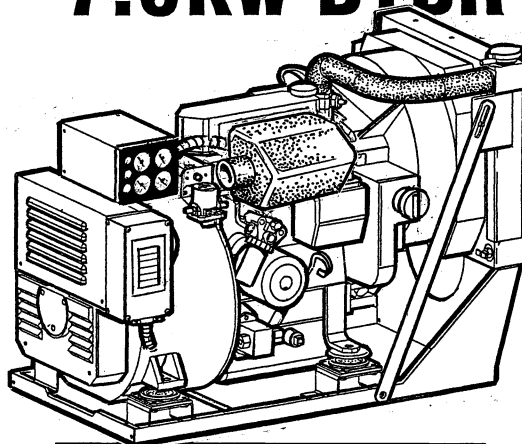




OPERATORS MANUAL
MOBILE and INDUSTRIAL
GENERATORS
5.0Kw BCDR / 5.0Kw BCDBR
7.6Kw BTDR



PUBLICATION NO. 041283
SECOND EDITION
APRIL 2006



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



Member National Marine Manufacturers Association

⚠ WARNING

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

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

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



A WARNING DECAL is provided by WESTERBEKE and should be fixed to a bulkhead near your engine or generator. WESTERBEKE also recommends installing CARBON MONOXIDE DETECTORS.

They are inexpensive and easily obtainable at your local hardware store

**CALIFORNIA
PROPOSITION 65 WARNING**

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.

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
 - Muscular twitching
 - Dizziness
 - Intense headache
 - Throbbing in temples
 - 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!

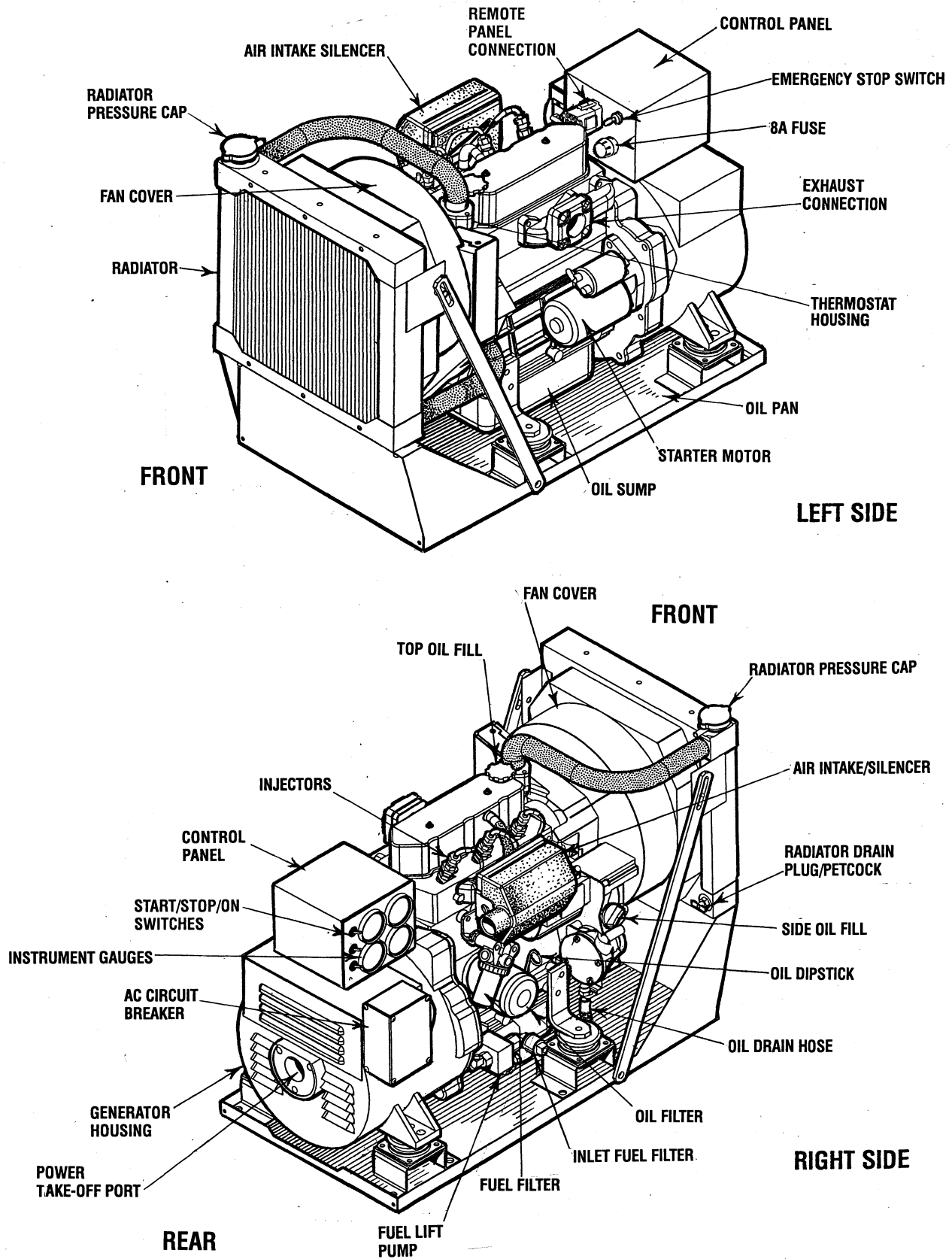
- Never operate an engine without its muffler installed.
- Do not run an engine with the air intake (silencer) removed.
- Do not run engines for long periods with their enclosures open.

⚠ 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 Ser. #

Expires

PRODUCT SOFTWARE

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NOTES, CAUTIONS AND WARNINGS

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

NOTE: *An operating procedure essential to note.*

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

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

INTRODUCTION

SERIAL NUMBER LOCATION

The engine 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.

FUEL, ENGINE OIL AND ENGINE COOLANT

FUEL

CAUTION: *Only use unleaded fuel with an octane rating of 89 or higher. Leaded fuel will cause serious harm to your engine and violate your warranty.*

Care Of The Fuel Supply

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

Purchase a well-known brand of fuel.

Install and regularly service a good, Coast Guard approved metal bowl type filter/water separator between the fuel tank and the engine.

ENGINE OIL

Use an engine oil regular or synthetic with an API classification of CF and/or CG-4. An oil viscosity rating of 15W-40 is recommended for all operating conditions. Change the engine lube oil and filter after the initial 50 hours of break-in operation and every 100 hours or less of operations thereafter.

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.*

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. It also lubricates and protects the cooling circuit from rust and corrosion. Use a good quality antifreeze that contains supplemental cooling additives (SCAs) that keep the antifreeze chemically balanced, crucial to long term protection.

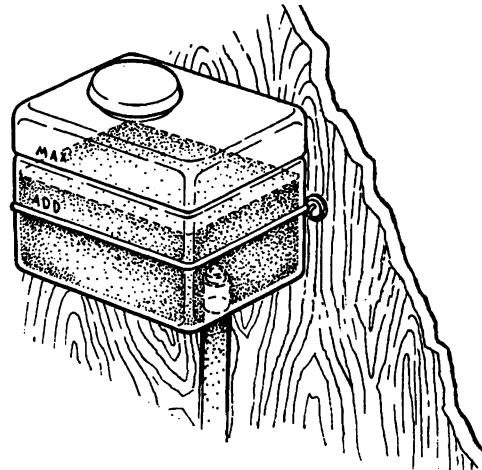
The water and antifreeze should be premixed before being poured into the cooling circuit.

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

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

COOLANT RECOVERY TANK

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



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.

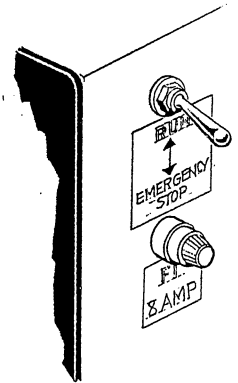
When the PREHEAT switch is depressed, the voltmeter, panel lights, gauges and meters and the hold coil of the fuel solenoid.

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 35 to 55 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

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

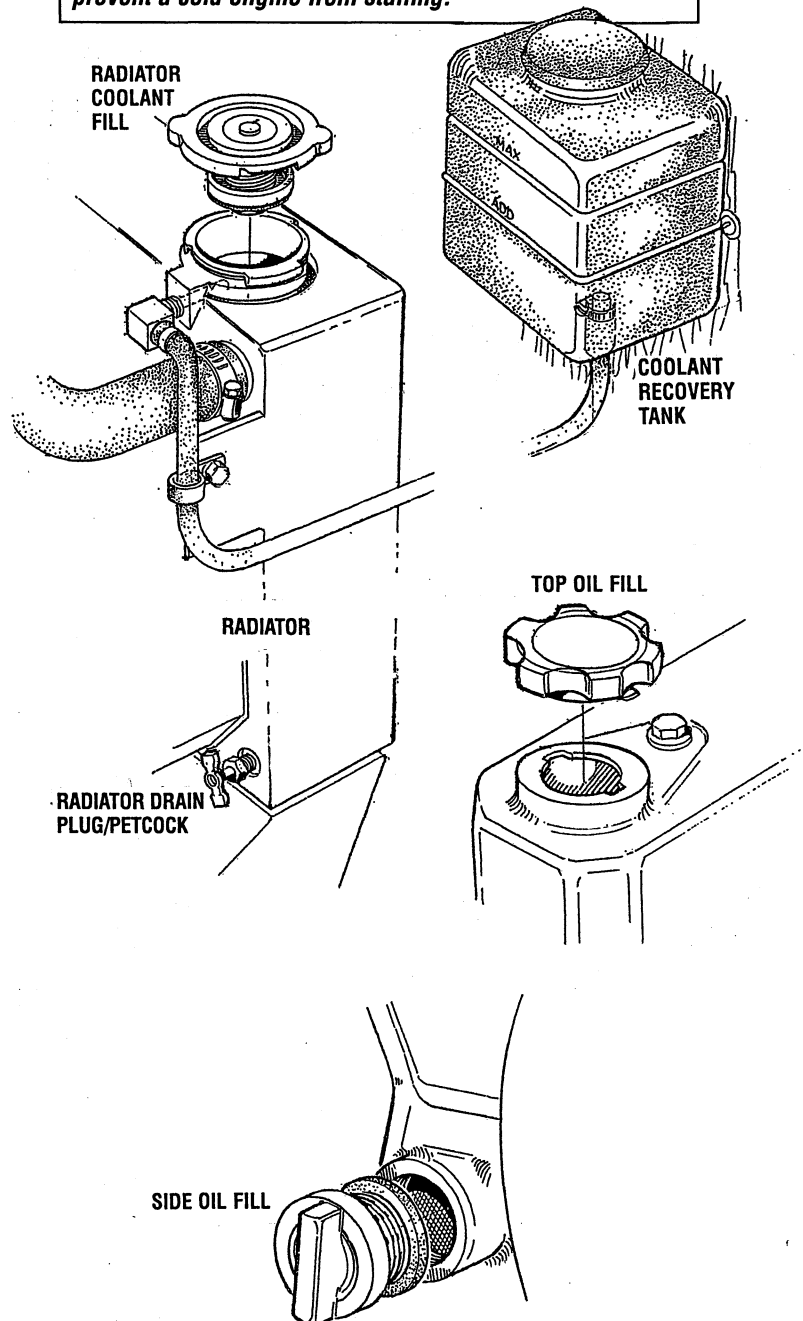
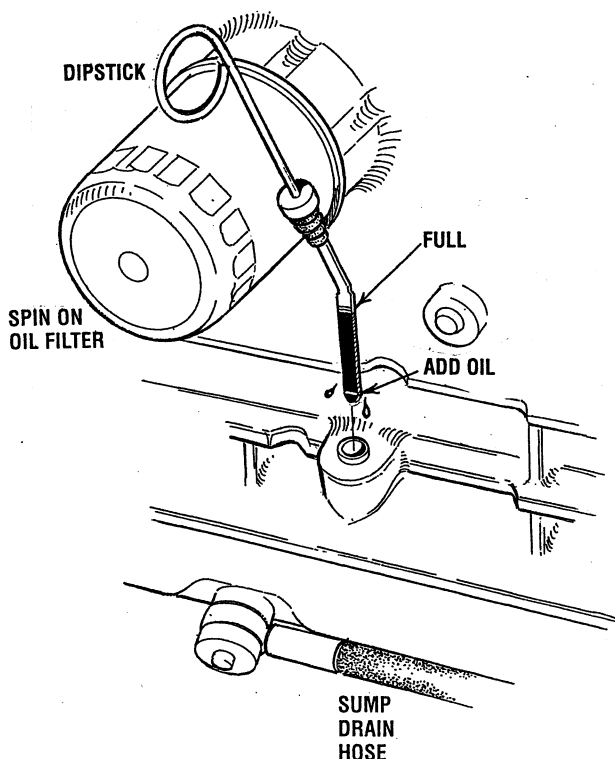
- Check the engine oil level. Add oil to maintain the level at the high mark on the dipstick.
- Check the fuel supply and examine the fuel filter/separator bowls for contaminants.
- Check the DC electrical system. Inspect wire connections and battery cable connections.
- Check the coolant level in both the plastic recovery tank and at the manifold.

NOTE: After the initial running of the generator, the air in the engine's cooling system should be purged through the plastic coolant recovery tank. Allow the engine to cool and then carefully remove the pressure cap on the radiator. Ensure that the radiator is completely full of antifreeze. If not, add mixture as needed to fill the radiator. Replace the pressure cap and then add antifreeze mixture to the plastic coolant recovery tank to fill it to half way between "add" and "max".

- Visually examine the unit. Look for loose or missing parts, disconnected wires, unattached hoses, and check threaded connections. Search for any leaks.
- 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 systems an incomplete or open neutral can supply the wrong line-to-neutral voltage on unbalanced loads.

⚠ 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.



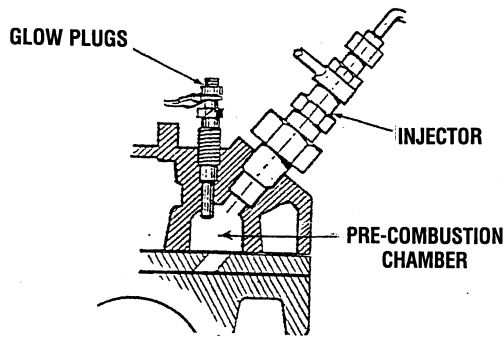
STARTING/STOPPING PROCEDURE

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 pre-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.

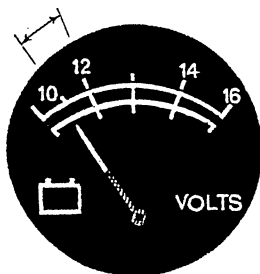


PREHEAT: Depress the PREHEAT switch. The voltmeter and panel lights, gauges and meters will be activated. The PREHEAT switch should be depressed in accordance with the following chart:

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.

A. When the PREHEAT switch is depressed at the remote start/stop panel the LED light will illuminate. When the START switch is depressed and the starter cranks the engine this LED light will dim. When the engine starts the LED light will brighten signaling to release the START switch. Continue to hold the PREHEAT depressed for a few seconds to allow oil pressure to build up which closes the oil pressure safety switch that is in the series path for 12V B+ to the K2 run relay/fuel run solenoid. The green LED will remain brightly illuminated while the engine is running.

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

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

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

STARTING/STOPPING PROCEDURE

STARTING UNDER COLD CONDITIONS

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

The battery should be fully charged to minimize voltage drop.

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

STOPPING PROCEDURE

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

Remote Stopping Procedure

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

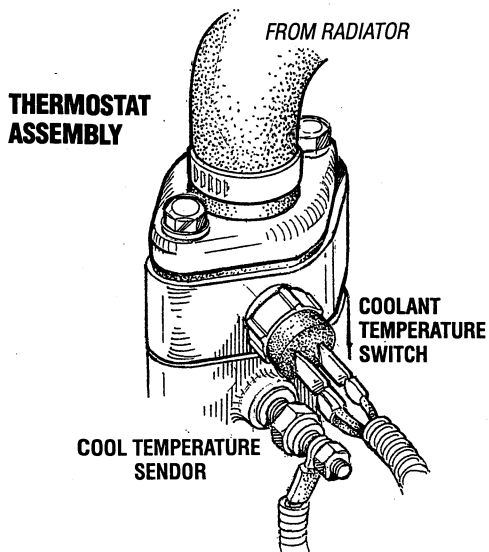
SAFETY SHUTDOWN SWITCHES

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:

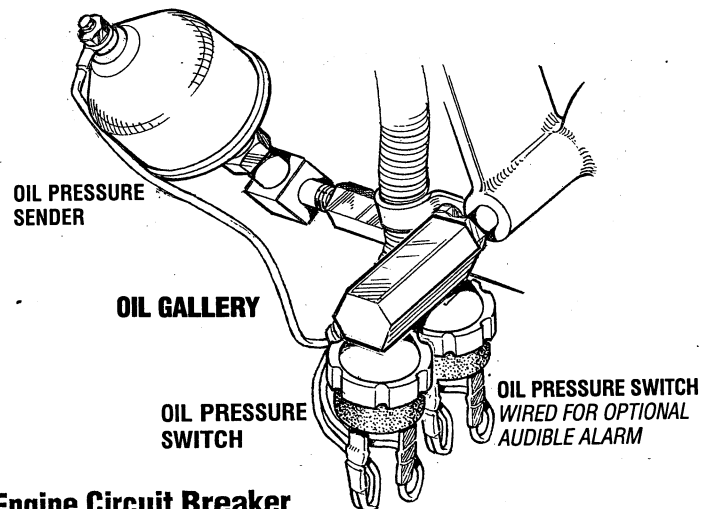
Coolant Temperature Switch

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 engine during the break-in period.

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

Start the engine according to the *STARTING PROCEDURE* section. Run the engine while checking that all systems (raw water pump, oil pressure, battery charging) are functioning. reach its full rated speed are signs of an overload.

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.

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

Avoid overload at all times. An overload is signaled by a smoky exhaust with reduced output voltage and frequency. Monitor the current being drawn from the generator and keep it within the generators' rating. Since the generator operates at 1800 rpm to produce 60 hertz, or at 1500 to produce 50 hertz, control of the generators engine break-in is governed by the current drawn from the generator.

NOTE: Be aware of motor starting loads and the high current drawn 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 governor adjustments required for engine speed (hertz) during the engine's break-in period (first 50 hours) or after this period (see *ENGINE SPEED (HERTZ) ADJUSTMENT* under *ENGINE ADJUSTMENTS*). A no-load voltage adjustment may also be required in conjunction with the engine's speed adjustment (see *GENERATOR INFORMATION*).

THE DAILY ROUTINE

CHECK LIST


Follow this checklist each day before starting your generator.

- Check that all generator circuit breakers (power panel) are in the off position before starting.
- Record the hourmeter reading in your log (engine hours relate to the maintenance schedule).
- Visually inspect the engine for fuel, oil, or water leaks.
- Check the oil level (dipstick).
- Check the coolant level in the coolant recovery tank.
- Check your fuel supply.
- Check the starting batteries (weekly).
- Check the drive belt for wear and proper tension (weekly).

CHECK WITH THE ENGINE RUNNING.

- Check for abnormal noise such as knocking, 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.

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

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

STOPPING THE GENERATOR

Remove the AC loads from the generator one at a time. Allow the generator to run for 3-5 minutes to stabilize the operating temperature, then turn the key to the off position. Once the generator is shutdown, close down all circuit breakers as a safety precaution.

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. 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 the system and that connections are tight and secure. Ensure that the muffler and piping are properly supported and not being affected by vibration or chaffing.
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.
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).
*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.

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 FILTERS

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

FUEL WATER SEPARATOR

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

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

FUEL INJECTION PUMP

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

The only adjustment the servicing mechanic should make to the fuel injection pump is the adjustment for the engines running 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 pump's mounting bolts should be clean and well secured by the mounting bolt to ensure proper pump operation.

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

INLET FUEL FILTER

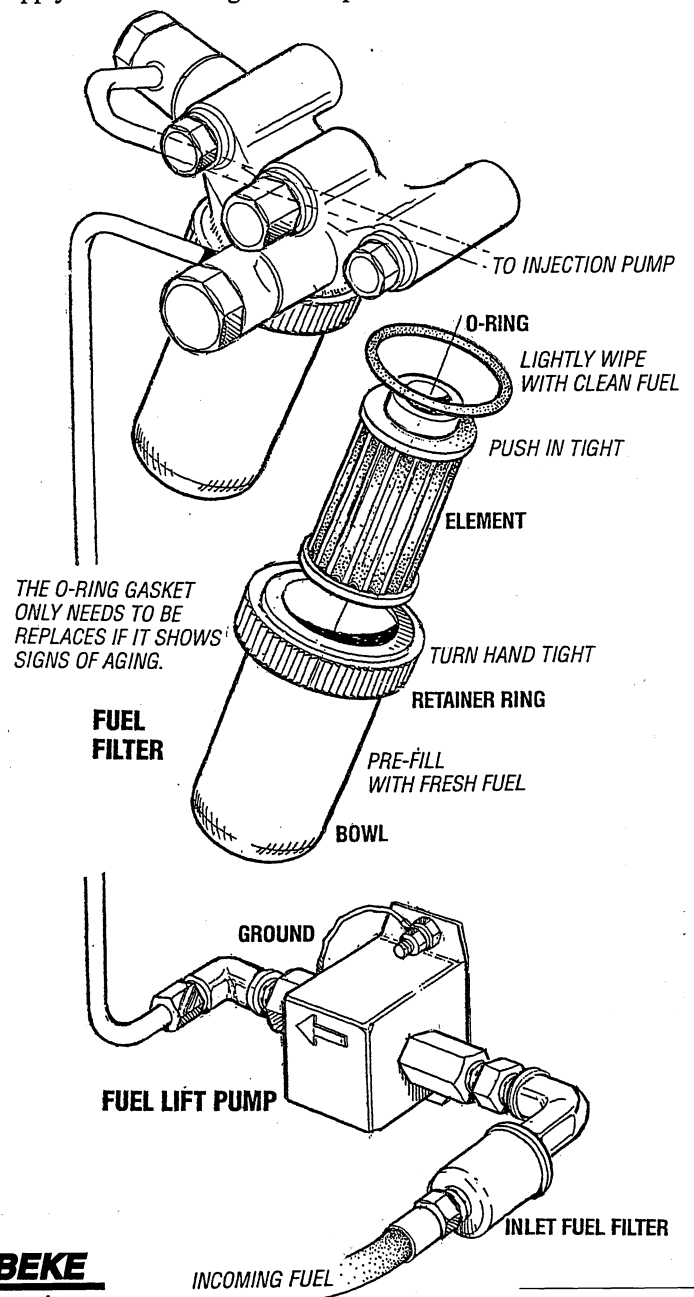
To ensure clean fuel into the fuel lift pump, there is a small in-line fuel filter connected to the fuel lift pump elbow. This filter should be replaced every 250 hours of operation.

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.



COOLING CIRCUIT

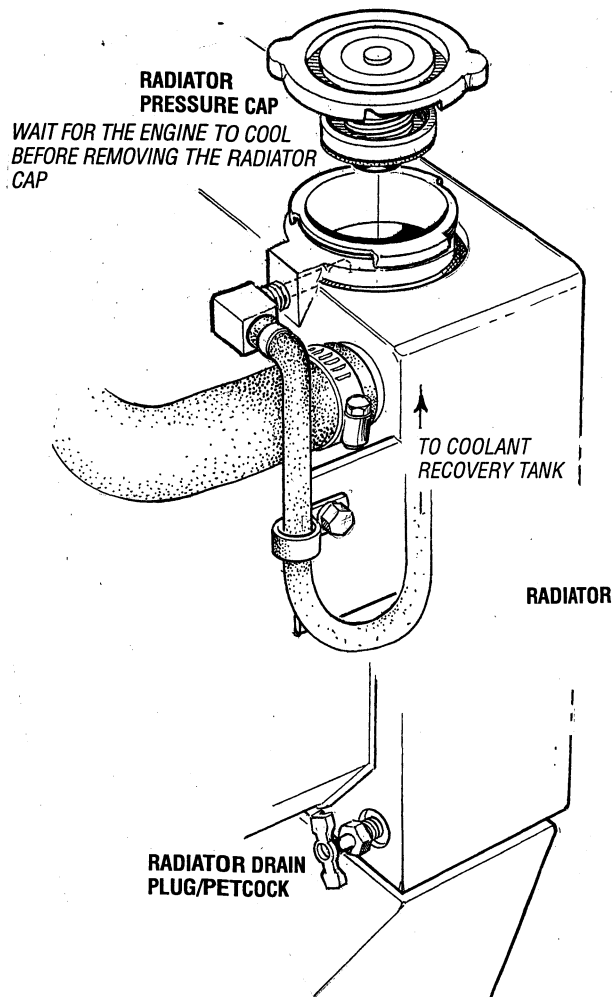
DESCRIPTION

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 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 from overheating). As the engine warms up, the thermostat gradually opens, allowing full flow of the engine's coolant to flow unrestricted to the external portion of the cooling system.

Coolant Recovery Tank

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

CHANGING COOLANT

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

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

Drain the engine coolant by removing the drain plug under the manifold and opening the manifold pressure cap. Flush the system with fresh water, then start the refill process.

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

Refilling the Antifreeze Coolant System

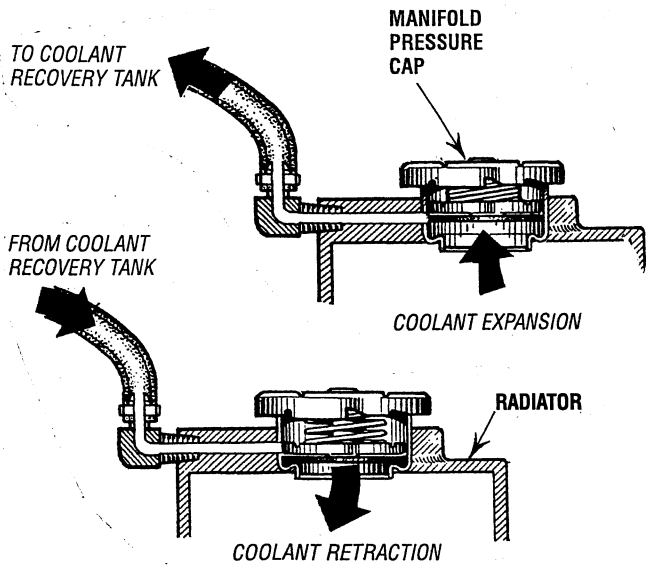
Re-install the engine block drain plug. Close the drain plug/petcock on the radiator. Pre-mix your antifreeze and add it to the radiator until the system is visibly near full.

Start the generator and continue to add the antifreeze mix as air is expelled. Observe the engine operating temperature. As the temperature nears 180°F. The thermostat should be opening and flow through the radiator observed.

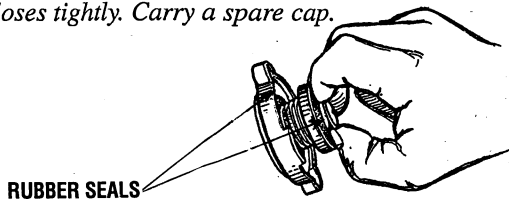
When all the air is expelled, top off the radiator and install the pressure cap, now add more antifreeze mixture to the remote recovery tank until half full.

Inspect the system for any leaks. Stop the engine and allow the system to cool down. Coolant in the plastic coolant recovery tank should be drawn into the engines cooling system. Add enough coolant to the recovery tank to place the level between the add and max marks.

ENGINE COOLING CIRCUIT



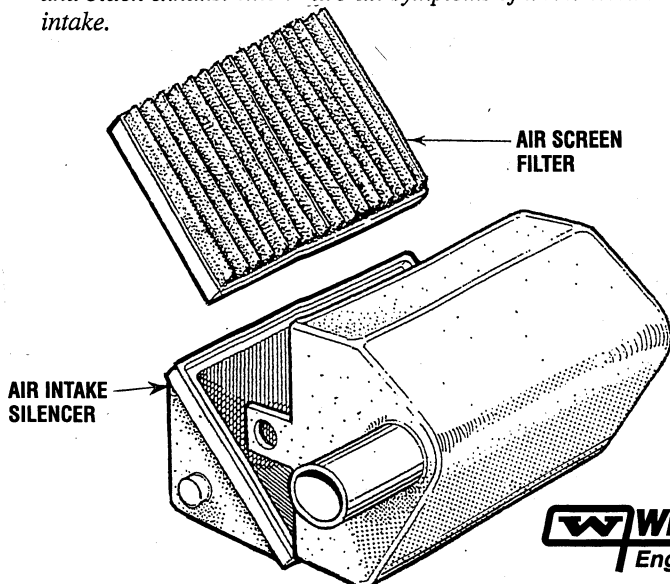
NOTE: Periodically check the condition of the radiator pressure cap. Ensure that the upper and lower rubber seals are in good condition and check that the vacuum valve opens and closes tightly. Carry a spare cap.



AIR INTAKE FILTER/SILENCER

There is a replaceable paper intake filter that should be inspected every 100 hours of unit operation or more frequently in dusty operating conditions. Contaminants in the filter can be shaken out or removed with the aid of compressed air. However, if this can not be accomplished the element/filter must be replaced.

NOTE: To operate efficiently a diesel engine must intake a continuous volume of clean air. Hard starting, an erratic idle, and black exhaust smoke are all symptoms of a restricted air intake.



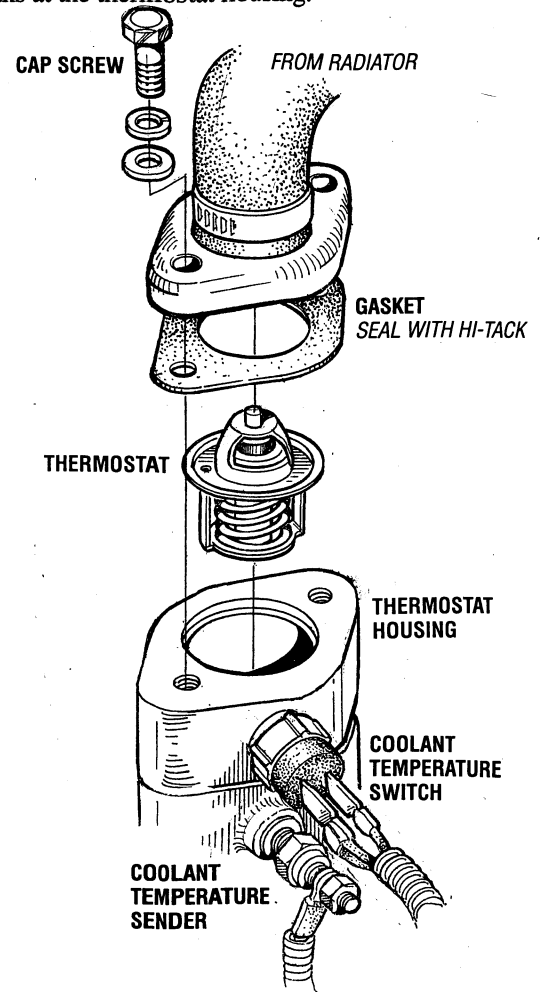
THERMOSTAT

A thermostat, located near the front of the engine, controls the engine's coolant temperature, as the coolant continuously flows through the engine's closed cooling system. When the engine is first started and the thermostat is closed, engine coolant bypasses the thermostat to provide proper circulation and cooling via a by-pass hose located between the circulating pump and below the thermostat. As the engine coolant reaches operating temperature, the thermostat gradually opens to allow coolant to flow through it. The thermostat is accessible and can be checked, cleaned or replaced as needed. Carry a spare thermostat and housing gasket.

To Replace the Thermostat

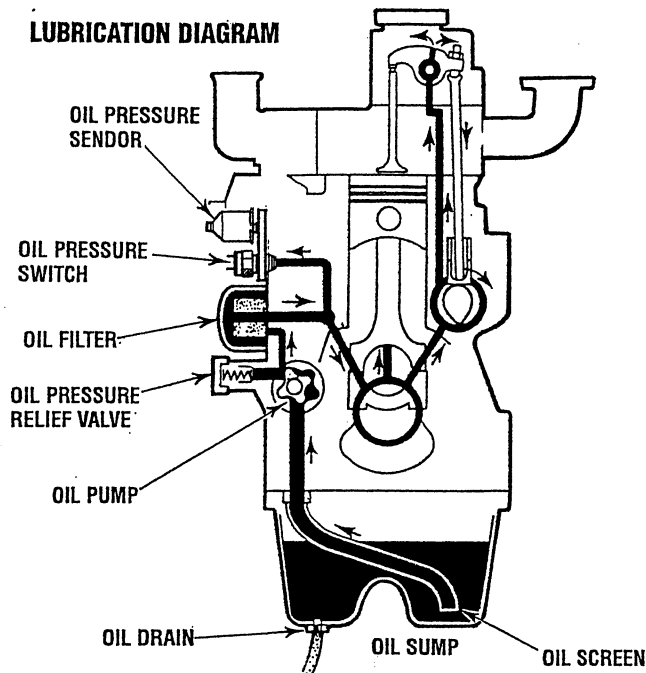
Remove the cap screws and disassemble the thermostat housing as shown. When installing the new thermostat and gasket, apply a thin coat of sealant on both sides of the gasket before pressing it into place. Do not over-tighten the cap screws.

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



ENGINE LUBRICATING OIL

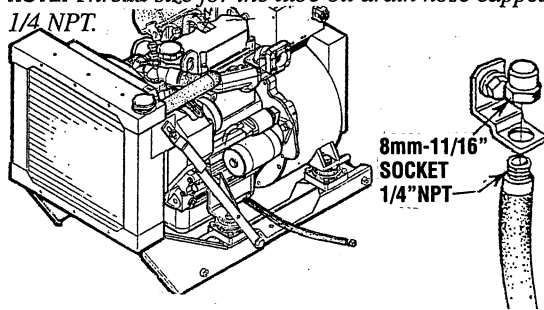
LUBRICATION DIAGRAM



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.

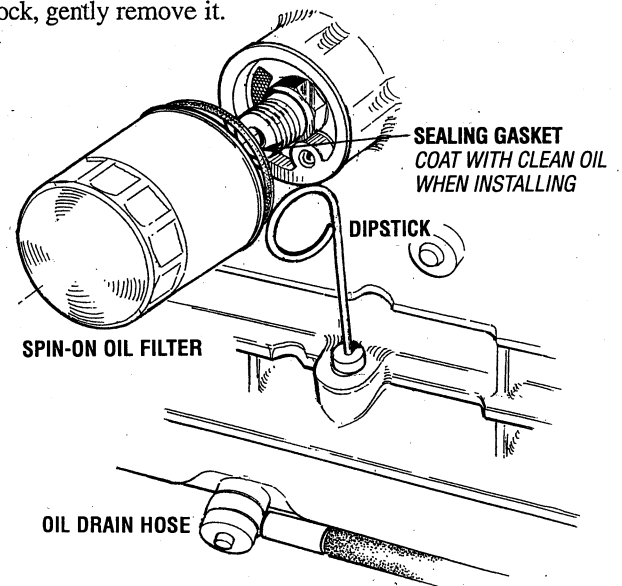


NOTE: During this procedure, fuel and oil may spill from the engine, have a suitable tray under the engine.

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 compartment.

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

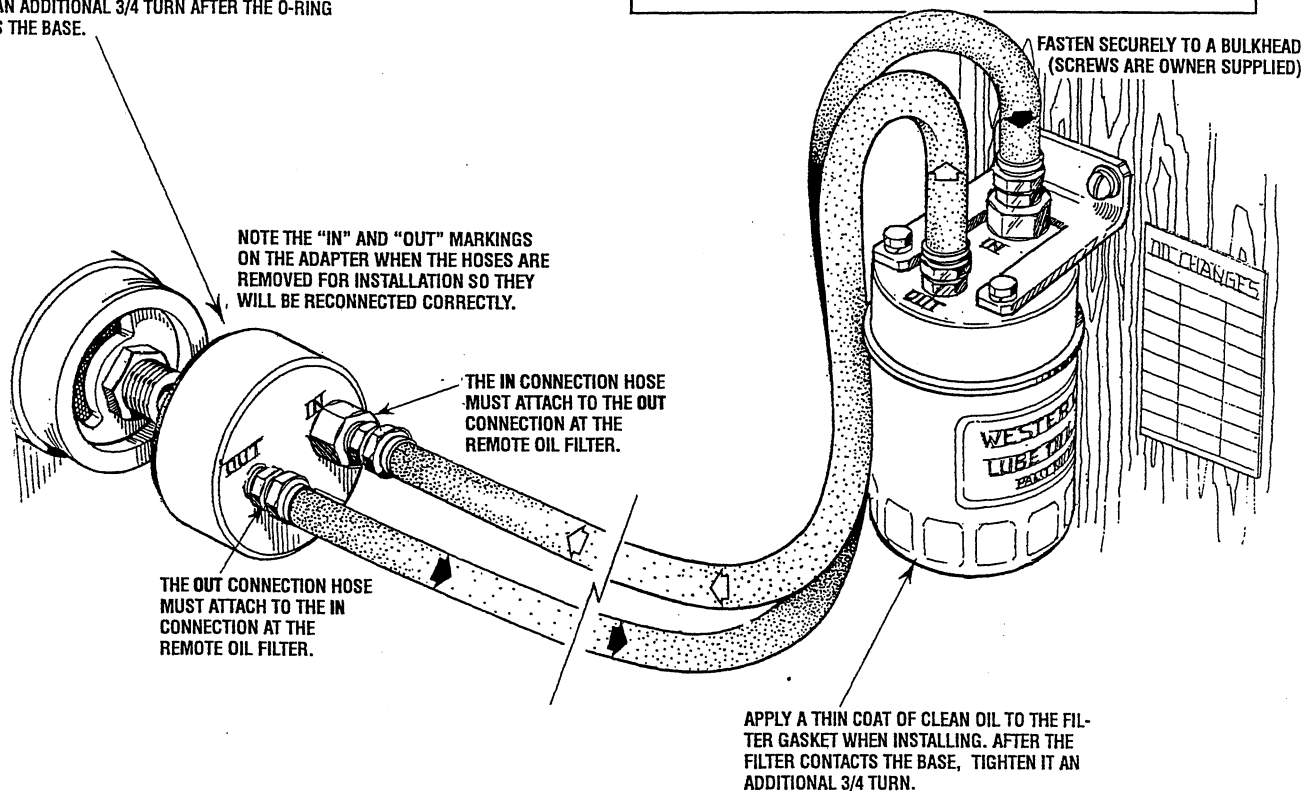
To install, simply remove the engine oil filter and thread on WESTERBEKE'S remote oil filter kit as shown. Always install this kit with the oil filter facing down as illustrated.

Contact your WESTERBEKE dealer for more information.

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

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

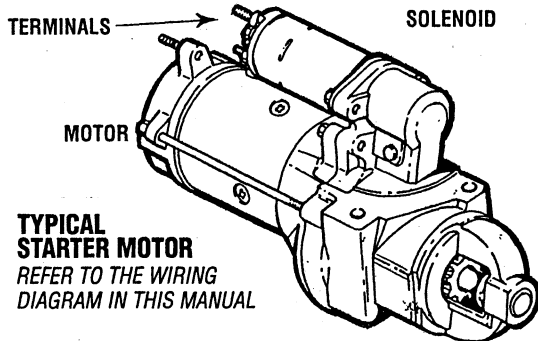
APPLY A THIN COAT OF CLEAN OIL TO THE O-RING WHEN INSTALLING THIS KIT. THREAD THE KIT ON, THEN HAND TIGHTEN AN ADDITIONAL 3/4 TURN AFTER THE O-RING CONTACTS THE BASE.



STARTER MOTOR

DESCRIPTION

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



TROUBLESHOOTING

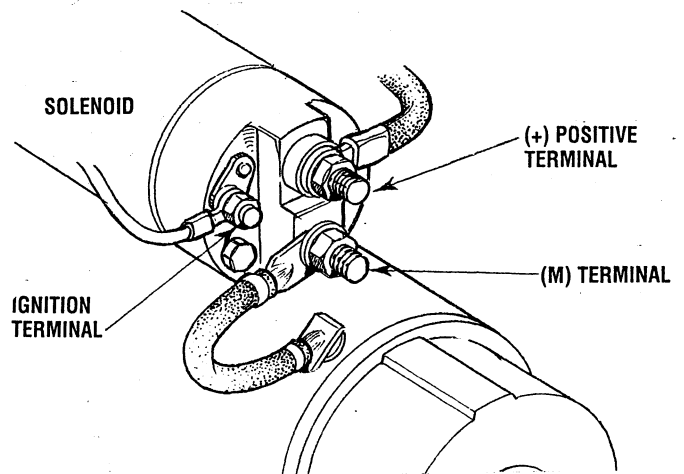
⚠ WARNING: *The following emergency starting procedures must not be used with gasoline engines. Sparks could cause an explosion and fire.*

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

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

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

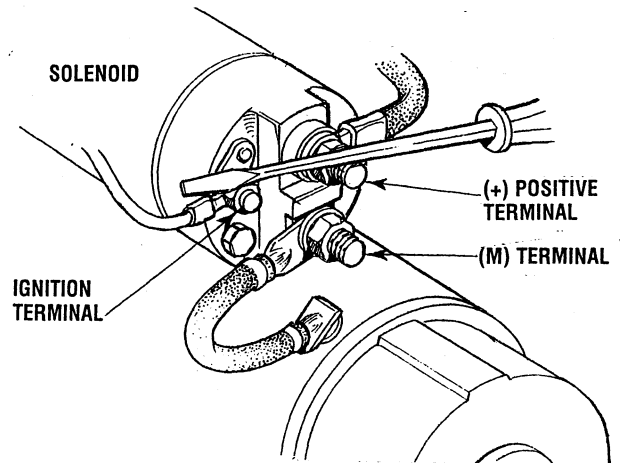
If you read 12 volts, the starter is faulty.



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

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

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

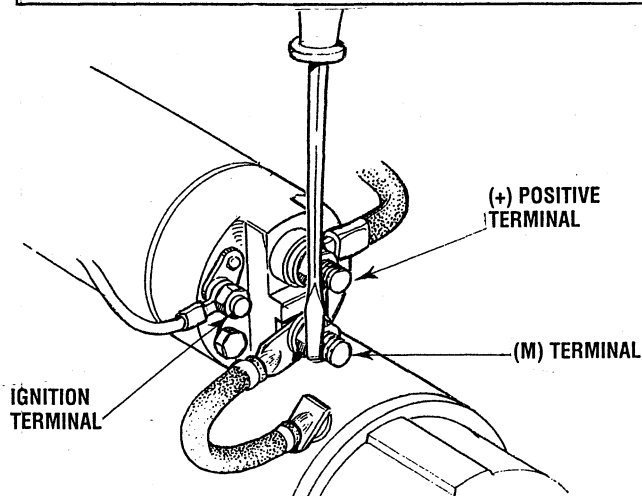


If nothing happens at all, the solenoid is not getting current.. Check the battery isolation switch and inspect the wiring connections. It is also possible that the solenoid is defective.

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

STARTER MOTOR

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



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

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

If the starter spins, the solenoid is faulty.

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

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

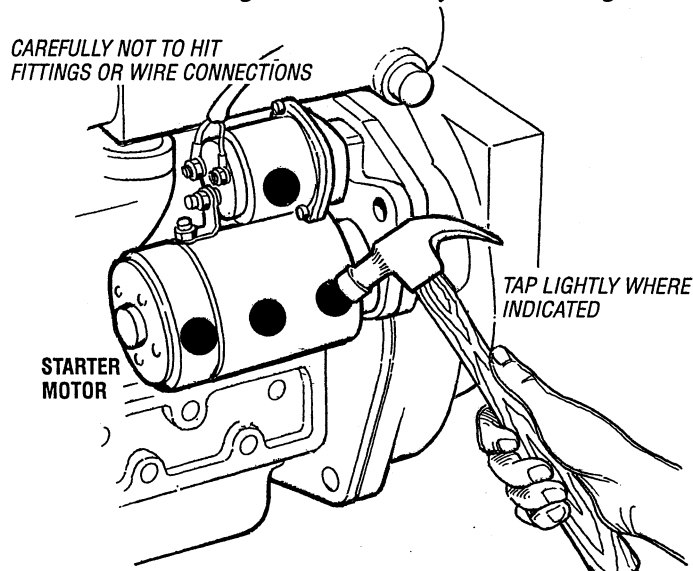
NOTE: Starter motors are either inertia type or pre-engaged. In the pre-engaged model, the solenoid also moves an arm that engages the starter motor to the flywheel of the engine. using a screwdriver to bypass the solenoid on such a starter will run the motor without engaging the flywheel.

EMERGENCY START

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

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

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



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

SERVICE

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

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

TO REMOVE FOR SERVICE

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

ENGINE TROUBLESHOOTING

The following troubleshooting table describes certain problems relating to engine service, the probable causes of the 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
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. 	<ol style="list-style-type: none"> 1. Check switch and/or battery connections. 2. Check emergency stop switch position. 2. Reset breaker; if breaker trips again, check preheat solenoid circuit and check circuit for shorts to ground. 3. Check K2 relay. 4. Check (+) connection to starter solenoid and (-) connection to engine ground stud. Check battery cable connections.
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. 	<ol style="list-style-type: none"> 1. Check connections. 2. Check that 12 volts are present at the (+) connection on the fuel run solenoid.
Generator engine cranks, but does not start, fuel solenoid energized.	<ol style="list-style-type: none"> 1. Faulty fueling system. 2. Preheat solenoid faulty. 	<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. 1d. Change inlet fuel filter. 2. Check solenoid.
Engine can't be stopped.	<ol style="list-style-type: none"> 1. Faulty DC alternator. 	<ol style="list-style-type: none"> 1. Remove "R" 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 voltmeter. Ensure 12 volts are present at the Exc. terminal.

ENGINE TROUBLESHOOTING

Problem	Probable Cause	Verification/Remedy
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 (32 KW only). 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 or collapsed muffler. 6. Pump water from fuel tank(s); change filters and bleed fuel system. 7. Check air intake filter cartridge.
Generator engine overheats/shuts down.	<ol style="list-style-type: none"> 1. Coolant not circulating. 	<ol style="list-style-type: none"> 1. Thermostat — remove and test in hot water. Replace thermostat. 1a. Loss of coolant — check hoses, hose clamps, drain plug, etc. for leaks. 1b. Broken or loose belts — tighten/replace. 1c. 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 starts, runs and shuts down	<ol style="list-style-type: none"> 1. Oil pressure switch. 2. Water temperature switch. 	<ol style="list-style-type: none"> 1. Check oil pressure switch. 2. Check water temperature switch.
Engine starts, runs at idle	<ol style="list-style-type: none"> 1. Electronic governor system faulty (optional system) 	<ol style="list-style-type: none"> 1. Check governor system components.

ENGINE ADJUSTMENTS

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

DRIVE BELT ADJUSTMENT (FAN BELT)

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

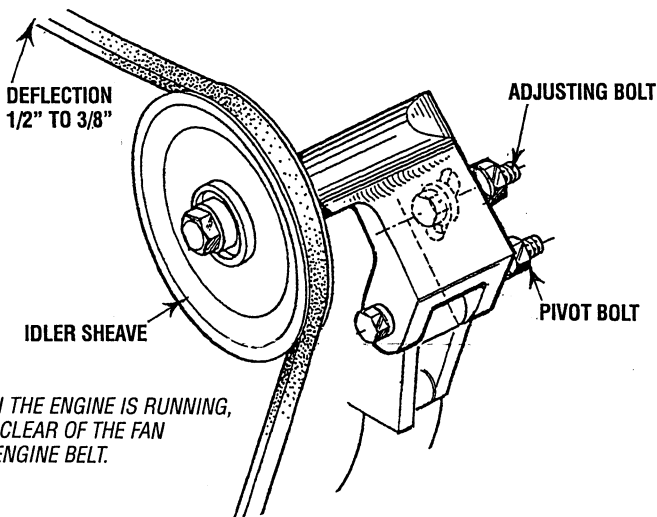
Excessive drive belt tension can cause rapid wear of the belt and reduce the service life of the fresh water pump's bearing. A slack belt or the presence of oil on the belt can cause belt slipping, resulting in high operating temperatures.

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

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

Adjusting Belt Tension

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



TORQUING THE CYLINDER HEAD BOLTS

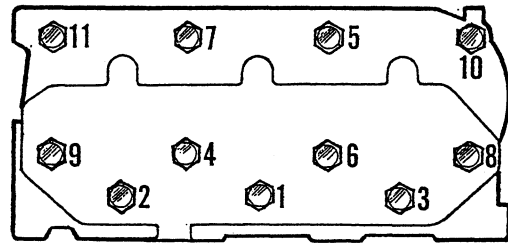
After the initial break-in period (approximately 50 hours) and every 500 hours thereafter, the cylinder head bolts should be re-torqued.

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

Bolts #1, 2, and 3, (12mm socket) 14 – 22 ft-lb

Bolts #4, 5, 6, 7, 8, (14mm socket) (54 – 61 ft-lb)

Rockershaft Hold Down Bolts - 12mm socket (11 – 16 ft-lb).



CYLINDER HEAD BOLT PATTERN

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)

ENGINE ADJUSTMENTS

VALVE CLEARANCE ADJUSTMENT

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

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

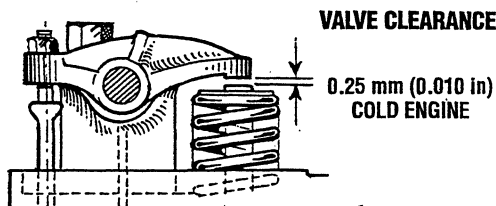
Pull off the air breather pipe from the rocker cover and take off the rocker cover bolts and the rocker cover to expose the rocker shaft and valve assembly.

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

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

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

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



Adjust the valves in #1 cylinder for both intake and exhaust. Proceed to the next cylinder in the firing order.

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

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

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

ENGINE COMPRESSION

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

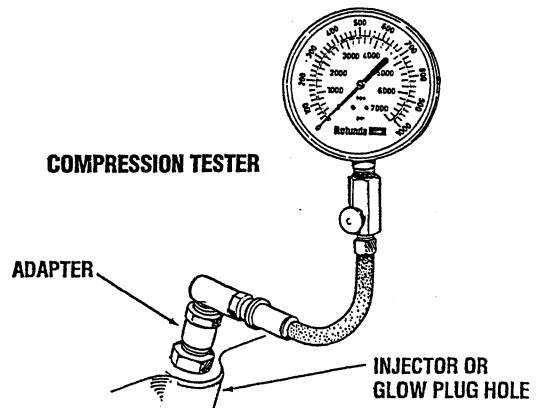
Standard compression pressure 398 lb/in² at 280 rpm (28.0 kg/cm²)

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

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

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

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



ENGINE ADJUSTMENTS

GLOW PLUGS

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

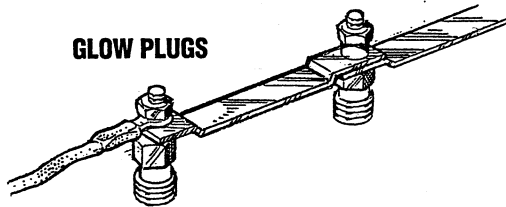
INSPECTION

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

TESTING

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

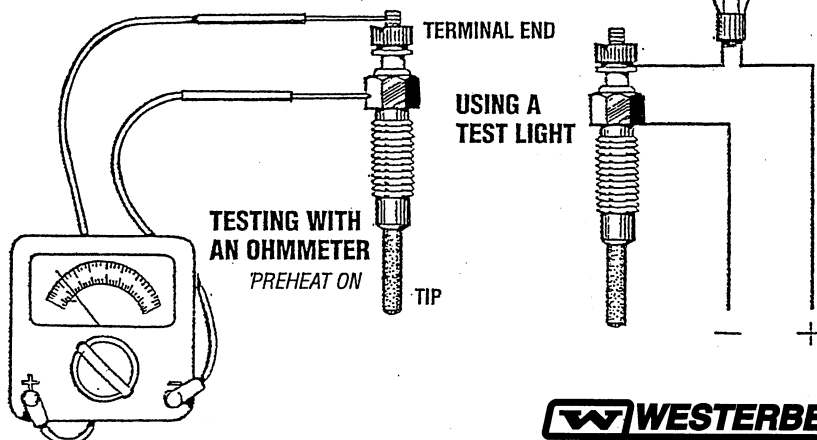
WARNING: These glow plugs will become very hot to the touch. Be careful not to burn your fingers when testing the plugs.



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

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

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



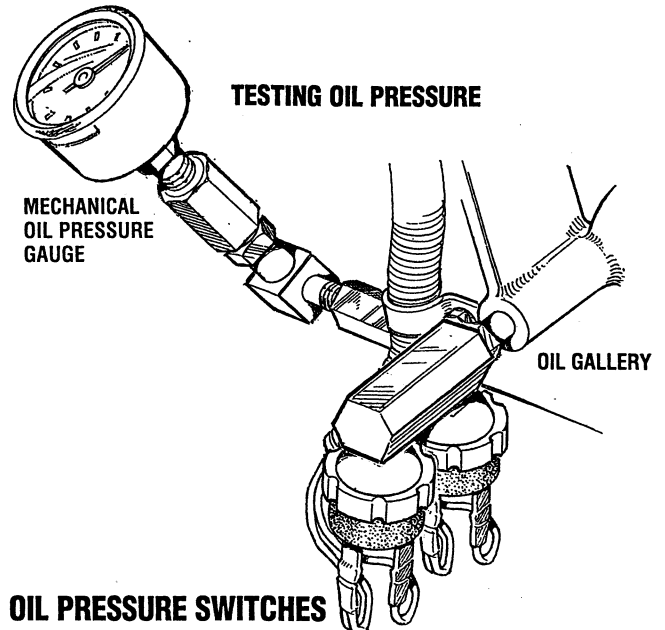
OIL PRESSURE

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 - 55 lb/in² (2.5 - 3.8 kg/cm²)

LOW OIL PRESSURE

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



OIL PRESSURE SWITCHES

There are two oil pressure switches. One is wired to the automatic shutdown circuit (see safety shutdown switches) to protect the engine from a sudden loss of oil or very low oil pressure.

The other oil pressure switch is available for connecting to an (optional) audible alarm that would sound a low pressure alarm (before the shutdown switch activates and shuts the engine down).

Note that this audible alarm will sound momentarily when the engine is started and sound again when the engine is shut off. This occurs as the oil pressure drops below 10 psi.

ENGINE ADJUSTMENTS

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

Injection Pump Timing Adjustment (Spill Timing)

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

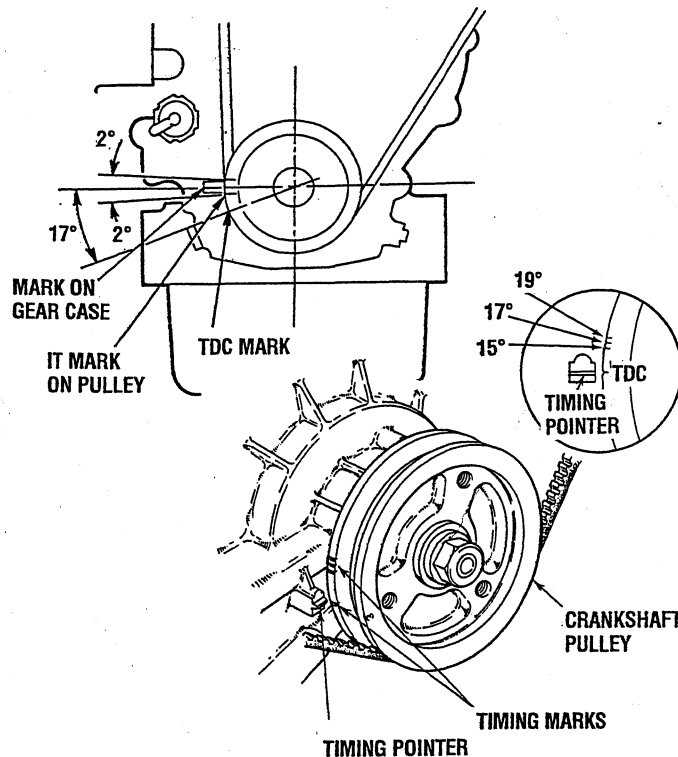
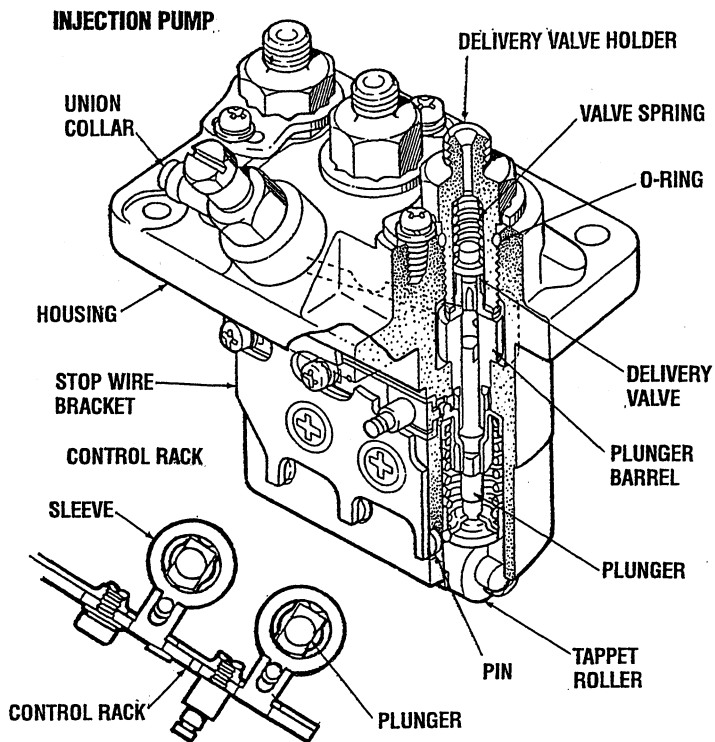
NOTE: The injection pump fuel rack needs to be in the full fuel delivery position when performing this spill timing. To do this, unscrew the fuel shut off solenoid and remove the side cover to expose the injection pump fuel rack. Manually move the fuel rack to the full fuel delivery position (move fully to the left) secure it in this position then proceed.

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

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

Move the throttle lever to its full open position and operate the electric lift pump. Slowly rotate the crankshaft clockwise (as viewed from the front), catching the fuel from the No. 1 fuel line, until the instant the fuel completely stops flowing (no drips). At this instant, the 11° BTDC timing mark on the crankshaft pulley should be directly aligned with the timing indicator on the front of the gear case ± .5 degrees.

If the specified injection timing (11° BTDC) cannot be attained, adjust the timing by increasing or decreasing the thickness of shim material under the injection pump's mounting flange to change the injection timing point. Changing the shim thickness by 0.004 inch (0.01mm) changes the injection timing by approximately one degree. To advance the timing, decrease the shim thickness, as required. To retard the timing, increase the shim thickness, as required. Refer to your Generator's Parts List for shim part numbers.



ENGINE ADJUSTMENTS

GENERATOR FREQUENCY ADJUSTMENT (HERTZ)

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

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

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

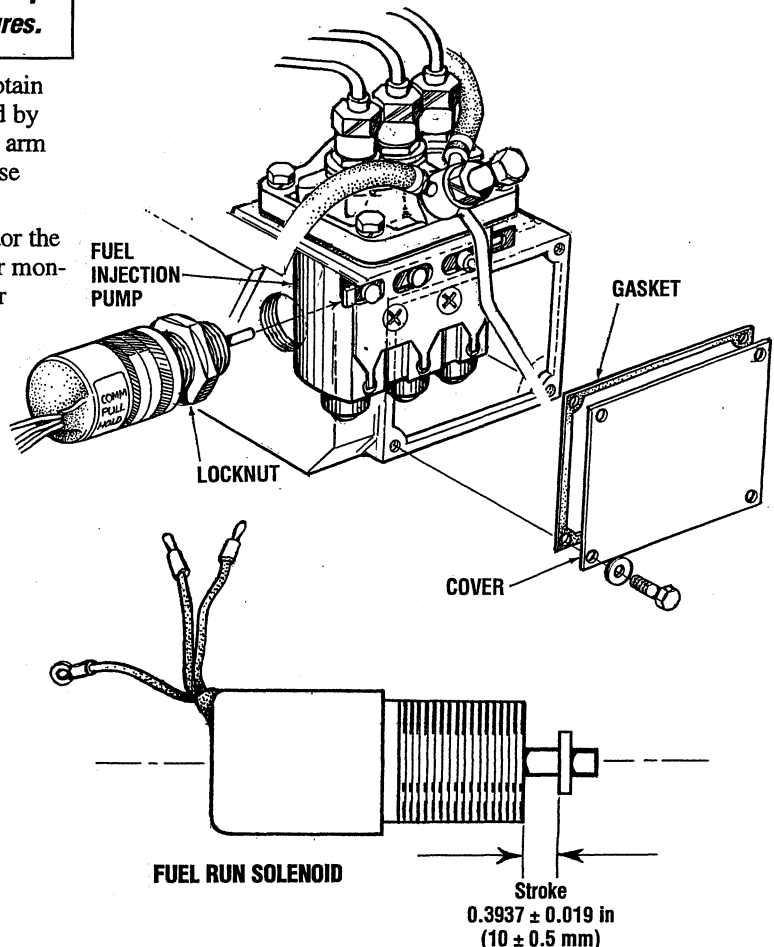
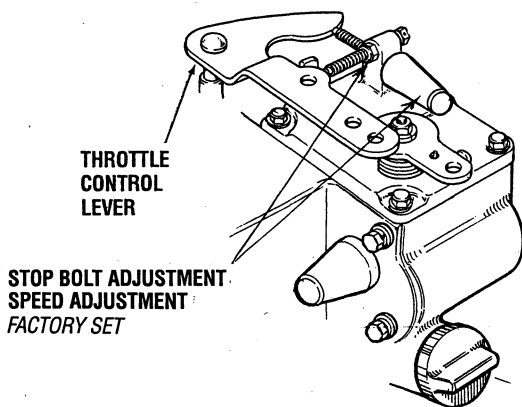
When the generator is run at 1500 rpm, the AC voltage output frequency is 50 Hertz.

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

1. With the engine stopped, connect the AC output leads to the AC terminal block in accordance with the AC voltage connections diagram specified for your generator set, and change the Hertz circuit connection to the capacitor. These connections are shown in the GENERATOR section of this manual.

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

2. Start the engine and adjust the engine's speed to obtain the frequency corresponding to the voltage selected by adjusting the stop bolts and positioning the throttle arm against these stop bolts to either increase or decrease engine no-load speed to adjust the Hertz produced.
3. To arrive at the appropriate frequency, either monitor the speed of the engine/generator with a tachometer, or monitor the frequency with a frequency meter, the latter method being the more precise of the two.



FUEL RUN SOLENOID

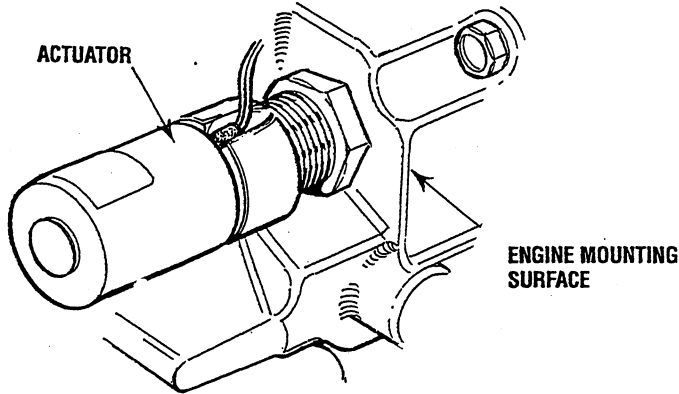
The fuel run solenoid is mounted in a threaded hole on the engine's block just aft of and below the engine's fuel injection pump. Proceed as follows when installing a replacement or new fuel run solenoid.

1. Visual access to the fuel injection pump's fuel rack is needed. To obtain this, remove the small square side cover and gasket just below the fuel injection pump.
2. Thread the locknut onto the solenoid and then apply a small amount of Teflon sealant to the threads on the solenoid.
3. Thread the solenoid into the hole on the engine and observe the solenoid plunger through the cover opening. Allow the plunger to contact the fuel rack and move fully into the injection pump. Do not thread further so as to push the plunger into the solenoid.
4. Back the solenoid out 1/4 - 1/2 of a turn and secure it in position with the locknut.
Locknut Torque Value 28.9 - 36.2 ft-lb (4.0 - 5.0 m-kg)
5. Properly connect the three electrical leads from the solenoid. Two of the connections plug into the engine harness and the third grounds to the engine block at an adjacent inboard threaded hole with an 8mm bolt.
6. Reassemble the cover and gasket and test run the unit. Make certain that the unit stops when the solenoid is de-energized.

ENGINE ADJUSTMENTS

ELECTRONIC GOVERNOR (OPTIONAL)

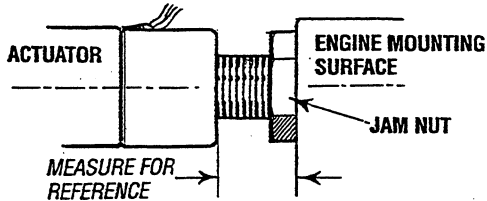
The Electronic Governor regulates the engine speed by sensing the engine's RPM with a magnetic pick-up at the flywheel. The governor's controller continuously monitors the engine's speed and if there is any discrepancy, the controller signals the actuator and the actuator adjusts the engine to the desired speed electronically.



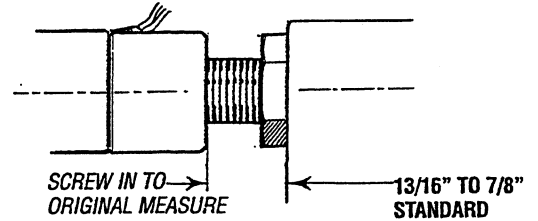
Actuator

The following instructions are for adjusting or replacing the actuator.

1. Shut-off the DC power to the generator.
2. Disconnect the actuator wires from the wiring harness.
3. Measure the distance between the actuator and the engine mounting surface as shown.



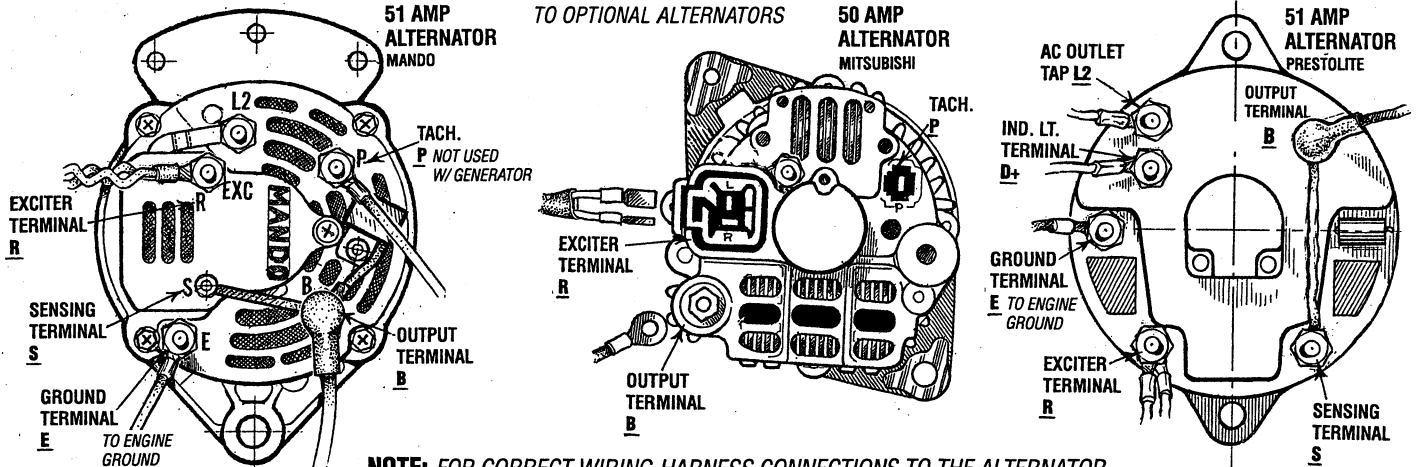
4. Back-off the 1 7/16" jam nut and unscrew the actuator.
5. Apply a small amount of teflon sealant to the replacement actuator and screw the actuator into the engine's mounting boss. Maintain the same distance between the actuator and the engine mounting surface as previously measured. Secure the actuator's position with the jam nut. (The standard distance is 13/16" to 7/8").
6. Reconnect the actuator wires and test the unit.



NOTE: For additional information and *Electronic Governor Troubleshooting*, refer to your *WESTERBEKE Service Manual*.

7.6KW BTRD GENERATOR ONLY ALTERNATORS TESTING/TROUBLESHOOTING

SEE WIRING DIAGRAM
FOR WIRE CONNECTIONS
TO OPTIONAL ALTERNATORS



NOTE: FOR CORRECT WIRING HARNESS CONNECTIONS TO THE ALTERNATOR, REFER TO THE WIRING DIAGRAMS IN THIS MANUAL.

DESCRIPTION

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

NOTE: The 5.0KW BCDR generator is not equipped with a belt driven DC alternator. Battery charging is accomplished by a battery charge circuit that is an integral part of the AC generator. This circuit supplies up to a 17 amp charge to the engine's starting battery. This circuit is protected by a 30 amp buss fuse.

ELECTRICAL CHARGING CIRCUIT

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

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

ALTERNATOR DESCRIPTION

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

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

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

VOLTAGE REGULATOR

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

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

ALTERNATOR TROUBLESHOOTING

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

LOW BATTERY/FAULTY CIRCUIT

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

A simple test is to try starting again lights on, if the light dims significantly or goes out, the battery is dead. If the light remains bright, look for a poor connection in the starting circuit.

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

ALTERNATORS TESTING/TROUBLESHOOTING

PRELIMINARY INSPECTION

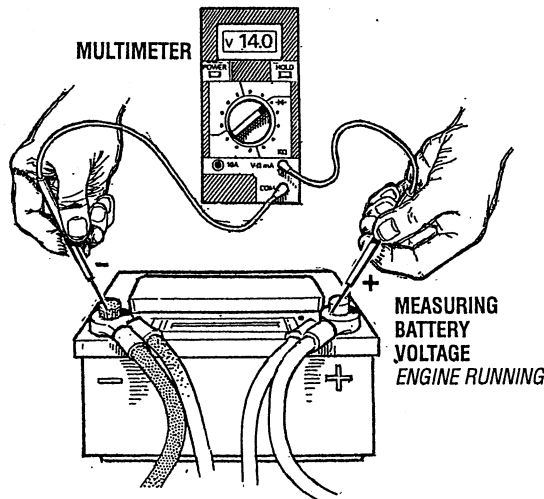
Before starting the actual alternator and voltage regulator, testing the following checks are recommended.

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

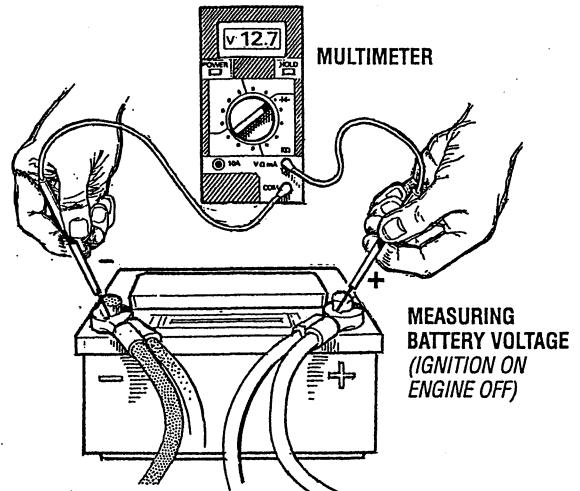
TESTING THE ALTERNATOR

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

1. Start the Engine.
2. After the engine has run for a few minutes, measure the starting battery voltage at the battery terminals using a multimeter set on DC volts.
 - a. If the voltage is increasing toward 14 volts, the alternator is working.
 - 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.



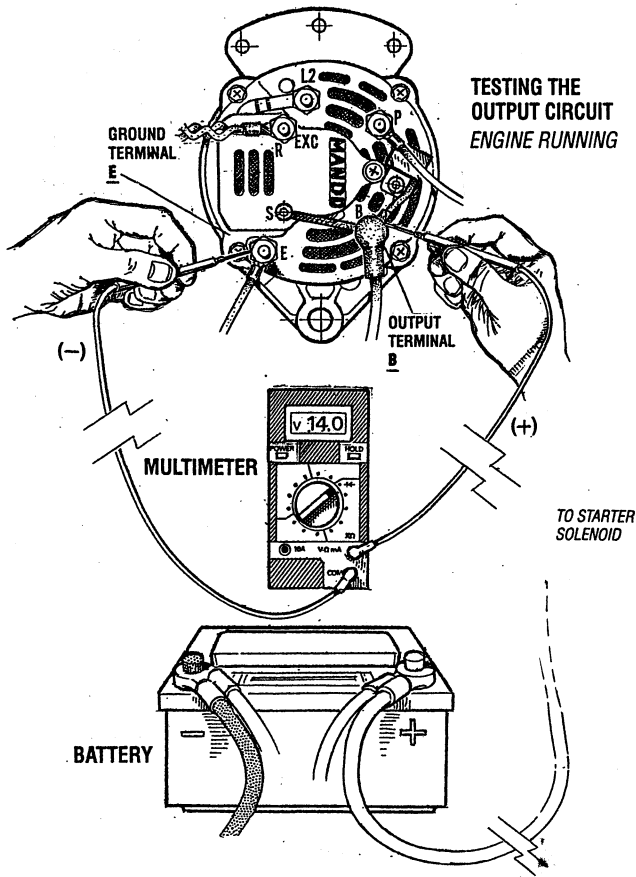
3. Turn off the engine. Inspect all wiring and connections. Ensure that the battery terminals and the engine ground connections are tight and clean
5. Turn on the ignition switch, but do not start the engine.
6. Check the battery voltage. If your battery is in good condition the reading should be 12 to 13 volts.



TESTING THE OUTPUT CIRCUIT

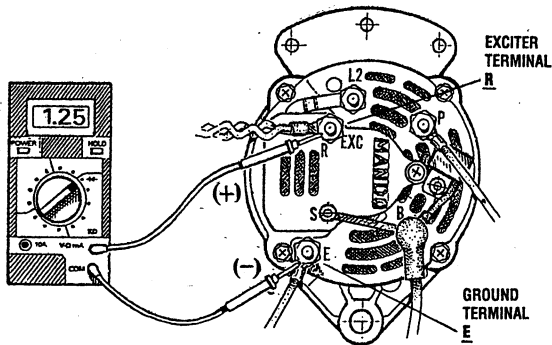
1. Connect the positive probe to the output terminal **B** and connect the negative probe to the ground terminal **E** on the alternator.
2. Wiggle the engine wiring harness while observing the voltmeter. The meter should indicate the approximate battery voltage, and should not vary. If no reading is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

ALTERNATORS TESTING/TROUBLESHOOTING

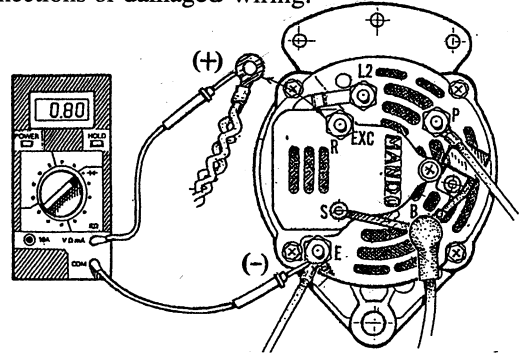


TESTING THE EXCITATION CIRCUIT

1. Connect the positive (+) multimeter probe to the excitation terminal **R** on the alternator and the negative (-) lead to the ground terminal **E** on the alternator.
2. Turn the ignition switch to the on position and note the multimeter reading. The reading should be 1.3 to 2.5 volts (see illustration).
3. If the reading is between .75 and 1.1 volts, the rotor field circuit probably is shorted or grounded.
4. If the reading is between 6.0 and 7.0 volts, the rotor field circuit probably is open



5. If no reading is obtained, an open exists in the alternator-excitation lead or in the excitation circuit of the regulator. Disconnect the lead from exc terminal **R**. Connect the positive multimeter probe to the excitation lead and the negative multimeter probe to ground terminal **E**. If the multimeter now indicates an approximate battery voltage, the voltage regulator is defective and must be replaced. If no voltage is indicated, check the excitation circuit for loose or dirty connections or damaged wiring.



ALTERNATOR REPAIR

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

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

BATTERY CARE

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

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

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

SPECIFICATIONS

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

DC CIRCUIT/BATTERY

BATTERY CHARGING

The DC Circuit functions to start, operate and stop the generator's engine. The circuit is best understood by reviewing the DC Wiring Diagram and Wiring Schematic. The engine's DC wiring is designed with three simple basic circuits: start, run and stop.

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

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

SPECIFICATIONS

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

BATTERY CHARGING CIRCUIT

NOTE: *The 5.0KW BCDR generator is not equipped with a belt driven DC alternator. Battery charging is accomplished by a battery charge circuit that is an integral part of the AC generator. This circuit supplies up to a 17 amp charge to the engine's starting battery. This circuit is protected by a 30 amp buss fuse.*

NOTE: *This charge circuit should not be used for any other purpose than maintaining the engine dedicated starting battery.*

Additional information on this charge circuit is found in the *BC GENERATOR* section of this manual.

TESTING THE CIRCUIT

If the battery is not charging, check the fuse. To test the circuit, remove the fuse and test with a voltmeter between the fuse holder connection and the ground. With the engine running, it should indicate 13-14 volts. If only the battery voltage is indicated, check the terminal connections at the battery.

BATTERY MAINTENANCE

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

- 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.

ALTERNATOR INSPECTION (7.6 BTDR)

The alternator should be cleaned and inspected. the housing can be wiped off with a solvent and the alternator terminal studs should be cleaned with a wire brush. Make certain those studs are tight. Also clean the wiring connections that connect to the wiring harness.

Turn the rotor pulley by hand. It should turn smoothly.

Depending on when the alternator was last serviced, the brushes may need replacing. If the alternator is at all suspect, send it to a service shop for testing and overhaul.

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.

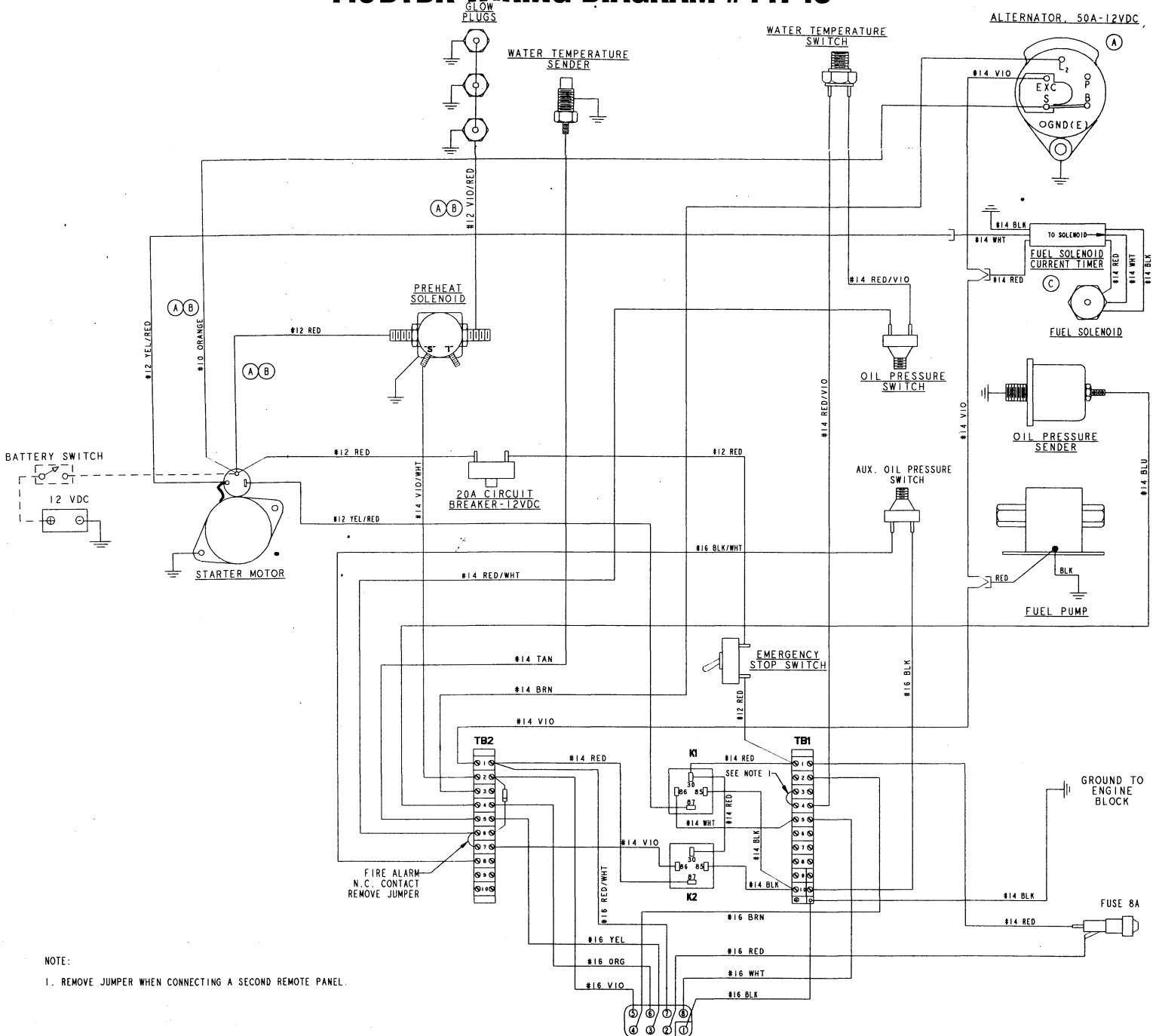
If both of the above gauge tests are positive, the gauge is undoubtedly OK and the problem lies either with the conductor from the sender to the gauge or with the sender.

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

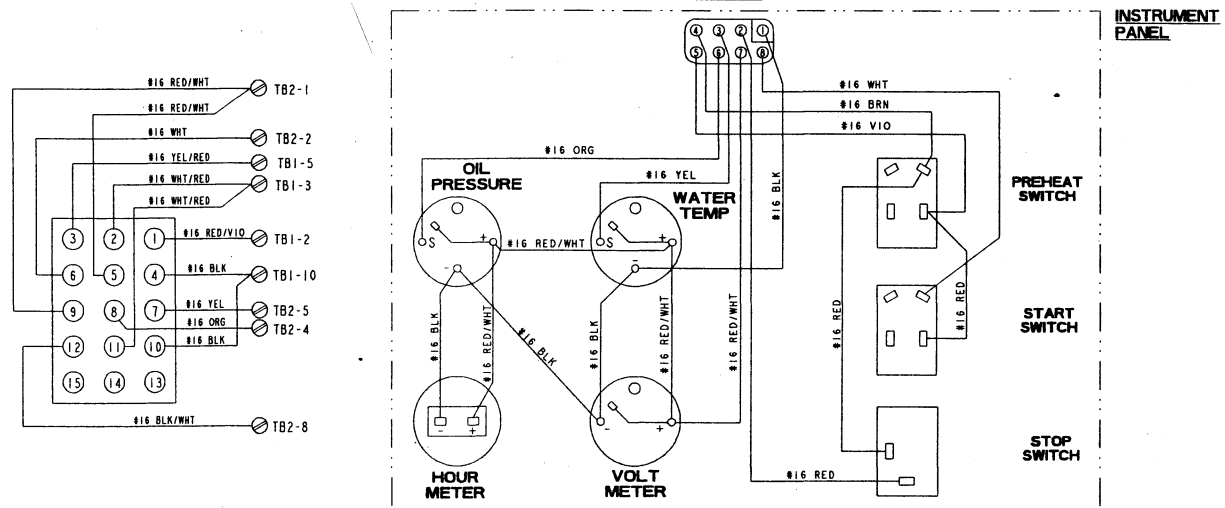
Assuming the gauge is OK, check the conductor from the sender to the sender terminal at the gauge for continuity.

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.

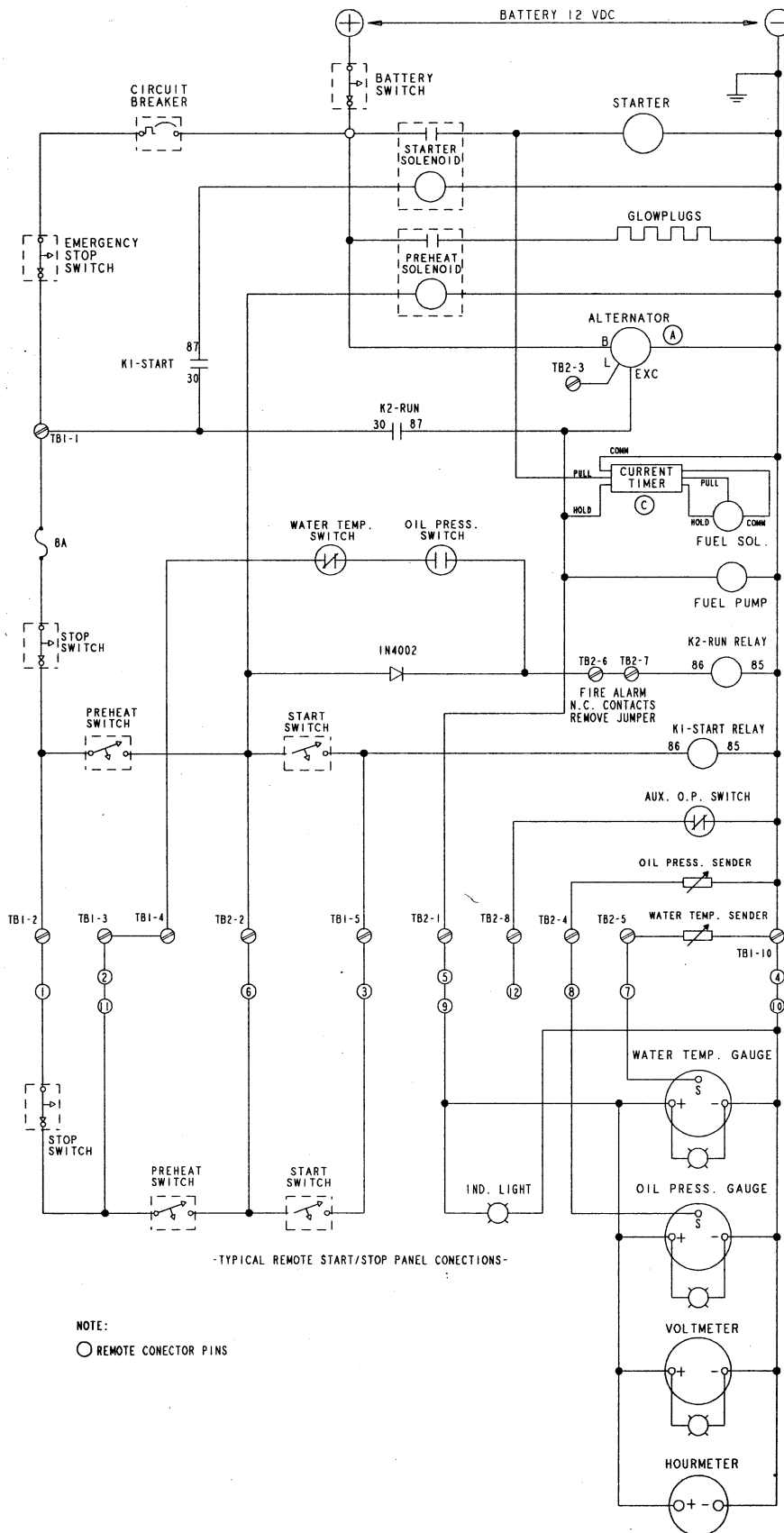
7.6BTDR WIRING DIAGRAM #44743



NOTE:
1. REMOVE JUMPER WHEN CONNECTING A SECOND REMOTE PANEL.



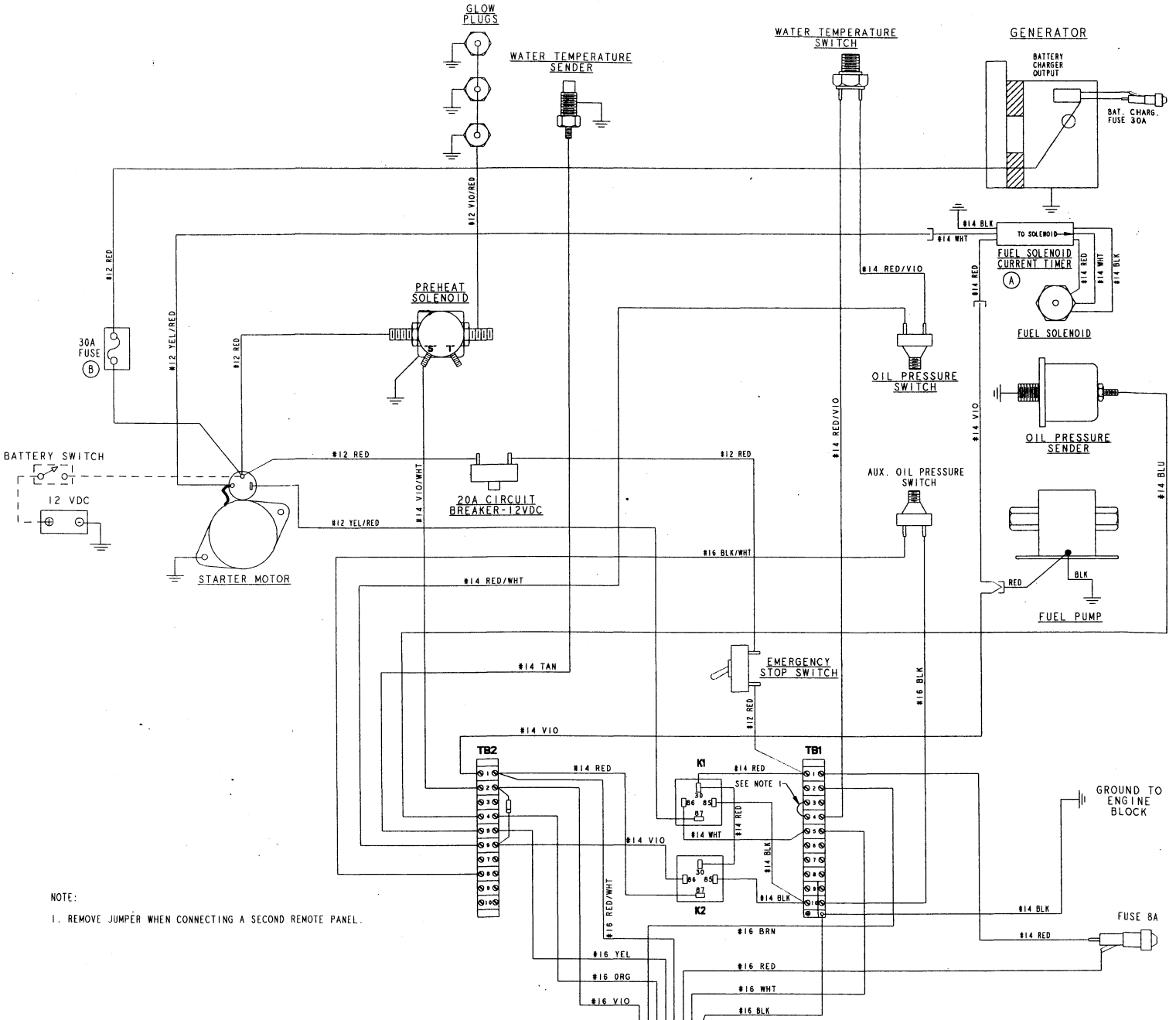
7.6BTDR WIRING SCHEMATIC #44743



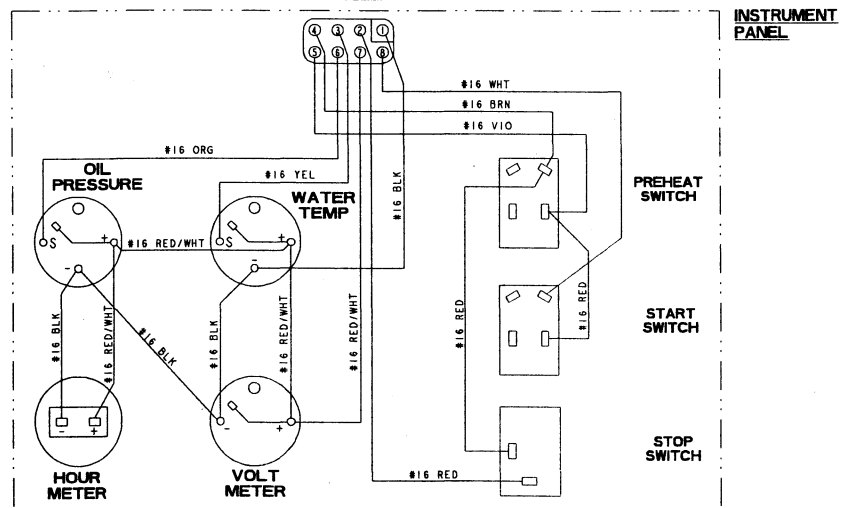
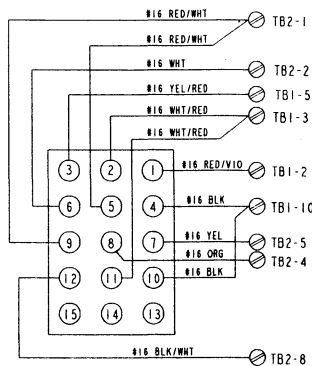
-TYPICAL REMOTE START/STOP PANEL CONNECTIONS-

NOTE:
 ○ REMOTE CONNECTOR PINS

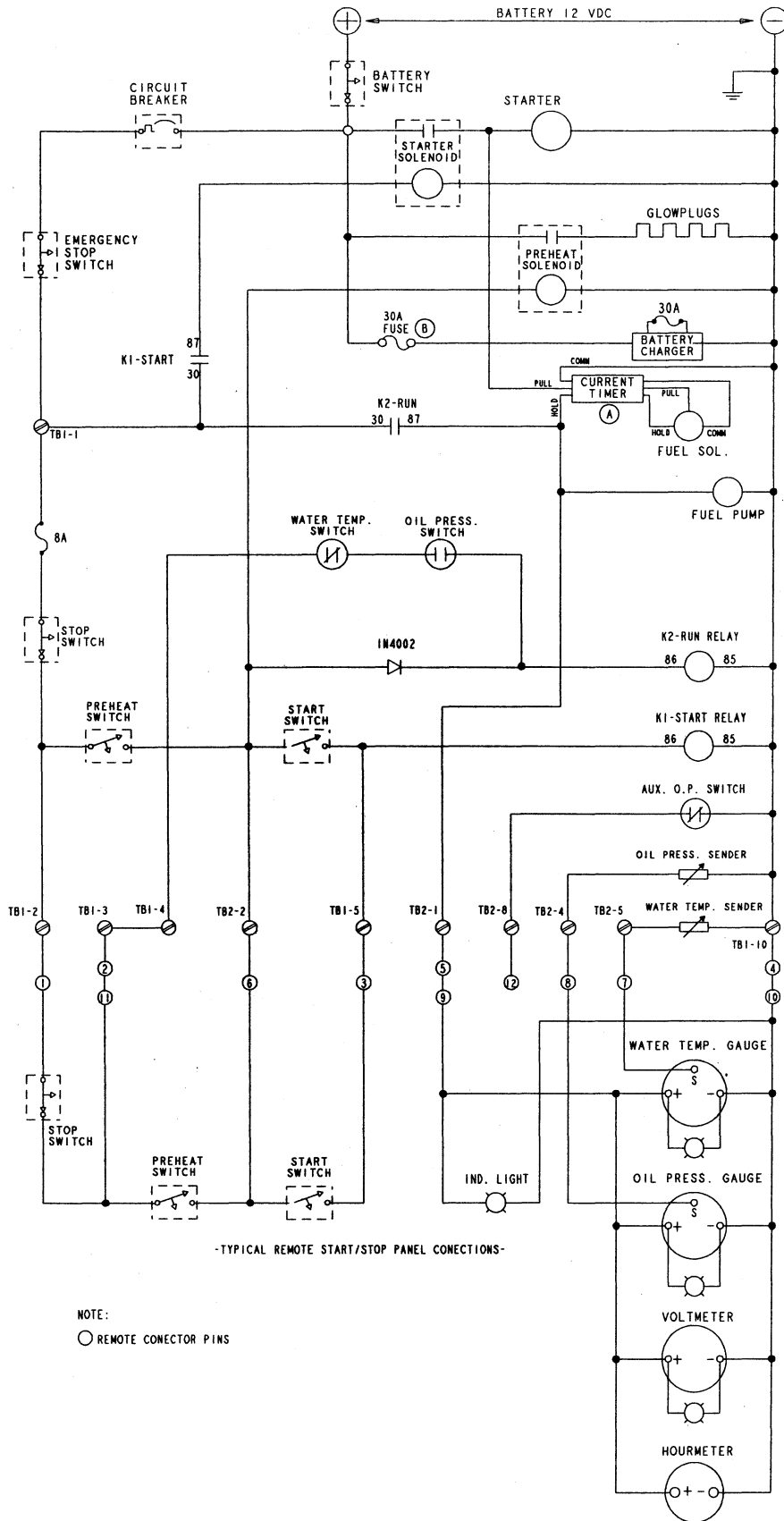
5.0BCDR WIRING DIAGRAM #44742



NOTE:
1. REMOVE JUMPER WHEN CONNECTING A SECOND REMOTE PANEL.



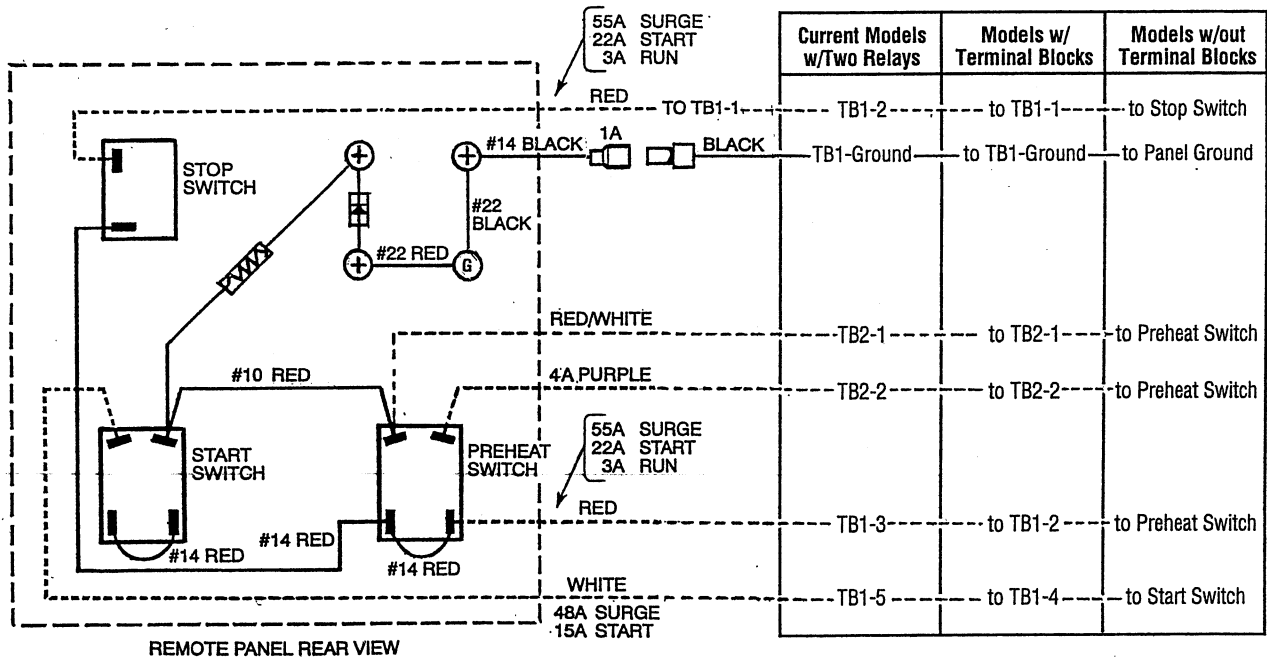
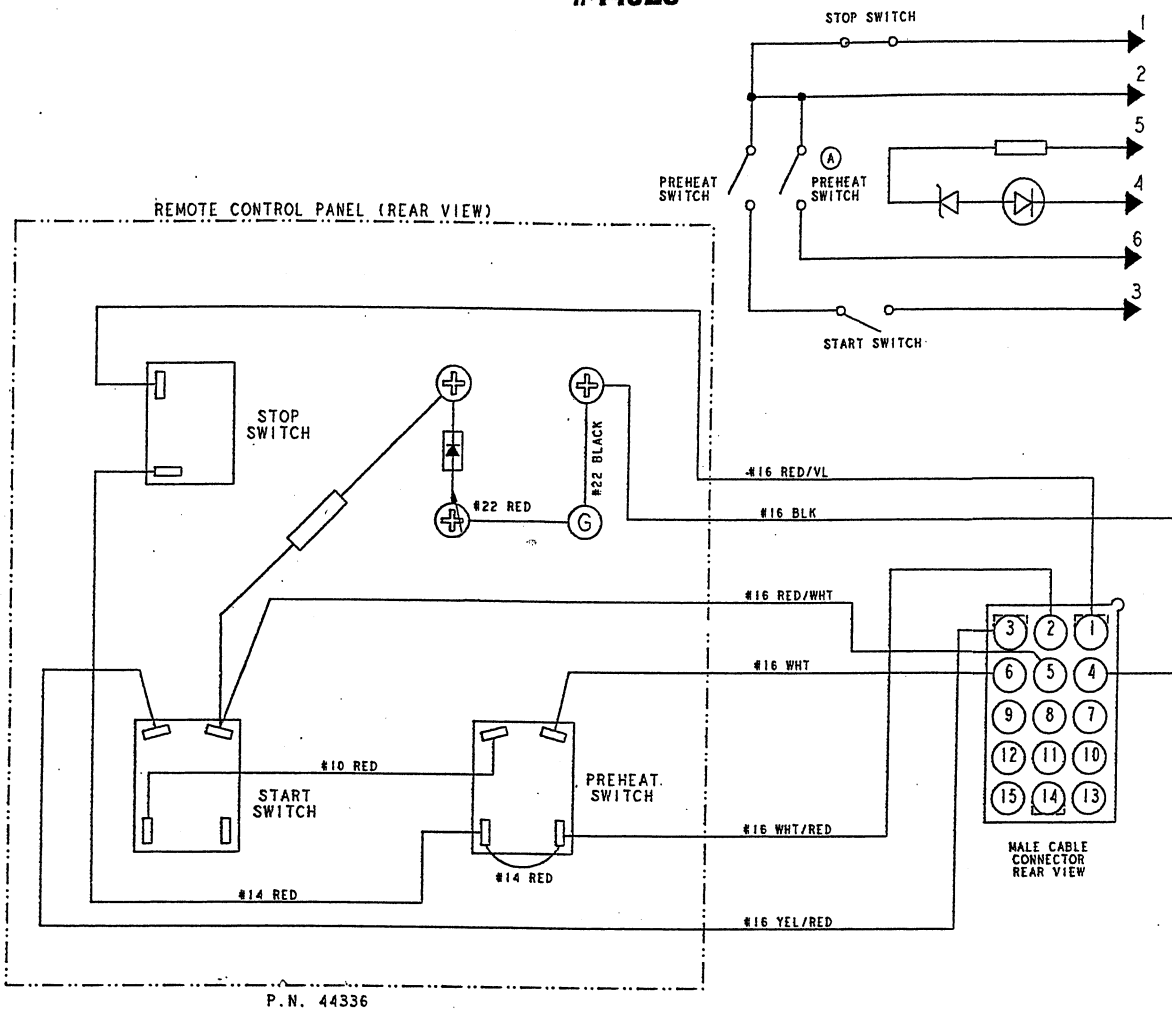
5.0BCDR WIRING SCHEMATIC #44742



-TYPICAL REMOTE START/STOP PANEL CONECTIONS-

REMOTE STOP/START PANEL WIRING DIAGRAM

#44329



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 ampmeter 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!

7.6KW BT GENERATOR TROUBLESHOOTING

This troubleshooting chart is designed to give insight into problems which may be encountered with BT brushless generators operating on compound transformer regulation. Owing to the simplicity of the equipment and controls, troubleshooting is relatively easy, once the relationship between cause and effect is understood.

WESTERBEKE recommends that the troubleshooting and repair of the generator be performed by a qualified technician with a thorough knowledge of electricity and the safety procedures necessary when dealing with high voltages.

Only a few basic tools are necessary for diagnosis and repair. These are hand tools: an amp probe and a quality volt-ohm-meter capable of reading less than one ohm due to the precision required in reading component winding resistances.

Before attempting any repairs, get a clear explanation of the problem as possible, preferably from an individual witnessing the problem. In some cases, this may bring to light a problem which is related to the method of operation rather than equipment fault. Have basic repair parts available, such as: diodes and a bridge rectifier, so that if the problem is found in one of these easily replaceable parts, repairs can be made efficiently.

Problem	Probable Cause	Verification/Remedy
High voltage (125 - 135 volts) at N/L with correct voltage when loaded (115 - 120 volts).	1. Generator's engine speed (rpm) high at N/L.	1. Check N/L speed and adjust N/L voltage.
High voltage at N/L and F/L.	1. Generator's engine speed (rpm) high. 2. Short in compound transformer auxiliary windings D-3.	1. Check N/L rpm and adjust N/L voltage. 2. Check continuity and connections of D-3 windings.
Low voltage (0 - 5 volts) at N/L with growling noise from generator and loss of engine speed when load is applied.	1. Main stator windings shorted C-1, C-2. 2. Compound transformer windings shorted D-1, D-2.	1. Check continuity and resistance values of C-1, C-2 windings and connections. 2. Check continuity and resistance values of D-1, D-2 windings.
Generator does not excite; voltage is 0 volts at N/L.	1. Generator's engine speed is slow. 2. Short in the main stator windings or transformer. 3. Shorted Posi-resistor.	1. Adjust the engine's speed and adjust N/L voltage. 2. Check the diodes as shown in this manual. 3. Test Posi-resistor.
Low voltage (60 - 100 volts) at N/L, when load is applied, voltage drops.	1. Diodes(s) in rotating exciter (B-2) shorted. 2. Rotating field windings. 3. Exciter rotor windings. 4. Exciter stator windings.	1. Check B-1 and B-2 in the rotating exciter as explained in this section. 2. Check for short. 3. Check for short a, b, c. 4. Check for short.
Voltage correct at N/L, but not at F/L with loss of engine rpm (hertz).	1. Generator overload. 2. Rotating diode failing. 3. Generator's engine speed is low. 4. Low power load factor.	1. Monitor the load. 2. Check the diode. 3. Check the governor operation. 4. Check the type of load applied. Consider use of optional regulator board.
Unstable voltage.	1. Engine's rpm fluctuating.	1. Check the engine operation and the fuel system. See <i>ENGINE ADJUSTMENTS</i> .
Residual Voltage (18 - 22 volts)	1. Bridge rectifier. 2. Exciter stator. 3. Transformer windings. 4. Main stator sux. windings.	1. Test rectifier. 2. Test winding for open. 3. Test winding for open. 4. Test winding for open.

7.6KW BT GENERATOR SINGLE PHASE

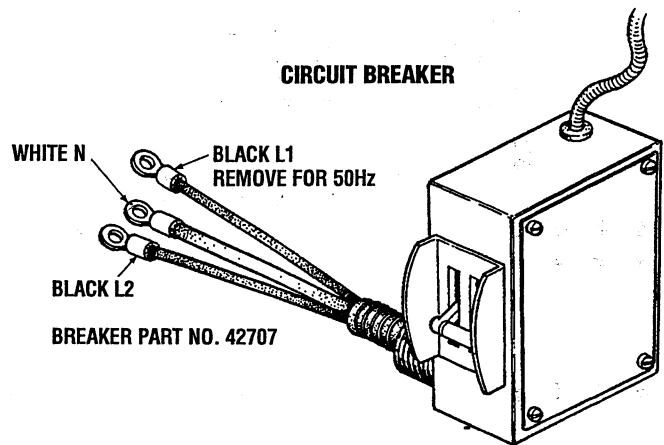
DESCRIPTION

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.

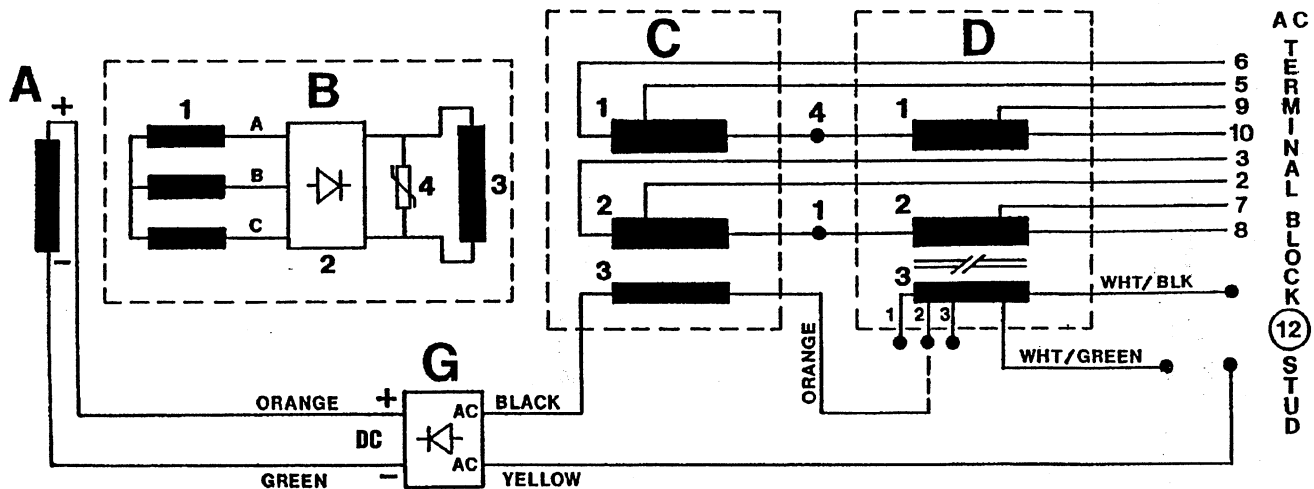
Circuit Breaker

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 AC power is coming from the generator to the vessel.

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



**INTERNAL WIRING FOR
12 STUD BT GENERATOR**



A. EXCITER STATOR WINDING

A - 1 Exciter Stator Windings

B. EXCITER ROTOR and FIELD

1. Auxiliary Windings (A - B - C)
2. Diodes (6)
3. Rotating Field Windings
4. Pozi 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

7.6KW BT GENERATOR SINGLE PHASE

NO-LOAD VOLTAGE ADJUSTMENT

1. Voltage adjustment is made with the generator regulation being governed by the compound transformer.
2. Operate the generator, apply a moderate load momentarily and remove it. Note the voltage output from the generator's 120 volt leg(S) (230 volt 50 hertz). The no-load voltage should be between 121 - 124 volts at 61.5 - 62 hertz (234 - 238 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 sometimes be accomplished by gently tapping the top of the laminated steel bar to reduce the gap between the existing shims and the transformer core.

Generator Frequency

1. Frequency is a direct result of engine/generator speed:
1800 rpm = 60 hertz; 1500 rpm = 50 hertz.
2. To change generator frequency follow the steps below.
 - a. Configure the AC terminal block for the desired voltage frequency as shown below. Ensure that the case ground wire is connected to the correct terminal block neutral ground stud.

NOTE: The white/green ground wire may be removed in those installations where the AC circuit has a separate neutral and ground circuit. This will prevent the unit from being a ground source in the vessel.

- b. Start the engine, monitor voltage and adjust engine no-load speed. Adjust the throttle arm or the throttle stop screw to produce engine speed desired.

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

- c. 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, 234 - 238 volts.

- d. 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

Maximum voltage drop acceptable at full rated output (amps)

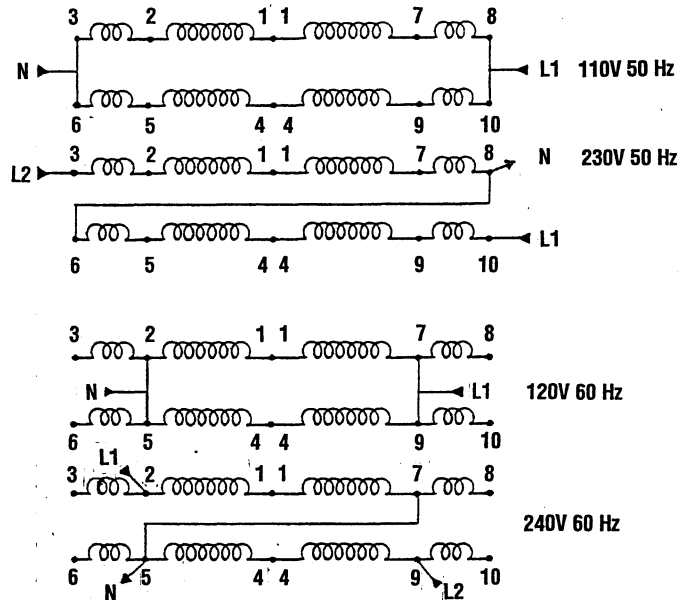
60 hertz: 108 - 110 volts

50 hertz: 215 - 220 volts

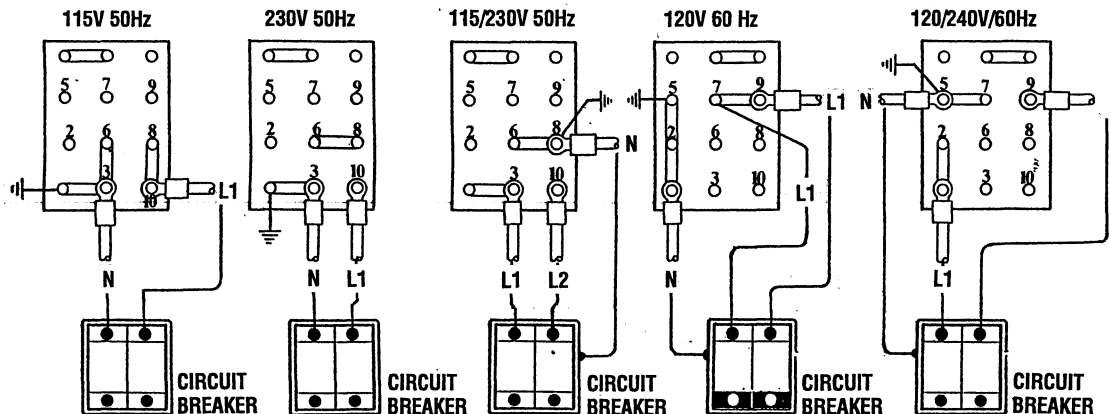
Should the voltage drop below the proper rate, loaded excitation can be increased to raise this voltage by repositioning the connection on the Voltage Connection Terminal.

TERMINAL BLOCK WIRING CONNECTIONS

Winding Connections Needed To Obtain The Proper Voltage and Frequency

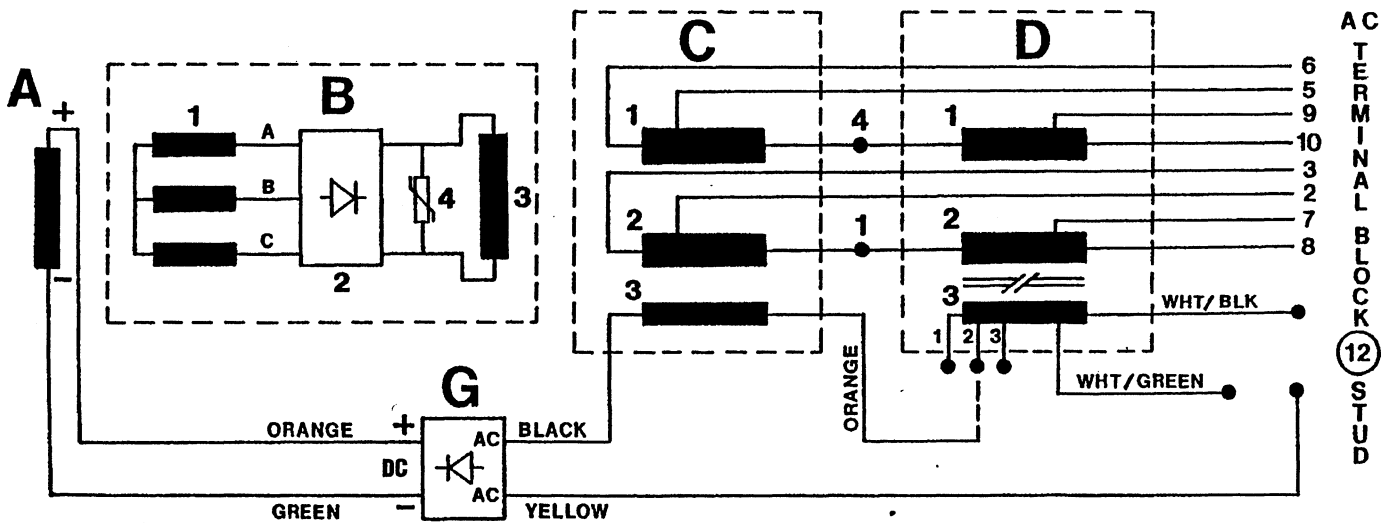


The frame ground wire must be moved when changing from 115 volts and 110/220 volts 50 hertz to 230 volts 50 hertz. From making connections to the AC terminal block, use terminal ends for 1/4 inch studs that will accept multi-strand copper wire sized for the amperage rating from the hot lead connection.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



7.6KW BT GENERATOR SINGLE PHASE

INTERNAL WIRING FOR 12 STUD BT GENERATOR



RESIDUAL VOLTAGE CHECK

1. Residual Voltage 18 - 22 volts AC.

NOTE: The amount of no-load voltage produced by the generator can be an indicator of where in the generator the problem/fault may lie.

This voltage is the AC voltage produced by the generator from magnetism in the exciter stator field. This voltage is measured between the AC neutral and hot leg(s) with no-load on the generator running at its hertz.

The presence of residual voltage is an indication that the following generator components are OK:

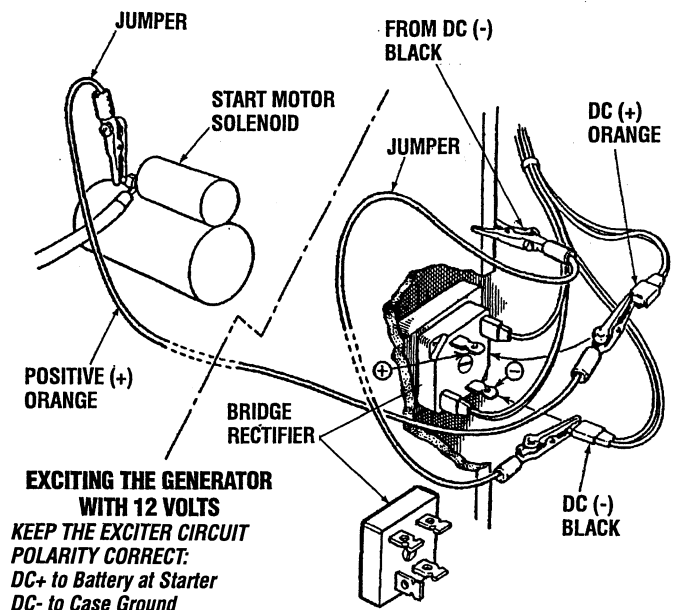
1. Exciter Rotor (B-1 a, b, & c) & (B-2)
2. Rotating Field (B-3)
3. Main Stator (C-1 & C-2)
4. Compound Transformer (D-1 & D-2)

The fault lies in one or more of the following components in the exciter circuit:

- A. Exciter Stator (A-1)
- B. Bridge Rectifier (G)
- C. Main Stator Auxiliary Windings (C-3)
- D. Compound Transformer Auxiliary Winding (D-3)

2. Twelve (12) volts DC excitation of the exciter stator windings should cause the generator to produce between 125 - 135 volts AC between each hot lead and the neutral. (Twelve volts DC is applied between the lifted (+) and (-) leads of the bridge rectifier, + to + and - to -.) Correct voltage produced with twelve volts DC excitation indicates the fault is in one or more of the above listed components B, D or E. If the generator does not produce 125 - 135 volts AC, then include A and C.
3. The absence of any voltage from the generator indicates a fault with the main stator windings C-1 and C-2 and/or the compound transformer windings D-1 and D-2. Other failed components that can produce this same no-voltage output are the posi-resistor in the exciter rotor and four or more failed diodes in the exciter rotor.

- a. Apply 12 volt DC excitation to the exciter stator windings as explained in paragraph 2. A fault in the main stator and/or compound transformer windings such as a short will cause the generator engine to load down and the shorted windings to eventually produce smoke as the excitation is continued.
4. Voltage output greater than residual and less than the rated output indicates a fault in the exciter rotor/field B-1, B-2, B-3. Excitation of the generator as explained in paragraph 2 should produce a partial rise in voltage output and, when removed, the voltage will return to the original low output.



NOTE: Current model bridge rectifiers are configured differently, but + and - are still located at the corners.

7.6KW BT GENERATOR SINGLE PHASE

BRIDGE RECTIFIER

The bridge rectifier is supplied AC voltage from the auxiliary windings in the generator stator (C-3) and the compound transformer (D-3). The AC voltage measured across the AC terminals of the rectifier during engine operation is as follows:

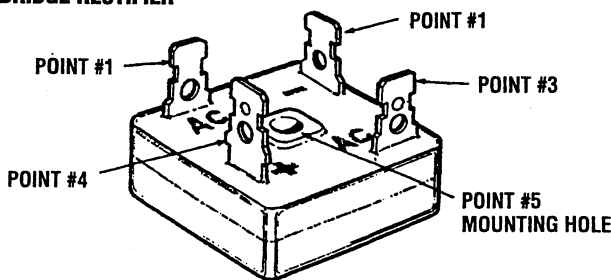
120 Volts	120/240 Volts
N/L F/L	N/L F/L
17 - 44 Volts AC	17 - 44 Volts AC

Diodes in the rectifier convert this AC voltage to DC and supply it to the windings of the exciter stator to induce a field through which the exciter rotor revolves. The DC voltage measured across the (+) and (-) terminals of the bridge rectifier during engine operation is as follows:

120 Volts	120/240 Volts
N/L F/L	N/L F/L
8 - 17 Volts DC	8 - 17 Volts DC

Failure of the bridge rectifier will result in a weak field being produced by the exciter stator windings. A weak field is present, due to the magnetism in the exciter stator, which will cause the generator to produce residual voltage.

BRIDGE RECTIFIER



Testing The Bridge Rectifier For Faults With An Ohmmeter

(Meter used: *Simpson 260*)

1. Set the ohmmeter scale on RX1 (+ DC) and set the needle to zero.
2. Connect the positive (+) lead from the ohmmeter to point #4. Taking the ohmmeter's negative (-) lead, momentarily contact points #1, #2, #3, and #5. The ohmmeter should register no deflection for any of the points touched.
3. Remove the positive (+) lead from point #4 and connect the negative (-) lead to point #4 and, with the positive (+) lead, momentarily touch points #1, #2, and #3. The ohmmeter's needle should deflect when each point is touched, showing a passage of meter voltage through the diodes in the rectifier.
4. Leaving the negative (-) ohmmeter lead on point #4, touch point #5 with the positive (+) lead. No deflection of the needle should occur.
5. Place the positive (+) lead of the ohmmeter on point #1 and the negative (-) lead on point #3. The ohmmeter should not register any deflection of the needle (no deflection indicates infinite resistance). Reverse these connections and the ohmmeter should again register no deflection.

If the rectifier fails any of the previous tests (1 -4) it is defective and should be replaced.

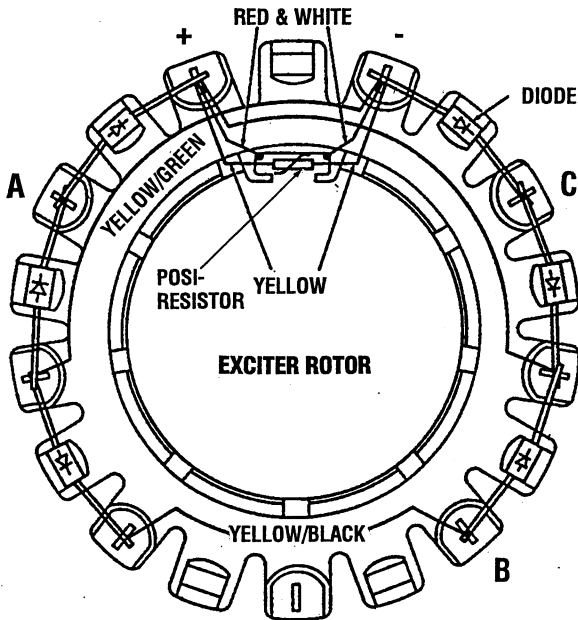
NOTE: *Different style/model meters may produce opposite results from the above tests.*

7.6KW BT GENERATOR SINGLE PHASE

EXCITER ROTOR/FIELD

Auxiliary windings group a, b and c. Locate the three terminal points on the exciter rotor for these auxiliary winding groups. Position the exciter rotor as shown in the illustration and count off the porcelain knobs from the 12 o'clock point either left or right to locate terminal points a, b and c. Measure the resistance value between the pairs of terminal points A & B, B & C, and C & A. There is no need to unsolder these connections unless a faulty reading appears. If this occurs, unsolder and verify the winding fault. There should be no continuity found between any of the three terminal points and the rotor shaft/case ground.

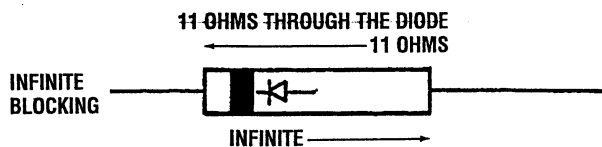
Auxiliary Windings 1.0 - 1.2 Ohms



Rotating Field Windings. Refer to the illustration above of the exciter rotor. The field winding connections are noted as the (+) and (-) connections of the red & white striped wires. Measure the resistance value with your ohmmeter between these two connection points. These connections need not be unsoldered unless a faulty reading appears. If this occurs unsolder the connection and verify the resistance reading. With these connections lifted, there should be no continuity to the rotor shaft. This would indicate a short to ground with these field windings.

Diodes. Six diodes are mounted on the exciter rotor; they rectify the AC voltage produced by the three groups of auxiliary windings to DC voltages and supply this DC voltage to the rotating field windings.

RESISTANCE VALUE

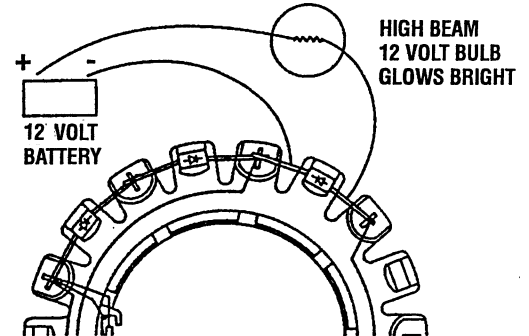


The diodes can be easily checked in place with the use of a common automotive 12-volt high beam headlight bulb, some jumper leads and the generator's 12 volt starting battery.

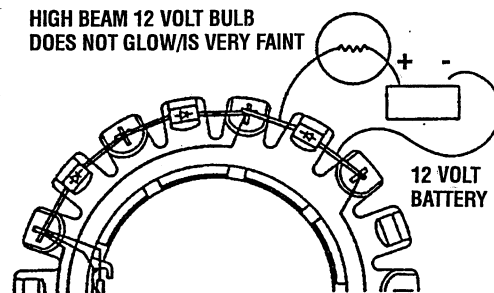
A short or an open in a diode can easily be found with the above without having to unsolder and isolate each diode to check it with an ohmmeter.

NOTE: Attempting to check diodes in place with an ohmmeter will give erroneous readings on the diodes due to the auxiliary winding's connections.

When leads are put across the diode, as illustrated, voltage passes through the diode allowing the headlight to glow brightly.



Reverse the leads across the diode. The diode should block voltage passing through it, and the headlight should not glow, or it may glow faintly.



- Should the bulb not glow with leads connected in both directions, the diode is open internally.
- Should the bulb glow with leads connected in both directions, the diode is shorted internally.

In both a and b above, the diode should be replaced. Check the resistance values of the rotating field windings and the integrity of the resistors connected between the field windings.

Rotating Field Windings 7.0-8.0 ohm. (Reading taken between the two red & white wires connected to the (+) and (-) terminals of the exciter rotor as shown in the illustration.)

Posi-resistor. (Infinite readings between both yellow leads lifted from the (+) and (-) terminals on the exciter rotor.) A shorted posi-resistor will destroy the rotating field and cause the AC output voltage to drop to zero.

7.6KW BT GENERATOR SINGLE PHASE

MEASURING RESISTANCE

Main Stator Windings

1. **Group #1.** The resistance value is measured between the lifted lead #4 from the insulated terminal below the transformer and lead #6 lifted from the AC terminal block. In order to totally isolate the stator windings of group #1, lead #5 should be lifted from the terminal block.
2. **Group #2.** The resistance value is measured between the lifted lead #1 from the insulated terminal below the transformer and lead #3 lifted from the AC terminal block. In order to totally isolate the stator windings of group #2, lead #2 should be lifted from the terminal block.

Main Stator Windings 20 - 22 Ohms

3. **Main Stator Auxiliary Windings** are measured between the double leads on the AC terminal of the bridge rectifier, unplugged from the rectifier and the double lead central prong connection of the regulator plug.

Main Stator Auxiliary Windings 1.5 - 1.8 Ohms

NOTE: No continuity should be found between either of these winding groups or to the generator case.

Compound Transformer

Group 1 measured between Lead #10 at the AC terminal block and Lead #4 at the junction box. Lift both leads along with lead #9 at the terminal block.

Group 2 measured between Lead #8 at the AC terminal block and Lead #4 at the junction block. Lift both leads along with lead #7 at the terminal block.

Compound Transformer Windings 0.019 - 0.021 Ohms

A three connection voltage connection terminal was added to this circuit located just below the AC terminal block at the lower left. Isolate the three numbered #1, #2, and #3 red and white-striped wires coming onto each of the three terminals. Lift the black and white-striped leads and the green and white-striped leads off of their connections on the AC terminal block. Measure the resistance value between the #1 red lead lifted from the terminal strip and the black and white striped lead lifted from the AC terminal block.

Transformer Auxiliary Windings 4.0 - 4.5 Ohms

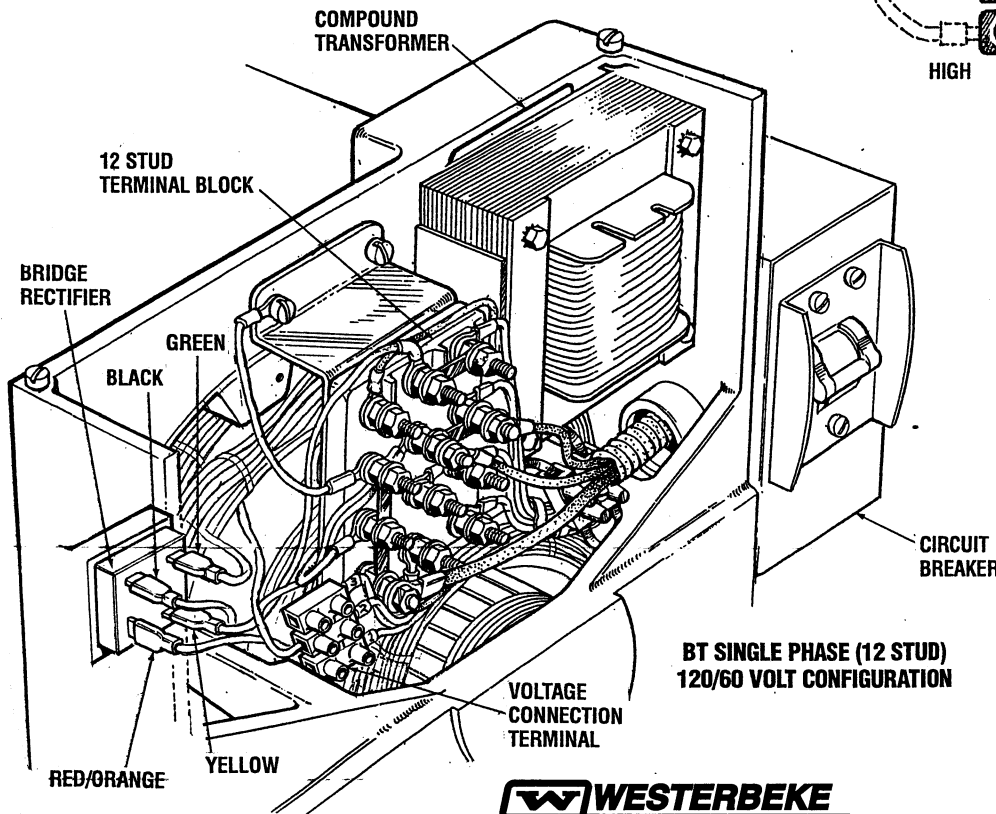
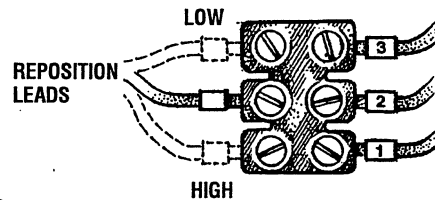
VOLTAGE CONNECTION TERMINAL

The addition of the three connection terminal is for the increase or decrease of full-load voltage output. Should full-load voltage fall below 108 volts, selecting a higher number terminal strip lead to connect the lead (red or red and white) will supply a higher AC voltage to the exciter circuit during full-load conditions, bringing the output voltage of the generator up.

No-load voltage should be properly adjusted by shimming the compound transformer: 121 - 124 volts at 61.5 - 62.0 hertz. The above should not be used as a means of compensating for incorrectly adjusting the generator's no-load voltage.

NOTE: For engine speed/hertz adjustment, see *ENGINE ADJUSTMENTS* in this manual.

VOLTAGE CONNECTION TERMINAL



BT SINGLE PHASE (12 STUD)
120/60 VOLT CONFIGURATION

SPECIFICATIONS - 7.6KW BTD GENERATOR

ENGINE SPECIFICATIONS

Engine Type	Diesel, four-cycle, three-cylinder, fresh water-cooled, vertical in-line overhead valve mechanism (11 Hp at 1800 rpm maximum).
Aspiration	Naturally aspirated
Governor	Centrifugal type
Combustion Chamber	Swirl type
Bore & Stroke	2.99 x 2.76 inches (76 x 70 mm)
Piston Displacement	59.09 cubic inches (0.952 liters)
Firing Order	1 - 3 - 2
Direction of Rotation	Clockwise, when viewed from the front
Compression Ratio	21 : 1
Dimensions	Height: 20.4 inches (518.6 mm) Width: 16.0 inches (406.40 mm) Length: 27.6 inches (518.6 mm)
Weight	395 lbs (1797 kgs)
Fuel Consumption	0.53 US gph (2 lph) at Full Rated Output
Inclination	Continuous 15° Temporary 25° (not to exceed 30 min.)
Generator Power Take Off	11 Horsepower (maximum)

TUNE-UP SPECIFICATIONS

Compression Pressure (Limit of Difference Between Cylinders)	398 psi (28 kg/cm ²) at 280 rpm limit 47.2 psi (3.0 kg/cm ²)
Valve Timing	Intake Opens 17° BTDC Intake Closes 47° ABDC Exhaust Opens 51° BBDC Exhaust Closes 13° ATDC
Spill Timing (Static)	11° ± 1.5
Valve Seat Angle	Intake 45° Exhaust 45°
Engine Speed	1800 rpm 60 Hertz 1500 rpm 50 Hertz
Valve Clearance (engine cold)	Intake and Exhaust 0.010 inches (0.25 mm)
Injector Pressure	1920 + 71 - 0 psi (135 + 5 - 0 kg/cm ²)
Emission Control System	Smoke puffer limiter

FUEL SYSTEM

General	Open flow, self bleeding - self priming
Fuel	No. 2 diesel oil (cetane rating of 45 or higher)
Fuel Injection Pump	In-line plunger, Bosch type
Nozzle	Throttle type
Fuel Filter	Canister type
Air cleaner	Paper air filter
Air Flow (engine combustion)	30.2 cfm (0.85 cmm)

ELECTRICAL SYSTEM

Starting Battery	12-Volt, (-) negative ground
Battery Capacity	600 - 900 Cold Cranking Amps (CCA)
DC Charging Alternator	51 Amp rated, belt driven
Starter	12-Volt, reduction gear, 1.2 KW
Starting Aid	Glow plugs, sheathed type
DC No-Load Current	± 2% of rated Amps
DC Cranking Current	175 - 200 Amps (engine cold)

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)	6.0 qts (5.5 liters)
Radiator Air Flow	695 cfm (20 cmm)

LUBRICATION SYSTEM

General	Pressure fed system with external relief valve
Oil Filter	Full flow, paper element, spin-on type
Sump Capacity (not including filter)	3.2 U.S. qts (3.03 liters) plus filter/cooler assembly
Operating Oil Pressure (engine hot)	35 - 55 psi (2.5 - 3.8 kg/cm ²)
Oil Grade	API Specification CF or CG-4, SAE 30, 10W-30, 15W-40

AC GENERATOR (SINGLE PHASE)

General - Single Phase	Brushless, four-pole, revolving field sealed lubricated single bearing design. Reconnectable single phase for 120/240 volts with solid state voltage regulator.
Voltage - Single Phase	120 or 120/240 Volts - 60 Hertz 230 Volts - 50 Hertz
Voltage Regulation	±5% no load to full load
Frequency Regulation	±0.05 Hertz no load to full load
Rating (Volts AC)	7.6 KW - 60 Hertz (1800 rpm) 120 Volts 166 Amps 120/240 Volts 63.3/31.6 Amps 5.7 KW - 50 Hertz (1500 rpm) 230 Volts 24.8 Amps

GENERATOR COOLING

Air Requirements (60 Hertz @ 1800 rpm)	200 cfm (5.66 cmm) generator
Note: Increase air supply 15% for 50 Hertz operation @ 1500 rpm	
Engine Combustion	30.2 cfm (0.85 cmm)
Generator Compartment Temperature	120°F (50°C) maximum Ambient Temperature

5.0KW BC GENERATOR SINGLE PHASE

DESCRIPTION

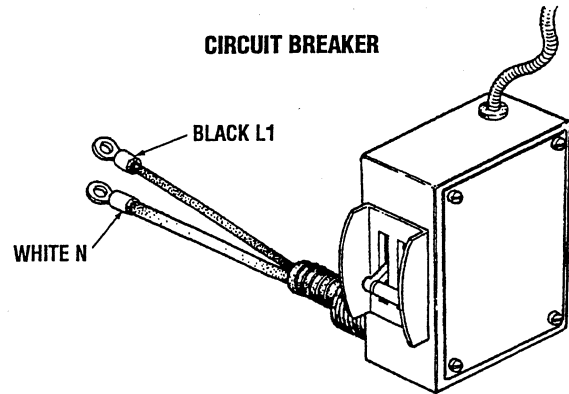
The BC generator is a brushless, self-excited generator which requires only the driving force of the engine to produce an AC output. The stator houses two sets of windings; the main stator windings and the exciter windings. When the generator is started, residual magnetism in the four rotating poles induces a current in the stator which then generates an even larger current in the exciter windings. This mutual build up of current in the four rotating poles and in the exciter windings quickly reaches the saturation point of the capacitor(s) and a regulated energy field is then maintained in the stator. At the same time, this regulated field produces a steady voltage in the stator windings which can then be drawn off the generator's AC terminals to operate AC equipment. The generator is a single-phase, reconnectable 120 volt AC two-wire or 120/240 volt AC three-wire, at 60 hertz; or 110 volt AC two-wire or 230 volt AC two-wire, at 50 hertz. Refer to the SPECIFICATIONS section of this manual for generator ratings. The generator's data plate gives the voltage, current and frequency rating of the generator. An AC wiring decal is affixed to the inside of the louvered cover at the generator end. A diagram of the various AC voltage connections is provided on the decal. An Integral Controller (IC) is mounted inside the generator and supplies a continuous DC charge to the generators starting battery when the generator is running. For more information see the INTEGRAL CONTROLLER DC CHARGER section in this manual.

Circuit Breaker

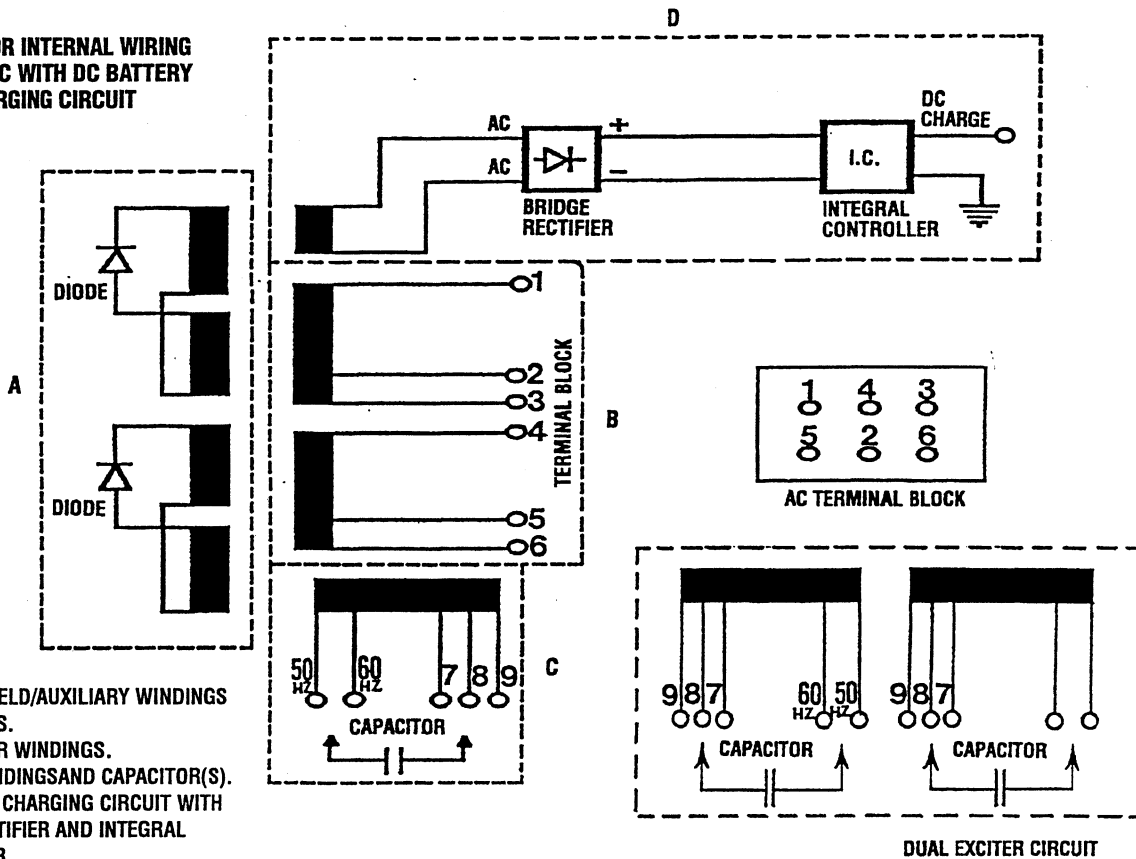
A circuit breaker is installed on all single phase WESTERBEKE generators. This circuit breaker will automatically disconnect generator power in case of an electrical overload. The circuit breaker can be manually shut off when servicing the generator to ensure that no power is coming into the generator.

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

60 Hz - 5.0 KW Circuit Breaker Part Number 42238
50 Hz - 4.0 KW Circuit Breaker Part Number 42704



GENERATOR INTERNAL WIRING SCHEMATIC WITH DC BATTERY CHARGING CIRCUIT



- A. ROTATING FIELD/AUXILIARY WINDINGS WITH DIODES.
- B. MAIN STATOR WINDINGS.
- C. EXCITER WINDINGS AND CAPACITOR(S).
- D. DC BATTERY CHARGING CIRCUIT WITH BRIDGE RECTIFIER AND INTEGRAL CONTROLLER.

5.0KW BC GENERATOR TROUBLESHOOTING

This troubleshooting chart is designed to give insight into problems which may be encountered with BT brushless generators operating on compound transformer regulation. Owing to the simplicity of the equipment and controls, troubleshooting is relatively easy, once the relationship between cause and effect is understood.

WESTERBEKE recommends that the troubleshooting and repair of the generator be performed by a qualified technician with a thorough knowledge of electricity and the safety procedures necessary when dealing with high voltages.

Only a few basic tools are necessary for diagnosis and repair. These are hand tools: an amp probe and a quality volt-ohm-meter capable of reading less than one ohm due to the precision required in reading component winding resistances.

Before attempting any repairs, get a clear explanation of the problem as possible, preferably from an individual witnessing the problem. In some cases, this may bring to light a problem which is related to the method of operation rather than equipment fault. Have basic repair parts available, such as: diodes and a bridge rectifier, so that if the problem is found in one of these easily replaceable parts, repairs can be made efficiently.

Problem	Probable Cause	Verification/Remedy
No AC Output at No Load.	1. Main stator winding is open or shorted.	1. Excite unit with 12 VDC. Check the stator windings.
Residual voltage (4 - 6 Volts) at N/L.	1. Faulty capacitor. 2. Faulty electrical connections. 3. Engine speed is too slow. 4. Faulty exciter winding.	1. Perform capacitor check. 2. Check all electrical connections, ensure they are clean and tight. 3. Adjust engine speed to correct N/L hertz. 4. Check winding resistance value. Check winding residual voltage output..
High No Load voltage output.	1. Engine speed is too fast. 2. No load voltage tap at capacitor. 3. Wrong hertz tap.	1. Adjust engine speed to correct no load hertz. 2. Change tap to lower number. 3. Check to ensure correct hertz tap attached.
Correct No Load voltage, voltage drops to 60 - 80 volts when load applied.	1. Faulty diode. 2. Poor governor reaction. 3. Overload on generator.	1. Isolate diodes and check for short. 2. Check engine speed under load. Adjust or repair governor as needed. 3. Check the engine speed. Monitor amperage draw with amprobe.
Correct No Load voltage, high voltage	1. Engine speed is too fast.	1. Check engine speed. Adjust or repair governor as needed.
Unstable voltage output.	1. Poor governor reaction. 2. Loose electrical connections.	1. Check the governor. Adjust or repair the governor as needed. 2. Check the security and cleanliness of the electrical connections.
Noisy Generator.	1. Rear support bearing faulty. 2. Unbalanced load (120/240 wired). 3. Generator rotor connection to engine is loose.	1. Inspect rear bearing. 2. Monitor the amperage draw from each leg using amprobe. 3. Check rotor security.

5.0KW BC GENERATOR SINGLE PHASE

DUAL EXCITER NO-LOAD VOLTAGE ADJUSTMENT

These generators have dual Hertz and no-load voltage adjustment connectors at each capacitor. There are five connectors available for each capacitor. Two connectors are for Hertz selection, 60 Hertz or 50 Hertz, and three connectors, #7, #8, and #9, are for no-load voltage adjustment.

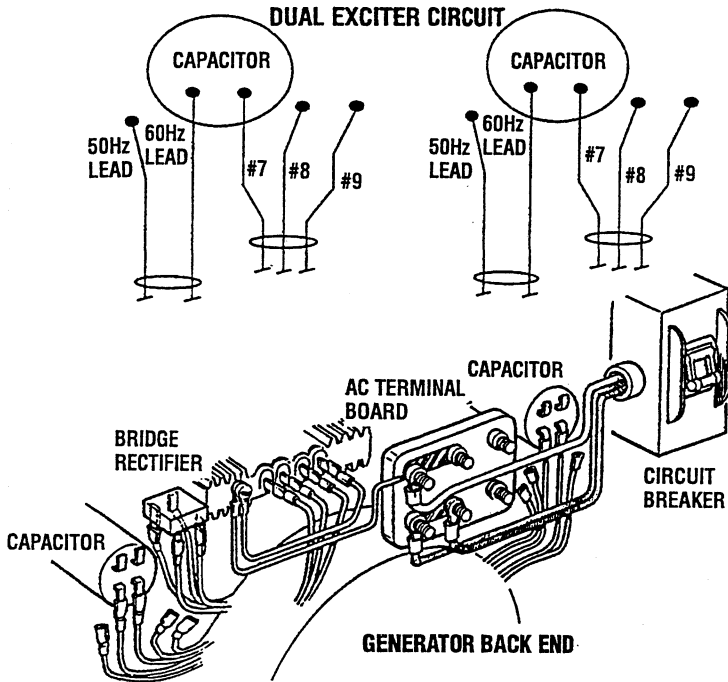
When making Hertz change or no-load voltage adjustments proceed as follows:

1. Shut the generator down.
2. Select the appropriate Hertz connection to plug into each capacitor #60, 60 Hertz, 1800 RPM or 50, #50 Hertz, 1500 RPM. The three other connectors at each capacitor, #7, #8, and #9, will have an effect on the no-load voltage produced by the generator. One connector from each group can be plugged into each capacitor. No-load voltage will increase or decrease approximately 4 - 6 AC volts between connectors used in any pair combination to achieve the prescribed no-load voltage as illustrated below.

NOTE: When changing Hertz produced by the generator, an engine speed adjustment at the throttle arm linkage must be made. The AC output connections on the terminal blocks must be selected for the voltage and Hertz to be produced. The Hertz plug connection at the capacitor must be changed for 50 Hertz (#5) or 60 Hertz (#6). The frame ground wire must be moved when changing from 115 volts, 50 Hertz to 230 volts, 50 Hertz.

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

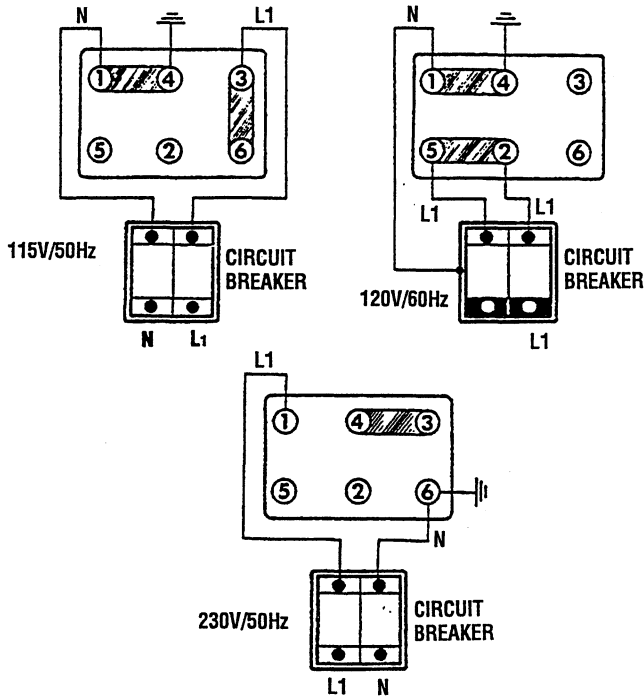
NOTE: Simply cross the capacitor's two terminals with an insulated (plastic handle) screwdriver. This will discharge any excess electricity.



5.0KW BC GENERATOR SINGLE PHASE

SINGLE EXCITER NO-LOAD VOLTAGE ADJUSTMENT

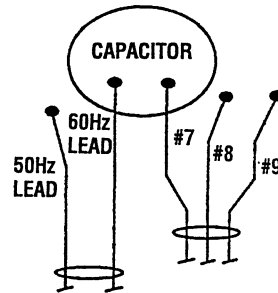
1. Remove the louvered metal plate, at the back of the generator, covering the AC terminal connections and the capacitor(s).
2. Start the generator and allow it to run for approximately five minutes so the engine can warm up. Make sure the generator is operating without any equipment drawing AC current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



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

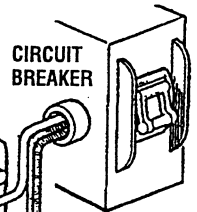
5. There are three plugs grouped for the right capacitor terminal, #7, #8, and #9. If the generator's no-load voltage is low, then disconnect the lower numbered plug and connect the plug with the next higher number. If the generator's no-load voltage is high, then disconnect the higher numbered plug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

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



NOTE: THE #7 WIRE IS SHOWN CONNECTED AS A DEMONSTRATION OF HOW THESE CONNECTIONS CAN BE MADE.

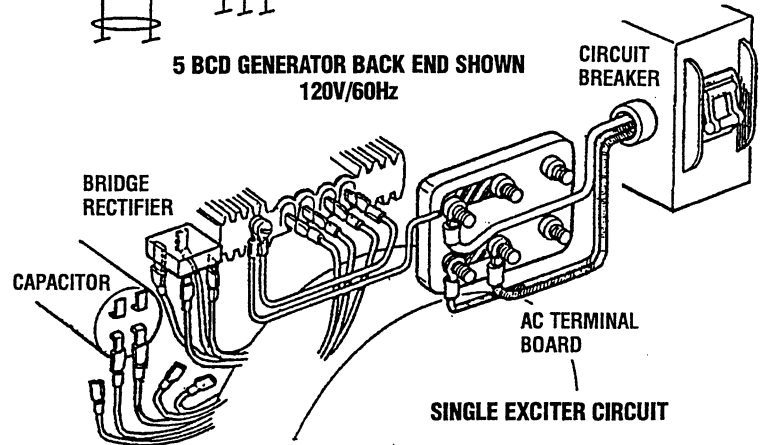
5 BCD GENERATOR BACK END SHOWN
120V/60Hz



4. Shut off the generator. Make sure the correct Hertz lead (60 Hertz #6, or 50 Hertz #5) is plugged into the capacitor(s).

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

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



SINGLE EXCITER CIRCUIT

See the ENGINE ADJUSTMENT section in this manual for ADJUSTING THE ENGINE SPEED.

5.0KW BC GENERATOR SINGLE PHASE

INTEGRAL CONTROLLER (I.C.)

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

Charging Voltage: 13.0 - 14.0 volts DC

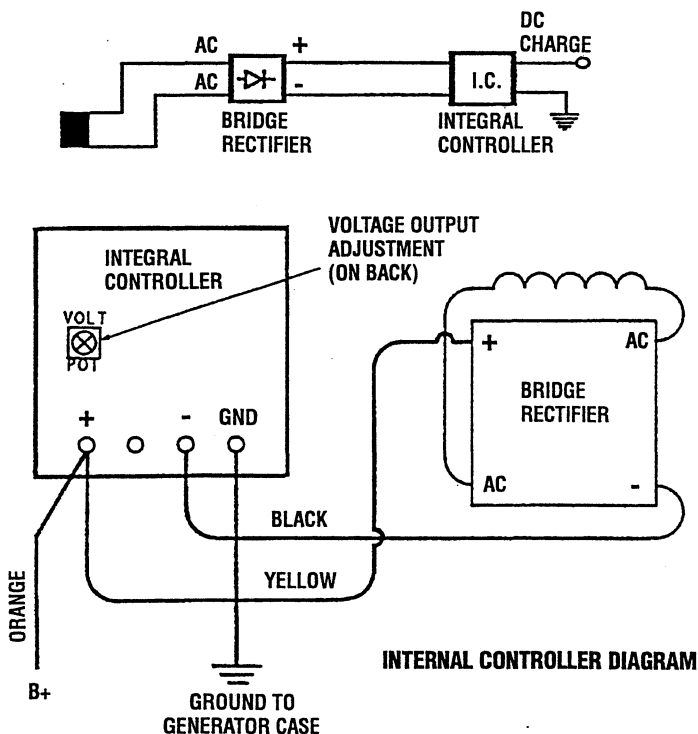
Charging Amperage: 0 - 10- amps DC

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

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

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

NOTE: New four wire controllers eliminate the ballast resistor circuit since the ballast resistor's function is now handled internally. Whenever replacing an early style controller with the newer four wire model, remove the ballast resistor and its wiring.



NOTE: Earlier model controllers had white/green (-) negative and white/black ground connections that are interchangeable.

Testing the Battery Charging Circuit

1. Bridge Rectifier

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

AC voltage running to the bridge rectifier (approximate):

No-load off the generator 16.0 volts AC

Full-load off the generator 17.5 volts AC

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

DC voltage running from the bridge rectifier (approximate):

No-load off the generator 17.0 volts DC

Full-load off the generator 18.5 volts DC

2. AC winding: 0.14 ohm

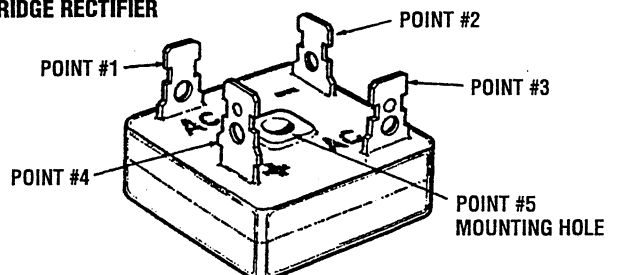
Lift the two AC wire leads off the bridge rectifier and measure the resistance between these two leads with an ohmmeter. It should measure 0.14 ohm. No continuity should exist between these two leads and the ground or the main AC stator windings.

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

- Set your ohmmeter's scale on RX1 (+ DC) and set the needle to zero.
- Connect the (+) positive lead from the ohmmeter to point #4. Taking the ohmmeter's negative (-) lead, momentarily touch points #1, #2, #3, and #5. The ohmmeter should register no deflection for any of the points touched.
- Remove the positive (+) lead from point #4 and connect the negative (-) lead; momentarily touch points #1, #2, and #3. The ohmmeter's needle should deflect when each point is touched.
- Leaving the negative ohmmeter (-) lead on point #4, touch point #5 with the positive lead. No deflection should take place.
- Place the positive (+) lead on point #1 and the negative (-) lead on point #3. The ohmmeter again should not register any deflection (no deflection indicated infinite resistance). Reverse these connections and the ohmmeter should again register no deflection. If the rectifier fails any of the previous tests (A-E), replace the rectifier because it is defective.

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

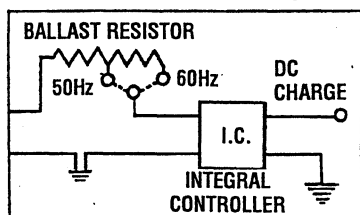
BRIDGE RECTIFIER



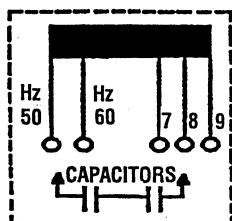
5.0KW BC GENERATOR SINGLE PHASE

Ballast Resistor 0.5 Ohm

Early model integral controllers have a ballast resistor installed along the DC positive (+) lead running from the bridge rectifier to the integral controller. This coil-type resistor functions to suppress high amperage draw coming from the controller when it is trying to charge a discharged starting battery.



Early controllers having this resistor in the DC charging circuit are of the three lead type. These three lead types consist of either three spade plugs in connections or consist of three wire leads from the controller.



TESTING THE EXCITER WINDINGS

Single Capacitor	Dual Capacitor	Dual Exciter
1.9 Ohms	2.2 Ohms	1.3 Ohms

An AC voltage is induced in these windings by the rotating field. Checking the residual voltage output from this winding can determine the condition of the winding when troubleshooting.

RESIDUAL VOLTAGE:

Single Capacitor Model:	10 - 14 Volts AC from each winding
Dual Capacitor Model:	14 - 16 Volts AC from each winding
Dual Exciter Model:	7 - 9 Volts AC from each winding

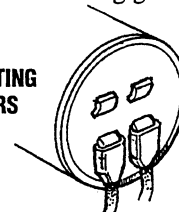
AC voltage can be measured across the capacitor(s) while the generator is operating. This voltage may be as high as 400 to 500 volts AC. This voltage buildup is accomplished as the exciter windings charge the capacitor(s) and the capacitor(s) discharge back into the exciter windings. This AC voltage reading is taken between the #60 Hertz connector and the # connection plugged into the capacitor(s) while the generator is operating at its rated Hertz (61.5 - 62.0). This flow of saturating AC in the exciter windings produces a phase-imbalance type of field that effects the auxiliary windings: a beneficial result that produces good motor starting characteristics for this type of generator.

To measure the resistance value of the exciter windings, locate the #9 and the #50 Hertz capacitor connections.

NOTE: Three numbered capacitor connections exist: #7, #8, and #9; and two Hertz connections, #50 and #60.

Unplug any other connections from the capacitor(s) noting their position on the capacitor. Place one lead of the ohmmeter on plug connection #9 and the other lead on plug connection #50 Hertz. Measure the resistance value of the exciter windings. Check to make sure there is no continuity to the ground/generator case from either of the two leads. Also check that no continuity exists between either the #50 Hertz plug or the #9 plug and any of the main stator windings leads on the AC terminal block. If continuity is found here, a fault exists between these two winding groups.

FIELD TESTING CAPACITORS



FIELD-TESTING THE CAPACITOR

With a capacitor meter, test the capacitor following the instructions included with the meter, and compare the results with the value shown on the capacitor. When a capacitor meter is not available, perform the following simple test:

1. Marking them so they may be reattached correctly, unplug the connections from the capacitor.
2. With a jumper, short across the two connections exposed in the previous step. This ensures the capacitor is discharged as it would be at shutdown.
3. With an ohmmeter set on the high R scale, place its plus (+) lead on one capacitor connection and the negative (-) lead on the other capacitor connection. A resistance should be read and should rise slowly as the meter attempts to charge the capacitor. This indicates a presumably good capacitor.
4. Indications of a defective capacitor:
 - a. Zero resistance or no rise in resistance value (shorted capacitor).
 - b. Infinite resistance (open capacitor).
 - c. No continuity should be found between the capacitor's connections and the capacitor's case or base.
5. Capacitor Ratings (Capacitor meter)
 - a. Single Capacitor Units: 25.0 microfarads (uF) 5°
 - b. Dual Capacitor Units: 31.5 microfarads (uF) 5°

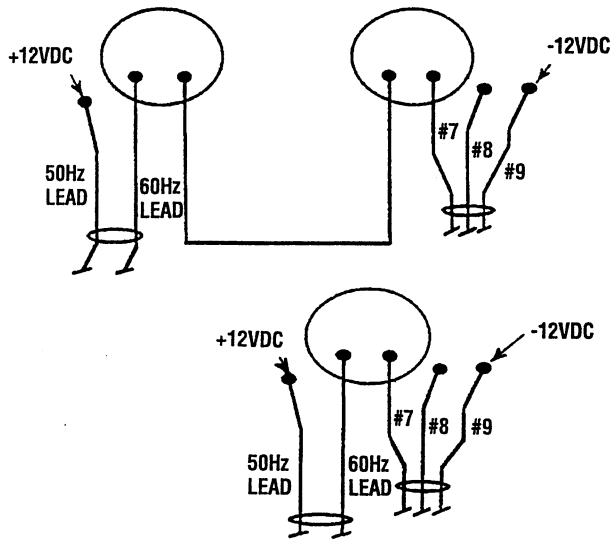
NOTE: Ratings are found on the capacitor case.

NOTE: The older single capacitor models used a 25.0 microfarad capacitor. All new model single capacitor units now have a 31.5 microfarad capacitor. When replacing a capacitor in either an early model or a later model, ensure that the correct rated capacitor is installed. The capacitor rating is marked on the housing of the capacitor:

25.0 Microfarad capacitor PN 035985
31.5 Microfarad capacitor PN 035978.

5.0KW BC GENERATOR SINGLE PHASE

6. 12 volt DC excitation (low or no AC output voltage) the generator may be excited using 12 volts DC taken from the engine's starting battery. This voltage is applied across the #50 and #9 leads of the exciter circuit windings with any other numbered leads unplugged from the capacitors(s). The generator's reaction during flashing will help determine its fault.



7. During 12 volt excitation, output voltage ranges are as follows:

Single Capacitor	Dual Capacitor	Dual Exciter
22 - 26 VAC	24 - 28 VAC	12 - 14 VAC

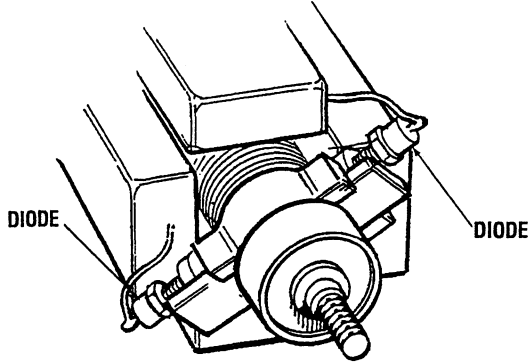
- A slight rise in the output voltage with the loading of the engine and/or a growling noise from the generator end will indicate a fault in the main stator windings.
- No rise or very slight rise in the output voltage will indicate a fault in the exciter windings.
- Normal output voltage as specified above, check exciter circuit capacitor(s).

5.0KW BC GENERATOR SINGLE PHASE

Testing Component Resistance Values

Rotating Field/Auxiliary Windings and Diodes

Two sets of windings are found in the rotor assembly. An AC voltage is produced in two groups of windings as the rotor turns at rated rpm. The AC voltage passes through each of the two diodes mounted on the isolated fixture just before the rotor carrier bearing. The AC sine wave is changed to a DC and this DC voltage is passed through the two groups of rotating field windings producing a DC field around these windings. This field affects the AC winding of the two main stator groups inducing an AC voltage in these windings that is available at the AC terminal block connections.



1. Rotating Field/Auxiliary Windings
5.0 KW BCG 3.8 Ohm

To check the resistance values, rotate the engine's crankshaft to position the diode(s) on the generator's shaft at 12 o'clock. To make a quick check of these windings, presume the diode is OK and place one of the ohmmeter's leads on the connection at the top of the diode and the other lead at the connection at the base of the diode. Compare readings with the value above. If a distinct difference is noted in the ohm value, carefully unsolder the lead on the top of the diode and remove the diode from its isolated heat sink using a thin walled, deep well 7/16 in (11 mm) socket.

NOTE: The aluminum heat sink that the diode threads into can be bent carefully outboard to make easier access to the diode.

With the diode removed, both leads for the first group of rotating field/auxiliary windings will be isolated with no interference from a possibly faulty diode.

Check the resistance value of the rotating windings by placing the ohmmeter's leads across the two exposed leads.

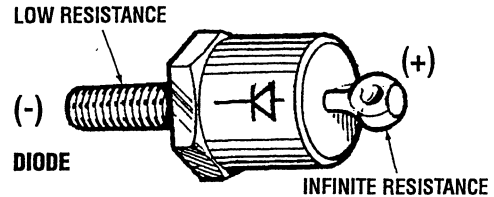
Also, verify that no continuity exists between these windings and the rotor shaft by leaving one ohmmeter lead attached to the winding lead and the other ohmmeter lead touching the shaft: no continuity should exist. If continuity is found, a short exists..

Repeat this same check on the second group of windings. Rotate the engine's crankshaft 180° to position the second diode and connections at 12 o'clock.

No continuity should be found between these two groups of windings.

2. Diodes 8 - 9.5 ohms (approximate) using a 260 Simpson Analog Meter

To check the diode, unsolder the connection from the top of the diode. Place one ohmmeter lead on the connection at the top of the diode and the other ohmmeter lead to the diode's base. Then reverse the position of the ohmmeter leads.



A low resistance should be found with the leads in one direction, and infinite resistance (blocking) in the other direction. Different meters will read different resistance values through the diode.

NOTE: Different meter models may show different ohm values, but should read the same for both diodes.

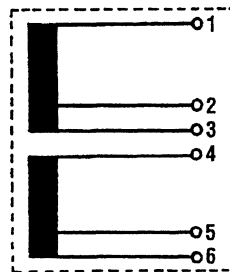
Diode Rating: 1600 amps 26 Amps

The diode's rating is far in excess of the circuit's requirements. Most likely a diode failure will result from an overspeed or load surge.

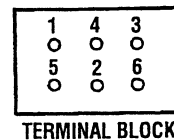
Main Stator Windings

Single Capacitor	Dual Capacitor	BC Model
0.6 Ohms	0.4 Ohms	0.3 Ohms

Residual voltage measured between #1-#3 and #4-#6 will be 2-3 volts AC between each pair of leads at the terminal block. This would be an indication that the stator windings are okay. Check exciter windings and artificially excite the generator.



NOTE: The numbered leads on the terminal block are not in any numerical order. They are shown below.



Group #1 – Measure resistance value between terminal with lead #1 and terminal with lead #3. (Check that there is no continuity of Group #1 windings to the case ground.)

Group #2 – Measure resistance value between terminal with lead #4 and terminal with lead #6. (Check that there is no continuity of Group #2 windings to the case ground.)

Check for a possible short between the two groups of stator windings by placing one lead of the ohmmeter on the terminal with the stator lead #3 and the other ohmmeter lead on the terminal with stator lead #6. There should be no continuity between the two groups of stator windings.

SPECIFICATIONS - 5.0KW BCDBR GENERATOR

ENGINE SPECIFICATIONS

Engine Type	Diesel, four-cycle, three-cylinder, fresh water-cooled, vertical in-line overhead valve mechanism (9.2 Hp at 1800 rpm maximum).
Aspiration	Naturally aspirated
Governor	Centrifugal type
Combustion Chamber	Swirl type
Bore & Stroke	2.76 x 2.76 inches (70 x 70 mm)
Piston Displacement	49.31 cubic inches (0.808 liters)
Firing Order	1 - 3 - 2
Direction of Rotation	Clockwise, when viewed from the front
Compression Ratio	23 : 1
Dimensions	Height: 24 inches (612 mm) Width: 18 inches (460 mm) Length: 34 inches (863 mm)
Weight	375 lbs (170 kgs)
Fuel Consumption	1.0 gph (4.2 lph) at 1800 rpm
Inclination	Continuous 14° Temporary 25° (not to exceed 30 min.)

TUNE-UP SPECIFICATIONS

Compression Pressure (Limit of Difference Between Cylinders)	398 psi (28 kg/cm ²) at 280 rpm limit (33.5 psi (2.5 kg/cm ²))
Valve Timing	Intake Opens 19° BTDC Intake Closes 51° ABDC Exhaust Opens 51° BBDC Exhaust Closes 19° ATDC
Valve Seat Angle	Intake 45° Exhaust 45°
Engine Speed	1800 rpm 60 Hertz 1500 rpm 50 Hertz
Valve Clearance (engine cold)	Intake and Exhaust 0.098 inches (0.25 mm)
Injector Pressure	1988 ± 142 psi (140 ± 10 kg/cm ²)
Emission Control Systems	Smoke puffer limiter

LUBRICATION SYSTEM

General	Pressure fed system by geared pump.
Oil Filter	Full flow, paper element, spin-on type.
Sump Capacity (not including filter)	3.2 U.S. qts (3.03 liters).
Operating Oil Pressure (engine hot)	35 - 55 psi (2.5 - 3.8 kg/cm ²).
Oil Grade	API Specification CF or CG-4, SAE 30, 10W-30, 15W-40.

FUEL SYSTEM

General	Open flow, self bleeding - self priming
Fuel	No. 2 diesel oil (cetane rating of 45 or higher)
Fuel Injection Pump	In-line plunger, Bosch type
Fuel Injection Timing (spill timing)	11 ± 5° BTDC (Before Top Dead Center)
Nozzle	Throttle type
Fuel Filter	Canister type
Air cleaner	Paper or filter
Air Flow (engine combustion)	26.0 cfm (0.73 cmm)

ELECTRICAL SYSTEM

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

COOLING SYSTEM

General	Fresh water-cooled block, thermostatically-controlled
Operating Temperature	170 - 190° F (77 - 88° C)
Fresh Water Pump	Centrifugal type, metal impeller, belt-driven
System Capacity (fresh water)	6 qts (5.6 liters)
Radiator Air Flow	695 cfm (20 cmm)

AC GENERATOR (SINGLE PHASE)

General - Single Phase	Brushless, four-pole, revolving field. Self-exciting, capacitor saturated field excitation. Pre-lubricated, single-bearing design. 120 volts, single phase.
Voltage - Single Phase	120 Volts - 60 Hertz 220 Volts - 50 Hertz
Voltage Regulation	±5% no load to full load
Frequency Regulation	3.0 Hertz (5%) no load to full load
Rating (Volts AC)	60 Hertz (1800 rpm) 120 Volts 41.6 Amps 50 Hertz (1500 rpm) 230 Volts 18 Amps
Electromagnetic interference level	Exceeds requirements for most marine radio telephones and standard televisions. Meets CE (Certified Europe) requirements.

GENERATOR COOLING

Cooling	Cast Centrifugal blower, direct connected.
Air Requirements	175 - 200 cfm (4.95 - 5.66 cmm) (60 Hertz @ 1800 rpm)
NOTE: Increase air supply 15% for 50 Hertz operation @ 1500 rpm.	
Generator Compartment Temperature	120° F (50° C) maximum Ambient Temperature

GenRemote CALIBRATION

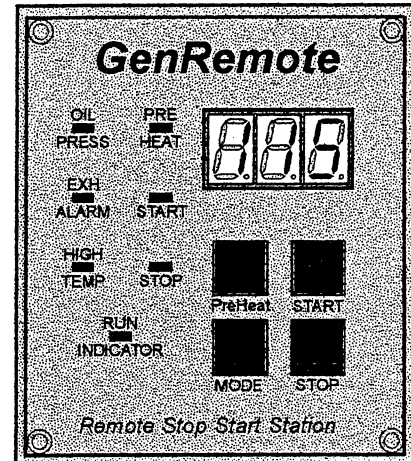
NOTE: THIS DATA APPLIES ONLY TO THE OPTIONAL GenRemote CONTROLS

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".

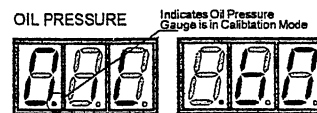
Calibration Method

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.

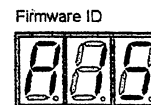
No calibration of the Frequency Meter is required or allowed. The Frequency Meter is factory calibrated to \pm one (1) Hz.

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.

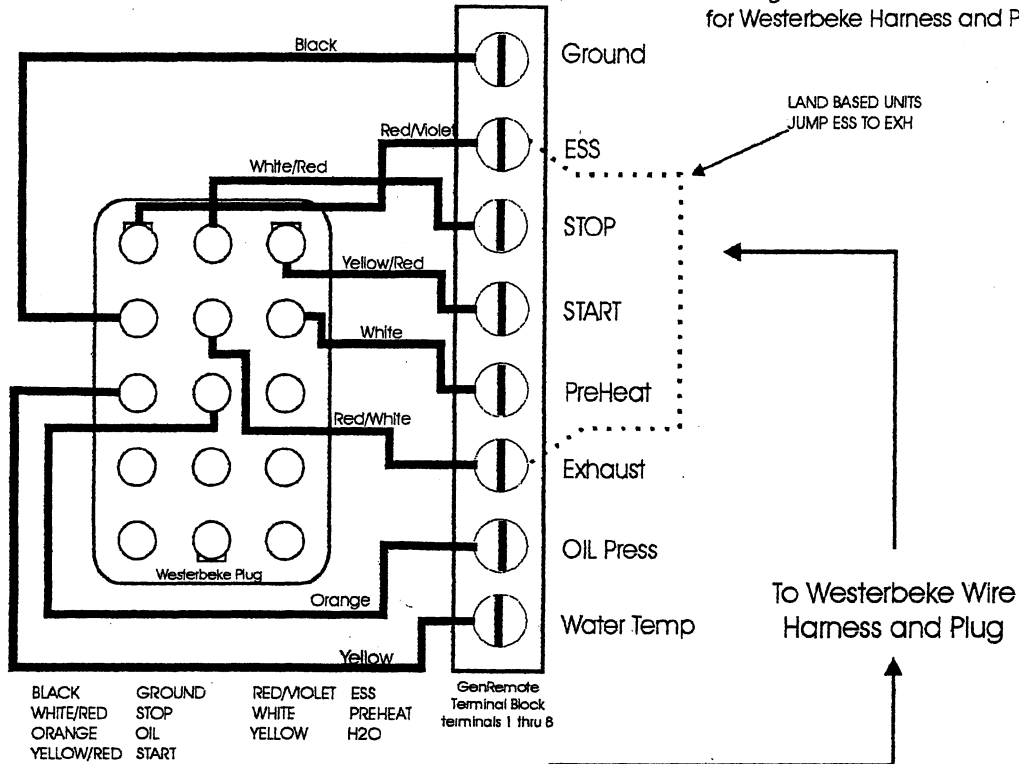
The alarm LED will remain lit after the generator shuts down to provide indication as to why the unit stopped.

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.

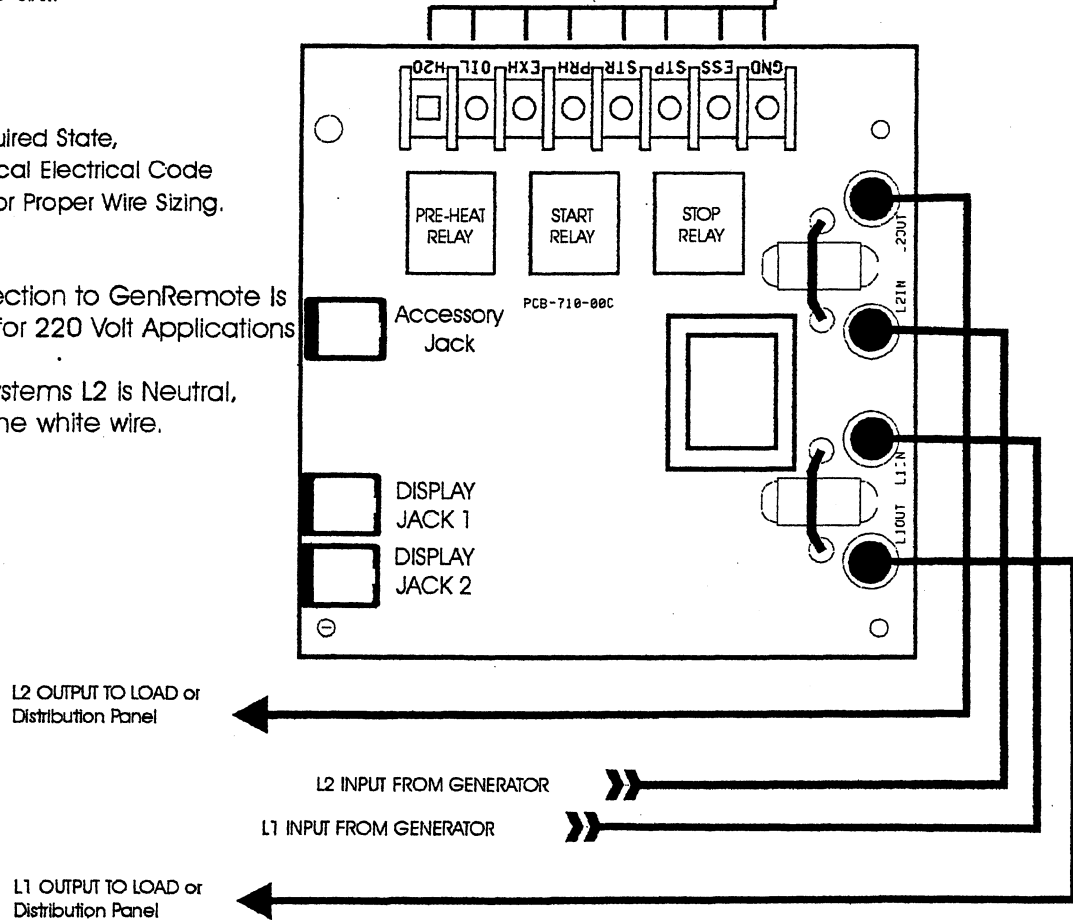


Notes:

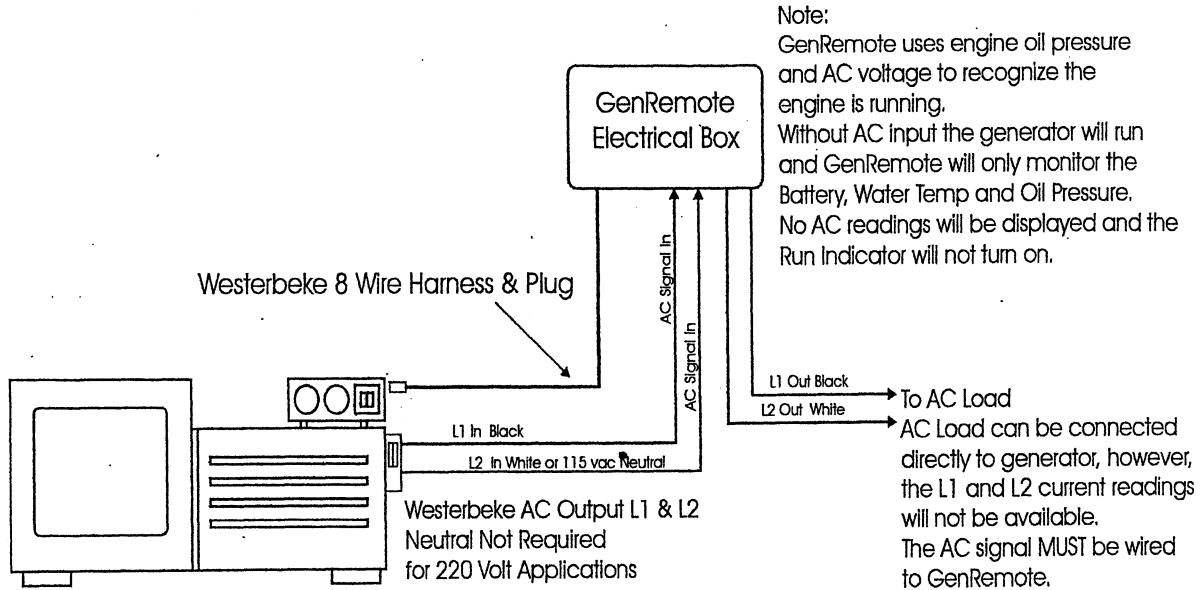
Follow The Required State, Federal and Local Electrical Code Requirements for Proper Wire Sizing.

Important !
Neutral Connection to GenRemote Is Not Required for 220 Volt Applications

For 115 Volt systems L2 is Neutral, this is usually the white wire.



GenRemote INSTALLATION DIAGRAM



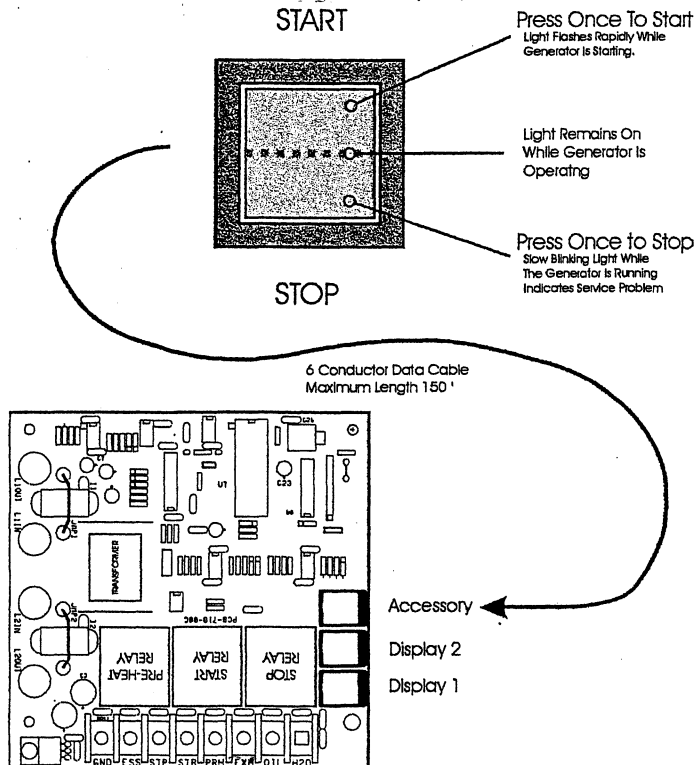
STOP/START ROCKER SWITCH

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.

POWER TAKE OFF SYSTEMS

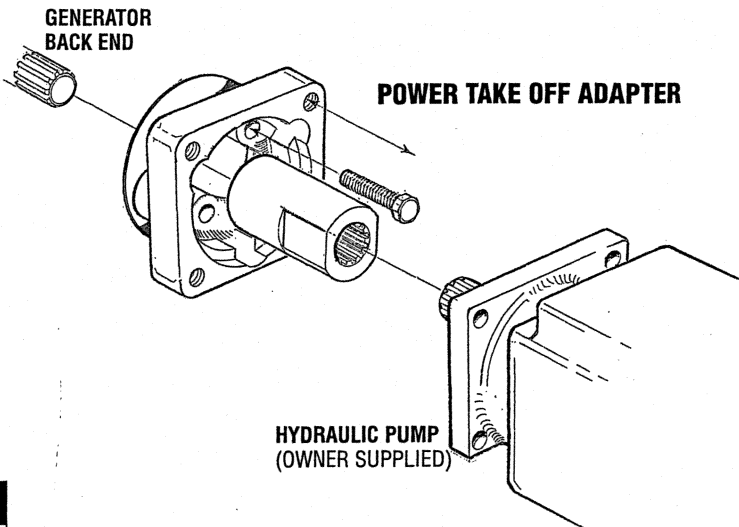
POWER TAKE OFF ADAPTER

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 auxiliary lighting and provides continuous operation of up to three extrication tools at the same time.

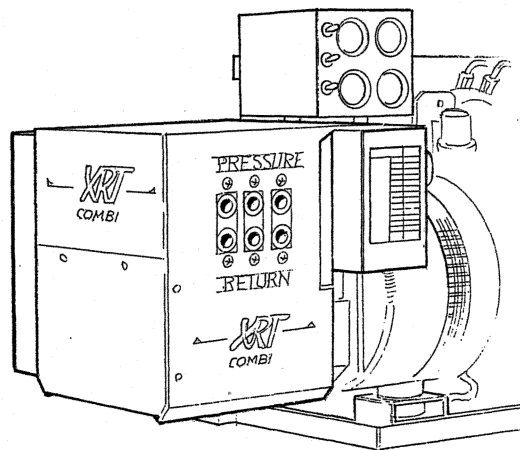


SPECIFICATIONS

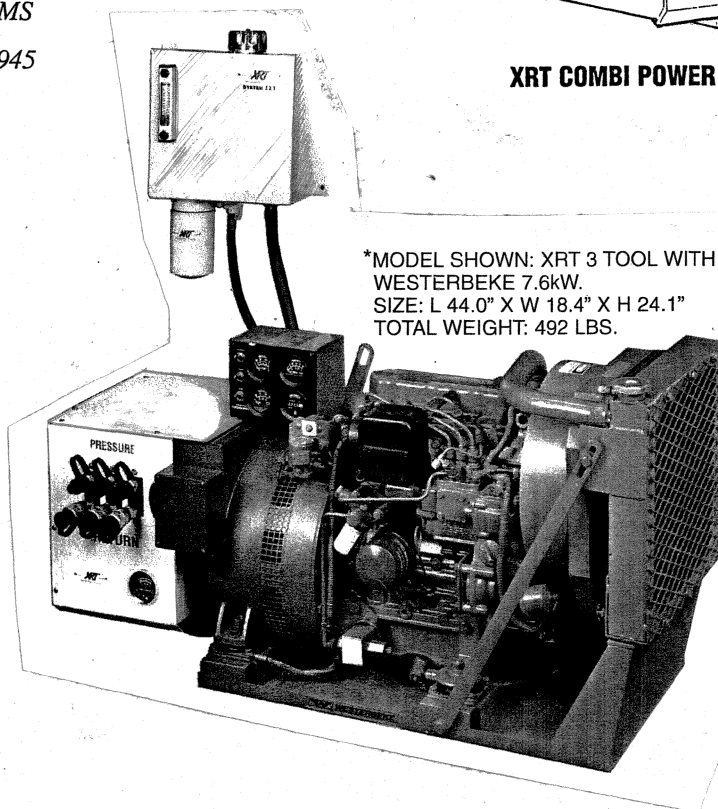
Components	Dual stage continuous duty pump, stainless high pressure fittings, three gallon reservoir with filter, pump enclosure with integral control block assemblies.
System Availability	5,000 psi phosphate ester fluid and mineral fluid systems up to 10,500psi.
Dimensions	COMBI pump in shroud. L:10" 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



*MODEL SHOWN: XRT 3 TOOL WITH WESTERBEKE 7.6kW.
SIZE: L 44.0" X W 18.4" X H 24.1"
TOTAL WEIGHT: 492 LBS.

STANDARD AND METRIC CONVERSION DATA

LENGTH-DISTANCE

Inches (in) x 25.4 = Millimeters (mm) x .0394 = Inches

Feet (ft) x .305 = Meters (m) x 3.281 = Feet

Miles x 1.609 = Kilometers (km) x .0621 = Miles

DISTANCE EQUIVALENTS

1 Degree of Latitude = 60 Nm = 111.120 km

1 Minute of Latitude = 1 Nm = 1.852 km

VOLUME

Cubic Inches (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

LIQUID WEIGHTS

Diesel Oil = 1 US gallon = 7.13 lbs

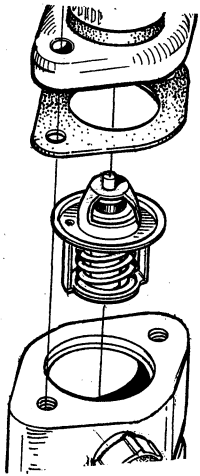
Fresh Water = 1 US gallon = 8.33 lbs

Gasoline = 1 US gallon = 6.1 lbs

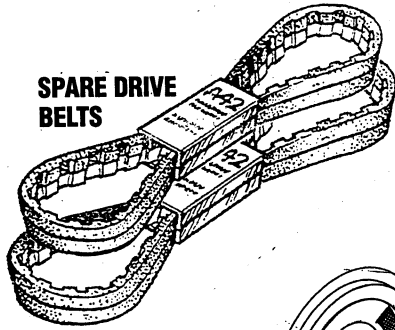
Salt Water = 1 US gallon = 8.56 lbs

SUGGESTED SPARE PARTS

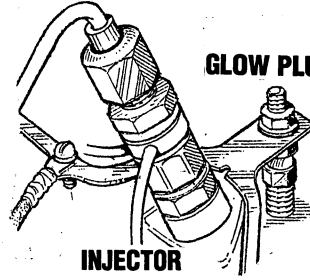
CONTACT YOUR WESTERBEKE DEALER FOR SUGGESTIONS AND ADDITIONAL INFORMATION



THERMOSTAT KIT

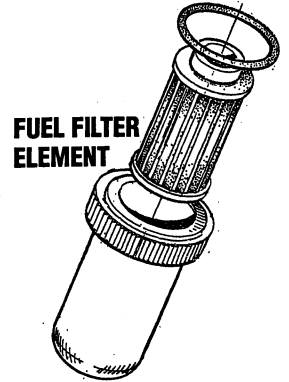


SPARE DRIVE BELTS

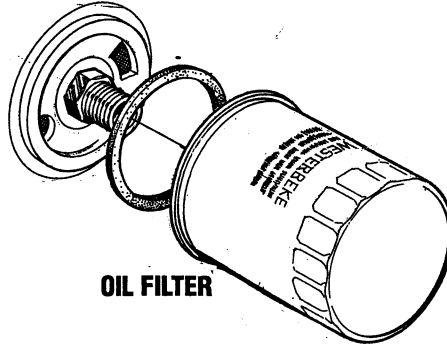


GLOW PLUGS

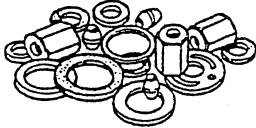
INJECTOR



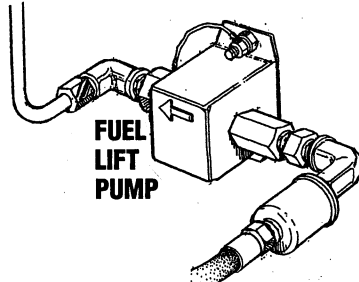
FUEL FILTER ELEMENT



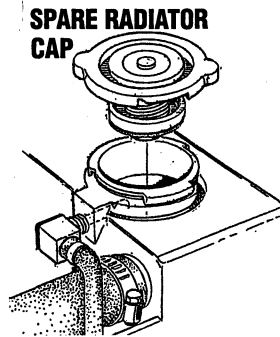
OIL FILTER



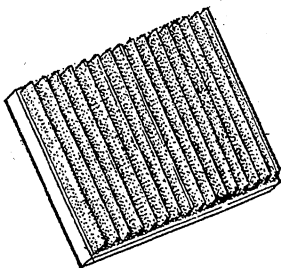
FUEL SYSTEM HARDWARE KIT



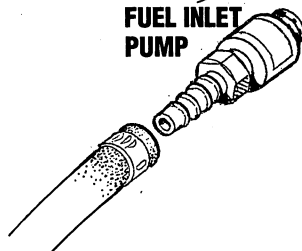
FUEL LIFT PUMP



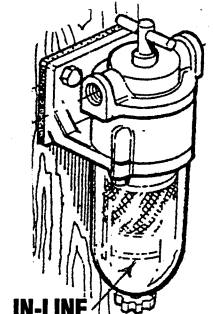
SPARE RADIATOR CAP



FILTER CARTRIDGE



FUEL INLET PUMP



IN-LINE FUEL FILTERS

