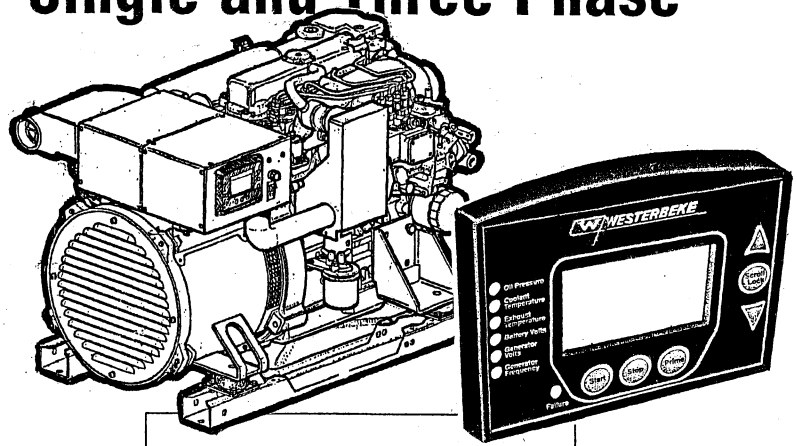
OPERATORS MANUAL
D-NET DIESEL GENERATORS
22.0 EDE 60Hz | 17.0 EDE 50Hz
17.0 EDE 60Hz | 13.5 EDE 50Hz
Single and Three Phase



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WESTERBEKE

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

⚠ WARNING

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

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

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

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

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

CALIFORNIA PROPOSITION 65 WARNING

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

WESTERBEKE
Engines & Generators

SAFETY INSTRUCTIONS

INTRODUCTION

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

PREVENT ELECTRIC SHOCK

> ⚠ **WARNING:** ***Do not touch AC electrical connections while engine is running. Lethal voltage is present at these connections!***

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

PREVENT BURNS — HOT ENGINE

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

- Monitor engine antifreeze coolant level at the plastic coolant recovery tank and periodicaly 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 fuel injector, fuel line, filter, fuel pump; or other potential sources of spilled fuel or fuel vapors. Use a suitable container to catch all fuel when removing the fuel lines or fuel filters.
- Do not operate with the air cleaner/silencer removed. Backfire can cause severe injury or death.
- Do not smoke or permit flames or sparks to occur near the fuel system. Keep the compartment and the engine clean and free of debris to minimize the chances of fire. Wipe up all spilled fuel and engine oil.
- Be aware — diesel fuel will burn.

PREVENT BURNS — EXPLOSION

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

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

SAFETY INSTRUCTIONS

ACCIDENTAL STARTING

- To prevent accidential starting when servicing the generator, turn OFF the DC breaker or remove the fuse from the generators control panel.
- To prevent accidential starting of the generator, when servicing, turn the battery selector switch to the OFF position.
- Make certain all personnel are clear of the engine before starting.
- Make certain all covers, guards, and hatches are re-installed before starting the engine.

BATTERY EXPLOSION

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

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

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

BATTERY ACID

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

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

TOXIC EXHAUST GASES

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

- Ensure that the exhaust system is adequate to expel gases discharged from the engine. Check the exhaust system regularly for leaks and make sure the exhaust manifolds/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 ABYCA-24. Consult your boat builder or dealer for installation of approved detectors.
- For additional information refer to ABYC T-22 (educational information on Carbon Monoxide).

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

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

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

AVOID MOVING PARTS

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

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

SAFETY INSTRUCTIONS

- Do not wear loose clothing or jewelry when servicing equipment; 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 Installatiion of Exhaust Systems for Propulsion and Auxilliary Engines
P-4 Marine Inboard Engines and Transmissions
E-11 AC & DC Electrical Systems on Boats
TA Batteries and Battery Chargers

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

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

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

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

Order From:

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

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

Order From:

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

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

Order From:

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

INSTALLATION

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

CODES AND REGULATIONS

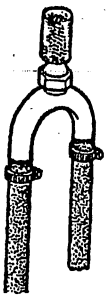
Strict federal regulations, ABYC guidelines, and safety codes must be complied with when installing engines and generators in a marine environment.

SIPHON-BREAK

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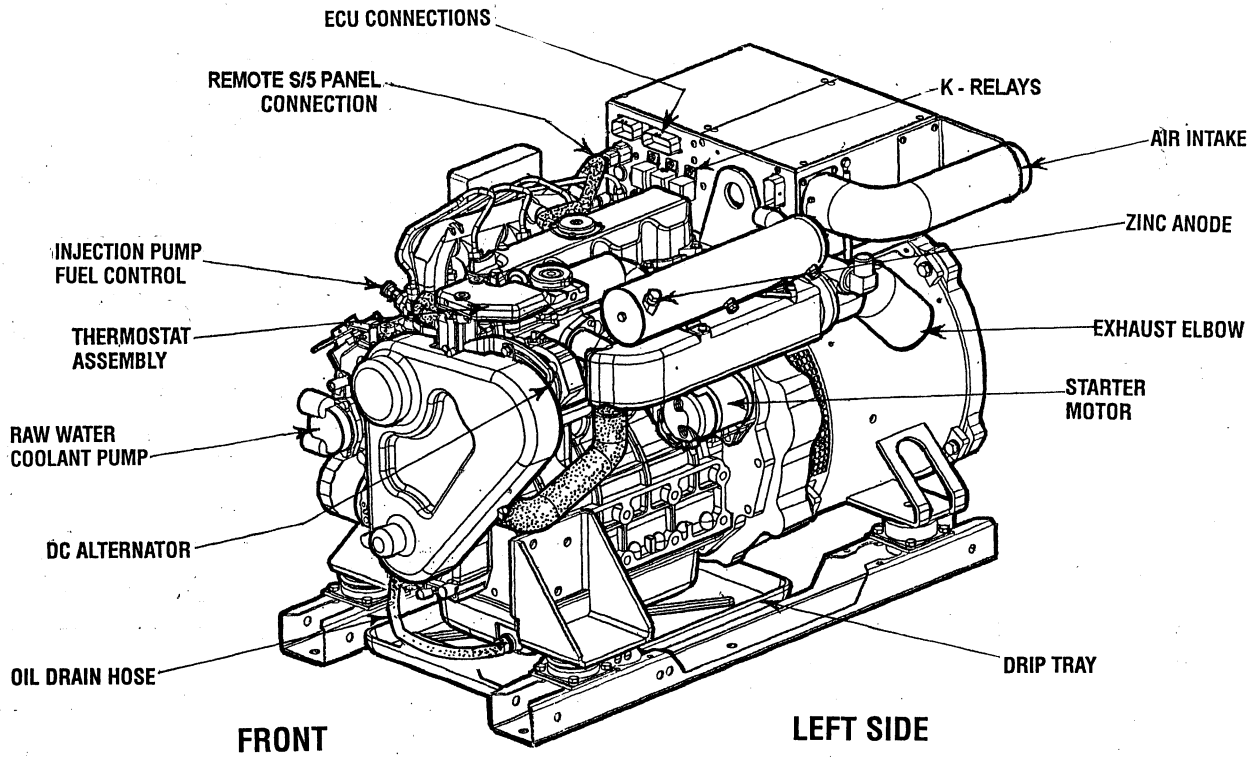
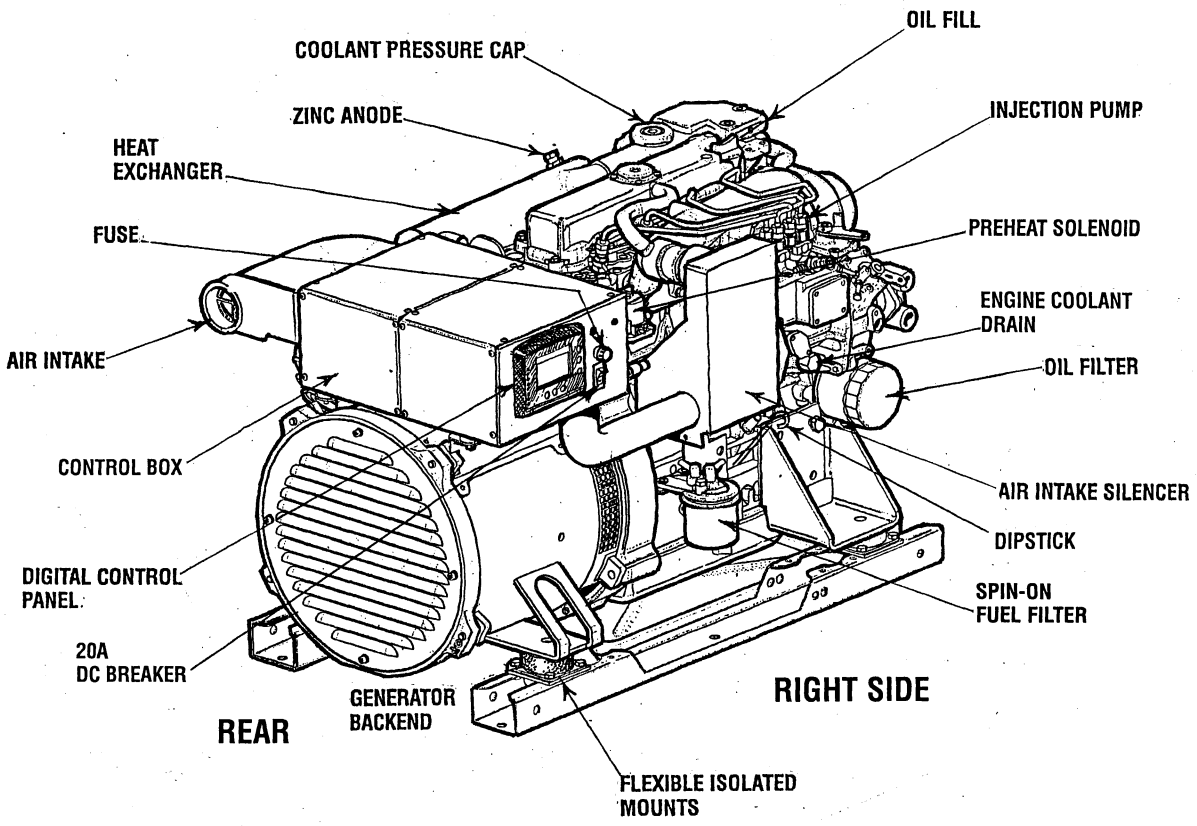
PARTS IDENTIFICATION





INTRODUCTION

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

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

This is your Operators Manual. A Service Manual is also available in hard copy thru a dealer or in pdf form off our website. If you are planning to install this equipment yourself. Review the Installation Manual supplied with this product.

Customer Identification Card

WESTERBEKE Engines & Generators

Customer Identification
WESTERBEKE OWNER
MAIN STREET
HOMETOWN, USA
Model Ser. #
Expires

WARRANTY PROCEDURES

Your WESTERBEKE Warranty Policy Statement is included in the product documentation package. There is a mail in warranty registeration card that you can fill out and mail in to register your warranty or go to our website www.westerbeke.com and register your product's warranty online. You should receive a Customer Warranty Registeration Card in the mail within 60 days of registering. If you do not, please contact the factory via help@westerbeke.com advising of this and providing your name, unit model, serial number and date unit was put into service.

PRODUCT SOFTWARE

Product software, (tech data, parts lists, manuals, brochures and catalogs), provided from sources other than WESTERBEKE are not within WESTERBEKE's control. WESTERBEKE customers should also keep in mind the time span between printings of WESTERBEKE product software and the unavoidable existence of earlier WESTERBEKE manuals. In summation, product software provided with WESTERBEKE products, whether from WESTERBEKE or other suppliers, must not and cannot be relied upon exclusively as the definitive authority on the respective product. It not only makes good sense but is imperative that appropriate representatives of WESTERBEKE or the supplier in question be consulted to determine the accuracy and currentness of the product software being consulted by the customer.

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.***

PROTECTING YOUR INVESTMENT

Care at the factory during assembly and thorough testing have resulted in a WESTERBEKE engine capable of many thousands of hours of dependable service. However, the manufacturer cannot control how or where the engine 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 a long engine/generator life.*

- Proper engine installation.
- An efficient, well-designed exhaust system that includes an anti-syphon break to prevent water from entering the engine.
- Changing the engine oil every 250 operating hours.
- Proper maintenance of all engine 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.

INTRODUCTION

SERIAL NUMBER LOCATION

The engine's model number and serial number are located on an I.D. plate that is mounted on the side of the water jacketed exhaust manifold. The engine serial number is also stamped into the engine block on the flat surface just outboard of the fuel injection pump. Take time to enter this information on the illustration below. It will provide a quick reference when seeking technical information and/or ordering needed 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.		

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

CARBON MONOXIDE DETECTOR

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

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

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

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

UNDERSTANDING THE DIESEL ENGINE

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

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

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

ORDERING PARTS

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

SPARES AND ACCESSORIES

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

INSTALLATION MANUAL

Publication #43400 provides detailed information for installing generators.

DIESEL FUEL, ENGINE OIL AND ENGINE COOLANT

DIESEL FUEL

USE A DIESEL FUEL WITH A CETANE RATING OF #45 OR HIGHER.
(No. 2-D (SAE J313) diesel fuel according to ASTM D975).

Care Of The Fuel Supply

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

Purchase a well-known brand of fuel.Install and regularly service a good, visual-type fuel filter/water separator between the fuel tank and the engine. The Raycor 500 MA or 230 RMAM are good examples of such filters.

ENGINE OIL

Use a heavy duty engine oil with an API classification of CF, CG-4, CH-4 or CI-4. Change the engine oil and filter after an initial 50 hours of 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 as in the **MAINTENANCE SCHEDULE**, not extended because synthetic oils are used.

SAE OIL VISCOSITY GRADES

For all temperatures use SAE 10W-40 or 15W-40.

OIL PRESSURE

The engine's oil pressure, during operation, is indicated by the oil pressure gauge on the instrument panel. During normal operation, the oil pressure will range between 35 and 65 psi 2.5 and 3.9 kg/cm^2).

NOTE: *A newly started, cold engine can have an oil pressure reading upwards of 60 psi (*4.2 kg/cm^2*). A warmed engine can have an oil pressure reading as low as 25 psi (*1.8 kg/cm^2*). These readings will vary depending upon the temperature of the engine, the load placed on the engine, and the RPM's.*

ENGINE COOLANT

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

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

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

PURCHASING ANTIFREEZE

Select a brand of antifreeze specified for diesel engines. Antifreeze specified for diesel engines contain a special additive to protect against cavitation erosion of the engine's cylinder walls. Prestone and Zerex are two nationally known brands that offer antifreeze specifically for use in diesel engines. Select the pre-mix variety so that the correct mixture will always be added to the cooling system when needed. Change the antifreeze mixture according to the MAINTENANCE SCHEDULE in this manual.

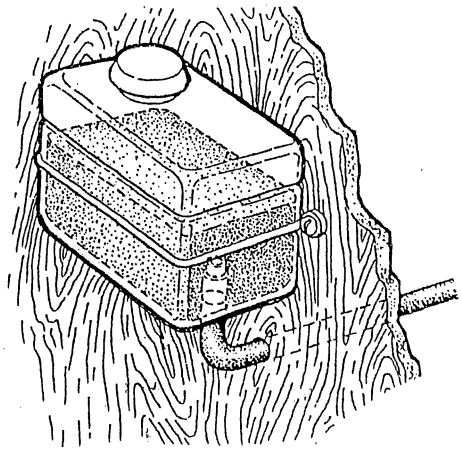
MAINTENANCE

Change the engine coolant every five years regardless of the number of operating hours as the chemical additives that protect and lubricate the engine have a limited life.

COOLANT RECOVERY TANK

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

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



PREPARATIONS FOR INITIAL START-UP

PRESTART INSPECTION

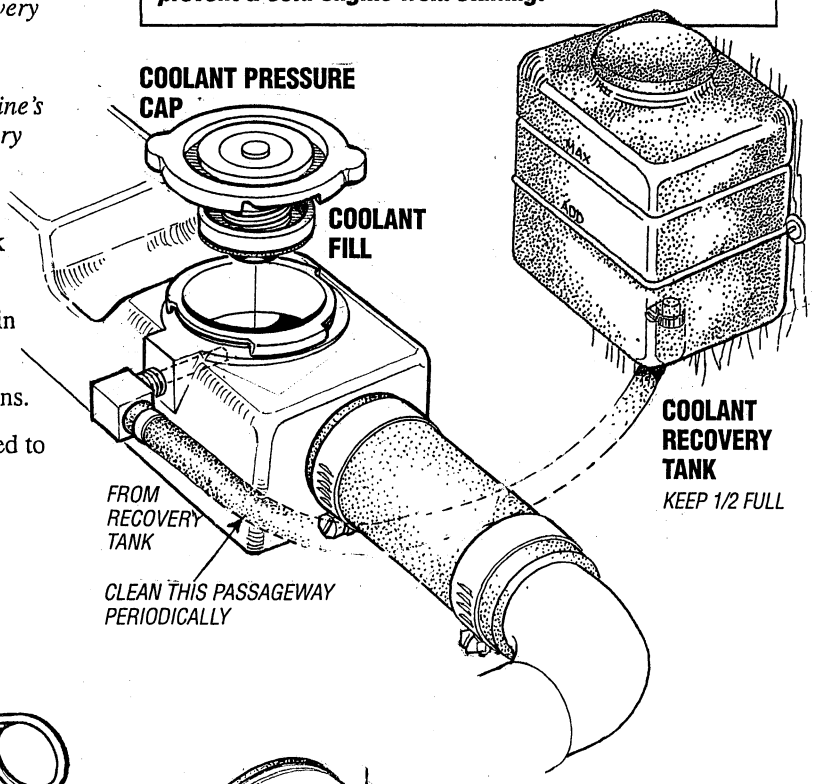
Before starting your generator for the first time or after a prolonged layoff, check the following items:

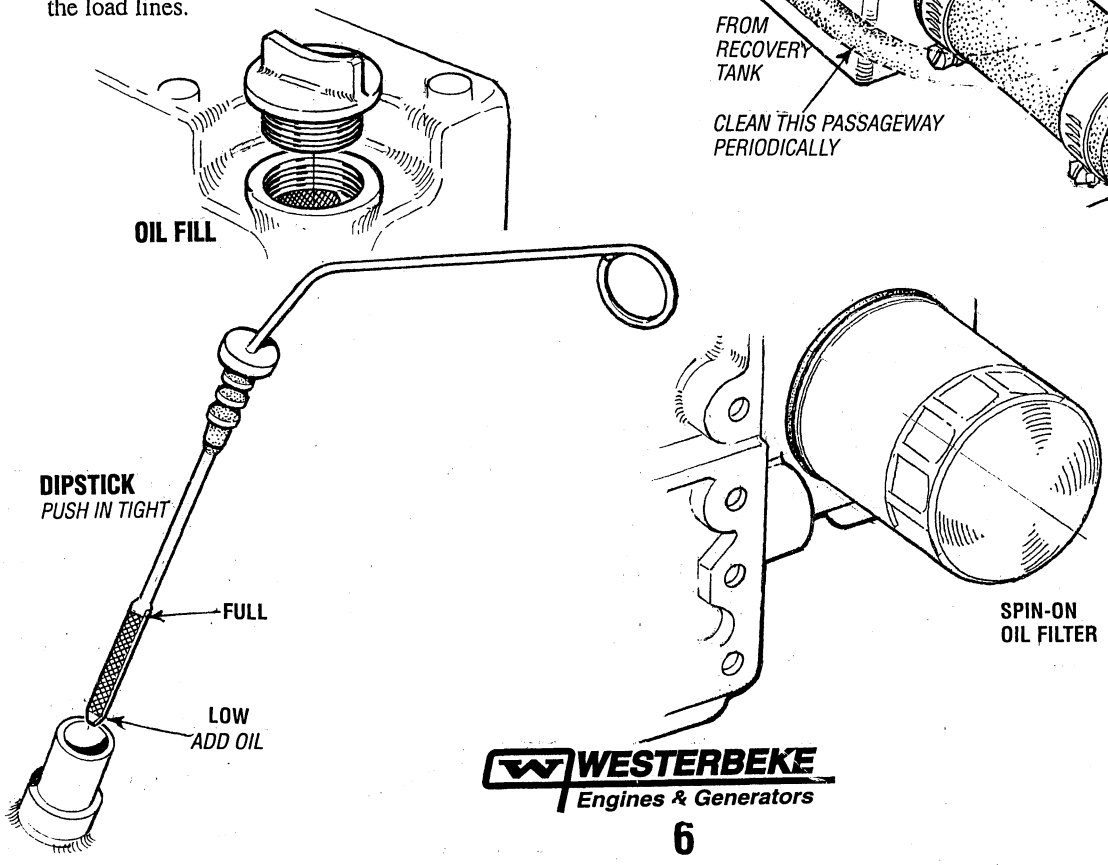
- Check the engine oil level: add oil to maintain the level at the full mark on the dipstick.
- Check the fuel supply and examine the fuel filter/separator bowls for contaminants.
- Check the DC electrical system. Inspect wire connections and battery cable connections.
- Check the coolant level in both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

  NOTE: *After the initial running of the generator, the air in the engine's cooling system will be purged to the coolant recovery tank. Open the air bleed petcock to ensure that the cooling system is purged of air. After shutdown and after the engine has cooled, the coolant from the recovery tank will be drawn into the engine's cooling system to replace the purged air.*

  Before subsequent operation of the generator, the engine's manifold should be topped off, and the coolant recovery tank may need to be filled to the MAX level.
- Visually examine the unit. Look for loose or missing parts, disconnected wires, unattached hoses, and check threaded connections. Search for any gasoline leaks.
- Check load leads for correct connections as specified in the wiring diagrams.
- Examine the air inlet and outlet for air flow obstructions.
- Be sure no other generator or utility power is connected to the load lines.
- Be sure that in power systems with a neutral line that the neutral is properly grounded (or ungrounded) as the system requires, and that the generator neutral is properly connected to the load neutral. In single phase systems an incomplete or open neutral can supply the wrong line-to-neutral voltage on unbalanced loads.
- Make certain the cooling water thru-hull petcock is open.

> ⚠ **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.***





DIGITAL CONTROL PANEL

DESCRIPTION

WESTERBEKE'S Digital Control Panel provides the operator with an LCD display that contunuously monitors all the operations of the generator in easy to understand text messages.

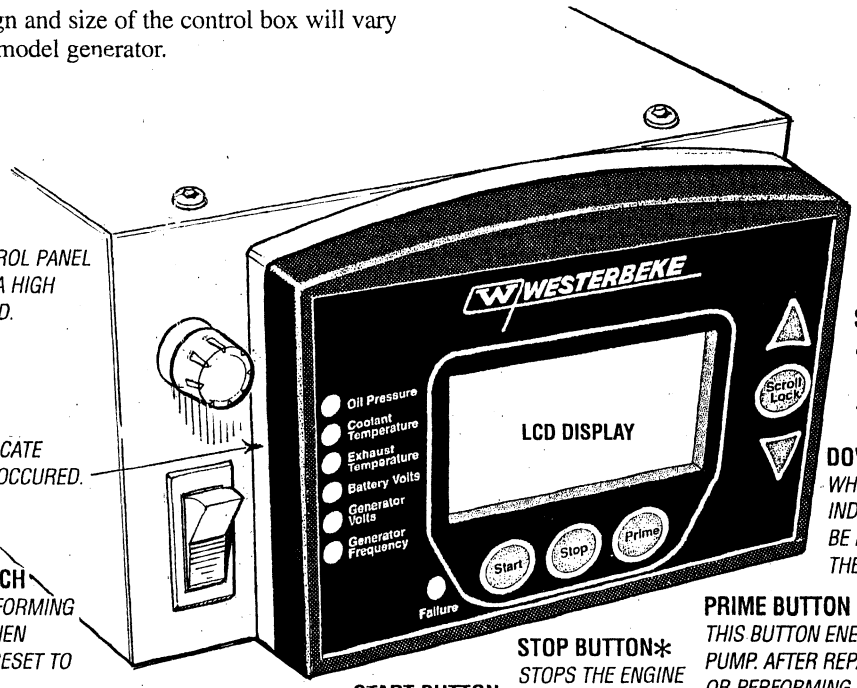
CONTROL BOX

Note that the design and size of the control box will vary depending on the model generator.

LCD DISPLAY

Operating temperatures may cause the LCD display to vary in color. This is normal and a change in color will not affect the operation on the control panel.

Periodically clean the control panel LCD screen using a soft cloth.



12A FUSE
PROTECTS THE CONTROL PANEL ELECTRONICS FROM A HIGH AMPERAGE OVERLOAD.

INDICATOR LIGHTS
SIX LIGHTS THAT INDICATE WHERE A FAULT HAS OCCURED.

20A BREAKER SWITCH
SHUT-OFF WHEN PERFORMING MAINTENANCE OR WHEN REPAIRING A FAULT. RESET TO RESTART THE ENGINE.

FAILURE LIGHT
A RED LIGHT WILL APPEAR IF THE RUN SEQUENCE IS INTERUPTED BY A FAILURE.

START BUTTON
STARTS THE ENGINE

STOP BUTTON*
STOPS THE ENGINE

PRIME BUTTON
THIS BUTTON ENERGIZES THE FUEL PUMP. AFTER REPAIRING A FAILURE OR PERFORMING MAINTENANCE, PRESSING THIS BUTTON WILL PURGE AIR OUT AND BRING FUEL IN TO THE LINES.

UP AND DOWN ARROWS
WHEN THE LCD DISPLAY IS IN ITS SCROLL MODE, THE UP AND DOWN ARROWS CAN BE USED TO ADJUST THE DARK AND LIGHT CONTRAST

UP-ARROW
*WHEN IN **SCROLL LOCK** MODE INDIVIDUAL FUNCTIONS CAN BE MONITORED BY PRESSING THE **UP-ARROW**.*

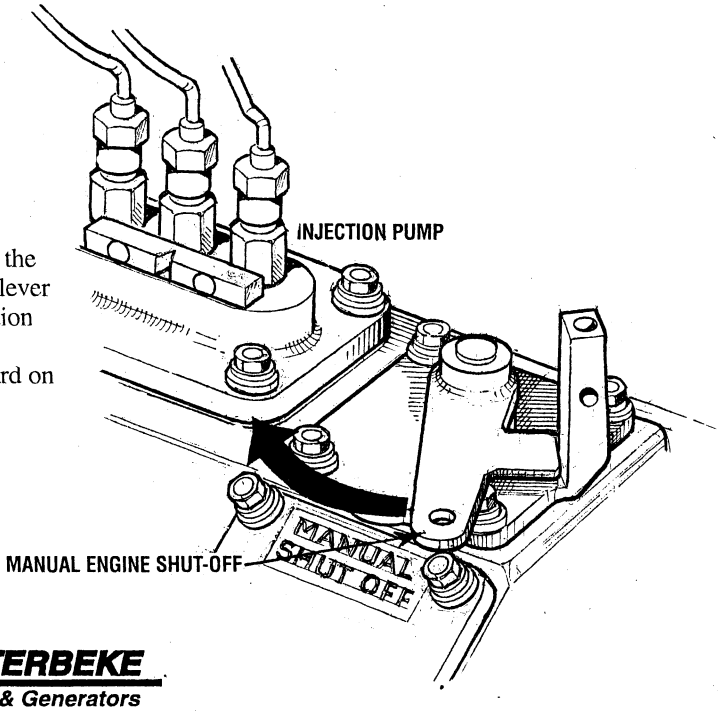
SCROLL LOCK
STOPS RUN SEQUENCE SO THAT A SINGLE FUNCTION CAN BE MONITORED

DOWN-ARROW
*WHEN IN **SCROLL LOCK** MODE INDIVIDUAL FUNCTIONS CAN BE MONITORED BY PRESSING THE **DOWN-ARROW**.*

LCD DISPLAY SEQUENCE
IS SHOWN ON THE FOLLOWING PAGE

*MANUAL ENGINE SHUT-OFF

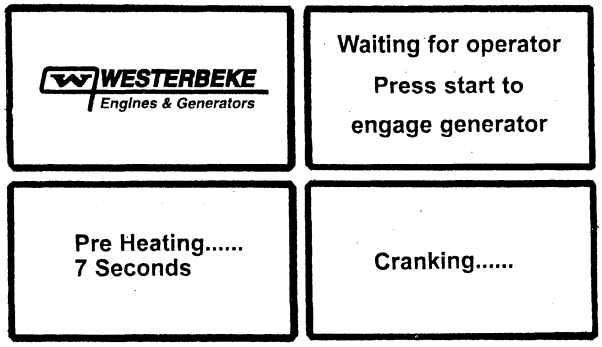
Should the stop button fail in its normal function to stop the engine, the engine is equipped with a manual shutdown lever located on the engine block to the right side of the injection pump. Simply hold the lever to the left until the engine comes to a complete stop. This shutdown lever is standard on current D-Net generators.



DIGITAL CONTROL PANEL/LCD SEQUENCE

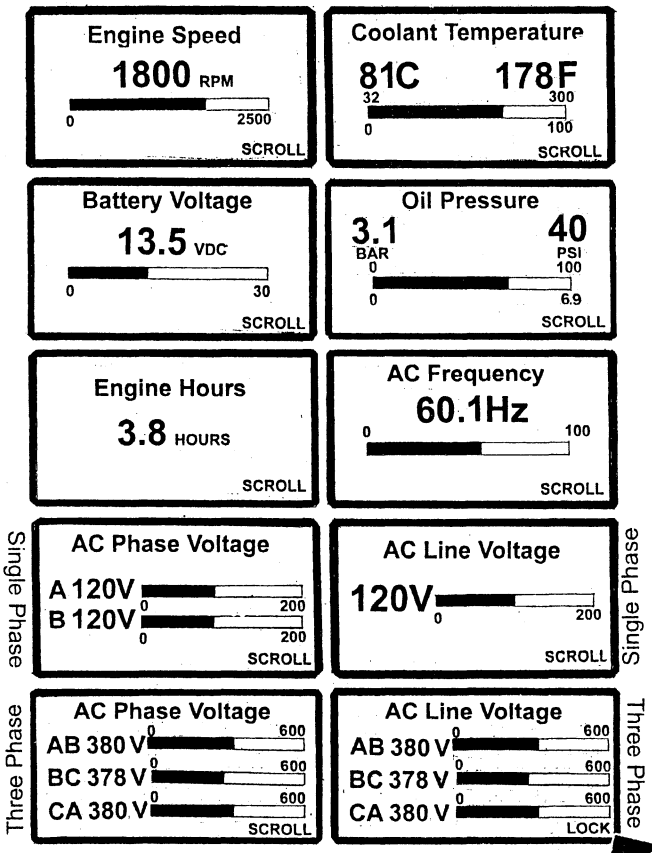
START SEQUENCE

With the pre-start inspection completed, press the START button and the automatic sequence will begin. The six indicator lights will illuminate green and the panel will display the following text:



RUN SEQUENCE

As the display cycles thru the engine functions, the speed will come up to 1800 rpms-60Hz (1500 rpms-50Hz) and the oil pressure and engine coolant will rise to their normal readings. The functions will cycle in the following sequemce:

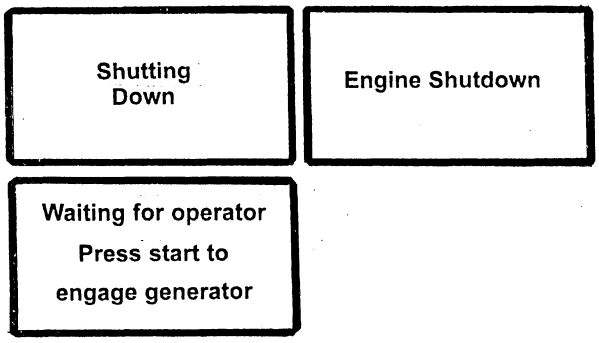


SCROLL LOCK

To stop the continuing sequence, press the SCROLL LOCK button. This enables the operator to monitor a single function for any length of time. The word LOCK will appear in the corner. Use the *up* and *down* arrows to find and observe other functions. To resume scrolling, press the SCROLL LOCK button again.

STOP SEQUENCE

To stop the generator, press the STOP button. The display will cycle thru the following text messages and shutdown.



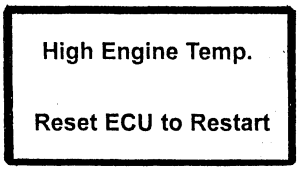
FAILURE LIGHT/SHUTDOWN

If a problem occurs, the generator will shutdown and the FAILURE light will illuminate red. In addition, one of the indicator lights will change from green to orange to reveal where the trouble has occured and the display will text message what has happened.

Examples:

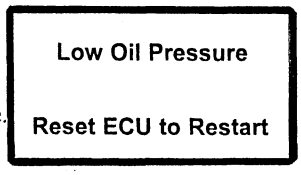
Failure Light is **red.**

Coolant Temperature Light is **orange.**



Failure Light is **red.**

Oil Pressure Light is **orange.**



When a failure occurs, refer to the troubleshooting chart, wiring diagram, and general operating text in this manual to assist in solving the trouble.

There are many combinations of messages that can be displayed but they are all self explanatory and the operator can easily isolate and correct the problem should one occur.

Before re-starting the generator, the 20 amp DC circuit breaker must be reset. With the problem corrected and the generator started, the sequences will begin cycling again.

NOTE: *Three phase voltages will vary depending on the AC output configuration of the generator.*

CAUTION: *Repeated crank cycles without a start can result in the engine's exhaust system filling with raw water. This raw water can enter the engine's cylinders by way of the exhaust manifold. If after three crank cycles, the unit does not start, drain the system's muffler and investigate and correct the cause of no start. Engine damage, the result of raw water entry, is not a warrantable issue.*

DIGITAL CONTROL BOX

FREQUENCY FAULT

Frequency is displayed on the LCD display screen while the engine is running in RPM and frequency (hertz).

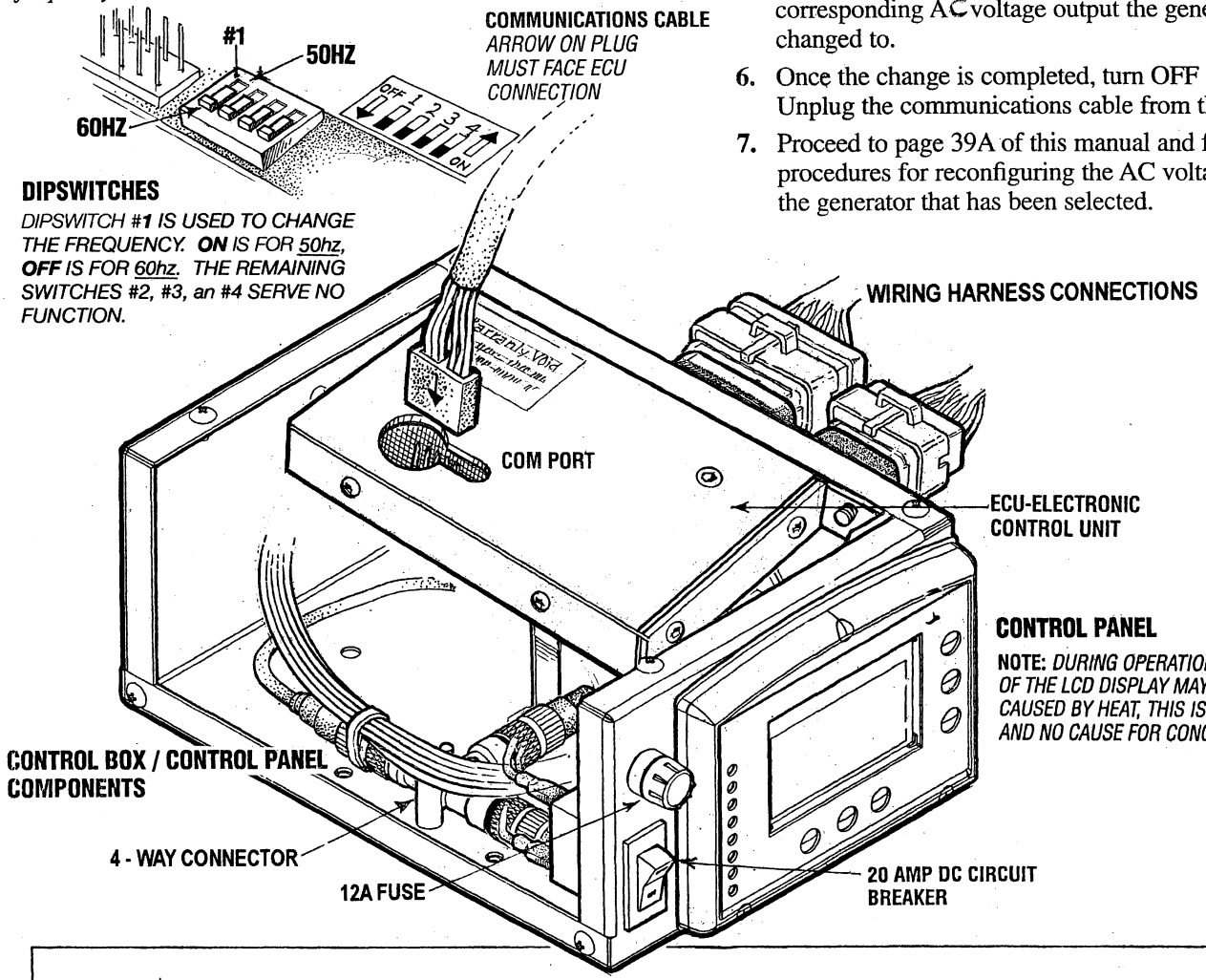
The ECU is receiving a low AC voltage signal and hertz signal from the MPU which is positioned on the bellhousing over the flywheel ring gear teeth. The ECU interprets this signal as both RPM and hertz.

Should this signal vary approximately 2% either up or down, a frequency fault shut down will occur, initiated by the ECU. The red failure LED on the display panel will illuminate, the frequency LED will turn from green to amber and the LCD display screen will show the fault text "overspeed."

NOTE: *If the unit shuts down for an underspeed condition, the same fault "overspeed" will show on the screen but the frequency LED will BLINK.*

GENERATOR FREQUENCY ADJUSTMENT (HERTZ)

1. Turn the DC breaker on the control panel to the OFF position.
2. Open the cover of the control box and view the ECU (Electronic Control Unit).
3. Access the opening of the ECU. The dipswitches are visable in the elongated area of this opening.
4. Access the #1 dipswitch and move it to the position that corresponds to the hertz operation desired. The illustration shows these dipswitches.
5. Plug in the communications cable from your laptop having the EC20 software. The communications cable plug connection should have the arrow on the plug facing the ECU connections. Reprogram the ECU for the corresponding AC voltage output the generator is being changed to.
6. Once the change is completed, turn OFF your laptop. Unplug the communications cable from the ECU.
7. Proceed to page 39A of this manual and follow the procedures for reconfiguring the AC voltage output of the generator that has been selected.



CAUTION (WESTERLINK or NMEA-2000): *The electronic components in the Digital Diesels draw a very small amount of amperage (milli-amps) from the generator's starting battery when the unit is in a static state. This maybe as much as 50 milli-amps for the system ECU and 50 milli-amps for each display. This can be as much as 72 amp-hours in a months time with no generator use. It is not necessary to be concerned with this slight amperage draw during normal seasonal use. However, if the generator set is not to be used for a number of months, such as winter storage, it is best to disconnect the DC power to the generator with a NMEA-2000 system or shut off the DC breaker on the generator's control box for a WESTERLINK system.*

NOTE: *Keep in mind that the Westerbeke generator maybe the DC power supply for the vessel's NMEA-2000 network.*

DIGITAL CONTROL BOX

EARLIER MODELS

FREQUENCY FAULT

Frequency is displayed on the LCD display screen while the engine is running in RPM and frequency (hertz).

The ECU is receiving a low AC voltage signal and hertz signal from the MPU which is positioned on the bellhousing over the flywheel ring gear teeth. The ECU interprets this signal as both RPM and hertz.

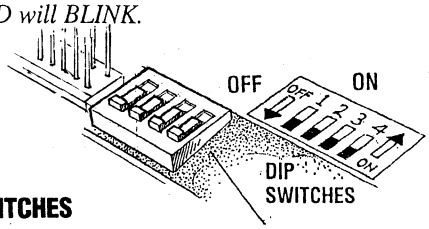
Should this signal vary approximately 2% either up or down, a frequency fault shut down will occur, initiated by the ECU. The red failure LED on the display panel will illuminate, the frequency LED will turn from green to amber and the LCD display screen will show the fault text "overspeed".

NOTE: *If the unit shuts down for an underspeed condition, the same fault "overspeed" will show on the screen but the frequency LED will BLINK.*

GENERATOR FREQUENCY ADJUSTMENT (HERTZ)

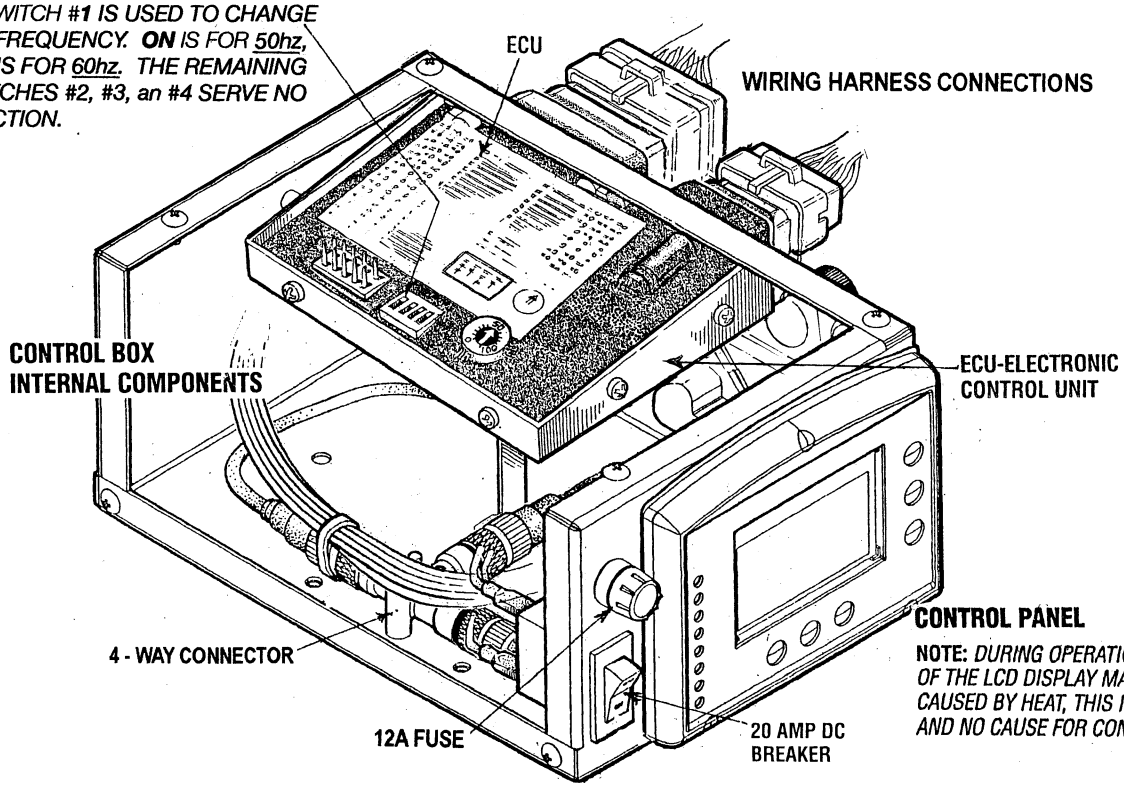
CAUTION: *When changing the generator frequency setting on the ECU, turn off the 20 amp DC circuit breaker on the control box. Turn it back on after the setting has been changed*

1. Turn the DC breaker on the control panel to the OFF position.
2. Open the cover of the control box and view the ECU (Electronic Control Unit).
3. Locate the #1 dipswitch on the ECU and move it to the position that corresponds to the Hertz operation desired). See the illustration below showing the ECU in the control box.
4. Replace the control box cover, turn the DC breaker ON and start the unit. Monitor the frequency that the engine/generator is operating is operating at the correct frequency.



DIPSWITCHES

*DIPSWITCH **#1** IS USED TO CHANGE THE FREQUENCY. **ON** IS FOR 50hz, **OFF** IS FOR 60hz. THE REMAINING SWITCHES #2, #3, an #4 SERVE NO FUNCTION.*



NOTE: *DURING OPERATION THE COLOR OF THE LCD DISPLAY MAY VARY. CAUSED BY HEAT, THIS IS NORMAL AND NO CAUSE FOR CONCERN.*

CAUTION (WESTERLINK or NMEA-2000): *The electronic components in the Digital Diesels draw a very small amount of amperage (milli-amps) from the generator's starting battery when the unit is in a static state. This maybe as much as 50 milli-amps for the system ECU and 50 milli-amps for each display. This can be as much as 72 amp-hours in a months time with no generator use. It is not necessary to be concerned with this slight amperage draw during normal seasonal use. However, if the generator set is not to be used for a number of months, such as winter storage, it is best to disconnect the DC power to the generator with a NMEA-2000 system or shut off the DC breaker on the generator's control box for a WESTERLINK system.*

NOTE: *Keep in mind that the Westerbeke generator maybe the DC power supply for the vessel's NMEA-2000 network.*

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 glazed or scored, which is caused by overloading the engine during the break-in period.

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

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

AFTER START-UP

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

After the first 10 hours of the 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.

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 governor adjustments required for engine speed (hertz) during the engine's break-in period (first 50 hours) or after this period see *ENGINE SPEED (HERTZ) ADJUSTMENT)* under *ENGINE ADJUSTMENTS*.. A no-load voltage adjustment may also be required in conjunction with the engine's speed adjustment see *GENERATOR INFORMATION.*

THE DAILY ROUTINE

CHECK LIST

Follow this check list each day before starting your generator.

- Check that all generator circuit breakers (power panel) are in the off position before starting.
- Record the hourmeter reading in your log (engine hours relate to the maintenance schedule.)

  Any deficiency or problems in the following items must be corrected before start up.
- Visually inspect the engine for fuel, oil, or water leaks.
- Check the oil level (dipstick).
- Check the coolant level in the coolant recovery tank.
- Check your fuel supply.
- Check the starting batteries (weekly).
- Check drive belts for wear and proper tension (weekly).

CHECK WITH THE ENGINE RUNNING.

- Check for abnormal noise such as knocking, vibrating and blow-back sounds.
- Confirm exhaust smoke:
  When the engine is cold - White Smoke.
  When the engine is warm - almost Smokeless.
  When the engine is overloaded - some Black Smoke.

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

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

STOPPING THE GENERATOR

Remove the AC amperage loads from the generator one at a time. Allow the generator to run for 3-5 minutes to stabilize the operating temperature. Then push the stop button. Once the generator shuts down, turn off the panel DC breaker as a safety precaution.

> **CAUTION (WESTERLINK or NMEA-2000):** *The electronic components in the Digital Diesels draw a very small amount of amperage (milli-amps) from the generator's starting battery when the unit is in a static state. This maybe as much as 50 milli-amps for the system ECU and 50 milli-amps for each display. This can be as much as 72 amp-hours in a months time with no generator use. It is not necessary to be concerned with this slight amperage draw during normal seasonal use. However, if the generator set is not to be used for a number of months, such as winter storage, it is best to disconnect the DC power to the generator with a NMEA-2000 system or shut off the DC breaker on the generator's control box for a WESTERLINK system.*
>
> **NOTE:** *Keep in mind that the Westerbeke generator maybe the DC power supply for the vessel's NMEA-2000 network.*

MAINTENANCE SCHEDULE

⚠ WARNING: ***Never attempt to perform any service while the unit is operating. Wear the proper safety equipment such as goggles and gloves, and use the correct tools for each type of maintenance performed. Shut off the control panel's DC breaker when servicing any of the engine's DC electrical components.***

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

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

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

AFTER THE FIRST 50 HOURS OF OPERATION

Generator (Back End)	Check that AC connections are clean and secure with no chafing. Refer to the GENERATOR section for more information.
***Inlet Fuel Filter**	Initial change, then every 250 hours or once a year.
***Fuel Filter and "O" Rings**	Initial change, then every 250 hours or once a year.
Engine Oil and Filter	Initial engine oil and filter change at 50 hours, the both every 200 hours.
***Exhaust System**	Initial check at 50 hours, then every 250 hours or once a year. Carefully inspect for leaks. Check that the exhaust hoses are properly attached and that the securing clamps are tight. Check for integrity/mounting security of water injected exhaust elbow.
Heat Exchanger	Open end caps and clean out debris. Change zinc anode if necessary.

EVERY 50 OPERATING HOURS OR MONTHLY

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

EVERY 100 OPERATING HOURS OR YEARLY

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

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

MAINTENANCE SCHEDULE

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

EVERY 250 OPERATING HOURS OR YEARLY

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

EVERY 500 OPERATING HOURS OR FIVE YEARS

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

EVERY 1000 OPERATING HOURS OR OR EVERY FIVE YEARS

***Heat Exchanger**	Remove the heat exchanger for professional cleaning and pressure testing. Change the antifreeze and flush the system.
***Adjusting the Valve Clearances**	Adjust the valves.
***Positive Crankcase Ventilation Valve (Rocker Cover)**	Disassemble and clean. Replace as needed.
***Fuel Injectors**	Pressure test injectors/re-build at 1500 hours.
***Starter Motor**	Remove, clean and lubricate the drive

⚠WARNING: ***Never attempt to perform any service while the unit is operating. Wear the proper safety equipment such as goggles and gloves, and use the correct tools for each type of maintenance performed. Shut OFF the control panel's DC breaker when servicing any of the engines DC electrical components.***

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

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

FUEL SYSTEM

DIESEL FUEL

Use No.2-D (SAE J313) diesel fuel with a cetane rating of #45 or higher. Grade diesel fuel according to ASTM D975. In conjunction with Ultra Low Sulphur Diesel. Use an additive such as Diesel Kleen + Cetane Boost produced by Power Services (product #3025) or equivalent to help restore fuel lubricity.

FUEL FILTERS

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

FUEL WATER SEPARATOR

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

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

FUEL LIFT PUMP

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

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

INLET FUEL FILTER

To ensure properly filtered fuel into the fuel pump, there is a small inlet filter before the inlet to the fuel pump. Replace this filter after the initial 50 hours of operation, then follow the Maintenance Schedule in this manual.

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

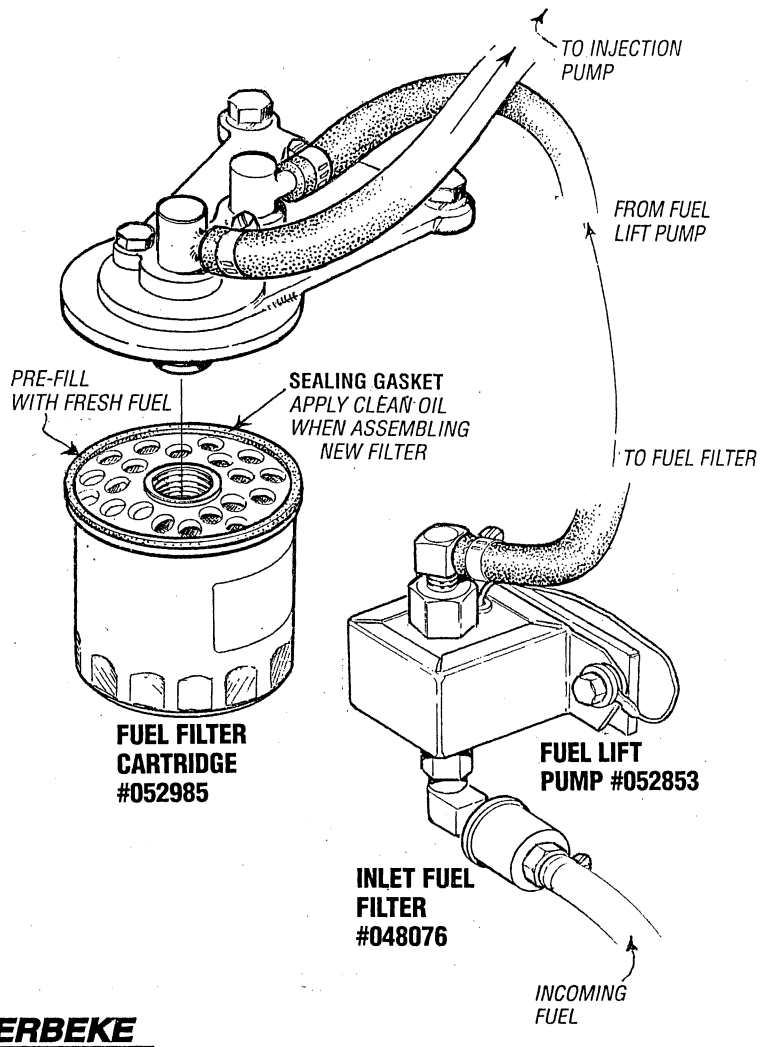
ENGINE FUEL FILTER

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

Changing the Fuel Filter Element

Refer to the illustration.

1. Shut **off** the fuel supply.
2. Unthread the fuel filter from its mounting bracket.
3. Ensure the sealing "O" ring comes off with the filter.
4. Apply some light oil or diesel to the sealing "O" ring of the new filter.
5. Thead the new filter onto its mounting bracket. When the "O" ring contacts the bracket, tighten securely.
6. Depressing and holding the PRIME button on the control panel activates the engine's fuel pump and primes the system. Hold for approximatelt 20 seconds.
7. Run the engine and inspect for leaks.



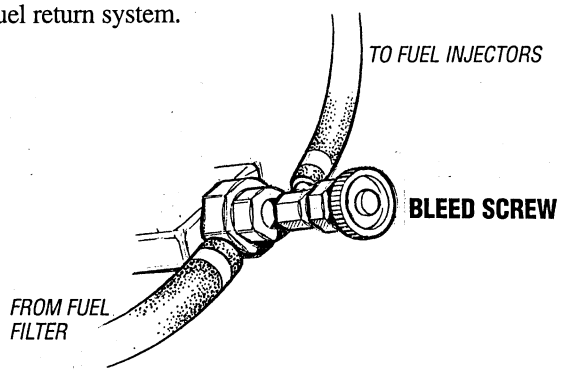
FUEL SYSTEM

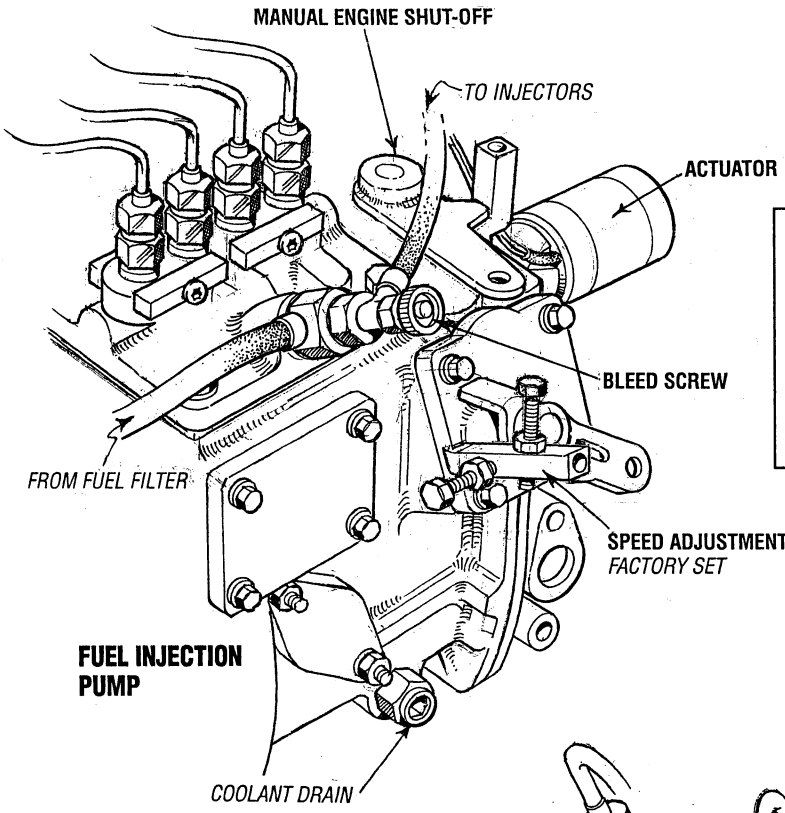
FUEL INJECTION PUMP

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

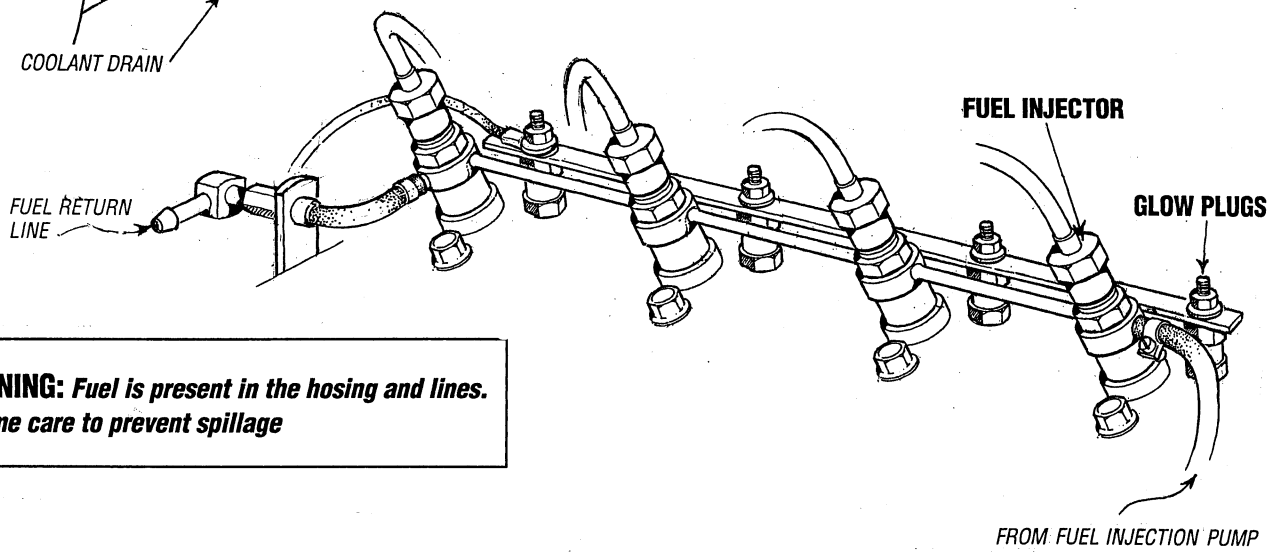
BLEED SCREW

The bleed screw on the injection pump should be left in the open position. This will then allow for ease in priming the engine's fuel system and during engine operation allow for air in the system to be delivered to the fuel tank through the fuel return system.





⚠ 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.***



⚠ WARNING: ***Fuel is present in the hosing and lines. Use extreme care to prevent spillage***

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.

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.

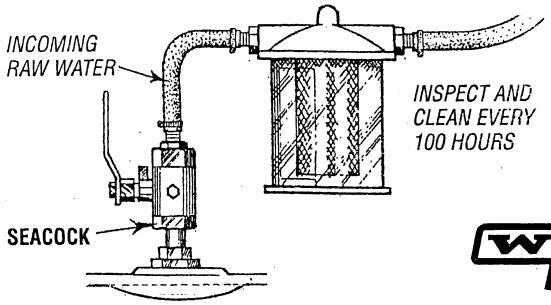
Perform the following maintenance after every 100 hours of operation:

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.

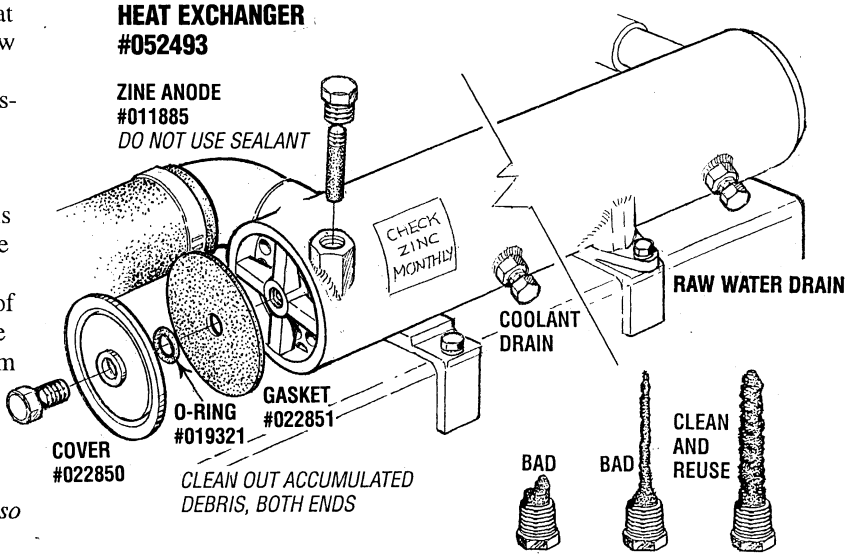
TYPICAL RAW WATER STRAINER
(OWNER INSTALLED)



Heat Exchanger

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

HEAT EXCHANGER
#052493



Zinc Anode

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

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

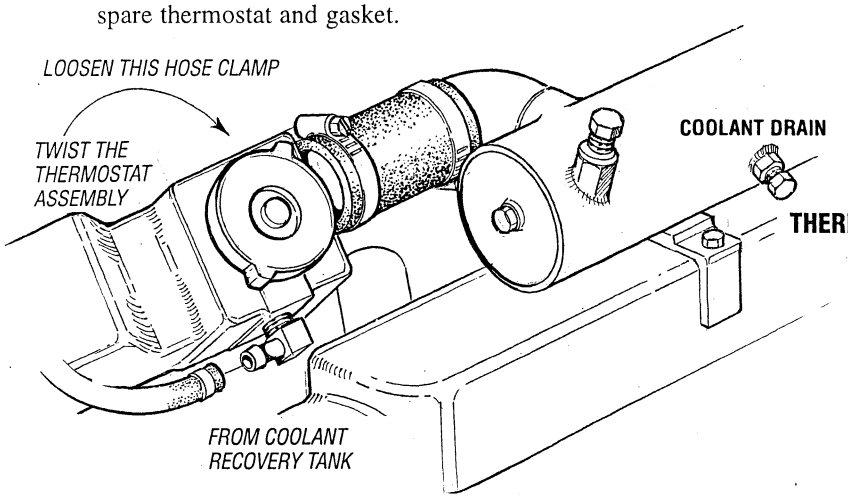
If the zinc pencil needs replacement, hold the hex boss into which the zinc pencil is threaded with a wrench while loosening the anode with another wrench. This prevents the hex boss from possibly tearing off the exchanger shell. After removing the zinc, note the condition of it. If the zinc is in poor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

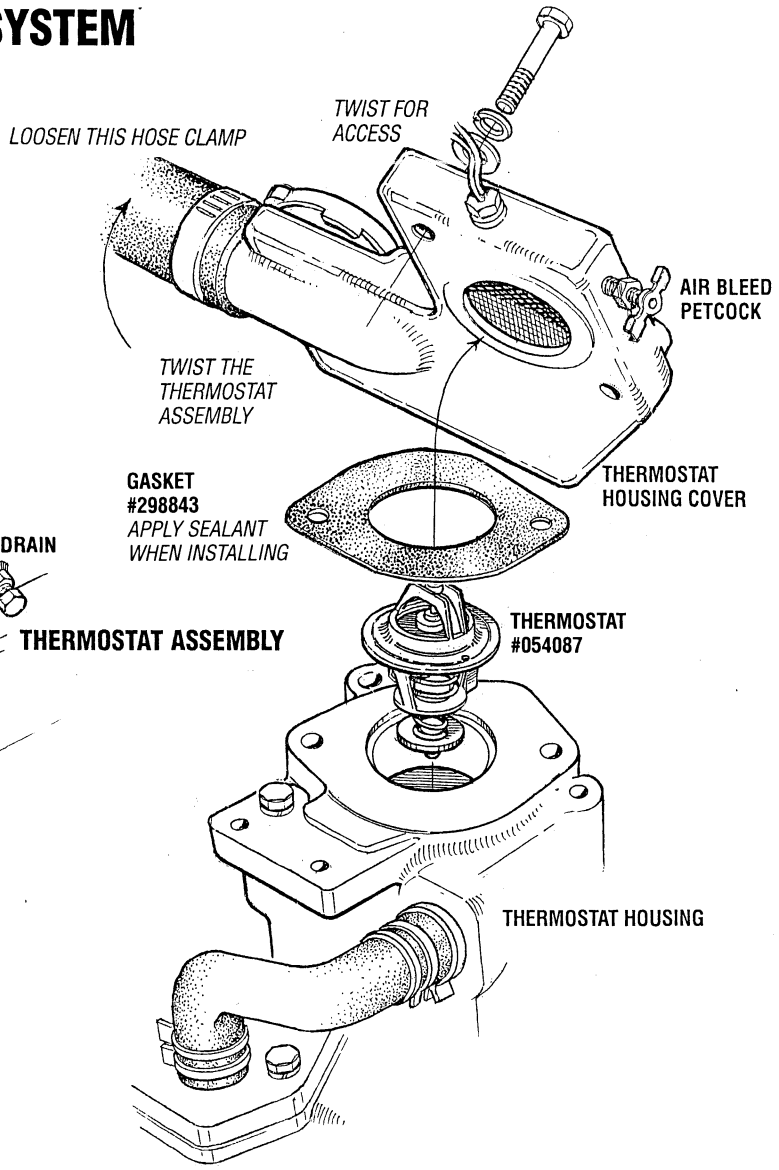
Heat Exchanger Service

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

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

1. **Drain off some coolant**: Release the coolant pressure cap and drain the coolant to the approximate level off the thermostat housing. This can be done using the heat exchanger drain plug.
2. **Rotate the thermostat assembly:** Loosen the hose clamp as shown and remove the three allen screws that hold down the thermostat housing cover, the assembly can now be twisted enough to access the gasket and thermostat.
3. **Remove/replace the gasket and thermostat:** When installing the new parts, apply a thin coat of sealant on both side of the gasket before pressing it into place.
4. **Re-assemble and test:** Turn the cover back into place and tighten the three screws. Do not over-tighten! Tighten the hose clamp and tighten the drains. Top off the coolant and run the engine. Check for normal temperature and for any leaks around the thermostat assembly.

> ⚠ **CAUTION:** ***The engine must be allowed to cool down before attempting these procedures. Not only is the surface of the engine hot but coolant temperatures can be at 190° F.***

COOLING SYSTEM

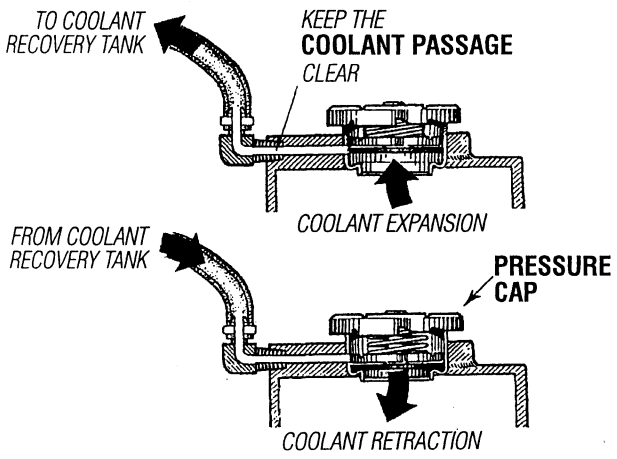
FRESH WATER COOLING CIRCUIT

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

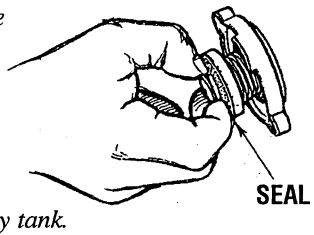
Fresh water coolant is pumped through the engine by a circulating pump, absorbing heat from the engine. The coolant then passes through the thermostat into the manifold, to the heat exchanger where it is cooled, and returned to the engine block via the suction side of the circulating pump.When the engine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

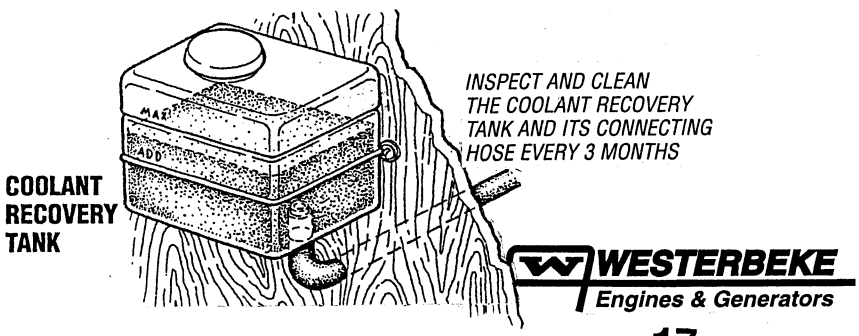
Coolant Recovery Tank

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 the upper and lower rubber seals are in good condition. Check to ensure the vacuum valve opens and closes tightly. Carry a spare cap. Check also to ensure the coolant passage is clear so coolant within the system is able to expand and contract to and from the coolant recovery tank.*





CHANGING COOLANT

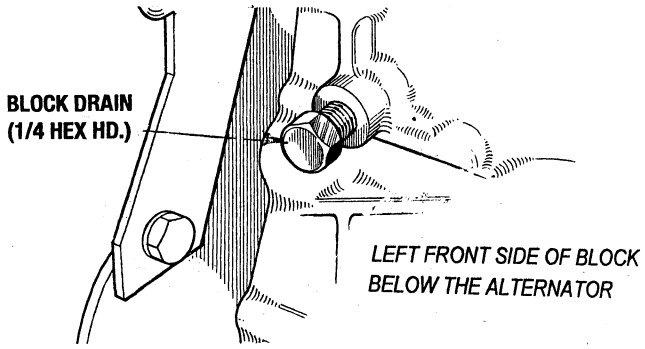
The engine's coolant must be changed according to the *MAINTENANCE SCHEDULE*. If the coolant is allowed to become contaminated, it can lead to overheating problems.

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

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

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

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



Refilling the Coolant

After closing all open drain plugs, pour new pre-mixed antifreeze coolant into the pressure cap filler neck opening. Fill slowly until coolant is visible in the filler neck opening. Start the engine and monitor coolant in the filler neck opening, adding coolant as needed to maintain the level in the filler neck opening.

When coolant is stable in the opening, momentarily open the air bleed petcock on the thermostat housing to release any air in that area. Add coolant so the filler neck opening is full. Install the pressure cap.

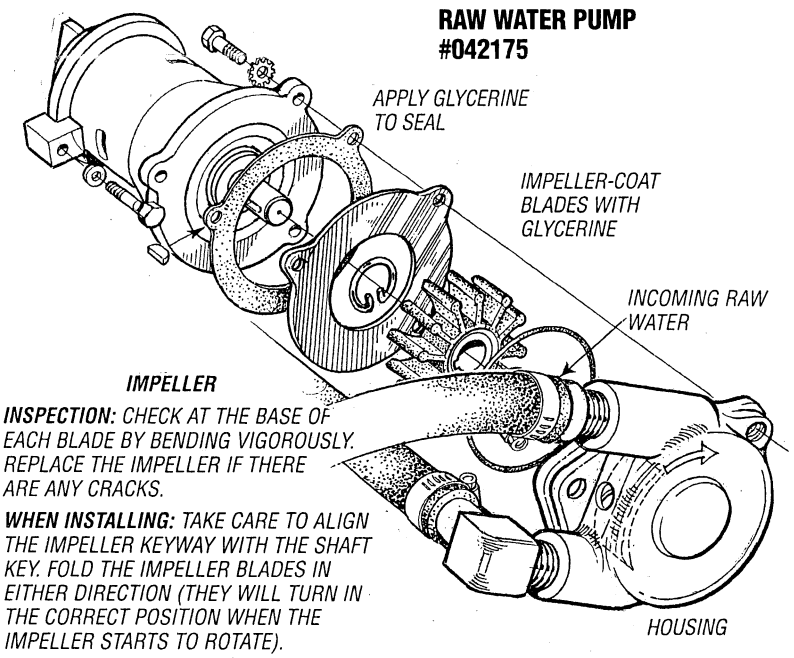
COOLING SYSTEM

RAW WATER COOLING CIRCUIT

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

Raw Water Pump

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



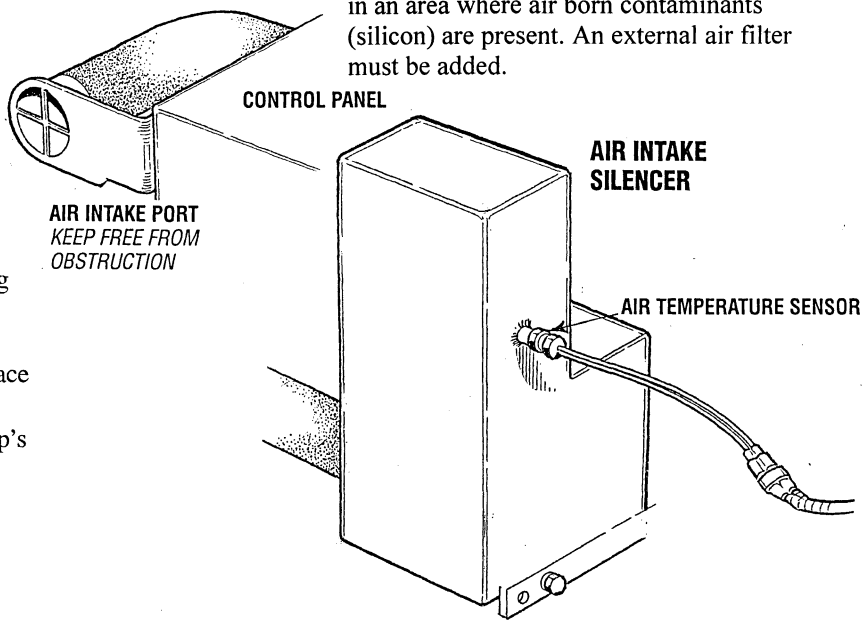
CHANGING THE RAW WATER PUMP IMPELLER

1. **Close the raw water intake valve** and unfasten the two hose connection on the inlet and outlet nipples of the pump.
2. Remove the cap screws and hold down brackets that secure the pump to the front gear case and lift the pump off the engine. Check the pump's shaft drive tang for wear and also the drive in the engine.
3. Remove the three cap screws that secure the impeller housing to the pump body (note the position of the housing to the pump body) and remove the housing exposing the sea water impeller.
4. Pull the impeller off the keyed shaft and install the replacement.
5. Lightly coat the inside of the impeller housing with glycerine lubricant. Check the condition of the housing sealing O-ring. Replace if needed.
6. Replace the impeller housing over the impeller positioning it correctly on the body and secure it in place with the three cap screws.
7. Secure the pump onto the gear case aligning the pump's shaft tang with the drive slot.
8. Reattach the water hoses and **open the water intake valve**. Run the unit and check for leaks.

AIR INTAKE/SILENCER

The air intake port supplies cooling air to the control panel electronics. this air flow continues to the engines air intake/silencer to supply fresh air to the engine. This system requires NO maintenance.

NOTE: If the unit is being operated in an area where air born contaminants (silicon) are present. An external air filter must be added.

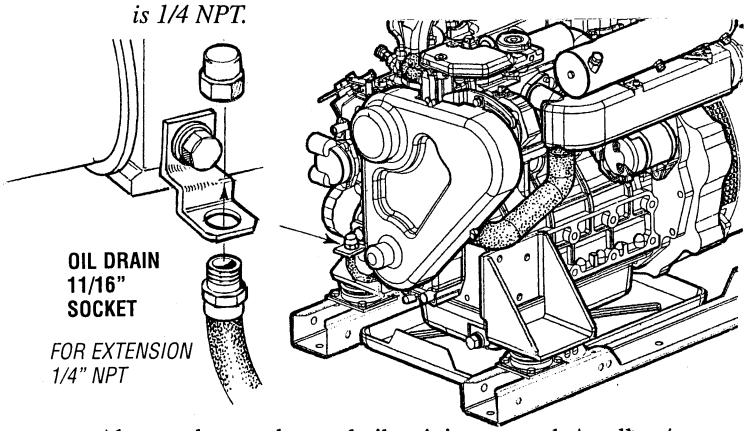


ENGINE LUBRICATING OIL

ENGINE OIL CHANGE

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

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



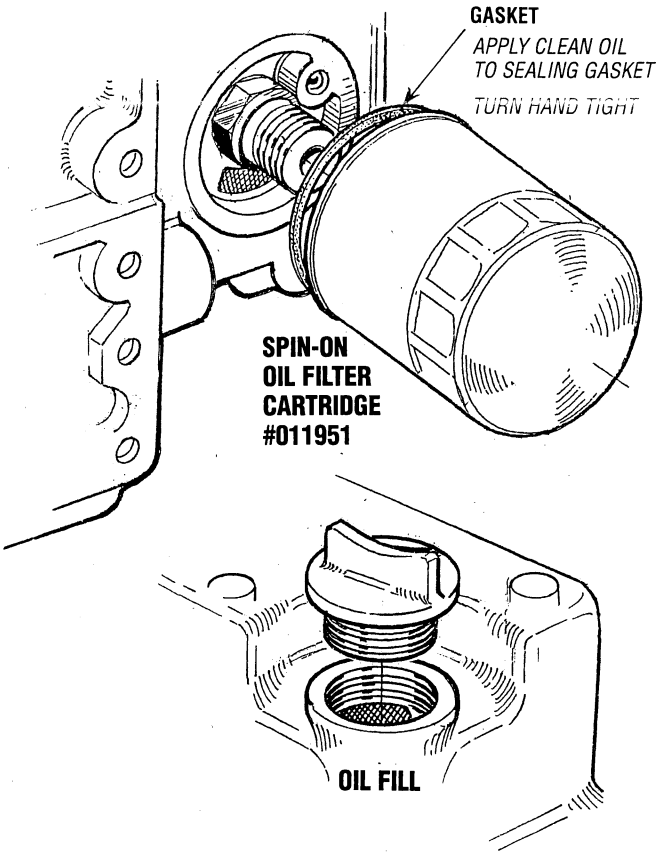
   Always observe the used oil as it is removed. A yellow/gray emulsion indicates the presence of water in the oil. Although this condition is rare, it does require prompt attention to prevent serious damage. Call a qualified mechanic should water be present in the oil. Raw water present in the oil can 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. ***Replacing the Oil Filter.*** When removing the used oil filter, you may find it helpful and cleaner to punch a hole in the upper and lower portion of the old filter to drain the oil from it into a container before removing it. This helps to lessen spillage. A small automotive filter wrench should be helpful in removing the old oil filter.

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

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

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

> ⚠ **WARNING:** ***Used engine oil contains harmful contaminants. Avoid prolonged skin contact. Clean skin and nails thoroughly using soap and water. Launder or discard clothing or rags containing used oil. Discard used oil properly.***

NOTE: *Change the engine lube oil and filter initially after the first 50 hours of engine break-in. Then follow the recommended change intervals in the MAINTENANCE SCHEDULE in this manual.*

OIL PRESSURE

DESCRIPTION

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

OIL PRESSURE

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

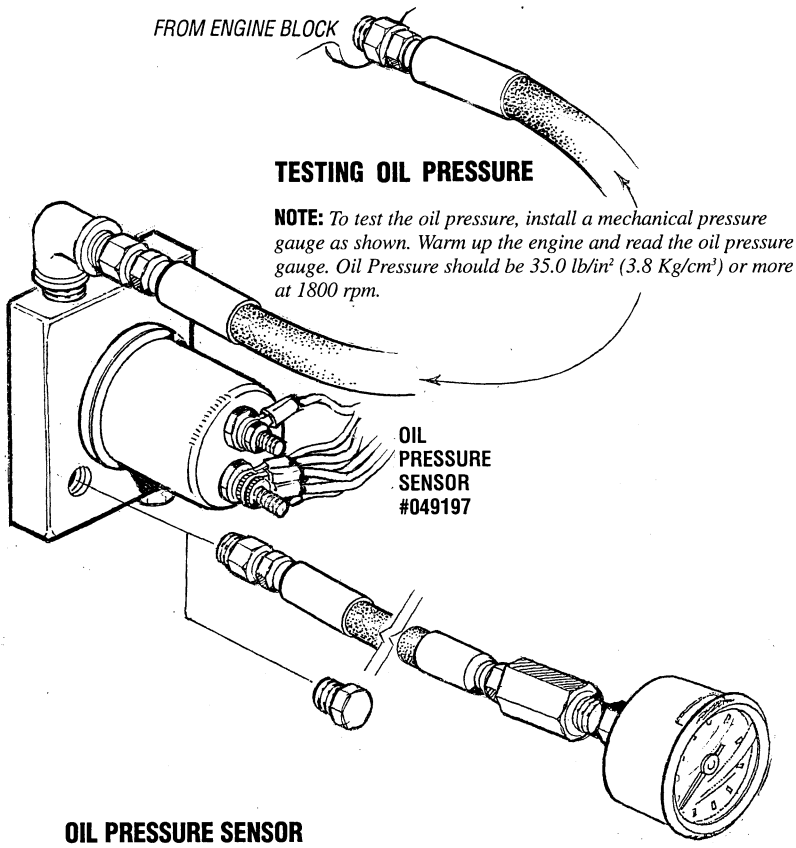
NOTE: *A newly started, cold engine can have an oil pressure reading up to 60 psi (4.2 kg/cm²). A warmed engine can have an oil pressure reading as low as 35 psi (2.5 kg/cm²). These readings will vary depending upon the temperature of the engine and the rpms.*

LOW OIL PRESSURE

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

OIL PRESSURE RELIEF VALVE

The oil pressure relief valve is located in the front gear case cover below the lube oil filter. It is held in place by an 8mm allen head plug. This valve opens at approximately 50 psi (343kpa) and operates to maintain the pressure in the lube oil feed system.



OIL PRESSURE SENSOR

An oil pressure sensor is mounted on the oil manifold for the engine. It sends a voltage signal to the ECU that is interpreted as pressure. Should this signal fall below a set point in the ECu. The ECU will open the K2 run relay shutting the unit down. It will then display the fault on the LCD Display screen. Engine oil pressure dropping 10 - 15 psi will cause this to occur.

NOTE: *To test the oil pressure, install a mechanical pressure gauge as shown. Warm up the engine and read the oil pressure gauge. Oil Pressure should be 35.0 lb/in² (3.8 Kg/cm²) or more at 1800 rpm.*

ENGINE TROUBLESHOOTING

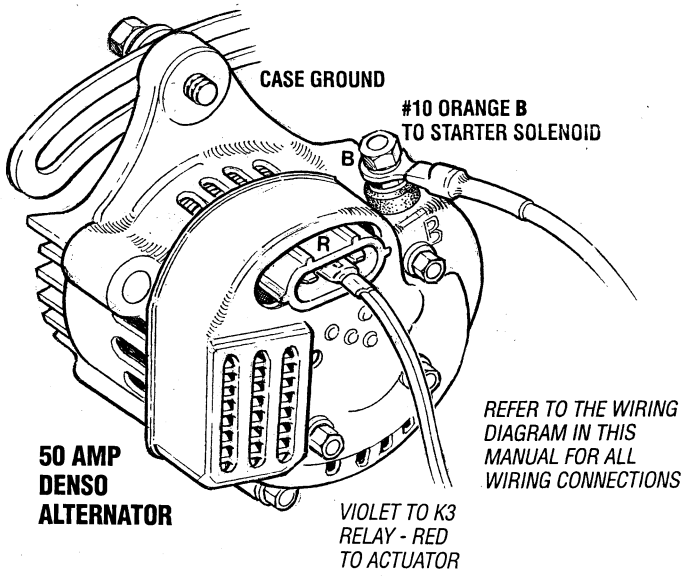
Note: *The engine's DC electrical system is protected by a 20 amp rocker type reset circuit breaker mounted on the control panel.*

Problem	Probable Cause	Verification/Remedy
START BUTTON depressed no panel indicatiins.	1. Battery Switch not on. 2. Circuit breaker tripped/off. 3. Loose battery connections.	1. Check switch and/or battery connections. 2. Reset breaker; if breaker trips again, check preheat solenoid circuit and check circuit for shorts to ground. 3. Check (+) connection to starter solenoid and (-) connection to engine ground stud. Check battery cable connections.
START switch depressed no starter engagement.	1. Connection to solenoid faulty. 2. Faulty solenoid. 3. Loose battery connection. 4. Low battery. 5. K1 Relay	1. Check connection. 2. Check that 12 volts are present at the solenoid connection. 3. Check battery connections. 4. Check battery charge state. 5. Check K1 relay.
START switch is depressed; panel indications OK; starter solenoid OK actuator not functioning.	1. Poor connections to actuator. 2. Defective actuator.	1. Check connections. 2. Remove and check actuator.
Generator engine cranks but does not start, actuator energized. **NOTE:** *There is an 8-10 sec crank cycle. If the engine does not start, the cycle will terminate and a underspeed fault will display on the LCD display screen.*	1. Faulty Fueling system. 2. Preheat solenoid faulty.	1. Check that the valves are open. 1a. Switch to combine house and start batteries. 1b. Replace batteries. 1c. Check fuel lift pump. 1d. Change inlet fuel filter. 2. Chech solenoid.
Battery runs down.	1. High resistance leak to ground. 2. Low resistance leak. 3. Poor battery connections. 4. DC Alternator not charging.	1. Check wiring. Insert sensitive (0 - .25 amp) meter in battery lines. **Do not start engine.** Remove connections and replace after short is located. 2. Check all wires for temperature rise to locate the fault. 3. Check cable connections at battery for loose connections, corrosion. 4. Check connections, check belt tension, test alternator. See DC ELECTRICAL SYSTEM/ALTERNATOR in ths manual.
Battery not charging	1. DC charge circuit faulty. 2. Alternator drive.	1. Perform DC voltage check of generator charging circuit. See DC ELECTRICAL SYSTEM/ALTERNATOR in ths 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 Exe terminal.
Generator engine stops. (Fault display under speed) **NOTE:** *There is an 8-10 sec crank cycle. If the engine does not start, the cycle will terminate and a underspeed fault will display on the LCD display screen.*	1. Switches and/or wiring loose. 2. Fuel starvation. 3. 20 Amp circuit breaker tripping. (LCD display blank) 4. Exhaust system is restricted. 5. Water in fuel. 6. Air intake obstruction.	1. Inspect wiring for short circuits and loose connections Inspect switches for proper operation. 2. Check fuel supply, fuel valves, fuel feed strainer. 3. Check for High DC amperage draw during operation. Ensure breaker is not overly sensitive to heat which would cause tripping. 4 Check for blockage or collapsed muffler. 5. Pump water from fuel tank(s), change filters and bleed fuel system. 6. Check air intake filter cartridge.
Engine starts, runs, and shuts down.	1. Faulty oil pressure sensor 2. Water temperature sensor. 3. Faulty exhaust temperature switch.	1. Check oil pressure sensor. 2. Check water temperature sensor. 3. Check temperature switch.
Exhaust smoking problems	1. Blue smoke. 2. White smoke. 3. White smoke.	1. Incorrect grade of engine oil. 1a. Crankcase is overfilled with engine oil (oil is blowing out through the exhaust). 2. Engine is running cold. 2a. Faulty injector or incorrect injector timing. 3. Improper grade of fuel or possible generator overload. 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.

ENGINE TROUBLESHOOTING
LCD DISPLAY FAULTS

PROBLEM	PROBABLE CAUSE	VERIFICATION/REMEDY
LCD DISPLAY DOES NOT ILLUMINATE	1. Check battery. 2. 20 amp breaker off. 3. Loose display connection. 4. 1 amp fuse blown (faulty).	1. Battery on. 2. Turn breaker on. 3. Check all cable connections. 4. Check/replace. Determine cause
LOW OIL PRESSURE	1. Oil level low/oil leak. 2. Lack of oil pressure 3. Ground connection. 4. Faulty control module (ECU). 5. Faulty oil pressure sensor.	1. Check oil level, add oil and repair leaks. 2. Test oil pressure. If OK, test oil pressure sendor, inspect oil filter, inspect oil pump. 3. Check ground connection. 4. Inspect all the plug connections/replace. 5. Check sensor/replace.
HIGH COOLANT TEMPERATURE	1. Check system coolant level. 2. Sea water pump. 3. Check water pump drive belt. 4. Faulty temperature sensor. 5. Ground connection. 6. Faulty control module (ECU).	1. Add coolant. Check for leaks. 2. Inspect impeller/pump/replace. 3. Adjust belt tension, replace belt. 4. Check sensor/replace. 5. Check ground circuit. 6. Check plug connections/replace.
HIGH EXHAUST TEMPERATURE	1. Check sea water flow. 2. Faulty exhaust temperature switch. 3. Ground Connection. 4. Faulty control module (ECU). 5. Sea water pump. 6. Faulty fire suppression system.	1. Inspect thru hull fitting, hose and strainer. Correct as needed. 2. Test/replace. 3. Check ground circuit. 4. Check plug connections. 5. Inspect impeller/replace. 6. By-pass system/check.
BATTERY VOLTAGE	1. Check alternator drive belt. 2. Check charge voltage. 3. Check battery connections. 4. Faulty control module (ECU).	1. Adjust tension/replace if worn. 2. Check excitation. Replace/repair alternator 3. Check + and - cables from battery to engine. 4. Check plug connections/replace.
GENERATOR FREQUENCY Overspeed (steady LED) Underspeed (flashing LED)	1. Check engine speed. 2. Check fuel supply. 3. Amperage load. 4. Crank cycle with no start. (underspeed fault) 5. Faulty MPU	1. Check speed setting. 2. Inspect filters/replace filters. Test fuel pump operation. 3. Check + and - cables from battery to engine. 4. Check cause for no start. 5. Check MPU. Signal Cranking Check MPU Coil resistance Check for damage.
LED DISPLAY EDGES TURN PINK	1. Compartment ambient temperature too high.	1. Ventilate compartment. **Note:** *Heat will often change the color of an LCD display. This will not effect the operation of the engine.*
WAITING FOR ECU	1. ECU and LCD display not compatible. 2. Loose cable connection. 3. Panel DC breaker OFF. 4. Blown 12A fuse 5. Terminating Resistors. 6. Battery Voltage to ECU.	1. Check compatibility with Westerlink or NMEA. 2. Check all cable connections. 3. Turn ON, check DC voltage across breaker. 4. Check/replace fuse. Check DC voltage across fuseholder 5. Check all terminating resistors are in place. 120 ohm per resister measured across pin #4 and #5. 6. Check between pins P2-24 and P2-25. P2 ECU plug unplugged from ECU. Power turned ON. If voltage is present, ECU is faulty.

ALTERNATORS TESTING/TROUBLESHOOTING



DESCRIPTION

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

ELECTRICAL CHARGING CIRCUIT

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

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

ALTERNATOR DESCRIPTION

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

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

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

VOLTAGE REGULATOR

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

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

ALTERNATOR TROUBLESHOOTING

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

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

LOW BATTERY/FAULTY CIRCUIT

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

PRELIMINARY INSPECTION

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

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

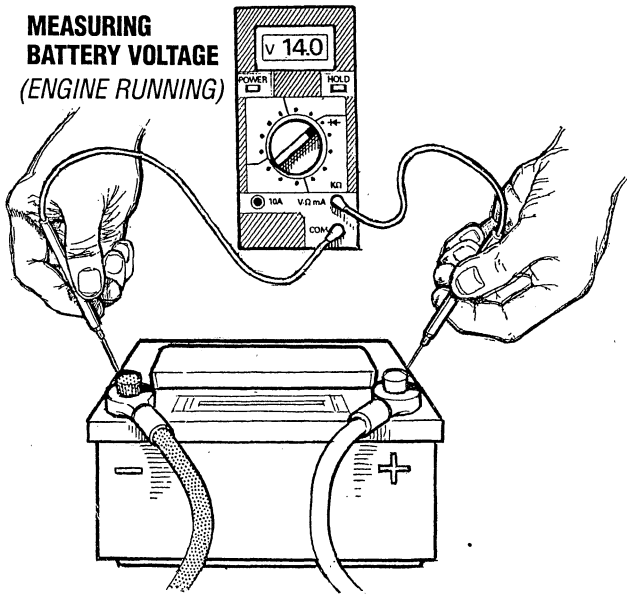
NOTE: *An isolator with a diode, a solenoid, or a battery selector switch is usually mounted in the circuit to isolate the batteries so the starting battery is not discharged along with the house batteries. If the isolator is charging the starting battery but not the house battery, the alternator is OK and the problem is in the battery charging circuit.*

ALTERNATORS TESTING/TROUBLESHOOTING

TESTING THE ALTERNATOR

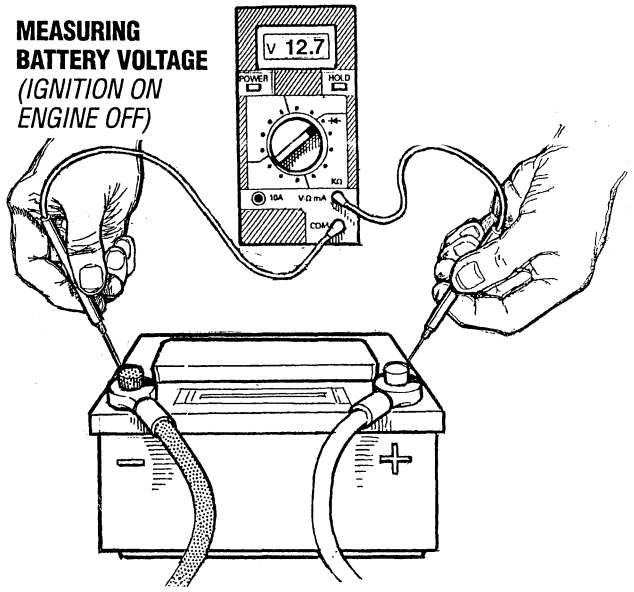
> **⚠ CAUTION:** ***Before starting the engine make certain that everyone is clear of moving parts! Keep away from sheaves and belts during test procedures.***

1. **Start the Engine.**
2. After the engine has run for a few minutes, measure the starting battery voltage at the battery terminals using a multimeter set on DC volts.
   a. If the voltage is increasing toward 14 volts, the alternator is working.
   b. If the voltage remains around 12 volts, a problem exists with either the alternator or the charging circuit; continue with Steps 3 through 6.



MEASURING BATTERY VOLTAGE *(ENGINE RUNNING)*

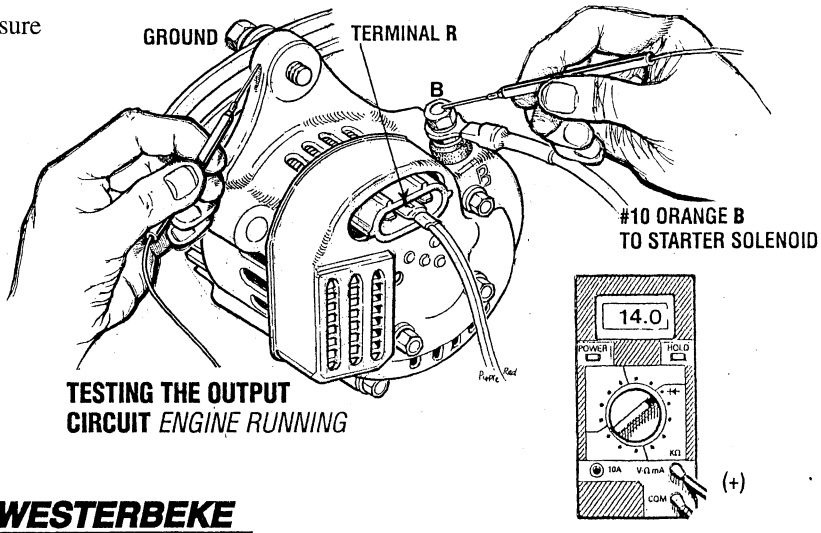
3. **Turn off the engine.** Inspect all wiring and connections. Ensure that the battery terminals and the engine ground connections are tight and clean
4. If a battery selector switch is in the charging circuit,ensure that it is on the correct setting.
5. **Turn on the ignition switch, but do not start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



MEASURING BATTERY VOLTAGE *(IGNITION ON ENGINE OFF)*

TESTING THE OUTPUT CIRCUIT

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

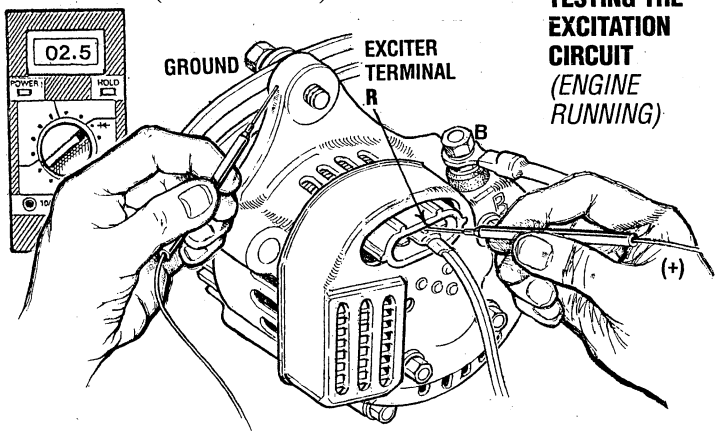


TESTING THE OUTPUT CIRCUIT *ENGINE RUNNING*

ALTERNATORS TESTING/TROUBLESHOOTING

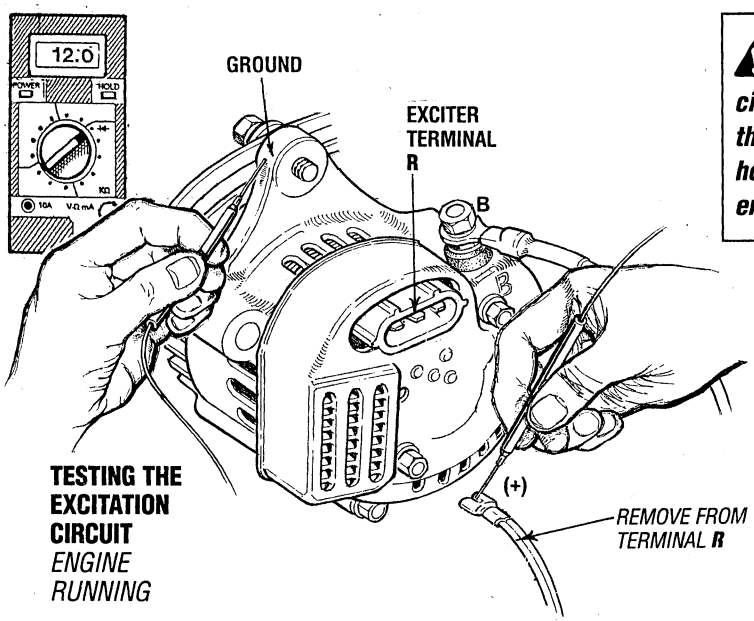
TESTING THE EXCITATION CIRCUIT

1. Connect the positive (+) multimeter probe to the excitation terminal **R** on the alternator and the negative (–) lead to ground.
2. **Turn the ignition switch to the on position** and note the multimeter reading. The reading should be 1.3 to 2.5 volts (see illustration).



TESTING THE EXCITATION CIRCUIT *(ENGINE RUNNING)*

3. **If the reading is between .75 and 1.1 volts,** the rotor field circuit probably is shorted or grounded.
4. **If the reading is between 6.0 and 7.0 volts,** the rotor field circuit probably is open.
5. **If no reading is obtained,** an open exists in the alternator-excitation lead or in the excitation circuit of the regulator. Disconnect the lead from exc terminal **R**. Connect the positive multimeter probe to the excitation lead and the negative multimeter probe to ground. If the multimeter now indicates an approximate battery voltage, the voltage regulator is defective and must be replaced. If no voltage is indicated, check the excitation circuit for loose or dirty connections or damaged wiring.



TESTING THE EXCITATION CIRCUIT *ENGINE RUNNING*

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.

When the problem has been solved and before the alternator is back in operation, take the time to tighten and clean the terminal studs. Also clean the connecting terminals from the wiring harness.

ALTERNATOR REPAIR

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

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

BATTERY CARE

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

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

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

> ⚠ **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.***

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.*

CHECKING VALVE CLEARANCE

Valve clearance must be checked and adjusted when engine is cold.

1. Remove the head cover.
2. Align the **ITC** mark line on the flywheel and projection on the housing so that the No.1 piston comes to the compression or overlap top dead center.
3. Check the following valve clearance (1) marked with ☆ using a feeler gauge.
4. If the clearance is not within the factory specification, adjust with the adjusting screw.

VALVE CLEARANCE 0.18 - 0.22mm (0.0071 - 0.0087 in)

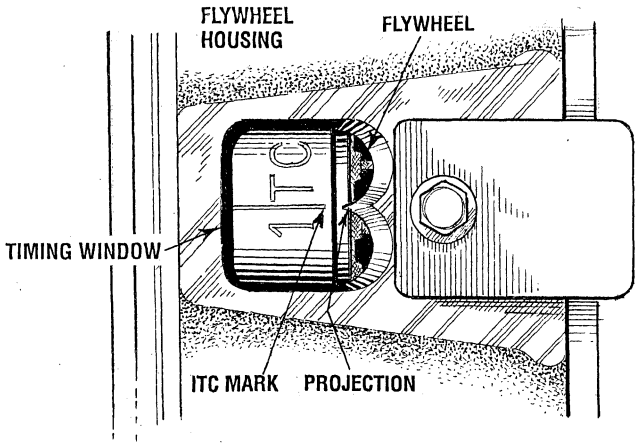
The **TC** marking line on the flywheel is just for the No. 1 There is no **TC** marking for the other cylinders. The No.1 piston comes to the top dead center position when the **TC** marking is aligned with the projection in the window on the flywheel-housing. Turn the flywheel 0.26 radius (15°) clockwise and counterclockwise to see if the piston is at the compression top dead center or the overlap position. Now, referring to the table below, readjust the valve clearance. The piston is at the top dead center when both the IN. and EX. valves do not move. It is at the overlap position when both the valves move.

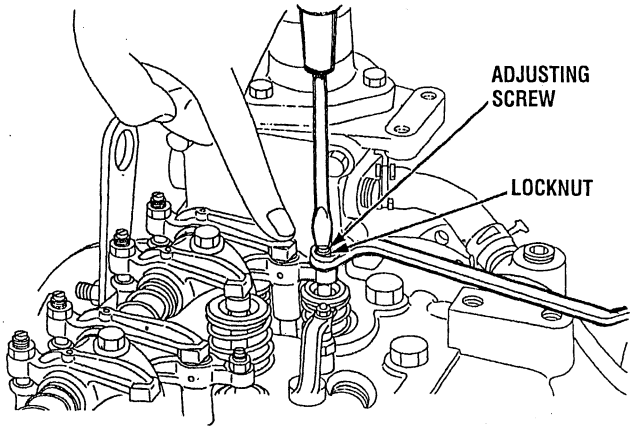
Finally, turn the flywheel 6.28 radius (360°) and align the **TC** marking and the projection perfectly. Adjust all the other valve clearances as required.

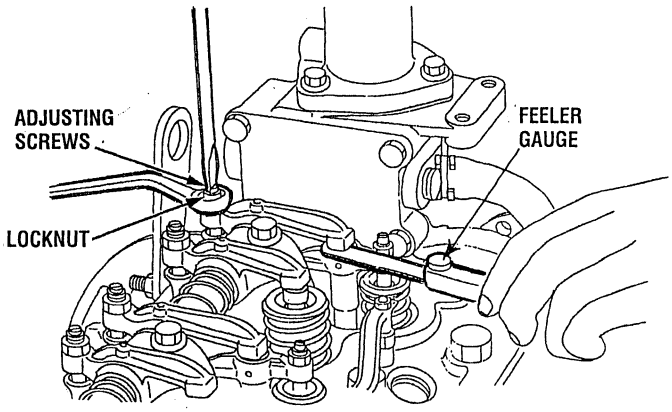
After turning the flywheel counterclockwise twice or three times, recheck the valve clearance.

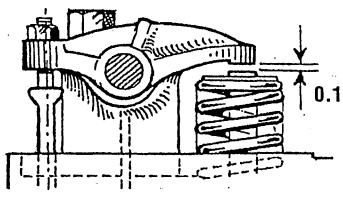
After adjusting the valve clearance, firmly tighten the locknut of the adjusting screw.

Adjustable cylinder location of piston		Valve arrangement			
		3 CYL.		4 CYL.	
		IN.	EX.	IN.	EX.
When No. 1 piston is compression top dead center	No. 1	☆	☆	☆	☆
	No. 2		☆	☆	
	No. 3	☆			☆
	No. 4	—	—		
When No. 1 piston is overlap position	No. 1				
	No. 2	☆			☆
	No. 3		☆	☆	
	No. 4	—	—	☆	☆

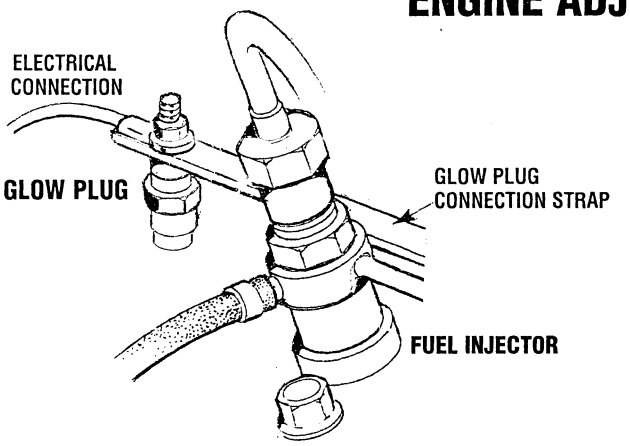








ENGINE ADJUSTMENTS



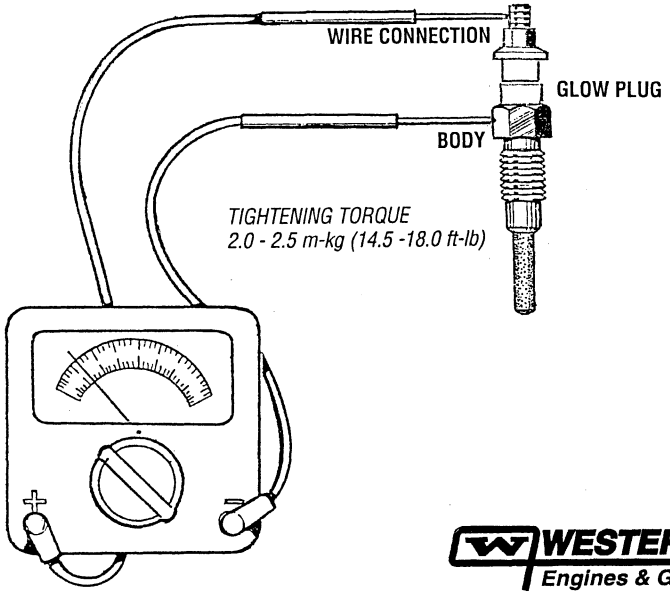
GLOW PLUGS

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

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.

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 0.90 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 (12-13 amps per plug)

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.



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*).

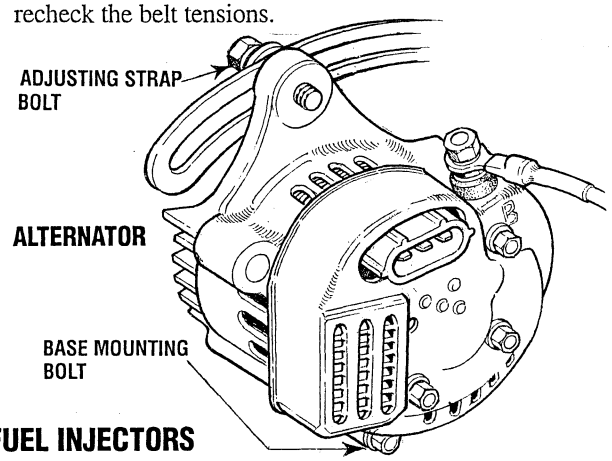
Drive belts must be properly tensioned. Loose drive belts will not provide proper alternator charging and will eventually damage the alternator. Drive belts that are too tight will pull the alternator out of alignment and/or cause the alternator to wear out prematurely. Excessive drive belt tension can 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.



FUEL INJECTORS

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

FUEL INJECTORS

REMOVING THE INJECTORS

NOTE: *Injector must be serviced in a "clean room" environment.*

1. Disconnect the high pressure lines from the injectors and loosen the lines at their attachment to the injection pump and move them out of the way of the injectors. Avoid bending the lines.
2. Using a 17mm long socket, remove the fuel return line in its entirety from the top of the injectors. Take care not to lose the two sealing washers and banjo bolt that attaches the fuel return line to each injector.

   NOTE: *Clean the area around the base of the injector prior to lifting it out of the cylinder head 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 17mm deep socket wrench to free it and then lift it out.*

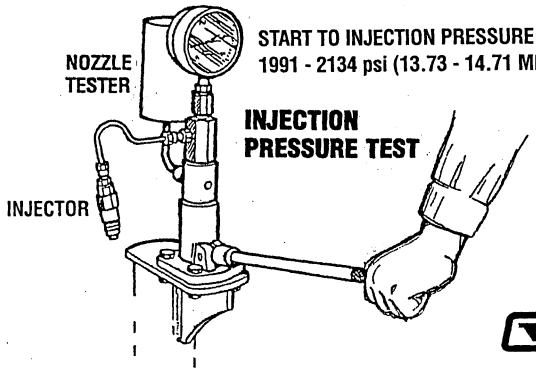
3. The injector seats in the cylinder head on a copper sealing washer. This washer should be removed with the injector and replaced with a new washer when the injector is reinstalled.

INJECTION TESTING

1. Using the nozzle tester, check the spray pattern and injection starting pressure of nozzle and, if it exceeds the limit, adjust or replace the nozzle. When using nozzle tester, take the following precautions:

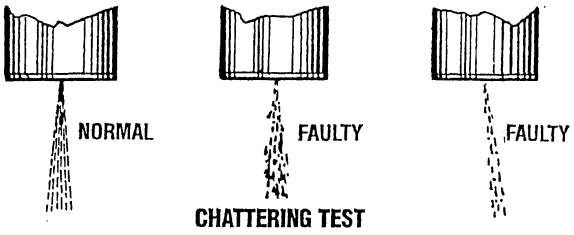
> ⚠ **CAUTION:** ***The spray injected from the nozzle is of such velocity that it may penetrate deeply into the skin of fingers and hands, destroying tissue. If it enters the bloodstream, it may cause blood poisoning.***

   a. If the diesel fuel of the nozzle tester is discolored, replace it. At the same time, clean or replace the filter.
   b. Set the nozzle tester in a clean place where there is no dust or dirt.
   c. Mount the nozzle and nozzle holder on the nozzle tester.
   d. Use the fuel at the approximate temperature of 68° F (20° C)
   e. Operate the hand lever of nozzle tester several times to bleed the air in the nozzle line, then move the hand lever at intervals of one stroke per second while reading the injection starting pressure.



Inspecting Spray Pattern

1. Operate the hand lever of the nozzle tester at intervals of one stroke per second to check if the fuel is injected correctly in its axial direction. A nozzle is defective if it injects fuel in an oblique direction or in several separate strips. Also, a spray in the form of particles indicates a defect. These defects may sometimes be caused by clogging with dust and, therefore, all parts should be carefully cleaned before reassembly. (Care should be taken not to expose ones skin to this spray as it may penetrate the skin and cause infection.)



CHATTERING TEST

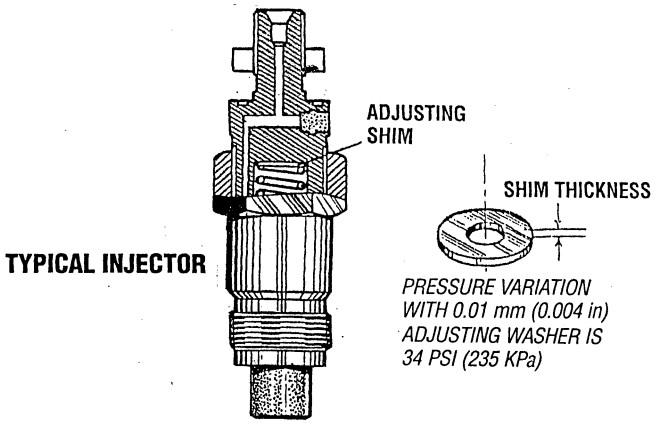
2. Apply the pressure of 1635 lb/in² (115 kg/cm²) to nozzle by operating the hand lever, and check the drips from the nozzle tip. If it drips or has a large accumulation of fuel on the bottom, it is considered defective and should be replaced. A very small amount of fuel may sometimes remain on the tip of the nozzle; however, this does not indicate a defect.

DRIP TEST

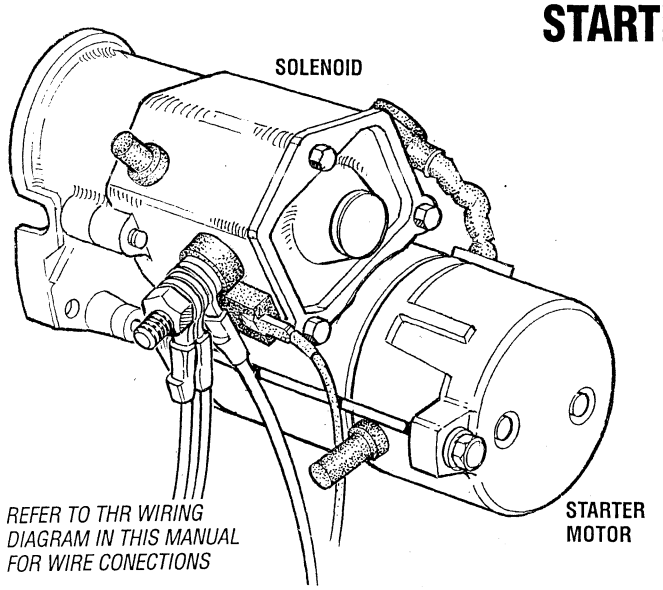
The injection starting pressure for the injectors is adjusted by increasing or decreasing the thickness of the adjusting shim.

The shim has 10 different thicknesses for every 0.0020 in (0.05 mm), between 0.0049in (1.25mm).to 0.0669in (1.7mm) With each 0.0020in (0.05mm) increase, injection pressure is increased approximately 71.1 lb/in² (5.0 kg/cm²). When replacing the shim, grip the retaining nut in a vise and remove the body with a wrench. Tighten the retaining nut to the specified torque.

INJECTOR TO CYLINDER HEAD TIGHTENING TORQUE
36.2 - 50.6 (49 - 68.6 Nm)



STARTER MOTOR

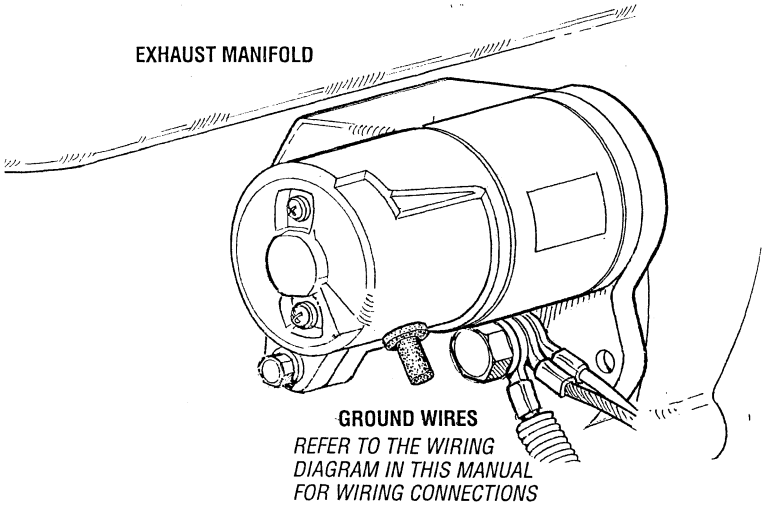


The starting system includes the battery, starter motor and solenoid, and the ignition switches - Start/Preheat.

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

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

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



TROUBLESHOOTING

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

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

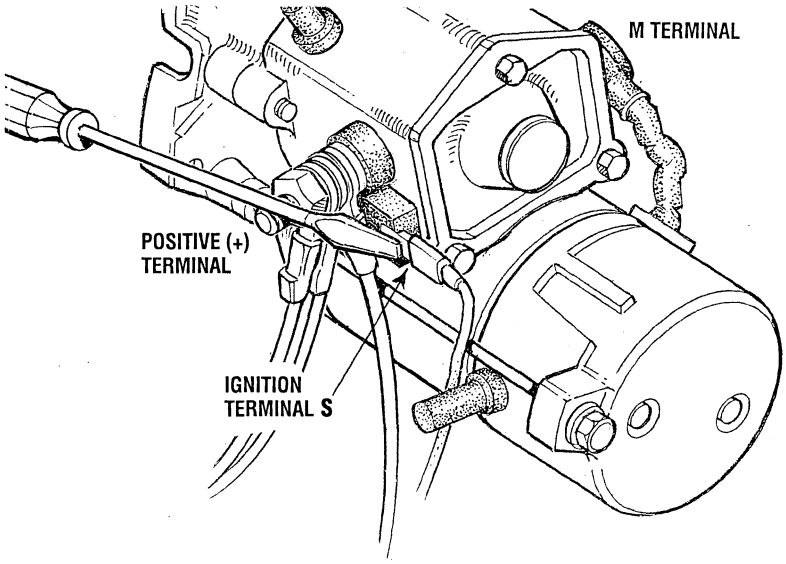
Using a multimeter, test the voltage between the positive terminal stud on the start solenoid and the engine block (ground).

If you read 12 volts, the starter is faulty.

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

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

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



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

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

STARTER MOTOR

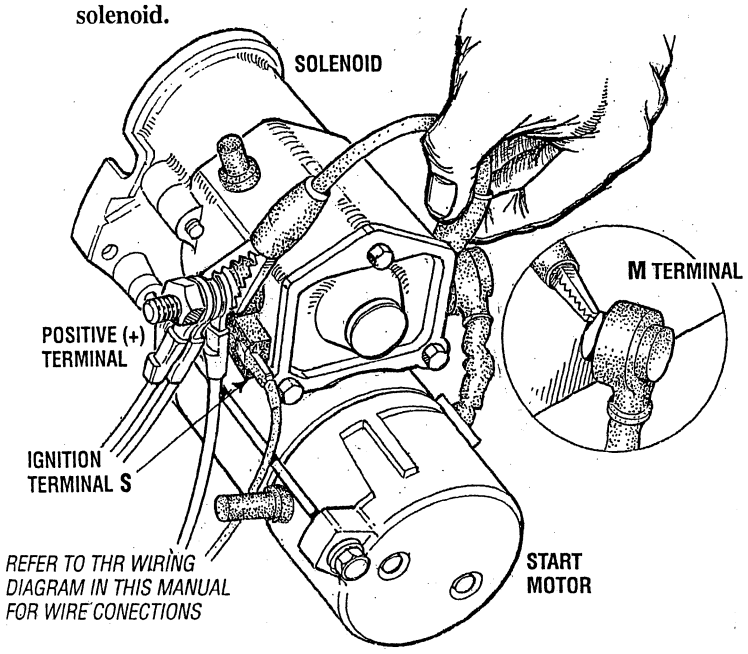
Test again by jumping the positive terminal to the **M** terminal. Pull back the covering on the **M** terminal to expose the connection. Attach a jumper cable to the positive (+) terminal. Use a battery type cable #8 or better. Tap the **M** terminal with the opposite end to see the results. Do not allow the jumper cable end to touch the solenoid or starter casing. This would cause a short.

> ⚠ **WARNING:** ***There will be arching as the full starting current should be flowing thru the jumper***

If the starter spins, the solenoid is faulty.

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

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



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

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

SERVICE

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

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

TO REMOVE FOR SERVICE

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

GENERATOR INFORMATION

USE OF ELECTRIC MOTORS

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

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

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

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

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

REQUIRED OPERATING SPEED

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

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

Generator Maintenance

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

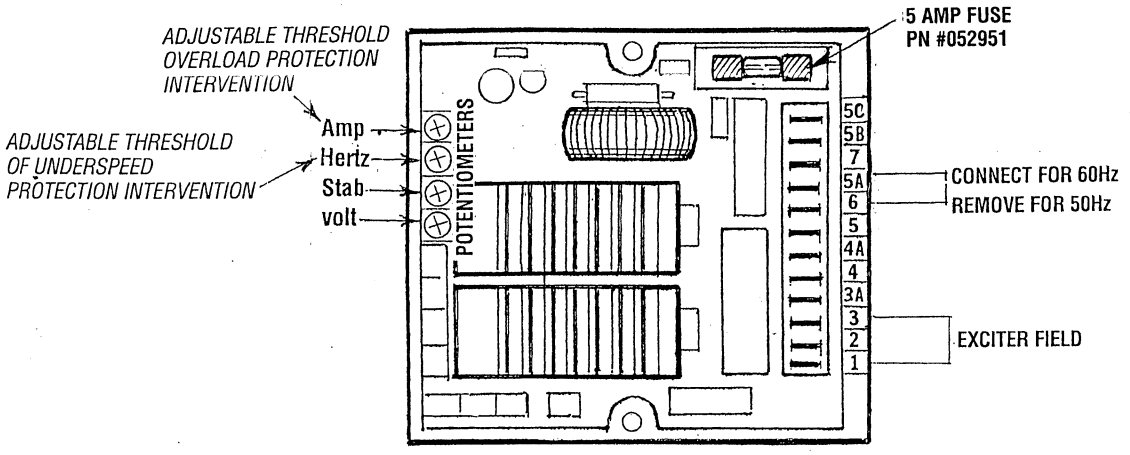
CARBON MONOXIDE DETECTOR

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

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

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

ELECTRONIC REGULATION #052944



DESCRIPTION

The voltage regulator (AVR) ensures optimum AC generator performance. This advanced design AVR is equipped with circuitry protection to guard against operating conditions that could be detrimental to the AC generator. The following information details the voltage regulators adjustments and connections. These procedures should be performed by a qualified technician.

TERMINAL CONNECTIONS

#1. Excitation field DC negative.

#2. Not used.

#3. Exciter field DC positive.

#3A. Supply voltage to regulator (AC).

#4. Sensing voltage.

#5. Supply voltage to regulator (AC).

#6. Jumper to **5A** for 60 Hz operation.

#7. Not used.

#5B. Not used.

#5C. Sensing voltage.

POSSIBLE CONNECTIONS

Exciter Field: The exciter field negative should be connected to terminal **1** of the electronic regulator (normally dark blue or black), while the positive (normally red or yellow) should be connected to terminal **3**.

Supply:
The supply (AUX winding) and sensing voltage are a separate connection to this generator's voltage regulator. Supply voltage (AC) is connected to terminals **3A** and **5**.

Sensing: Sensing should be connected to terminals **4** and **5** and can vary from 80 to 350 VAC. The sensing is single phase only and therefore is normally connected to one alternator phase.

Operation at 60 Hz: When operating at 60 Hz, terminals **5A** and **6** should be connected to each other in order to keep the low frequency protection correctly regulated.

> ⚠ **WARNING:** ***Be aware that high voltages may be present. Take all necessary precautionms to safe guard against electrical hazards.***

FUNCTIONS OF THE REGULATOR POTENTIOMETERS

Volt: With this potentiometer, it is possible to adjust the voltage generated by the alternator in a very simple way. If the screw is turned clockwise, the voltage increases, if the screw is turned counterclockwise it decreases.

Stab: This potentiometer optimizes alternator performance. If turned clockwise, the stability decreases and the response time decreases but the voltage tends to be less stable. If turned counterclockwise, the response time increases and the voltage tends to be more stable.

In order to adjust this potentiometer correctly, we advise using the following method.

1. The generator must be working, starting from zero load and the potentiometer must be at maximum stability (turned fully counterclockwise).
2. Slightly turn clockwise until the light generated by the filament lamp oscillates, at this point, turn the potentiometer slowly counterclockwise until the light stabilizes.

ELECTRONIC REGULATION #052944

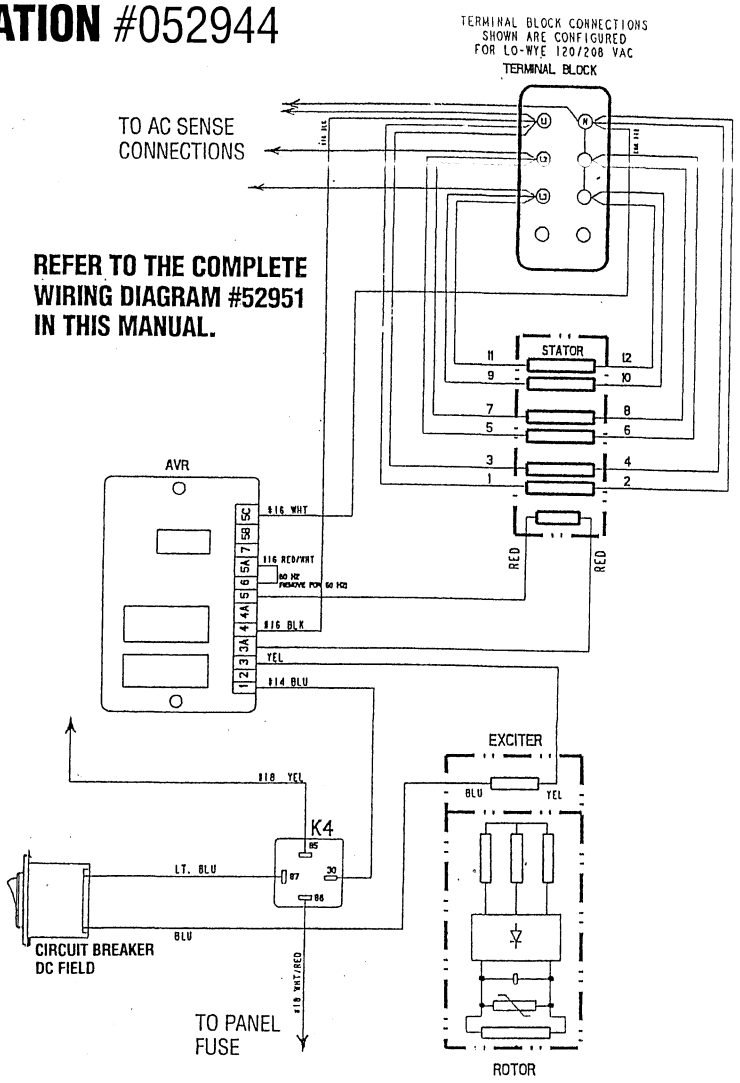
Hertz: With this potentiometer, which is normally pre-calibrated then sealed by the manufacturer, it is possible to adjust the low frequency protection intervention. To recalibrate this protection, you must take the generator to a normal zero load condition, turn the potentiometer clockwise until the limit position is reached, then decrease the nominal speed by 10 %. Then turn the potentiometer counterclockwise and measure the voltage value until it has decreased by 5 volts.

When the speed decreases by more than 10% of the nominal value, the voltage also decreases proportionally, blocking generator overheating. Even if we advise calibrating this protection at 10% of the nominal value, it is obviously possible to calibrate the threshold at other values.

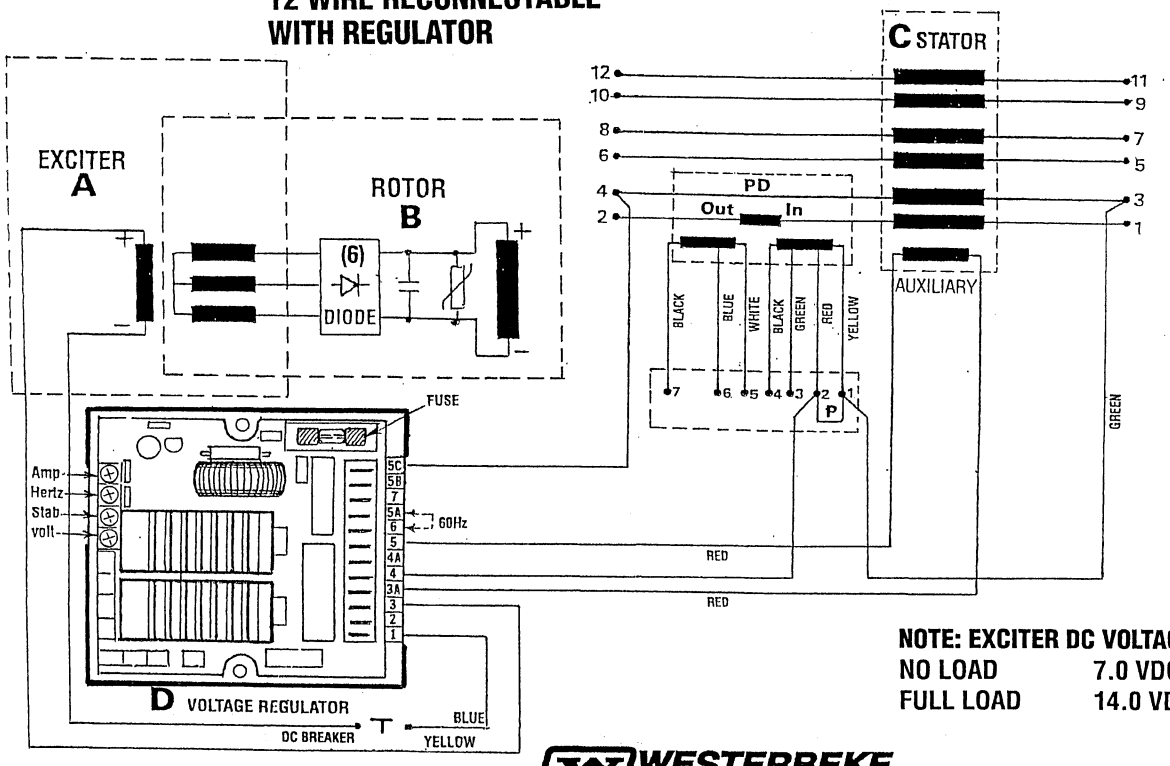
Amp: With this potentiometer, it is possible to adjust the intervention level of the overload protection. This protection system has an intervention delay, which permits a temporary overload, necessary when starting motors or similar applications.

To modify this protection, you must overload the generator by 15% of the normal load, turn the potentiometer to minimum (counterclockwise) and wait about twenty seconds. During this period of time the voltage value decreases. In this condition and while turning the potentiometer clockwise, fix the generator voltage value at 10% less than the nominal one. At this point, while the initial overload is being removed, the voltage increases to the nominal value.

Fuse: The electronic regulator is equipped with a fuse, which protects the alternator from overheating in cases of regulator malfunction. The fuse (250V-5A, quick acting, F type) can be replaced easily.



INTERNAL WIRING DIAGRAM 12 WIRE RECONNECTABLE WITH REGULATOR



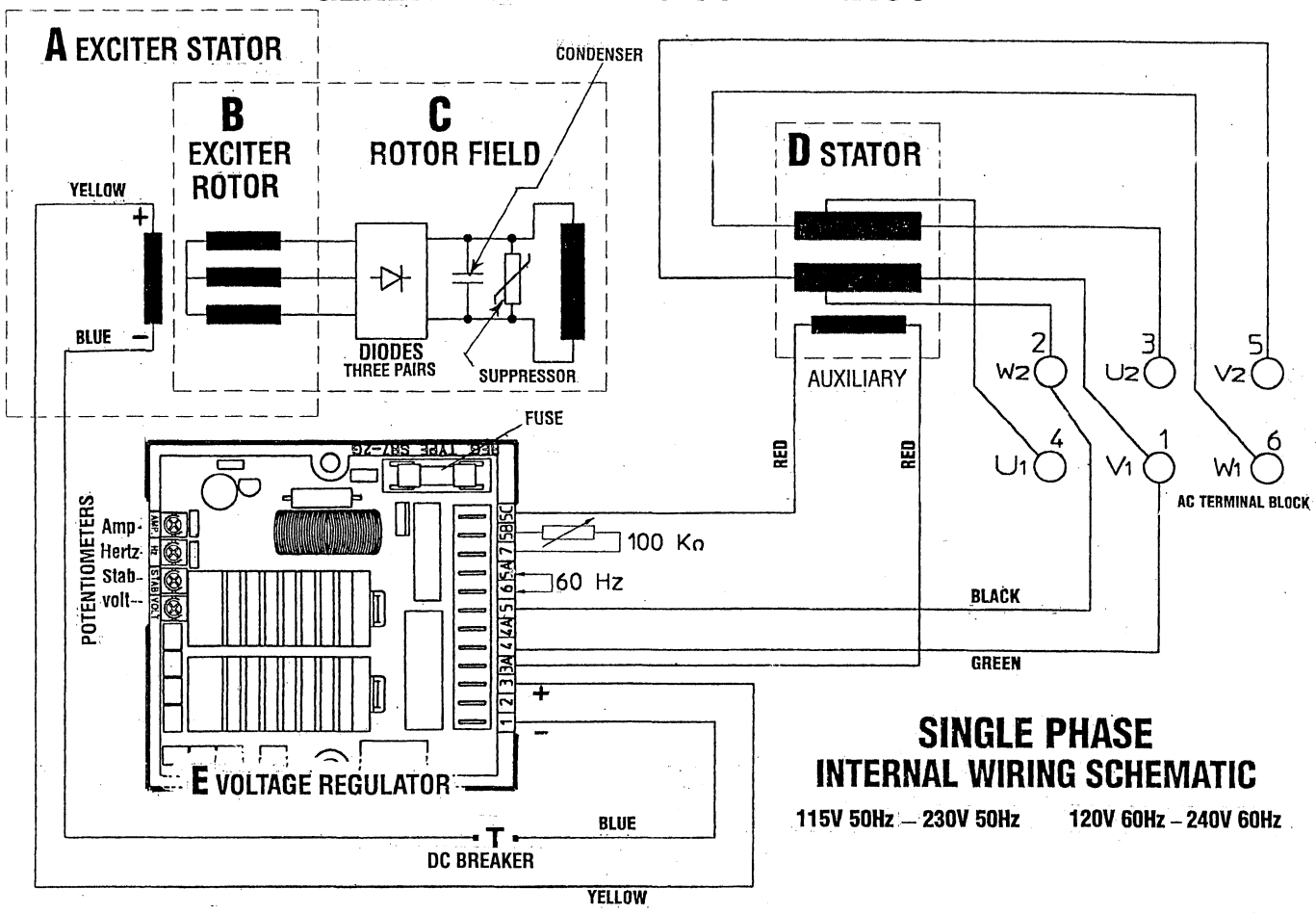
COMPONENT RESISTANCE VALUES IN OHMS (AT 86°F)

STATOR (each winding)	0.041
AUXILIARY	0.9
EXCITER STATOR	11.3
EXCITER ROTOR (each pair)	0.72
ROTOR	2.7

NOTE: EXCITER DC VOLTAGE / AUXILIARY VOLTAGE

NO LOAD	7.0 VDC	215 VAC
FULL LOAD	14.0 VDC	222 VAC

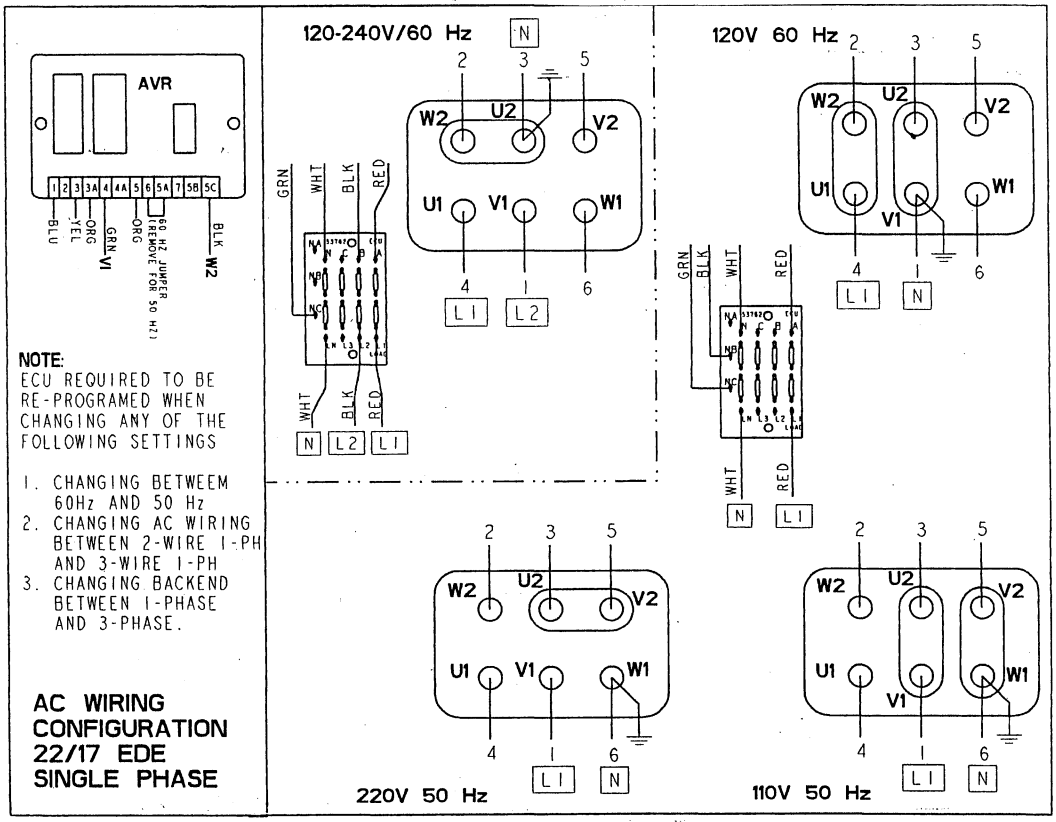
GENERATOR WIRING SCHEMATICS



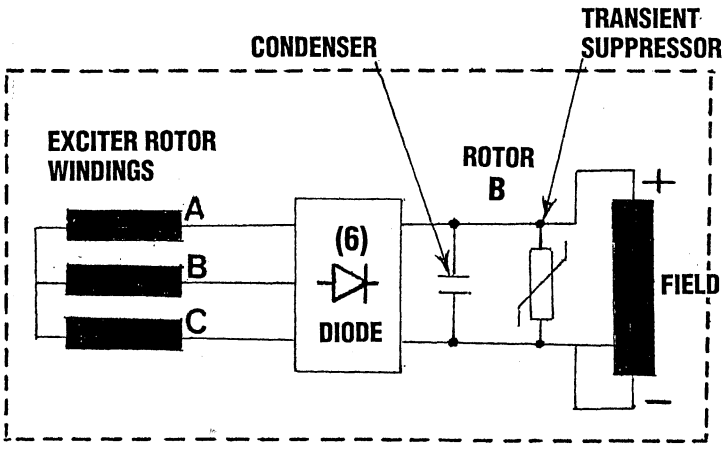
SINGLE PHASE
INTERNAL WIRING SCHEMATIC

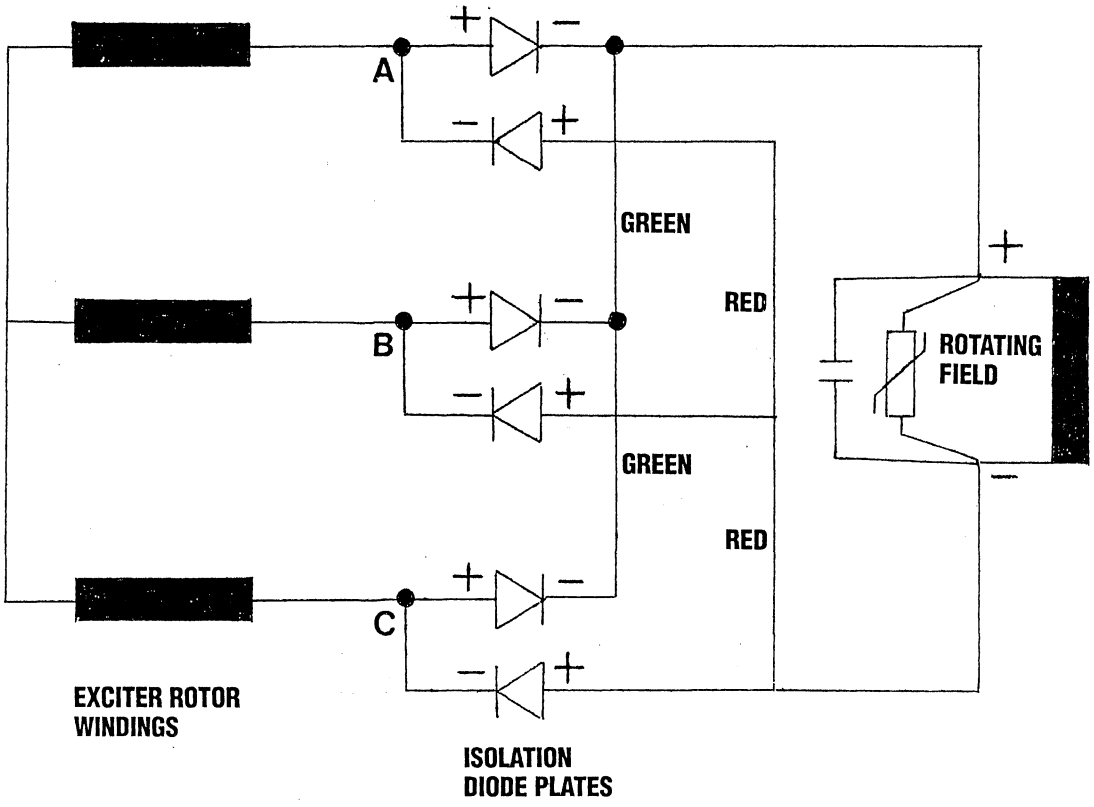
115V 50Hz – 230V 50Hz **120V 60Hz – 240V 60Hz**

AC OUTPUT CONFIGURATIONS VOLTAGE SENSING BOARD CONNECTIONS



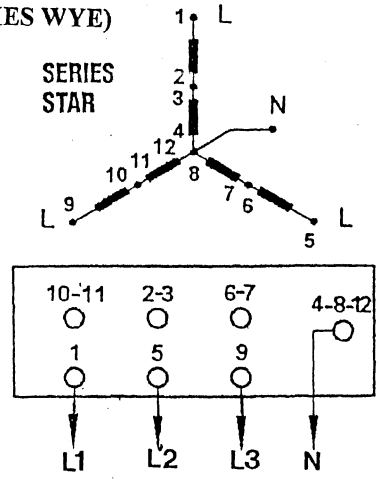
INTERNAL WIRING SCHEMATIC
EXCITER ROTOR/ROTATING FIELD





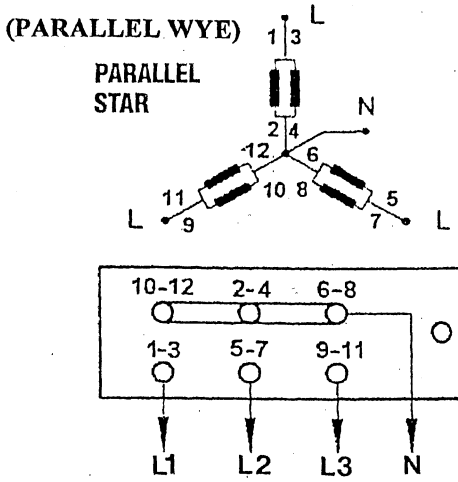
TWELVE LEAD WINDING/TERMINAL BOARD CONNECTIONS
AND (NOMINAL) VOLTAGES

(SERIES WYE)

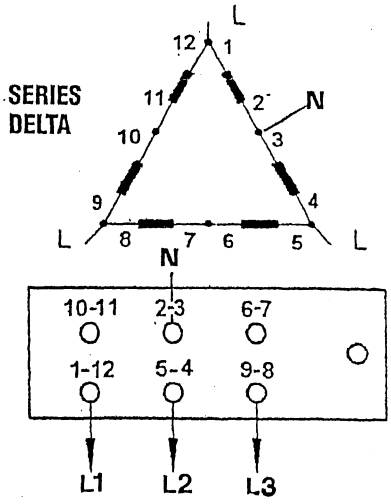


50 Hz L-L 400 volts
50 Hz L-N 230 volts
60 Hz L-L 480 volts
60 Hz L-N 277 volts

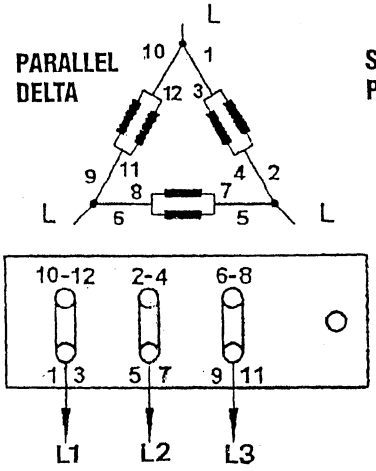
(PARALLEL WYE)



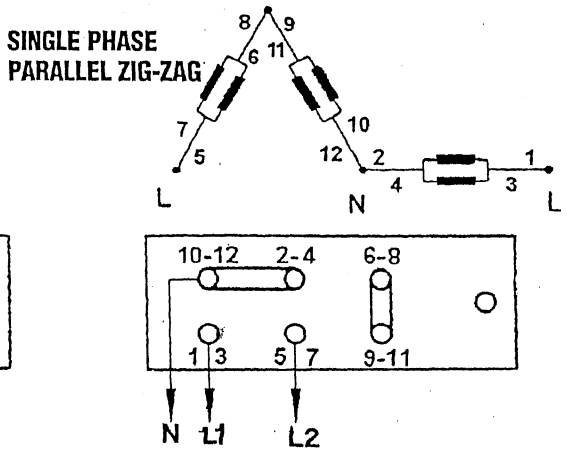
50 Hz L-L 200 volts
50 Hz L-N 115 volts
60 Hz L-L 240 volts
60 Hz L-N 138 volts



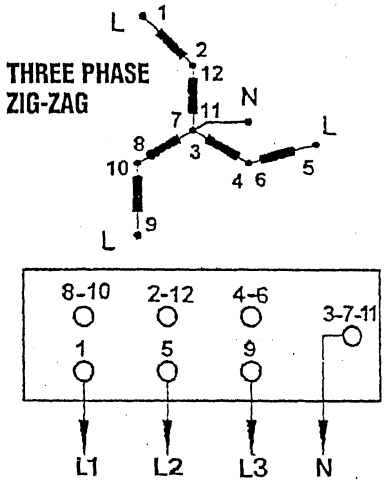
50 Hz L-L 230 volts
50 Hz L-N 115 volts
60 Hz L-L 277 volts
60 Hz L-N 138 volts
(Refer to Note #1)



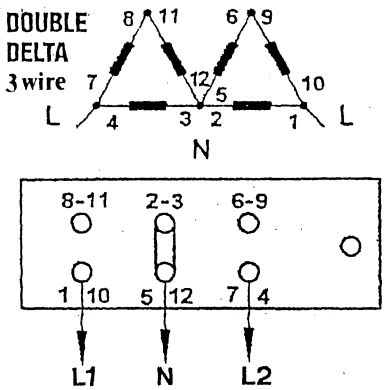
50 Hz L-L 115 volts
60 Hz L-L 138 volts



50 Hz L-L 230 volts
50 Hz L-N 115 volts
60 Hz L-L 277 volts
60 Hz L-N 138 volts
(Refer to Note #1)



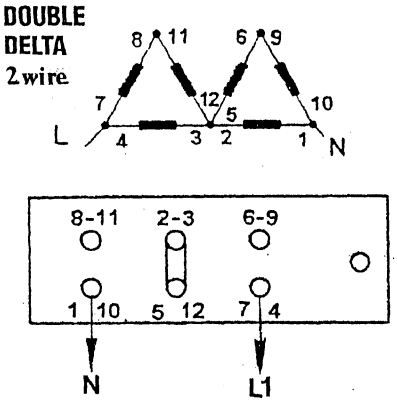
50 Hz L-L 346 volts
50 Hz L-N 200 volts
60 Hz L-L 415 volts
60 Hz L-N 240 volts
(Refer to Note #2)



50 Hz L-L 230 volts
50 Hz L-N 115 volts
60 Hz L-L 240 volts
60 Hz L-N 120 volts

Note #1 *Single phase amperage load. The phase current must not exceed the nominal value.*

Note #2 *Three phase zig-zag connection. The rated power must be multiplied by 0.866.*



50 Hz L-N 230 volts
60 Hz L-N 240 volts

CHANGING VOLTAGE OUTPUT AND CHANGING HERTZ

> **⚠ CAUTION:** ***As a precaution against an unintentional start, shut off the 20 Amp DC breaker on the control panel.***

1. Refer to the previous page that illustrate the various AC voltage output configurations for both 60 & 50 hertz applications. Select the configuration for the hertz/voltage required.

2. Reconfigure the AC connections on the terminal block carefully following the illustration. Reference the voltage sensing board illustration and its connections to the AC terminal block. There are three line connections when needed and a neutral. These connections **MUST** correspond to and be connected to the line (L) connection(s) and neutral on the AC terminal block.

3. When an L2 or L# is not present on the AC terminal block, insulate and tie off the unused sensing connections.

4. Inside the control box, locate the ECU and verify that the position of the #1 dipswitch is in the correct position for the hertz/frequency the generator will now be operating at.

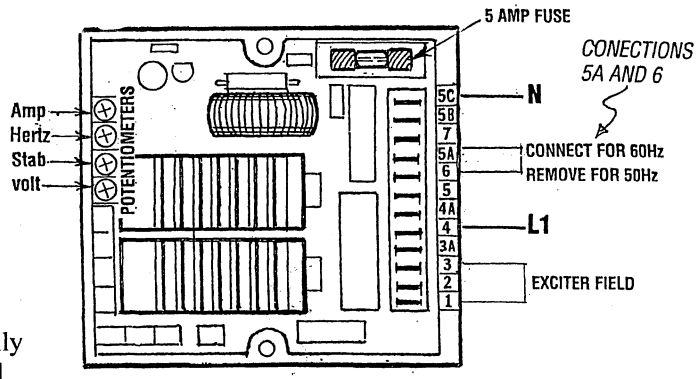
5. Connect or remove the jumper on the voltage regulator board between connections 5A and 6 for the hertz operation selected. Reference the illustration on this page.

6. Using the EC20 Monitoring Software for D-Net models. (available from the Westerbeke Distributor). Connect your laptop with the software installed to the communication pins on the ECU using the #055351 communications cable connected between your laptop and the ECU. (Note: The arrow on the plug connection for the ECU must face the harness plug connection of the ECU).

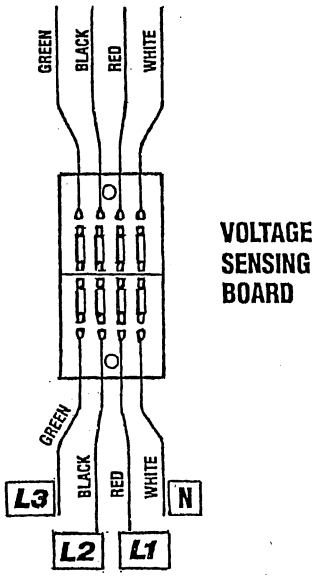
7. Turn ON the 20 amp panel DC breaker and then turn ON your laptop. Reconfigure the ECU using the software to the AC voltage(s) out put that the generator has been reconfigured to.

8. Verify all connections are correct and turn OFF the AC breaker on the control panel. Start the generator and monitor AC output voltage and hertz. Adjust AC voltage as needed using the volt pod on the AVR.

9. Turn ON the AC breaker and load test the generator monitoring operation. You can monitor the operation using the software in your laptop. When satisfied with generator operation. Stop the generator. Turn OFF the panel DC breaker, turn OFF your laptop and unplug it from the ECU. Then turn the control panel DC breaker back ON.



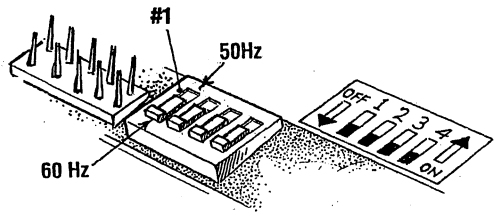
AUTOMATIC VOLTAGE REGULATOR
PN. 052944



VOLTAGE SENSING BOARD

DIPSWITCHES

*DIPSWITCH #**1** IS USED TO CHANGE THE FREQUENCY. **ON** IS FOR 50hz, **OFF** IS FOR 60hz. THE REMAINING SWITCHES #2, #3, an #4 SERVE NO FUNCTION.*



BE TROUBLESHOOTING

NOTE: AC generator troubleshooting must be performed with the generator operating at the correct hertz.

FAULT	PROBABLE CAUSE	
NO AC VOLTAGE OUTPUT AT NO LOAD.	**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.** Open in exciter stator winding. **5.** Open in rotating field winding.
RESIDUAL VOLTAGE PRODUCED AT NO LOAD 15 - 20 VOLTS AC.	**1.** Blown 5 AMP fuse auxiliary circuit feed to AVR. **2.** Faulty voltage regulator	**3.** Shorted or open main stator auxiliary winding.
LOW AC VOLTAGE OUTPUT AT NO LOAD 60 - 100 VAC.	**1.** Reset voltage potentiometer. **2.** Open or shorted diodes in. exciter rotor 1 to 3 diodes. **3.** Open or short in one of the three exciter rotor windings.	**4.** Faulty voltage regulator. **5.** Short in rotating field winding. **6.** Short in the exciter stator..
HIGH AC OUTPUT VOLTAGE 150 VAC OR HIGHER.	**1.** Reset voltage potentiometer. **2.** Faulty voltage regulator.	
UNSTABLE VOLTAGE OUTPUT. (ENGINE SPEED STEADY)	**1.** STB pod on regulator needs adjustment.	**2.** Faulty voltage regulator.
AC VOLTAGE DROP UNDER LOAD 60 - 100 VOLTS AC.	**1.** Diode(s) on exciter rotor breaking down when load is applied (inductive) 1-3 diodes.	

NOTE: *REFER TO THE SERVICE MANUAL FOR A COMPLETE GUIDE TO TROUBLESHOOTING, ADJUSTMENTS, AND DISASSEMBLY OF THE AC GENERATOR.*

EXCITER ROTOR TROUBLESHOOTING

LOW VOLTAGE - EXCITER ROTOR AND ROTATING FIELD

Position the exciter rotor/rotating field so the transient suppressor is visible at the 12 O'Clock position.

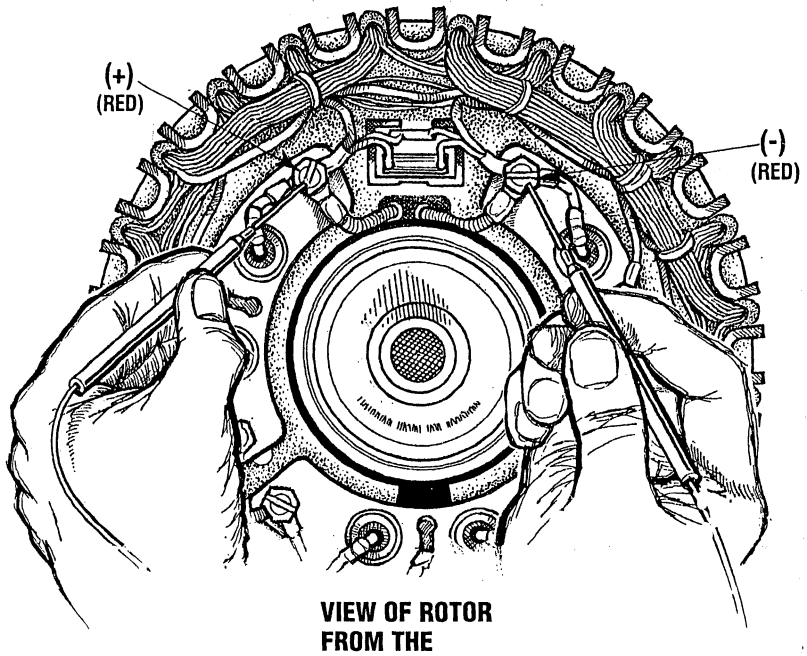
TESTING THE ROTATING FIELD WINDINGS

Place the ohm meter probes on the two large red wires (+) and (-). These are the connecting wires for the rotating field windings.

These wires do not need to be lifted off their connections unless, when testing, there is an ohm valve discrepancy or a continuity to ground (the rotor shaft).

If this occurs, lift these two flarge field wires off the diode plates, isolate them, and repeat the above test.

NOTE: *When removing these wires, be careful not to drop the screws or washers into the rotor.*

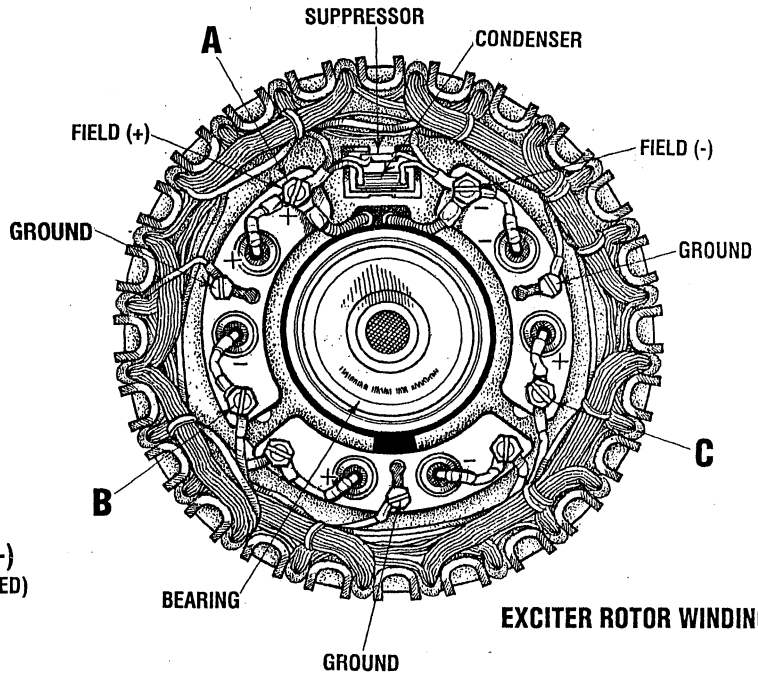


VIEW OF ROTOR FROM THE BEARING END

12 O-CLOCK POSITION

TESTING THE EXCITER ROTOR WINDINGS

These windings are tested in pairs: **A** to **B**, **B** to **C**, and **C** to **A** as shown on the drawing.



EXCITER ROTOR WINDINGS

Disconnect these three wires from the diode bridge plates taking care not to drop any screws or washers.

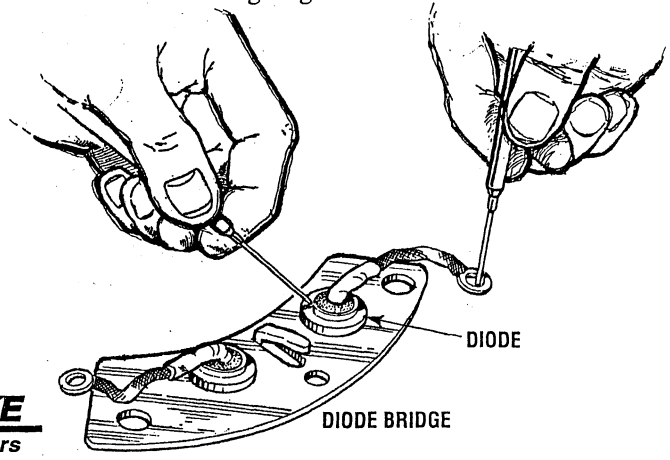
With the wires clear from the bridge plates, test each pair with an ohm meter, **A** to **B**, **B** to **C**, and **C** to **A.**

No continuity should be found between the rotor and any of these three winding pairs.

TESTING THE DIODES

Diodes can be checked with an ohmmeter. Disconnect the wire of the particular diode and test its resistance in both directions. A perfectly functioning diode will show a very high resistance in one direction and a very low resistance in the opposite direction. A faulty diode will show either a very low resistance, or an infinite resistance in both directions.

Should the whole bridge be replaced, remember to tighten the screws with a suitable wrench and strictly comply with the polarities and internal wiring diagrams in this manual.



GENERATOR SERVICING

TESTING THE MAGNETIC PICK UP COIL

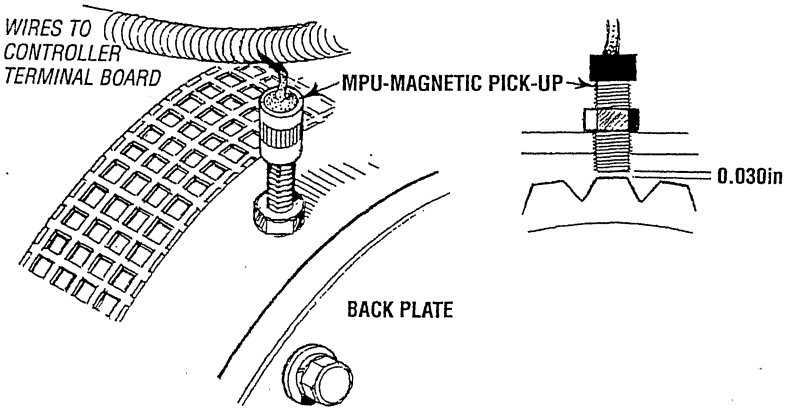
Test the speed sensor connector for voltage and resistance values.

If the values are correct, remove and inspect the magnetic pick up. With the wires disconnected, unscrew the magnetic pick up from the generator housing and visually inspect the contact end. If any damage is detected, replace the unit.

NOTE: *Carefully follow the installation instructions provided with the new magnetic pick up coil.*

SPEED SENSOR TEST VALUES
VOLTAGE (while cranking)
1.5 - 2.5 VAC

RESISTANCE (at rest) **950 - 1000 ohm**



MAGNETIC PICK-UP [MPU] INSTALLATION

The MPU is installed in the threaded opening on the side of the flywheel bellhousing. This positions the MPU over the teeth of the flywheel ring gear.
Viewing through this opening, manually rotate the engine crankshaft so as to position the flat of one of the ring gear's teeth directly under the opening. Thread the MPU into the opening until it gently contacts the flat of this tooth (Thread is 3/8" x 24). Back the MPU out of the opening one turn and then lock it in this position with the jam nut. This will position the end of the MPU approximately 0.030 inches away from the flats of the ring gear teeth.

To ensure the MPU is positioned correctly, slowly rotate the crankshaft by 360° by hand to assure there is no physical contact between the MPU and the ring gear teeth.

If contact is felt between the MPU and the flywheel teeth, the MPU may be damaged. Remove the MPU and inspect it. Replace if necessary and repeat the above installation procedure.

NOTE: *When replacing the Magnetic Pick-Up (MPU) it **MUST** be replaced without cutting and splicing into the existing wiring cable. Doing so will cause a erratic AC signal to the controller.*

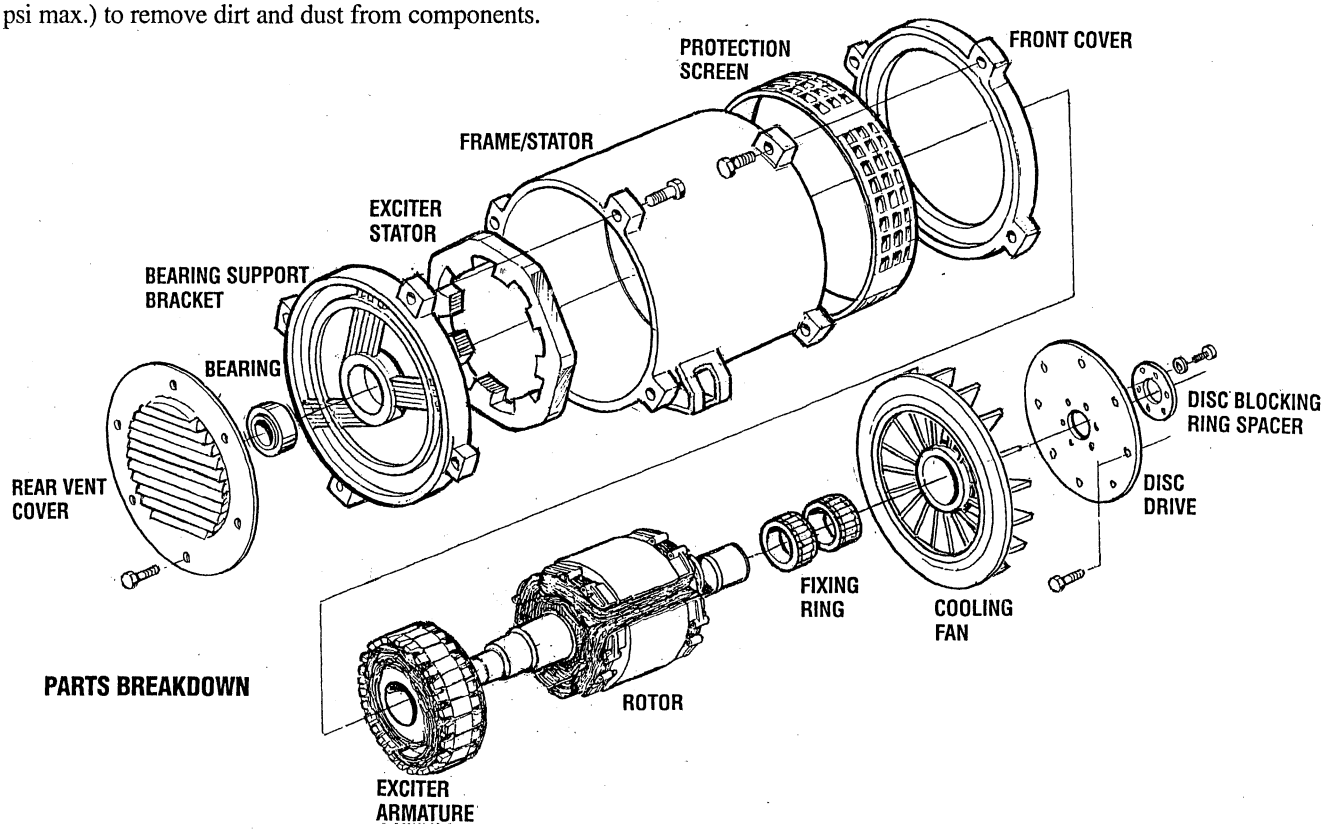
BE GENERATOR
MAINTENANCE/PARTS BREAKDOWN

INSPECTION/CLEANING

Periodically inspect the rotor carrier bearing. Replace this bearing at 10,000 hours of normal operation or sooner if wear is evident.

Inspect and clean the control box interior, look for loose, broken, or burned wires and terminals. Use low air pressure (25 psi max.) to remove dirt and dust from components.

Remove all dirt, oil, grease and dust build up from the external surface of the generator. Build-up reduces heat dissipation and causes the AC generator end to operate at a higher temperature. This results in a loss of efficiency and reduces service life.

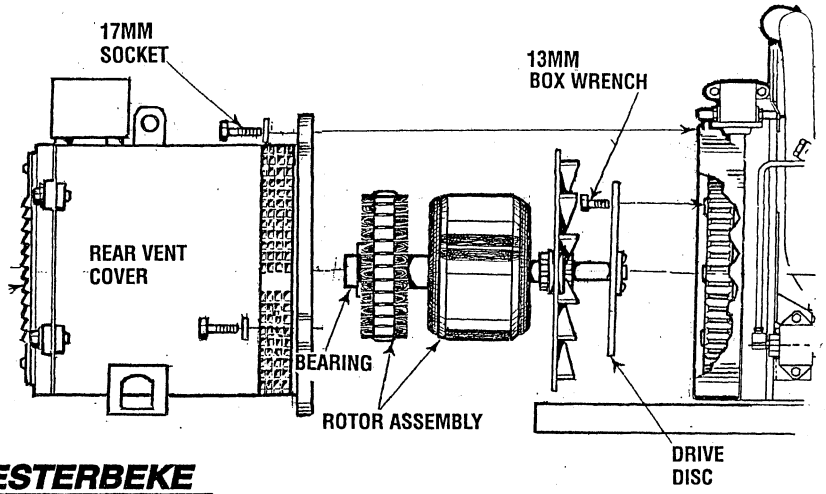


PARTS BREAKDOWN

DISASSEMBLY

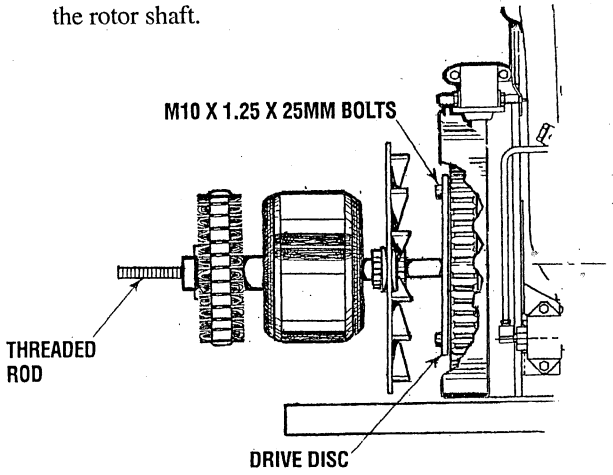
Should it become necessary to disassemble the stator/rotor assembly from the engine, use the following as a guide.

1. Properly support/lift the rear of the engine to allow the generator to be unbolted from the rear support isolators.
2. Mark, then disconnect the electrical leds that exit the generator from their connections in the control box. Be sure to properly mark the connection points the generator leds connect to. Make an illustration if needed whether the generator is to be reinstalled or a replacement is to be installed. This is to ensure proper reconnection of electrical leds. Unbolt the control box and lift it off the generator.
3. Remove the rear vent cover. Support the generator with a sling or fabricated lifting eye. Using a 17mm socket wrench remove the four bolts that attach the generator stator housing assembly to the flywheel housing. carefully work the stator assembly off the rear bearing and off and over the rotor assembly.
4. Support the rotor assembly with a sling and using a 17mm box wrench, unbolt the rotor assembly from the flywheel.

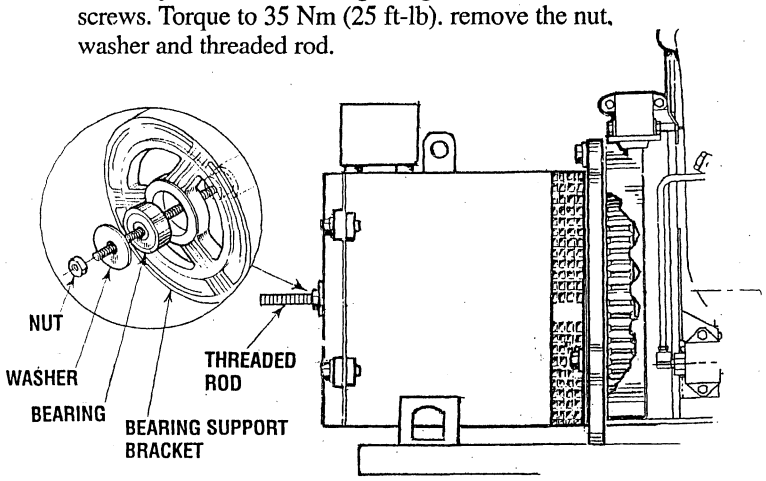


ASSEMBLY OF THE GENERATOR TO THE ENGINE

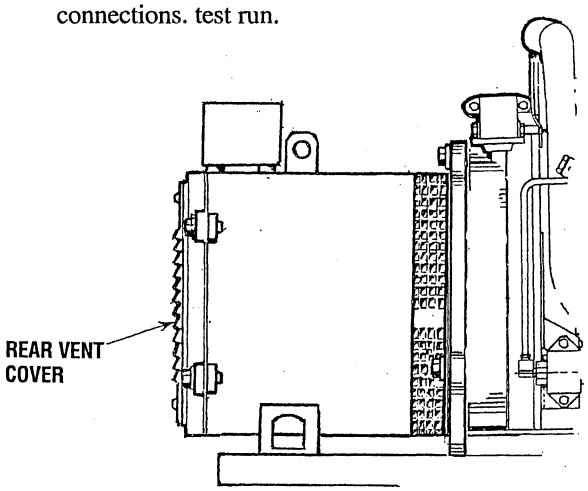
1. Position the rotor assembly onto the flywheel aligning the holes in the drive discs with the holes in the flywheel. Install the M8 x 1,25 x 25mm bolts (blue loctite on threads) and torque to 21 Nm (16 ft-lb). Install a threaded rod M12 x 1.75 x 90mm long into the threaded end of the rotor shaft.



2. With the aid of a sling or fabricated lifting eye, support the stator housing assembly and carefully guide it over the rotor assembly until the rear bearing contacts the bearing boss in the rear support.
3. Place a large washer of at least 80mm in diameter with a center hole of 15mm onto the threaded rod followed by a 12mm x 1.75 nut. Center the rear bearing in the bearing boss of the support plate. Tighten the nut until the bearing seats fully into the boss. Secure the stator housing assembly to the bell housing using the four M10 x 35mm screws. Torque to 35 Nm (25 ft-lb). remove the nut, washer and threaded rod.



4. Rotate the generator by hand two full revolutions to ensure the generator rotates freely. Reinstall the rear vent cover.
5. Secure the generator to its rear isolators. Route the generator wiring into the control box and mount the control box to the generator. Reconnect all wire connections. test run.



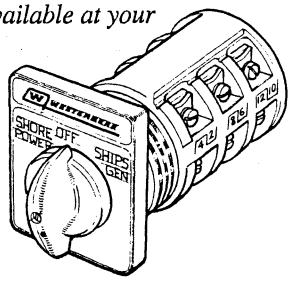
SHORE POWER TRANSFER SWITCH CONNECTIONS

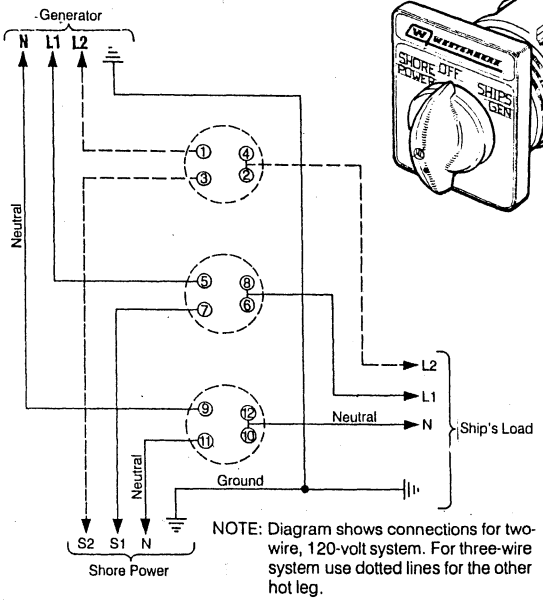
DESCRIPTION

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

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

NOTE: *Ship to shore switches are available at your WESTERBEKE dealer.*



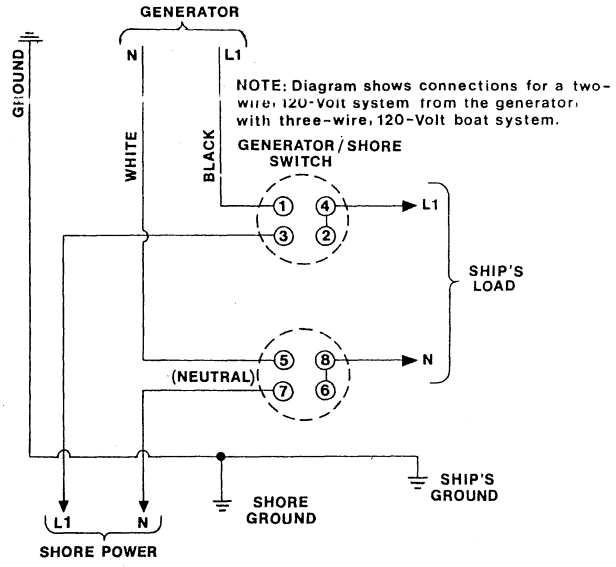


NOTE: Diagram shows connections for two-wire, 120-volt system. For three-wire system use dotted lines for the other hot leg.

120/240-60HZ Hertz Three Wire Configuration

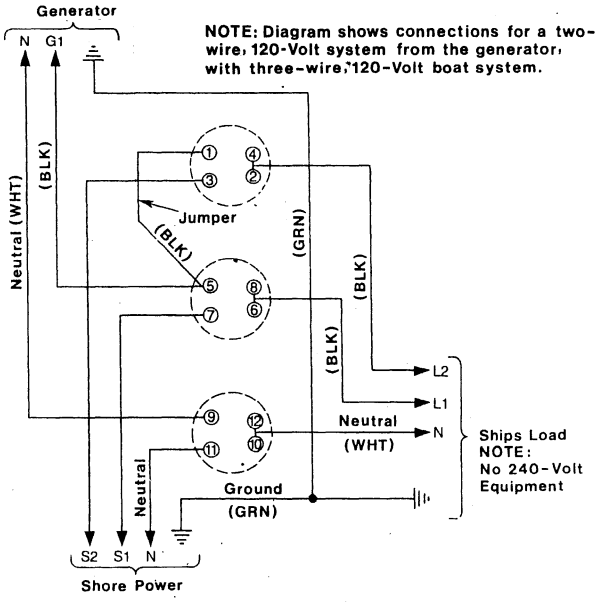
Note the repositioning of the white ground lead on the terminal block to the generator case.

> **⚠ CAUTION:** ***Heavy motor leads should be shut off before switching shore power to generator power or vice-versa because voltage surges induced by switching with heavy AC loads on the vessel being operated may cause damage to the exciter circuit components in the generator.***



120 Volt/60 Hertz Three Wire Configuration

Note the repositioning of the white ground lead on the terminal block to the generator case.



230 Volt/50 Hertz Two Wire Configuration

Notice the repositioning of the white ground lead on the terminal block to the generator case.

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.

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 Oill 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.

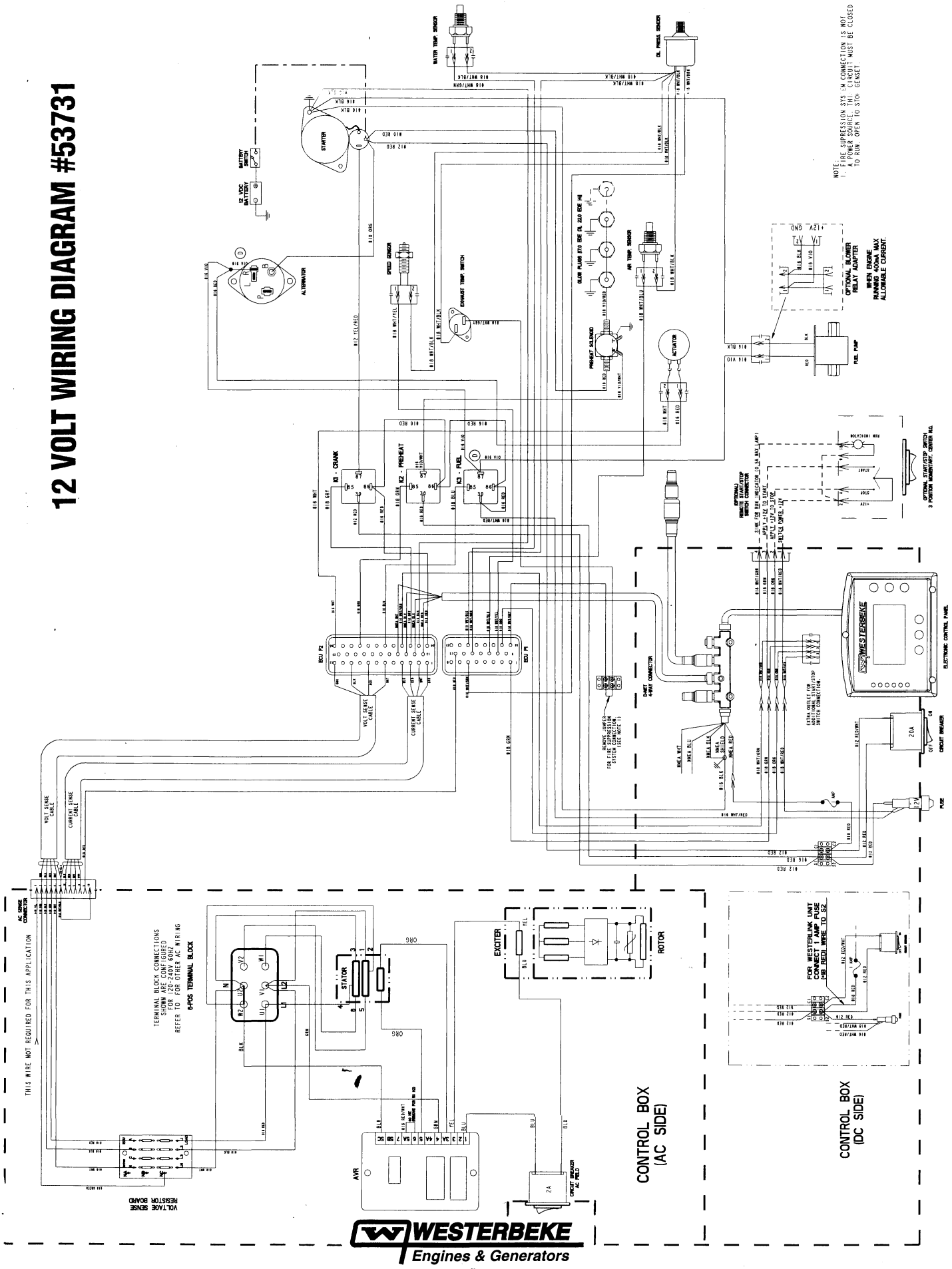
1. Remove the oil-soaked cloths from the intake manifold.
2. Remove the raw water pump cover and gasket and discard the old gasket. Install the raw water pump impeller removed during lay-up (or a replacement, if required). Install the raw water pump cover with a new cover gasket.
3. Reinstall the batteries 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.

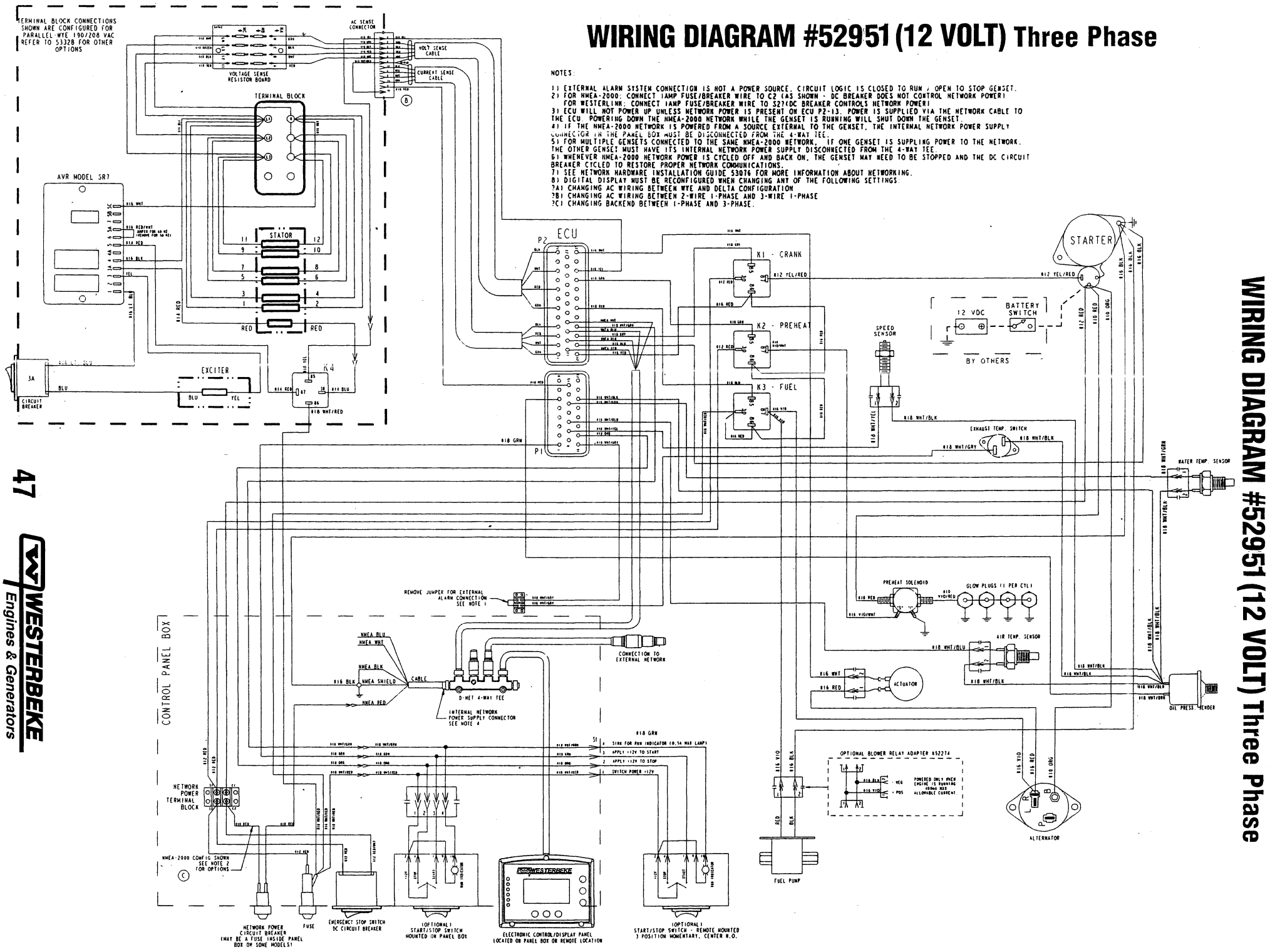
12 VOLT WIRING DIAGRAM #53731

12 VOLT WIRING DIAGRAM #53731



WESTERBEKE
Engines & Generators

WIRING DIAGRAM #52951 (12 VOLT) Three Phase



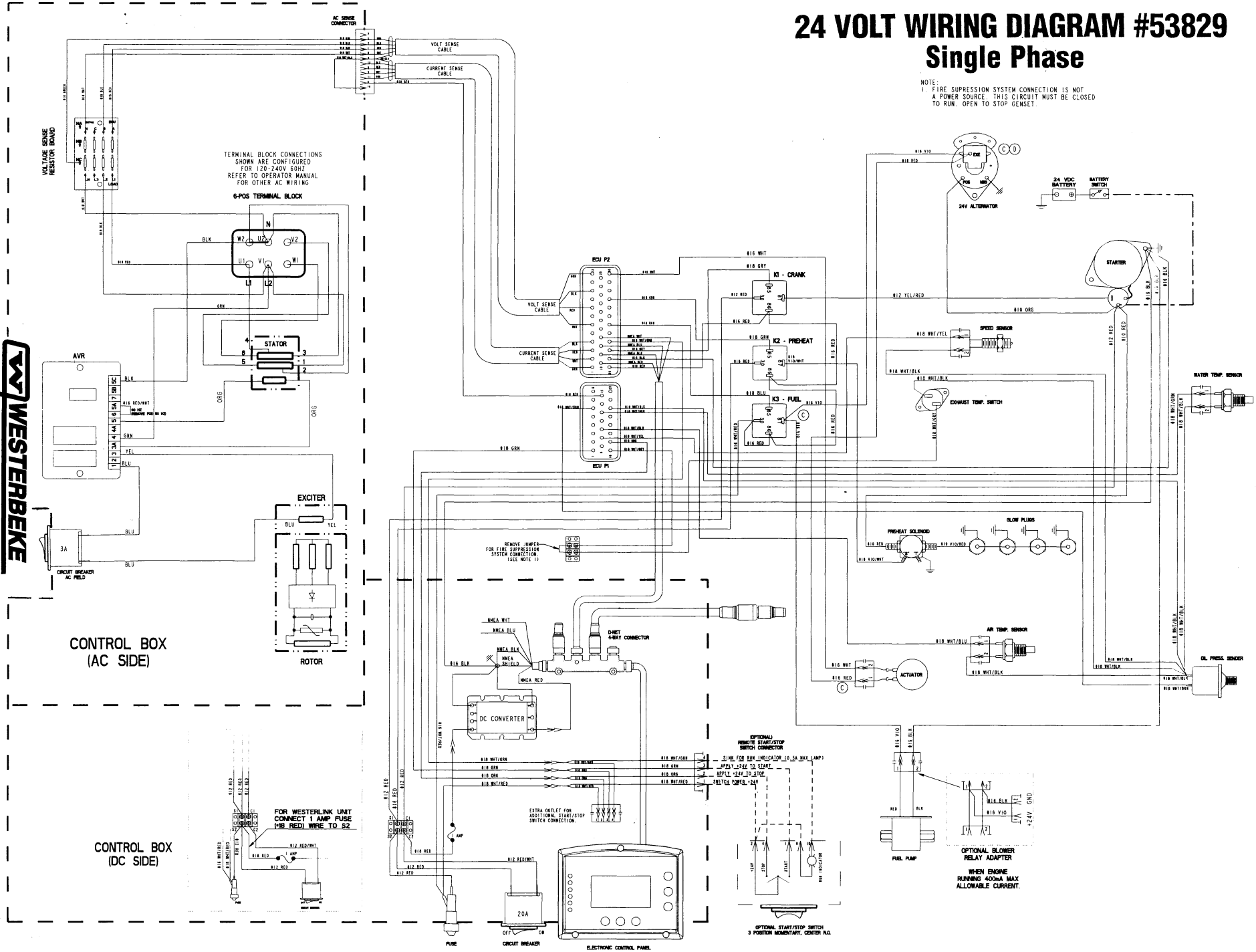
NOTES:

1) EXTERNAL ALARM SYSTEM CONNECTION IS NOT A POWER SOURCE. CIRCUIT LOGIC IS CLOSED TO RUN ; OPEN TO STOP GENSET.
2) FOR NMEA-2000: CONNECT 14AMP FUSE/BREAKER WIRE TO C2 (AS SHOWN - DC BREAKER DOES NOT CONTROL NETWORK POWER)
   FOR WESTERLINK: CONNECT 14AMP FUSE/BREAKER WIRE TO S2?(DC BREAKER CONTROLS NETWORK POWER)
3) ECU WILL NOT POWER UP UNLESS NETWORK POWER IS PRESENT ON ECU P2-13. POWER IS SUPPLIED VIA THE NETWORK CABLE TO THE ECU. POWERING DOWN THE NMEA-2000 NETWORK WHILE THE GENSET IS RUNNING WILL SHUT DOWN THE GENSET.
4) IF THE NMEA-2000 NETWORK IS POWERED FROM A SOURCE EXTERNAL TO THE GENSET, THE INTERNAL NETWORK POWER SUPPLY CONNECTOR (A) THE PANEL BOX MUST BE DISCONNECTED FROM THE 4-WAY TEE.
5) FOR MULTIPLE GENSETS CONNECTED TO THE SAME NMEA-2000 NETWORK, IF ONE GENSET IS SUPPLING POWER TO THE NETWORK, THE OTHER GENSET MUST HAVE ITS INTERNAL NETWORK POWER SUPPLY DISCONNECTED FROM THE 4-WAY TEE.
6) WHENEVER NMEA-2000 NETWORK POWER IS CYCLED OFF AND BACK ON, THE GENSET WAY NEED TO BE STOPPED AND THE DC CIRCUIT BREAKER CYCLED TO RESTORE PROPER NETWORK COMMUNICATIONS.
7) SEE NETWORK HARDWARE INSTALLATION GUIDE 53076 FOR MORE INFORMATION ABOUT NETWORKING.
8) DIGITAL DISPLAY MUST BE RECONFIGURED WHEN CHANGING ANY OF THE FOLLOWING SETTINGS:
?A) CHANGING AC WIRING BETWEEN WYE AND DELTA CONFIGURATION
?B) CHANGING AC WIRING BETWEEN 2-WIRE 1-PHASE AND 3-WIRE 1-PHASE
?C) CHANGING BACKEND BETWEEN 1-PHASE AND 3-PHASE.

WIRING DIAGRAM #52951 (12 VOLT) Three Phase

WESTERBEKE Engines & Generators

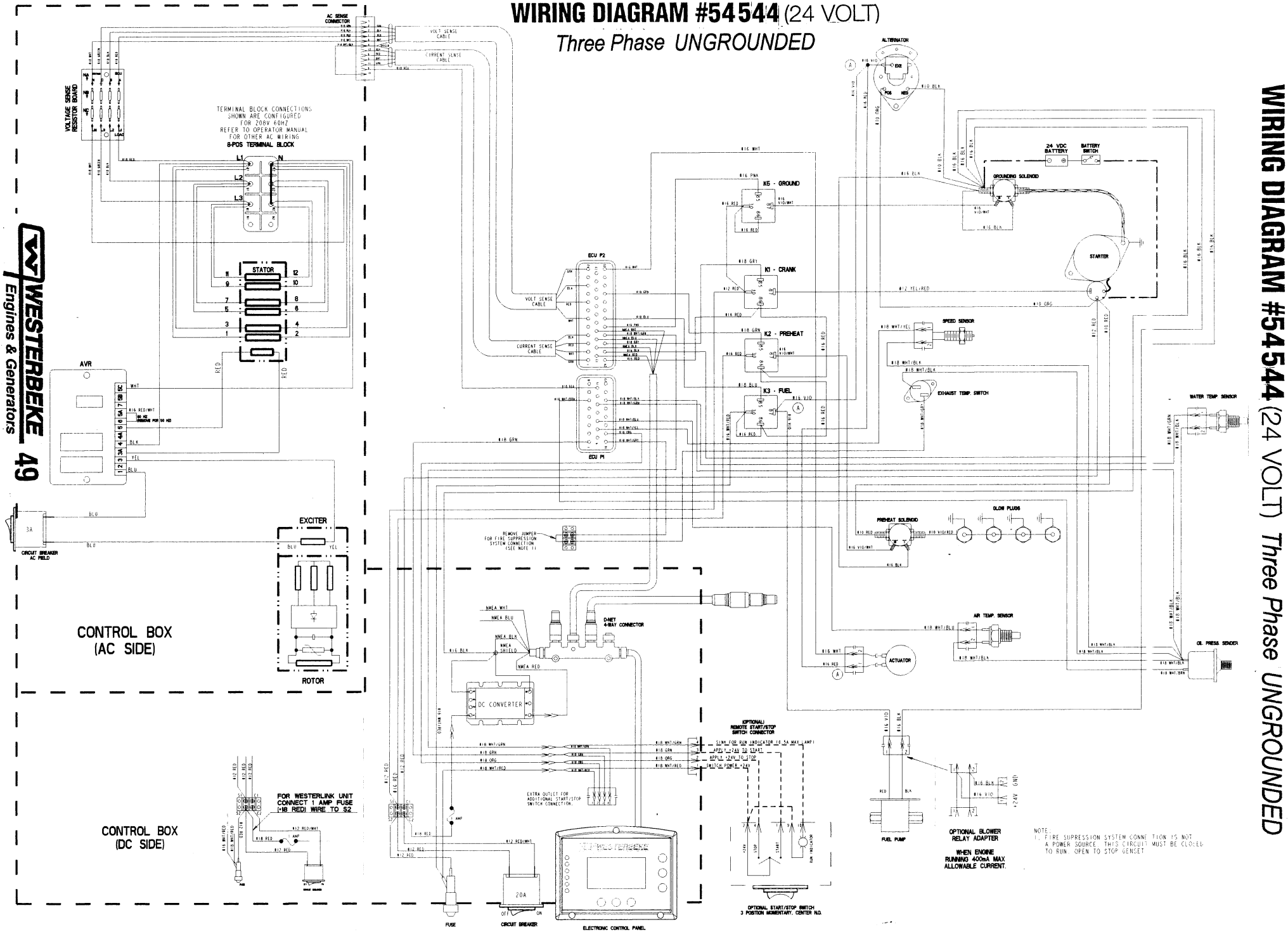
24 VOLT WIRING DIAGRAM #53829
Single Phase



24 VOLT WIRING DIAGRAM #53829 SINGLE PHASE

WIRING DIAGRAM #54544 (24 VOLT)

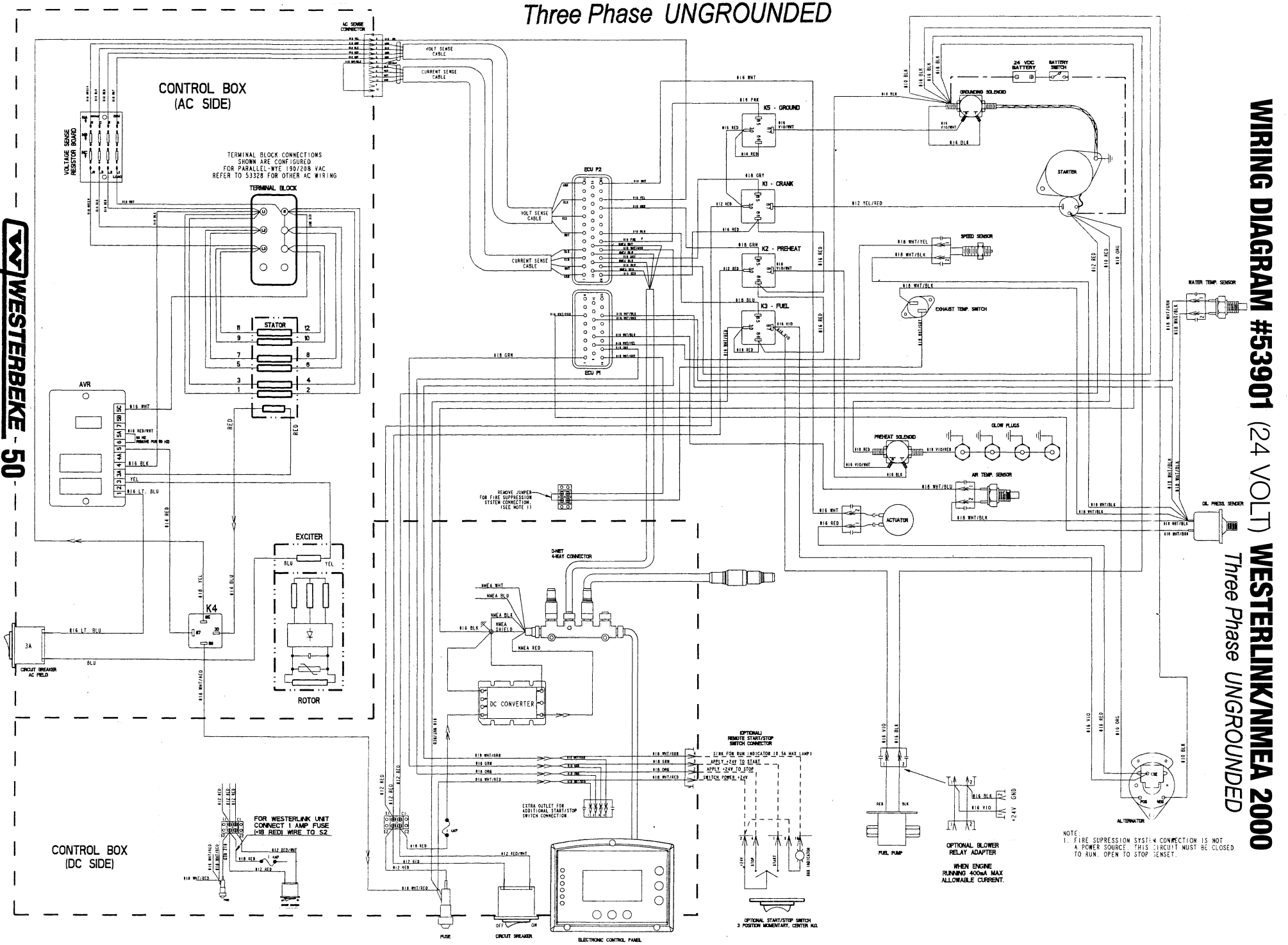
Three Phase UNGROUNDED



WIRING DIAGRAM #54544 (24 VOLT) Three Phase UNGROUNDED

WIRING DIAGRAM #53901 (24 VOLT) WESTERLINK/NMEA 2000

Three Phase UNGROUNDED



WESTERBEKE 50

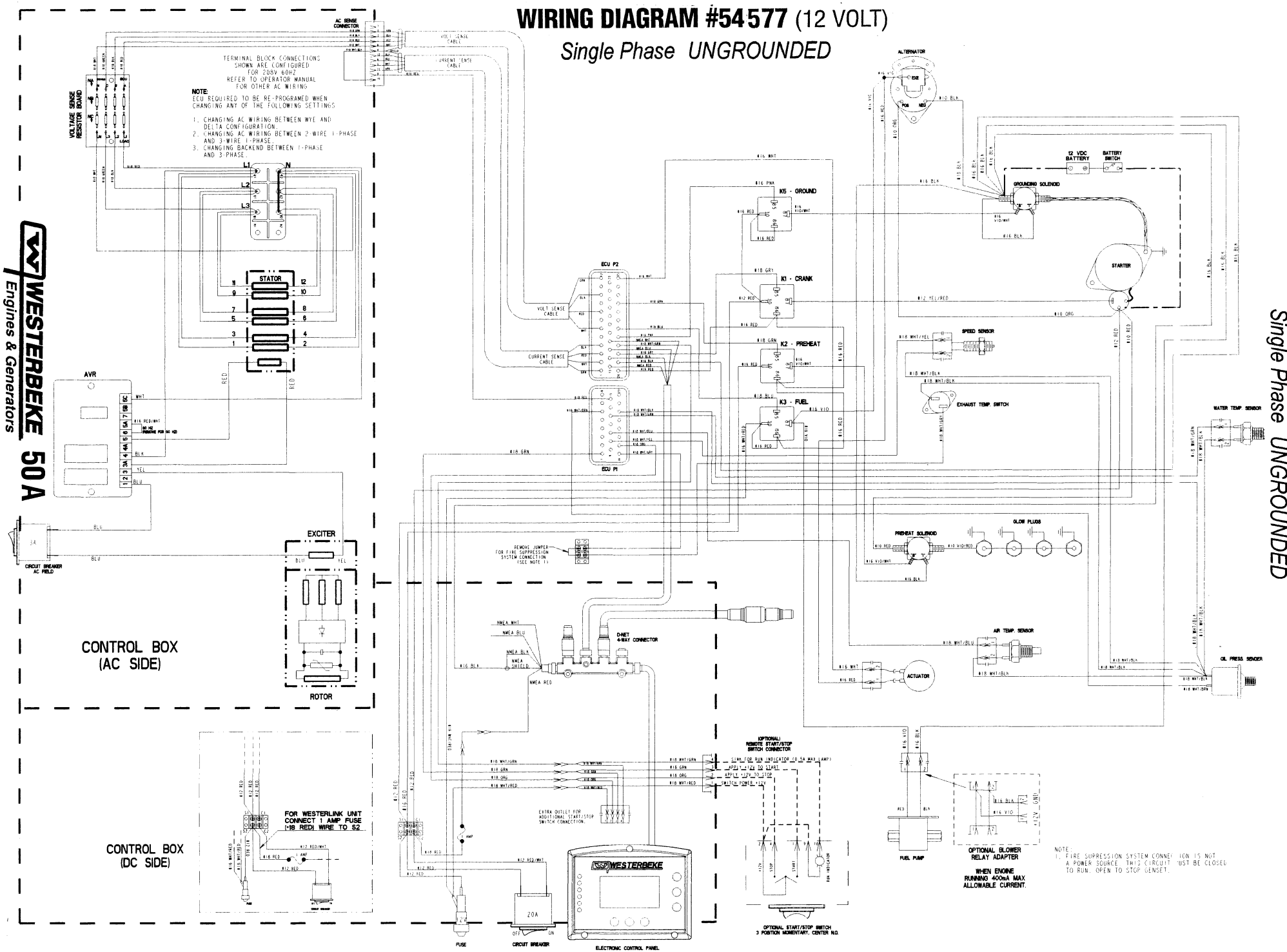
Engines & Generators

WIRING DIAGRAM #53901 (24 VOLT) WESTERLINK/NMEA 2000

Three Phase UNGROUNDED

WIRING DIAGRAM #54577 (12 VOLT)

Single Phase UNGROUNDED



WIRING DIAGRAM #54577 (12 VOLT)

Single Phase UNGROUNDED

SPECIFICATIONS 22.0/17.0 EDE

ENGINE SPECIFICATIONS

Engine Type	Diesel, four-cycle, four-cylinder, fresh water-cooled, vertical in-line overhead valve mechanism.
HP @ 1800/1500 rpm	37.0/30.2
Aspiration	Naturally aspirated
Compression Ratio	22.6:1
Governor	Electronic
Combustion Chamber	Swirl type
Bore & Stroke	87 x 92.4 mms (3.43 x 3.64 inches)
Piston Displacement	2.19 liters (134.1 cubic inches)
Firing Order	1 - 3 - 4 - 2
Inclination	Continuous 20° Temporary 30° (not to exceed 10 min.)
Weight (dry)	829 lbs (376.0 kgs)

TUNE-UP SPECIFICATIONS

Compression Pressure (allowable limit)	626 psi (44 kgf/cm²) at 250 rpm 472 psi (30.5 kgf/cm²) at 250 rpm
Variation between cylinders	10% or less
Injection Timing	18° BTDC
Engine Speed	1800 rpm 60 Hertz 1500 rpm 50 Hertz
Valve Clearance (engine cold)	0.18 to 0.22 mm (0.0071 to 0.0087 inches)
Injector Pressure	1991 to 2134 psi (140 to 150 kgf/cm²)
Valve Timing	Intake Opens 14° BTDC Intake Closes 36° ABDC Exhaust Opens 45° BBDC Exhaust Closes 17° ATDC

ELECTRICAL SYSTEM

Starting Battery	12-Volt DC (-) negative ground
Battery Capacity	800-1000 CCA
DC Charging Alternator	40 Amp rated, belt-driven
Starter	1.4Kw, 12VDC direct drive
Starting Aid	Glow plugs, sheathed type
DC Cranking Current	170 - 180 Amps

LUBRICATION SYSTEM

General	Pressure fed system with external relief valve
Oil Filter	Full flow, paper element, spin-on type
Sump Capacity	8.0 U.S. qts (7.6 liters)
Operating Oil Pressure (engine hot)	28 - 57 psi (2.0 - 4.0 kg/cm²)
Oil Grade	API Specification CF, CG-4, CF-4, CH-4, CI-4 SAE 10W-40, 15W-40

COOLING SYSTEM

General	Fresh water-cooled engine block, thermostatically-controlled with heat exchanger.
Operating Temperature	160 - 180° F (71 - 82° C)
Fresh Water Pump	Centrifugal type, metal impeller, belt-driven
Raw Water Pump	Positive displacement, rubber impeller, gear-driven.
System Capacity (fresh water)	6 qts (5.6 liters)
Raw Water Flow Rate (at 1800 rpm)	6.0 gpm (22.7 lpm)

FUEL SYSTEM

General	Open flow, self bleeding, self priming (electromagnetic fuel pump)
Fuel	No. 2 diesel (cetane rating of 45 or higher)
Fuel Injection Pump	Bosch type mini-pump
Fuel Injection Timing	18° BTDC (spill)
Injector Nozzle	Bosch throttle type
Fuel Filter	Spin-on type
Air Intake	Metal screen/intake silencer box
Fuel Consumption at rated amperage output	1.99 gph (7.5 lph) at 1800rpm 1.22 gph (4.6 lph) at 1500 rpm

GENERATOR COOLING

Engine Combustion Air Requirements	1800 rpm (70 cfm) 1.9 cmm 1500 rpm (58 cfm) 1.6 cmm

AC GENERATOR

General - 3 Phase	Brushless, four pole revolving field, sealed lubricated single bearing design. 6 wire reconnectable with solid state voltage regulator.
Voltage - Single Phase	120 or 120/240 volts 60 Hz 115/230 volts 50 Hz
AC Amperage (Single Phase)	120 volts/183.2 amps 240 volts/91.7 amps 230 volts/73.9 amps
Voltage Regulation	+ or - 2% no load to full rated amperage outlet
Frequency Regulation	+ or - .3 hz (.5%) no load to full rated amperage outlet
Generator Compartment Ambient Temperature Recommendations	122°F (50°C) maximum **NOTE:** *Forced ventilation should be provided to maintain generator compartment temperatures below 122°F (50°C).*

KEEL COOLING

Coolant Flow Fresh Water Pump	16 gal/min (60.5 litres) @ 1800 rpm
Exhaust Connection	2 1/2 NPT female
Coolant Hose Size	1 1/4 I.D. (31.75 mm)
Heat Rejection	76,000 BTU/Hr 19,000 Kcal/Hr

SPECIFICATIONS 17.0/13.5 EDE

ENGINE SPECIFICATIONS

Engine Type	Diesel, four-cycle, three-cylinder, fresh water-cooled, vertical in-line overhead valve mechanism.
Aspiration	Naturally aspirated
Compression Ratio	23.8:1
Governor	Electronic
Combustion Chamber	Spherical type
Bore & Stroke	87 x 102.4 mm (3.43 x 4.12 inches)
Piston Displacement	1.82 liters (111.43 cubic inches)
Fuel Consumption at rated amperage outlet	1.50 gph (5.7 lph) at 1800 rpm 1.22 gph (4.6 lph) at 1500 rpm
HP@ 1800/1500 RPM	31.0/26.0
Engine Combustion Air Requirements	1800 rpm 58 cfm (1.64 cmm) 1500 rpm 48 cfm (1.36 cmm)
Firing Order	1 - 2 - 3
Inclination	Continuous 20° Temporary 30° (not to exceed 10 min.)
Weight (dry)	829 lbs (376.0 kgs)

TUNE-UP SPECIFICATIONS

Compression Pressure (allowable limit)	512 - 583 psi (36 - 41 kgf/cm²) at 250 rpm 370 psi (26 kgf/cm²) at 250 rpm
Variation between cylinders	10% or less
Injection Timing	18° BTDC
Engine Speed	1800 rpm 60 Hertz 1500 rpm 50 Hertz
Valve Clearance (engine cold)	0.18 to 0.22 mm (0.0071 to 0.0087 inches)
Injector Pressure	1991 to 2134 psi (140 to 150 kgf/cm²)
Valve Timing	Intake Opens 14° BTDC Intake Closes 36° ABDC Exhaust Opens 45° BBDC Exhaust Closes 17° ATDC

ELECTRICAL SYSTEM

Starting Battery	12-Volt DC (-) negative ground
Battery Capacity	800-1000 CCA
DC Charging Alternator	40 Amp rated, belt-driven
Starter	2.0Kw, 12VDC direct drive
Starting Aid	Glow plugs, sheathed type
DC Cranking Current	240 (includes glow plugs)

LUBRICATION SYSTEM

General	Pressure fed system with external relief valve
Oil Filter	Full flow, paper element, spin-on type

LUBRICATION SYSTEM

Sump Capacity	7.4 U.S. qts (7.0 liters)
Oil Grade	API Specification CF, CG-4, CF-4, CH-4, CI-4 SAE 10W-40, 15W-40

COOLING SYSTEM

General	Fresh water-cooled engine block, thermostatically-controlled with heat exchanger.
Operating Temperature	160 - 180° F (71 - 82° C)
Fresh Water Pump	Centrifugal type, metal impeller, belt-driven
Raw Water Pump	Positive displacement, rubber impeller, gear-driven.
System Capacity (fresh water)	5 qts (4.7 liters)
Raw Water Flow Rate (at 1800 rpm)	6.0 gpm (22.7 lpm)

FUEL SYSTEM

General	Open flow, self bleeding, self priming (electromagnetic fuel pump)
Fuel	No. 2 diesel (cetane rating of 45 or higher)
Fuel Injection Pump	Bosch type mini-pump
Fuel Injection Timing	18° BTDC (spill)
Injector Nozzle	Bosch throttle type
Fuel Filter	Spin-on type
Air Intake	Metal screen/intake silencer box

GENERATOR COOLING

Air requirements (generator cooling)	450 cfm (12.7 cmm)

NOTE: *Increase cooling air flow 15% for slower turning 50 Hertz units.*

Generator Compartment Ambient Temperature	122°F (50°C) maximum

AC GENERATOR

General - Single Phase	Brushless, four pole revolving field. Sealed lubricated, single bearing design. 6 wire reconnectable with solid state voltage regulator.
Voltage - Single Phase	120 or 120/240 volts 60 Hz 230 volts 50 Hz
Voltage Regulation	+ or - 2% no load to full load
Frequency Regulation	+ or - .3 hz (.5%) no load to full rated amperage outlet
AC Amperage (Single Phase)	120 volts/141.7 amps 240 volts/70.8 amps 230 volts/58.7 amps
Generator Compartment Ambient Temperature Recommendations	122°F (50°C) maximum **NOTE:** *Forced ventilation should be provided to maintain generator compartment temperatures below 122°F (50°C).*

GENERATOR SPECIFICATIONS 3 PHASE

17.0/13.5 EDE

AC GENERATOR (Single Phase)		
Three Phase	Brushless, six-pole, revolving field. Seal lubricated, single bearing design. 12 lead reconnectable for low voltage WYE, high voltage Delta. Solid state voltage regulator with protection circuitry.	
Voltage - 3 phase (60 Hertz)	Low Voltage WYE High Voltage WYE DELTA	240 Volts 480 Volts 240 Volts
Voltage - 3 Phase (50 Hertz)	High Voltage WYE DELTA	400 Volts 230 Volts
Amperage - 3 phase (60 Hertz)	Low Voltage WYE High Voltage WYE DELTA	51 Amps 25 Amps 51 Amps
Amperage - 3 phase (50 Hertz)	High Voltage WYE DELTA	24 Amps 42 Amps
Generator Compartment Ambient Temperature Recommendations	122°F (50°C) maximum **NOTE:** *Forced ventilation should be provided to maintain generator compartment temperatures below 122°F (50°C)*	
Generator Cooling Air requirements	450 cfm (12.7 cmm) **NOTE:** *Increase air flow 15% for slower turning 50 Hertz units.*	

22.0/17.0 EDE

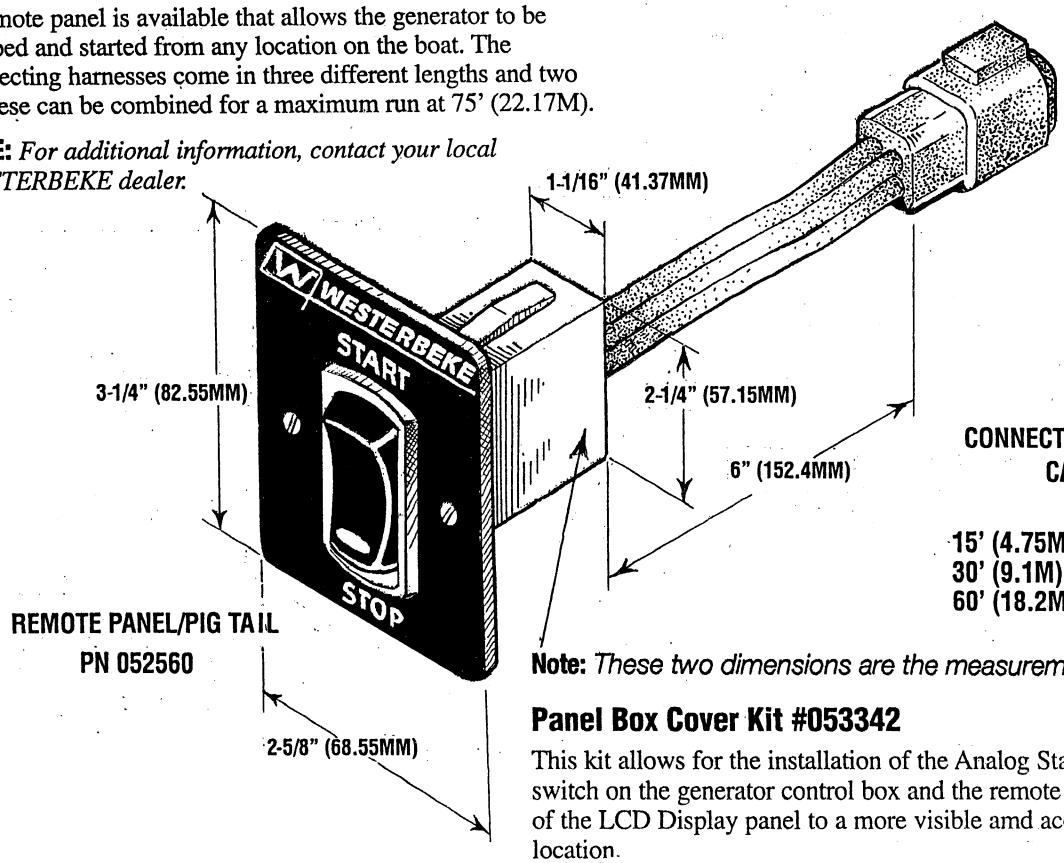
AC GENERATOR (3 Phase)		
Three Phase 22.0 Kw - 60 Hertz 17.0 Kw - 50 Hertz	Brushless, six-pole, revolving field. Seal lubricated, single bearing design. 12 lead reconnectable for low voltage WYE, high voltage Delta. Solid state voltage regulator with protection circuitry.	
Voltage - 3 phase (60 Hertz)	Low Voltage WYE High Voltage WYE DELTA	240 Volts 480 Volts 2240 Volts
Voltage - 3 Phase (50 Hertz)	High Voltage WYE DELTA	400 Volts 230 Volts
Amperage - 3 phase (60 Hertz)	Low Voltage WYE High Voltage WYE DELTA	66 Amps 33 Amps 66 Amps
Amperage - 3 phase (50 Hertz)	High Voltage WYE DELTA	30 Amps 53 Amps
Generator Compartment Ambient Temperature Recommendations	122°F (50°C) maximum **NOTE:** *Forced ventilation should be provided to maintain generator compartment temperatures below 122°F (50°C)*	
Generator Cooling Air requirements	500 cfm (15.0 cmm) **NOTE:** *Increase air flow 15% for slower turning 50 Hertz units.*	

REMOTE STOP/START PANEL AND EXTENSION HARNESSES

DESCRIPTION

A remote panel is available that allows the generator to be stopped and started from any location on the boat. The connecting harnesses come in three different lengths and two of these can be combined for a maximum run at 75' (22.17M).

NOTE: *For additional information, contact your local WESTERBEKE dealer.*



CONNECTING EXTENSION CABLES

15' (4.75M)	PN 052959
30' (9.1M)	PN 052789
60' (18.2M)	PN 052960

Note: *These two dimensions are the measurement of the cut-out opening.*

Panel Box Cover Kit #053342

This kit allows for the installation of the Analog Start/Stop switch on the generator control box and the remote mounting of the LCD Display panel to a more visible amd accessible location.

LCD DISPLAY EXTENSION CABLES NMEA MICRO-C

PART NUMBER	LENGTH
053025	1/2 METER - 1.6 FEET
053026	1 METER - 3.2 FEET
053027	2 METER - 6.5 FEET
053028	3 METER - 9.8 FEET
053029	4 METER - 13.1 FEET
053030	5 METER - 16.4 FEET
053031	6 METER - 19.6 FEET
053032	7 METER - 22.9 FEET
053033	8 METER - 26.2 FEET
053034	9 METER - 29.5 FEET
053035	10 METER - 32.8 FEET
053061	12.2 METER - 40.0 FEET

REMOTE OIL FILTER (OPTIONAL)
PN.#054372

INSTALLATION

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

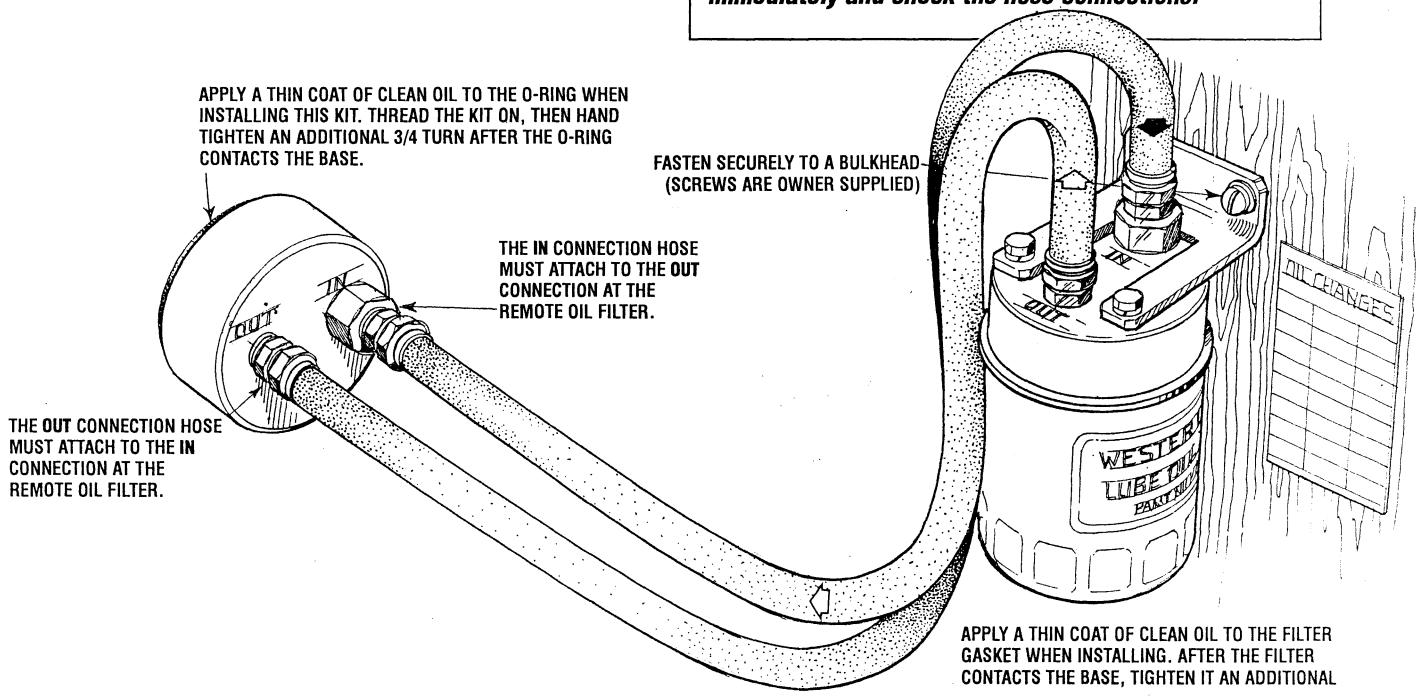
NOTE: *Refer to ENGINE OIL CHANGE in this manual for instructions on removing the oil filter.*

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

Contact your WESTERBEKE dealer for more information.

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

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

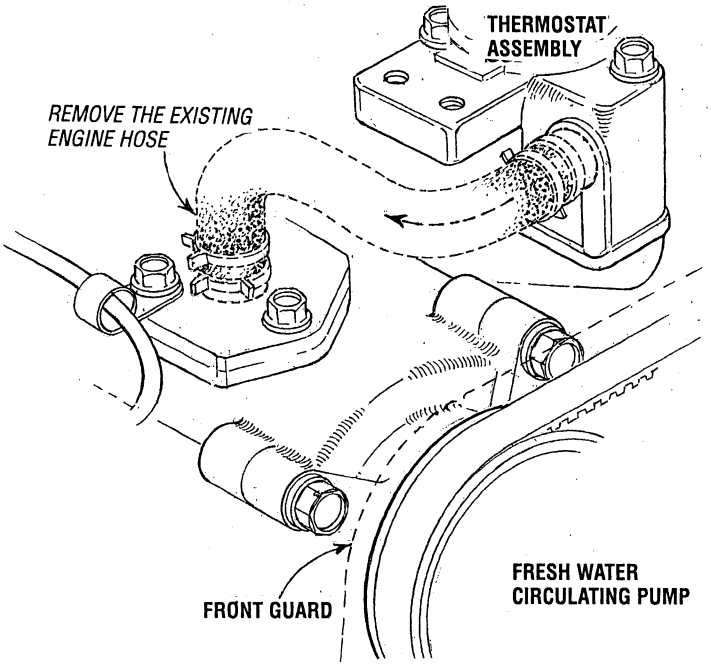


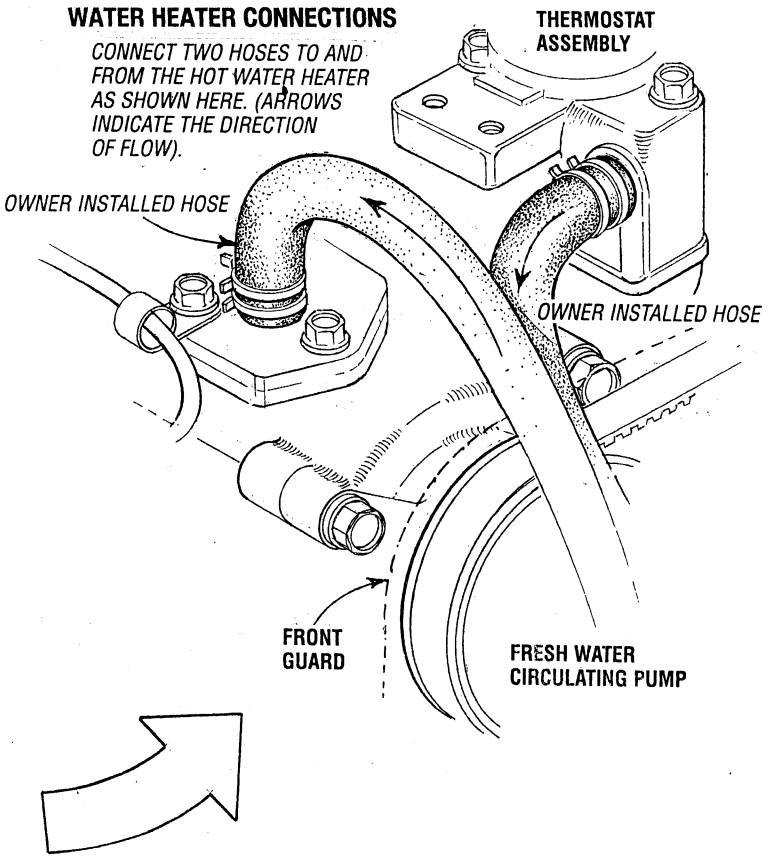
WATER HEATER CONNECTIONS

WATER HEATER INSTALLATIONS

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

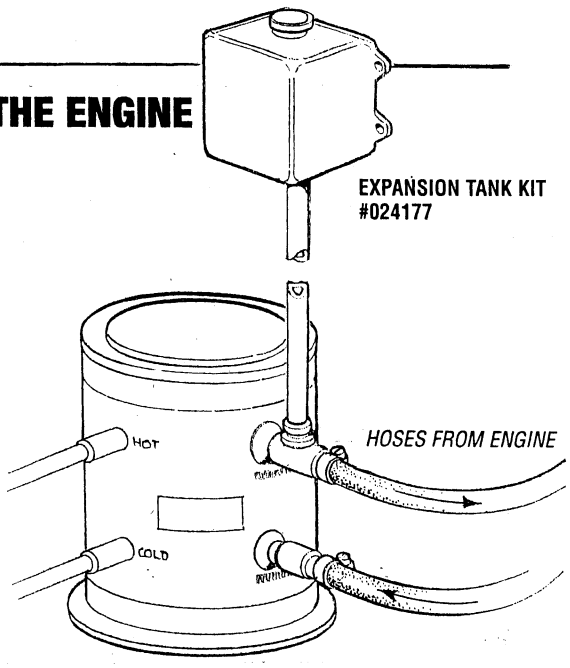
Hoses should rise continuously from their low point at the heater to the engine so that air will rise naturally from the heater to the engine. If trapped air is able to rise to the heater, then an air bleed petcock must be installed at the higher fitting on the heater for bleeding air while filling the system.





HEATING CIRCUIT ABOVE THE ENGINE

NOTE: *If any portion of the heating circuit rises above the engine's own pressure cap, then a pressurized (aluminum) remote expansion tank (Kit #024177)* ***must*** *be installed in the circuit to become the highest point. Tee the remote expansion tank into the heater circuit, choosing the higher of the two connections for the return. Tee at the heater, and plumb a single line up to the tanks location and the other back to the engine's return. Install the remote expansion tank in a convenient location so the coolant level can easily be checked. The remote expansion tank will now serve as a check and system fill point.* ***The plastic coolant recovery tank is not used when the remote expansion tank kit is installed, since this tank serves the same function.*** *Remove and store the plastic recovery tank if it has been already installed.*



TYPICAL HOT WATER TANK

DECIMAL TO METRIC EQUIVALENT CHART

Fractions of an inch	Decimal (in.)	Metric (mm)	Fractions of an inch	Decimal (in.)	Metric (mm)
1/64	0.015625	0.39688	33/64	0.515625	13.09687
1/32	0.03125	0.79375	17/32	0.53125	13.49375
3/64	0.046875	1.19062	35/64	0.546875	13.89062
1/16	0.0625	1.58750	9/16	0.5625	14.28750
5/64	0.078125	1.98437	37/64	0.578125	14.68437
3/32	0.09375	2.38125	19/32	0.59375	15.08125
7/64	0.109375	2.77812	39/64	0.609375	15.47812
1/8	0.125	3.175	5/8	0.625	15.87500
9/64	0.140625	3.57187	41/64	0.640625	16.27187
5/32	0.15625	3.96875	21/32	0.65625	16.66875
11/64	0.171875	4.36562	43/64	0.671875	17.06562
3/16	0.1875	4.76250	11/16	0.6875	17.46250
13/64	0.203125	5.15937	45/64	0.703125	17.85937
7/32	0.21875	5.55625	23/32	0.71875	18.25625
15/64	0.234375	5.95312	47/64	0.734375	18.65312
1/4	0.250	6.35000	3/4	0.750	19.05000
17/64	0.265625	6.74687	49/64	0.765625	19.44687
9/32	0.28125	7.14375	25/32	0.78125	19.84375
19/64	0.296875	7.54062	51/64	0.796875	20.24062
5/16	0.3125	7.93750	13/16	0.8125	20.63750
21/64	0.328125	8.33437	53/64	0.828125	21.03437
11/32	0.34375	8.73125	27/32	0.84375	21.43125
23/64	0.359375	9.12812	55/64	0.859375	21.82812
3/8	0.375	9.52500	7/8	0.875	22.22500
25/64	0.390625	9.92187	57/64	0.890625	22.62187
13/32	0.40625	10.31875	29/32	0.90625	23.01875
27/64	0.421875	10.71562	59/64	0.921875	23.41562
7/16	0.4375	11.11250	15/16	0.9375	23.81250
29/64	0.453125	11.50937	61/64	0.953125	24.20937
15/32	0.46875	11.90625	31/32	0.96875	24.60625
31/64	0.484375	12.30312	63/64	0.984375	25.00312
1/2	0.500	12.70000	1	1.00	25.40000

STANDARD AND METRIC CONVERSION DATA

LENGTH-DISTANCE

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

DISTANCE EQUIVALENTS

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

VOLUME

Cubic Inches (in^3) x 16.387 = Cubic Centimeters x .061 = in^3
Imperial Pints (IMP pt) x .568 = Liters (L) x 1.76 = IMP pt
Imperial Quarts (IMP qt) x 1.137 = Liters (L) x.88 = IMP qt
Imperial Gallons (IMP gal) x 4.546 = Liters (L) x .22 = IMP gal
Imperial Quarts (IMP qt) x 1.201 = US Quarts (US qt) x .833 = IMP qt
Imperial Gallons (IMP gal) x 1.201 = US Gallons (US gal) x .833 = IMP gal
Fluid Ounces x 29.573 = Milliliters x .034 = Ounces
US Pints (US pt) x .473 = Liters(L) x 2.113 = Pints
US Quarts (US qt) x .946 = Liters (L) x 1.057 = Quarts
US Gallons (US gal) x 3.785 = Liters (L) x .264 = Gallons

MASS-WEIGHT

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

PRESSURE

Pounds Per Sq In (psi) x 6.895 = Kilopascals (kPa) x .145 = psi
Inches of Mercury (Hg) x .4912 = psi x 2.036 = Hg
Inches of Mercury (Hg) x 3.377 = Kilopascals (kPa) x .2961 = Hg
Inches of Water (H_2O) x .07355 = Inches of Mercury x 13.783 = H_2O
Inches of Water (H_2O) x .03613 = psi x 27.684 = H_2O
Inches of Water (H_2O) x .248 = Kilopascals (kPa) x 4.026 = H_2O

TORQUE

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

VELOCITY

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

POWER

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

FUEL CONSUMPTION

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

TEMPERATURE

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

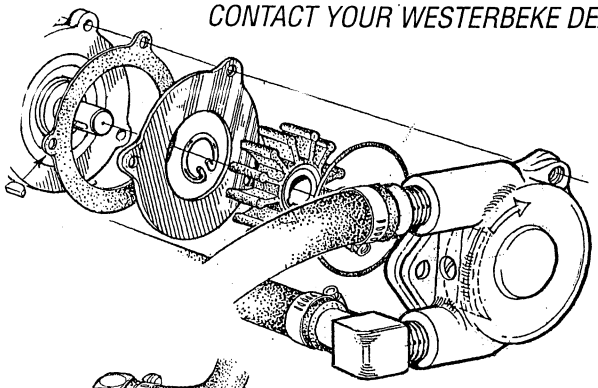
LIQUID WEIGHTS

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

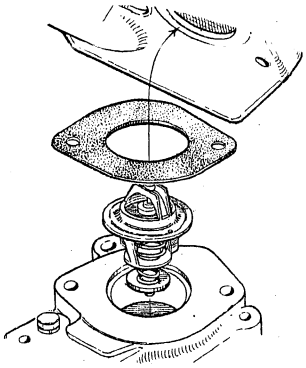
SUGGESTED SPARE PARTS

WESTERBEKE MARINE GENERATORS

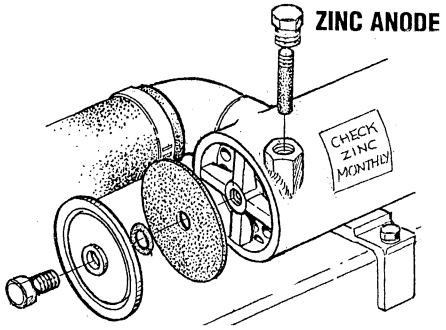
CONTACT YOUR WESTERBEKE DEALER FOR SUGGESTIONS AND ADDITIONAL INFORMATION



RAW WATER PUMP GASKET AND IMPELLERS

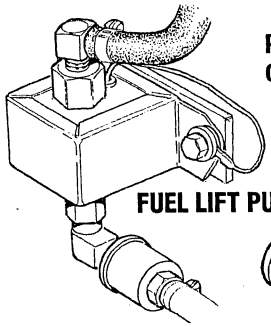


THERMOSTAT KIT

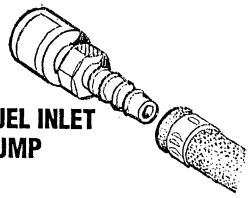


ZINC ANODE

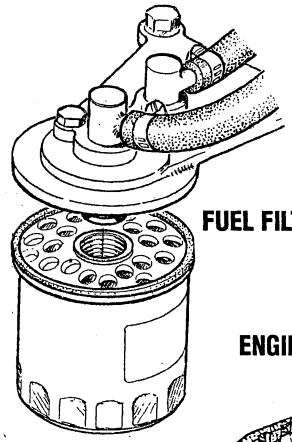
O-RING AND GASKET SET



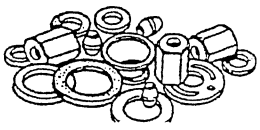
FUEL LIFT PUMP



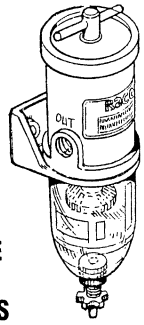
FUEL INLET PUMP



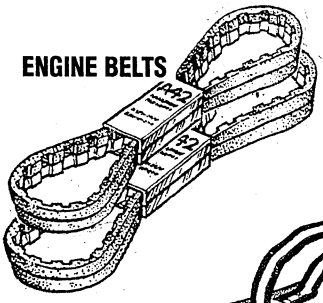
FUEL FILTERS



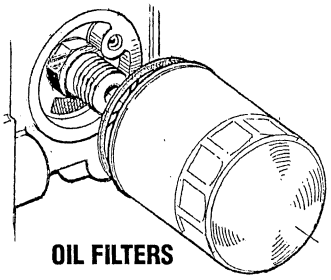
HARDWARE KIT



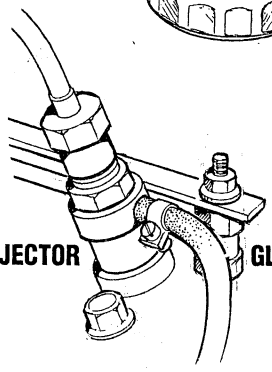
IN-LINE FUEL FILTERS
(OWNER INSTALLED)



ENGINE BELTS

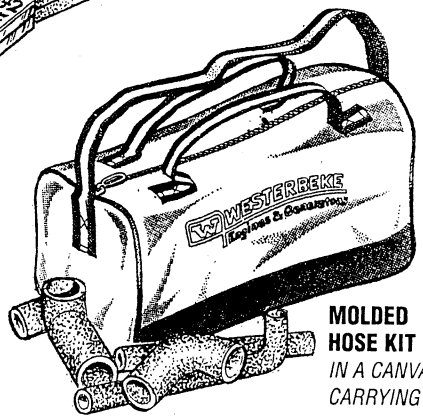


OIL FILTERS



INJECTOR **GLOW PLUG**

12A FUSE
(ON FRONT OF THE CONTROL PANEL)



MOLDED HOSE KIT
IN A CANVAS CARRYING BAG

WESTERBEKE RECOMMENDS HAVING ENOUGH SPARE ENGINE OIL (YOUR BRAND) FOR AN OIL CHANGE (5 QTS.) AND A GALLON OF PREMIXED COOLANT.

SPARE PARTS KITS

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

Kit A

Drive Belts
Oil Filter
Fuel Filter
Fuel System Hardware Kit
Fuel Pump Inlet Filter

Kit B

Drive Belts
Oil Filter
Fuel Filter
Fuel System Hardware Kit
Fuel Pump Inlet Filter
Injector
Overhaul Gasket Kit
Glow Plug

WESTERBEKE
Engines & Generators

1202-3/2015