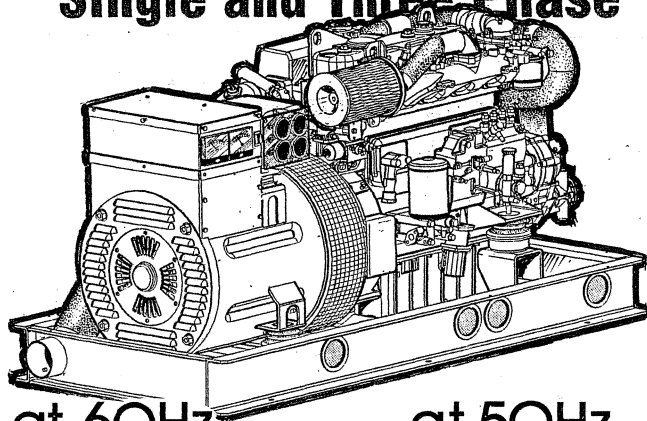




OPERATORS MANUAL

DIESEL GENERATORS

Single and Three Phase



at 60Hz

40BEDA

45BED(A)

55BED

60BEDA

65BED

70BEDA

95BED(A)

at 50Hz

30BEDA

35BED(A)

50BED

45BED(A)

55BED

60BEDA

80BED(A)

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**CALIFORNIA
PROPOSITION 65 WARNING**

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

⚠ WARNING:

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

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

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



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

WESTERBEKE also recommends installing CARBON MONOXIDE DETECTORS in the living/sleeping quarters of your vessel. They are inexpensive and easily obtainable at your local marine store.

SAFETY INSTRUCTIONS

INTRODUCTION

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

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

PREVENT ELECTRIC SHOCK

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

- Do not operate this machinery without electrical enclosures and covers in place.
- Shut off electrical power before accessing electrical equipment.
- Use insulated mats whenever working on electrical equipment.
- Make sure your clothing and skin are dry, not damp (particularly shoes) when handling electrical equipment.
- Remove wristwatch and all jewelry when working on electrical equipment.

PREVENT BURNS — HOT ENGINE

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

- Monitor engine antifreeze coolant level at the plastic coolant recovery tank and periodically at the filler cap location on the water jacketed exhaust manifold, but only when the engine is COLD.

⚠ 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!

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

SAFETY INSTRUCTIONS

ACCIDENTAL STARTING

⚠ WARNING: Accidental starting can cause injury or death!

- Turn OFF the DC breaker on the control panel or turn the unit's battery selector switch to OFF before servicing the engine.
- Make certain all personnel are clear of the engine before starting.
- Make certain all covers, guards, and hatches are re-installed before starting the engine.

BATTERY EXPLOSION

⚠ WARNING: Battery explosion can cause injury or death!

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

BATTERY ACID

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

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

TOXIC EXHAUST GASES

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

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

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

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

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

AVOID MOVING PARTS

⚠ WARNING: Rotating parts can cause injury or death!

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

SAFETY INSTRUCTIONS

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

HAZARDOUS NOISE

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

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

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

OPERATORS MANUAL

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

ENGINE AND GENERATOR INSTALLATIONS

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

Sections of the ABYC standards of particular interest are:

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

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

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

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

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

Order From:

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

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

Order From:

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

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

Order From:

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

INSTALLATION

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

CODES AND REGULATIONS

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

SIPHON-BREAK

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

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

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



AVAILABLE FROM
YOUR WESTERBEKE
DEALER

SIPHON-BREAK WITH STAINLESS
LOOP

EXHAUST SYSTEM

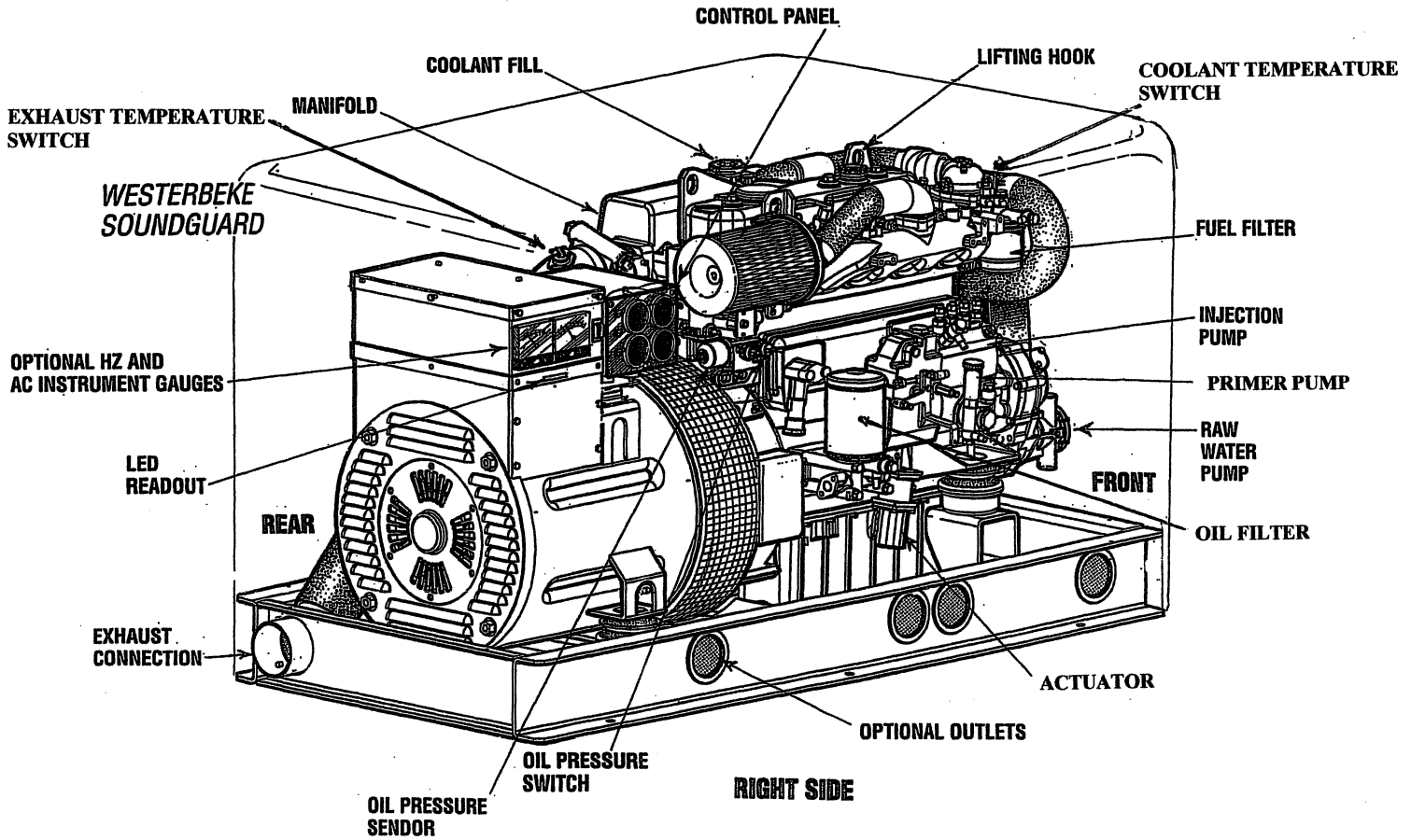
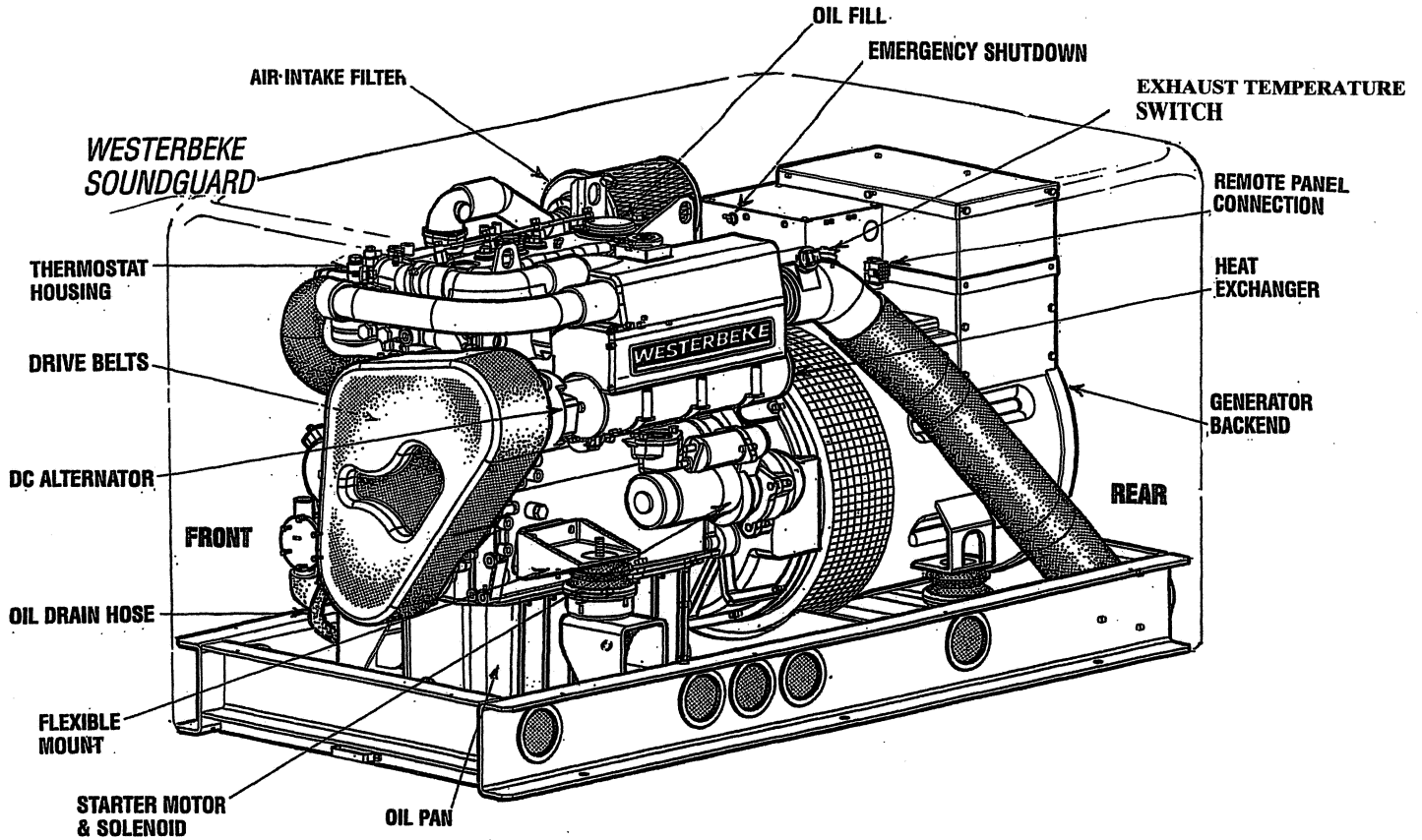
The exhaust system's hose **MUST** be certified for marine use. Corrugated Marine Exhaust Hose is recommended. The use of this type of hose allows for extreme bends and turns without the need of additional fitting and clamps to accomplish these bends and turns. In this regard, a single length of corrugated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

A detailed Marine Installation Manual covering gasoline and diesel, engines and generators, is supplied with each unit. A pdf is available to download from our website at www.westerbeke.com.

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PARTS IDENTIFICATION



INTRODUCTION

This WESTERBEKE 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 engine require servicing, contact your nearest WESTERBEKE dealer for assistance.

This is your Operators Manual. A Service Manual will also be available from your WESTERBEKE dealer. If you are planning to install this equipment contact yourself, contact your WESTERBEKE dealer for WESTERBEKE'S Installation Manual.

WARRANTY PROCEDURES

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



Customer Identification

MR. GENERATOR OWNER

MAIN STREET

HOMETOWN, USA

Model 45Kw

Ser. #E212XXXX

Expires 9/20/02

Customer Identification Card (Typical)

The WESTERBEKE serial number is an alphanumeric number that can assist in determining the date of manufacture of your WESTERBEKE engine/generator. The first character indicates the decade (A=1960s, B=1970s, C=1980s, D=1990s E=2000s), the first number represents the year in the decade, and the second and third numbers represent the month of manufacture.

PRODUCT SOFTWARE

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

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ORDERING PARTS

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

SPARES AND ACCESSORIES

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

NOTES, CAUTIONS AND WARNINGS

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

NOTE: *An operating procedure essential to note.*


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

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




INTRODUCTION

SERIAL NUMBER LOCATION

The engine's model number and serial number are located on a nameplate mounted on the side of the engine's manifold. The engine's serial number is stamped into the engine block (left side) behind the alternator, below the manifold. 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. 



The generator serial number and model number are located on a decal on the generator housing. Take the time to enter the information on the blank decal provided. This will provide a quick reference when seeking technical information and/or ordering 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. _____		

UNDERSTANDING THE DIESEL ENGINE

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

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

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

PROTECTING YOUR INVESTMENT

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

NOTE: Six important steps to ensure long generator life:

- Proper engine and generator installation and alignment.
- An efficient well-designed exhaust system that includes an anti-siphon break to help prevent water from entering the engine.
- Changing the engine oil and oil filters every 250 operating hours.
- Proper maintenance of all engine and generator components according to the maintenance schedule in this manual.
- Use clean, filtered diesel fuel.
- Winterize your engine according to the "Lay-up and Recommissioning" section in this manual.

DIESEL FUEL, ENGINE OIL AND ENGINE COOLANT

DIESEL FUEL

No. 2-D (Cetane rating of #45 or higher) SAE J313, grade of fuel according to ASTM D975.

CARE OF THE FUEL SUPPLY

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

Purchase a well-known brand of fuel.

Install and regularly service a good, visual-type fuel filter/water separator between the fuel tank and the engine. The Racor 500 or larger is a good example of such a filter.

ENGINE OIL

Use a heavy duty diesel oil with an API classification of CF, CG-4, CH-4 or CI-4. Change the engine oil and filter after an initial 50 hours of break-in operation. Then follow the oil and filter change intervals as specified in the **MAINTENANCE SCHEDULE** in this manual.

Westerbeke Corporation does not approve or disapprove of the use of synthetic oils. If synthetic oils are used, engine break-in must be performed using conventional oil. Oil change intervals must be listed in the **MAINTENANCE SCHEDULE** section in this manual and not be extended if synthetic oils are used.

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

OIL PRESSURE

The engine's oil pressure, during operation, is indicated by the oil pressure gauge on the instrument panel. During normal operation, the oil pressure will range between 25 and 85 psi.

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

ENGINE COOLANT

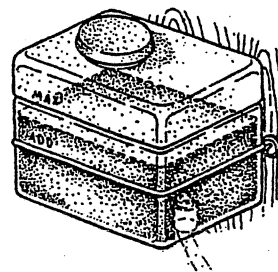
Westerbeke recommends the use of pre-mixed both for gasoline and diesel engine cooling systems. This ensures that when antifreeze needs to be added, the correct mixture will be added. For Diesel engine cooling systems, Premixed Extended Life Heavy Duty Diesel Antifreeze is recommended. This is specially formulated to help prevent cavitation erosion of the cylinder walls of the diesel engine.

When pre-mixed is not available, select a well known brand and mix 50/50. 50% antifreeze and 50% distilled water, thoroughly mix the two before adding it to the cooling system. Change the antifreeze mixture according to the **MAINTENANCE SCHEDULE** in the manual.

COOLANT RECOVERY TANK

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

NOTE: *This tank, with its short run of plastic hose, must be located above the level of the engine's manifold.*



GENERATOR CONTROL PANELS

DESCRIPTION OF SWITCHES

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

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



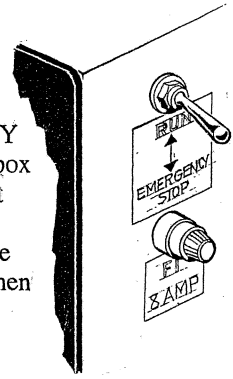
PREHEAT: The PREHEAT toggle switch when depressed activates the preheat circuit, K2 run relay, instruments on the control panel and excites the DC alternator.

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, depress the START switch which 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 has normally closed contacts. This provides DC power to the K2 run relay through the three safety shut-down switches and the over-speed PC Board. Depressing this toggle switch opens the contacts, breaking the DC circuit through de-energizing the K2 run relay, shutting down the generator.

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 between 30 to 60 psi.

DC Voltmeter

Indicates the amount the battery is being charged should show 13.5V to 14.4V.

Hourmeter

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

REMOTE PANEL

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



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

PREPARATIONS FOR INITIAL START-UP

PRESTART INSPECTION

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

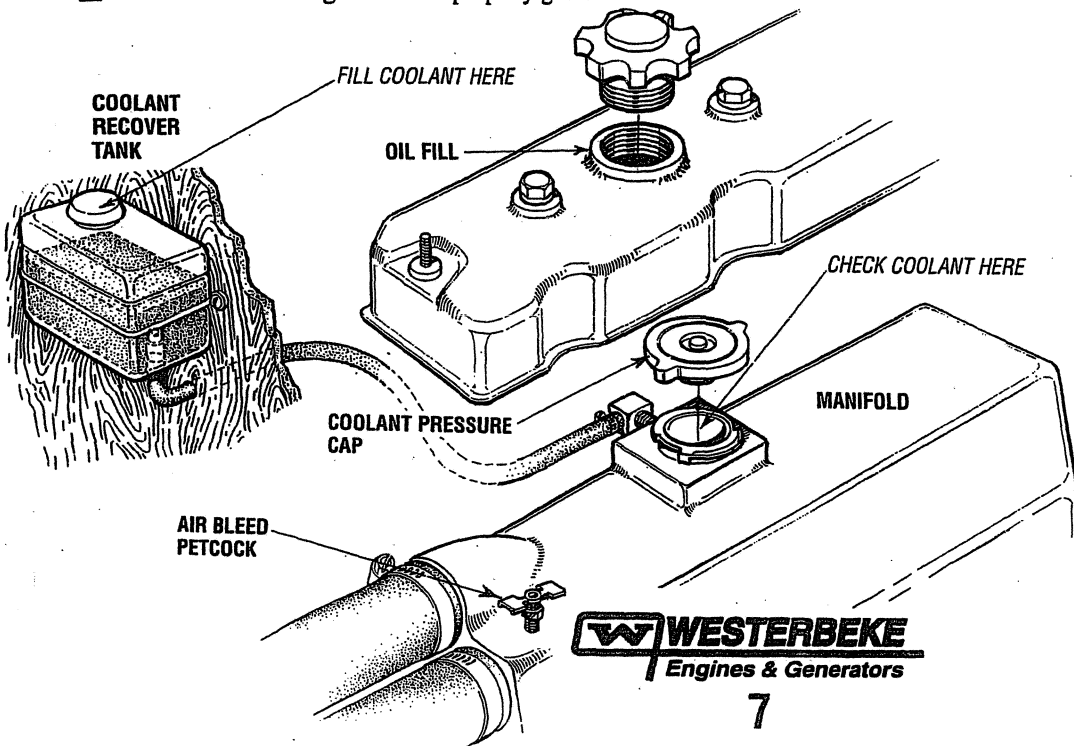
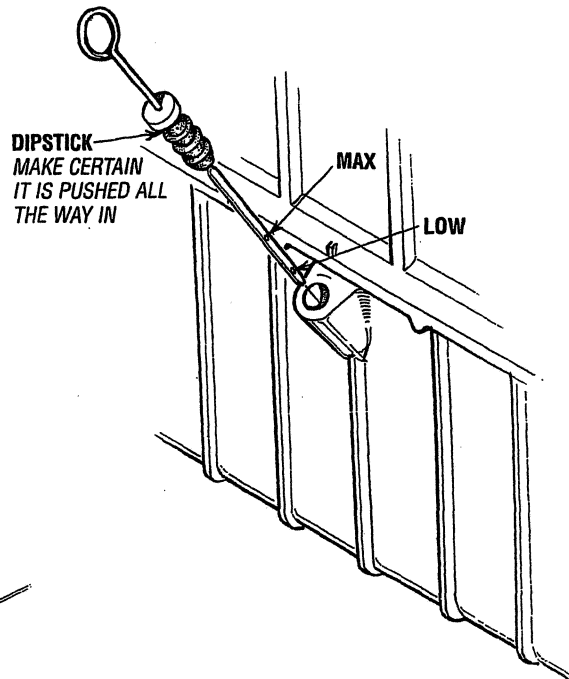
Before starting your generator set for the first time or after a prolonged layoff, check the following items:

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

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

GENERATOR VOLTAGE

The speed of the generator engine is adjusted at the factory by electronic governing at 50 or 60 Hz \pm 0.5% from no load to full load.



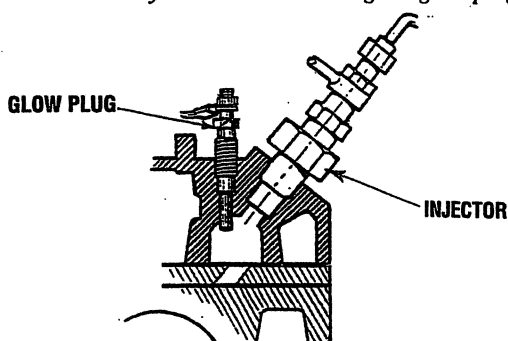
STARTING/STOPPING PROCEDURE

THE STARTING SYSTEM

Westerbeke diesel generators use electric starters assisted by glow plugs for both normal and cold weather starting. The illustration below shows a cross-sectional view of one cylinder. The glow plug is located in the combustion chamber so that its tip is in the injector nozzle's spray path. When the glow plug is energized by the PREHEAT switch, 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 switch must be depressed for the time specified in the preheat chart. Then, while keeping the PREHEAT switch engaged, the START switch 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.

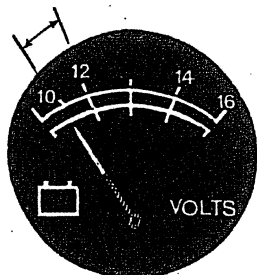


PREHEAT: Depress the PREHEAT switch. The voltmeter and panel lights, gauges and meters will be activated. The PREHEAT switch should be depressed in accordance with the following chart:

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.*

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

Remote Starting Procedure

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

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

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.

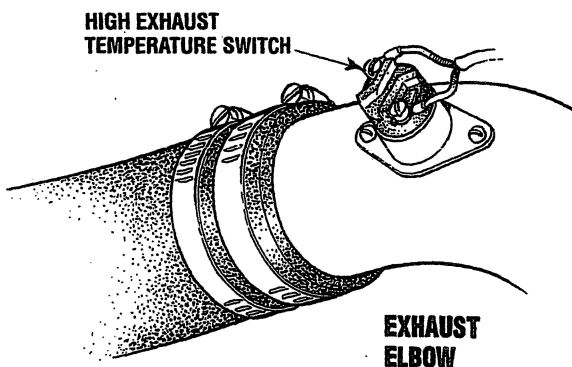
SAFETY SHUTDOWN SWITCHES

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:

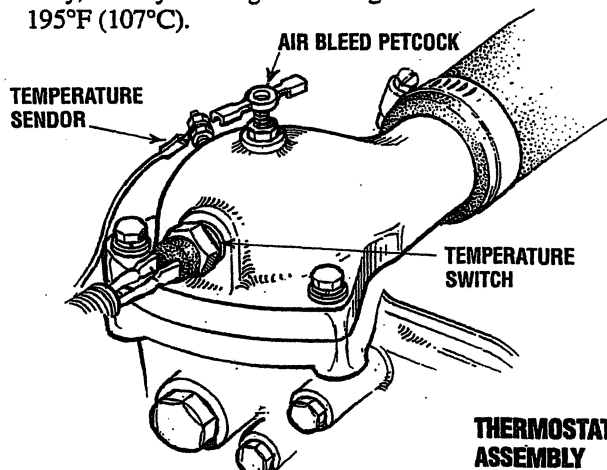
High Exhaust Temperature Switch

An exhaust temperature switch is located on the exhaust elbow. Normally closed, this switch will open and interrupt the DC voltage to the K2 relay (shutting OFF the engine) should the switch's sensor indicate an excessive exhaust temperature (an inadequate supply of raw water causes high exhaust temperatures). This switch opens at 260-270°F (127-132°C). This switch resets at approximately 225°F (107°C).



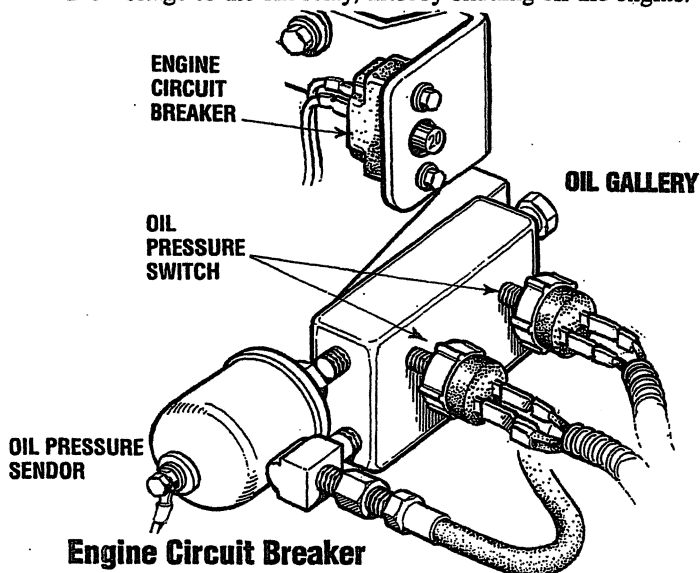
Coolant Temperature Switch

A high coolant temperature switch is located on the thermostat housing. Normally closed, this switch, should the fresh water coolant's operating temperature reach approximately 210°F (99°C), will open and interrupt the DC voltage to the K2 relay, thereby shutting off the engine. This switch resets at 195°F (107°C).



Low Oil Pressure Switch

A low oil pressure shutdown switch is located off the engine's oil gallery. Normally open in a static state, this switch's sensor monitors the engine's oil pressure. Should the engine's oil pressure fall to 5-10 psi, this switch will open interrupting the DC voltage to the K2 relay, thereby shutting off the engine.



Engine Circuit Breaker

The generator's engine is protected by an engine mounted manual reset circuit breaker (20 amps DC). Excessive current draw or electrical overload anywhere in the instrument panel wiring or engine wiring will cause the breaker to trip. In this event the generator will shut down and the voltage to the K2 relay is terminated. If this should occur, check and repair the source of the problem. After repairing the fault, reset the breaker and restart the generator.

GENERATOR BREAK-IN PROCEDURE

DESCRIPTION

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

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

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

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

AFTER START-UP

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

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

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

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

CHECK THE FOLLOWING

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

To protect against unintentional overloading of the generator, each of the generator's output leads should be routed through a circuit breaker rated for the amperage that lead will carry.

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

GENERATOR ADJUSTMENTS

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

THE DAILY OPERATION

CHECK LIST

Follow this check list each day before starting your generator.

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

START THE GENERATOR

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

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

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

STOPPING THE GENERATOR

Remove the major AC loads from the generator one at a time. Allow the generator to run for 3-5 minutes as this will allow the generator temperature to stabilize and also allow the engines with a turbo charger for its rpm's to reduce while the engine oil pressure is still available for lubrication. Depress and hold the STOP switch until the generator comes to a complete stop.

TURBOCHARGED GENERATOR

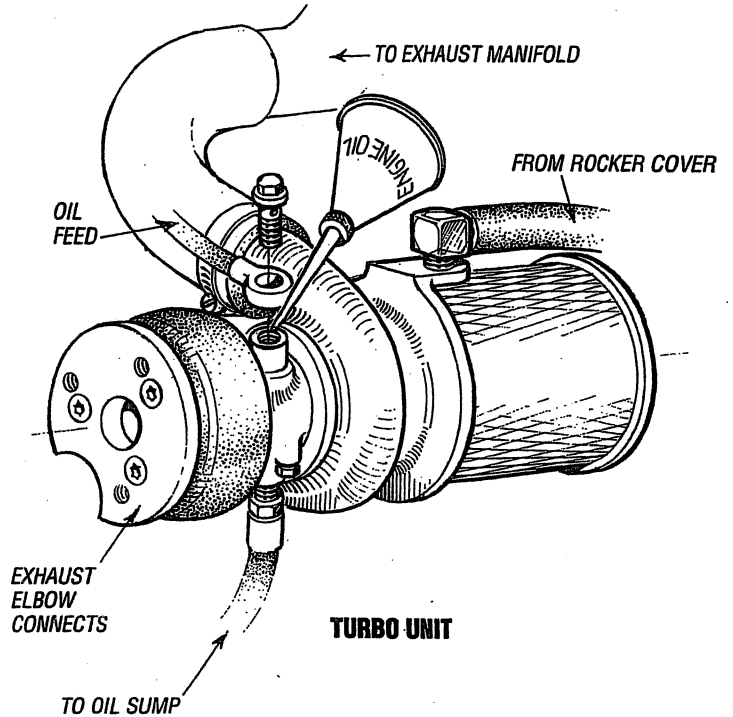
The startup, warm-up, and stopping procedures are the same as a non-turbo generator.

NOTE: Be certain to use the same shutdown procedure, allowing the turbocharger to cool down.

CAUTION: Failure to cool down the turbocharger could result in insufficient lubrication of its bearings.

When starting a turbocharged generator after a long period of time (more than a month) proceed as follows:

- Remove the air intake duct and the oil inlet side pipe.
- Pour oil (engine oil) into the turbocharger through the oil inlet pan.
- Turn the impeller by hand to lubricate the bearings.
- Secure the air intake duct and the oil inlet side pipe.



MAINTENANCE SCHEDULE

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

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

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

SCHEDULED MAINTENANCE	CHECK EACH DAY	HOURS OF OPERATION							MAINTENANCE DESCRIPTION
		50	100	250	500	750	1000	1250	
Fuel Supply	<input type="checkbox"/>								Diesel No. 2 rating of 45 cetane or higher.
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>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"/>	Change at 50 hours then every 250 hours.
Starting Batteries (and House Batteries)	<input type="checkbox"/> weekly								Check electrolyte levels every 50 operating hours and make sure connections are very tight. Clean off excessive corrosion.
Engine Oil and Filter		<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Initial engine oil and filter change at 50 hours, then change both every 250 hours.
Heat Exchanger/Zinc Anode		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Inspect zinc anode, replace if needed. Clear the heat exchanger end of zinc anode debris.
Fuel/Water Separator			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Change filter every 200 hours.
Exhaust System		<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>	Initial check at 50 hours, then every 250 hours. Inspect for leaks. Check anti-siphon valve operation. Check the exhaust elbow for carbon and/or corrosion buildup on inside passages; clean and replace as necessary. Check that all connections are tight. Check casting integrity.
Engine Hoses			<input type="checkbox"/>	<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.
Raw Water Pump				<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>	Remove the pump cover and inspect the impeller, gasket, cam and cover for wear. Check the bearings and seals (the shaft can turn, but not wobble). Lubricate when reassembling.
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.

MAINTENANCE SCHEDULE

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

SCHEDULED MAINTENANCE	CHECK EACH DAY	HOURS OF OPERATION							MAINTENANCE DESCRIPTION
		50	100	250	500	750	1000	1250	
Coolant System					<input type="checkbox"/>			<input type="checkbox"/>	Drain, flush, and refill cooling system with appropriate antifreeze mix.
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"/>		<input type="checkbox"/>		Check and adjust injection opening pressure and spray condition (Refer to your service manual).
*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. Reinstall with anti-seize compound on threads.
*Engine Cylinder Compression							<input type="checkbox"/>		Check compression pressure and timing, (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>).
*Heat Exchanger							<input type="checkbox"/>		Remove, have professionally cleaned and pressure tested.
Feed Pump Strainer					<input type="checkbox"/>		<input type="checkbox"/>		Clean every 500 operating hours.
Turbocharger (if applicable)		<input type="checkbox"/>						<input type="checkbox"/>	Initial 50 hour check, inspect all connections for oil and exhaust leaks. Check mounting bolts for tightness. Check for air leakage. Inspect the radial and axial play of the rotor shaft. Lubricate the shaft bearings.
Electronic Governor Control		<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 adjustments are not a warrantable adjustment during or after the unit's break-in.</i>

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

COOLING SYSTEM

DESCRIPTION

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

FRESH WATER COOLING CIRCUIT

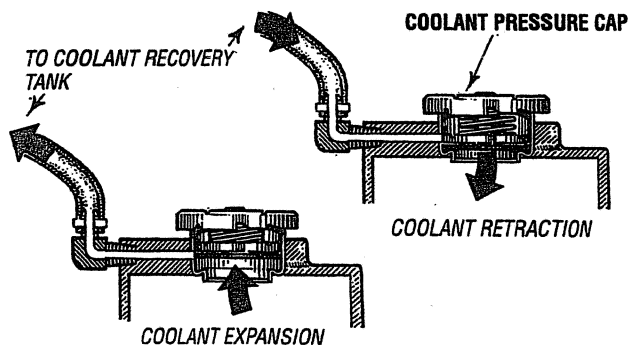
NOTE: Refer to the *ENGINE COOLANT* section for the recommended antifreeze and water mixture to be used as the fresh water coolant.

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

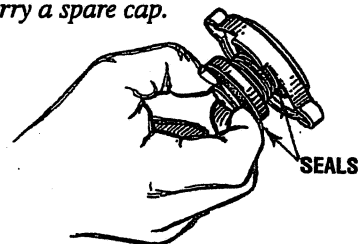
When the engine is started cold, external coolant flow is prevented by the closed thermostat (although some coolant flow is bypassed around the thermostat to prevent the exhaust manifold from overheating). As the engine warms up, the thermostat gradually opens, allowing full flow of the engine's coolant to flow unrestricted to the external portion of the cooling system.

Coolant Recovery Tank

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



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



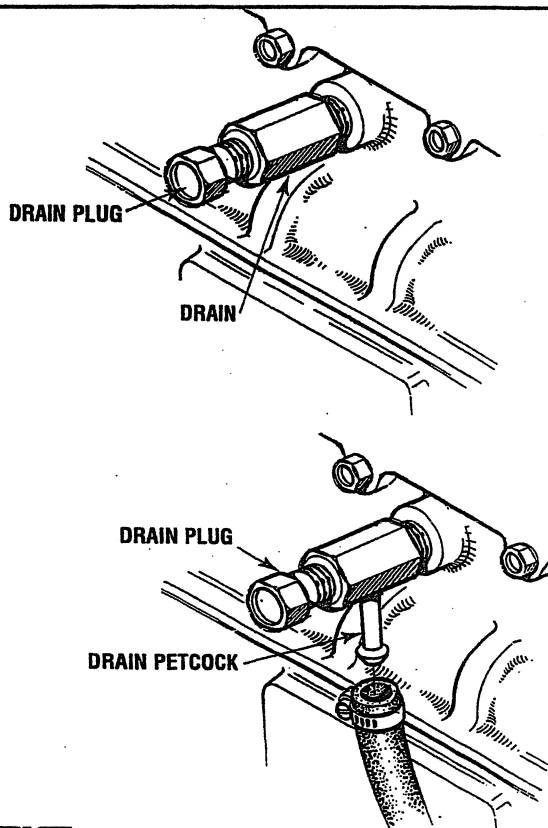
CHANGING COOLANT

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

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

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

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



SOME ENGINE MODELS ARE EQUIPPED WITH A PETCOCK THAT ALLOWS FOR A HOSE TO BE ATTACHED

COOLING SYSTEM

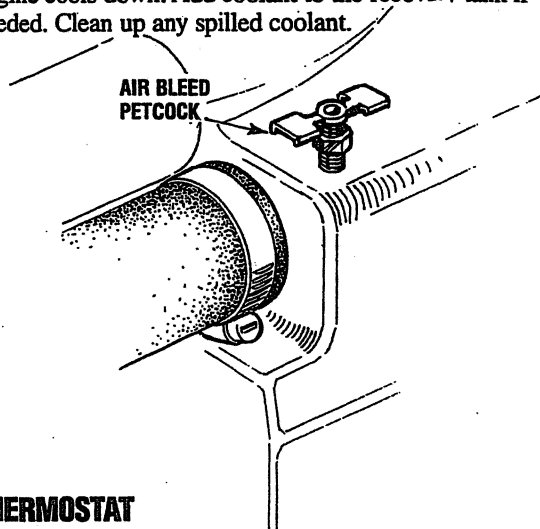
Refilling the Coolant

After closing the engine block drain, pour clean, premixed coolant into the manifold and when the coolant is visible in the manifold, start the engine and run it at slow idle. Open the air bleed petcocks on the manifold and the thermostat housing.

Monitor the coolant in the manifold and add as needed. Fill the manifold to the filler neck and when the coolant flowing from the petcock is free of air bubbles, close the petcock and install the pressure cap.

Remove the cap on the coolant recovery tank and fill with coolant mix to halfway between LOW and MAX and replace the cap. Run the engine and observe the coolant expansion flow into the recovery tank. When the petcock on the thermostat housing is free of air bubbles, close that petcock.

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



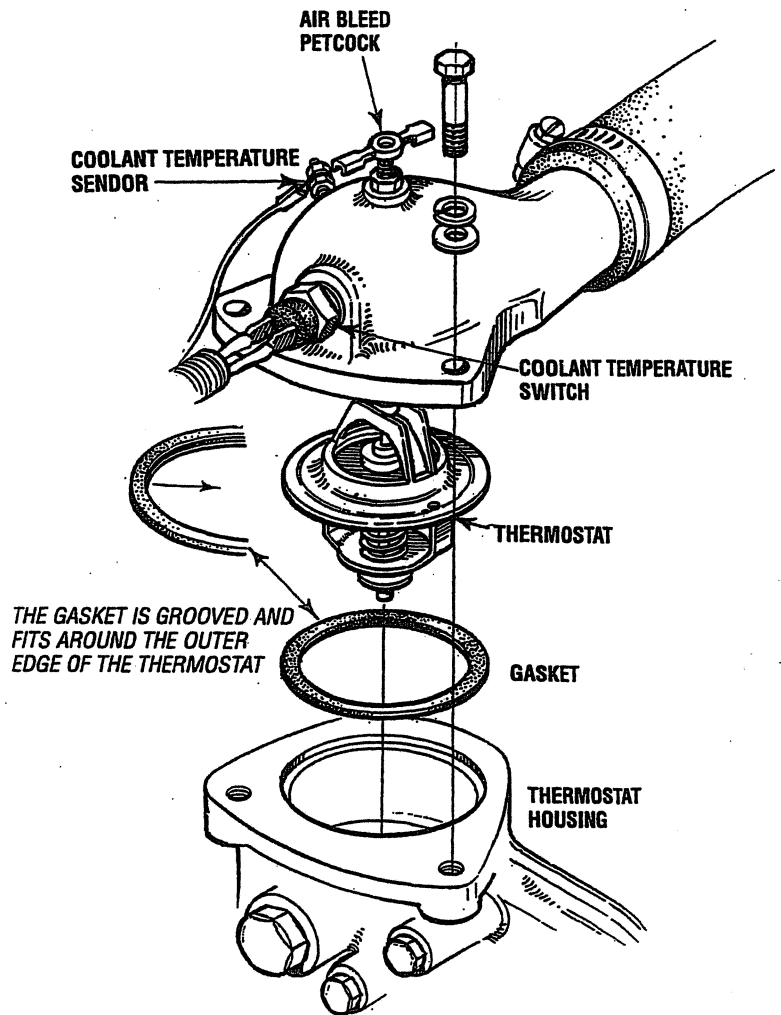
THERMOSTAT

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

Replacing the Thermostat

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

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



CHANGING THE THERMOSTAT

COOLING SYSTEM

RAW WATER COOLING CIRCUIT

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

Raw Water Pump

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

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

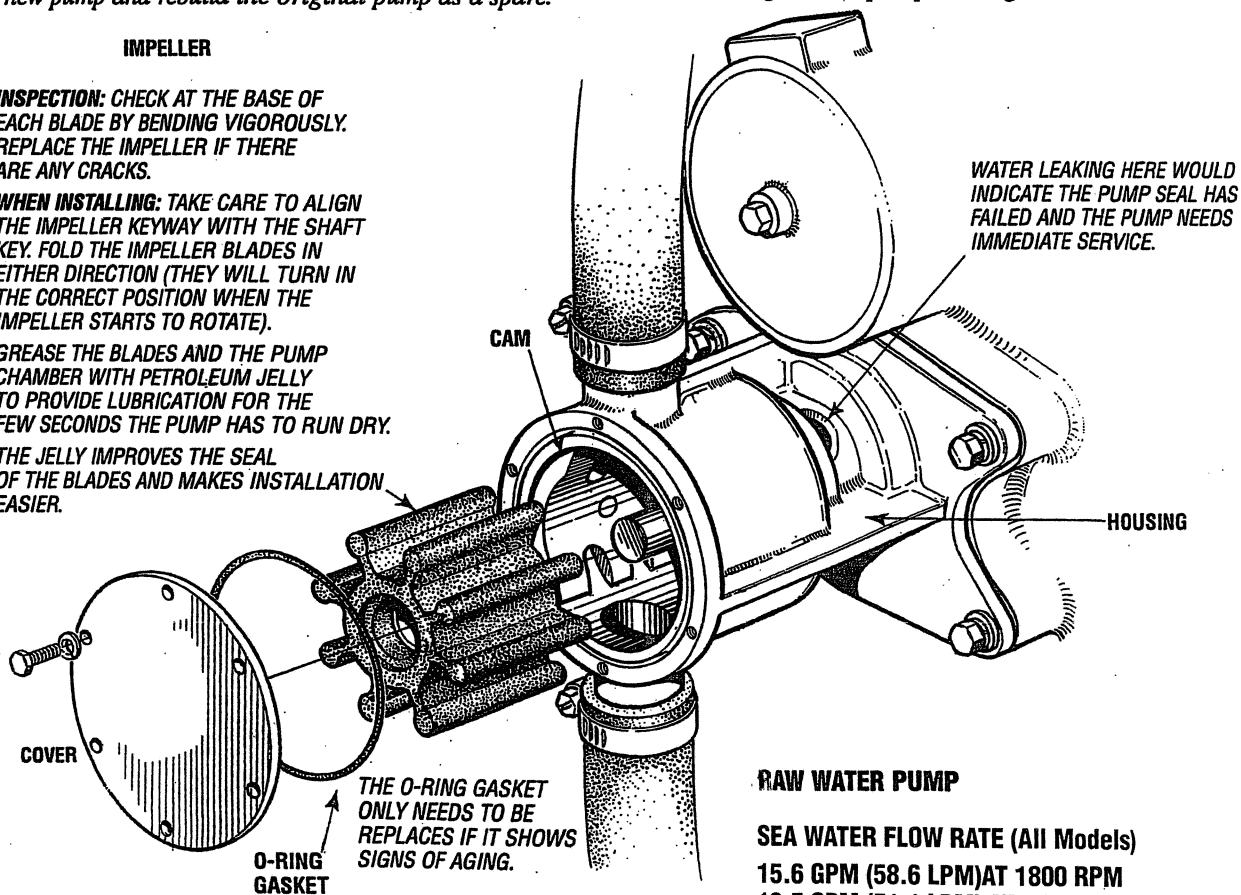
IMPELLER

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

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

GREASE THE BLADES AND THE PUMP CHAMBER WITH PETROLEUM JELLY TO PROVIDE LUBRICATION FOR THE FEW SECONDS THE PUMP HAS TO RUN DRY.

THE JELLY IMPROVES THE SEAL OF THE BLADES AND MAKES INSTALLATION EASIER.



Changing the Raw Water Pump Impeller

Close the raw water intake valve. Remove the pump cover and, with the aid of two small screwdrivers, carefully pry the impeller out of the pump. Install the new impeller and gasket. Move the blades to conform to the curved cam plate and push the impeller into the pumps housing. When assembling, apply a thin coating of lubricant to the impeller and O-ring. Open the raw water intake valve.

To be certain the pump is operating properly, run the engine and check the following:

- Inspect the raw water pump for leaks.
- After warm up, monitor the temperature gauge. It should indicate a normal engine temperature.
- Check aft. There should be a steady flow of water from the stern tube.

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

Impeller Puller

WESTERBEKE recommends using an impeller puller to remove the impeller, this will prevent damage to the blades and to the edges of the pump housing.

RAW WATER PUMP

SEA WATER FLOW RATE (All Models)

15.6 GPM (58.6 LPM) AT 1800 RPM

13.5 GPM (51.1 LPM) AT 1500 RPM

COOLING SYSTEM

HEAT EXCHANGER

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

Heat Exchanger Service

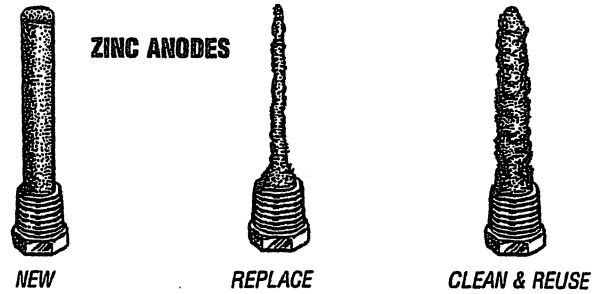
After approximately 1000 hours of operation, remove, clean and pressure test the engine's heat exchanger. (A local automotive radiator shop should be able to clean and test the heat exchanger.)

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

Zinc Anode

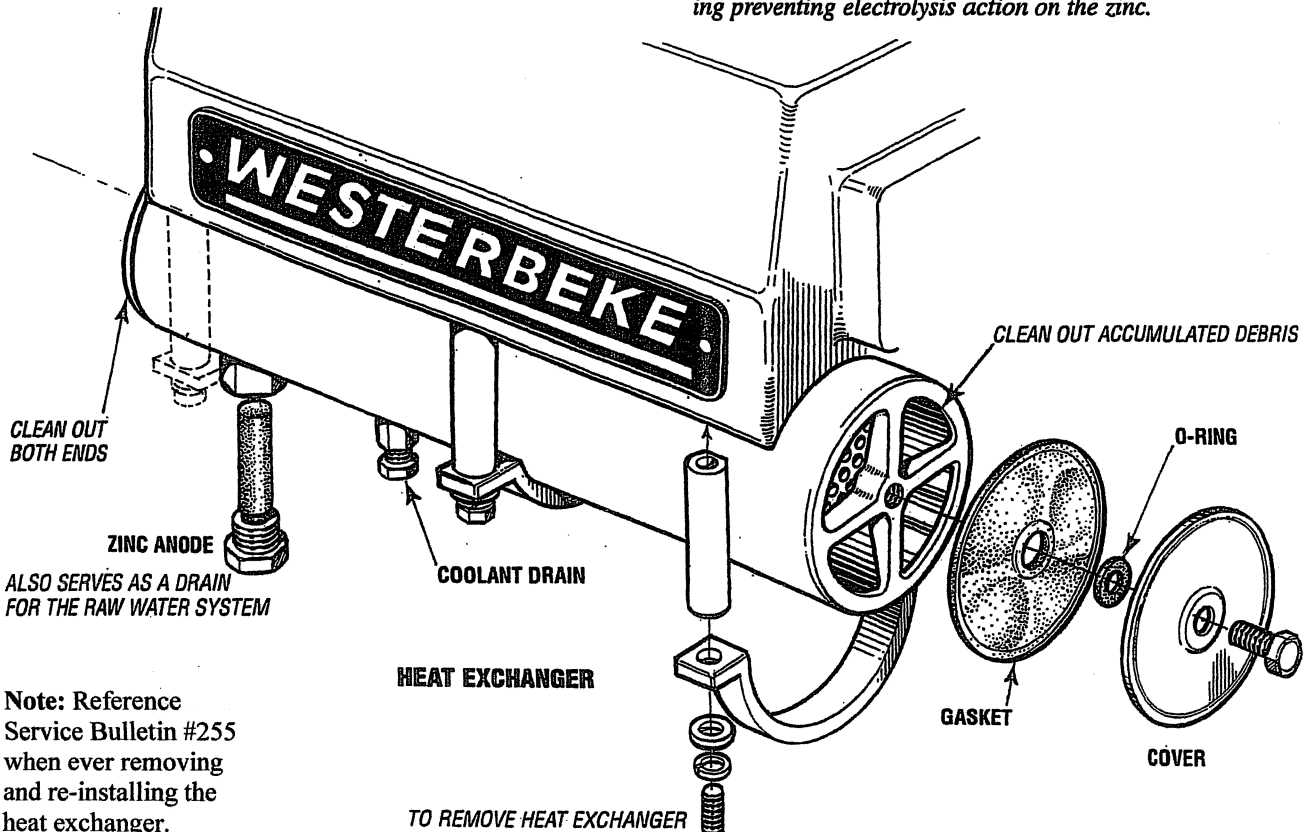
A zinc anode, or *pencil*, is located in the raw water cooling circuit within the heat exchanger. The purpose of having zinc anodes is to sacrifice them to electrolysis action taking place in the raw water cooling circuit, thereby reducing the effects of electrolysis on other components of the system.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

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



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

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



Note: Reference Service Bulletin #255 when ever removing and re-installing the heat exchanger.

COOLING SYSTEM

Raw Water Intake Strainer

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

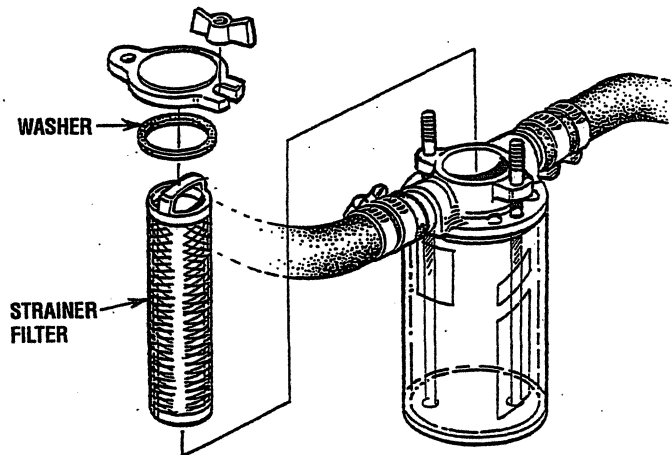
A clean raw water intake strainer is a vital component of the engine's cooling system. Include a visual inspection of this strainer when making your periodic engine check. The water in the glass should be clear.

Perform the following maintenance after every 100 hours of operation:

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

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

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

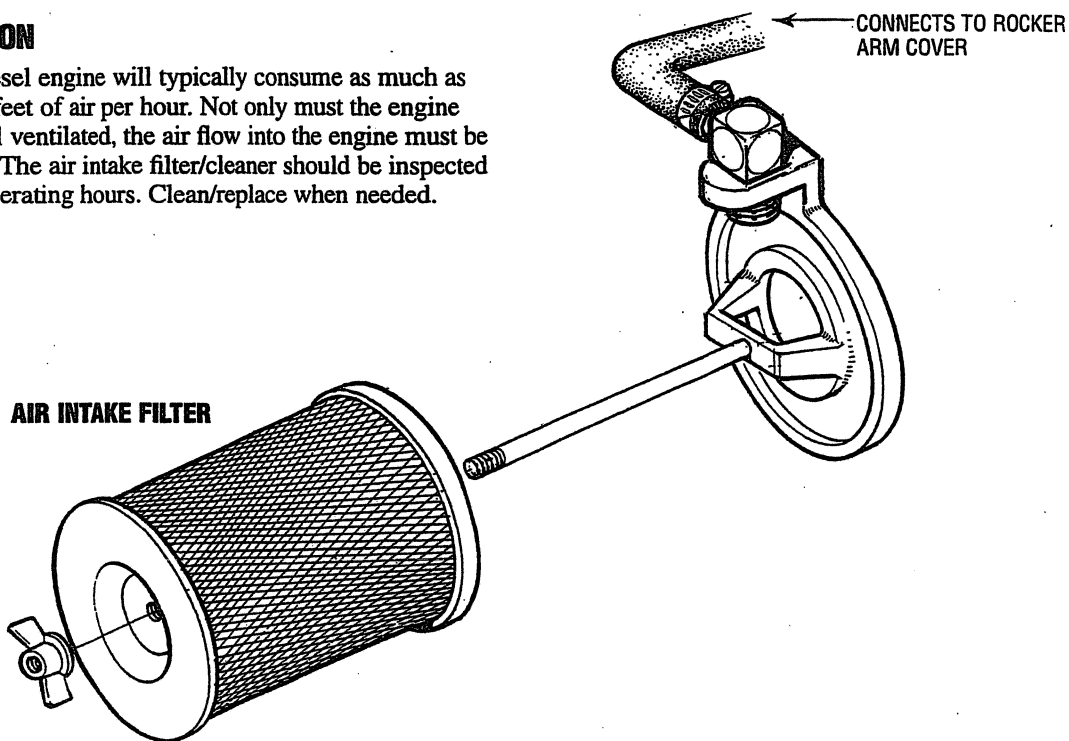


**TYPICAL RAW WATER INTAKE STRAINER
Owner Installed**

AIR INTAKE FILTER

DESCRIPTION

A marine diesel engine will typically consume as much as 6,000 cubic feet of air per hour. Not only must the engine room be well ventilated, the air flow into the engine must be unrestricted. The air intake filter/cleaner should be inspected every 100 operating hours. Clean/replace when needed.



FUEL SYSTEM

DIESEL FUEL

Use No. 2 diesel fuel with a cetane rating of 45 or higher. SAE J313 with a grade of diesel according to ASTM D975.

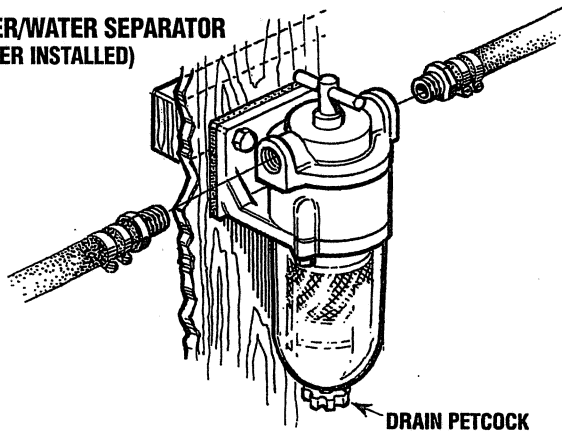
FUEL FILTER / WATER SEPARATOR

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

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

A typical fuel filter/water separator is illustrated in this diagram. This is the Racor Model 500. Keep in mind that if a water separator type filter is not installed between the fuel supply tank and engine-mounted fuel system, any water in the fuel will affect the fuel pump, engine filter, and injection equipment. The owner/operator is responsible for making certain the fuel reaching the engine's injection equipment is free of impurities. This process is accomplished by installing and maintaining a proper filtration/separation system.

**FILTER/WATER SEPARATOR
(OWNER INSTALLED)**



FUEL INJECTION PUMP

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

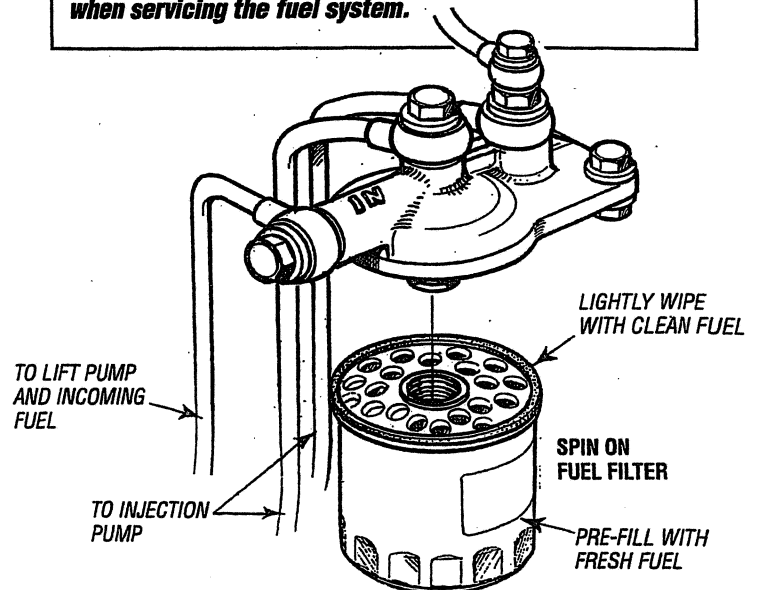
FUEL LIFT PUMP

The fuel lift pump is an integral part of the fuel injection pump.

FUEL FILTERS

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

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



Changing the Fuel Filter

1. Shut the fuel supply off.
2. Slip a plastic bag over the fuel filter to prevent fuel spillage then loosen the fuel filter, turning counterclockwise with a filter wrench.
3. Using a rag, wipe clean the sealing face on the housing bracket so the new filter can be seated properly.
4. Lightly oil the sealing O-ring on the new filter. To reinstall, turn the filter assembly counterclockwise carefully until the O-ring contacts the sealing surface of the housing bracket. Turn 2/3 further with the filter wrench.

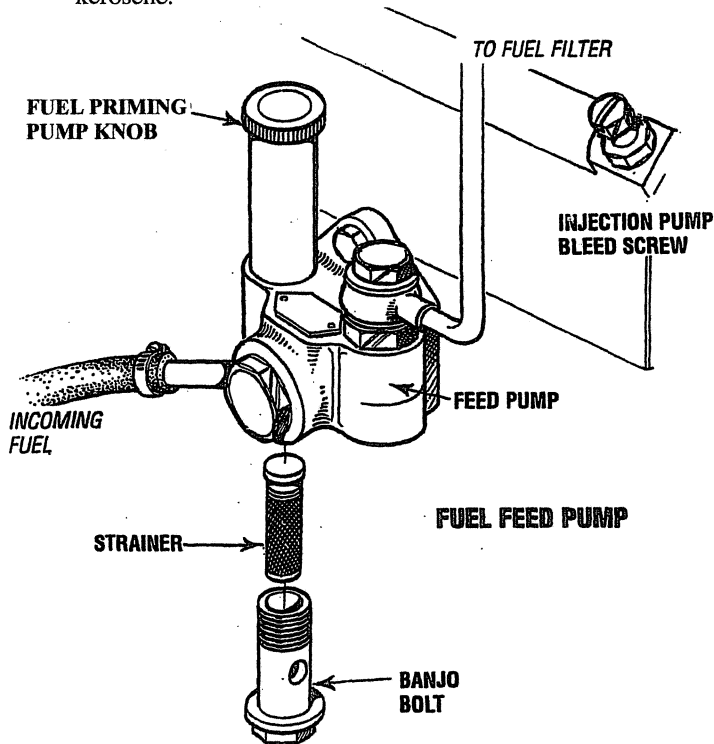
NOTE: The cartridge contains fuel. Take care not to spill it during disassembly.

5. Open the fuel supply. The filter will fill with fuel. Check for leaks.
6. Run the generator to make certain there are no leaks.

FUEL SYSTEM

FUEL FEED PUMP STRAINER

An additional fuel screen is located in the feed pump. This screen (strainer) is removed for cleaning by releasing the banjo bolt at the bottom. This screen should be cleaned every 500 operating hours. Use compressed air and/or clean with kerosene.



After changing the fuel filter and cleaning the fuel feed pump strainer, WESTERBEKE recommends the following procedure for ensuring there is no air trapped in the fuel system.

BLEEDING (PRIMING) THE FUEL SYSTEM

1. Loosen the bleeding screw on the fuel injection pump.
2. Turn the feed pump knob counterclockwise until the pump knob is forced up by the spring.
3. Depressing the pump knob will cause it to drain out the air mixed fuel from the loosened bleeding screws.
4. Repeat the pumping action until no bubbles are visible in the flowing fuel.
5. Tighten the bleed screw and the feed pump knob.

FUEL ADDITIVES

The use of a biocide on a regular basis such as Bio-Bor is highly recommended, with a reduction in the sulfur content of diesel fuel (15 PPM). An additive such as Diesel Kleen + Cetane Boost is recommended to help restore lubricity back into the diesel fuel now that the reduction in sulfur content has been removed. (Follow the manufacture's instructions found on the containers).

SPARE PARTS

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

ENGINE LUBRICATING OIL

DESCRIPTION

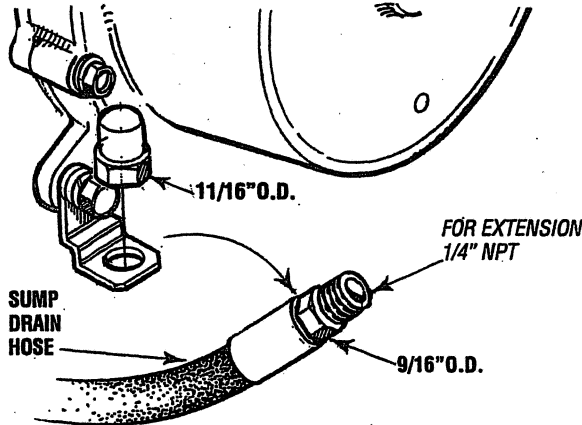
The lubricating system is a pressure feeding system using an oil pump. The engine oil is drawn from the oil sump by the oil pump, which drives the oil, under pressure, through the oil filter, oil cooler and various lubricating points in the engine. The oil then returns to the oil sump to repeat the continuous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

Oil Pressure

The engine's oil pressure, during operation, is indicated by the oil pressure gauge on the instrument panel. During normal operation, the oil pressure will range between 25 and 85 psi.

ENGINE OIL CHANGE

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



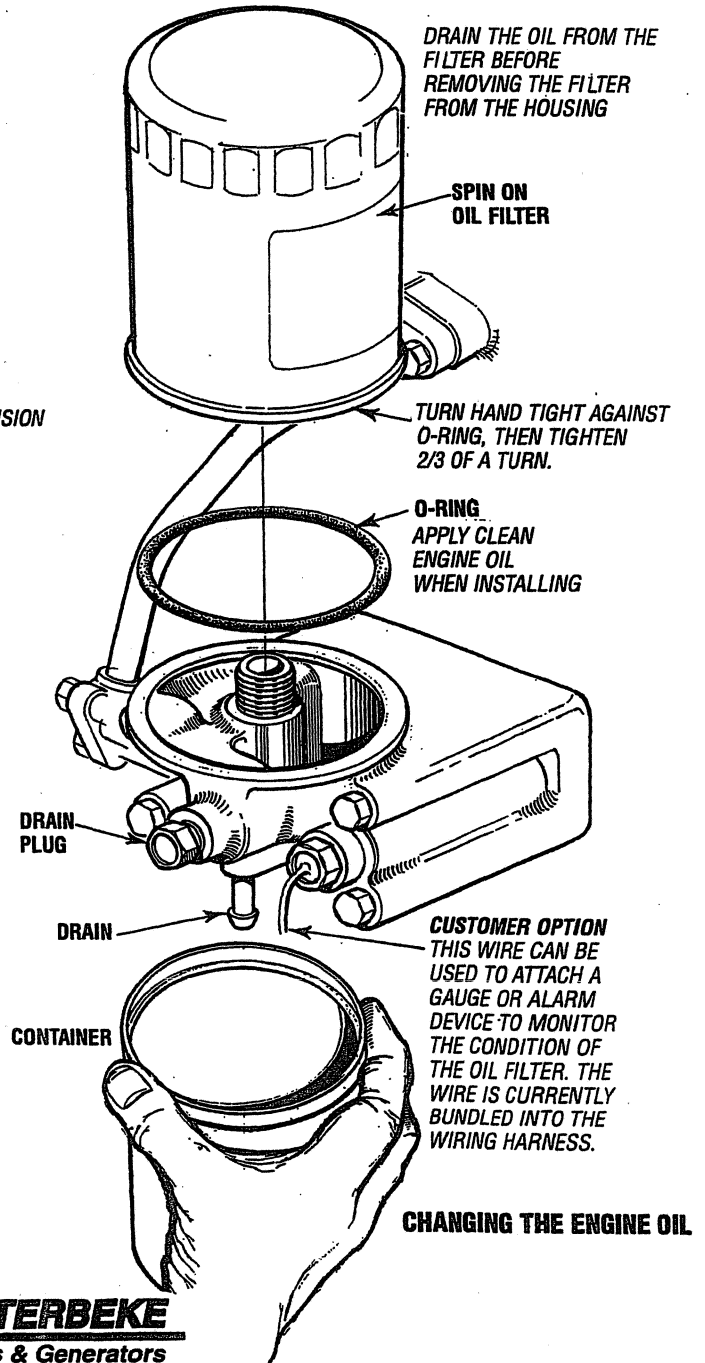
Always observe the used oil as it is removed. A yellow/gray emulsion indicates the presence of water in the oil. Although this condition is rare, it does require prompt attention to prevent serious damage. Call a qualified mechanic should water be present in the oil. Raw water present in the oil can be the result of a fault in the exhaust system attached to the engine and/or a siphoning of raw water through the raw water cooling circuit into the exhaust, filling the engine. This problem is often caused by the absence of an anti-siphon valve, its poor location or lack of maintenance.

2. **Draining the Oil Filter.** Back off the drain plug until oil flows from the drain (into an appropriate container). After draining, remove the filter and wipe off any excess oil. **Tighten the drain plug.**

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

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

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



REMOTE OIL FILTER (OPTIONAL)

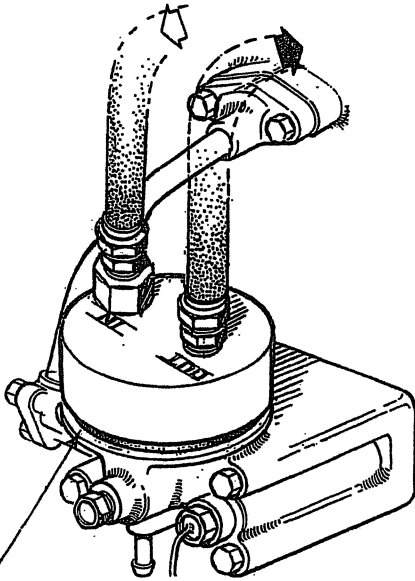
INSTALLATION

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

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

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.

NOTE THE "IN" AND "OUT" MARKINGS ON THE ADAPTER WHEN THE HOSES ARE REMOVED FOR INSTALLATION SO THEY WILL BE RECONNECTED CORRECTLY.



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.

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.

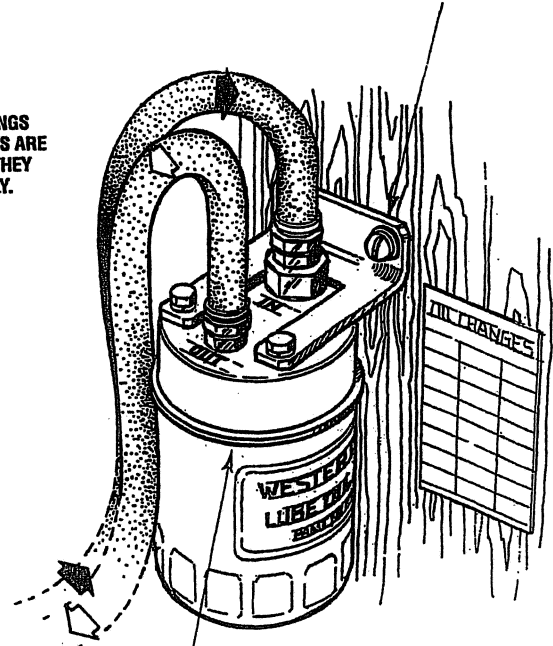
NOTE: Westerbeke is not responsible for engine failure due to incorrect installation of the Remote Oil Filter.

REMOTE OIL FILTER KITS:

4 Cylinder Models: #044995

6 Cylinder Models: #044998

FASTEN SECURELY TO A BULKHEAD
(SCREWS ARE OWNER SUPPLIED)

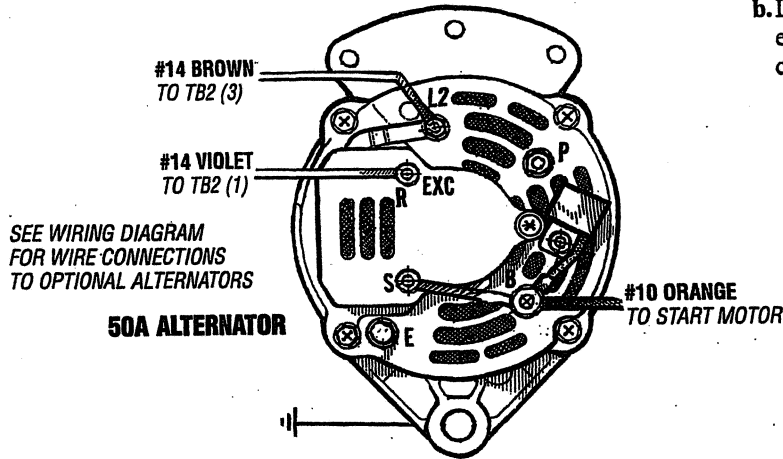


APPLY A THIN COAT OF CLEAN OIL TO THE FILTER GASKET WHEN INSTALLING. AFTER THE FILTER CONTACTS THE BASE, TIGHTEN IT AN ADDITIONAL 3/4 TURN.

DC ELECTRICAL SYSTEM

ALTERNATOR

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



ALTERNATOR TROUBLESHOOTING

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

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

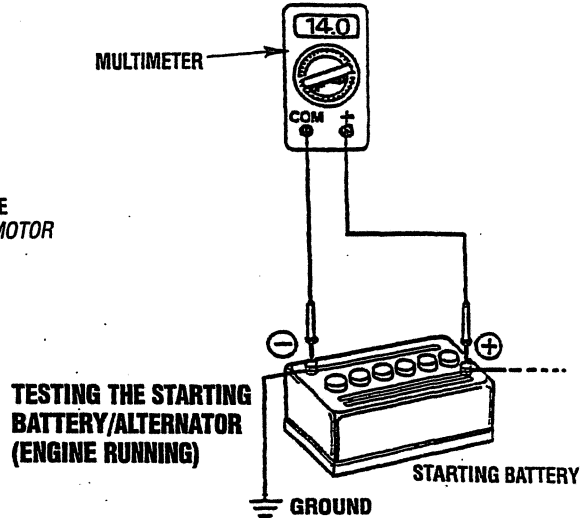
The alternator charging circuit charges the starting battery and the service battery. An isolator with a diode, a solenoid or a battery selector switch is usually mounted in the circuit to isolate the batteries so the starting battery is not discharged along with the service battery. If the alternator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

Testing the Alternator

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

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

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

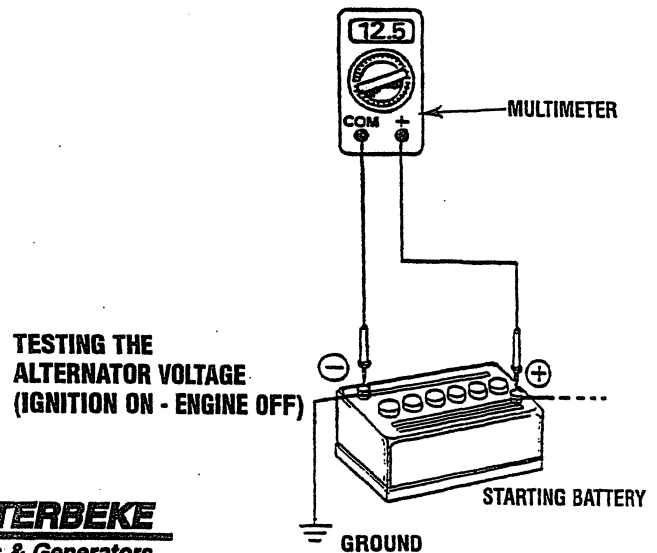


TESTING THE STARTING BATTERY/ALTERNATOR (ENGINE RUNNING)

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

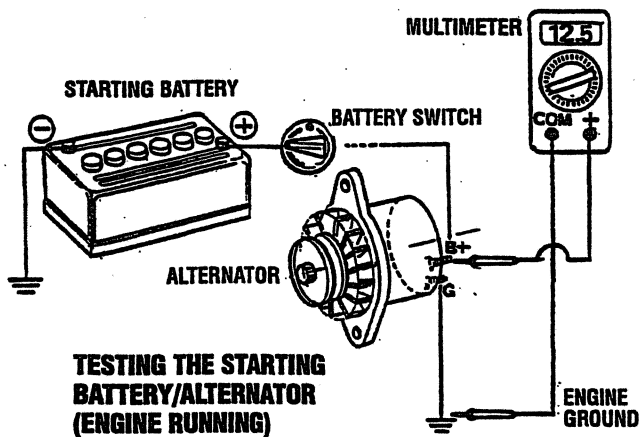
CAUTION: To avoid damage to the battery charging circuit, never shut off the engine battery switch when the engine is running!

4. If a battery selector switch is in the charging circuit, ensure that it is on the correct setting.
5. Turn on the ignition switch, but do not start the engine.
6. Check the battery voltage. If the battery is in good condition, the reading should be 12 to 13 volts.



TESTING THE ALTERNATOR VOLTAGE (IGNITION ON - ENGINE OFF)

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



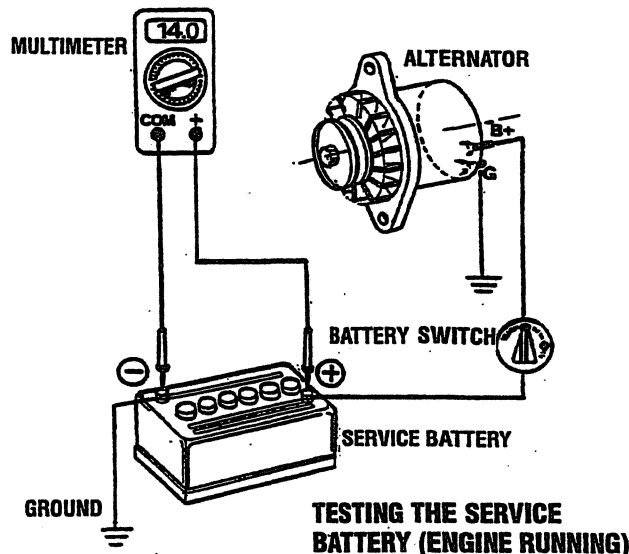
8. Start the engine again. Check the voltage between the alternator output and ground.
- The voltage reading for a properly operating alternator should be between 13.5 and 14.5 volts. If your alternator is over- or under-charging, have it repaired at a reliable service facility.

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

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

Checking the Service Battery

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



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

12 VOLT DC CONTROL CIRCUIT

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

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

BATTERY

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

Battery Care

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

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

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

GLOW PLUGS

DESCRIPTION

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

INSPECTION

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

TESTING

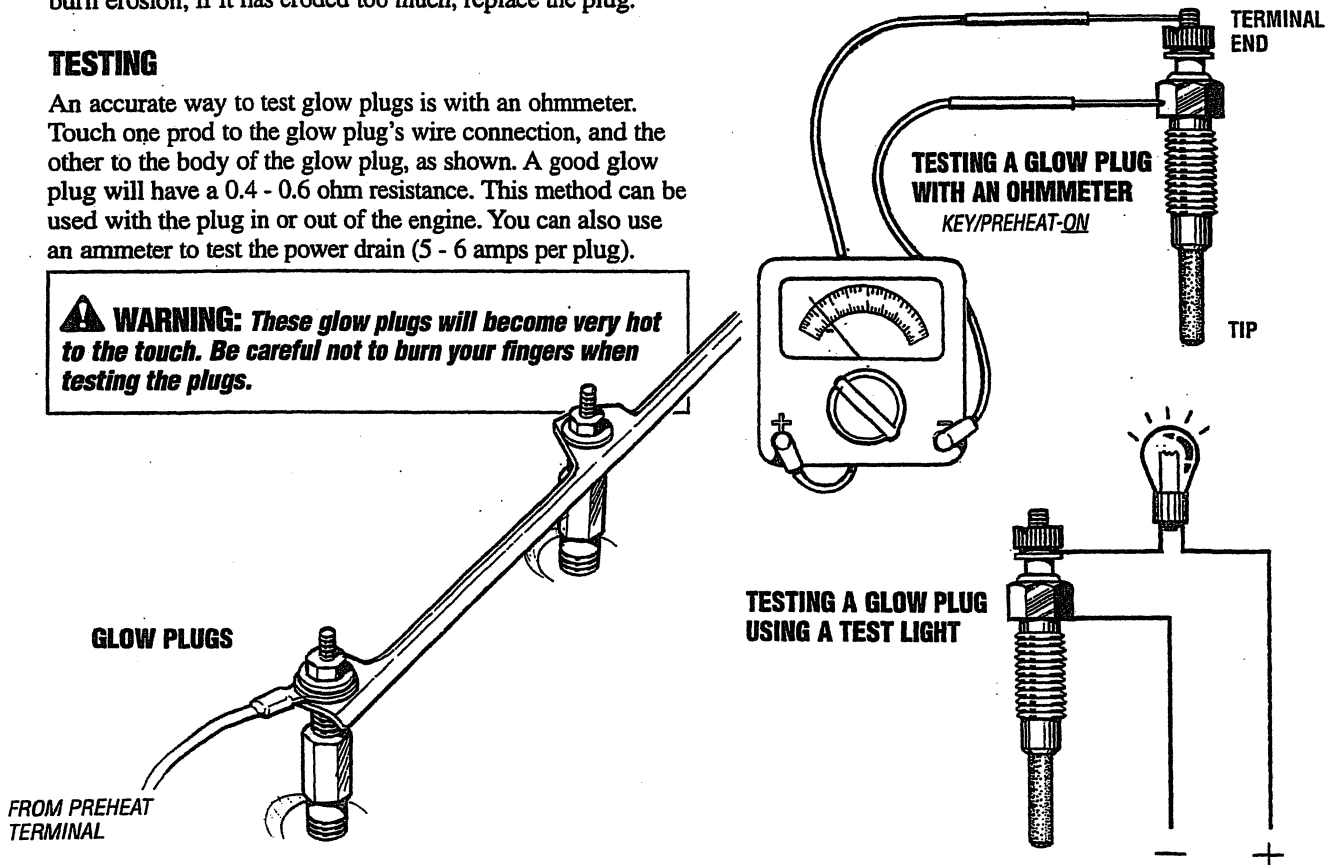
An accurate way to test glow plugs is with an ohmmeter. Touch one prod to the glow plug's wire connection, and the other to the body of the glow plug, as shown. A good glow plug will have a 0.4 - 0.6 ohm resistance. This method can be used with the plug in or out of the engine. You can also use an ammeter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

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

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

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

Glow Plug Tightening Torque 19.5 ft-lb (2.7 m-kg)



ELECTRONIC GOVERNOR

Electronic Governor System

The system is composed of three basic components:

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

Controller Adjustment

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

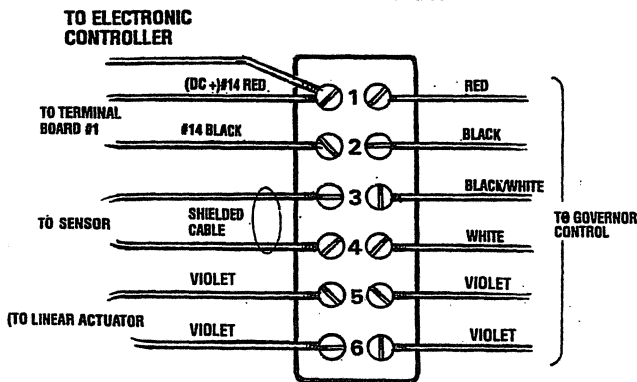
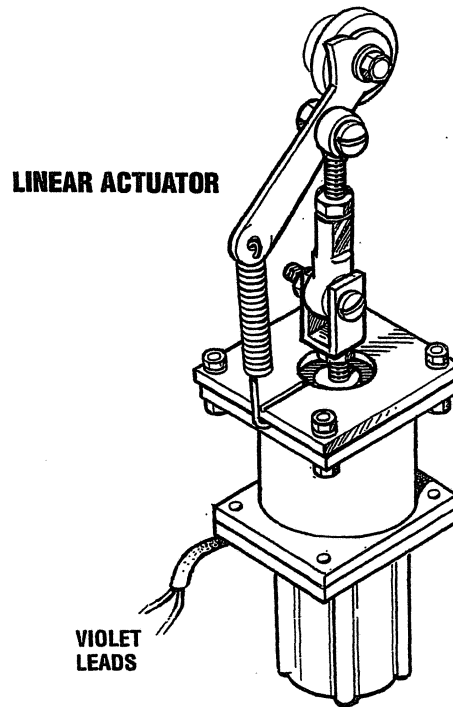
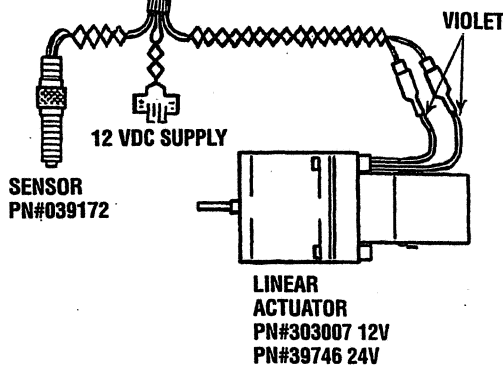
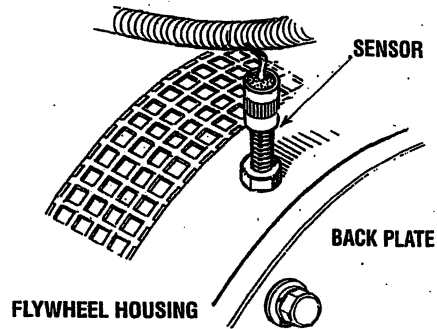
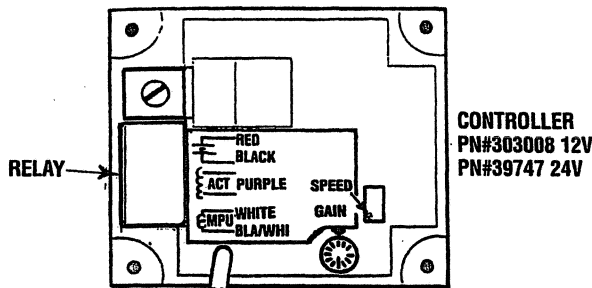
NOTE: A high gain adjustment can induce an oscillating of the actuator producing a hunting mode. In such cases, lessen the gain adjustment.

Calibration

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

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

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



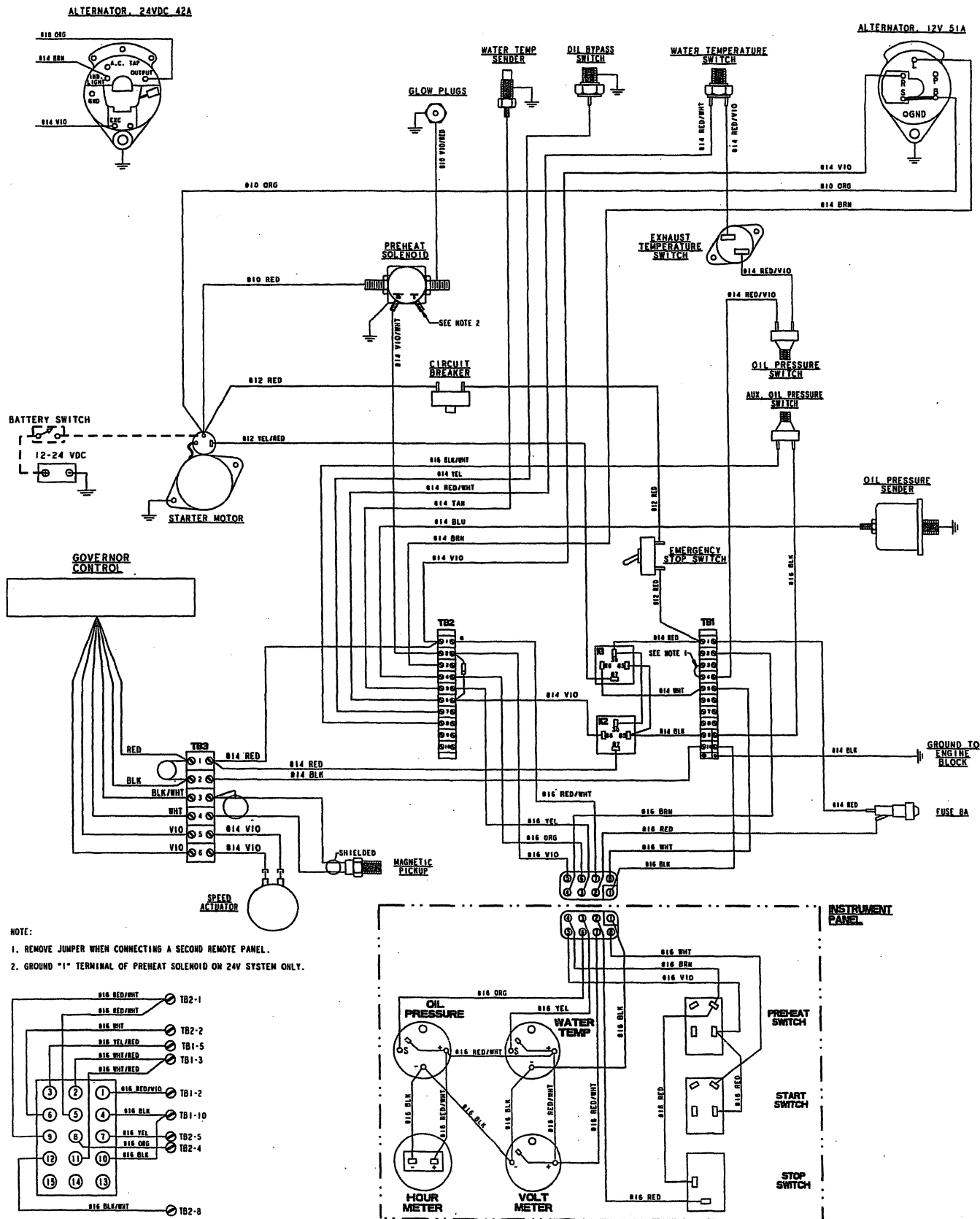
TERMINAL BOARD #3
REFER TO WIRING DIAGRAMS

TROUBLESHOOTING THE ELECTRONIC GOVERNOR

Problem	Probable Cause	Verification/Remedy
System appears dead (Engine runs at idle.)	<ol style="list-style-type: none"> 1. Low battery voltage at controller. 2. Stuck linkage. 3. No signal or weak signal from sensor. (Measure AC voltage from sensor while engine is running at idle. Voltage should be 1.5 volts or greater.) 4. Check Actuator – depress PREHEAT and check for battery voltage between negative black lead at terminal block. <ol style="list-style-type: none"> a. Purple lead to black. b. Second purple to black. 5. Perform the following check between terminals at the actuator and the negative DC lead at the controller terminal block. (Preheat depressed). <ol style="list-style-type: none"> a. Low voltage (1.20-2.0 VDC) at either actuator connection. b. Battery voltage at both actuator connections. c. Battery voltage at one actuator lead but not the other. 	<ol style="list-style-type: none"> 1. Check wiring for cause. Check battery state of charge. 2. Lubricate, free up linkage between controller and throttle arm. 3. Check for improperly installed or damaged sensor in flywheel housing. Replace or adjust. 4. Replace controller if battery voltage is not present at both leads. <ol style="list-style-type: none"> a. Broken actuator lead. b. Broken actuator lead. c. Replace the actuator.
Actuator fully extends when PREHEAT is depressed and stays extended.	<ol style="list-style-type: none"> 1. Check controller. Lift one of the purple actuator leads from the terminal block. Depress PREHEAT. <ol style="list-style-type: none"> a. Actuator fully extends. b. Actuator does not fully extend and connections. <p>NOTE: Release PREHEAT and reconnect the purple lead.</p>	<ol style="list-style-type: none"> a. Short in lead to actuator. b. Replace controller.
Actuator hunts (oscillates) and engine running.	<ol style="list-style-type: none"> 1. Linkage between actuator and throttle binding. 2. Improper adjustment of GAIN on controller. 3. Inadequate DC power supply to controller, complete the following tests: Connect a DC voltmeter across the plus and negative leads at the controller terminal block. Lift both purple leads from the terminal block. Connect one purple lead to the C plus terminal and the other to the DC negative. Momentarily depress PREHEAT. The actuator should fully extend. <p>3a. Sensor positioned marginally too far away from flywheel teeth giving erratic signal voltage to controller.</p>	<ol style="list-style-type: none"> 1. Lubricate/free-up. 2. Lessen GAIN adjustment (Recalibrate the Controller). 3. If actuator does not fully extend, check the actuator leads. If the voltage is less than specified, check for loose or poor connections, low battery voltage, voltage drop in DC circuit due to remote panel installation and small wire sizes making connections. DC voltage registering on the meter should be: 12 VDC System – 9.6 VDC or higher 24 VDC System – 19.2 VDC or higher NOTE: Reconnect actuator leads properly after making this test. 3a. Check the position of the sensor.

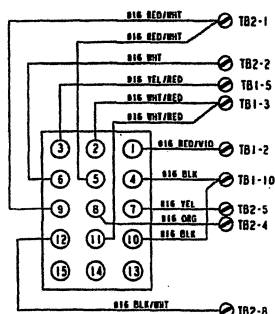
NOTE: For additional troubleshooting information, reference the booklet on our website: www.westerbeke.com.
 Titled ELECTRONIC GOVERNORS - ANALOG DIESEL MODELS.

WIRING DIAGRAM 44780

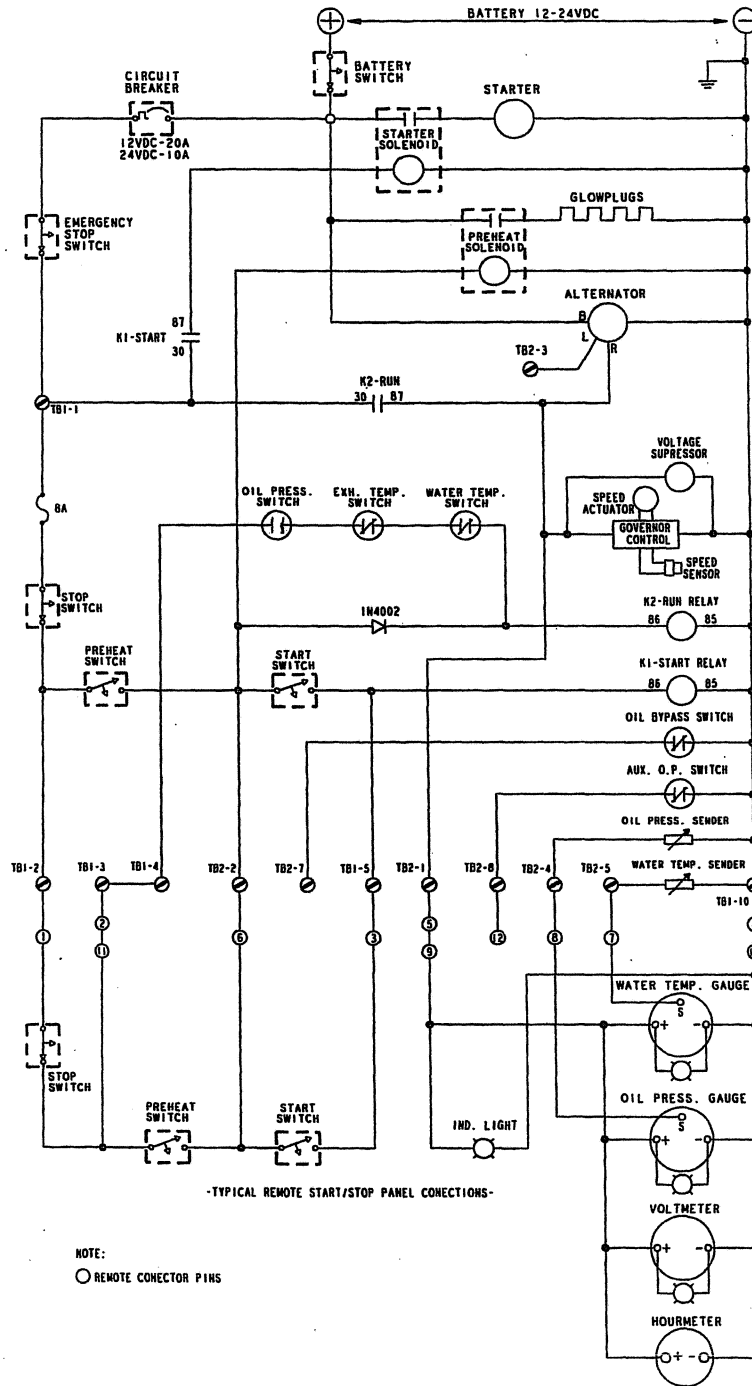


NOTE:

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



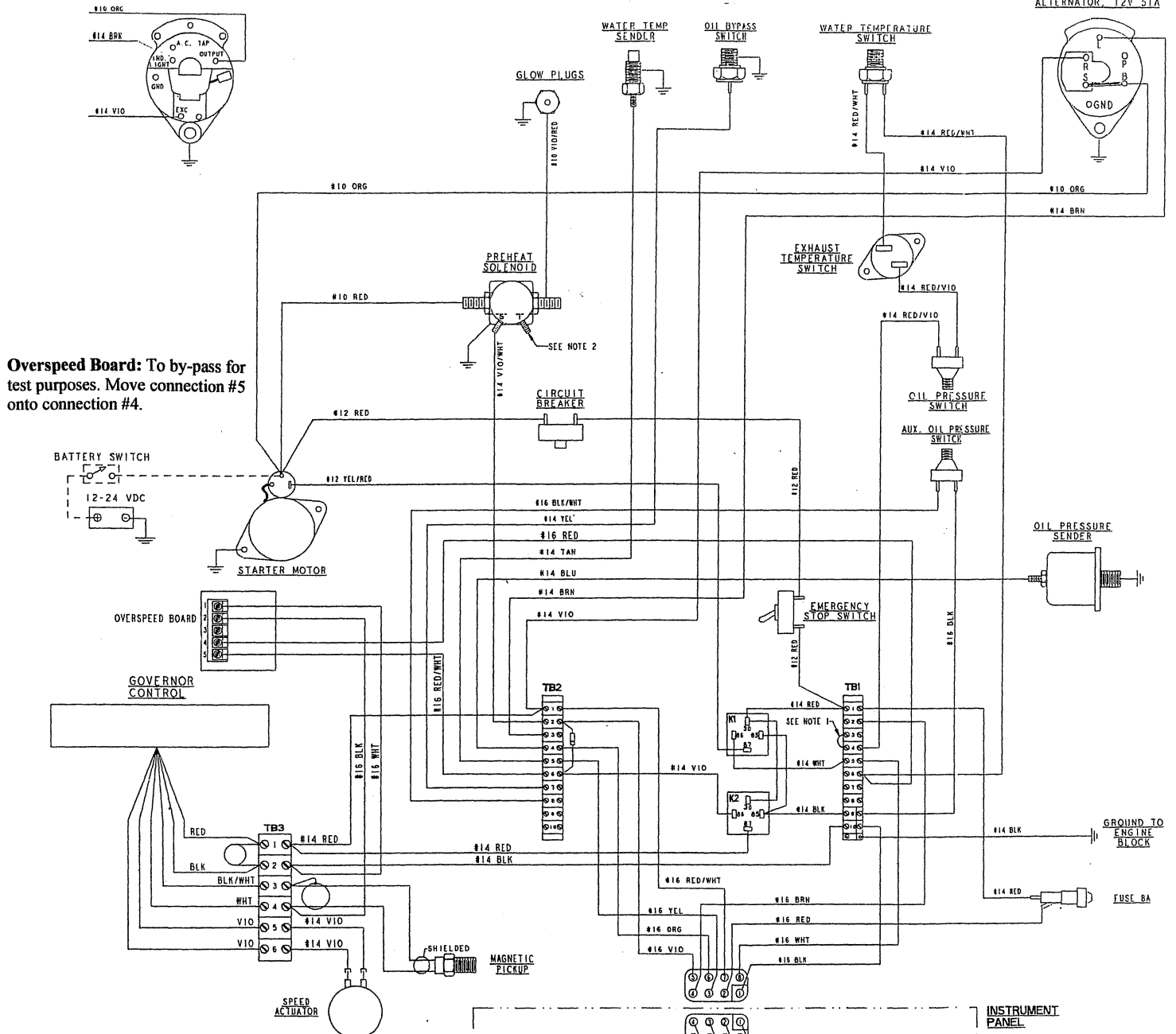
WIRING SCHEMATIC 44780



WIRING DIAGRAM 44780 OVERSPEED BOARD

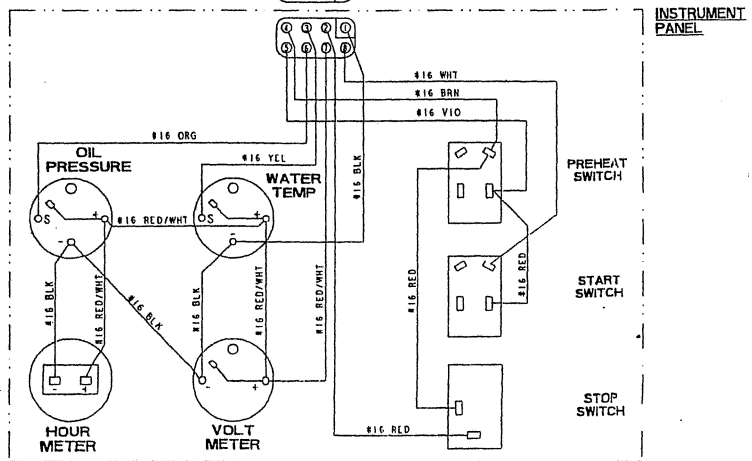
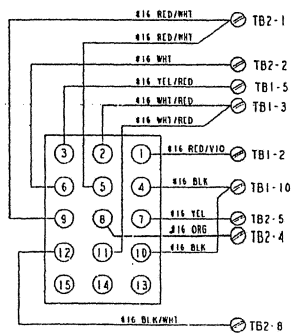
ALTERNATOR, 24VDC 42A

ALTERNATOR, 12V 51A



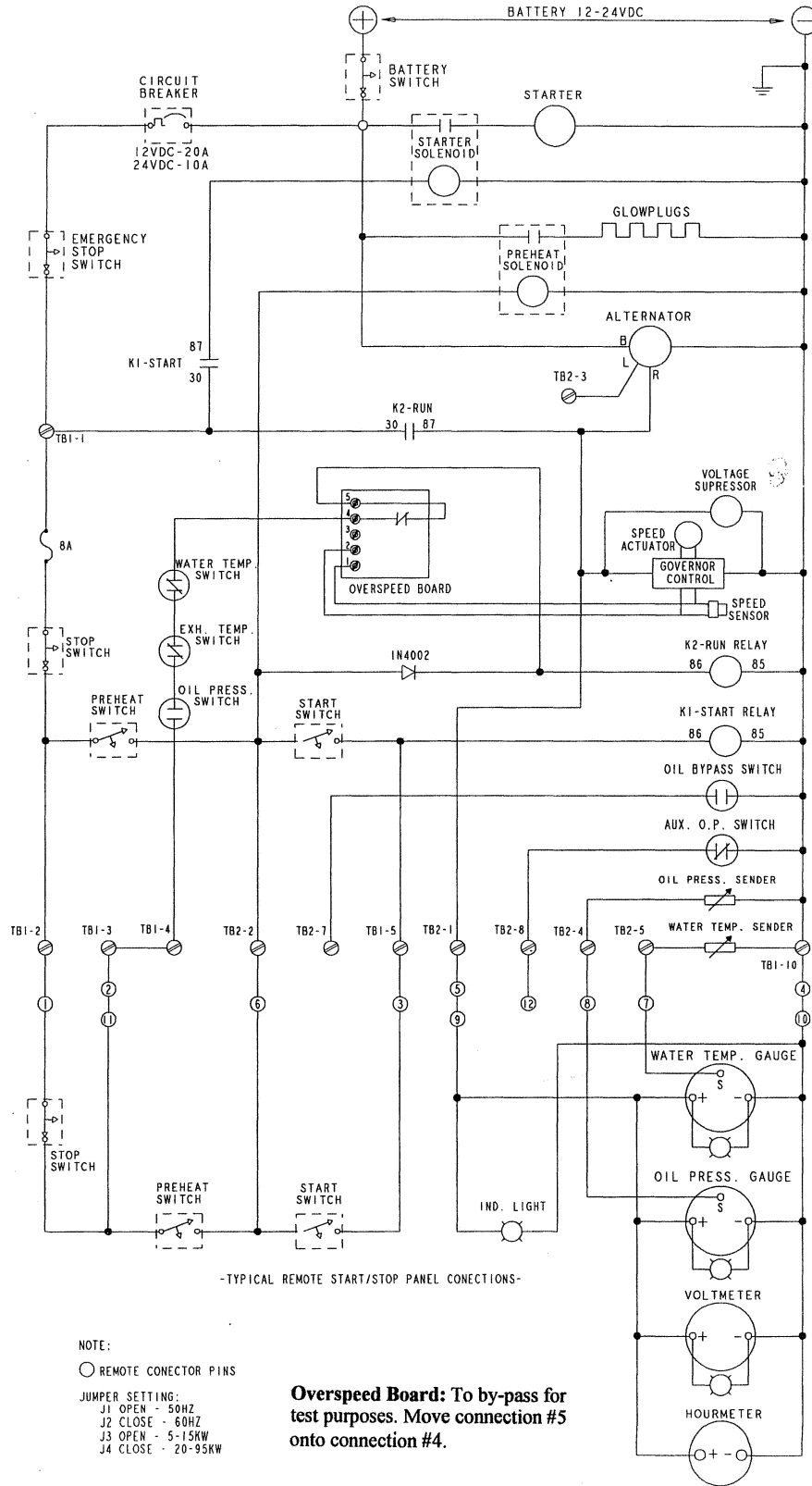
NOTE:

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

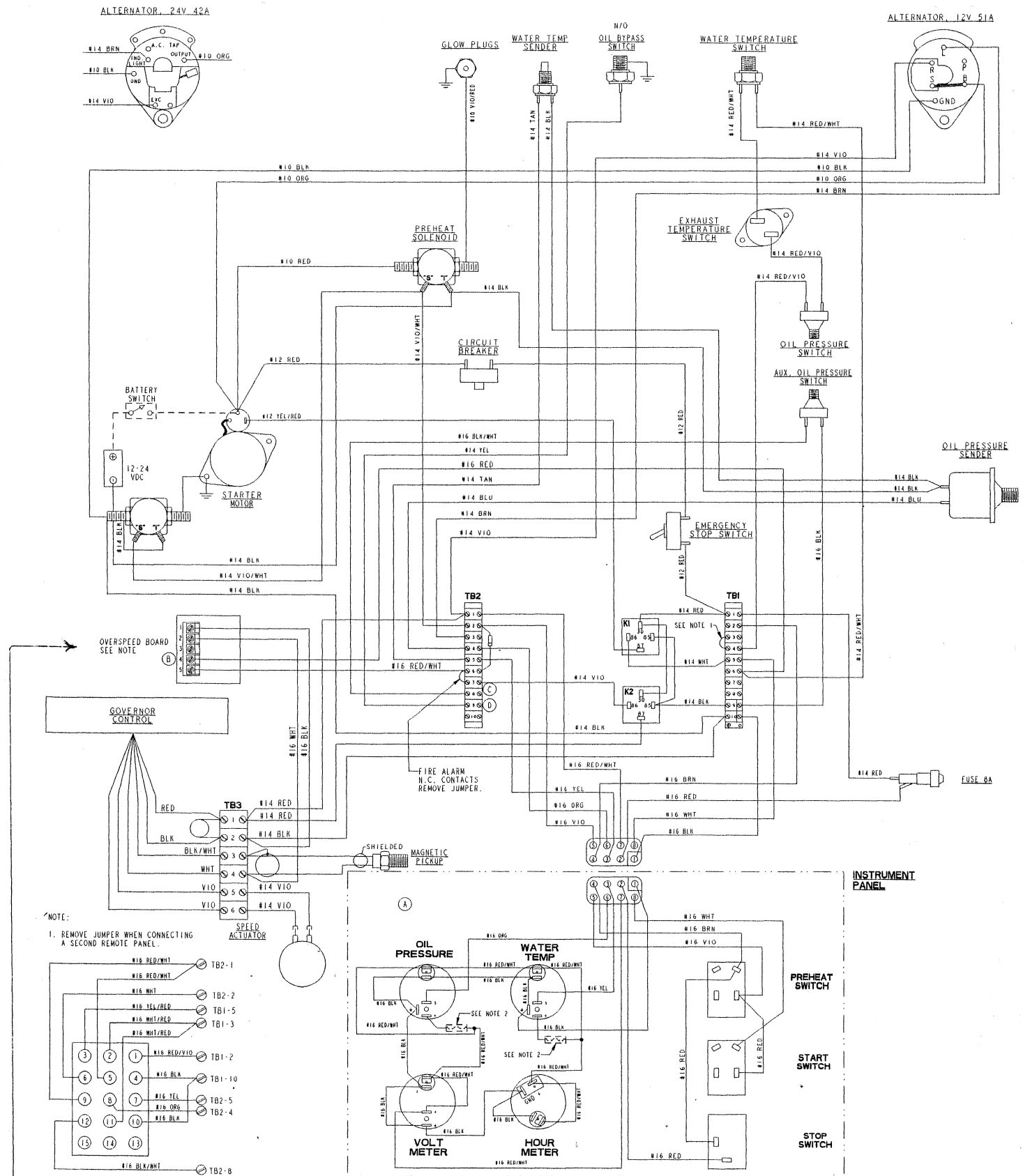


WIRING SCHEMATIC 44780

OVERSPEED BOARD



WIRING DIAGRAM 45673 UNGROUND

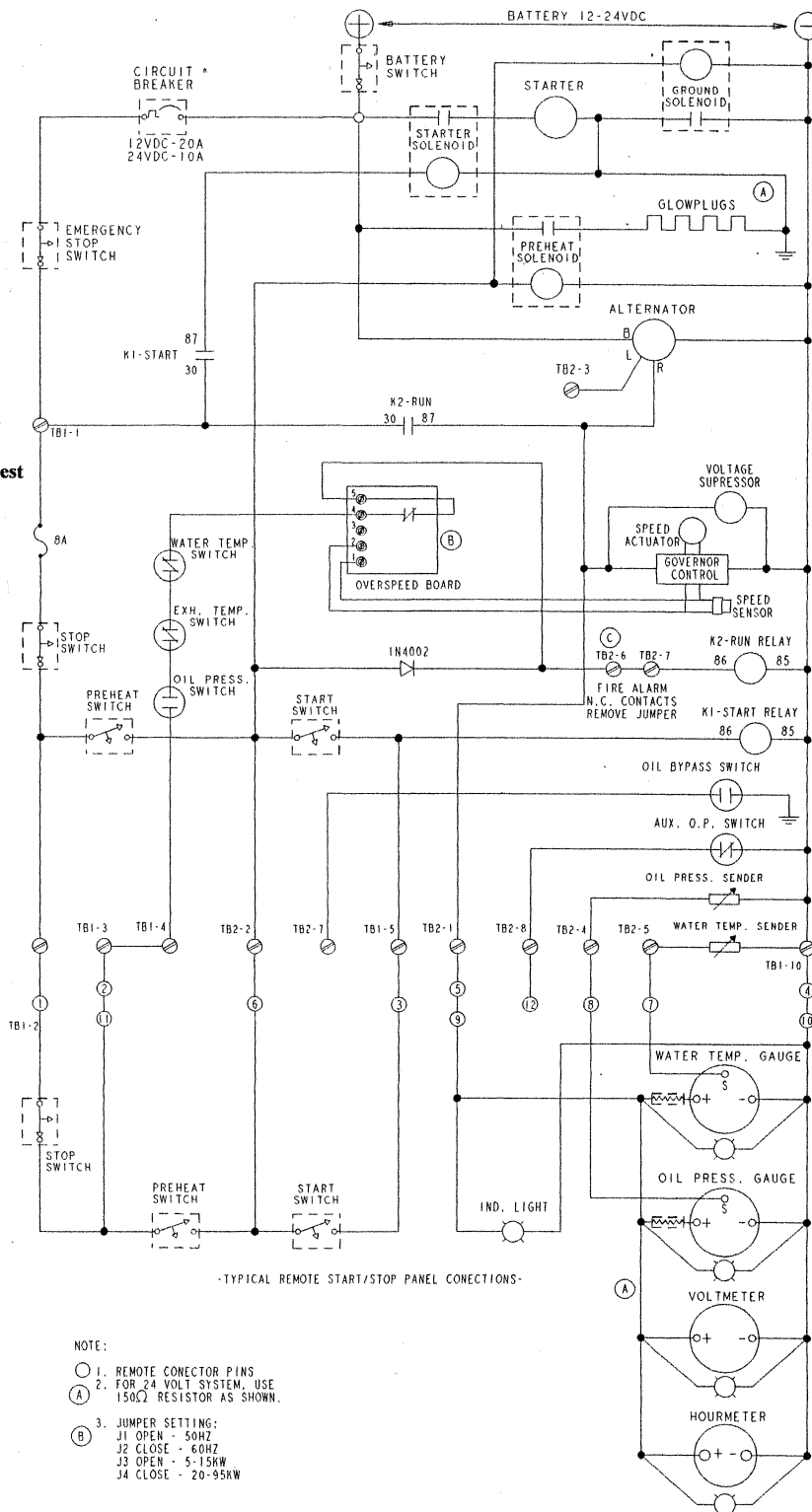


NOTE:
1. REMOVE JUMPER WHEN CONNECTING
A SECOND REMOTE PANEL.

Overspeed Board – To by-pass for test purposes. Move connection #5 onto connection #4.

WIRING SCHEMATIC 45673

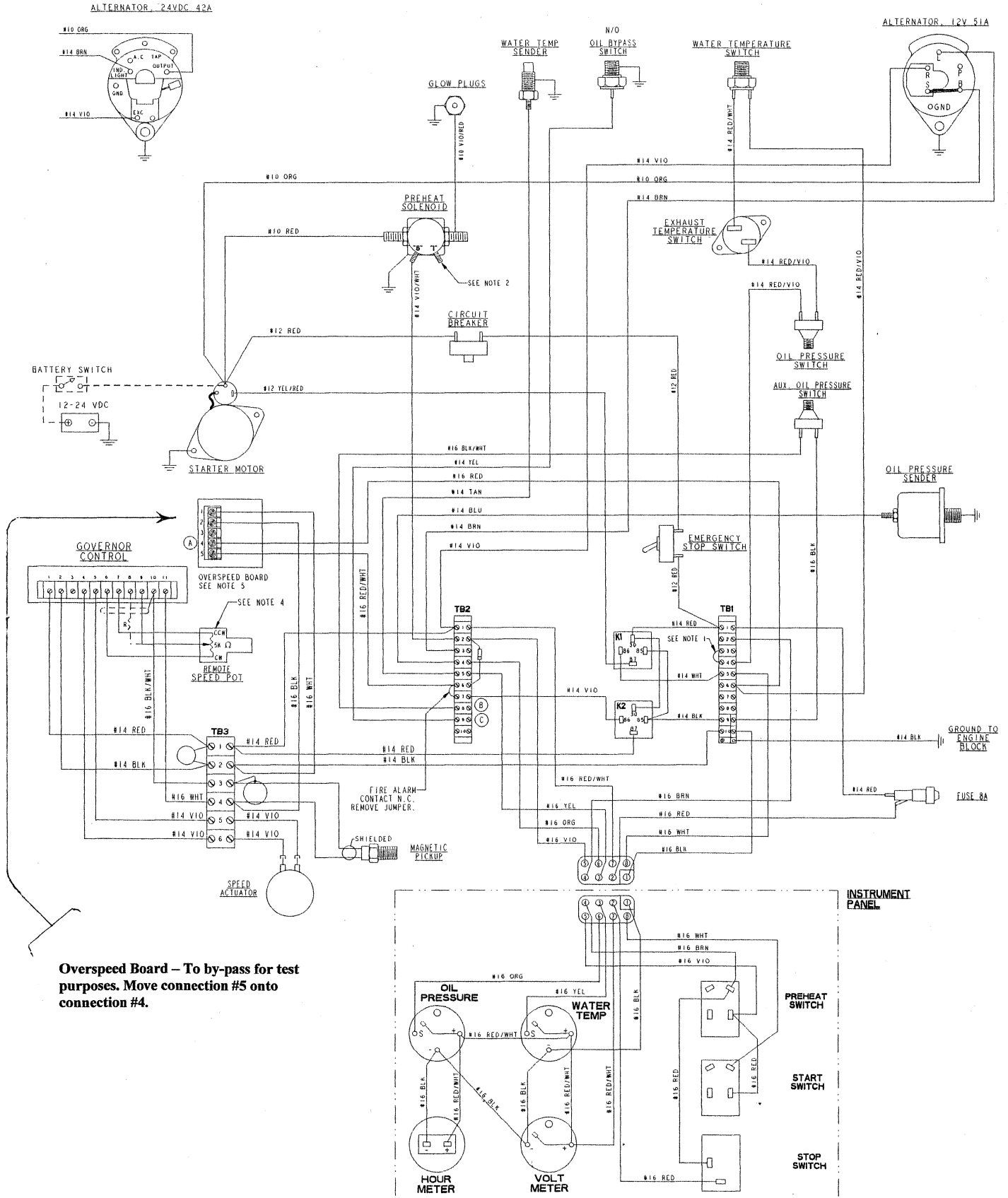
UNGROUND



Overspeed Board – To by-pass for test purposes. Move connection #5 onto connection #4.

WIRING DIAGRAM 48350

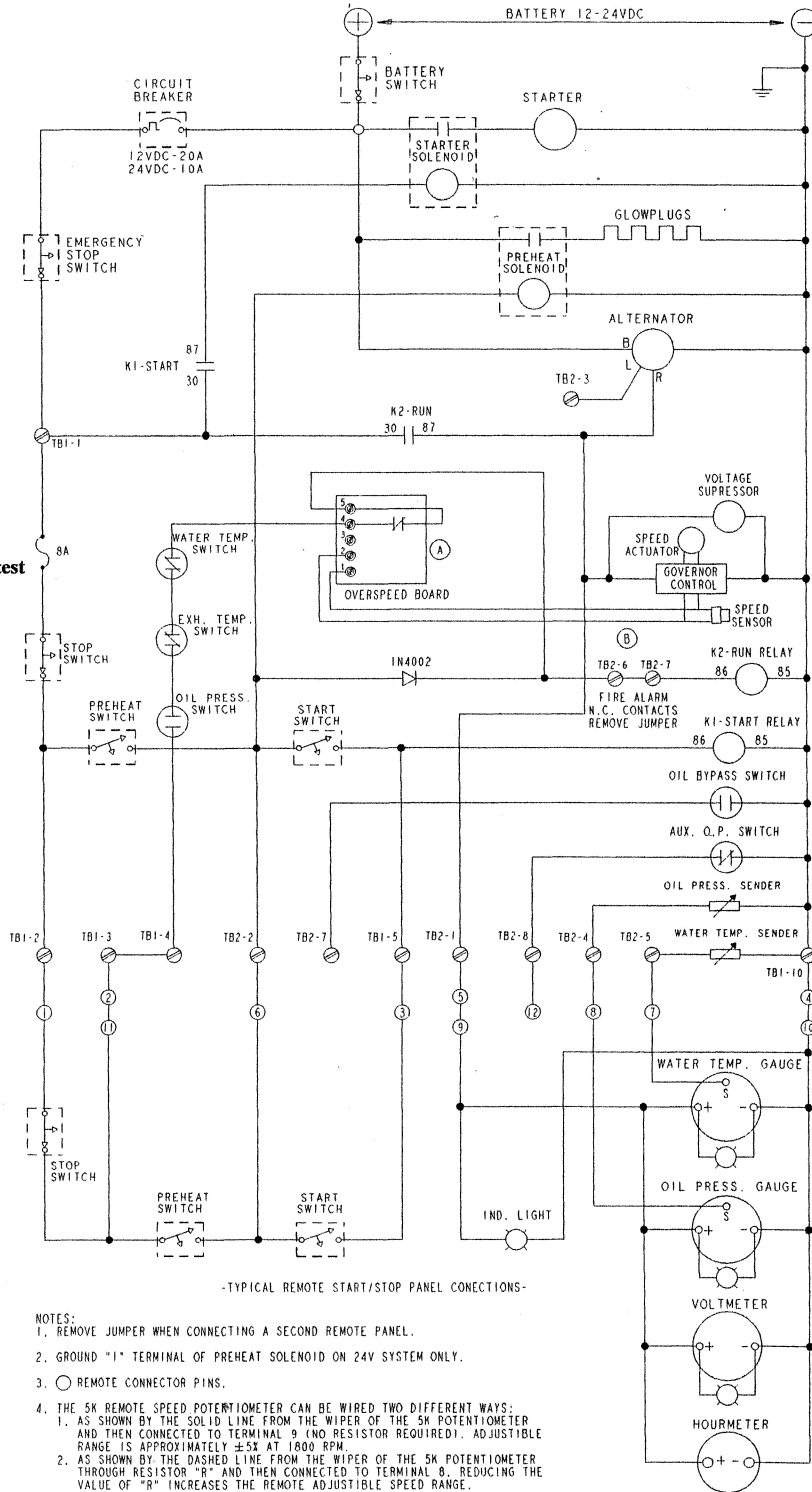
UNGROUNDED PARALLEL



Overspeed Board – To by-pass for test purposes. Move connection #5 onto connection #4.

WIRING SCHEMATIC 48350

UNGROUNDED PARALLEL



Overspeed Board – To by-pass for test purposes. Move connection #5 onto connection #4.

-TYPICAL REMOTE START/STOP PANEL CONNECTIONS-

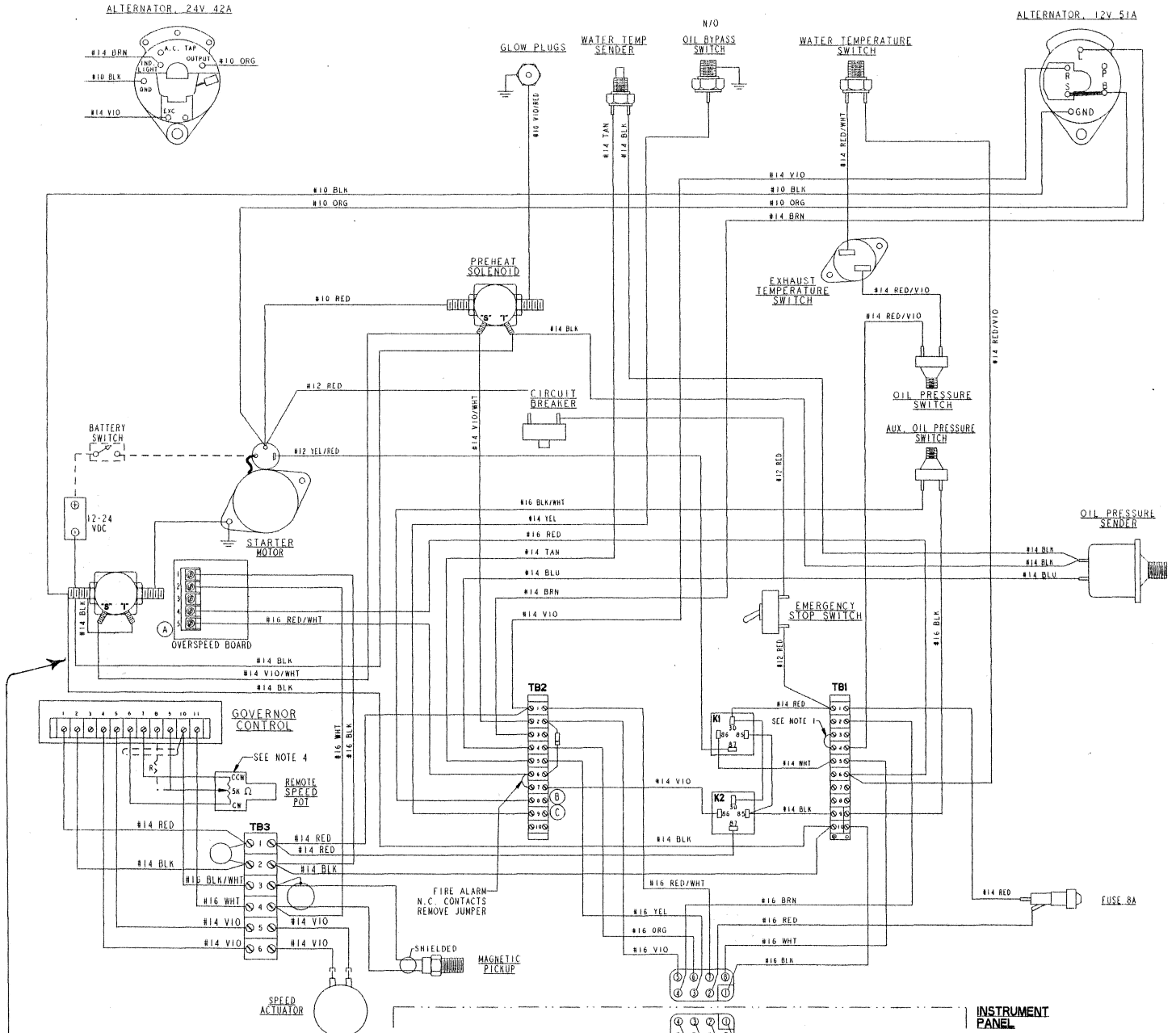
NOTES:

1. REMOVE JUMPER WHEN CONNECTING A SECOND REMOTE PANEL.
2. GROUND "1" TERMINAL OF PREHEAT SOLENOID ON 24V SYSTEM ONLY.
3. ○ REMOTE CONNECTOR PINS.
4. THE 5K REMOTE SPEED POTENTIOMETER CAN BE WIRED TWO DIFFERENT WAYS:
 1. AS SHOWN BY THE SOLID LINE FROM THE WIPER OF THE 5K POTENTIOMETER AND THEN CONNECTED TO TERMINAL 9 (NO RESISTOR REQUIRED). ADJUSTIBLE RANGE IS APPROXIMATELY $\pm 5\%$ AT 1800 RPM.
 2. AS SHOWN BY THE DASHED LINE FROM THE WIPER OF THE 5K POTENTIOMETER THROUGH RESISTOR "R" AND THEN CONNECTED TO TERMINAL 8. REDUCING THE VALUE OF "R" INCREASES THE REMOTE ADJUSTIBLE SPEED RANGE.
5. JUMPER SETTING:

J1	OPEN	- 50HZ
J2	CLOSE	- 60HZ
J3	OPEN	- 5-15KW
J4	CLOSE	- 20-95KW

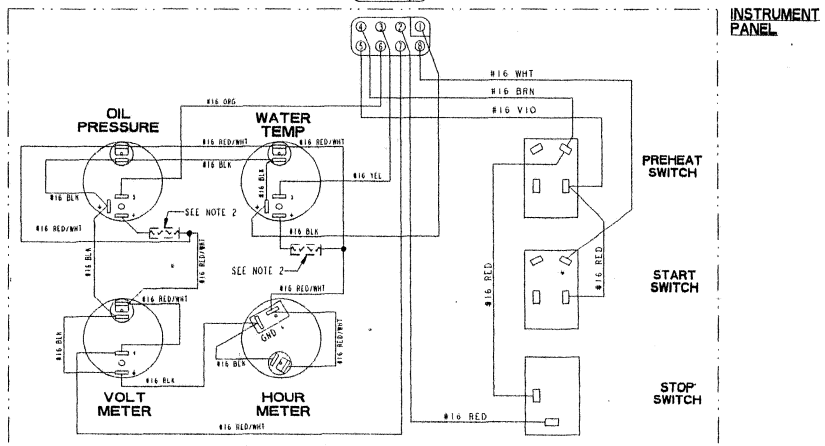
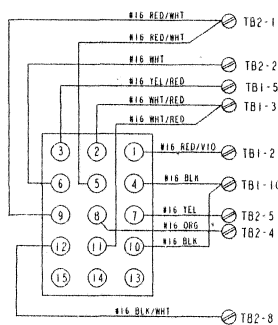
WIRING DIAGRAM 48910

UNGROUND PARALLEL



NOTE:

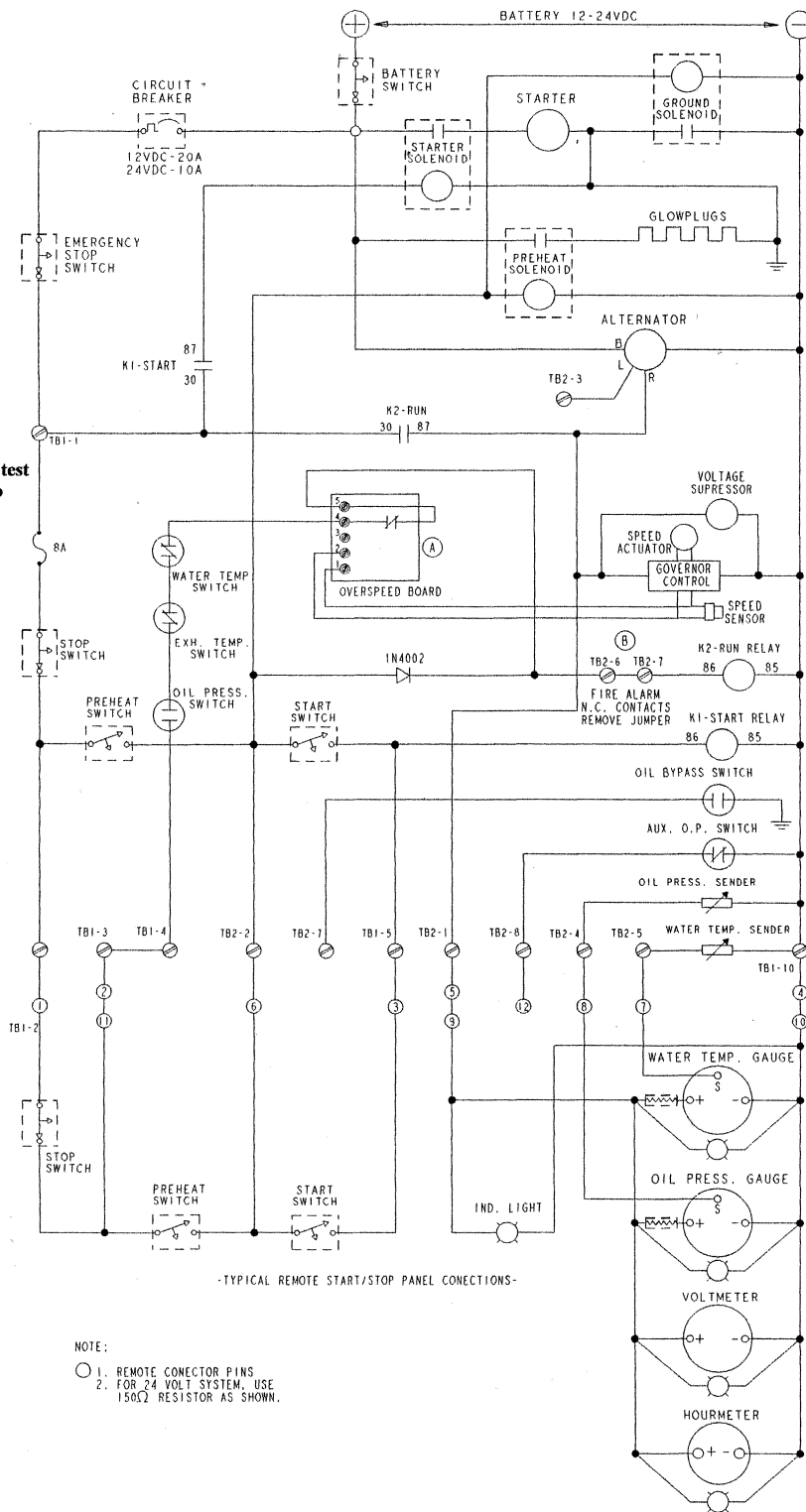
1. REMOVE JUMPER WHEN CONNECTING A SECOND REMOTE PANEL.



Over-speed Board – To by-pass for test purposes. Move connection #5 onto connection #4.

WIRING SCHEMATIC 48910

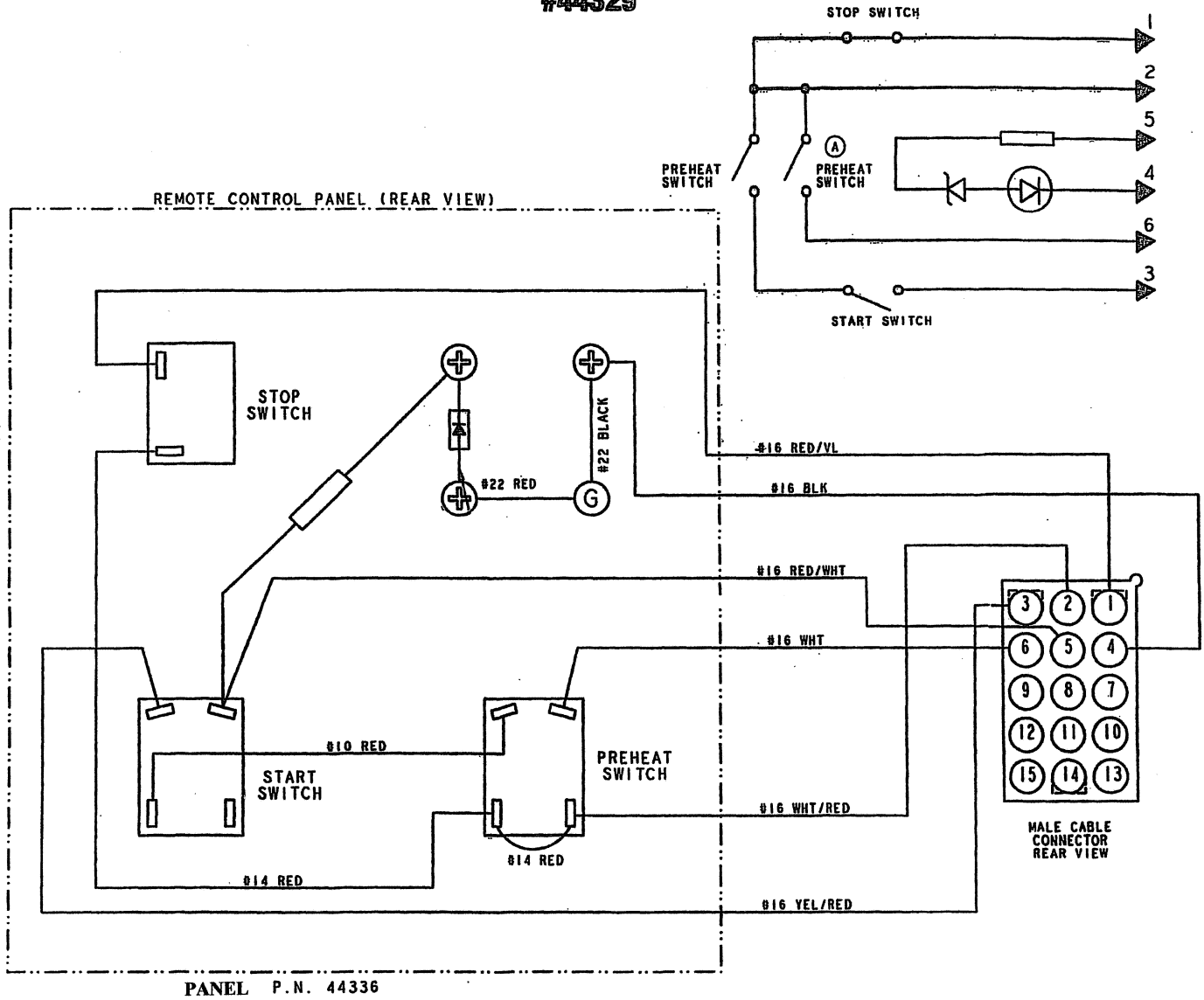
UNGROUND PARALLEL



Overspeed Board – To by-pass for test purposes. Move connection #5 onto connection #4.

REMOTE STOP/START PANEL

#44329



ENGINE ADJUSTMENTS

DRIVE BELT ADJUSTMENT

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

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

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

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

Adjusting Belt Tension

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

STARTER AND ALTERNATOR SERVICE

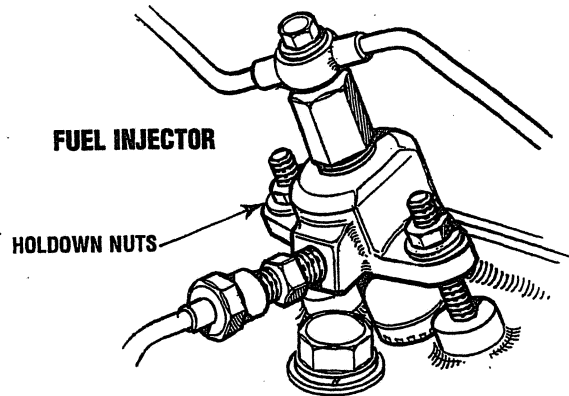
The starter and the alternator should be serviced every 1200 operating hours.

Starter commutator cleaning.

Alternator slip ring cleaning.

Carbon brushes and the brush contact check.

Refer to your *WESTERBEKE SERVICE MANUAL*.



FUEL INJECTORS

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

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

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

The fuel injectors should be pressure tested after 750 operating hours.

INJECTION STARTING PRESSURE 2630 psi (18.1 Mpa) (185 Kg/cm²)
INJECTION HOLDDOWN NUTS TORQUE 13.7 ± 1.5 ft-lb (1.9 ± 0.2 Kg-m)

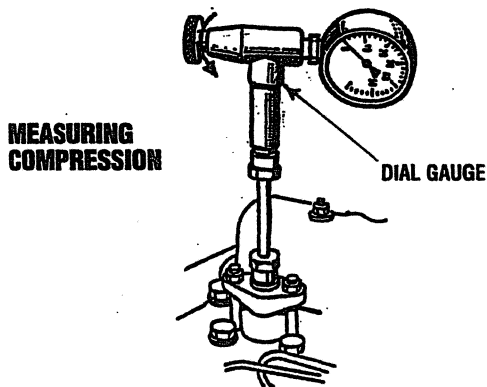
ENGINE ADJUSTMENTS

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

TESTING ENGINE COMPRESSION

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

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



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

COMPRESSION PRESSURE 441 psi (31.0 Kg/cm²) at 200 rpm.

ALLOWABLE LIMIT 370PSI (26.0 Kg/cm²).

MAXIMUM PERMISSIBLE DIFFERENCE BETWEEN CYLINDERS
28.44 psi (2.0 Kg/cm²)

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

7. Re-install the glow plugs and reset the fuel shut-off to the run position.
8. Open the raw water seacock (thru-hull).

Low Compression

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

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

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

OIL PRESSURE

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

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

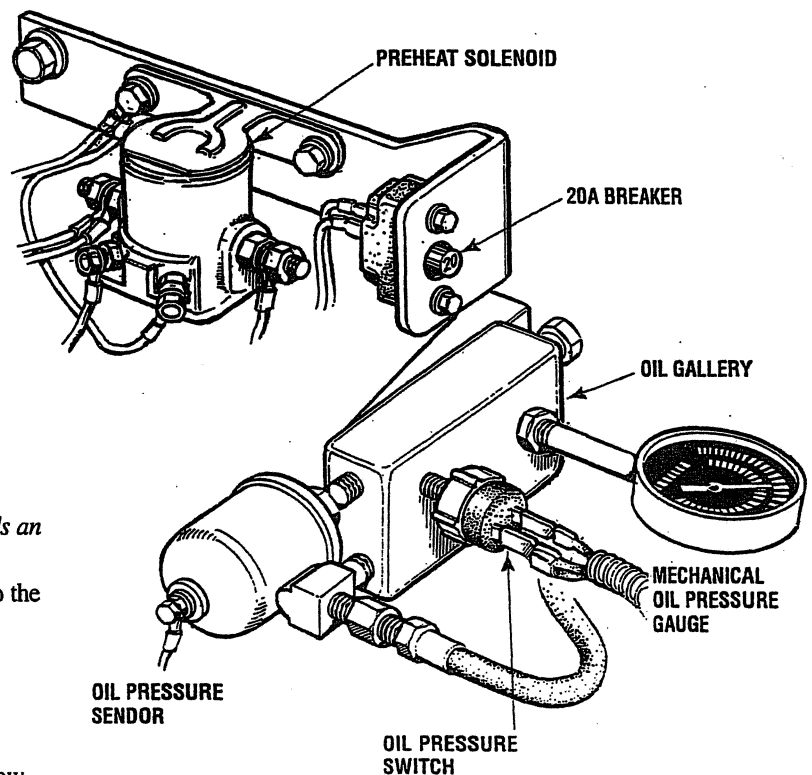
Oil pressure at 1800 (or 1500) rpm should maintain a reading of 50 psi.

TESTING OIL PRESSURE

To test the oil pressure, remove the oil pressure switch 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 50 psi at 1800 rpm.

SENDER AND SWITCH TORQUE 9 - 13 ft-lb (1.2 - 1.8 m - kg).

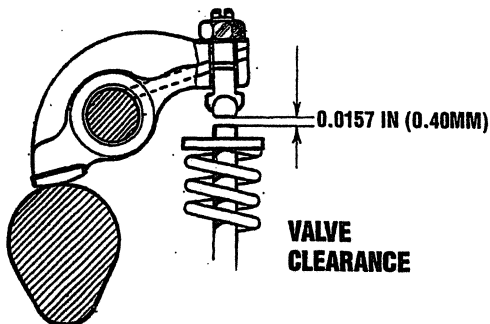


ENGINE ADJUSTMENTS

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

VALVE CLEARANCE ADJUSTMENT

The valve clearance must be adjusted every 200 operating hours, or whenever the valve rocker is abnormally noisy. Valve adjustment should only be done when engine is cold. Cold engine valve clearance is 0.0157 in (0.40 mm).



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

ADJUSTMENT PROCEDURE

Chart shows six cylinder model

Cylinder No.	1	2	3	4	5	6
Valve arrangement	I E	I E	I E	I E	I E	I E
When No. 1 cylinder is at TDC in the compression stroke	○ ○			○ ○		○
When No. 6 cylinder is at TDC in the compression stroke		⊙ ⊙		⊙ ⊙		⊙ ⊙

- In order to bring No. 1 or No. 6 piston (six cyl.) No. 4 piston (four cyl.) to the top dead center in the compression stroke, align the TDC mark and the crank shaft pulley mark.
- Do the adjustment on the circle marked valves in the above table where No. 1 piston is in the TDC in the compression stroke. After these steps, do the adjustment on the double circle marked valves where the No. 6 piston (six cyl.) No. 4 piston (four cyl.) is on TDC in the compression stroke.

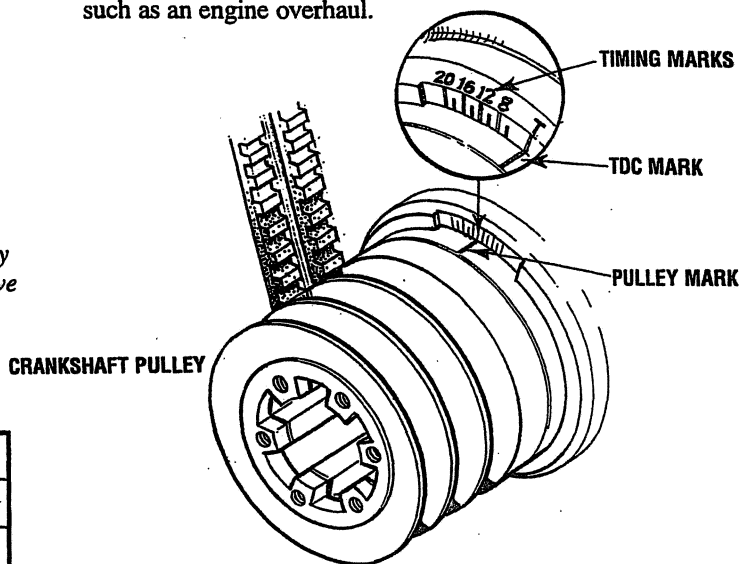
Chart shows four cylinder model

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

- After adjusting the valves with piston No. 1 at TDC, rotate the crankshaft 360° again aligning the TDC mark and the pulley mark. This brings piston No. 6 or No. 4 to TDC, then adjust the remaining valves.

INJECTION TIMING CHECK/ADJUSTMENT

Improper injection timing can cause engine failure. In normal servicing, this check and adjustment is unnecessary, however, it might be necessary in conjunction with other related work such as an engine overhaul.

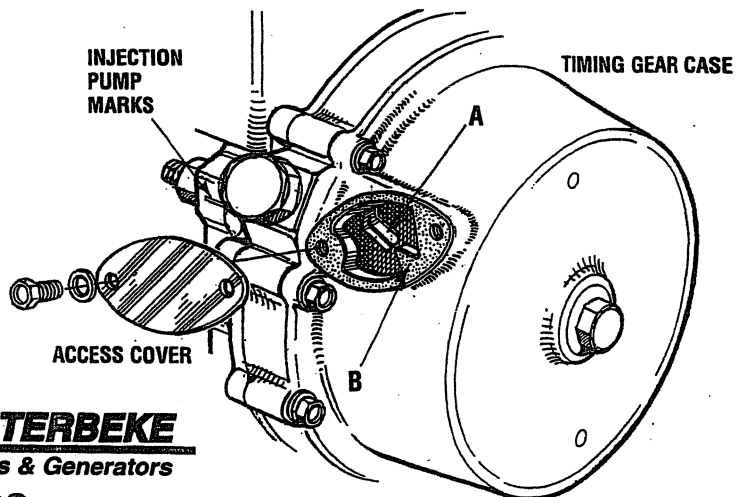


CHECK PROCEDURE

Bring No. 1 piston to the top dead center on the compression stroke. Turn the crankshaft pulley clockwise (viewed at engine front) and align the mark on the crankshaft pulley with the TDC mark.

Remove the access cover at the front of the injection pump and check the alignment between the pointer **A** on the injection pump gear lock plate and the projected pointer **B** on the timing gear case. If **A** and **B** are in alignment, the timing is set correctly.

If they are in alignment, No. 1 cylinder is at the TDC on the compression stroke. If it is in misalignment, recheck by turning the crankshaft pulley one more turn to repeat the procedure to make sure that it is in alignment.

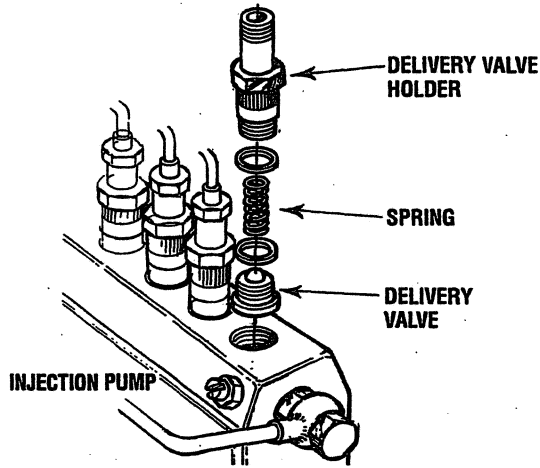


ENGINE ADJUSTMENTS

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

Check the crankshaft position for the start of fuel injection.

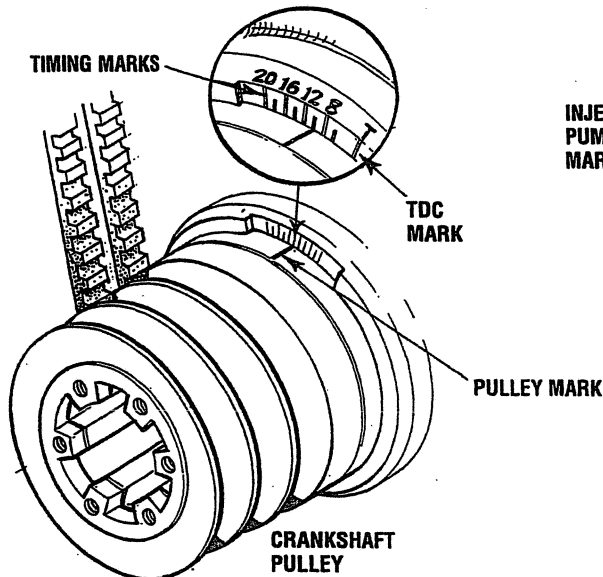
1. Turn the crankshaft pulley counterclockwise viewed from the engine front about 30°.
2. Remove No. 1 high pressure injection line.



3. Remove the injection pump No. 1 delivery valve holder, delivery valve and spring and reinstall the delivery valve holder back into the pump.

DELIVERY VALVE HOLDER TIGHTENING TORQUE:
39 - 44 Nm (4 - 4.5 Kg-m/28.9 - 32.5 ft-lb)

4. Slowly turn the crankshaft pulley clockwise and at the same time, feed fuel to the injection pump by slowly pumping the feed pump. When the fuel stops to flow out from No. 1 delivery valve holder, stop turning the crankshaft pulley and pumping. This is the beginning of fuel injection.



5. Notice which injection timing mark is aligned with the pulley mark. The timing mark in alignment with the pulley mark indicates the degrees before (TDC), the start of fuel injection

The degrees before TDC differs depending on the engine model. Refer to the specifications on the injection timing for the respective model engine. If the timing is incorrect, do the following adjustment.

ADJUSTMENT PROCEDURES

1. Align the pulley mark and the specified timing mark. (Refer to the injection timing specifications.)
2. Loosen the four injection pump attachment nuts.
3. To advance the timing, pivot the injection pump at the pump drive shaft away from the engine.

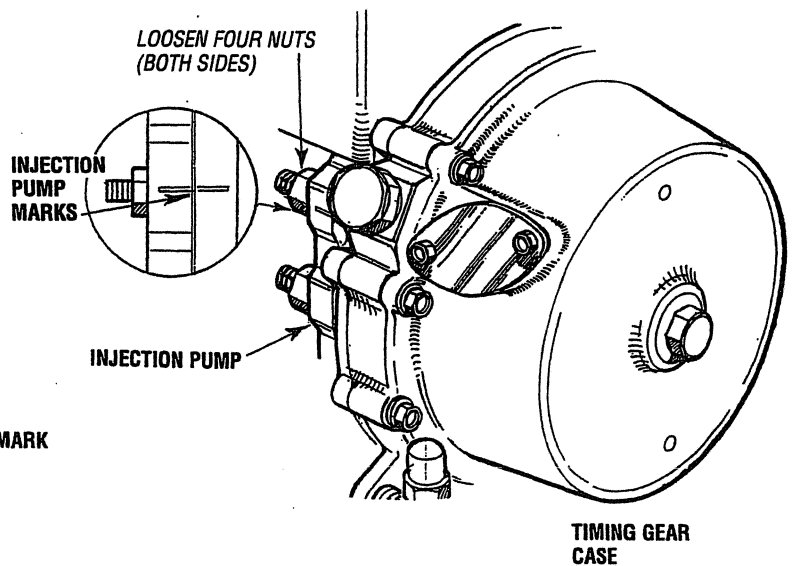
To retard the timing, pivot the injection pump at the pump drive shaft toward the engine.

NOTE: The 1mm misalignment between the timing marks on the crankshaft pulley correspond to about 2° in crank angle.

4. Recheck the timing, following procedures 1 through 5.
5. Tighten the four injection pump attachment nuts.
6. Again remove No. 1 delivery valve holder, and reinstall the delivery valve, spring and the valve holder.

DELIVERY VALVE HOLDER TIGHTENING TORQUE:
39 - 44 Nm (4 - 4.5 Kg-m/28.9 - 32.5 ft-lb)

7. Reinstall the No. 1 high pressure injection line.



ENGINE TROUBLESHOOTING

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

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

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

ENGINE TROUBLESHOOTING

Problem	Probable Cause	Verification/Remedy
Engine overheats.	<ol style="list-style-type: none"> 1. Raw water not circulating.. 2. Coolant not circulating. 	<ol style="list-style-type: none"> 1. Raw water pump failure. Check impeller/replace 2. Obstruction at raw water intake or raw water filter. 2a. Thermostat - remove and test in hot water. Replace thermostat. 2b. Loss of coolant - check hoses, hose clamps, drain plug, etc for leaks. 2c. Broken or loose belts - tighten/replace. 2d. Air leak in system, run engine and open the pressure cap to bleed air. Add coolant as needed.
Engine running then shuts down	<ol style="list-style-type: none"> 1. Safety shutdown circuit reacting to operating issue. 2. Faulty safety shutdown switch or O/S PC Board. 	<ol style="list-style-type: none"> 1. Check oil, coolant and exhaust, 2. Test/By-Pass switches. By-Pass O/S PC Board.
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. <ol style="list-style-type: none"> 1a. Crankcase is overfilled with engine oil (oil is blowing out through the exhaust). 2. Engine is running cold. <ol style="list-style-type: none"> 2a. Faulty injector or incorrect injector timing. 3. Improper grade of fuel. <ol style="list-style-type: none"> 3a. Fuel burn incomplete due to high back pressure in exhaust or insufficient air for proper combustion (Check for restrictions in exhaust system; check air intake.). 3b. Improperly timed injectors or valves or poor compression. 3c. Lack of air — check air intake and air filter. Check for proper ventilation. 3d. Overload.

TROUBLESHOOTING COOLANT TEMPERATURE AND OIL PRESSURE GAUGES

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

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

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

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

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

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

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

GENERATOR INFORMATION

USE OF ELECTRIC MOTORS

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

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

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

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

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

Required Operating Speed

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

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

Generator Frequency Adjustment

Frequency is a direct result of engine/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 generator's drive engine's speed must be changed. Along with a reconfiguring of the AC output connections at the generator, a regulator board voltage output adjustment must also be made. See *ELECTRONIC GOVERNOR* in the manual.

CAUTION: Prior to any cleaning or maintenance, make certain all switches are off and the generator is at room temperature.

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. Typical materials suggested are Daubert Chemical Co. "Non-Rust AC-410" and Ashland "Tectyle 506" or equivalent.
- In addition to periodic cleaning, the generator should be inspected for (a) tightness of all connections, (b) evidence of overheated terminals and (c) loose or damaged wires.
- The drive discs on single bearing generators should be checked periodically if possible for tightness of screws and for any evidence of incipient cracking failure. Discs should not be allowed to become rusty because rust may accelerate cracking. The bolts which fasten the drive disc to the generator shaft must be hardened steel SAE grade 8, identified by 6 radial marks, one at each of the 6 corners of the head.
- The rear armature bearing is lubricated and sealed; no maintenance is required. However, if the bearing becomes noisy or rough-sounding, have it replaced.
- Examine bearing at periodic intervals. No side movement of shaft should be detected when force is applied. If side motion is detectable, bearings are wearing or wear on shaft of bearing socket outside bearing has occurred. Repair must be made quickly or major components will rub and cause major damage to generator.
- Compressed air can be used to clean the generator exterior. Do not use compressed air on internal components.

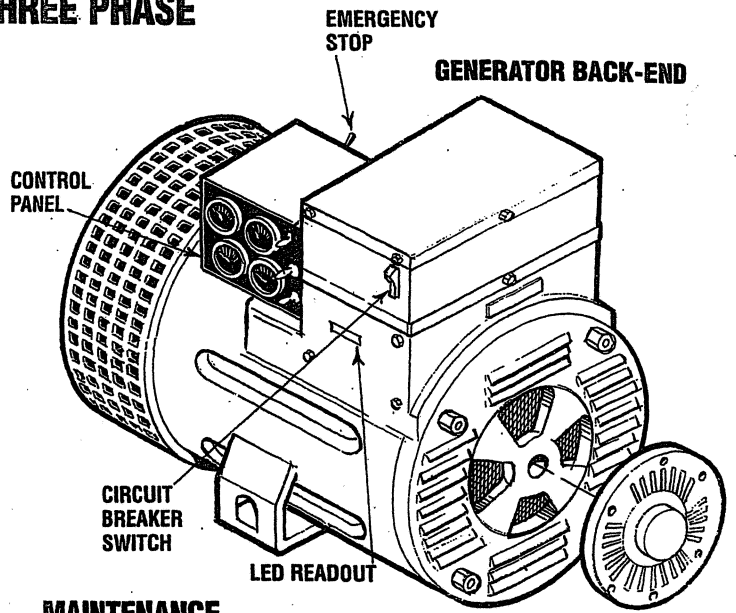
THE DC GENERATOR SINGLE AND THREE PHASE

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 excitor 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. An AC voltage is produced in the auxiliary windings of the main stator and is, in turn, supplied to a voltage regulator. The regulator produces a DC voltage to further excite the exciter stator windings, enabling the generator to produce a rated AC output. The voltage regulator senses AC voltage output and adjusts DC excitation to the exciter stator winding according to amperage load the generator is furnishing. To maintain a constant voltage output.

PARALLEL OPERATION

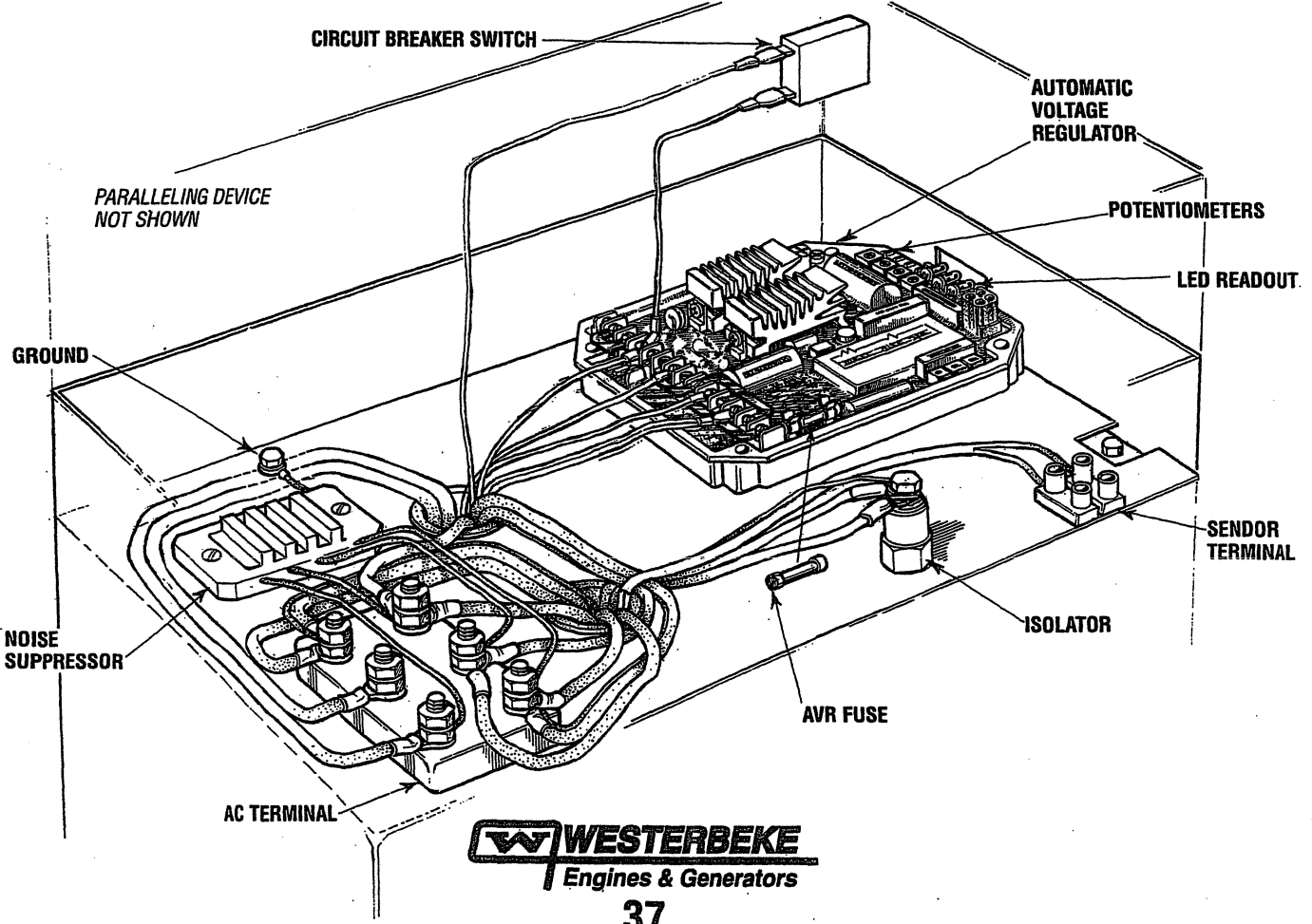
Two or more of these generators may be run in parallel by simply adding a parallel device. The parallel device is added to the electrical terminal box to ensure equal output of generator voltage. Contact your WESTERBEKE dealer or the WESTERBEKE factory for information on parallel operation.



MAINTENANCE

CAUTION: Prior to performing any maintenance, make certain that the generator is shut down, switches are off and the unit is at room temperature.

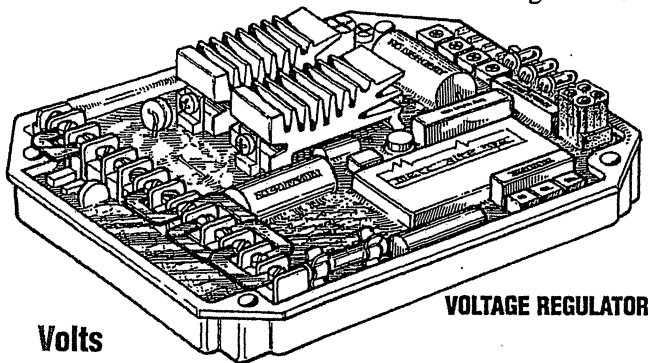
Use compressed air to clean the generators exterior. Do not use liquids or water. Do not use compressed air on any interior components as this could result in short circuits.



VOLTAGE REGULATOR ADJUSTMENTS

Description

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



Volts

This potentiometer is used to adjust output voltage. At proper engine operating speed the output voltage should be held at $\pm 1\%$ from a no-load condition to a full rated generator output and from power factor 1.0 - 0.8 with engine drive speed variations up to -6%.

Prior to starting the engine, turn the VOLT and STAB trimmers (using a mini phillips screwdriver) fully in a counter clockwise (Minimum) direction until you feel them hit their stops.

Turn the AMP and HERTZ trimmers completely clockwise (Maximum) in the same manner.

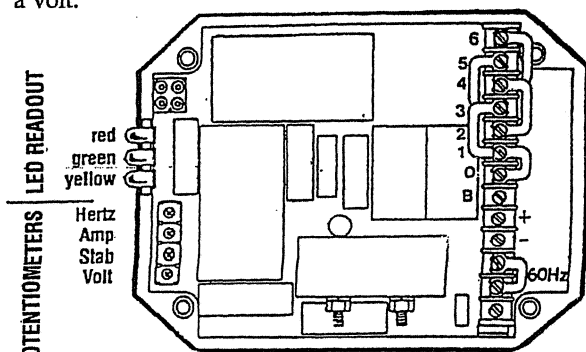
With the generator running at no-load, at normal speed, and with VOLT adjust at minimum, it is possible that output voltage will oscillate. Slowly rotate the VOLT adjust clockwise. The voltage output of the generator will increase and stabilize. Increase the voltage to the desired value. In this situation, only the green LED will stay lit.

Stability

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

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

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



VOLTAGE REGULATOR DIAGRAM

Amp-Hertz

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

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

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

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

Setting the Overload Protection

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

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

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

Setting the Underspeed Protection

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

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

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

GENERATOR AC VOLTAGE CONNECTIONS

AC VOLTAGE CONNECTIONS

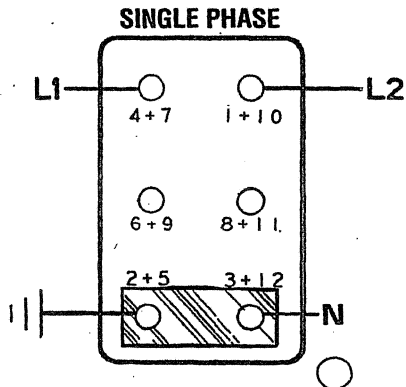
The frame ground wire (white/green) must be properly positioned when changing the AC output configuration of the AC terminal block. For making connections to the AC terminal block, use terminal ends for 3/8 inch studs that will accept multi strand copper wire sized for the amperage rating from the hot lead connection. The frame ground wire is white or white with a green strip. It connects between the neutral stud and the generator frame.

Generator Frequency

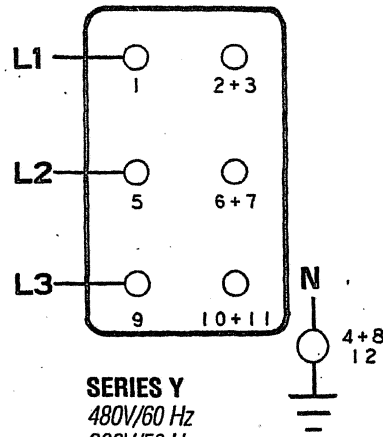
1. Frequency is a direct result of engine/generator speed:
1800 rpm = 60 hertz; 1500 rpm = 50 hertz.
2. To change generator frequency

Configure the AC terminal block for the desired voltage frequency as shown. Ensure that the case ground wire is connected to the correct terminal block neutral ground stud.

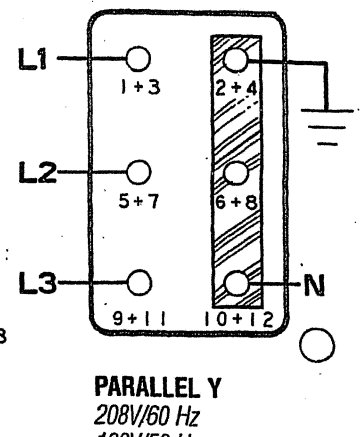
NOTE: The white/green ground wire may be removed in those installations where the AC circuit has a separate neutral and ground circuit. This will prevent the unit from being a ground source in the vessel.



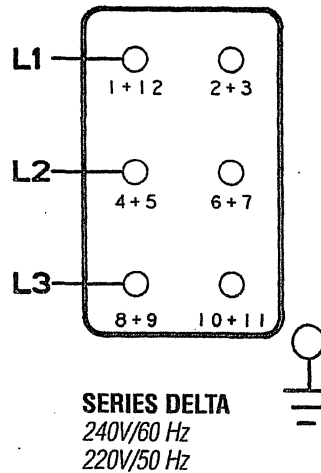
DOUBLE DELTA
120-240V/60 Hz
110-220V/50 Hz



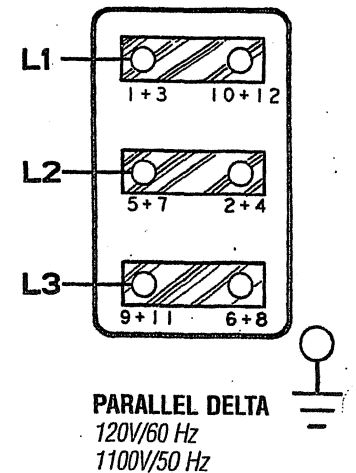
SERIES Y
480V/60 Hz
380V/50 Hz



PARALLEL Y
208V/60 Hz
190V/50 Hz



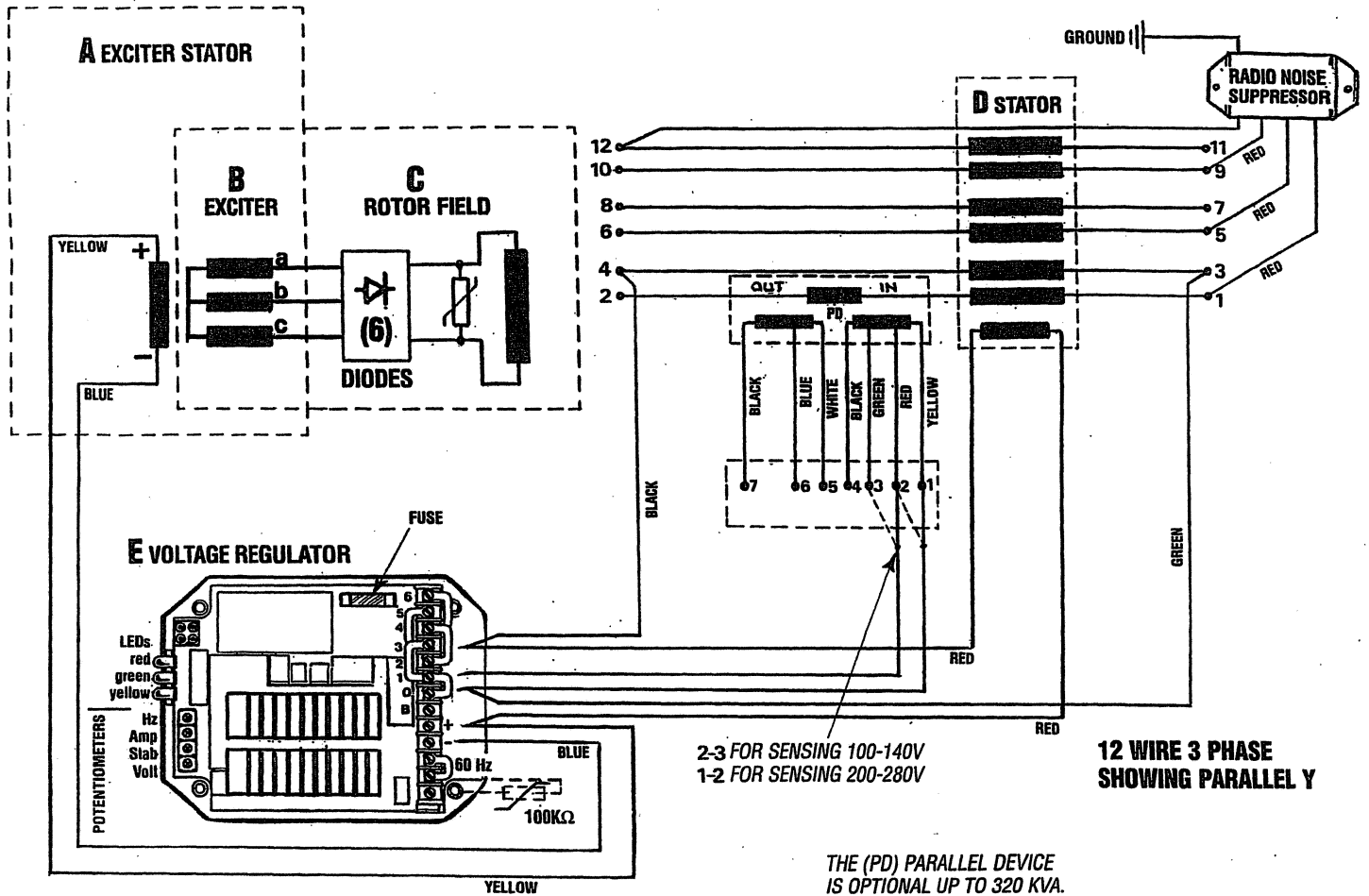
SERIES DELTA
240V/60 Hz
220V/50 Hz



PARALLEL DELTA
120V/60 Hz
110V/50 Hz

NOTE: IF WIRING FOR 50 Hz, THE 60 Hz JUMPER MUST BE REMOVED FROM THE REGULATOR.

INTERNAL WIRING DIAGRAM 12 WIRE - 3 PHASE - RECONNECTABLE



BE TROUBLESHOOTING

NOTE: AC GENERATOR TROUBLESHOOTING MUST BE PERFORMED WITH ENGINE OPERATING AT 60 HERTZ.

PROBLEM	PROBABLE CAUSE
No AC voltage output at no load.	<ol style="list-style-type: none"> 1. Short or open in the main stator winding. 2. Shorted pozi-resistor on exciter rotor. 3. Four or more shorted or open diodes on exciter rotor. 4. Short or open in exciter stator winding. 5. Short or open in rotating field winding.
Residual voltage produced at no load 15 - 20 volts AC.	<ol style="list-style-type: none"> 1. Blown 6 AMP fuse auxiliary circuit feed to AVR. 2. Faulty voltage regulator 3. Shorted or open main stator auxiliary winding. 4. AC circuit breaker tripped.
Low AC voltage output at no load 60 - 100 VAC.	<ol style="list-style-type: none"> 1. Reset voltage potentiometer. 2. Open or shorted diodes in exciter rotor 1 to 3 diodes. 3. Open or shorted exciter rotor winding 4. Faulty voltage regulator
High AC output voltage 150 VAC or higher.	<ol style="list-style-type: none"> 1. Reset voltage potentiometer. 2. Faulty voltage regulator
Unstable voltage output.	<ol style="list-style-type: none"> 1. STB pod on regulator needs adjustment. 2. Faulty voltage regulator.
AC voltage drop under load 60 - 100 volts AC.	<ol style="list-style-type: none"> 1. Diode(s) on exciter rotor breaking down when load is applied (inductive) 1-3 diodes.

40 BEDA GENERATOR SPECIFICATIONS

GENERAL	
Engine Type	Diesel, four cylinder, four-cycle, marine engine. Vertical in-line overhead valve, water cooled direct injection.
Aspiration	Turbo Charged.
Governor	Integral with injection pump.
Bore & Stroke	4.13 x 4.92 inches (105 x 125 mm).
Piston Displacement	264 cubic inches (4.3 liter).
Firing Order	1 - 3 - 4 - 2.
Direction of Rotation	Clockwise, when viewed from the front.
Engine Torque	210 ft-lb @ 1500 rpm.
Compression Ratio	17:1
Dimensions - inches (mm) w/out transmission	Height: 33.6 inches (855 mm) Width: 30.6 inches (778 mm) Length: 62.5 inches (1588 mm)
Weight (dry)	1646 lbs (747 kgs).
TUNE-UP SPECIFICATIONS	
Compression Pressure (Limit of difference)	441 psi (31 kg/cm ²) at 200 rpm Not to exceed 28.44 psi (20.0 kg/cm ²).
Injector Pressure	2133 psi (150 kf/cm ²).
Valve Seat Angle	Intake 45°. Exhaust 45°.
Valve Clearance (engine cold)	Intake and Exhaust. 0.016 inches (0.40 mm).
Engine Speed	50 Hz @ 1500 rpm 60 Hz @ 1800 rpm
GENERATOR DATA	
Generator Power @ 1800 (1500) rpm 40KW (30KW)	
Design	Brushless, four pole, revolving field, power take-off
Frequency	All units adjustable to 50 or 60 Hertz.
Phase	Three phase. Single phase units available.
Power Factor	0.8
Wire	12 lead reconnectable
Voltage Regulation	Standard ± 1% no load to full load.
Insulation	Class "H", as defined by NEMA MG1-.65
Cooling	Direct drive centrifugal blower.
Temperature Rise	Within NEMA MG1-22.40 definition - full load
Interference Level	Meets "CE" requirements
Voltage Output	60 Hertz 50 Hertz
Configuration	L-L L-N L-L L-N
Series Star	480 277 400 230
Parallel Star	208 120 230 127
Series Delta	240 120 230 115
Parallel Delta	130 110
Double Delta	240 120 230 115
Voltage regulator is adjustable ± 5%	
3 Phase amperage calculation: Amps=Watts/[Voltage x 1.732 x P.F.]	

FUEL SYSTEM	
General	Closed system with bleed points.
Fuel	No. 2 diesel oil (cetane rating of 45 or higher).
Fuel Injection Pump	BOSCH Model A type (In-line).
Fuel Injection Timing	14° BTDC
Nozzle	Multi-hole
Fuel Filter (on engine)	Full flow replaceable.
Air cleaner	Replaceable paper element.
Air Flow (engine combustion)	123 cfm (3.4 cmm).
Fuel Consumption	3.7 U.S. gph (14.0 lph) @ 1800 rpm. 3.0 U.S. gph (11.4 lph) @ 1500 rpm
ELECTRICAL SYSTEM	
Starting Battery	12 Volt, (-) negative ground.
Battery Capacity	750 – 900 Cold Cranking Amps (CCA).
DC Charging Alternator	51 Amp rated, belt-driven.
Starting Aid	Glow plugs.
Starter	12 Volt, 2.9 KW.
DC Cranking Current	450 CCA.
LUBRICATION SYSTEM	
General	Gear type/pressure circulation.
Oil Filter	Full flow, paper element, spin-on type.
Sump Capacity (not including filter)	14.5 U.S. qts (13.8 liters).
Operating Oil Pressure (engine hot)	25 – 85 psi.
Oil Grade	API Specification CG-4, SAE 10W-40, 15W-40.
EXHAUST SYSTEM	
Exhaust Elbow	45° elbow
Exhaust Hose Size	4" I.D. (101.6 mm) hose
ENGINE AIR REQUIREMENTS	
Combustion Air	1230 cfm (3.4 cmm)
Note: The pressure differential between the outside of the engine compartment versus the inside of the engine compartment should not exceed 2 inches of water (51 mm) at full open throttle (measure with a manometer).	
COOLING SYSTEM	
General	Fresh water-cooled block, thermostatically-controlled with heat exchanger.
Operating Temperature	170 – 190° F (77 – 88° C).
Fresh Water Pump	Centrifugal type, metal impeller, belt-driven.
Raw Water Pump	Positive displacement, rubber impeller, engine-driven.
Coolant (Fresh Water) System Capacity	17 US qts (16.1 liters).

45 BEDA GENERATOR SPECIFICATIONS

GENERAL	
Engine Type	Diesel, four cylinder, four-cycle, marine engine. Vertical in-line overhead valve, water cooled direct injection.
Aspiration	Turbo Charged.
Governor	Integral with injection pump.
Bore & Stroke	4.13 x 4.92 inches (105 x 125 mm).
Piston Displacement	264 cubic inches (4.3 liter).
Firing Order	1 - 3 - 4 - 2.
Direction of Rotation	Clockwise, when viewed from the front.
Engine Torque	210 ft-lb @ 1500 rpm.
Compression Ratio	17:1
Dimensions - inches (mm) w/out transmission	Height: 33.6 inches (855 mm) Width: 30.6 inches (778 mm) Length: 62.5 inches (1588 mm)
Weight (dry)	1601 lbs (729 kgs).

TUNE-UP SPECIFICATIONS	
Compression Pressure (Limit of difference)	441 psi (31 kg/cm ²) at 200 rpm Not to exceed 28.44 psi (20.0 kg/cm ²).
Injector Pressure	2133 psi (150 kf/cm ²).
Valve Seat Angle	Intake 45°. Exhaust 45°.
Valve Clearance (engine cold)	Intake and Exhaust. 0.016 inches (0.40 mm).
Engine Speed	50 Hz @ 1500 rpm 60 Hz @ 1800 rpm

GENERATOR DATA	
Generator Power @ 1800 (1500) rpm 45KW (35KW)	
Design	Brushless, four pole, revolving field, power take-off
Frequency	All units adjustable to 50 or 60 Hertz.
Phase	Three phase. Single phase units available.
Power Factor	0.8
Wire	12 lead reconnectable
Voltage Regulation	Standard ± 1% no load to full load.
Insulation	Class "H", as defined by NEMA MGI-1.65
Cooling	Direct drive centrifugal blower.
Temperature Rise	Within NEMA MGI-22.40 definition - full load
Interference Level	Meets "CE" requirements
Voltage Output	60 Hertz 50 Hertz
Configuration	L-L L-N L-L L-N
Series Star	480 277 400 230
Parallel Star	208 120 230 127
Series Delta	240 120 230 115
Parallel Delta	130 110
Double Delta	240 120 230 115
Voltage regulator is adjustable ± 5%	
3 Phase amperage calculation: Amps=Watts/[Voltage x 1.732 x P.F.]	

FUEL SYSTEM	
General	Closed system with bleed points.
Fuel	No. 2 diesel oil (cetane rating of 45 or higher).
Fuel Injection Pump	BOSCH Model A type (In-line).
Fuel Injection Timing	14° BTDC
Nozzle	Multi-hole
Fuel Filter (on engine)	Full flow replaceable.
Air cleaner	Replaceable paper element.
Air Flow (engine combustion)	123 cfm (3.4 cmm).
Fuel Consumption	3.7 U.S. gph (14.0 lph) @ 1800 rpm. 3.0 U.S. gph (11.4 lph) @ 1500 rpm

ELECTRICAL SYSTEM	
Starting Battery	12 Volt, (-) negative ground.
Battery Capacity	750 - 900 Cold Cranking Amps (CCA).
DC Charging Alternator	51 Amp rated, belt-driven.
Starting Aid	Glow plugs.
Starter	12 Volt, 2.9 KW.
DC Cranking Current	450 CCA.

LUBRICATION SYSTEM	
General	Gear type/pressure circulation.
Oil Filter	Full flow, paper element, spin-on type.
Sump Capacity (not including filter)	14.5 U.S. qts (13.8 liters).
Operating Oil Pressure (engine hot)	25 - 85 psi.
Oil Grade	API Specification CG-4, SAE 10W-40, 15W-40.

EXHAUST SYSTEM	
Exhaust Elbow	45° elbow
Exhaust Hose Size	4" I.D. (101.6 mm) hose

ENGINE AIR REQUIREMENTS	
Combustion Air	1230 cfm (3.4 cmm)
Note: The pressure differential between the outside of the engine compartment versus the inside of the engine compartment should not exceed 2 inches of water (51 mm) at full open throttle (measure with a manometer).	

COOLING SYSTEM	
General	Fresh water-cooled block, thermostatically-controlled with heat exchanger.
Operating Temperature	170 - 190° F (77 - 88° C).
Fresh Water Pump	Centrifugal type, metal impeller, belt-driven.
Raw Water Pump	Positive displacement, rubber impeller, engine-driven.
Coolant (Fresh Water) System Capacity	17 US qts (16.1 liters).

45 BED GENERATOR SPECIFICATIONS

GENERAL	
Engine Type	Diesel, four cylinder, four-cycle, marine engine. Vertical in-line overhead valve, water cooled direct injection.
Aspiration	Naturally aspirated.
Governor	Integral with injection pump.
Bore & Stroke	4.02 x 4.65 inches (102.0 x 118.0 mm).
Piston Displacement	262 cubic inches (4.3 liter).
Firing Order	1 - 3 - 4 - 2.
Direction of Rotation	Clockwise, when viewed from the front.
Engine Torque	210 ft-lb @ 1500 rpm.
Compression Ratio	17:1
Dimensions - inches (mm) w/out transmission	Height: 33.6 inches (855 mm) Width: 30.6 inches (778 mm) Length: 62.5 inches (1588 mm)
Weight (dry)	1585 lbs (719 kgs).
TUNE-UP SPECIFICATIONS	
Compression Pressure (Limit of difference)	441 psi (31 kg/cm ²) at 200 rpm Not to exceed 28.44 psi (20.0 kg/cm ²).
Injector Pressure	2133 psi (150 kf/cm ²).
Valve Seat Angle	Intake 45°. Exhaust 45°.
Valve Clearance (engine cold)	Intake and Exhaust. 0.016 inches (0.40 mm).
Engine Speed	50 Hz @ 1500 rpm 60 Hz @ 1800 rpm
GENERATOR DATA	
Generator Power @ 1800 (1500) rpm 45KW (35KW)	
Design	Brushless, four pole, revolving field, power take-off
Frequency	All units adjustable to 50 or 60 Hertz..
Phase	Three phase. Single phase units available.
Power Factor	0.8
Wire	12 lead reconnectable
Voltage Regulation	Standard ± 1% no load to full load.
Insulation	Class "H", as defined by NEMA MG1-1.65
Cooling	Direct drive centrifugal blower.
Temperature Rise	Within NEMA MG1-22.40 definition - full load
Interference Level	Meets "CE" requirements
Voltage Output	60 Hertz 50 Hertz
Configuration	L-L L-N L-L L-N
Series Star	480 277 400 230
Parallel Star	208 120 230 127
Series Delta	240 120 230 115
Parallel Delta	130 110
Double Delta	240 120 230 115
Voltage regulator is adjustable ± 5%	
3 Phase amperage calculation: Amps=Watts/[Voltage x 1.732 x P.F.]	

FUEL SYSTEM	
General	Closed system with bleed points.
Fuel	No. 2 diesel oil (cetane rating of 45 or higher).
Fuel Injection Pump	BOSCH Model A type (In-line).
Fuel Injection Timing	14° BTDC
Nozzle	Multi-hole
Fuel Filter (on engine)	Full flow replaceable.
Air cleaner	Replaceable paper element.
Air Flow (engine combustion)	123 cfm.
Fuel Consumption	3.5 U.S. gph (13.2 lph).
ELECTRICAL SYSTEM	
Starting Battery	12 Volt, (-) negative ground.
Battery Capacity	750 – 900 Cold Cranking Amps (CCA).
DC Charging Alternator	51 Amp rated, belt-driven.
Starting Aid	Glow plugs.
Starter	12 Volt, 2.9 KW.
DC Cranking Current	450 CCA.
LUBRICATION SYSTEM	
General	Gear type/pressure circulation.
Oil Filter	Full flow, paper element, spin-on type.
Sump Capacity (not including filter)	14.5 U.S. qts (13.8 liters).
Operating Oil Pressure (engine hot)	25 – 85 psi.
Oil Grade	API Specification CG-4, SAE 10W-40, 15W-40.
EXHAUST SYSTEM	
Exhaust Elbow	45° elbow
Exhaust Hose Size	4" I.D. (101.6 mm) hose
ENGINE AIR REQUIREMENTS	
Combustion Air	1230 cfm
Note: The pressure differential between the outside of the engine compartment versus the inside of the engine compartment should not exceed 2 inches of water (51 mm) at full open throttle (measure with a manometer).	
COOLING SYSTEM	
General	Fresh water-cooled block, thermostatically-controlled with heat exchanger.
Operating Temperature	170 – 190° F (77 – 88° C).
Fresh Water Pump	Centrifugal type, metal impeller, belt-driven.
Raw Water Pump	Positive displacement, rubber impeller, engine-driven.
Coolant (Fresh Water) System Capacity	17 US qts (16.1 liters).

55 BED GENERATOR SPECIFICATIONS

GENERAL	
Engine Type	Diesel, four cylinder, four-cycle, turbocharged marine engine. Vertical in-line overhead valve, water cooled direct injection.
Aspiration	Turbo charged.
Governor	Integral with injection pump.
Bore & Stroke	4.02 x 4.65 inches (102.0 x 118.0 mm).
Piston Displacement	202 cubic inches (4.3 liter).
Firing Order	1 - 3 - 4 - 2.
Direction of Rotation	Clockwise, when viewed from the front.
Engine Torque (max.)	280 ft-lb @ 1500 rpm.
Compression Ratio	17:1.
Dimensions - inches (mm) w/out sound guard	Height: 33.6 inches (855 mm) Width: 30.6 inches (778 mm) Length: 62.5 inches (1588 mm)
Weight (dry)	1647 lbs (746 kgs).
TUNE-UP SPECIFICATIONS	
Compression Pressure (Limit of difference)	441 psi (31 kg/cm ²) at 200 rpm Not to exceed 28.44 psi (20.0 kg/cm ²).
Injector Pressure	2133 psi (150 kf/cm ²).
Valve Seat Angle	Intake 45° Exhaust 45°
Valve Clearance (engine cold)	Intake and exhaust 0.016 inches (0.40 mm).
Engine Speed	50 Hz @ 1800 rpm 60 hz @ 1800 rpm
GENERATOR DATA	
Generator Power @ 1800 (1500) rpm 55KW (45KW)	
Design	Brushless, four pole, revolving field, power take-off
Frequency	All units adjustable to 50 or 60 Hertz..
Phase	Three phase. Single phase units available.
Power Factor	0.8
Wire	12 lead reconnectable
Voltage Regulation	Standard ± 1% no load to full load.
Insulation	Class "H", as defined by NEMA MGI-1.65
Cooling	Direct drive centrifugal blower.
Temperature Rise	Within NEMA MGI-22.40 defination - full load
Interference Level	Meets "CE" requirements
Voltage Output	60 Hertz 50 Hertz
Configuration	L-L L-N L-L L-N
Series Star	480 277 400 230
Parallel Star	208 120 230 127
Series Delta	240 120 230 115
Parallel Delta	130 110
Double Delta	240 120 230 115
Voltage regulator is adjustable ± 5%	
3 Phase amperage calculation: Amps=Watts/[Voltage x 1.732 x P.F.]	

FUEL SYSTEM	
General	Closed system with bleed points.
Fuel	No. 2 diesel oil (cetane rating of 45 or higher).
Fuel Injection Pump	BOSCH Model A type (In-line).
Fuel Injection Timing	12° BTDC
Nozzle	Multi-hole
Fuel Filter (on engine)	Full flow replaceable.
Air cleaner	Replaceable paper element.
Air Flow (engine combustion)	160 cfm.(4.5 cmm).
Fuel Consumption	4.8 U.S. gph (18.2 lph).

ELECTRICAL SYSTEM	
Starting Battery	12 Volt, (-) negative ground
Battery Capacity	750 – 900 Cold Cranking Amps (CCA)
DC Charging Alternator	51 Amp rated, belt-driven
Starting Aid	Glow plugs
Starter	12 Volt, 2.9 KW
DC No-load Current	± 2% of rated amps
DC Cranking Current	450 amps (engine cold).

LUBRICATION SYSTEM	
General	Gear type/pressure circulation
Oil Filter	Full flow, paper element, spin-on type.
Sump Capacity (not including filter)	14.5 U.S. qts (13.8 liters)
Operating Oil Pressure (engine hot)	250 – 85 psi
Oil Grade	API Specification CG-4, SAE 10W-40, 15W-40

COOLING SYSTEM	
General	Fresh water-cooled block, thermostatically-controlled with heat exchanger.
Operating Temperature	170 – 190° F (77 – 88° C)
Fresh Water Pump	Centrifugal type, metal impeller, belt-driven.
Raw Water Pump	Positive displacement, rubber impeller, engine-driven.
Coolant (Fresh Water) System Capacity	17 US qts (16.1 liters)

EXHAUST SYSTEM	
Exhaust Elbow	45° elbow
Exhaust Hose Size	4" I.D. (101.6 mm) hose

ENGINE AIR REQUIREMENTS	
Combustion Air	160 cfm (4.5 cmm)
Note: <i>The pressure differential between the outside of the engine compartment versus the inside of the engine compartment should not exceed 2 inches of water (51 mm) at full open throttle (measure with a manometer).</i>	

60 BEDA GENERATOR SPECIFICATIONS

GENERAL	
Engine Type	Diesel, four cylinder, four-cycle, turbocharged marine engine. Vertical in-line overhead valve, water cooled direct injection.
Aspiration	Turbo charged.
Governor	Integral with injection pump.
Bore & Stroke	4.13 x 4.92 inches (105 x 125 mm).
Piston Displacement	264 cubic inches (4.3 liter).
Firing Order	1 - 3 - 4 - 2.
Direction of Rotation	Clockwise, when viewed from the front.
Engine Torque (max.)	210 ft-lb @ 1500 rpm.
Compression Ratio	17:1.
Dimensions - inches (mm) w/out sound guard	Height: 33.6 inches (855 mm) Width: 30.6 inches (778 mm) Length: 62.5 inches (1588 mm)
Weight (dry)	1647 lbs (746 kgs).

TUNE-UP SPECIFICATIONS	
Compression Pressure (Limit of difference)	441 psi (31 kg/cm ²) at 200 rpm Not to exceed 28.44 psi (20.0 kg/cm ²).
Injector Pressure	2133 psi (150 kf/cm ²).
Valve Seat Angle	Intake 45° Exhaust 45°
Valve Clearance (engine cold)	Intake and exhaust 0.016 inches (0.40 mm).
Engine Speed	50 Hz @ 1800 rpm 60 hz @ 1800 rpm

GENERATOR DATA	
Generator Power @ 1800 (1500) rpm	60KW (50KW)
Design	Brushless, four pole, revolving field, power take-off
Frequency	All units adjustable to 50 or 60 Hertz..
Phase	Three phase. Single phase units available.
Power Factor	0.8
Wire	12 lead reconnectable
Voltage Regulation	Standard ± 1% no load to full load.
Insulation	Class "H", as defined by NEMA MG1-1.65
Cooling	Direct drive centrifugal blower.
Temperature Rise	Within NEMA MG1-22.40 definition - full load
Interference Level	Meets "CE" requirements
Voltage Output	60 Hertz 50 Hertz
Configuration	L-L L-N L-L L-N
Series Star	480 277 400 230
Parallel Star	208 120 230 127
Series Delta	240 120 230 115
Parallel Delta	130 110
Double Delta	240 120 230 115
Voltage regulator is adjustable ± 5%	
3 Phase amperage calculation: Amps=Watts/[Voltage x 1.732 x P.F.]	

FUEL SYSTEM	
General	Closed system with bleed points.
Fuel	No. 2 diesel oil (cetane rating of 45 or higher).
Fuel Injection Pump	BOSCH Model A type (In-line).
Fuel Injection Timing	12° BTDC
Nozzle	Multi-hole
Fuel Filter (on engine)	Full flow replaceable.
Air cleaner	Replaceable paper element.
Air Flow (engine combustion)	123 cfm.(3.5 cmm).
Fuel Consumption	4.8 U.S. gph (18.2 lph).

ELECTRICAL SYSTEM	
Starting Battery	12 Volt, (-) negative ground
Battery Capacity	750 – 900 Cold Cranking Amps (CCA)
DC Charging Alternator	51 Amp rated, belt-driven
Starting Aid	Glow plugs
Starter	12 Volt, 2.9 KW
DC No-load Current	± 2% of rated amps
DC Cranking Current	450 amps (engine cold).

LUBRICATION SYSTEM	
General	Gear type/pressure circulation
Oil Filter	Full flow, paper element, spin-on type.
Sump Capacity (not including filter)	14.5 U.S. qts (13.8 liters)
Operating Oil Pressure (engine hot)	250 – 85 psi
Oil Grade	API Specification CG-4, SAE 10W-40, 15W-40

COOLING SYSTEM	
General	Fresh water-cooled block, thermostatically-controlled with heat exchanger.
Operating Temperature	170 – 190° F (77 – 88° C)
Fresh Water Pump	Centrifugal type, metal impeller, belt-driven.
Raw Water Pump	Positive displacement, rubber impeller, engine-driven.
Coolant (Fresh Water) System Capacity	17 US qts (16.1 liters)

EXHAUST SYSTEM	
Exhaust Elbow	45° elbow
Exhaust Hose Size	4" I.D. (101.6 mm) hose

ENGINE AIR REQUIREMENTS	
Combustion Air	123 cfm (3.5 cmm)
Note: The pressure differential between the outside of the engine compartment versus the inside of the engine compartment should not exceed 2 inches of water (51 mm) at full open throttle (measure with a manometer).	

65 BED GENERATOR SPECIFICATIONS

GENERAL	
Engine Type	Diesel, six cylinder, four-cycle, Vertical in-line, overhead valve, fresh water cooled direct injection, marine engine.
Aspiration	Naturally aspirated.
Governor	Integral with injection pump.
Bore & Stroke	4.13 x 4.92 inches (105.0 x 125.0 mm)
Piston Displacement	396 cubic inches (6.5 liter)
Firing Order	1 - 5 - 3 - 6 - 2 - 4
Direction of Rotation	Clockwise, when viewed from the front.
Engine Torque	298 ft-lb @ 1500 rpm.
Compression Ratio	17:1
Dimensions - inches (mm) w/out transmission	Height: 34.2 inches (868 mm) Width: 30.6 inches (778 mm) Length: 74.9 inches (1903 mm)
Weight (dry)	1937 lbs (878 kgs).
TUNE-UP SPECIFICATIONS	
Compression Pressure (Limit of difference)	441 psi (31 kg/cm ²) at 200 rpm Not to exceed 28.44 psi (20.0 kg/cm ²).
Injector Pressure	2631 psi (185 kf/cm ²).
Valve Seat Angle	Intake 45° Exhaust 45°
Valve Clearance (engine cold)	Intake and Exhaust 0.016 inches (0.40 mm)
Engine Speed	50 Hz @ 1500 rpm 60 Hz @ 1800 rpm
GENERATOR DATA	
Generator Power @ 1800 (1500) rpm 65KW (55KW)	
Design	Brushless, four pole, revolving field, power take-off
Frequency	All units adjustable to 50 or 60 Hertz..
Phase	Three phase. Single phase units available.
Power Factor	0.8
Wire	12 lead reconnectable
Voltage Regulation	Standard ± 1% no load to full load.
Insulation	Class "H", as defined by NEMA MG1-1.65
Cooling	Direct drive centrifugal blower.
Temperature Rise	Within NEMA MG1-22.40 definition - full load
Interference Level	Meets "CE" requirements
Voltage Output	60 Hertz 50 Hertz
Configuration	L-L L-N L-L L-N
Series Star	480 277 400 230
Parallel Star	208 120 230 127
Series Delta	240 120 230 115
Parallel Delta	130 110
Double Delta	340 120 230 115
Voltage regulator is adjustable ± 5%	
3 Phase amperage calculation: Amps=Watts/[Voltage x 1.732 x P.F.]	

FUEL SYSTEM	
General	Closed system with bleed points.
Fuel	No. 2 diesel oil (cetane rating of 45 or higher).
Fuel Injection Pump	BOSCH Model A type (In-line).
Fuel Injection Timing	14° BTDC
Nozzle	Multi-hole
Fuel Filter (on engine)	Full flow replaceable.
Air cleaner	Replaceable paper element.
Air Flow (engine combustion)	170 cfm.(6.2 cmm).
Fuel Consumption	4.9 U.S. gph (18.5 lph).
ELECTRICAL SYSTEM	
Starting Battery	12 Volt, (-) negative ground
Battery Capacity	750 – 900 Cold Cranking Amps (CCA)
DC Charging Alternator	51 Amp rated, belt-driven
Starting Aid	Glow plugs
Starter	12 Volt, 2.9 KW actuated shift.
DC No-load Current	±2% of rated amps
DC Cranking Current	450 CCA
LUBRICATION SYSTEM	
General	Gear type/pressure circulation
Oil Filter	Full flow, paper element, spin-on type.
Sump Capacity (not including filter)	14.5 U.S. qts (13.8 liters)
Operating Oil Pressure (engine hot)	28 – 85 psi
Oil Grade	API Specification CG-4, SAE 10W-40, 15W-40
COOLING SYSTEM	
General	Fresh water-cooled block, thermostatically- controlled with heat exchanger.
Operating Temperature	170 – 190° F (77 – 88° C)
Fresh Water Pump	Centrifugal type, metal impeller, belt-driven.
Raw Water Pump	Positive displacement, rubber impeller, engine-driven.
Coolant (Fresh Water) System Capacity	25 US qts (23.7 liters)
EXHAUST SYSTEM	
Exhaust Elbow	45° elbow
Exhaust Hose Size	4" I.D. (101.6 mm) hose
ENGINE AIR REQUIREMENTS	
Combustion Air	170 cfm (6.2 cmm)
Note: The pressure differential between the outside of the engine compartment versus the inside of the engine compartment should not exceed 2 inches of water (51 mm) at full open throttle (measure with a manometer)	

70 BEDA GENERATOR SPECIFICATIONS

GENERAL	
Engine Type	Diesel, six cylinder, four-cycle, Vertical in-line, overhead valve, fresh water cooled direct injection, marine engine.
Aspiration	Turbo charged.
Governor	Integral with injection pump.
Bore & Stroke	4.13 x 4.92 inches (105.0 x 125.0 mm)
Piston Displacement	396 cubic inches (6.5 liter)
Firing Order	1 - 5 - 3 - 6 - 2 - 4
Direction of Rotation	Clockwise, when viewed from the front.
Engine Torque	298 ft-lb @ 1500 rpm.
Compression Ratio	17:1
Dimensions - inches (mm) w/out transmission	Height: 34.2 inches (868 mm) Width: 30.6 inches (778 mm) Length: 74.9 inches (1903 mm)
Weight (dry)	1937 lbs (878 kgs).
TUNE-UP SPECIFICATIONS	
Compression Pressure (Limit of difference)	441 psi (31 kg/cm ²) at 200 rpm Not to exceed 28.44 psi (20.0 kg/cm ²).
Injector Pressure	2631 psi (185 kt/cm ²).
Valve Seat Angle	Intake 45° Exhaust 45°
Valve Clearance (engine cold)	Intake and Exhaust 0.016 inches (0.40 mm)
Engine Speed	50 Hz @ 1500 rpm 60 Hz @ 1800 rpm
GENERATOR DATA	
Generator Power @ 1800 (1500) rpm 70KW (60KW)	
Design	Brushless, four pole, revolving field, power take-off
Frequency	All units adjustable to 50 or 60 Hertz..
Phase	Three phase. Single phase units available.
Power Factor	0.8
Wire	12 lead reconnectable
Voltage Regulation	Standard \pm 1% no load to full load.
Insulation	Class "H", as defined by NEMA MG1-.65
Cooling	Direct drive centrifugal blower.
Temperature Rise	Within NEMA MG1-22.40 defination - full load
Interference Level	Meets "CE" requirements
Voltage Output	60 Hertz 50 Hertz
Configuration	L-L L-N L-L L-N
Series Star	480 277 400 230
Parallel Star	208 120 230 127
Series Delta	240 120 230 115
Parallel Delta	130 110
Double Delta	240 120 230 115
Voltage regulator is adjustable \pm 5%	
3 Phase amperage calculation: Amps=Watts/[Voltage x 1.732 x P.F.]	

FUEL SYSTEM	
General	Closed system with bleed points.
Fuel	No. 2 diesel oil (cetane rating of 45 or higher).
Fuel Injection Pump	BOSCH Model A type (In-line).
Fuel Injection Timing	14° BTDC
Nozzle	Multi-hole
Fuel Filter (on engine)	Full flow replaceable.
Air cleaner	Replaceable paper element.
Air Flow (engine combustion)	170 cfm.(6.2 cmm).
Fuel Consumption	4.9 U.S. gph (18.5 lph).
ELECTRICAL SYSTEM	
Starting Battery	12 Volt, (-) negative ground
Battery Capacity	750 – 900 Cold Cranking Amps (CCA)
DC Charging Alternator	51 Amp rated, belt-driven
Starting Aid	Glow plugs
Starter	12 Volt, 2.9 KW actuated shift.
DC No-load Current	\pm 2% of rated amps
DC Cranking Current	450 CCA
LUBRICATION SYSTEM	
General	Gear type/pressure circulation
Oil Filter	Full flow, paper element, spin-on type.
Sump Capacity (not including filter)	14.5 U.S. qts (13.8 liters)
Operating Oil Pressure (engine hot)	28 – 85 psi
Oil Grade	API Specification CG-4, SAE 10W-40, 15W-40
COOLING SYSTEM	
General	Fresh water-cooled block, thermostatically-controlled with heat exchanger.
Operating Temperature	170 – 190° F (77 – 88° C)
Fresh Water Pump	Centrifugal type, metal impeller, belt-driven.
Raw Water Pump	Positive displacement, rubber impeller, engine-driven.
Coolant (Fresh Water) System Capacity	25 US qts (23.7 liters)
EXHAUST SYSTEM	
Exhaust Elbow	45° elbow
Exhaust Hose Size	4" I.D. (101.6 mm) hose
ENGINE AIR REQUIREMENTS	
Combustion Air	170 cfm (6.2 cmm)
Note: The pressure differential between the outside of the engine compartment versus the inside of the engine compartment should not exceed 2 inches of water (51 mm) at full open throttle (measure with a manometer)	

95 BED(A) GENERATOR SPECIFICATIONS

GENERAL	
Engine Type	Diesel, six cylinder, four-cycle, Vertical in-line, overhead valve, fresh water cooled direct injection, marine engine.
Aspiration	Turbo charged.
Governor	Integral with injection pump.
Bore & Stroke	4.13 x 4.92 inches (105.0 x 125.0 mm)
Piston Displacement	396 cubic inches (6.5 liter)
Firing Order	1 - 5 - 3 - 6 - 2 - 4
Direction of Rotation	Clockwise, when viewed from the front.
Engine Torque	423 ft-lb @ 1800 rpm.
Compression Ratio	17:1
Dimensions - inches (mm) w/out transmission	Height: 34.2 inches (867 mm) Width: 30.6 inches (778 mm) Length: 75.0 inches (1903 mm)
Weight (dry)	2100 lbs (952 kgs).

TUNE-UP SPECIFICATIONS	
Compression Pressure (Limit of difference)	441 psi (31 kg/cm ²) at 200 rpm Not to exceed 28.44 psi (20.0 kg/cm ²).
Injector Pressure	2631 psi (185 kf/cm ²).
Valve Seat Angle	Intake 45° Exhaust 45°
Valve Clearance (engine cold)	Intake and Exhaust 0.016 inches (0.40 mm)
Engine Speed	50 Hz @ 1500 rpm 60 Hz @ 1800 rpm

GENERATOR DATA	
Generator Power @ 1800 (1500) rpm 95KW (80KW)	
Design	Brushless, four pole, revolving field, power take-off
Frequency	All units adjustable to 50 or 60 Hertz..
Phase	Three phase. Single phase units available.
Power Factor	0.8
Wire	12 lead reconnectable
Voltage Regulation	Standard ± 1% no load to full load.
Insulation	Class "H", as defined by NEMA MG1-1.65
Cooling	Direct drive centrifugal blower.
Temperature Rise	Within NEMA MG1-22.40 definition - full load
Interference Level	Meets "CE" requirements
Voltage Output	60 Hertz 50 Hertz
Configuration	L-L L-N L-L L-N
Series Star	480 277 400 230
Parallel Star	208 120 230 127
Series Delta	240 120 230 115
Parallel Delta	130 110
Double Delta	240 120 230 115
Voltage regulator is adjustable ± 5%	
3 Phase amperage calculation: Amps=Watts/[Voltage x 1.732 x P.F.]	

FUEL SYSTEM	
General	Closed system with bleed points.
Fuel	No. 2 diesel oil (cetane rating of 45 or higher).
Fuel Injection Pump	BOSCH Model A type (In-line).
Fuel Injection Timing	12° BTDC
Nozzle	Multi-hole
Fuel Filter (on engine)	Full flow replaceable.
Air cleaner	Replaceable paper element.
Air Flow (engine combustion)	240 cfm.(6.2 cmm).
Fuel Consumption	7.2 U.S. gph (27.3 lph).

ELECTRICAL SYSTEM	
Starting Battery	12 Volt, (-) negative ground
Battery Capacity	750 - 900 Cold Cranking Amps (CCA)
DC Charging Alternator	51 Amp rated, belt-driven
Starting Aid	Glow plugs
Starter	12 Volt, 2.9 KW actuated shift.
DC No-load Current	± 2% of rated amps
DC Cranking Current	450 CCA

LUBRICATION SYSTEM	
General	Gear type/pressure circulation
Oil Filter	Full flow, paper element, spin-on type.
Sump Capacity (not including filter)	22 U.S. qts (20.8 liters)
Operating Oil Pressure (engine hot)	28 - 85 psi (3.5 - 4.2 kg/cm ²)
Oil Grade	API Specification CG-4, SAE 10W-40, 15W-40

COOLING SYSTEM	
General	Fresh water-cooled block, thermostatically-controlled with heat exchanger.
Operating Temperature	170 - 190° F (77 - 88° C)
Fresh Water Pump	Centrifugal type, metal impeller, belt-driven.
Raw Water Pump	Positive displacement, rubber impeller, engine-driven.
Coolant (Fresh Water) System Capacity	25 US qts (23.7 liters)

EXHAUST SYSTEM	
Exhaust Elbow	45° elbow
Exhaust Hose Size	4" I.D. (101.6 mm) hose

ENGINE AIR REQUIREMENTS	
Combustion Air	240 cfm (6.2 cmm)
Engine Cooling	200 cfm (5.6 cmm)
Note: The pressure differential between the outside of the engine compartment versus the inside of the engine compartment should not exceed 2 inches of water (51 mm) at full open throttle (measure with a manometer)	

LAY-UP & RECOMMISSIONING

GENERAL

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

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

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

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

Propeller Shaft Coupling [Propulsion Engine]

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

Fresh Water Cooling Circuit

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

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

Lubrication System

With the engine warm, drain all the engine oil from the oil sump. Remove and replace the oil filter and fill the sump with new oil. Use the correct grade of oil. Refer to the *ENGINE LUBRICATING OIL* pages in this manual for the oil changing procedure. Run the engine and check for proper oil pressure and make sure there are no leaks.

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

Fuel System [Gasoline]

Top off your fuel tanks with *unleaded* gasoline of 89 octane or higher. A fuel conditioner such as *Sta-Bil* gasoline stabilizer should be added. Change the element in your gasoline/water separator and clean the metal bowl. Re-install and make certain there are no leaks. Clean up any spilled fuel.

Fuel System [Diesel]

Top off your fuel tanks with No. 2D diesel fuel. Fuel additives should be added prior to topping off to ensure they mix with the fuel being added and fuel still in the tank. Additives, such as Bio-bor and Diesel Kleen + Cetane Boost should be added at this time to control bacteria growth and condition the fuel. Care should be taken that the additives used are compatible with the primary fuel filter/water separator used in the system. Change the element in your primary fuel filter/water separator clean the separator sediment bowl.

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

Raw Water Cooling Circuit

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

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

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

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

Cylinder Lubrication [Gasoline]

Spray fogging oil into the open air intake, with the flame arrester removed, while the engine is running. The fogging oil will stall out the engine and coat the valves, cylinders and spark plugs for winter protection.

LAY-UP & RECOMMISSIONING

Starter Motor

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

Cylinder Lubrication [Diesel]

If you anticipate a long lay-up period (12 months or more) WESTERBEKE recommends removal of the glow plugs for access to the cylinders. Squirt some Marvel Mystery Oil into the cylinder walls. Rotate the engine crankshaft by hand two revolutions and re-install the glow plugs.

If your engine does not have glow plugs, the injectors will have to be removed. Be sure to have replacement sealing washers for the injectors and return fuel line as needed.

Intake Manifold [Gasoline]

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

Batteries

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

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

Transmission [Propulsion Engine]

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

Spare Parts

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

Recommissioning

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

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

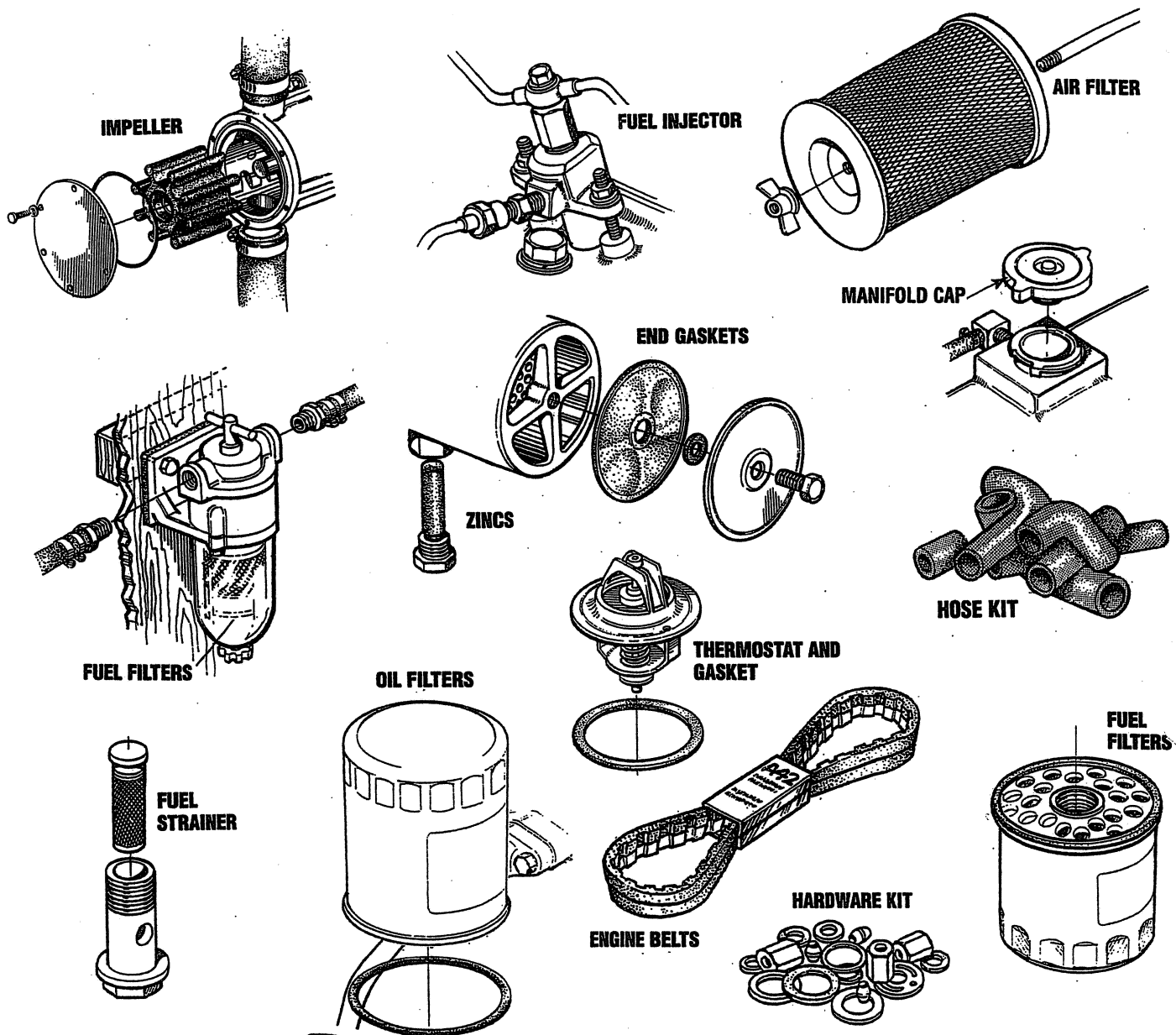
⚠ CAUTION: *Wear rubber gloves, a rubber apron, and eye protection when servicing batteries. Lead acid batteries emit hydrogen, a highly explosive gas, which can be ignited by electrical arcing or a lighted cigarette, cigar, or pipe. Do not smoke or allow an open flame near the battery being serviced.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

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

SUGGESTED SPARE PARTS

WESTERBEKE MARINE DIESEL GENERATORS

CONTACT YOUR WESTERBEKE DEALER FOR ADDITIONAL SUGGESTIONS AND INFORMATION



SPARE PARTS KITS

WESTERBEKE offers Spare Parts Kits in two versions each packaged in a canvas duffel bag. Kit A has the basic spares. Kit B is for more complete for offshore cruising.



The red and black duffel bag is 18" long with a full zipper, dual handles, and a carrying strap.

Kit A

Impeller
Heat Exchanger Gasket
Fuel Filter
Oil Filter
Drive Belts
Zincs
Thermostat

B Kit

Impeller
Heat Exchanger Gasket
Fuel Filter
Oil Filter
Drive Belts
Zincs
Thermostat
Complete Gasket Kit
Injector
Air Filter (separate)

WESTERBEKE
Engines & Generators

