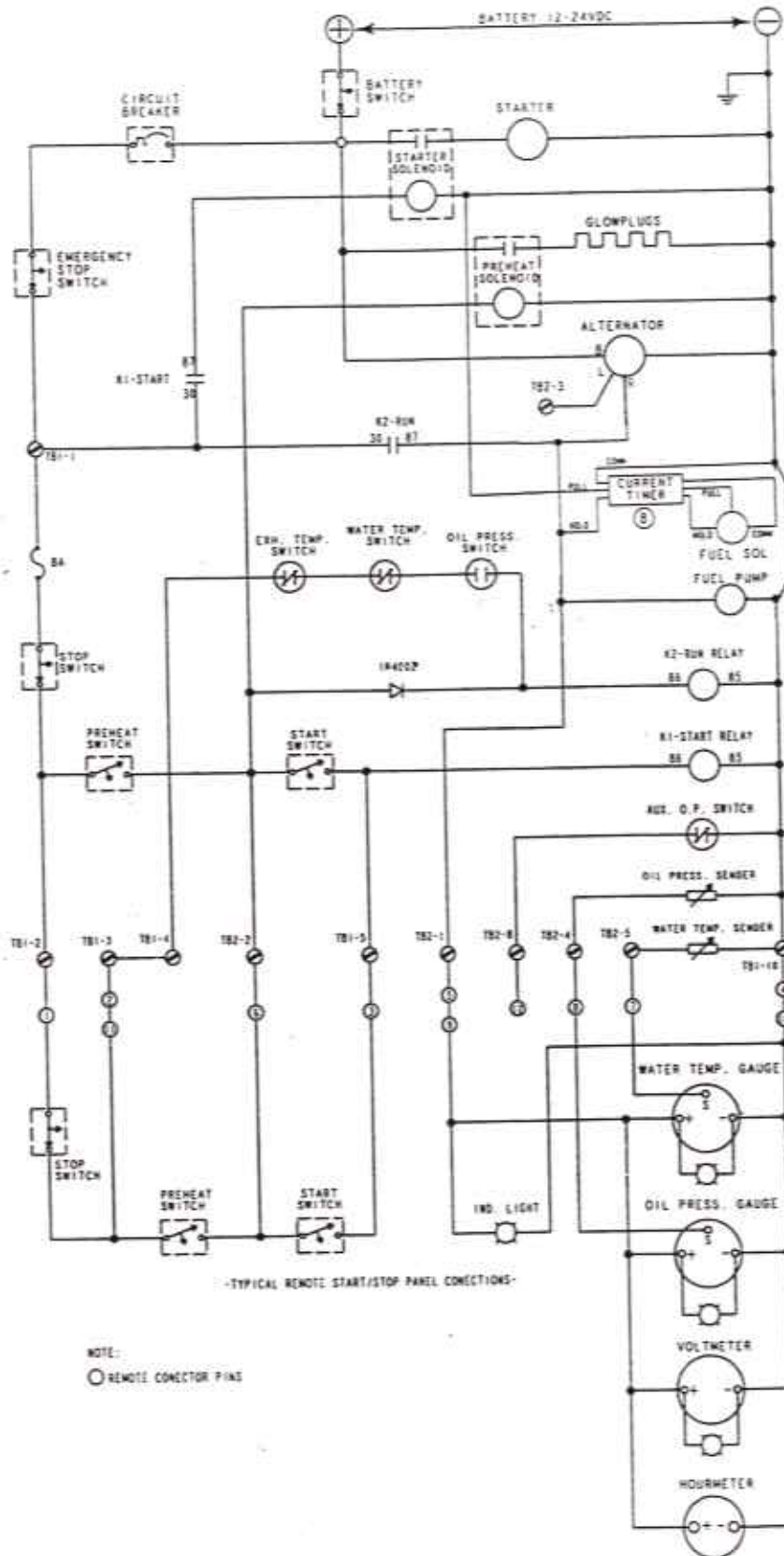


- NOTE:
1. REMOVE JUMPER WHEN CONNECTING A SECOND REMOTE PANEL.
 2. GROUND "*" TERMINAL OF PREHEAT SOLENOID ON 24V SYSTEM ONLY.

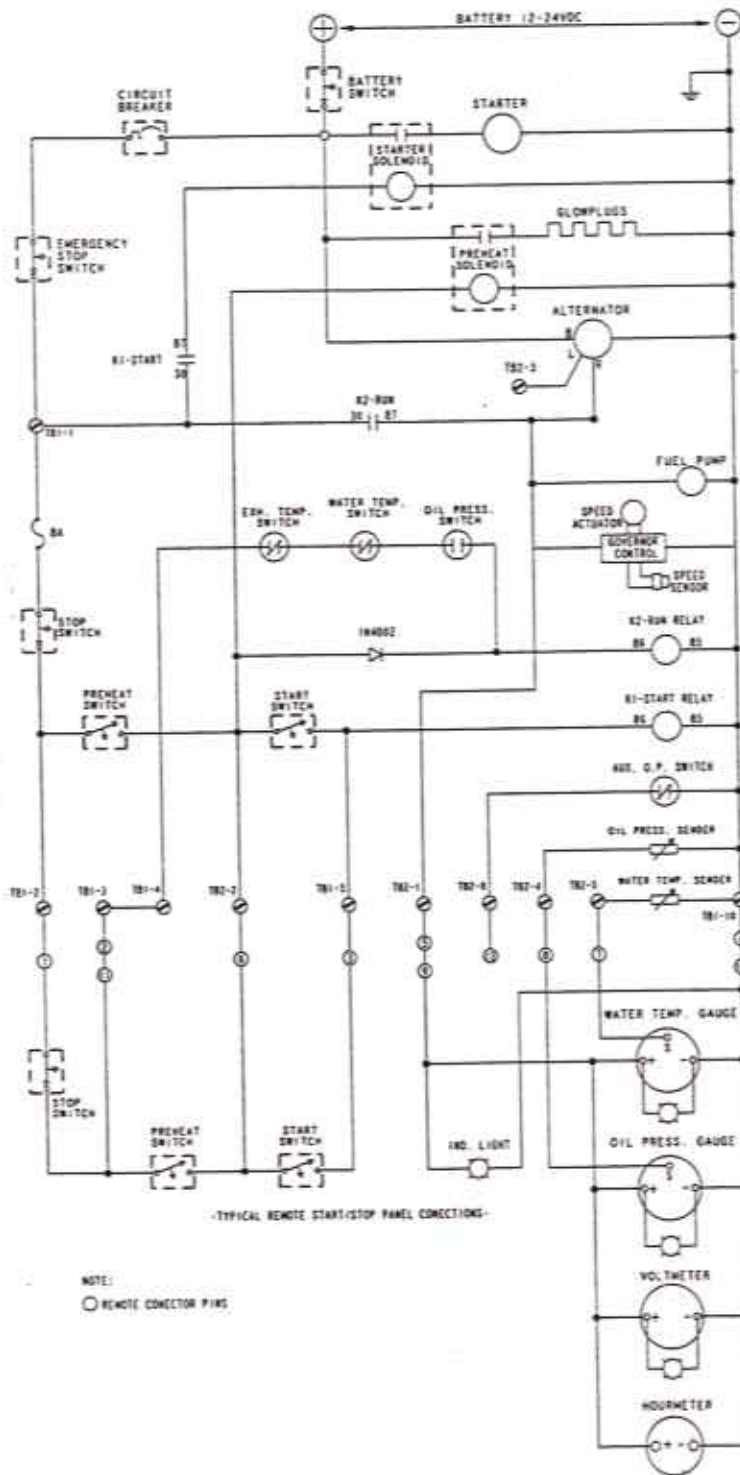


GENERATOR WIRING SCHEMATIC

#44735

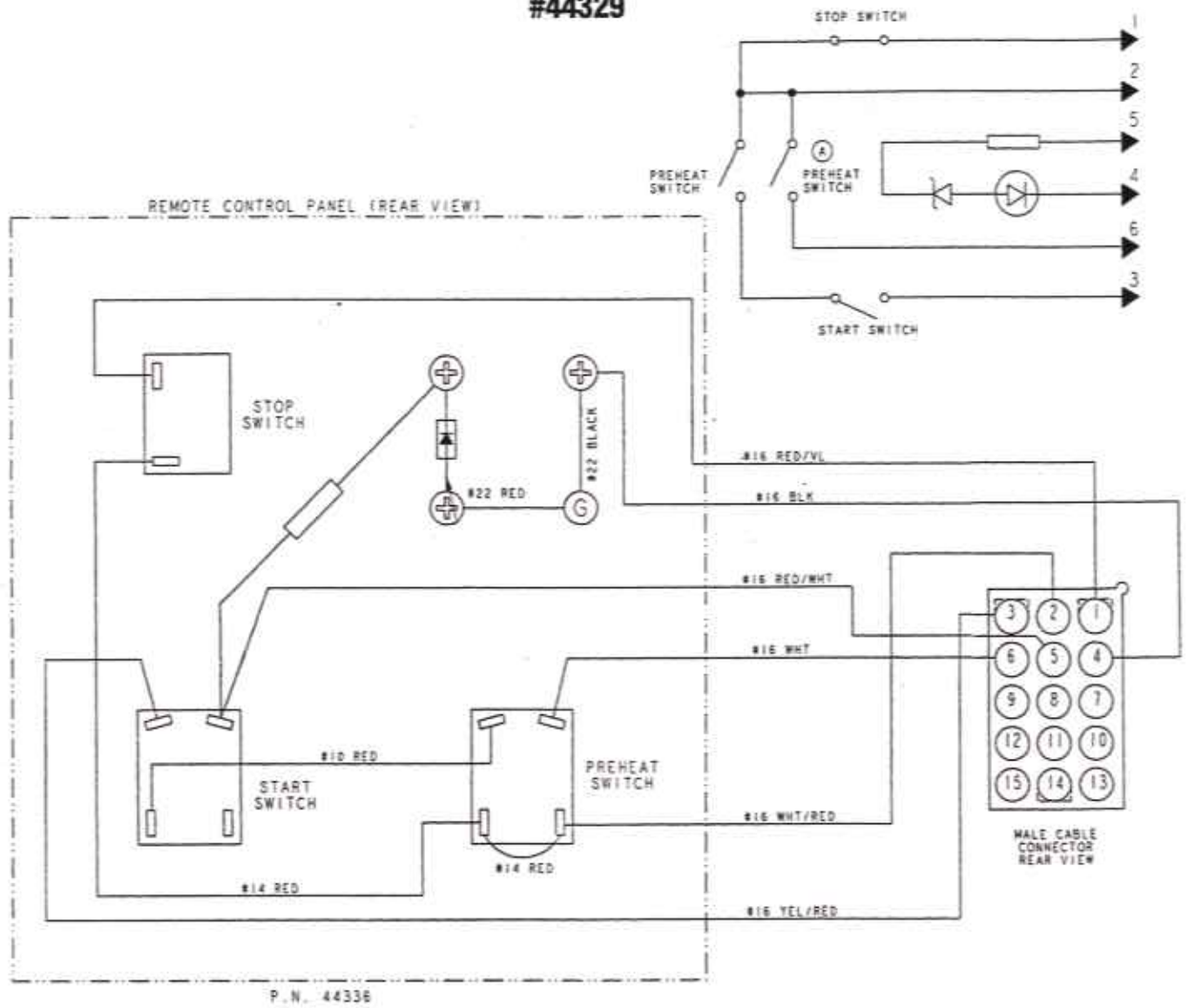


GENERATOR WIRING SCHEMATIC #044927 (OPTIONAL ELECTRONIC GOVERNING)



REMOTE INSTRUMENT PANEL

#44329



ENGINE TROUBLESHOOTING

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

Note: *The engine's electrical system is protected by a 20 amp manual reset circuit breaker located on a bracket at the rear of the engine.*

Problem	Probable Cause	Verification/Remedy
Key switch on, PREHEAT switch depressed; no panel indications; fuel solenoid or electrical fuel pump	<ol style="list-style-type: none"> 1. Battery Switch not on. 2. Emergency stop switch off. 3. 20-Amp circuit breaker tripped. 4. K2 relay 5. Loose battery connections. 6. Preheat solenoid not operating. 	<ol style="list-style-type: none"> 1. Check switch and/or battery connections. 2. Check emergency stop switch position. 3. Reset breaker; if breaker trips again, check preheat solenoid circuit and check circuit for shorts to ground. 4. Check K2 relay. 5. Check (+) connection to starter solenoid and (-) connection to engine ground stud. Check battery cable connections. 6. Check solenoid "S" terminal for voltage.
START SWITCH DEPRESSED, no starter engagement.	<ol style="list-style-type: none"> 1. Connection to solenoid faulty. 2. Faulty switch. 3. Faulty solenoid. 4. Loose battery connections. 5. Low battery. 6. K1 relay. 	<ol style="list-style-type: none"> 1. Check connection. 2. Check switch with ohmmeter. 3. Check that 12 volts are present at the solenoid connection. 4. Check battery connections. 5. Check battery charge state. 6. Check K1 relay.
START switch is depressed; panel indications OK; starter solenoid OK fuel solenoid not functioning.	<ol style="list-style-type: none"> 1. Poor connections to fuel solenoid. 2. Defective fuel solenoid. 3. Current limiter. 	<ol style="list-style-type: none"> 1. Check connections. 2. Check that 12 volts are present at the (+) connection on the fuel run solenoid. 3. Check limiter.
Generator engine cranks, but does not start, fuel solenoid energized.	<ol style="list-style-type: none"> 1. Faulty fueling system. 2. Preheat solenoid faulty. 3. Low battery. 	<ol style="list-style-type: none"> 1. Check that fuel valves are open. <ol style="list-style-type: none"> 1a. Switch to combine house and start batteries. 1b. Replace batteries. 1c. Check fuel lift pump. 2. Check solenoid. 3. Replace batteries.
Engine can't be stopped.	<ol style="list-style-type: none"> 1. Faulty DC alternator. 	<ol style="list-style-type: none"> 1. Remove Exc. connection at alternator, repair alternator.
Battery runs down.	<ol style="list-style-type: none"> 1. Oil Pressure switch. 2. High resistance leak to ground. 3. Low resistance leak. 4. Poor battery connections. 5. DC alternator not charging.. 	<ol style="list-style-type: none"> 1. Observe if gauges and panel lights are activated when engine is not running. Test the oil pressure switch. 2. Check wiring. Insert sensitive (0 - 25 amp) meter in battery lines. (Do not start engine.) Remove connections and replace after short is located. 3. Check all wires for temperature rise to locate the fault. 4. Check cable connections at battery for loose connections, corrosion. 5. Check connections, check belt tension, test alternator. See <i>DC ELECTRICAL SYSTEM/ALTERNATOR</i>.
Battery not charging	<ol style="list-style-type: none"> 1. DC charge circuit faulty. 2. Alternator drive. 	<ol style="list-style-type: none"> 1. Perform D.C. voltage check of generator charging circuit. See <i>DC ELECTRICAL SYSTEM/ALTERNATOR</i> in this manual. 2. Check drive belt tension. Alternator should turn freely. Check for loose connections. Check output with voltmeter. Ensure 12 volts are present at the Exc. terminal.
Generator engine stops.	<ol style="list-style-type: none"> 1. Fuel feed pump strainer is dirty. 2. Switches and/or wiring loose or disconnected. 3. Fuel starvation. 4. 20 Amp circuit breaker tripping. 5. Exhaust system is restricted. 6. Water in fuel. 7. Air intake obstruction. 	<ol style="list-style-type: none"> 1. Clean strainer. 2. Inspect wiring for short circuits and loose connections. Inspect switches for proper operation. 3. Check fuel supply, fuel valves, fuel feed strainer.. 4. Check for high DC amperage draw during operation. Ensure breaker is not overly sensitive to heat which would cause tripping. 5. Check for blockage, collapsed hose, carbon buildup at exhaust elbow. 6. Pump water from fuel tank(s); change filters and bleed fuel system. 7. Check air intake filter cartridge.

ENGINE TROUBLESHOOTING

Problem	Probable Cause	Verification/Remedy
Generator engine overheats/shuts down.	1. Coolant not circulating.	<ol style="list-style-type: none"> 1. Thermostat — remove and test in hot water. Replace thermostat. 2. 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.	<ol style="list-style-type: none"> 1. Loss of oil. 2. Oil pressure switch. 	<ol style="list-style-type: none"> 1. Check dipstick, look for oil leaks at oil filter and at oil drain hose connection. 2. Replace oil pressure switch.
Exhaust smoking problems	<ol style="list-style-type: none"> 1. Blue smoke. 2. White smoke. 3. Black smoke. 	<ol style="list-style-type: none"> 1. Incorrect grade of engine oil. 1a. Crankcase is overfilled with engine oil (oil is blowing out through the exhaust). 2. Engine is running cold. 2a. Faulty injector or incorrect injector timing. 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.
Engine alarm sounds, pulsates.	<ol style="list-style-type: none"> 1. Loss of oil. 2. Oil pressure switch. 	<ol style="list-style-type: none"> 1. Check dipstick, look for oil leaks at oil filter and at oil drain hose connection. 2. Replace oil pressure switch.
Engine alarm sounds continuously.	<ol style="list-style-type: none"> 1. Engine coolant. 2. High temperature switch opens at too low a temperature. 	<ol style="list-style-type: none"> 1. Check engine coolant level. 2. Check for satisfactory operation with switch by-passed, check with ohmmeter, replace if faulty.

ENGINE ADJUSTMENTS

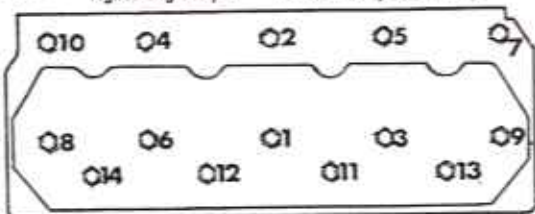
NOTE: WESTERBEKE recommends that the following engine adjustments be performed by a competent engine mechanic. The information below is provided to assist the mechanic.

VALVE CLEARANCE ADJUSTMENT

Make the following adjustments when the engine is cold.

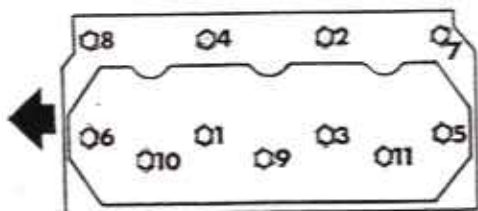
1. Remove the cylinder head cover.
2. Slightly loosen the cylinder head bolts and retighten them to the specified torque in the number sequence shown below.

Tightening Torque 65 ± 4 lb-ft (88 ± 5 Nm)



FOUR CYLINDER

FRONT



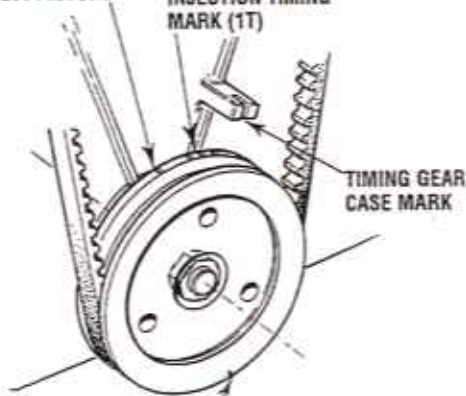
THREE CYLINDER

3. Find top dead center compression position for No.1 piston by using the procedure that follows:
 - (a) Turn the crankshaft until TDC mark on the crankshaft pulley is aligned with the mark on the timing gear case.

TDC (TOP DEAD CENTER)
MARK FOR NO.1
AND NO.4 PISTONS

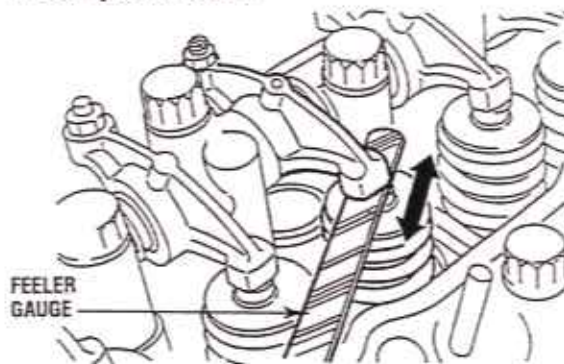
INJECTION TIMING
MARK (1T)

TIMING GEAR
CASE MARK

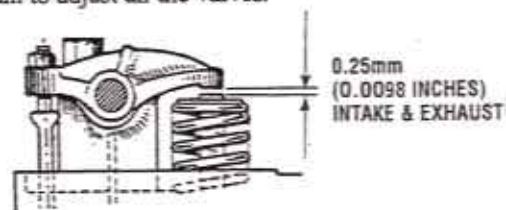


TDC MARK FOR
NO.2 AND NO.3 PISTONS

- (b) With No.1 piston at top dead center on the compression stroke, the rocker arms will not be moved when the crankshaft is turned approximately 20° in both directions.
- (c) If the rocker arms move, No.1 piston is at top dead center on the intake or exhaust stroke. In such a case, turn the crankshaft 360° in the direction of engine rotation again. No.1 piston is now at top dead center on the compression stroke.



4. Loosen the lock nut for the adjusting screw. With a feeler gauge inserted between the rocker arm and valve cap, adjust the valve clearance by turning the adjusting screw. Make certain to adjust all the valves.



5. Install the cylinder head cover.
Head Cover Bolt Torque $2 - 3$ ft-lb ($0.3 - 0.45$ m-kg)

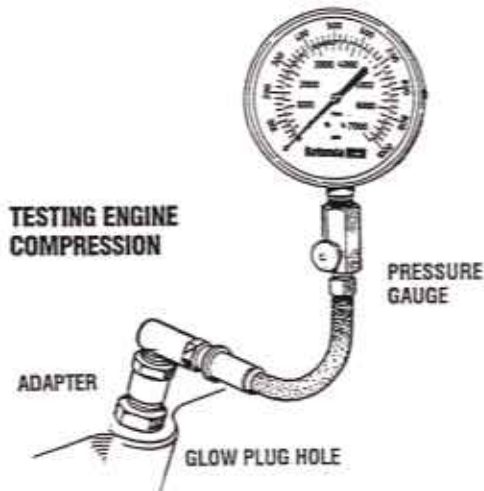
ENGINE ADJUSTMENTS

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

TESTING ENGINE COMPRESSION

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

1. Warm the engine to normal operating temperature.
2. Move the control lever to a position for shutting off the fuel. (Disconnect the wires if a fuel shutdown solenoid is used).
3. Remove all the glow plugs from the engine and install the compression gauge/adaptor combination to the cylinder on which the compression is to be measured.



4. Crank the engine and allow the gauge to reach a maximum reading, then record that reading.
5. Repeat this process for each cylinder.

COMPRESSION PRESSURE 427 psi (30 Kgf/cm²) at 290 rpm.

MAXIMUM PERMISSIBLE DIFFERENCE BETWEEN CYLINDERS
42.7 psi (3.0 Kgf/cm²)

NOTE: If the readings are below the limit, the engine needs repair.

6. Re-install the glow plugs and reset the fuel shut-off to the run position.

LOW COMPRESSION

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

Install the pressure gauge and repeat the above test. If the compression reading rises dramatically, the fault is with the rings.

If the compression valve does not rise, the problem is with the valves.

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

FUEL INJECTORS

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

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

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

INJECTOR TO CYLINDER HEAD TIGHTENING TORQUE
40 ± 4 ft-lb (5.5 ± 0.5 kgf-m)

DRIVE BELT ADJUSTMENT (FAN BELT)

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

Drive belts must be properly tensioned. Loose drive belts will not provide proper alternator charging and will eventually damage the alternator. Drive belts that are too tight will pull the alternator out of alignment and/or cause the alternator to wear out prematurely. Excessive drive belt tension can also cause rapid wear of the belt and reduce the service life of the fresh water pumps 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 mid-point between the two pulleys on the longest span of the belt. A spare belt or belts should always be carried on board.

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

Adjusting Belt Tension

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

CONTROL PANEL TROUBLESHOOTING

MANUAL STARTER DISCONNECT (TOGGLE SWITCHES)

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

Problem	Probable Cause	Verification/Remedy
PREHEAT depressed, no panel indications fuel solenoid, electric fuel pump and preheat solenoid not energized.	<ol style="list-style-type: none"> 1. Oil Pressure switch. 2. 20 amp circuit breaker tripped. 3. K2 relay faulty. 	<ol style="list-style-type: none"> 1. Check switches and/or battery connections. 2. Reset breaker. If it opens again, check preheat solenoid circuit and run circuit for shorts to ground. 3. Check relay.
START SWITCH DEPRESSED , no starter engagement.	<ol style="list-style-type: none"> 1. Connection to solenoid faulty. 2. Faulty switch. 3. Faulty solenoid. 4. Loose battery connections. 5. Low battery. 6. K1 relay. 	<ol style="list-style-type: none"> 1. Check connection. 2. Check switch with ohmmeter. 3. Check that 12 volts are present at the solenoid connection. 4. Check battery connections. 5. Check battery charge state. 6. Check relay.
NO IGNITION , cranks, does not start.	<ol style="list-style-type: none"> 1. Faulty fueling system. 2. Check for air in the fuel system. 3. Faulty fuel lift pump. 	<ol style="list-style-type: none"> 1. Check for fuel. 2. Allow system to bleed. 3. Replace fuel lift pump.
NOT CHARGING BATTERY	<ol style="list-style-type: none"> 1. Faulty alternator drive. 	<ol style="list-style-type: none"> 1. Check the drive belt and its tension. Be sure the alternator turns freely. Check for loose connections. Check the output with a voltmeter. Ensure 12V are present at the regulator terminal.
BATTERY RUNS DOWN	<ol style="list-style-type: none"> 1. Oil pressure switch. 2. High resistance leak to ground. 3. Low resistance leak to ground. 4. Faulty alternator. 	<ol style="list-style-type: none"> 1. Observe if the gauges and panel lights are activated when the engine is not running. Test the oil pressure switch. 2. Check the wiring. Insert sensitive (0-25 amp) meter in battery lines (Do NOT start engine). Remove connections and replace after short is located. 3. Check all wires for temperature rise to locate the fault. 4. After a good battery charging, disconnect alternator at output. If leakage stops. Remove alternator and bench test. Repair or replace.

TROUBLESHOOTING WATER TEMPERATURE AND OIL PRESSURE GAUGES

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

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

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

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

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

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

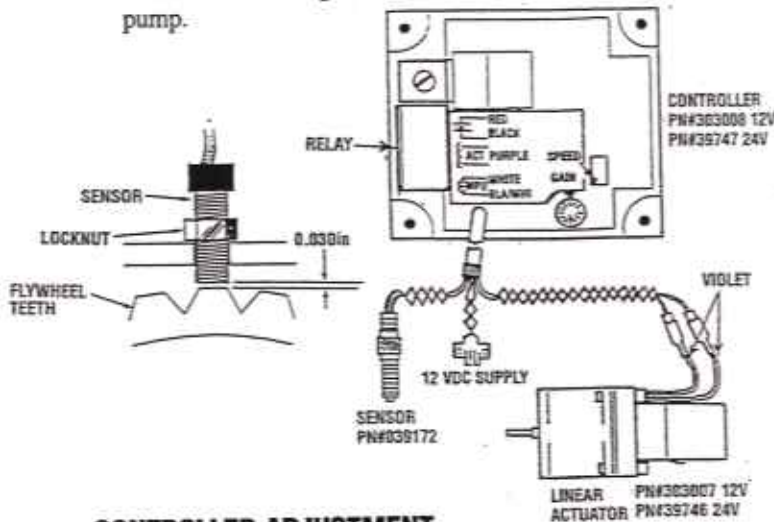
Check that the engine block is connected to the ground. Some starters have isolated ground terminals and if the battery is connected to the starter (both plus and minus terminals), the ground side will not necessarily be connected to the block.

ELECTRIC GOVERNOR ADJUSTMENTS

DESCRIPTION

The system is composed of three basic components:

1. **Controller.** Mounted in the instrument panel.
2. **Sensor.** Installed on the bellhousing over the flywheel ring gear.
3. **Actuator.** Mounted at the front of the engine and attached with linkage to the throttle arm of the injection pump.



CONTROLLER ADJUSTMENT

1. **Speed.** This adjustment is used to raise or lower the engine's speed to the desired hertz.
2. **Gain.** This adjustment affects the reaction time of the actuator to the generator/engine load changes.

NOTE: A high gain adjustment can induce an oscillating of the actuator producing a hunting mode. In such cases, lessen the gain adjustment.

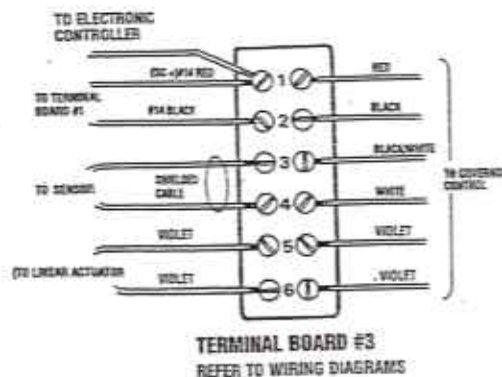
Calibration

1. With no power to the governor, adjust the GAIN to 9:00 o'clock.
2. Start the engine and adjust the speed by turning the speed pot clockwise to desired speed.

NOTE: Controllers are factory adjusted to minimum rpm. However, for safety, one should be capable of disabling the engine if an overspeed should exist.

3. At no-load, turn the GAIN potentiometer clockwise until the engine begins to hunt. If the engine does not hunt, physically upset the governor linkage.
4. Turn the GAIN potentiometer counterclockwise until stable.

NOTE: The controller operates on 12VDC. The voltage range is $\pm 20\%$ (9.6VDC 12VDC 14.4VDC). If voltage varies above or below these ranges, the controller will not operate and the engine will run in an idle mode until proper voltage is supplied to the controller.



INSPECTION AND ADJUSTMENT

The controller has two adjustment pods. You need a mini screw driver to adjust these. One is speed and the gain. These are noted on the drawing of the controller.

When you press the preheat switch the actuator linkage attached to the throttle arm of the injection pump should move outward towards the injection pump and return back into the actuator in a quick motion.

Start the engine. The speed should be in the low idle range 600-700 rpm. If the engine speed is higher than this idle range, shut the engine down. Check the linkage between the actuator and throttle arm. The throttle arm stop should be about touching the open idle stop screw boss. Adjust the linkage to position the throttle lever. The controller has an adjustment screw for speed adjustment. Turn this screw outward (counterclockwise) a few turns. Restart the engine.

NOTE: If there is any oscillating of the actuator linkage producing hunting, adjust the gain towards zero "0" until this hunting is removed.

Increase the engine speed slowly with the speed adjusting screw turning it inward (clockwise). In some instances this screw may need to be turned 6-10 turns before an increase in engine speed is noted. Bring the engine speed to 1800 rpm (60 Hz), 1500 rpm (50 Hz). Momentarily push the actuator linkage towards the actuator and release. The actuator should quickly regain proper speed. If there is any hunting adjust the gain towards zero "0" until this hunting is removed.

When the gain is adjusted you may need to readjust the speed at no load, shut the generator down.

Push the DC exciter circuit breaker in. Start the generator. Check speed (Hertz) set at 60 Hz.

Load the generator.

If the governor is slow to react and maintain 60 Hertz adjust the gain clockwise. Again you may need to adjust the speed at no load.

You will find the governor will maintain 60 ± 0.5 Hertz right up to the full rated amperage output for the generator.

LINEAR ACTUATOR TROUBLESHOOTING

Problem	Test/Check	Correct
System appears dead. (No actuator movement) Engine runs, but at idle speed	<ol style="list-style-type: none"> 1. Check the battery voltage at the controller terminal block with the Preheat/On switch depressed. 2. Inspect the linkage for binding or sticking. 3. If there is no signal or a weak signal from the MPU, measure the AC voltage between the white and black/white wire leads from the MPU on the controller terminal block. While cranking the engine or with the engine running at idle, voltage should be 1.5-2.5 VAC. NOTE: The AC input impedance of meter must be 5000 ohms/volts or greater. NOTE: When making this test on diesel units, disable the preheat solenoid by disconnecting the "S" terminal connection so as not to damage the glow plugs. 4. Check the actuator with the preheat/on switch depressed. This provides DC voltage to the controller. Measure the DC voltage between the actuator connections on the controller block and the black DC (-) power connection on the controller terminal block. Both connections should have battery voltage +0.00 or -0.75 VDC. <ol style="list-style-type: none"> a. Purple lead to Black DC (-). b. Purple lead/purple/white lead to Black DC (-). NOTE: Continue this test (ONLY) if the battery voltage is not present. <ol style="list-style-type: none"> c. The following checks are performed between the connections at the actuator and the Black DC (-) connection on the controller terminal block. This is to determine if there is a break in the line between the controllers terminal block connection and the actuator connections or the actuator leads themselves. NOTE: The actuator should fully extend and retract when the preheat switch is depressed and held, for diesels. Retract and hold in for gasoline units. <ol style="list-style-type: none"> 1) Low voltage (1.0-2.0 VDC) at either actuator connections. 2) Battery voltage at both actuator connections. 3) Battery voltage at one actuator connection but not at the second. 	<ol style="list-style-type: none"> 1. Inspect the DC circuit back to the starting battery. 2. Free up the linkage and clean and lubricate the linkage. 3. Check for damage to or improper adjustment of magnetic pick-up. Replace or re-adjust. 4. Low voltage (1.0-2.0 VDC) at either actuator connections. <ol style="list-style-type: none"> a. Replace the controller if battery voltage is not present at both the Purple leads. <ol style="list-style-type: none"> 1) Broken actuator lead, repair. 2) Broken actuator lead, repair or replace actuator. 3) Check actuator winding for open. Replace actuator.
Actuator lever goes to full extension when the preheat switch is depressed and stays extended.	<ol style="list-style-type: none"> 1. Check the controller by removing the two purple leads one at a time that come from the actuator off the controller terminal block. Lift one actuator lead and depress the preheat/on switch. Reconnect and do the same with the second. NOTE: Early controllers had two solid purple leads for the actuator connections. Later model controllers have one solid purple and a purple/white stripe for the actuator connection. The purple/white lead is designated (+) and is specific only in gasoline DC circuits. <ol style="list-style-type: none"> a. Actuator goes to full extension (Diesel), Does not retract (Gasoline). b. Actuator does not extend (Diesel). 	<ol style="list-style-type: none"> 1. Check for a shorted actuator lead. Replace the controller because it should not cause the actuator lever to go to full fuel when the engine is not running. <ol style="list-style-type: none"> a. Check for shorted actuator load. b. Replace controller.
Actuator hunts during operation.	<ol style="list-style-type: none"> 1. Linkage or rod end bearings are sticking or binding. 2. Improper governor adjustment. 3. Inadequate power supply voltage. <ol style="list-style-type: none"> a. Connect a DC voltmeter to Red (+) and Black (-) leads at the controller terminal block. b. Disconnect both leads coming from actuator from controller terminal block. c. Connect one lead from the actuator to the Red (+) on the terminal block and the other actuator lead to the Black (-) on the terminal block. d. Momentarily depress the preheat/on switch. The actuator should extend fully and stay extended (diesel) and retract (gasoline) as long as the switch is depressed. Measure the DC voltage across the Red (+) and Black (-) leads while performing this test. DC voltage must be greater than 80% of the DC voltage measured across the battery supply. $24 \text{ VDC} @ 80\% = 19.2 \text{ VDC}$ $12 \text{ VDC} @ 80\% = 9.6 \text{ VDC}$ NOTE: Reconnect the actuator leads properly after completing this test. <ol style="list-style-type: none"> e. MPU positioned marginally too far away from flywheel teeth giving erratic AC input to controller. 	<ol style="list-style-type: none"> 1. Lubricate or replace. 2. Re-adjust the calibration. 3. If actuator doesn't fully extend (diesels) or retract (gasoline) then check the actuator leads. If the voltage is less than specified, check for loose or poor connections in the DC circuit back to the battery, check the K2 relay and its connections. e. Check the position of the MPU.

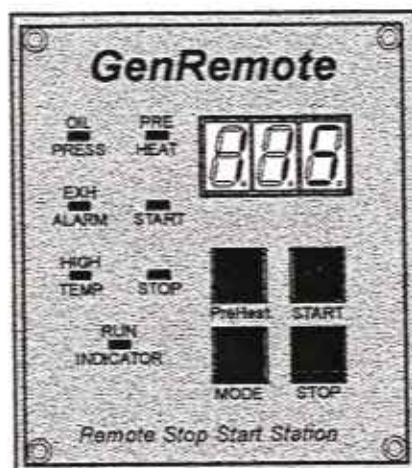
If problems continue to persist, contact your WESTERBEKE dealer for additional assistance.

The unit consists of a **Power Logic Module**, **Display Panel** and six conductor shielded **Display Cable**. The shielded cable links the display to the module and can be up to 300 feet long. Two display panels can be daisy chained to one (1) module output. The module supports two display cable outputs allowing for a total of four (4) displays per module. Total allowed cable length per module, including both display cable outputs, is six-hundred (600') feet.

The logic module is powered directly from the generator's cranking battery and consumes less than 70 milli amps (70/1000 of an amp) when the generator is idle. DC operating voltage can be 12 or 24 volts. The AC generator output can be 115V, 240V, 50/60 Hz, single phase (1Ø) or three (3 Ø) phase.

Generator and Engine Monitoring

1. DC Voltage
2. Oil Pressure
3. Water Temperature
4. AC Voltage
5. AC Current L-1
6. AC Current L-2
7. Line Frequency Hz
8. Engine Hours Up to 10,000 Hours
9. Exhaust Over Temperature Alarm



GenRemote is designed to safely interface with the existing engine sensors. The digital display is easily calibrated to match the readings of the manufacturer supplied mechanical gauge package.

The GenRemote circuitry is isolated from the generators OEM electrical system. This assures that GenRemote will not interfere with the manufacturers supplied gauge package. Electrical isolation also allows normal generator operation should the GenRemote be accidentally disconnected from the generator.

Electrical Hook-Up

Electrical hookup includes interconnecting with both the generators AC and DC systems.

The AC wires Required: The 115 volt Line One [L-1] is Black. Line Two [L-2] is White. The 220 volt Line - 2 [L-2] is Black with a Red Stripe. The 220 VAC Neutral connection is White and is **Not** connected to the GenRemote.

The 220 VAC Generator Neutral is the same as Green Ground wire. The 115/220 VAC Neutral [White Color] is connected to the generator frame.

The DC Wire Harness Supplied Color Code as follows: Green is Ground, White is ESS [Emergency Stop Switch], White/Black is the Stop Switch, Black is Preheat, Orange is Oil Pressure, Red is Water Temperature, Yellow is the Exhaust High Temperature Alarm [marine applications only] and Black/Red is the Start Button.

IMPORTANT! The Exhaust High Temp terminal is connected to the ESS terminal when it is not used.

GenRemote CONTROL STATION

IMPORTANT! The generator must be running and the system fully operational before the calibration mode can be accessed.

Enter the Calibration Mode: Press and holding the Mode Button for 10 seconds. Entry is indicated when the hundreds place decimal of the 3-digit, 7-segment display **turns on**.

Calibration Button Functions

- Mode Button:** Press and hold the mode button to enter the calibration mode.
- Preheat Button:** Use the Preheat Button to manually advance through the AutoGauge Scroll functions until the desired gauge is reached.
- Stop Button:** Use the Stop Button to decrement or reduce the gauge value.
- Start Button:** Use the Start Button to increment or increase the gauge value.
- Mode Button:** Press the mode button to exit the calibration mode. Not pressing any button for 30 seconds will also exit the calibration mode.
- Firmware I.D.** The firmware identification number will appear in the display when the calibration mode is exited. A typical firmware identification number is "A15".

Calibration Method

Calibrate the AutoGaugeScroll by using the values derived from the mechanical gauge package supplied with the generator.

Calibrate the AC Volt and Current Meter with a standard Amp and Voltmeter normally carried by most service technicians.

No calibration of the Frequency Meter is required or allowed. The Frequency Meter is factory calibrated to \pm one (1) Hz.

NOTE: The unit will automatically exit the Calibration Mode if no buttons are pressed for thirty (30) seconds.



Firmware Identification

When calling for service or warranty repair it is useful to have the firmware identification number. The unit's age, software revision level and the systems hardware can be identified from this number. The firmware identification number is also placed on the 28 pin microprocessor located in the control module assembly. The firmware number appears in the display when the calibration mode is exited.



FAIL SAFE PROCEDURES

The fail-safe system is setup to display potential failures approximately 10% lower than the OEM settings. This allows time for the operator to manually shut down the generator before serious damage occurs.

Failures are displayed by turning on the appropriate warning LED. For Example, the high coolant temperature alarm will appear at 195 ° F and the OEM safety switch will stop the generator at 210 ° F.

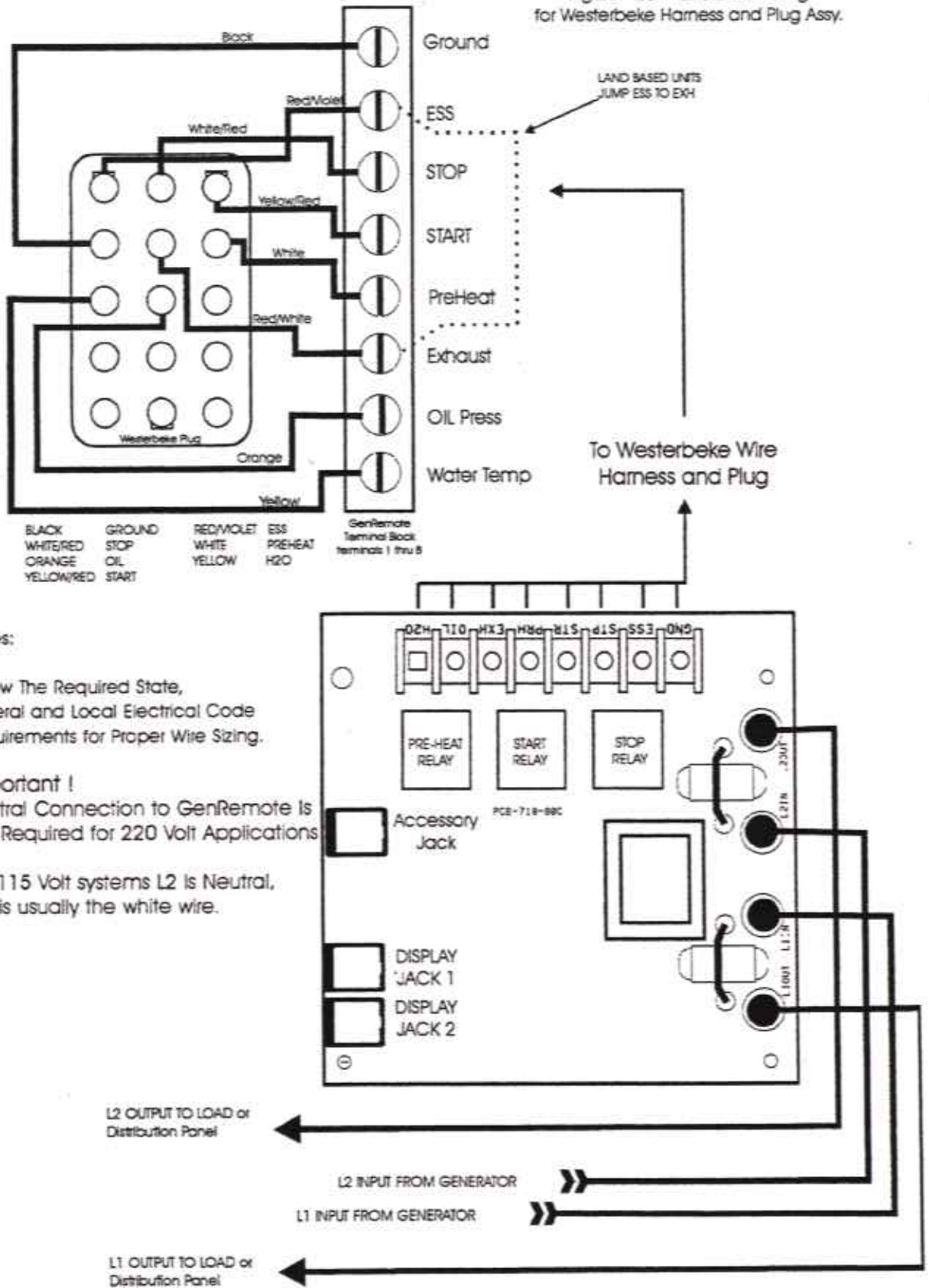
The alarm LED will remain lit after the generator shuts down to provide indication as to why the unit stopped.

The alarm LED can be cleared by pressing the stop button or by restarting the unit.

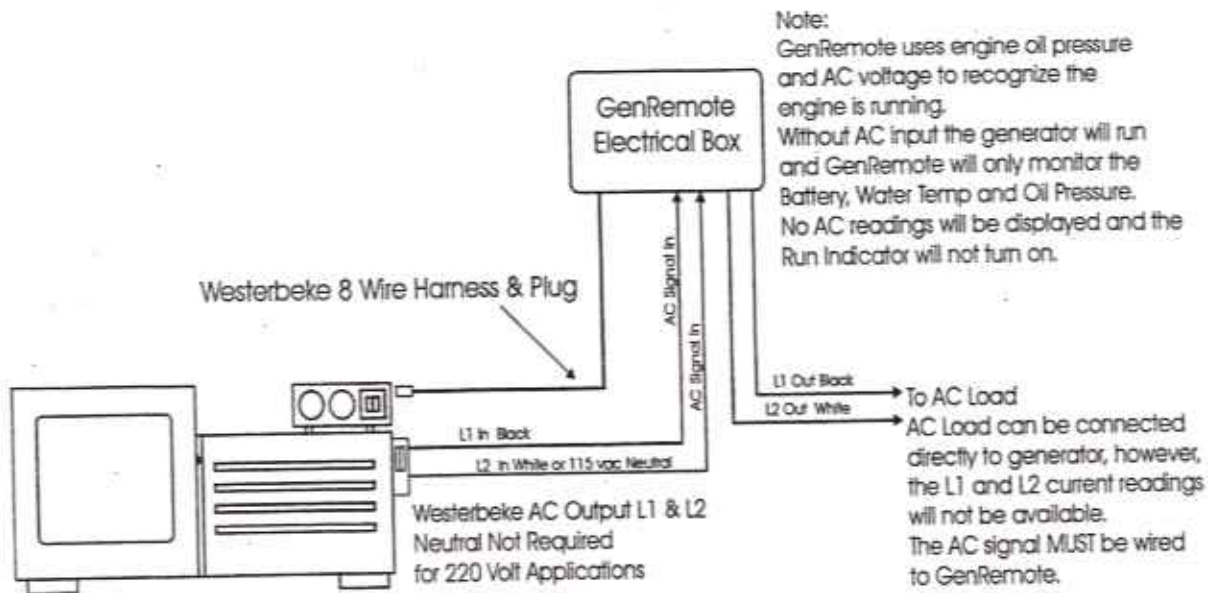
- The Fail-Safe Protocols include:
- 1 - Oil Pressure
 - 2 - Coolant Temperature
 - 3 - Exhaust Over temperature KLIXON

GenRemote WIRING DIAGRAM

Figure - 2a Westerbeke Wiring for Westerbeke Harness and Plug Assy.



GenRemote INSTALLATION DIAGRAM



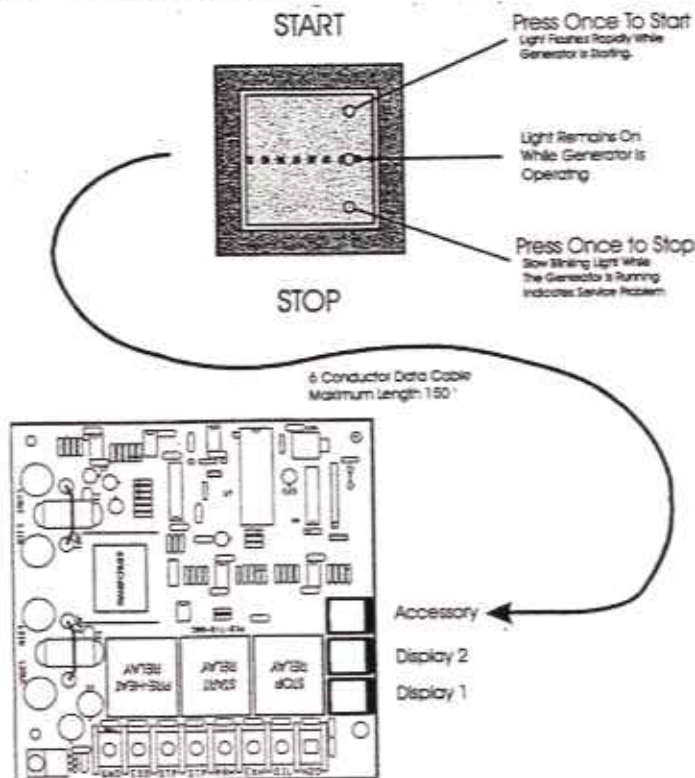
STOP/START ROCKER SWITCH

The One Illuminated Button Start / Stop Rocker Switch is provided for areas where remote start stop functions are required and no space is available for the standard display panel.

Start the generator by pressing and releasing the upper rocker once. The lamp will flicker rapidly while the generator is starting. The indicator lamp will remain on and steady while the generator is running.

Stop the generator by pressing and releasing the lower rocker once.

Trouble Indicator: The indicator lamp will flicker slowly while the generator is operating if a service problem is developing. Possible problems include, High Coolant Water Temperature, Low Oil Pressure and High Exhaust Temperature Safety Switch.



GenRemote SPECIFICATIONS

DC OPERATING VOLTAGES	12 OR 24 VDC
DC CURRENT REQUIREMENT--MODULE	50 MA
DC CURRENT REQUIREMENT--DISPLAY	20 MA
DC CURRENT EACH ADDITIONAL DISPLAY	15 MA
AC VOLTAGES	120 / 240 VAC
PHASE	1 Ø OR 3 Ø
STANDARD CURRENT METER	60 AMPS
REMOTE CURRENT METER	200 AMPS
START RELAY	7 AMPS
STOP RELAY	7 AMPS
PREHEAT RELAY	7 AMPS
MAXIMUM # OF DISPLAYS PER MODULE	4
MAXIMUM # OF DISPLAYS DAISY CHAINED	2
MAXIMUM DISPLAY CABLE LENGTH (ONE DIRECTION)	300 FT.
TOTAL ALLOWED DISPLAY CABLE LENGTH	600 FT.
TEMPERATURE RANGE	0 ° F THROUGH 180 ° F

NOTE: Each module will support a maximum of four displays. No more than two (2) displays should be daisy chained to one module output. The module supports two (2) separate display output lines.

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 generators capacity, and finally loaded to its full capacity as indicated on the generators 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 ammeter is not installed to monitor voltage and load, check it with a portable meter and amp probe.

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

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 tightness of all connections, evidence of overheated terminals and 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, inspect the bearing and shaft for wear. 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 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 generator are leaking in your area.

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

POWER TAKE OFF SYSTEMS

POWER TAKE OFF ADAPTER

A power take off adapter can be attached to the generator backend. This adapter allows access to the full power of the engine for a variety of hydraulic and electrical accessories.

Contact your *WESTERBEKE COMMERCIAL GENERATOR SUPPLIER* for additional information.

XRT POWER SYSTEM

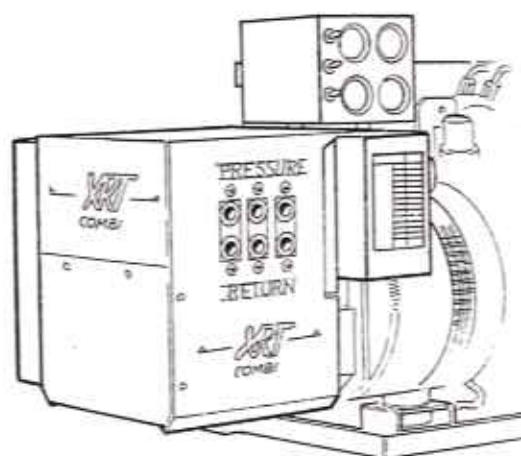
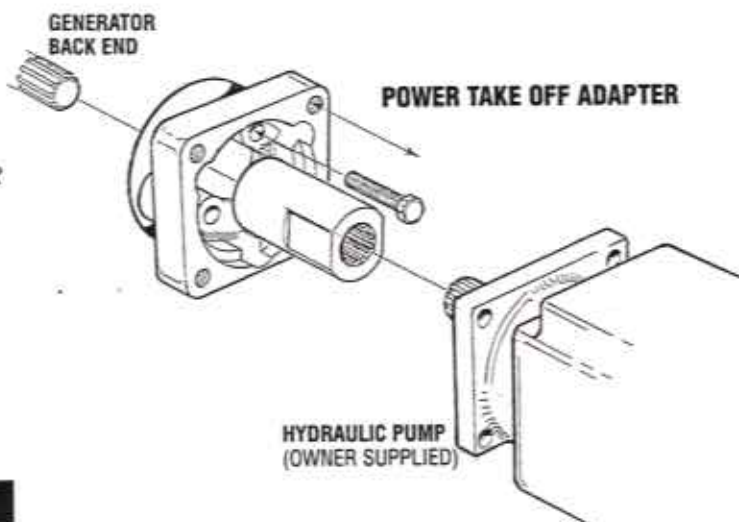
The XRT power system combined with a Westerbeke generator provides electrical and hydraulic power for fire/emergency apparatus. The system generates electrical power for auxillary lighting and provides continuous operation of up to three extrication tools at the same time.

SPECIFICATIONS

Components	Dual stage continuous duty pump, stainless high pressure fittings, three gallon reservoir with filter, pump enclosure with integral control block assemblies.
System Availability	5,000 psi phosphate ester fluid and mineral fluid systems up to 10,500psi.
Dimensions	COMBI pump in shroud. L: 10" x W: 15" x H: 14" x 42 lbs Reservoir: H: 12" x W: 12" x D: 6.5" Open Center Valves: L: 3.75" x W: 2.75" x H: 4.0"

For additional information, contact XRT POWER SYSTEMS at www.xrtcombi.com or call (800) 343-0480.

XRT POWER SYSTEMS
32 Tioga Way
Marblehead, MA 01945



XRT COMBI POWER SYSTEM

BT GENERATOR

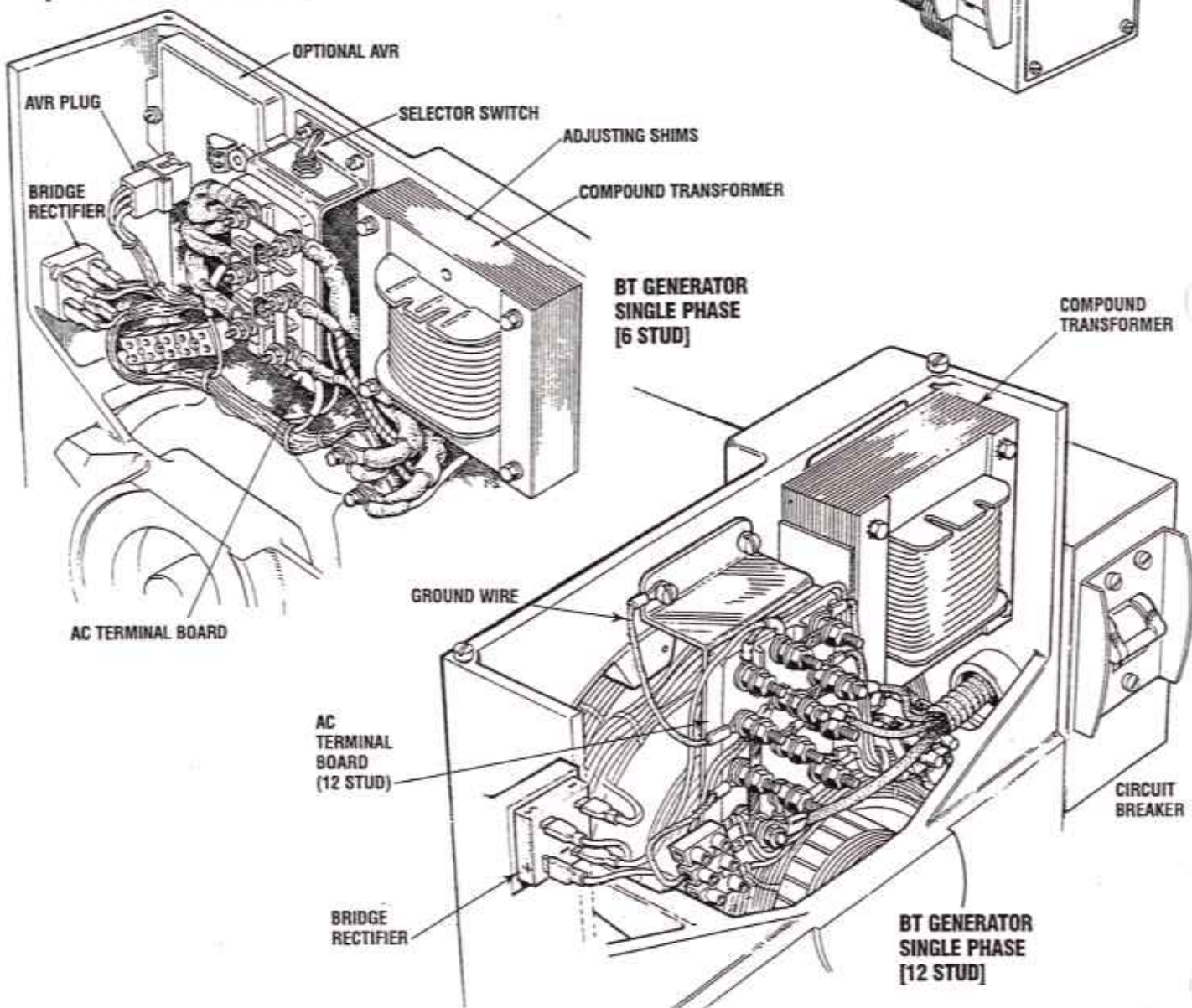
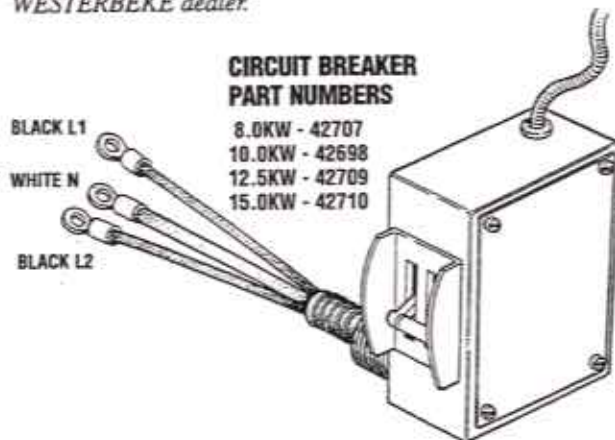
This generator is a four-pole, brushless, self-excited generator which requires only the driving force of the engine to produce AC output. The copper and laminated iron in the exciter stator are responsible for the self-exciting feature of this generator. The magnetic field produced causes an AC voltage to be induced into the related exciter rotor windings during rotation. Diodes located in the exciter rotor rectify this voltage to DC and supply it to the windings of the rotating field. This creates an electromagnetic field which rotates through the windings of the main stator, inducing an AC voltage which is supplied to a load. A step down transformer is connected in parallel to the AC output of the main stator. An AC voltage is produced in the auxiliary windings of the transformer and the main stator and is, in turn, supplied to a full-wave bridge rectifier. The rectifier produces a DC voltage to further excite the exciter stator windings, enabling the generator to produce a rated AC output. An optional solid-state voltage regulator is available to work in tandem with the transformer regulator to produce a more stable AC output.

A circuit breaker is installed on all 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 no power is coming into the boat.

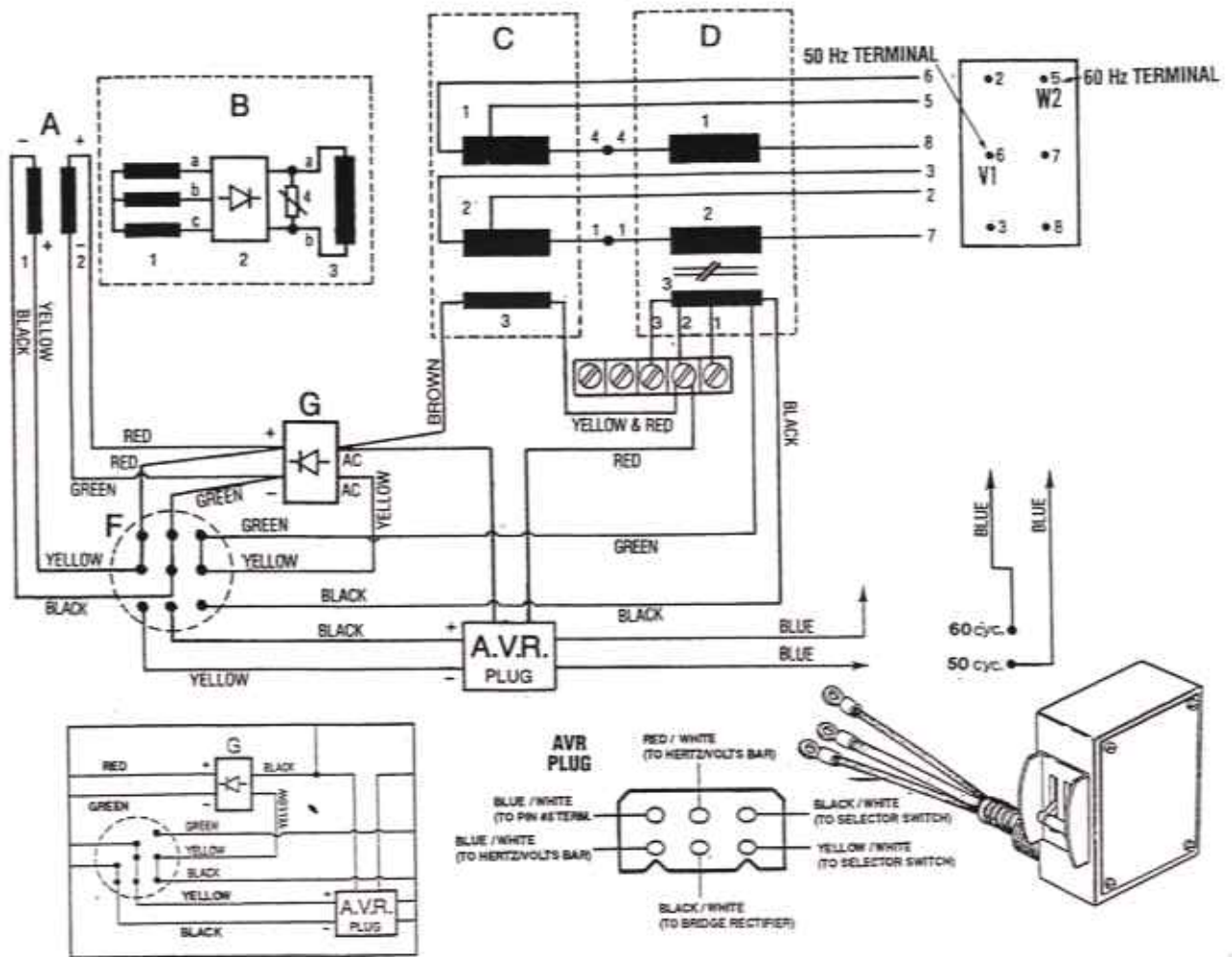
NOTE: This circuit breaker is available as a WESTERBEKE add-on kit for earlier model generations; contact your WESTERBEKE dealer.

CIRCUIT BREAKER PART NUMBERS

BLACK L1	8.0KW - 42707
WHITE N	10.0KW - 42698
BLACK L2	12.5KW - 42709
	15.0KW - 42710



BT GENERATOR / SINGLE PHASE [SIX STUD]



INTERNAL WIRING SCHEMATIC (SIX STUD) W/OPTIONAL VOLTAGE REGULATOR

A. EXCITER STATOR WINDINGS 1 & 2
A - 1 and A - 2 Exciter Stator Windings
(Selector in **COMP** position)

B. EXCITER ROTOR and FIELD
1. Auxiliary Windings (A - B - C)
2. Diodes (6)
3. Rotating Field Windings
4. Posi Resistor

C. MAIN STATOR
1. Main Stator Windings
2. Main Stator Windings
3. Main Stator Auxiliary Windings

D. COMPOUND TRANSFORMER
1. Compound Transformer Windings
2. Compound Transformer Windings
3. Compound Transformer Auxiliary Windings

Resistance readings and voltage checks can be accessed easily for the components in the exciter circuit A, G, C-3 and D-3 by locating the color coded wires at the connection points shown on the above schematic. When checking winding resistance values be sure to lift both of the component's electrical connections.

G. BRIDGE RECTIFIER

A.V.R.

Optional Automatic Voltage Regulator Plug (6 Prong).

BT GENERATOR SINGLE PHASE

OPTIONAL AUTOMATIC VOLTAGE REGULATOR (AVR) BT 6 STUD MODELS ONLY

An optional solid-state voltage regulator (board #34410) is available for use with the BT series generators. When installed, and the regulation switch is moved to the ELEC position, the regulator works together with the standard compound transformer regulator to regulate the generator's voltage output. In the ELEC mode, the regulator provides excitation to the group 1 exciter windings, and the transformer provides excitation to the group 2 exciter windings.

Installation

1. The regulator is mounted using existing tapped holes in the generator's case. Use two (2) M4 x 0.7mm screws, each 15mm long, with lock washers to mount the regulator board.
2. Connect the 6-prong generator plug to the receptacle on the regulator board.

NOTE: The plug is keyed to engage the regulator receptacle in one direction. Check this and insert it correctly.

3. Before moving the selector switch to the ELEC position, the NO-Load voltage produced by the generator when in the COMP position will have to be adjusted. The NO-Load voltage should be adjusted down between 114 - 118 volts (60Hz) or 224 - 228 volts (50Hz) following the procedures as explained earlier in this manual.
4. With the generators no load voltage properly adjusted, move the selection switch into the ELEC position. Adjust the regulator board potentiometer to set NO-Load voltage at 120 - 122 volts at 61.5 - 62.0 Hertz (230 - 234 volts at 51.5 - 52.0 Hertz). The regulator board is operating in parallel with the compound transformer and should maintain voltage output within ± 5 per cent from NO-Load to FULL-Load.

NOTE: Do not use the regulator to force NO-Load voltage down. Use the compound transformer for this function. Using the regulator to perform this causes the regulator to use more exciter circuit power. This leaves less exciter circuit power for loaded conditions.

GENERATOR VOLTAGE ADJUSTMENT

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

Generator Frequency

- Frequency is a direct result of engine/generator speed:
1800 rpm = 60 hertz
1500 rpm = 50 hertz.
- To change generator frequency follow the steps below.
 - Connect the AC output leads to the AC terminal block, following the illustrations on this page.
 - If an AVR is installed, reposition the blue or blue/white lead to correspond to the hertz selected on the Voltage/Hertz Connection Bar.

If there is no automatic voltage regulator (AVR) installed, do not change the wiring on the Voltage/Hertz Connection Bar. Simply reconfigure the AC terminal for the hertz change.

- Start the engine, monitor voltage and adjust engine no-load speed. Adjust diesel units by the linkage between the throttle arm and fuel solenoid or the throttle lever on the injection pump.

60 hertz:	no-load speed,	61.5 - 62.0 hertz.
50 hertz:	no-load speed,	51.5 - 52.0 hertz.

- After the no-load hertz adjustment is made, the no-load voltage may need to be readjusted. In most cases, if the generator was producing the correct no-load voltage at the previous hertz setting, it would be correct at the changed hertz setting.

In the event it needs adjustment, adjust the shim thickness under the laminated steel bar of the transformer.

- | | | |
|-----------|------------------|----------------|
| 60 hertz: | no-load voltage, | 121-124 volts. |
| 50 hertz: | no-load voltage, | 232-236 volts. |

- Load the generator to the rated amperage output corresponding to the hertz speed of the generator.

Rated Loaded Speed

60 hertz: loaded speed, 58.5 - 59.0 hertz

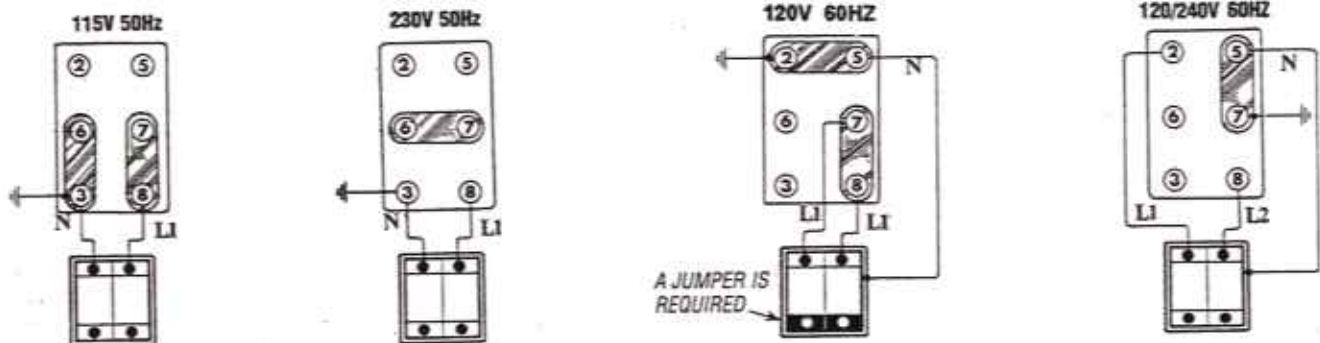
50 hertz: loaded speed, 48.5 - 49.0 hertz

The lowest acceptable voltage at full rated output (amps)

60 hertz: 108 - 110 volts

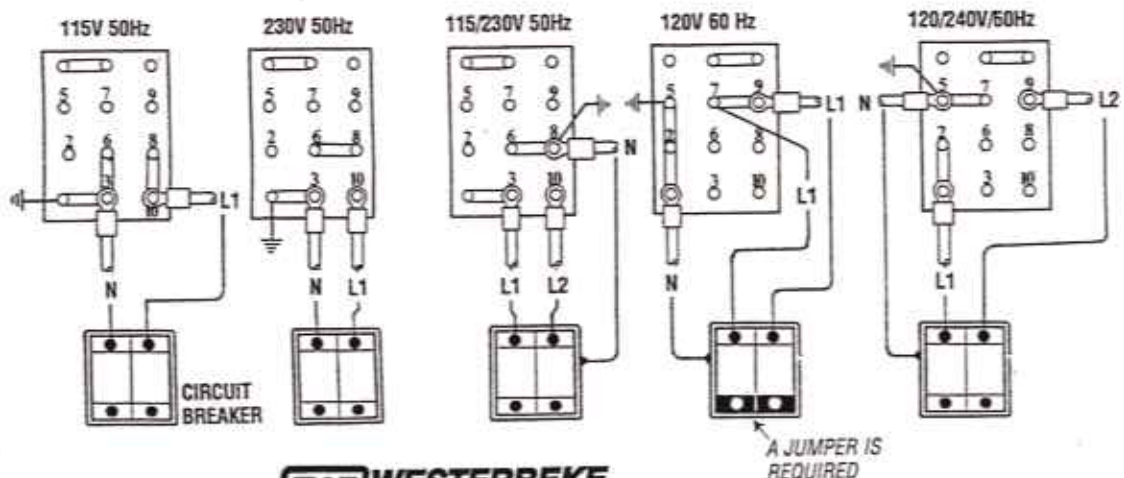
50 hertz: 205 - 210 volts

SIX STUD AC VOLTAGE CONNECTIONS



TWELVE STUD AC VOLTAGE CONNECTIONS

The frame ground wire must be moved when changing from 115 volts and 110/220 volts 50 hertz to 230 volts 50 hertz. From making connections to the AC terminal block, use terminal ends for 1/4 inch studs that will accept multi-strand copper wire sized for the amperage rating from the hot lead connection. The frame ground wire is white or white with a green strip. It connects between the neutral stud and the generator frame.



GENERATOR VOLTAGE ADJUSTMENT

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

NO-LOAD VOLTAGE ADJUSTMENT

Voltage adjustment is made with the generator regulation being governed by the compound transformer.

1. The selector switch, if installed, *must* be in the COMP position.
2. To confirm no-load voltage, start the generator and apply a momentary (moderate) load to excite the transformer. The voltage produced by the generator after the momentary load is removed is no-load voltage. Note the voltage output from the generators 120 volt leg(s) (230 volt 50 hertz). The no-load voltage should be between 121-124 volts at 61.5-62 hertz (232- 236 volts at 51.5-52 hertz).

NOTE: The no-load voltage should be adjusted to the voltage produced by the generator once started and a momentary load should be applied to excite the transformer and then removed. The voltage produced by the generator after this momentary load is removed is no-load voltage.

3. To raise or lower the voltage, shims of varying thickness (non-conductive material) are placed or removed from under the steel laminated bar on top of the compound transformer. The material used for shimming should not soften at temperatures in the 176° F (80° C) range. A small reduction in no-load voltage (1 to 3 volts) can some times be accomplished by gently tapping the top of the laminated steel bar to reduce the gap between the existing shims and the transformer core.

NOTE: No-load voltage may be effected needing readjustment with the compound transformer. Do not use these adjustments to compensate for overload conditions being placed on the generator/engine (inductive-motor type loads). Loss of generator hertz/speed, the result of overload, will cause a drop in voltage output.

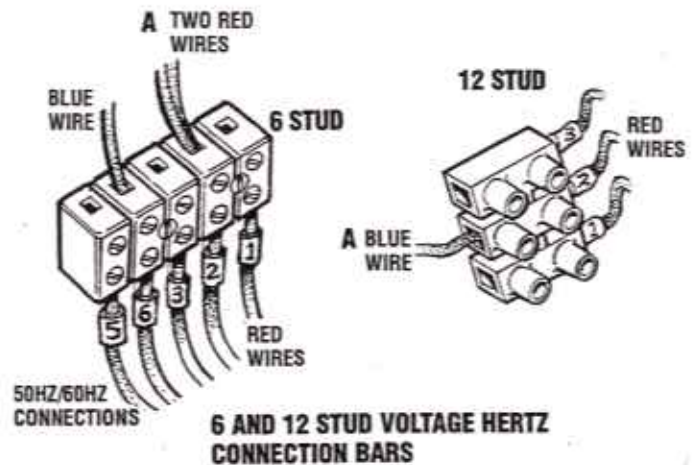
Shim thickness of 0.001 inch will change the no-load voltage by approximately 4 - 6 volts. Adding shim material raises the no-load voltage. Removing shim material lowers no-load voltage.

FULL-LOAD VOLTAGE ADJUSTMENT

The voltage hertz connection bar that is used when changing from 60Hz to 50Hz can also be used to increase or decrease the generators' full-load output.

Fine voltage adjustments can be performed by repositioning wires **A** to leads #1, #2, and #3 increasing the loaded voltage progressively in that order. A no-load voltage adjustment will have to be made as well.

Should full-load output fall below 108 volts-60Hz (210 volts-50Hz), the voltage should be adjusted.

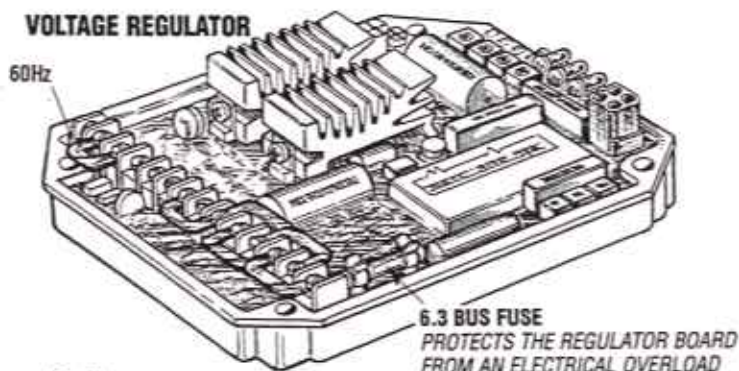


NOTE: When the optional voltage regulator is installed and if the Blue/White (Blue) lead is not correctly positioned to correspond to the Hertz the unit is operating at, the regulator will sense incorrect voltage and cause the generator to produce abnormally high output voltage.

BT GENERATOR VOLTAGE REGULATOR ADJUSTMENTS [THREE PHASE]

Description

The voltage regulator is an advanced design which ensures optimum AC generator performance. It is equipped with complete protection circuitry to guard against operating conditions that could be detrimental to the AC generator.



Volts

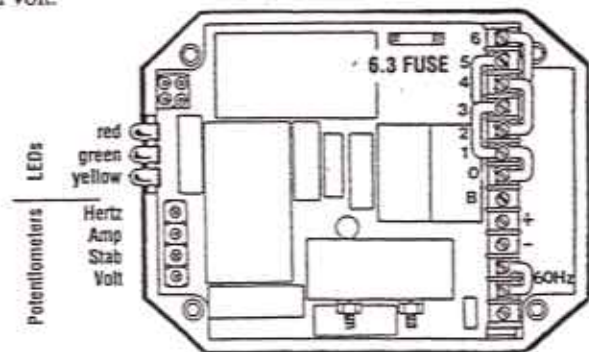
This potentiometer is used to adjust output voltage. At proper engine operating speed the output voltage should be held at $\pm 1\%$ from a no-load condition to a full rated generator output and from power factor 1.0 - 0.8 with engine drive speed variations up to -6%. Prior to starting the engine, turn the VOLT and STAB trimmers (using a mini phillips screwdriver) fully in a counter clockwise (Minimum) direction until you feel them hit their stops. Turn the AMP and HERTZ trimmers completely clockwise (Maximum) in the same manner. With the generator running at no-load, at normal speed, and with VOLT adjust at minimum, it is possible that output voltage will oscillate. Slowly rotate the VOLT adjust clockwise. The voltage output will increase and stabilize. Increase the voltage to the desired value. In this situation, only the green LED will stay lit.

Stability

This potentiometer permits variation of the regulator's response to generator load changes so as to limit overcompensation and obtain a minimum recovery time to the normal voltage output.

In order to adjust the regulator stability the generator must be running at no-load and the output must be monitored.

Turn the STAB adjust slowly clockwise until the voltage starts to fluctuate. At this point rotate the STAB adjust counterclockwise until the voltage is stable within 1 or 2 tenths of a volt.



VOLTAGE REGULATOR DIAGRAM

Amp-Hertz

These two adjustments are used in conjunction with the two protection circuits in the voltage regulator that are indicated by the illumination of colored LED lights.

1. Delayed overload protection (yellow LED).
2. Low speed protection (red LED).

Both systems have an intervention threshold which can be adjusted using the respective potentiometer. Each of the two circuits are able to cause an adequate reduction in excitor voltage to safeguard the excitor windings and prevent their overheating.

The overload protection system has a delay which permits temporary overloading of the generator during times such as motor start-up or other similar load surge demands. The regulator also has a third LED (green), that glows during generator operation to indicate correct operation of the regulator with the generator.

Setting the Overload Protection

In order to set the AMP overload protection, the generator must be loaded to its full output rating.

1. Load the generator to its rating, then decrease the speed of the engine by 10.10% (54 Hertz on 60 hertz units, 45 hertz on 50 hertz units).
2. Rotate the AMP adjustment counterclockwise until it hits its stop. Wait about 15-20 seconds after which the AC output of the generator should drop and the yellow LED light should come on.
3. Slowly rotate the AMP adjustment clockwise until the output voltage increases to approximately 97% of the voltage output at the start of the adjustment. At this point the yellow LED light should come on.
4. Return to nominal speed, the yellow LED will turn off and the generator voltage will rise to its normal value. Should this not happen, repeat the adjustment.

NOTE: When changing from 60 hertz to 50 hertz operation, remove the 60 hertz jumper bar from the regulator board.

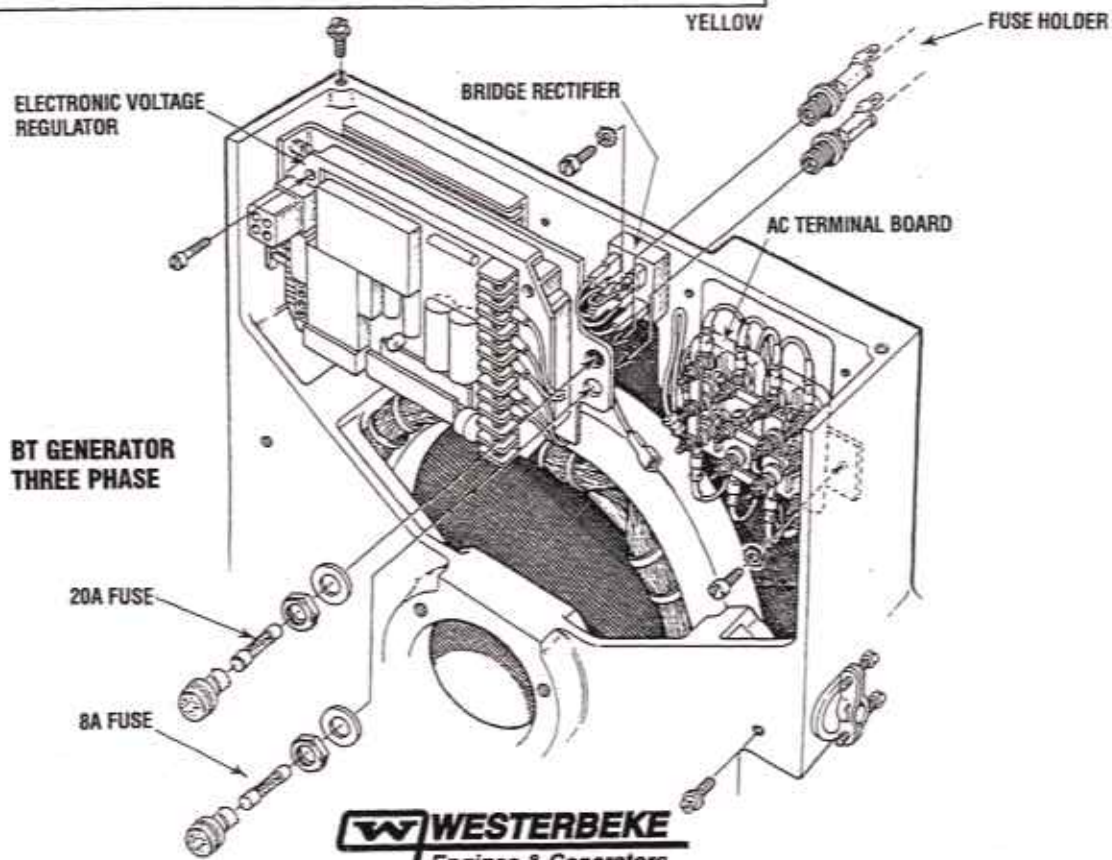
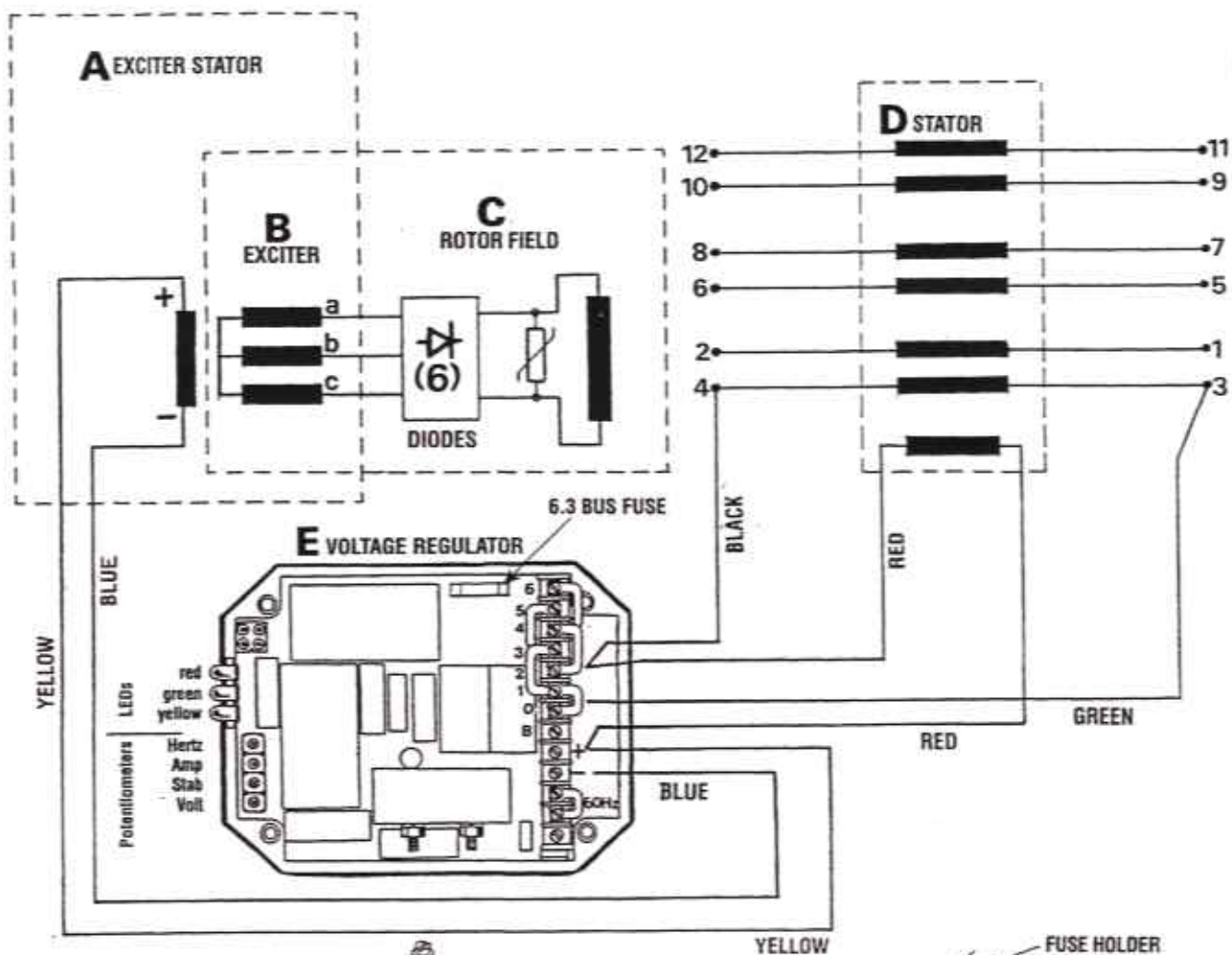
Setting the Underspeed Protection

NOTE: If the unit is operating at 60 Hertz ensure that the jumper strap is in place on the regulator board between the two 60 Hertz terminals. In order to adjust the underspeed setting, the generator should be running at no-load.

1. To adjust the underspeed (low frequency) protection circuit, lower the engine speed at 90% of its normal running speed (54 hertz on 60 hertz units, 45 hertz on 50 hertz units).
2. Rotate the Hertz adjustment counterclockwise slowly until the generator's AC output voltage starts to decrease and at the same time the red "LED" light comes on.
3. Increase the engine speed to its normal speed (frequency). The red "LED" light will go out and the AC voltage output will return to normal.

With the above adjustments made, the regulator should function normally.

BT GENERATOR INTERNAL WIRING 3 PHASE TWELVE WIRE RECONNECTABLE



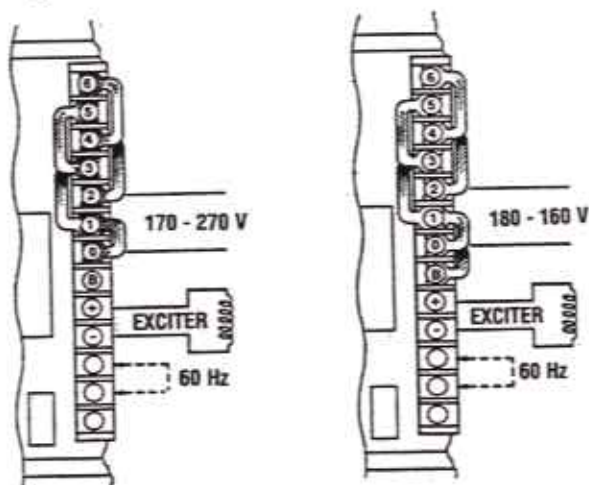
REGULATOR SENSING 3 PHASE WYE-DELTA CONFIGURATIONS

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

Description

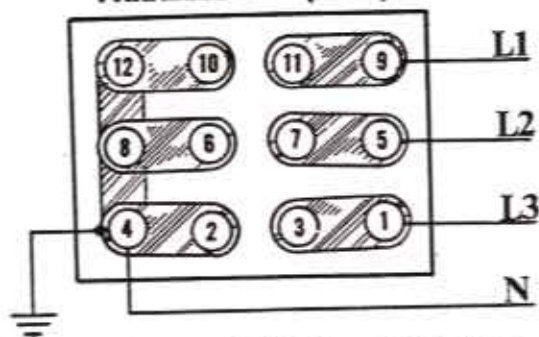
The regulator is equipped with seven numbered terminals (0 to 6) and their related brass jumpers. The illustrations shown connection points and jumpers for the 3 phase configuration of the generator. The sensing leads connect between pin #1 and pin #2 on the AC terminal block and connection #2 and #0 on the voltage regulator board.

NOTE: Series Delta requires the installation of a jumper on the regulator board between terminal B and 1.



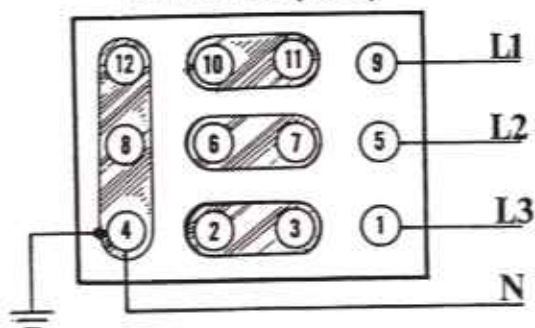
3 PHASE VOLTAGE REGULATOR

PARALLEL WYE (STAR)



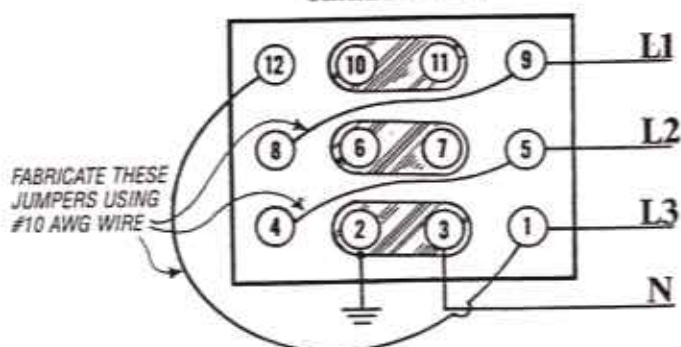
L - L	208 VAC	3Ø 60 Hertz
L - N	120 VAC	1Ø 60 Hertz
L - L	190 VAC	3Ø 50 Hertz
L - N	115 VAC	1Ø 50 Hertz

SERIES WYE (STAR)



L - L	460 VAC	3Ø 60 Hertz
L - N	265 VAC	1Ø 60 Hertz
L - L	380 VAC	3Ø 50 Hertz
L - N	230 VAC	1Ø 50 Hertz

SERIES DELTA



L - L	240 VAC	3Ø 60 Hertz
L2, L3, - N	120 VAC	1Ø 60 Hertz
L - L	230 VAC	3Ø 50 Hertz
L2, L3, - N	115 VAC	1Ø 50 Hertz

BT GENERATOR TROUBLESHOOTING CHART

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

Problem	Probable Cause	Verification/Remedy
Low voltage at N/L and F/L. No adjustment from regulator potentiometer.	<ol style="list-style-type: none"> 1. Regulator board defective. 2. Exciter stator winding A-1 open. 	<ol style="list-style-type: none"> 1. Replace the regulator board. Adjust N/L voltage with transformer; then switch to ELEC and adjust with A.V.R. potentiometer. 2. Check resistance values of C-3 and D-3 windings and their connections.
Low voltage at N/L and voltage drops further as a load is applied.	<ol style="list-style-type: none"> 1. Diode(s) in exciter rotor shorted (B-2). 2. Auxiliary windings in exciter rotor shorted (B-2). 	<ol style="list-style-type: none"> 1. Check the diodes in the exciter rotor. 2. Check the resistance values and continuity to ground.
Voltage OK at N/L and low at F/L.	<ol style="list-style-type: none"> 1. Auxiliary windings in the exciter rotor. 2. Exciter stator compound winding A-2 is open 3. Auxiliary windings D-3 or C-3 open. 	<ol style="list-style-type: none"> 1. Check the resistance values and continuity to ground. 2. Check the continuity and the connection of the winding. 3. Check the continuity and the connection of the winding.
Voltage unstable.	<ol style="list-style-type: none"> 1. Defective regulator board. 2. Engine is hunting. 3. Electrical connections. 	<ol style="list-style-type: none"> 1. Check the stability of DC voltage from the regulator to the exciter stator windings. Operate the unit on COMP. Replace the regulator board. 2. Check the engine operation and the fuel system. 3. Check for clean and secure connections.

SPECIFICATIONS 10.0KW/8.0KW BTDA

GENERAL

Engine Type	Diesel, four-cycle, three-cylinder, fresh water-cooled, vertical in-line overhead valve mechanism.
Displacement	80.4 cubic inches (1.318 liter)
Aspiration	Naturally aspirated.
Combustion Chamber	Swirl type.
Bore & Stroke	3.07 x 3.62 inches (78 x 92 mm)
Firing Order	1 - 3 - 2
Direction of Rotation	Clockwise, when viewed from the front.
Compression Ratio	22:1
Weight (Engine Only)	276 lbs (276 kgs) without transmission.
Inclination	Continuous 15° Temporary 25° (not to exceed 30 min.)

TUNE-UP SPECIFICATIONS

Compression Pressure Minimum	427 psi (30 kg/cm ²) at 280 rpm 384 psi (27 kg/cm ²)
Valve Timing	Intake Opens Intake Closes
Spilled Timing (Static)	17° (spill)
Valve Seat Angle	45°
Engine Timing	17° BTDC
Injector Pressure	1991 + 71 - 0 psi (140 + 5 - 0 kgf/cm ²).
Valve Seat Angle	Intake 45° Exhaust 30°
Valve Clearance (engine cold)	0.0098 inches 0.25 mm

LUBRICATION SYSTEM

General	Pressure fed system.
Oil Filter	Full flow, paper element, spin-on type.
Sump Capacity (not including filter)	3.9 U.S. qts (3.7 liters)
Operating Oil Pressure (engine hot)	50 - 60 psi (3.5 - 4.2 kg/cm ²)
Oil Grade	API Specification CF or CG-4, SAE 30, 10W-30, 15W-40

FUEL SYSTEM

General	Open flow, self priming.
Fuel	No. 2 diesel oil (cetane rating of 45 or higher).
Fuel Injection Pump	In-line plunger type (BOSCH).
Fuel Injection Timing	0° TDC (Top Dead Center)
Nozzle	Throttle type.
Fuel Filter	Spin-on replaceable (PN#024363).
Air cleaner	Replaceable paper filter cartridge.
Air Flow (engine combustion)	140 cfm (3.9 cmm) at 3600 rpm.
Fuel Lift Pump	12 volt DC lift capacity of 5' (1.5 mm) solid state

ELECTRICAL SYSTEM

Starting Battery	12 Volt, (-) negative ground
Battery Capacity	400 - 600 Cold Cranking Amps (CCA)
DC Charging Alternator	51 Amp rated, belt-driven
Starting Aid	Glow plugs, sheathed type
Starter	12 Volt, reduction gear

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.
System Capacity (Fresh Water)	1.9 US qts (1.8 liters)

SPECIFICATIONS 15KW BTDC/12.5KW BTDB

GENERAL

Engine Type	Diesel, four-cycle, four-cylinder, fresh water-cooled, vertical in-line overhead valve mechanism.
Displacement	107.3 cubic inches (1.758 liter)
Aspiration	Naturally aspirated.
Combustion Chamber	Swirl type.
Bore & Stroke	3.07 x 3.62 inches (78 x 92 mm)
Firing Order	1 - 3 - 4 - 2
Direction of Rotation	Clockwise, when viewed from the front.
Compression Ratio	22:1
Dimensions - inches (mm)	Height: 24.0 inches (609.6 mm)
Engine Only	Width: 19.0 inches (482.6 mm) Length: 34.6 inches (878.8 mm)
Weight (dry)	569 lbs (258.10 kgs)
Fuel Consumption	1.42 g/hr (5.38 ltr/hr) at 1800 rpm
HP @ 1800 RPM	25 HP

TUNE-UP SPECIFICATIONS

Compression Pressure	427 psi (30 kg/cm ²) at 280 rpm
Minimum	384 psi (27 kg/cm ²)
Spilled Timing (Static)	17° (spill)
Valve Seat Angle	Intake 45° Exhaust 30°
Engine Speed	1800 rpm (60Hz) 1500 rpm (50Hz)
Valve Seat Angle	Intake 45° Exhaust 30°
Valve Clearance	0.0098 inches (0.25 mm)
Injector Pressure	1991 + 71 - 0 psi (140 + 5 - 0 kgf/cm ²).
Engine Timing	17° BTDC

ELECTRICAL SYSTEM

Starting Battery	12 Volt, (-) negative ground
Battery Capacity	400 - 600 Cold Cranking Amps (CCA)
DC Charging Alternator	51 Amp rated, belt-driven
Starting Aid	Glow plugs, sheathed type
Starter	12 Volt, reduction gear

FUEL SYSTEM

General	Open flow, self priming.
Fuel	No. 2 diesel oil (cetane rating of 45 or higher).
Fuel Injection Pump	In-line plunger type (BOSCH).
Nozzle	Throttle type.
Fuel Filter	Spin-on replaceable (PN#024363).
Air cleaner	Replaceable paper filter cartridge.
Fuel Lift Pump	12 volt DC lift capacity of 5' (1.5 mm) solid state

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.
System Capacity (Fresh Water)	8.0 US qts (7.6 liters)

LUBRICATION SYSTEM

General	Pressure fed system.
Oil Filter	Full flow, paper element, spin-on type.
Sump Capacity (not including filter)	5.5 U.S. qts (5.2 liters)
Operating Oil Pressure (engine hot)	50 - 60 psi (3.5 - 4.2 kg/cm ²)
Oil Grade	API Specification CF or CG-4

SPECIFICATION 10.0KW BTDA

AC GENERATOR (Single Phase)	
Single Phase	Brushless, four-pole, revolving field. Pre-lubricated, single bearing design. Reconnectable, single phase transformer regulation (optional solid-state voltage regulation).
Voltage	120 or 120/240 Volts - 60 Hertz 220 Volts - 50 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 83.3 Amps
10.0KW	120/240 Volts 83.3/41.6 Amps
50 Hertz (1500 rpm)	220 Volts 34.1 Amps
7.5KW	
Generator Cooling Air Requirements (60 Hertz) at 1800 rpm	225 - 250 cfm (5.66 - 6.37 cmm)
	NOTE: Increase air supply 15% for 50 Hertz operation (1500 rpm)

AC GENERATOR (3 Phase)		
General - 3 Phase 10.0 KW - 60 Hertz 7.5 KW - 50 Hertz	Brushless six pole, revolving field. Sealed lubricated single bearing design. 12 Lead reconnectable for low voltage WYE, high voltage Delta. Solid State voltage regulator with protection circuitry.	
Voltage - 3 Phase (60 Hertz)	Low voltage WYE High voltage WYE DELTA	208 volts 480 volts 240 volts
Voltage - 3 Phase (50 Hertz)	High voltage WYE DELTA	380 volts 220 volts
Amperage - 3 Phase (60 Hertz)	Low voltage WYE High voltage WYE DELTA	35 Amps 15 Amps 30 Amps
Amperage - 3 Phase (50 Hertz)	High voltage WYE DELTA	14 Amps 24 Amps
Engine Combustion Air Requirements (60 Hertz) at 1800 rpm	32 cfm (.906 cmm)	

SPECIFICATION 8.0KW BTDA

AC GENERATOR (Single Phase)	
Single Phase	Brushless, four-pole, revolving field. Pre-lubricated, single bearing design. Reconnectable, single phase transformer regulation (optional solid-state voltage regulation).
Voltage	120 or 120/240 Volts - 60 Hertz 220 Volts - 50 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 66 Amps
8.0KW	120/240 Volts 66/33 Amps
50 Hertz (1500 rpm)	220 Volts 27 Amps
6.0KW	
Generator Cooling Air Requirements (60 Hertz) at 1800 rpm	175 - 200 cfm (4.95 - 5.66 cmm)
	NOTE: Increase air supply 15% for 50 Hertz operation (1500 rpm)
Engine Combustion Air Requirements (60 Hertz) at 1800 rpm	32 cfm (.906 cmm)
Engine Compartments	100-200 cfm (2.83 - 5.66 cmm)

SPECIFICATIONS 15KW BTDC

AC GENERATOR (Single Phase)	
Single Phase	Brushless, four-pole, revolving field. Pre-lubricated, single-bearing design. Reconnectable, single-phase transformer regulation (optional solid-state voltage regulation).
Voltage	120 or 120/240 Volts - 60 Hertz 230 Volts - 50 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)	60 Hertz (1800 rpm) 120 Volts 125 Amps 120/240 Volts 125/62.5 Amps 50 Hertz (1500 rpm) 230 Volts 60 Amps
Generator Cooling Air Requirements (60 Hertz) at 1800 rpm	225 - 250 cfm (6.37 - 7.08 cmm) NOTE: Increase air supply 15% for 50 Hertz operation (1500 rpm).
Engine Combustion Air Requirements (60 Hertz), at 1800 rpm	41 cfm (1.16 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).

AC GENERATOR (3 Phase)		
Three Phase 15.0 Kw - 60 Hertz 12.0 Kw - 50 Hertz	Brushless, six-pole, revolving field. Sealed lubricated, single-bearing design. 12 Lead reconnectable for low voltage WYE, high voltage Delta. Solid state voltage regulator with protection circuitry	
Voltage - 3 phase 60 Hertz	Low Voltage WYE High Voltage WYE DELTA	208 Volts 480 Volts 240 Volts
Voltage - 3 Phase 50 Hertz	High Voltage WYE DELTA	380 Volts 230 Volts
Amperage - 3 phase 60 Hertz	Low Voltage WYE High Voltage WYE DELTA	52 Amps 22 Amps 45 Amps
Amperage - 3 phase 50 Hertz	High Voltage WYE DELTA	22 Amps 39 Amps
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).	

SPECIFICATIONS 12.5KW BTDB

AC GENERATOR (Single Phase)	
Single Phase	Brushless, four-pole, revolving field. Pre-lubricated, single-bearing design. Reconnectable, single-phase transformer regulation (optional solid-state voltage regulation).
Voltage	120 or 120/240 Volts - 60 Hertz 230 Volts - 50 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) 12.5KW 50 Hertz (1500 rpm) 9.3KW	120 Volts 104 Amps 120/240 Volts 104/52 Amps 230 Volts 60 Amps
Generator Cooling Air Requirements (60 Hertz) at 1800 rpm	200- 225 cfm (6.37 - 7.08 cmm) NOTE: Increase air supply 15% for 50 Hertz operation (1500 rpm).
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).

AC GENERATOR (3 Phase)		
Three Phase 12.5 Kw - 60 Hertz 9.3 Kw - 50 Hertz	Brushless, six-pole, revolving field. Sealed lubricated, single-bearing design. 12 Lead reconnectable for low voltage WYE, high voltage Delta. Solid state voltage regulator with protection circuitry	
Voltage - 3 phase 60 Hertz	Low Voltage WYE High Voltage WYE DELTA	208 Volts 480 Volts 240 Volts
Voltage - 3 Phase 50 Hertz	High Voltage WYE DELTA	380 Volts 230 Volts
Amperage - 3 phase 60 Hertz	Low Voltage WYE High Voltage WYE DELTA	43 Amps 18 Amps 37 Amps
Amperage - 3 phase 50 Hertz	High Voltage WYE DELTA	17 Amps 30 Amps
Engine Combustion Air Requirements (60 Hertz), at 1800 rpm	41 cfm (1.16 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).	

ENGINE TORQUE SPECIFICATIONS

MAJOR BOLTS AND NUTS

Bolt or Nut	Diameter	Pitch	Width across flats	Clamp length	TORQUE		
					kg -m	ft - lb	N -m
Alternator Bracket	---	---	---	---	3.8-5.3	27-38	36.6
Back Plate	---	---	---	---	3.3-4.8	24-35	32.5
Connecting Rod Cap	M9	1.0	14	---	3.55±0.25	27±7.2	34.8±2.5
Coolant Pump	---	---	---	---	1.6±2.4	12-17	17.2
Coolant Pump Pulley	---	---	---	---	1.6±2.4	12-17	17.2
Coolant Temperature Sender	---	---	---	---	1.2±1.8	9-13	12.2
Coolant Temperature Switch	---	---	---	---	1.2±1.8	9-13	12.2
Crankshaft Pulley Nut	M18	1.5	27	---	17.5±2.5	127±18	172±25
Cylinder Head Bolt	M10	1.25	14	87	9±0.5	65±4	88±5
Delivery Valve Holder	---	---	19	---	4.5±0.5	32±5.4	44±5
Engine Mounts	---	---	---	---	3.2±4.7	23-34	31.1
Exhaust Manifold	---	---	---	---	1.6±2.4	12-17	7.2
Flywheel Bolt	M12	1.25	19	29	13.5±0.5	98±4	132±5
Fuel Filter Assembly	---	---	---	---	4.6±6.8	33-49	44.7
Fuel Injection Nozzle Holder	M20	1.5	21	---	5.5±0.5	40±4.4	54±5
Fuel Injection Pipe Nut	M12	1.5	---	---	3±0.5	22±4	29±5
Fuel Leak-Off Pipe Nut	M12	1.5	18	---	2.75±0.25	20±2	27±2.5
Fuel Solenoid Locknut	---	---	---	---	4.0±5.0	28.9±36.2	39.18
Glow Plug	M10	1.25	12	60	1.75±0.25	12±7.2	17.2±2.5
Glow Plug Connection Plate	M4	0.7	8	---	0.125±0.025	0.9±0.2	1.2±0.2
Intake Manifold	---	---	---	---	1.6±2.4	12-17	16.2
Main Bearing Cap Bolt	M10	1.25	17	81	5.25±0.25	38±2	51.5±2.5
Oil Filter	M20	1.5	---	---	1.2±0.1	8.7±0.7	12±1
Oil Pan Bolt	M8	1.25	12	25	2.8±0.3	20.3±2.2	27±5.3
Oil Pan Drain Plug	M14	1.5	22	10	4.0±5	29±4	39±5
Oil Pressure Sender	---	---	---	---	1.2±1.8	9-13	12.2
Oil Pressure Switch	PT1/8	---	26	11	1±0.2	7.2±1.4	10±2
Pressure Relief Valve	M22	1.5	22	33	5.0±5	36±4	49±5
Rear Plate Bolt (stamping)	M8	1.25	12	16	1.15±0.15	8.3±1.1	11.3±1.5
Rear Plate Bolt (standard)	M12	1.25	17	28	6.5±1	47±7	64±10
Retaining Nut for Delivery Valve Holder Body	M16	0.75	19	---	3.75±0.25	27±2	37±2.5
Rocker Cover Bolt	M8	1.25	12	40	1.15±0.15	8.3±1.1	11.3±1.5
Rocker Shaft Bracket Bolt	M8	1.25	12	58.1	1.5±0.5	11±4	14.7±5
Sliding Sleeve Shaft	M10	1.25	14	29.5	3.6±0.6	26±4	35±6
Special Nut for Torque Spring Set	M12	1.0	17	---	2±0.5	14±4	20±5
Starter B Terminal	M8	1.25	12	---	1.1±0.1	8.0±7	10.8±1
Stop Solenoid	M30	1.5	36	---	4.5±0.5	32±5.4	44±5
Thermostat Housing	---	---	---	---	0.3-0.45	2-3	2.7
Thermoswitch	M16	1.5	17	31.5	2.3±0.4	16.6±3	22.6±4

STANDARD HARDWARE

BOLT HEAD MARKINGS

Bolt strength classes are embossed on the head of each bolt.

Customary (inch) bolts are identified by markings two to grade eight (strongest). The marks correspond to two marks less than the actual grade, i.e.; a grade seven bolt will display five embossed marks.



Metric bolt class numbers identify bolts by their strength with 10.9 the strongest.



- NOTES:**
1. Use the torque values listed below when specific torque values are not available.
 2. These torques are based on clean, dry threads. Reduce torque by 10% when engine oil is used.
 3. Reduce torques by 30% or more, when threading capscrews into aluminum.

STANDARD BOLT & NUT TORQUE SPECIFICATIONS			
Capscrew Body Size (Inches) - (Thread)	SAE Grade 5 Torque Ft-Lb (Nm)	SAE Grade 6-7 Torque Ft-Lb (Nm)	SAE Grade 8 Torque Ft-Lb (Nm)
1/4 - 20 - 28	8 (11) 10 (14)	10 (14)	12 (16) 14 (19)
5/16 - 18 - 24	17 (23) 19 (26)	19 (26)	24 (33) 27 (37)
3/8 - 16 - 24	31 (42) 35 (47)	34 (46)	44 (60) 49 (66)
7/16 - 14 - 20	49 (66) 55 (75)	55 (75)	70 (95) 78 (106)
1/2 - 13 - 20	75 (102) 85 (115)	85 (115)	105 (142) 120 (163)
9/16 - 12 - 18	110 (149) 120 (163)	120 (163)	155 (210) 170 (231)
5/8 - 11 - 18	150 (203) 170 (231)	167 (226)	210 (285) 240 (325)
3/4 - 10 - 16	270 (366) 295 (400)	280 (380)	375 (508) 425 (569)
7/8 - 9 - 14	395 (536) 435 (590)	440 (597)	605 (820) 675 (915)
1 - 8 - 14	590 (800) 660 (895)	660 (895)	910 (1234) 990 (1342)

METRIC BOLT & NUT TORQUE SPECIFICATIONS					
Bolt Dia.	Wrench Size	Grade 4.6 Ft-Lb (Nm)	Grade 4.8 Ft-Lb (Nm)	Grade 8.8 - 9.8 Ft-Lb (Nm)	Grade 10.9 Ft-Lb (Nm)
M3 M4 M5	5.5 mm 7 mm 8 mm	0.3 (0.5) 0.8 (1.1) 1.5 (2.5)	0.5 (0.7) 1 (1.5) 2 (3)	1 (1.3) 2 (3) 4.5 (6)	1.5 (2) 3 (4.5) 6.5 (9)
M8 M9 M10	10 mm 13 mm 16 mm	3 (4) 7 (9.5) 14 (19)	4 (5.5) 10 (13) 18 (25)	7.5 (10) 18 (25) 37 (50)	11 (15) 35 (26) 55 (75)
M12 M14 M16	18 mm 21 mm 24 mm	26 (35) 37 (50) 59 (80)	33 (45) 55 (75) 85 (115)	63 (85) 103 (140) 159 (215)	97 (130) 151 (205) 232 (315)
M18 M20 M22	27 mm 30 mm 33 mm	81 (110) 118 (160) 159 (215)	118 (160) 166 (225) 225 (305)	225 (305) 321 (435) 435 (590)	321 (435) 457 (620) 620 (840)
M24 M27 M30	36 mm 41 mm 46 mm	203 (275) 295 (400) 402 (545)	288 (390) 417 (565) 568 (770)	553 (750) 811 (1100) 1103 (1495)	789 (1070) 1154 (1565) 1571 (2130)
M33 M36	51 mm 55 mm	546 (740) 700 (950)	774 (1050) 992 (1345)	1500 (2035) 1925 (2610)	2139 (2900) 2744 (3720)

SEALANTS & LUBRICANTS

GASKETS/SEALANTS

Oil based PERMATEX #2 and it's HIGH TACK equivalent are excellent all purpose sealers. They are effective in just about any joint in contact with coolant, raw water, oil or fuel.

A light coating of OIL or LIQUID TEFLON can be used on rubber gaskets and O-rings.

LOCTITE hydraulic red sealant should be used on oil adapter hoses and the oil filter assembly.

Coat both surfaces of the oil pan gasket with high temp RED SILICONE sealer.

When installing gaskets that seal around water (coolant) passages, coat both sides with WHITE SILICONE grease.

High-copper ADHESIVE SPRAYS are useful for holding gaskets in position during assembly.

Specialized gasket sealers such as HYLOMAR work well in applications requiring non-hardening properties. HYLOMAR is particularly effective on copper cylinder-head gaskets as it resists fuel, oil and water.

Use LIQUID TEFLON for sealing pipe plugs and fillings that connect coolant passages. **Do not use tape sealants!**

BOLTS & FASTENERS/ASSEMBLIES

Lightly oil head bolts and other fasteners as you assemble them. Bolts and plugs that penetrate the water jacket should be sealed with PERMATEX #2 or HIGH TACK.

When assembling the flywheel, coat the bolt threads with LOCTITE blue.

Anti-seize compounds and thread locking adhesives such as LOCTITE protect threaded components yet allows them to come apart when necessary. LOCTITE offers levels of locking according to the job.

LITHIUM based grease is waterproof, ideal for water pump bearings and stuffing boxes.

Heavily oil all sliding and reciprocating components when assembling. **Always use clean engine oil!**

STANDARD AND METRIC CONVERSION DATA

LENGTH-DISTANCE

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

VOLUME

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

MASS-WEIGHT

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

PRESSURE

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

TORQUE

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

VELOCITY

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

POWER

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

FUEL CONSUMPTION

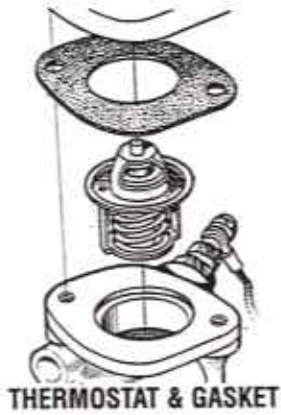
Miles Per Hour IMP (MPG) x .354 = Kilometers Per Liter (Km/L)
Kilometers Per Liter (Km/L) x 2.352 = IMP MPG
Miles Per Gallons US (MPG) x .425 = Kilometers Per Liter (Km/L)
Kilometers Per Liter (Km/L) x 2.352 = US MPG

TEMPERATURE

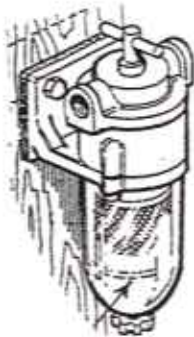
Degree Fahrenheit (°F) = (°C X 1.8) + 32
Degree Celsius (°C) = (°F - 32) x .56

SUGGESTED SPARE PARTS

CONTACT YOUR WESTERBEKE DEALER FOR SUGGESTIONS AND ADDITIONAL INFORMATION



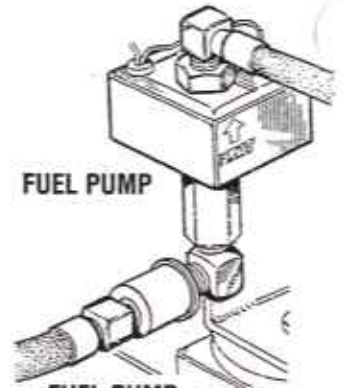
THERMOSTAT & GASKET



FUEL LINE FILTERS
(OWNER INSTALLED)



FUEL FILTERS



FUEL PUMP

**FUEL PUMP
INLET FILTER**



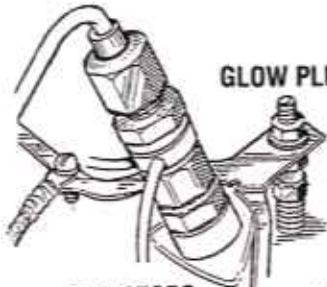
**AIR INTAKE
FILTERS**



OIL FILTERS

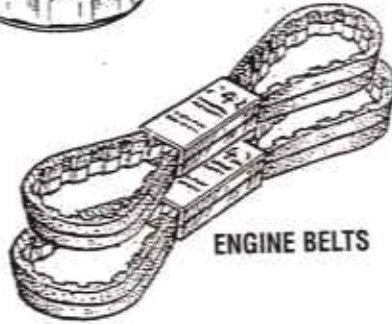


HARDWARE KIT

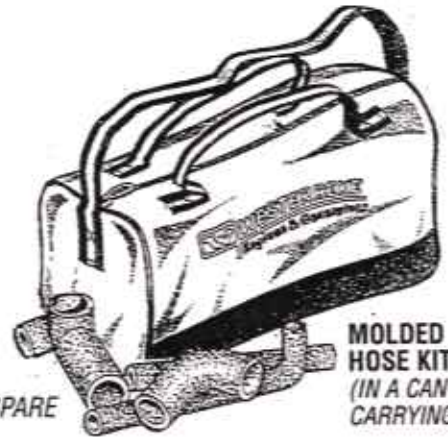


GLOW PLUGS

INJECTORS



ENGINE BELTS



**MOLDED
HOSE KIT**
(IN A CANVAS
CARRYING BAG)

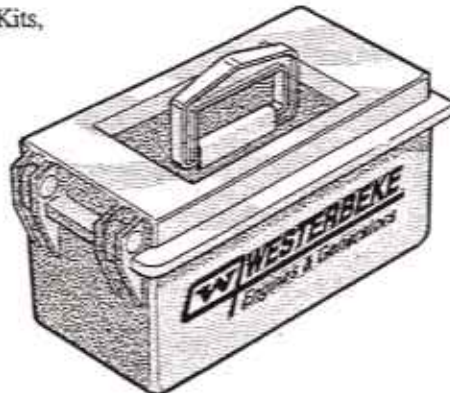
WESTERBEKE RECOMMENDS CARRYING ENOUGH SPARE ENGINE OIL (YOUR BRAND) FOR AN OIL CHANGE AND A GALLON OF PREMIXED COOLANT.

SPARE PARTS KITS

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

KIT A

DRIVE BELTS
OIL FILTER
FUEL FILTER
FUEL SYSTEM HARDWARE KIT
FUEL PUMP INLET FILTER



KIT B

DRIVE BELTS
OIL FILTER
FUEL FILTER
INJECTOR
OVERHAUL GASKET KIT
AIR FILTER
GLOW PLUG
FUEL SYSTEM HARDWARE KIT
FUEL PUMP INLET FILTER

WESTERBEKE
Engines & Generators



