

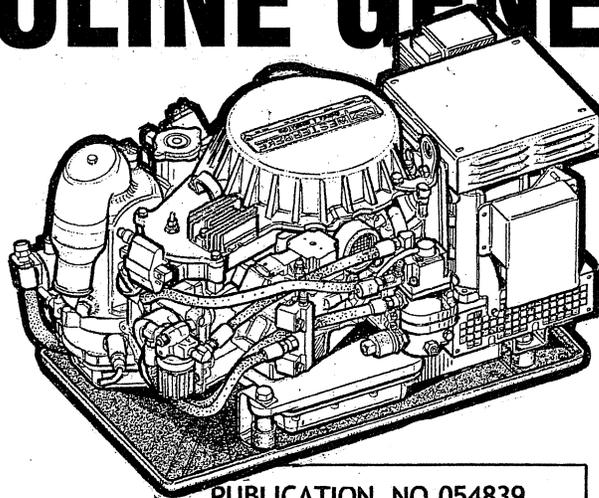


# **OPERATORS MANUAL**

## **3.5 SBCG 60Hz and 50Hz**

### **Single Phase**

# **GASOLINE GENERATOR**



PUBLICATION NO.054839  
JANUARY 2018 – REVISION #3



*Low Carbon Monoxide Emissions*

**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.**

**⚠ WARNING:**

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

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

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



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

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

**Gasoline with an ETHANOL content higher than 10% (E10) is not allowed and may void warranty.**



**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, or when connected to shore power. Lethal voltage is present at these connections!**

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

## PREVENT BURNS — HOT ENGINE

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

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

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

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

## PREVENT BURNS — FIRE

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

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

## PREVENT BURNS — EXPLOSION

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

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

# SAFETY INSTRUCTIONS

## ACCIDENTAL STARTING

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

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

## BATTERY EXPLOSION

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

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

## BATTERY ACID

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

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

## TOXIC EXHAUST GASES

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

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

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

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

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

## AVOID MOVING PARTS

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

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

# SAFETY INSTRUCTIONS

- Do not wear loose clothing or jewelry when servicing equipment; tie back long hair and avoid wearing loose jackets, shirts, sleeves, rings, necklaces or bracelets that could be caught in moving parts.
- Make sure all attaching hardware is properly tightened. Keep protective shields and guards in their respective places at all times.
- Do not check fluid levels or the drive belt's tension while the engine is operating.
- Do not allow any swimming or activity around or near the exhaust discharge opening for the generator while the generator is operating. Carbon Monoxide poisoning or death can occur.

## HAZARDOUS NOISE

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

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

**▲ 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.

## GASOLINE ENGINE AND GENERATOR INSTALLATIONS

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

Sections of the ABYC standards of particular interest are:

H-2 Ventilation for Boats using Gasoline

H-24 Gasoline Fuel Systems

P-1 Installation of Exhaust Systems

for Propulsion and Auxiliary Engines

P-4 Marine Inboard Engines and Transmissions

E-11 AC and DC Electrical Systems on Boats

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

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

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

**ABYC** (American Boat and Yacht Council)  
"Standards and Technical Information Reports for Small Craft"

Order from:

ABYC  
613 Third Street, Suite 10  
Annapolis, MD 21403  
[www.abycinc.org](http://www.abycinc.org)

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

Order from:

NFPA  
11 Tracy Drive  
Avon Industrial Park  
Avon, MA 02322

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

Order from:

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

# CARBON MONOXIDE “CO”/ LOW-CO GENERATORS

## IMPORTANT INFORMATION

### DESCRIPTION

Carbon monoxide “CO” is a component of engine exhaust. It is a colorless, tasteless, odorless, lighter than air poisonous gas that can kill you without any warning. CO poisoning is one of the major safety risks associated with boating. It is a threat that must not be underestimated.

Westerbeke Low-CO generators are designed to reduce normal levels of CO in the engine exhaust by approximately 99%.

Several standards for CO have been published, expressed in parts per million “ppm” and hours of exposure:

Regulator	CO ppm	Exposure Hours
EPA	9	8
ACGIH	25	8
EPA	35	1
NIOSH	35	8
OSHA	50	8
ACGIH	125	0.5
NIOSH	200	0.0
NIOSH (IDLH)	1200	0.0

**1200 ppm is the so-called IDLH concentration - IMMEDIATELY DANGEROUS TO LIFE AND HEALTH.**

A city in California characterizes the effect of CO concentration this way:

Parts per Million	Responses
25	Permissible exposure level, no apparent toxic symptoms.
100	No poisoning for long period. Allowable for several hours.
200	Should not be exposed above this level for any period of time. A possible mild frontal headache in two to three hours.

Even though the generator normally produces very low levels Westerbeke Low-CO generators are designed to reduce normal levels of CO in the engine exhaust by approximately 99%, an exhaust leak of untreated exhaust would be extremely dangerous. For this reason it is extremely important to install a CO detector near the generator and to be sure it is always turned on and functioning properly. If this detector sounds, do not turn it off, assuming it is a false signal. You can not taste, smell, or otherwise detect CO. Leave the detector on, turn off all engines and generators, evacuate the boat leaving ports and hatches open, and seek professional help.

As soon as CO leaves the exhaust outlet, the level is subject to dilution in the open air. The closer a person is to the exhaust outlet, the higher the concentration of CO.

In a closed space, such as the engine compartment, the boat, or underneath a stern swim platform, concentrations will potentially rise to the undiluted level emanating from the exhaust system due to a lack of fresh air to dilute the exhaust gas. Therefore, one should never rely on dilution of the exhaust to provide a margin of safety.

Westerbeke Low-CO generators achieve an approximate 99% reduction of typical CO by precise control of the engine’s air/fuel ration coupled with after treatment in a special catalyst. CO emissions are not the same for every model because each engine is different. Also, certain fuel system components are commonized across several engine models being adequate for some and extra-adequate for others, thus producing different CO levels for different models.

The fuel system which accomplishes the required precise air/fuel ratio control is comprised of many different components: purchased sub-assemblies, machined castings, sensors, electronics and others. Because of the extreme level of CO reduction, any variability in the functioning of any these components can and will cause variability of the CO output.

CO concentration also varies with load. Usually, but not always, the worst case CO concentration occurs at maximum load.

### INSPECTION

The catalyst is critical to optimizing CO levels. Any water intrusion into the engine’s exhaust system will likely quickly compromise the proper operation of the catalyst.

Westerbeke’s exhaust system installation instructions dated June 2016 Revision 4 must be adhered to.

**NOTE:** *Water intrusion is not a product defect and is not covered under warranty, neither Westerbeke’s normal product warranty nor the emissions specific warranty mandated by various regulating authorities such as EPA and CARB.*

Maintenance of any components affecting the flow of air into the engine or the flow of fuel to the engine is critically important. Fuel filters, air filters, flame arrester screens **MUST** be properly maintained.

Inspection of the catalyst at the prescribed intervals is critically important. The exhaust elbow is removed by loosening the metal clamp to provide a view of the output surface of the catalyst. Any visual irregularity of the normal flush, honeycomb appearance is most likely a result of water intrusion. The cause of the irregularity must be identified and addressed. If there is irregularity, the catalyst and sealing gasket must be replaced. The water injected exhaust elbow casting must be inspected also for corrosion and replaced as needed. Upon careful reassembly of the catalyst, new sealing gasket, and exhaust elbow, check for the presence of CO while the engine is running. This must be performed with a CO analyzer.

# EMISSIONS

This genset meets the requirements of California's Exhaust Emissions Standards as stated on the nameplate.

California users of this genset should be aware that unauthorized modifications or replacement of fuel, exhaust, air intake, or speed control system components that affect engine emissions are prohibited. Unauthorized modification, removal or replacement of the engine label is prohibited.

*Federal Emissions Compliance Period:* The Federal Emissions Compliance Period referred to on the nameplate indicates the number of operating hours for which the engine has been shown to meet Federal Emissions requirements.

Category C= 250 hrs, B=500 hrs, A =1000.hrs.

You should carefully review operator (Owner) Installation and other manuals and information you receive with your genset. If you are unsure that the installation, use, maintenance or service of your genset is authorized, you should seek assistance from an approved WESTERBEKE dealer.

California genset users may use the table below as an aid in locating information related to the California Air Resources Board requirements for emissions control.

**EMISSIONS CONTROL INFORMATION TABLE**

<b>Emissions Warranty Information</b>	The California emissions control warranty statement is located in the same packet, if information as this manual when the genset is shipped from the factory.
<b>Engine Fuel Requirements</b>	The engine is certified to operate on unleaded gasoline. See <i>FUEL RECOMMENDATIONS</i> .
<b>Engine Valve Adjustment</b>	See <i>MAINTENANCE SCHEDULE</i> .
<b>Engine Ignition Timing</b>	See <i>MAINTENANCE SCHEDULE</i> .
<b>Engine Lubricating Oil Requirements</b>	See <i>ENGINE OIL RECOMMENDATIONS</i> .
<b>Engine Adjustments</b>	ECU.
<b>Engine Emission Control System</b>	The engine emission control system consists of engine design and precision manufacture.
<b>Catalyst</b>	See <i>MAINTENANCE SCHEDULE</i> .
<b>Oxygen Sensor</b>	See <i>MAINTENANCE SCHEDULE</i> .
<b>Back Pressure</b>	See <i>MAINTENANCE SCHEDULE</i> .

# CARBON MONOXIDE “CO”/ LOW-CO GENERATORS

## IMPORTANT INFORMATION

Catalyst performance will degrade over time. As the generator accumulates operating hours, CO concentrations will increase. **The catalyst must be replaced every 2,000 hours of engine operation.**

**Verification of satisfactory CO levels must be done seasonally or each 500 hours (which ever occurs first).**

Verification involves actual sampling of exhaust gas with an appropriate CO analyzer.

There are two locations where exhaust gas can be sampled. Dry, but hot, exhaust gas can be sampled at the 1/8NPT plugged opening on the top of the water injected exhaust elbow's casting. Measurements at this location may not be practical in all instances due to the high exhaust temperature, temperature limits of the analyzer, safety concerns over temperatures involved or the possibility of high levels of CO. The other location is the boat's exhaust outlet, which contains entrained cooling water (except dry stack exhaust systems). Only analyzers with probes should be used at this location and it is critical that the probe not ingest water. Probe-type analyzers have an air pump drawing a gas sample through the probe. As a result, they tend to ingest water when it is present. Be sure to aim the probe downwards with the opening pointed in the direction of the water flow and just out of the flow. Position the analyzer as high as possible with the tubing leading to the probe running continuously downhill. Observe the usually translucent tubing between the probe and the analyzer and be sure no water is being ingested. If any water is ingested into the analyzer, it must be repaired or replaced and recalibrated.

When measuring CO at the exhaust outlet be aware of the ambient CO level by also measuring CO away from and upwind of the exhaust outlet, especially in marinas. the CO level at the exhaust will be influenced upwards by the ambient level.

**For changing the exhaust catalyst and measuring the exhaust back pressure, refer to the Table of Contents.**

Whenever taking the time to verify proper CO levels from the exhaust with a CO analyzer, always take the opportunity to use the analyzer to “sniff” around the engine looking for CO from exhaust leaks. Pay close attention to the connection of the cylinder block to the sump plate, the sump plated to the water injected exhaust elbow casting and all subsequent downstream exhaust components and hoses and connection points. Remember, exhaust gas that has not yet passed through the catalyst is raw exhaust, untreated exhaust gas and is very high in CO content.

Analyzers usually require periodic calibration. Follow the instructions that come with the analyzer very carefully regarding calibration.

The following are manufacturers that offer CO analyzers: Extech, TIF, Testo, TSI, Bacharach, Fluke, Monoxor, Fyrite, Zellweger Analytics, Industrial Scientific Corp, GFG, TPI, Teledyne and others. Westerbeke recommends analyzers with a probe connected to the analyzer by a length of transparent tubing. They are slightly more expensive than those with the sensor built into one end of the analyzer, but they allow you to sample the exhaust coming out of the boat's exhaust outlet.

# INSTALLATION

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

## CODES AND REGULATIONS

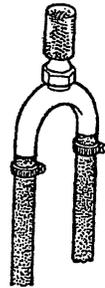
Strict federal regulations, ABYC guidelines, and safety codes must be complied with when installing engines and generators in a marine environment.

## 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

## 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.

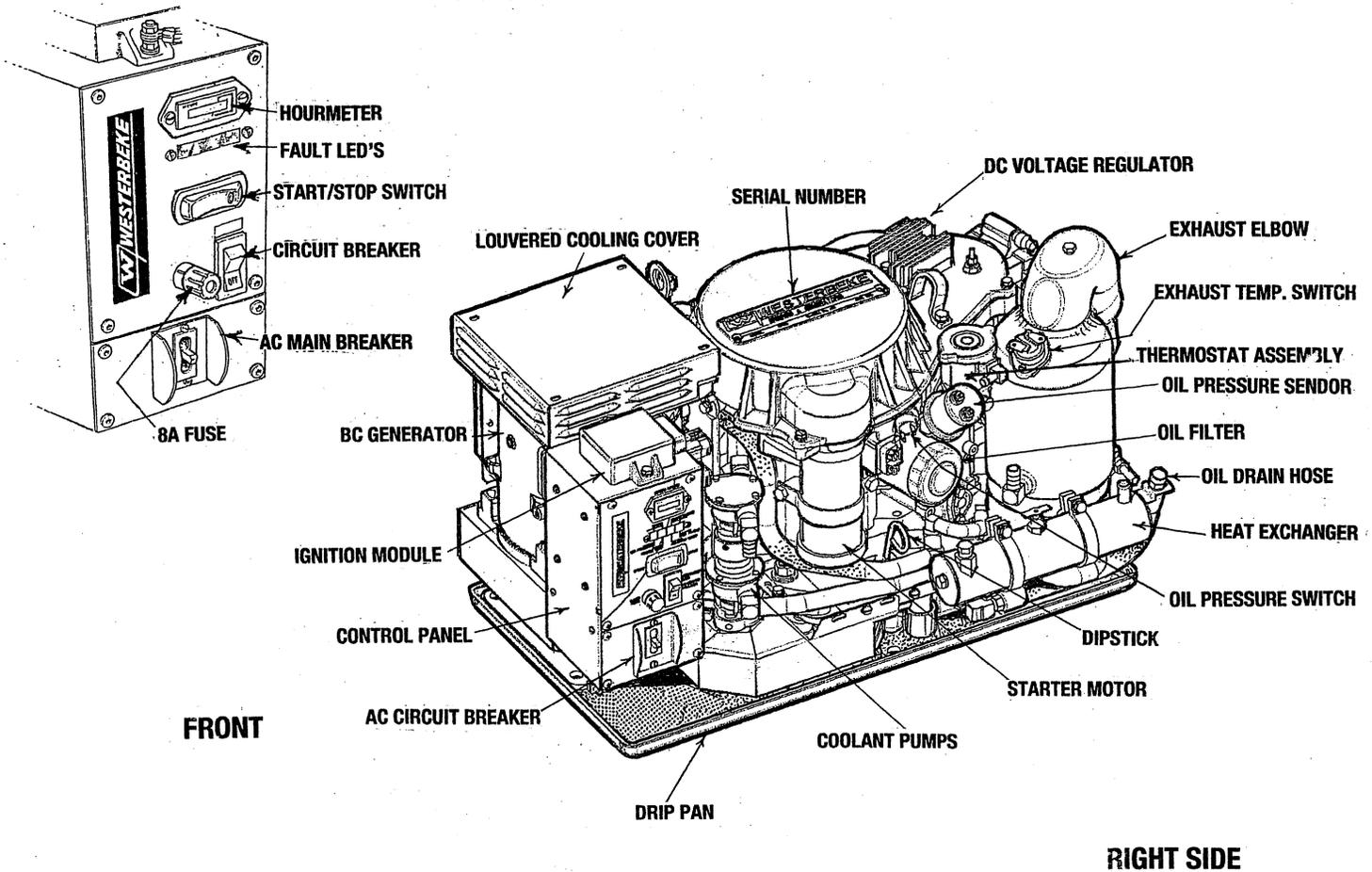
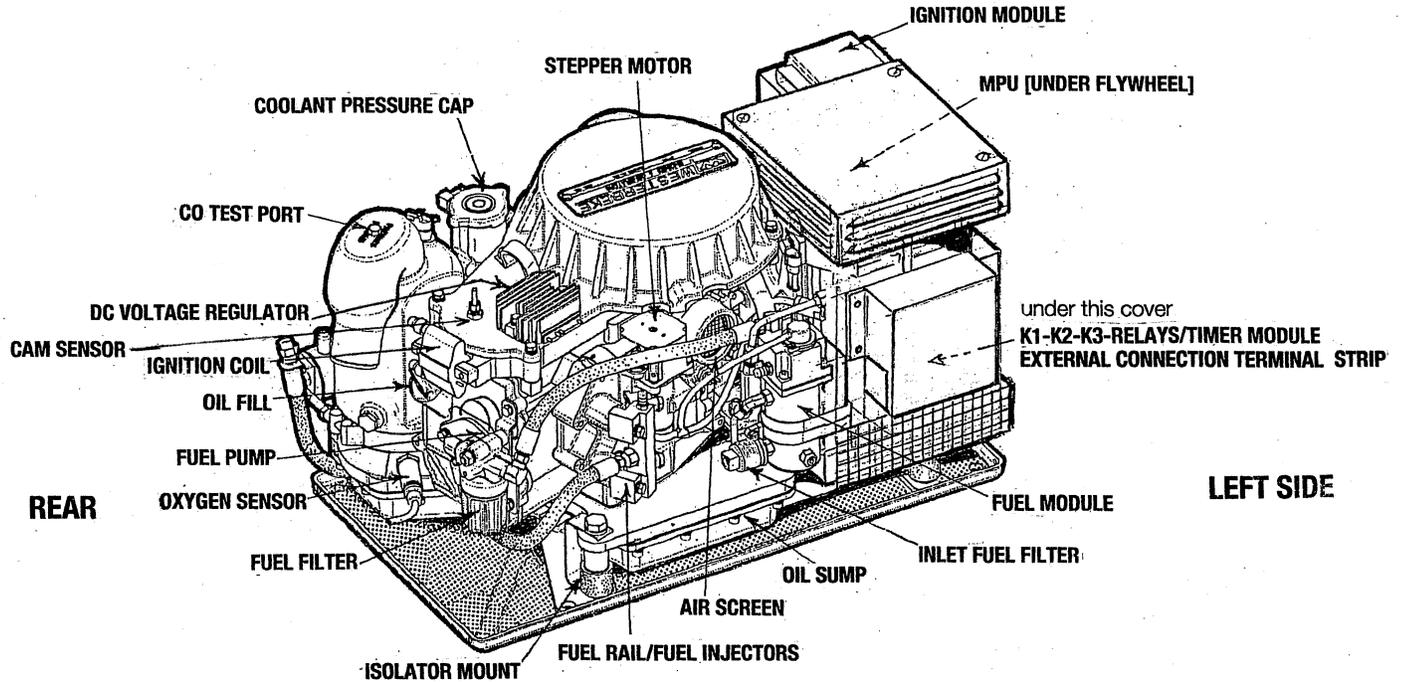
**A detailed Marine Installation Manual covering gasoline and diesel, engines and generators, is supplied with each unit. A pdf is available to download from our website at [www.westerbeke.com](http://www.westerbeke.com).**



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# PARTS IDENTIFICATION 3.5 SBCG GENERATOR



# INTRODUCTION

These high performance marine engines are products of WESTERBEKE's long years of experience and advanced technology. We take great pride in the superior durability and dependable performance of our engines and generators. Thank you for selecting WESTERBEKE.

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

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

## WARRANTY PROCEDURES

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

## Customer Identification Card

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

## PRODUCT SOFTWARE

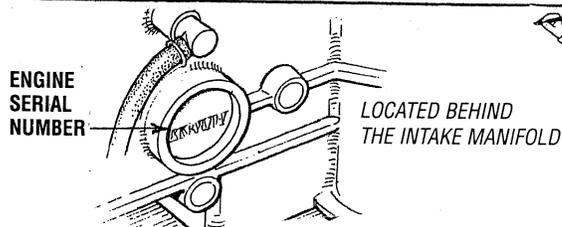
Product software, (technical data, parts lists, manuals, brochures and catalogs), provided from sources other than WESTERBEKE are not within WESTERBEKE's control.

*WESTERBEKE CANNOT BE RESPONSIBLE FOR THE CONTENT OF SUCH SOFTWARE, MAKES NO WARRANTIES OR REPRESENTATIONS WITH RESPECT THERETO, INCLUDING ACCURACY, TIMELINESS OR COMPLETENESS THEREOF AND WILL IN NO EVENT BE LIABLE FOR ANY TYPE OF DAMAGE OR INJURY INCURRED IN CONNECTION WITH OR ARISING OUT OF THE FURNISHING OR USE OF SUCH SOFTWARE.*

WESTERBEKE customers should keep in mind the time span between printings of WESTERBEKE product software and the unavoidable existence of earlier WESTERBEKE product software. The 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.

## SERIAL NUMBER LOCATION

The *engine's* serial and model number are etched on a nameplate located on top of the unit (flywheel cover). The engine's serial number is also stamped on the engine block.



Take the time to enter this information on the illustration of the nameplate as shown above, as this will provide a quick reference when seeking technical information and/or ordering parts.

The *generator's* serial number and model number is located on a decal on the the generator control panel. Take the time to enter the information on the blank decal below. This will provide a quick reference when seeking technical information and/or ordering parts.

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

Fill in the information for your own reference. 

# INTRODUCTION

## ORDERING PARTS

Whenever replacement parts are needed, always provide the generator and engine model and serial numbers. In addition, include a complete part description and part number for each part needed (see the separately furnished Parts Catalog). Also insist upon WESTERBEKE packaged parts because *will fit* or generic parts are frequently not made to the same specifications as original equipment.

## NOTES, CAUTIONS AND WARNINGS

As this manual takes you through the operating procedures, maintenance schedules, and troubleshooting of your generator, 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 the engine or generator.*

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

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

## SPARES AND ACCESSORIES

Certain spare parts will be needed to support and maintain your WESTERBEKE generator or engine when cruising (see *SUGGESTED SPARE PARTS*). Often even simple items such as proper fuel and oil filters can be difficult to obtain along the way. WESTERBEKE will provide you with a suggested spares and accessories brochure to assist you in preparing an on-board inventory of the proper WESTERBEKE parts.

## PROTECTING YOUR INVESTMENT

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

**NOTE:** *Seven important steps to ensure long generator life:*

- *Proper engine and generator installation.*
- *An efficient well-designed exhaust system that includes an anti-siphon break to prevent water from entering the engine.*
- *Changing the engine oil and oil filters every 100 operating hours.*
- *Proper maintenance of all engine and generator components according to the maintenance schedule in this manual.*
- *Use clean, unleaded fuel #89 octane. No higher than E10 ethanol blend.*
- *Winterize your engine according to the "Lay-up and Recommissioning" section in this manual.*

## UNDERSTANDING THE GASOLINE GENERATOR

The gasoline engine driving an AC generator is in many ways similar to a gasoline automobile engine. The cylinders are in-line, and the engine's cylinder head has an overhead camshaft which is belt-driven. The engine incorporates a pressure type lubrication system, and a water-cooled engine block.

To a large degree, the generator's engine requires the same preventive maintenance that is required of a gasoline automobile engine. The most important factors to the generator's longevity are proper ventilation, maintenance of the fuel system, ignition system, and cooling system.

## 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!

# INSTALLATION

## RIGGING AND LIFTING

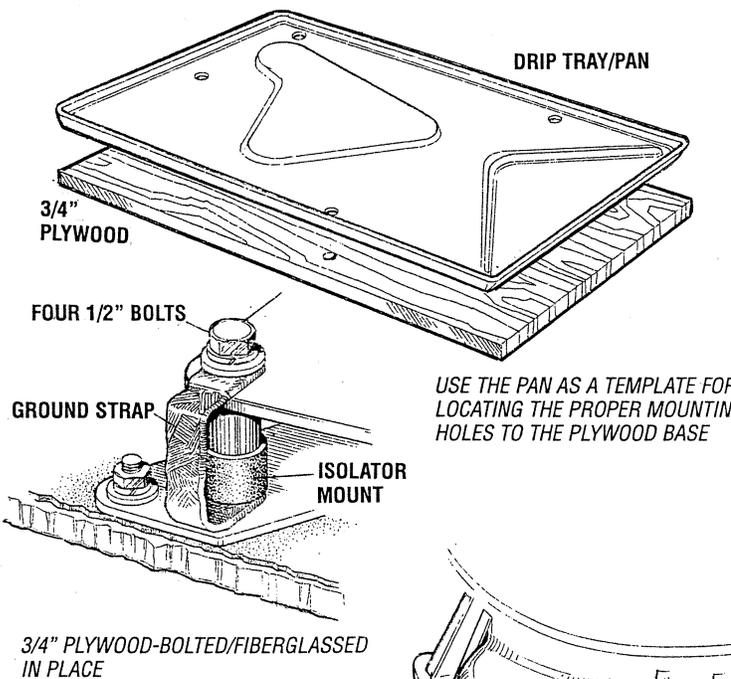
The engine/generator is fitted with lifting eyes. Attach wire rope or chain slings capable of supporting the engine/generators weight to the eyes and lift the engine/generator by means of tackle attached to these slings. The lifting eyes have been designed to carry the full weight: auxiliary slings are not necessary.

**NOTE:** Rigging work is best done by someone experienced and competent in handling machinery.

## LOCATION AND MOUNTING

A solid, level mounting platform is very important for the proper operation of your generator. Select a location that will allow adequate space on all sides for ventilation and servicing. Locate the generator away from living quarters, and away from bilge splash and vapors.

Refer to WESTERBEKE'S installation manual for detailed information on installing a Marine Generator in a boat.



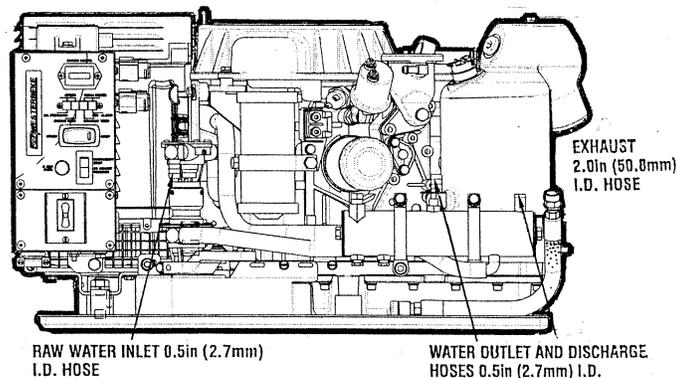
**BATTERY ATTACHMENTS TO STARTER MOTOR**  
REFER TO THE WIRING DIAGRAM IN THIS MANUAL

(-) NEGATIVE LEAD

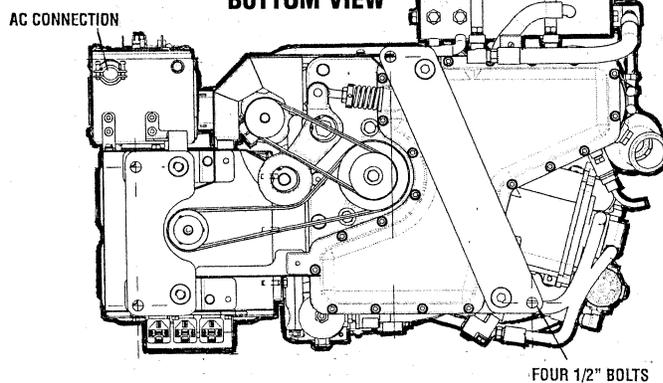
(+) POSITIVE LEAD

**NOTE:** Ensure that the B+ battery cable connected to the remote mounted starter solenoid is properly supported to prevent unwanted stress on the solenoid.

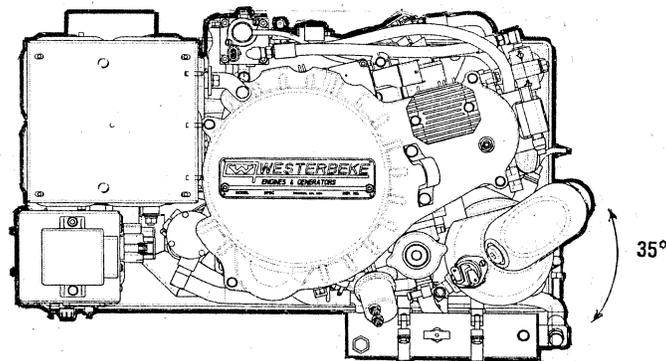
**SIDE VIEW**



**BOTTOM VIEW**



**TOP VIEW**



**DIMENSION (INCHES AND MM)**

## DIMENSIONAL DRAWINGS

For dimensional drawings. View the drawings on the Westerbeke website [www.westerbeke.com](http://www.westerbeke.com) for the most current drawings with dimensions.

# INSTALLATION/EXHAUST SYSTEM

## RAW WATER DISCHARGE

The fresh water that flows thru the engine is cooled by a continuous flow of raw water (via the heat exchanger). As the raw water is discharged overboard, it is used to cool the exhaust system.

## RAW WATER SUPPLY HOSE (INSTALLING)

The raw water supply hose from the discharge connection on the engines cooling system to the inlet connection of the water injected exhaust elbow **must be** looped a minimum of 12 inches (30cm) above the vessels loaded water line.

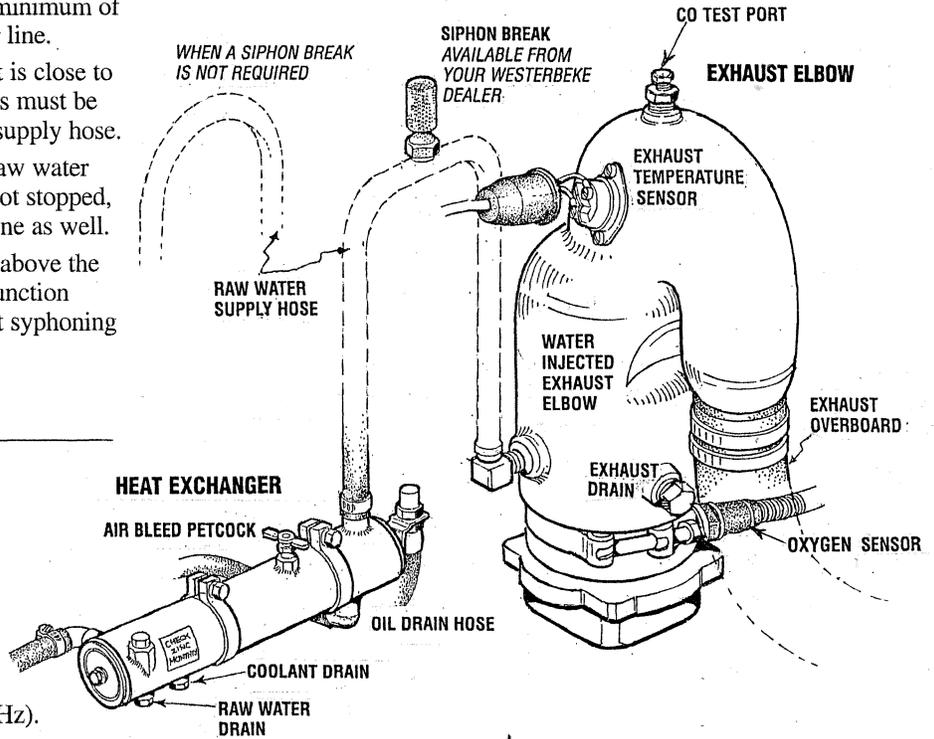
On installations where the water injected exhaust is close to or below the vessels loaded water line, provisions must be made to install a syphon break in the raw water supply hose.

The function of the syphon break is to stop the raw water flow after the engine is shutdown. This flow, if not stopped, will fill the exhaust system and possibly the engine as well.

The raw water supply hose must be looped well above the loaded water line to allow the syphon break to function during all attitudes of vessel operation to prevent syphoning when the generator is not operating.

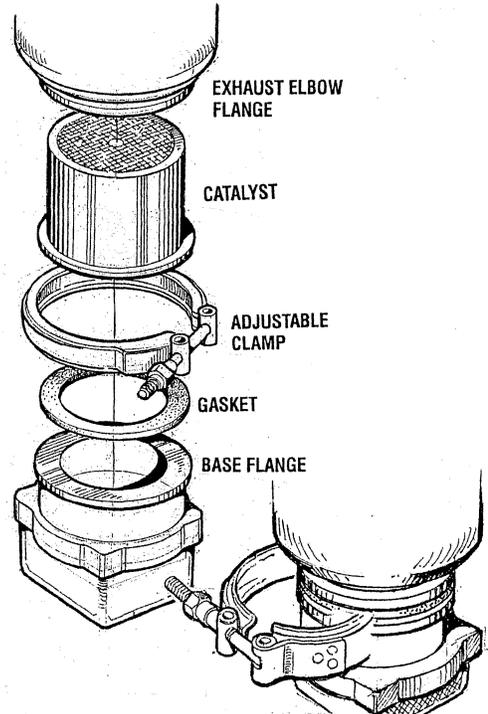
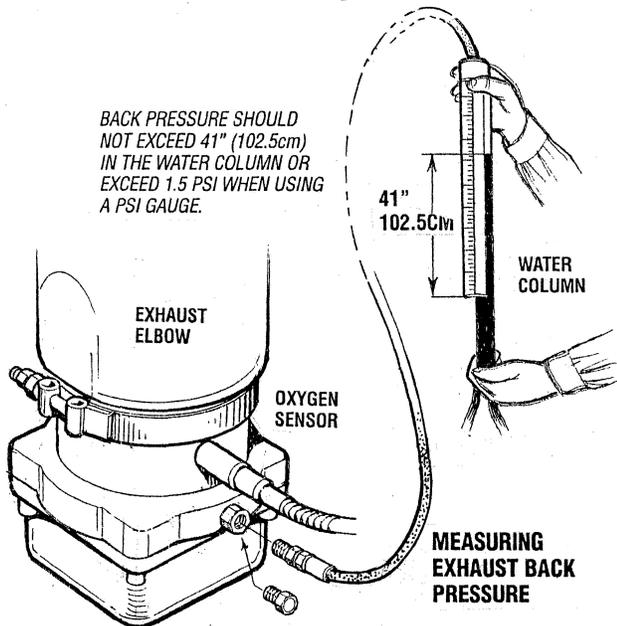
When the generators location is above the loaded water line of the vessel during all attitudes of vessel operation, it is still advisable to loop the raw water discharge hose at least 6 inches or more above the generator and then down to the inlet connection on the water injected exhaust elbow.

**NOTE:** Always use a quality hose with good wall integrity or wire reinforced hose so it will maintain its shape when looped and also provide proper mechanical support for the hose.



## EXHAUST BACK PRESSURE

Measure back pressure after the engine has reached its normal operating temperature and with rated amperage output applied to the generator (30 amps @ 60Hz and 15 amps @ 50Hz). Westerbekes Installation Manual Pub. #43400 has detailed information on back pressure.



POSITION THE CLAMP OVER THE TWO FLANGES (AND GASKET) AND TIGHTEN SECURELY

# FUEL, ENGINE OIL AND ENGINE COOLANT

## GASOLINE

Use only unleaded gasoline with an octane rating of 89 or higher. Higher octane is recommended. The use of lower octane gasoline will adversely affect engine performance. Ethanol blends must not exceed E-10.

When fueling, follow U.S. Coast Guard Regulations. Close all hatches and companionways to prevent fumes from entering the vessel. Ventilate properly after fueling and before starting the generator or main engines.

Use only clean fresh fuel! It is important to buy clean fuel, and keep it clean. The best fuel can be rendered unsatisfactory by careless handling or improper storage facilities. To assure that the fuel going into the tank for your engine's daily use is clean and pure, the following practice is advisable:

Purchase a well-known brand of fuel.

Install and regularly service a good, Coast Guard approved metal bowl type filter/water separator between the fuel tank and the engine. **This filter rating must be 10 microns or smaller.**

## ENGINE OIL

Use a heavy duty engine oil as called for in the Specifications Section of this manual. Change the engine oil and filter after the initial 50 hours of break-in operation. Then follow the oil and filter change intervals as specified in MAINTENANCE SCHEDULE in this manual.

Westerbeke Corporation does not approve or disapprove 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 listed in the MAINTENANCE SCHEDULE section of this manual and not extended if synthetic oils are used.

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

## OVER-FILLING

**CAUTION:** The oil sump on this generator's engine can unintentionally be over-filled!

After shutdown, the oil in the engine's internal passages can linger and take a number of hours to drain back into the sump. Allow at least a few hours for the oil to settle back into the sump before checking the dipstick reading.

(Re-starting the engine is not a problem as the engine's internal passages are well lubricated).

Over-filling the engine's sump will result in erratic operation, and/or a smokey oil laden exhaust, hard starting and possible no start.

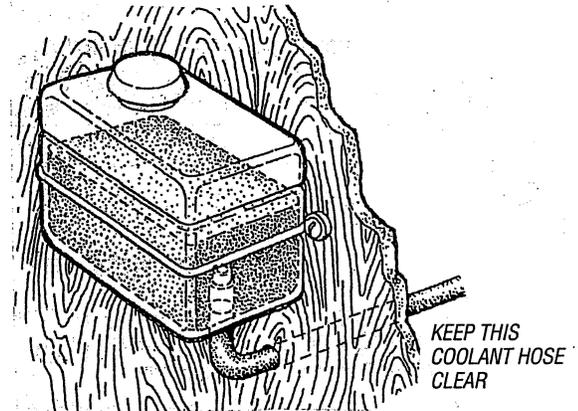
## ENGINE COOLANT

Engine coolant a 50/50 mixture of antifreeze and distilled water. This coolant allows the engine to run at its proper temperature by transferring heat from the engine to the coolant. It also lubricates and protects the cooling system from rust and corrosion. A 50/50 mixture of antifreeze and distilled water will protect the engine to -34°F (1.12°C).

## PURCHASING ANTIFREEZE

Rather than preparing the mixture, WESTERBEKE recommends buying the premixed antifreeze so that when adding coolant, the mixture will always be correct.

There are two common types of antifreeze, Ethylene Glycol (green) and Propylene Glycol (red/purple). Either can be used but do not mix the two and if changing from one to another, flush the engine thoroughly.



## COOLANT RECOVERY TANK

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

**NOTE:** This coolant recovery tank, with its short length of hose, is best located at or above the cooling systems pressure/fill cap.

# CONTROL PANEL - START/STOP PANEL

## DESCRIPTION

**To Start:** Press the rocker switch to the start position and release. (The switch will revert to its center position). The engine will crank and start electronically. A **green LED** on the switch will indicate the engine is running.

**NOTE:** There is a brief delay while the ECU self-tests before the start button responds.

Apply a light load to the generator and allow the engine to warm up to operating temperature before applying heavy loads.

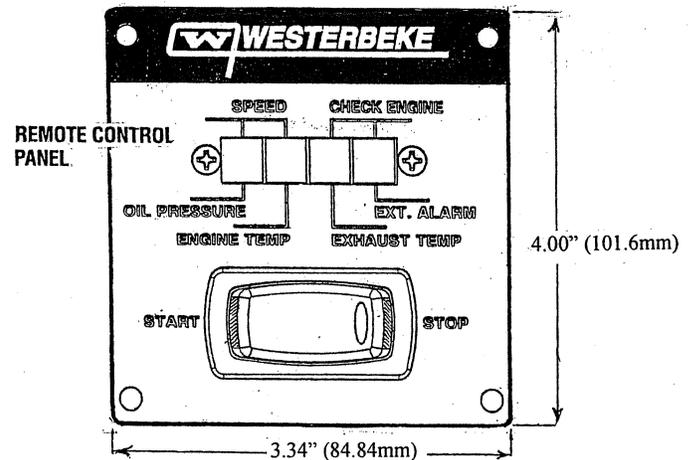
**To Stop:** Press the rocker switch to stop and release. The ECU will receive the signal to shut the engine down. The green LED will go off indicating the unit has shut-down.

**NOTE:** This green LED may illuminate dimly when the engine is not running. This is part of the self diagnostic circuit and is normal.

## FAILURE TO START

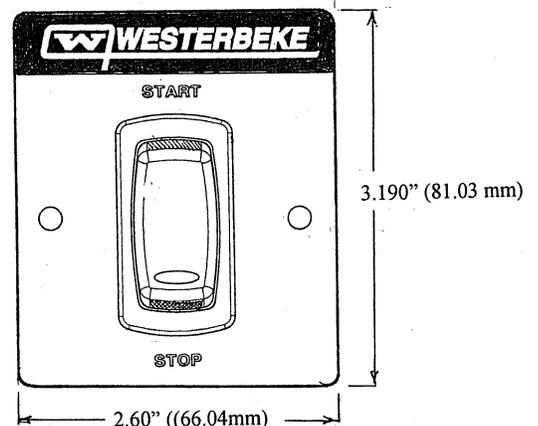
The start cycle will automatically terminate if the engine fails to start after 8 seconds of cranking. Three start attempts can be performed before an underspeed fault occurs. **This prevents prolonged cranking which can result in the exhaust filling with water and backing into the engine.**

To try repeat start attempts while solving and repairing the problem, close the thru-hull (water intake valve). When the starting problem is corrected do not forget to open the thru-hull.



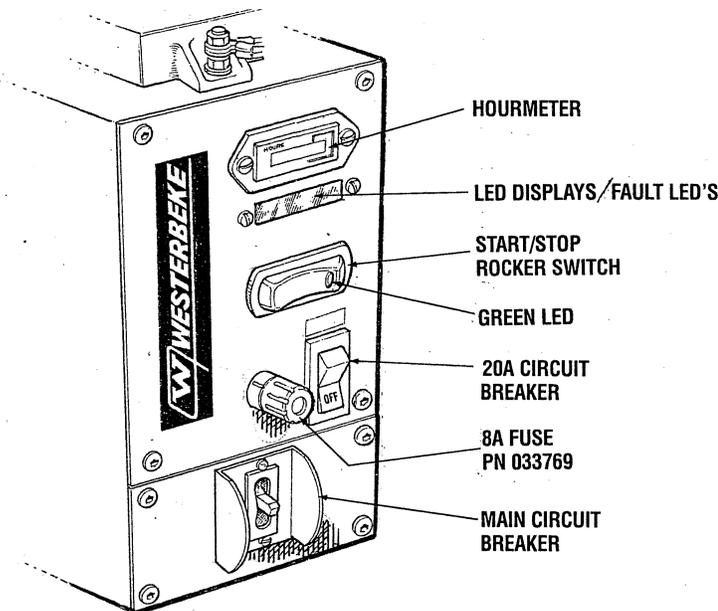
## REMOTE PANEL (with Fault LEDs)

An optional remote panel and plug-in extension harness are available that allows for remote operation of the generator. The Start/Stop sequence is identical. Once installed, the engine can be operated by either panel.



## REMOTE PANEL (STOP/START SWITCH ONLY)

**NOTE:** For wiring these remote panels, refer to the Wiring Diagram section in this manual.



## SHUTDOWN (Refer to SAFETY SHUTDOWN SWITCHES)

A shutdown is when the ECU (Electronic Control Unit) stops the generator because it has detected an operating fault which could cause damage to the engine, the generator, or create an unsafe operating condition.

## AMPERAGE DRAIN

There is a very small amount of amperage being drawn from the unit's starting battery by the electronics on the unit when the generator is not in use. To prevent this and draw down of the starting battery, turn **OFF** either the panel DC breaker or the starting battery switch when the unit will not be operated for a period of time.

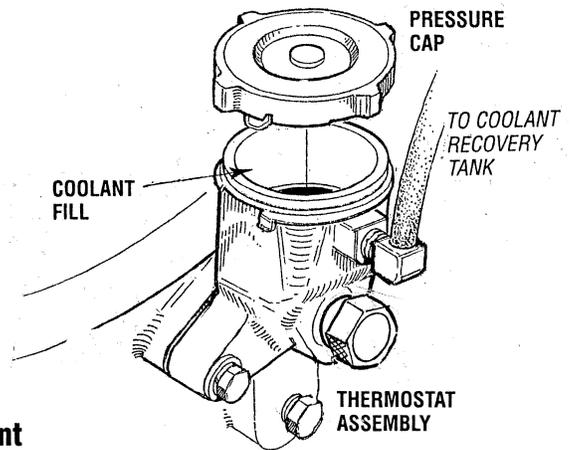
# PREPARATIONS FOR INITIAL START-UP

## PRESTART INSPECTION

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

- Make certain the cooling water thru-hull petcock is open.
- **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 load leads for correct connection as specified in the wiring diagrams.
- Examine air inlet and outlet for air flow obstructions.
- Be sure no other generator or utility power is connected to load lines.
- Be sure that in power systems with a neutral line that the neutral is properly grounded (or ungrounded) as the system requires, and that the generator neutral is properly connected to the load neutral. In single phase systems an incomplete or open neutral can supply the wrong line-to-neutral voltage on unbalanced loads.
- Visually examine the unit. Look for loose or missing parts, disconnect wires, unattached hoses, and check threaded connections. Make sure there is no leakage.

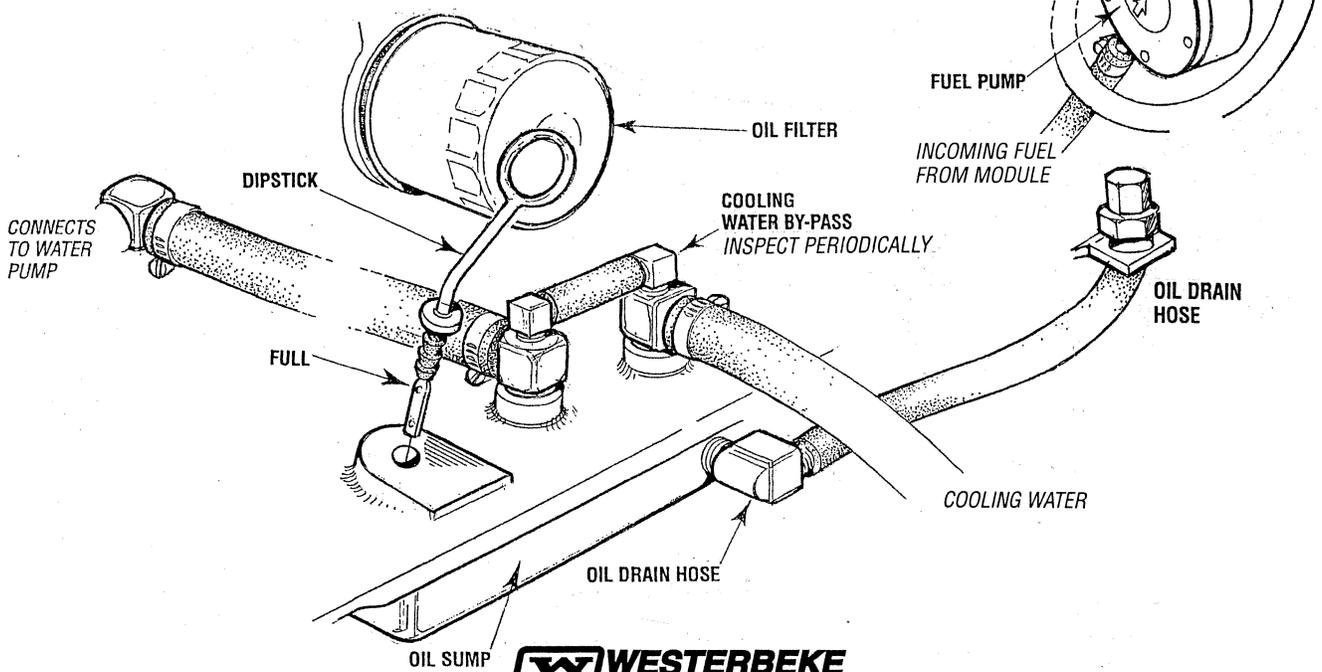
**CAUTION:** When starting the generator, it is recommended that all-AC loads, especially large motors, be switched OFF until the engine has come up to speed and starts to warm up. This precaution will prevent damage caused by unanticipated operation of the AC machinery and will prevent a cold engine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



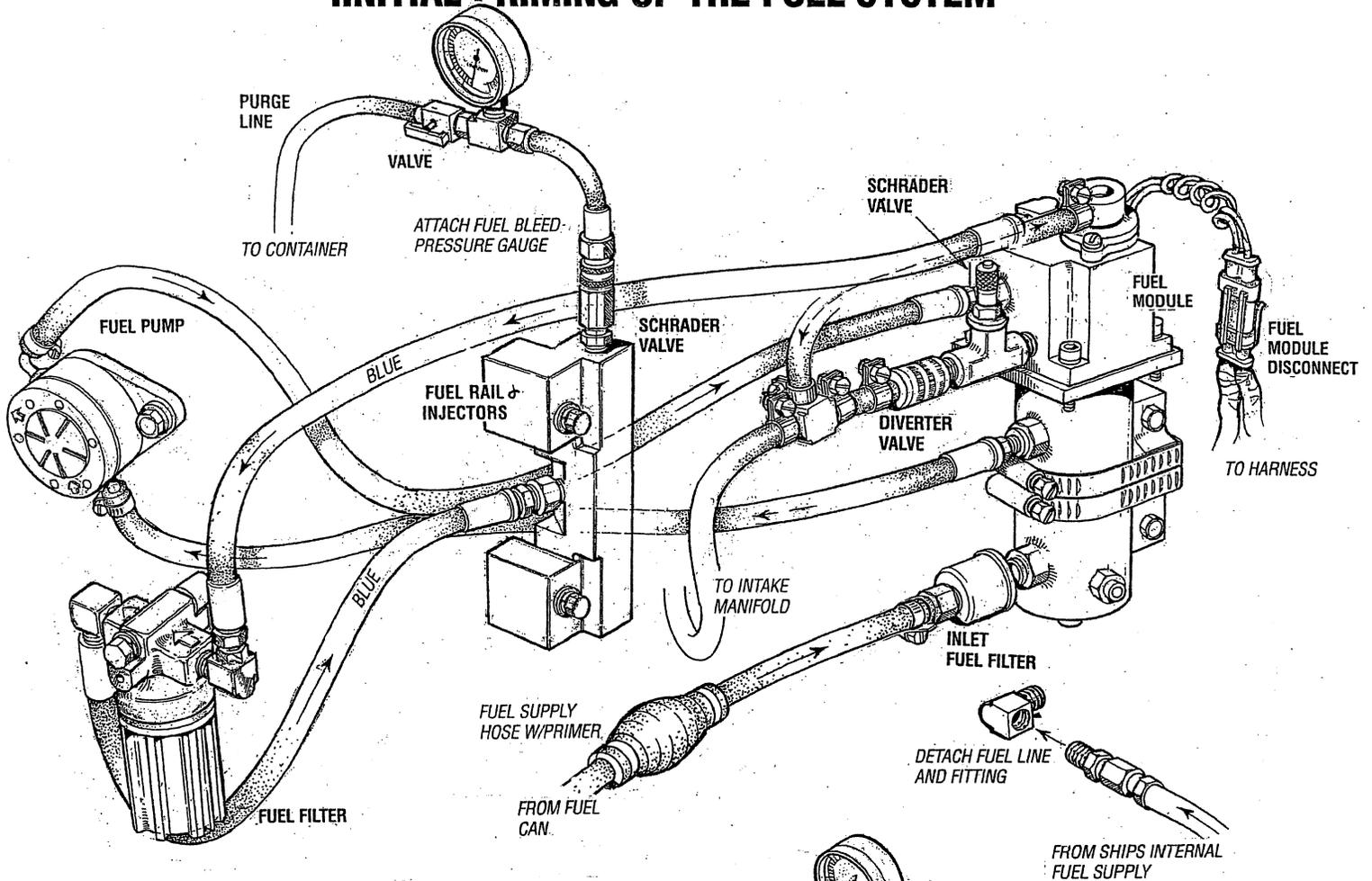
## Coolant

- **Check the coolant level** in both the plastic coolant recovery tank and at the filler neck opening on the unit.

**NOTE:** After the initial running of the generator, the air in the engine's cooling system should be purged to the plastic coolant recovery tank. After shutdown and as the engine cools, coolant should be drawn back into the engine's cooling system to replace the displaced air. Once cooled, open the air bleed petcock on the engine's heat exchanger to allow any air left in that area to be expelled. Then close it. Open the pressure cap on the system filler neck and ensure the system is completely full. Replace the cap and fill the plastic coolant recovery tank half way between MAX and LOW.



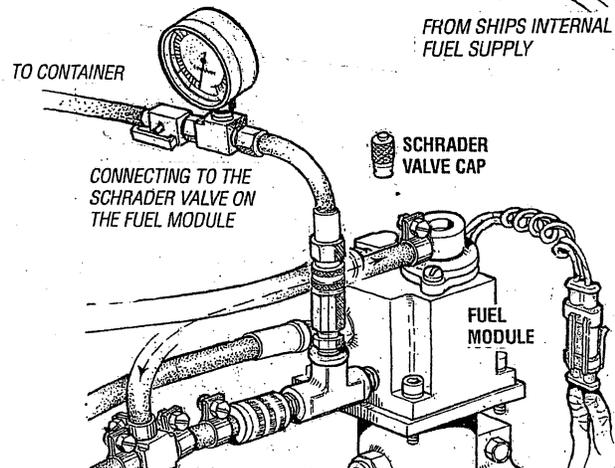
# INITIAL PRIMING OF THE FUEL SYSTEM



**NOTE:** The generators fuel system must be primed with fuel before its initial start.

## INSTRUCTIONS

1. Connect a Snap-On #EEFI-500 or equivalent fuel bleed/pressure gauge set (available at auto supply stores) to the schrader valve on the fuel rail at the injectors. Direct the purge line from this tool into a container and open the valve to the purge line.
2. Temporarily attach a separate fuel supply hose with Primer Bulb to the fuel inlet connection on the engine.
3. Operate the primer bulb moving fuel into the engines fuel system. Monitor the fuel/air flow through the purge line into the container. Once clear fuel free of air is moving through the purge line, stop priming.
4. Remove the fuel bleed/pressure gauge set and replace the cap on the schrader valve.
5. Remove the separate fuel supply hose from the inlet connection and connect the ships internal supply. Be careful to prevent any fuel spillage.
6. Start the unit and allow the unit to warm up and load test. Check for any fuel system leaks.
7. Re-bleed once running, low first then high pressure schrader.



**NOTE:** The fuel bleed/pressure gauge set can be connected to the schrader valve on the fuel module while the engine is running with the purge line directed into a container and be used to bleed any air that may have entered the system while performing step #5. Care should be taken when opening the valve on the purge line. It need only be opened slightly to allow any air to escape.

**CAUTION:** Fuel and fuel vapors are explosive! Do not allow any smoking, open flames or other source of fire near the fuel system. be certain that fuel lines are tight and free of leaks. Wipe up any spilled fuel and properly dispose of soiled rags.

# SAFETY SHUTDOWN SENSORS AND SWITCHES

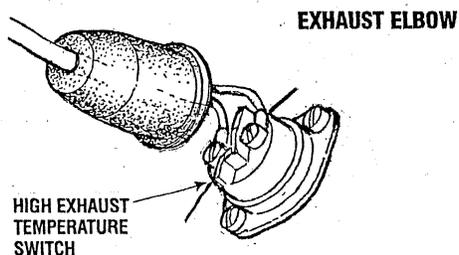
## SAFETY SHUTDOWN SWITCH/SENSORS

The engine is protected by four automatic shutdown circuits. Should a shutdown occur, **do not attempt to restart without finding and correcting the cause.** Refer to the heading *Engine starts, runs and then shuts down* in the **ENGINE TROUBLESHOOTING** section of this manual.

The following is a description of these automatic shutdown circuits:

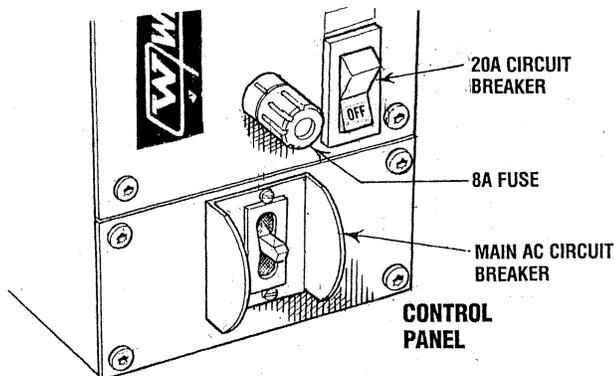
### High Exhaust Temperature Switch

An exhaust temperature switch is located on the water injected exhaust elbow. Normally closed contacts, this switch will open and the ECU will interpret this as a high exhaust temperature issue and de-energize the K2 and K3 relays, stopping the generator.



### Main AC Circuit Breaker

The main circuit breaker at the control panel will automatically disconnect the AC power if there is an overload. This circuit breaker must be manually switched off when servicing the engine/generator.



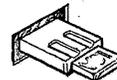
### Engine DC Circuit Breaker

The generator's engine DC circuit is protected by a rocker type DC 20 amp breaker mounted on the control box. *This also serves as an Emergency Stop Switch.* Excessive DC current draw or DC electrical overload anywhere in the instrument panel wiring or engine wiring will cause the breaker to trip to the OFF position. In this event, the DC power to the ECU will be interrupted, stopping the generator. No panel LED will illuminate. Check and repair the source of the problem. After repairing the fault, reset the breaker and restart the generator. The DC breaker must be cycled OFF then ON to clear any ECU shutdown from the ECU after the fault situation has been repaired.

## Fuses

A FL-15A fuse located on the control panel protects the electrical wiring. If an amperage overload occurs, the fuse will blow and shut down the engine.

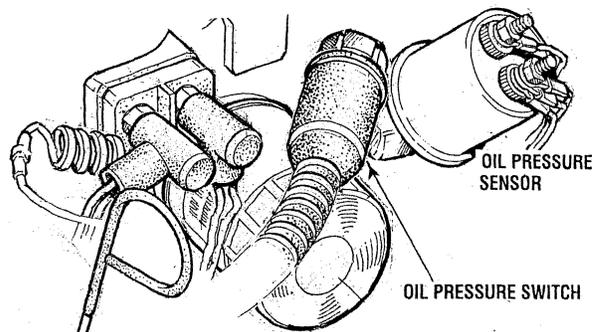
A 20A ATM fuse protects the battery charging circuit. If this fuse fails, the engine will continue to run but the battery will not be charging.



ATM 20A FUSE

## Oil Pressure Sensor

An oil pressure sensor is located off the engine's oil gallery. Oil pressure on the sensor affects the DC voltage through the sensor to the ECU. Should the voltage reach a preset value, the ECU will interpret this as a low oil pressure issue and open the K2 run relay, stopping the generator. The oil pressure LED on the panel will illuminate.



## Oil Pressure Switch

The oil pressure switch senses the engine's oil pressure. If the oil pressure falls below 5 PSI, the switch will shut off the fuel pump and the engine will shut down. The switch will reset itself when the oil pressure is restored.

## Water Temperature Sensor

A water temperature sensor is located at the thermostat housing. This resistance of the sensor changes as a function of temperature. The ECU measures this resistance and converts it to the corresponding engine coolant temperature. When the coolant temperature reaches the warning threshold, the CHECK ENGINE LED on the panel illuminates. If the coolant temperature exceeds the shut-down threshold, the ECU will open the K2 and K3 relays shutting down the generator and the coolant temperature LED on the panel will illuminate.

## High/Low RPM Shutdown

The ECU monitors engine rpm via the MPU (Magnetic Pick-Up) that is mounted under the flywheel. When the engine speed falls or rises to a pre-set rpm level, the ECU will shut down the engine and the fault LED for speed will illuminate.

# MAINTENANCE SCHEDULE

**WARNING:** Never attempt to perform any service while the engine is running. Wear the proper safety equipment such as goggles and gloves, and use the correct tools for each job. When servicing/replacing DC components, turn off the 20 amp DC circuit breaker on the control panel, or disconnect the battery terminals.

## SCHEDULED MAINTENANCE

## EXPLANATION OF SCHEDULED MAINTENANCE

### DAILY CHECK BEFORE START-UP

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)	Check for water and dirt in fuel. Drain filter if necessary. Replace filter per manufacturer's recommendation.
Fuel Supply	Fresh unleaded gasoline with an octane rating of 89 or higher.
Visual Inspection of Engine	Check for fuel, oil and water and exhaust leaks. Check for rust or corrosion. Inspect wiring and electrical connections. Ensure that bolts & nuts tight. Surface of the engine should be kept clean.

### INITIAL 50 HOURS OF OPERATION

Valve Clearance	Initial Adjustment.
Generator Drive Belt	Measure spring tension, inspect belt condition. Adjust tension as needed.
Engine Oil and Filter	Initial engine oil and filter change at 50 hours, then change both every 100 hours.
Exhaust System	Initial check at 50 hours, then every 250 hours. Carefully inspect for leaks. Check anti-siphon valve operation. Check the exhaust elbow for carbon and/or corrosion buildup on inside passages; clean and replace as necessary.
Zinc Anode	Inspect/clean
Fuel Filter	Initial change.
Fuel Inlet Filter	Initial change.
Spark Plugs	Check gap (0.035 in/0.8-0.9 mm)
Flame Arrester Screen	Initial cleaning of screen.
Water Pump	Adjust belt tension (3/8 - 1/2 deflection).

### EVERY 50 OPERATING HOURS OR WEEKLY

Drive Belts (Water Pump)	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 (and House 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.
Fuel Pump	Inspect for leaks, ensure fuel and electrical connections are clean and tight.
Zinc Anode	<b>NOTE:</b> Work out your own schedule, boats location, use of shore power can make a difference. Inspect monthly to determine schedule.

### EVERY 100 OPERATING HOURS OR YEARLY

Engine Oil and Filter	Change engine oil and filter.
Flame Arrester Screen	Clean screen, inspect rubber sealing ring and replace if necessary.
Timing Belt	Check for wear, cracks and stretching.
Generator Drive Belt	Measure spring length, inspect belt condition. Adjust as needed. Reference Service Bulletin #276.
Spark Plugs	Check plug gap. Adjust/replace as needed.

### EVERY 250 OPERATING HOURS OR YEARLY

Valve Clearance	Adjust valves.
Generator	Wipe generator clean of dust and engine exhaust Remove vent cover and inspect for loose connections and overheated wires or windings. make certain vents are clear and unobstructed.
Impeller(s)	Inspect impeller(s) for condition. Replace as needed.

# MAINTENANCE SCHEDULE

## SCHEDULED MAINTENANCE

## EXPLANATION OF SCHEDULED MAINTENANCE

### EVERY 250 OPERATING HOURS OR YEARLY (cont.)

*Exhaust CO Level	Sample exhaust with CO analyzer.
*Exhaust Elbow	Test exhaust elbow for structural integrity. Replace if elbow is corroded or deteriorated. Always use a new gasket. <b>NOTE:</b> <i>A leaking exhaust elbow or gasket can cause carbon monoxide exposure!</i>
Exhaust System	Carefully inspect for leaks. Check anti-siphon valve operation. Check the exhaust elbow for carbon and/or corrosion build-up on inside passages. Clean and replace as necessary.
*Exhaust System Back Pressure	Perform back pressure test to ensure system has not developed restrictions that will increase pressure above 1.5 psi or 41 inches of water column at full operating amperage load. Correct as needed.
Fuel Filter and O-Rings	Remove and replace fuel filter and all sealing O-rings.
Fuel Filter Inlet	Remove and replace inlet fuel filter.
Generator	Check that AC connections are clean and secure. Ensure wires have no chafing. See <i>GENERATOR INFORMATION</i> .
Hoses	Engine hoses should be firm and tight. Replace if hoses become spongy, brittle or delaminated. Check and tighten all hose clamps.
Spark Plugs	Replace spark plugs.
Vibration Isolators/Engine Mounts	Check vibration isolators, brackets and mounting hardware.
Zinc Anode	Remove and replace zinc anode. Open heat exchanger end cap(s) and clean out debris. Replace gasket and O-rings if needed.

### EVERY 500 OPERATING HOURS OR YEARLY

Raw Water Pump	Remove the dual pumps. Follow the instructions in this manual and disassemble both pumps. Inspect and replace any worn parts. Lubricate, reassemble and install. With engine running, check for leaks and for proper pumping action.
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### EVERY 500 OPERATING HOURS OR EVERY TWO YEARS

Coolant System	Drain, flush and re-fill the cooling system with appropriate antifreeze mix. Replace the thermostat and coolant pressure cap.
Engine Compression, Head Bolt Torque and Valve Clearances	Incorrect valve clearance will result in poor engine performance. Check the head bolt torque and adjust the valve clearances. Check that the compression pressure is within published specifications.
Starter Motor	Check solenoid and motor for corrosion. Remove and lubricate. Clean and lubricate the starter motor pinion drive.
Diverter Valve	Replace.

### EVERY 1000 OPERATING HOURS OR EVERY FOUR YEARS

*Engine Timing Belt	Remove and replace the timing belt. <b>NOTE:</b> <i>Failure to replace the timing belt at the recommended interval could result in timing belt failure resulting in major damage to the engine.</i>
Heat Exchanger	Remove the heat exchanger for professional cleaning and pressure testing.

### EVERY 2000 OPERATING HOURS

*Oxygen Sensor	Remove and replace exhaust oxygen sensor. Inspect every 1,000 hours.
*Catalyst	Remove and replace exhaust catalyst. (assy. #049103)

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

**NOTE:** *The operation of the unit's "LOW CO" system must be monitored at least once an operating season. This is to ensure that the system is operating properly. Free system diagnostic software is available for use with a laptop by contacting your area Westerbeke Distributor.*

# ENGINE LUBRICATING OIL

## DESCRIPTION

Use a heavy duty engine oil with an API classification of SJ, SL, or SM. Change the engine oil and filter after an initial 50 hours of break-in operation. Then follow the oil change interval as specified in the **MAINTENANCE SCHEDULE** in this manual.

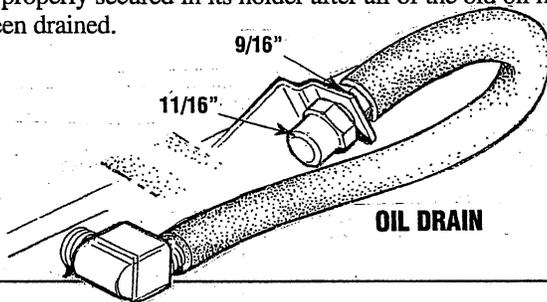
**An oil viscosity of SAE-15W-40 is recommended for this engine in all conditions and all seasons.**

Westerbeke Corporation does not approve or disapprove 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 listed in the **MAINTENANCE SCHEDULE** section of this manual and not be extended if synthetic oils are used.

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

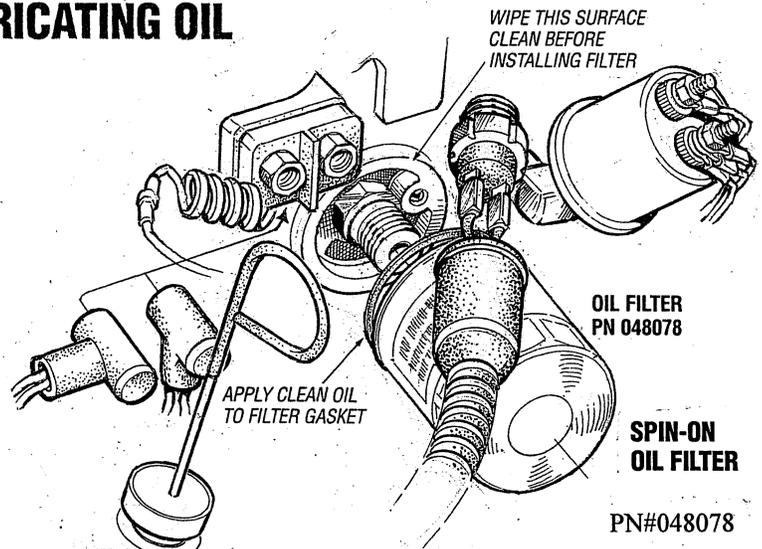
## CHANGING THE ENGINE OIL

The engine oil should be warm. Remove the oil drain hose from its attachment bracket and lower it into a container and allow the oil to drain, or attach a pump to the end of the drain hose and pump the old oil out. Make sure the oil drain hose is properly secured in its holder after all of the old oil has been drained.



**⚠ 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.*

Always observe the old oil as it is removed. A yellow/gray emulsion indicates the presence of water in the oil. Although this condition is rare, it does require prompt attention to prevent serious damage. Call a competent mechanic if water is present in the oil. Water present in the oil can be the result of a fault in the exhaust system attached to the engine and/or a siphoning through the water cooling circuit into the exhaust, filling it up into the engine.



## CHANGING THE OIL FILTER

When removing the used oil filter, you may find it helpful to punch a hole in the upper and lower portion of the old filter to drain the oil into a container before removing it. This helps to lessen spillage. An automotive filter wrench should be helpful in removing the old oil filter. Place some paper towels and a plastic bag around the filter when unscrewing it to catch any oil that's in the filter. 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 oil filter adapter, gently remove it. When installing the new oil filter element, wipe the filter gasket's sealing surface on the oil filter adapter free of oil and apply a thin coat of clean engine oil to the rubber sealing gasket on the oil filter. Screw the filter onto the threaded oil filter stub, and tighten the filter firmly by hand.

**NOTE:** *Use genuine WESTERBEKE oil filters. Generic filters are not recommended.*

## REFILLING THE OIL SUMP

Add fresh oil through the valve cover. After refilling the oil, run the engine for a few moments while checking the engine's oil pressure. Make sure there is no leakage around the new oil filter or from the oil drain system.

## OVER-FILLING

**CAUTION:** *The oil sump on this generator's engine can unintentionally be over-filled!*

After shutdown, the oil in the engines internal passages can linger and take a number of hours to drain back into the oil sump. Allow at least a few hours for the oil to settle back into the sump before checking the dipstick. An overnight period will provide an even more accurate dipstick reading.

(Re-starting the engine is not a problem as the engine's internal passages are well lubricated).

Over-filling the engine's sump will result in erratic operation, and/or a smokey white oil laden exhaust, hard starting and possible no start.

# FUEL SYSTEM

## GASOLINE

Use only unleaded gasoline with an octane rating of 89 or higher. Higher octane is recommended. The use of lower octane gasoline will affect engine performance adversely. Ethanol blend must not exceed E10.

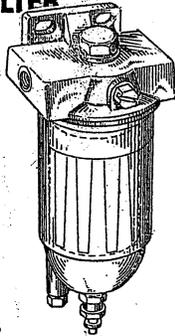
**NOTE:** The generator compartment should have a gasoline fume detector/alarm properly installed and working.

## GASOLINE/WATER SEPARATOR AND FILTER

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

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

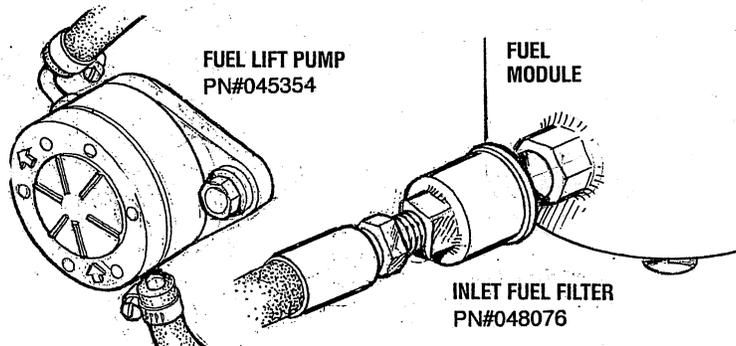
These gasoline filters must have *metal* bowls (not "see-through") to meet U.S. Coats Guard requirements. The metal bowls have drain valves to use when checking for water and impurities. This filter rating must be 10 microns or smaller.



TYPICAL FUEL FILTER/WATER SEPARATOR

## FUEL 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 engine mounted fuel pump is maintenance free.



## INLET FUEL FILTER

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

1. Shut off the fuel supply to the generator. Disconnect the fuel supply line to the inlet filter and unscrew the filter from the pump inlet. Take care to catch any fuel that may be present.
2. Thread on the replacement inlet filter and connect the fuel supply line. Use care when connecting and tightening the fuel supply line so as not to distort the inlet filter.
3. Turn on the fuel supply to the generator and start the generator. Ensure that there are no leaks.

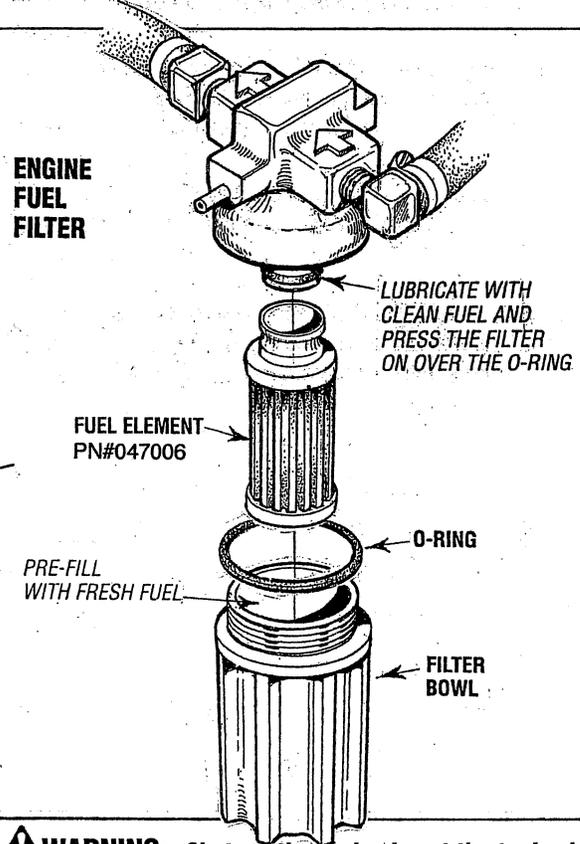
## ENGINE FUEL FILTER

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 Filter Element

1. Shut the fuel supply to the generator off.
2. Ensure system fuel pressure is at zero. Bleed off the system pressure using a Schrader valve located on the injector throttle body. Use extreme care as pressure may be as high as 45 PSI or more. Use towels to wrap the valve and catch or subdue any fuel spray.
3. Unscrew the fuel bowl from the housing and pull the filter element down and off. Use care to catch any fuel that may be present.
4. Replace the sealing "O" ring. Install the new filter element and thread on the fuel bowl then tighten by hand.
5. Open the fuel supply to the generator and start the unit. Ensure that there are no leaks.

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



**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.

# COOLING SYSTEM

## FRESH WATER COOLING CIRCUIT

Fresh water (antifreeze) is moved through the engine by a belt driven circulating pump, absorbing heat from the engine. Some of the coolant by-passes the thermostat to maintain circulation in the engine and is drawn through the heat exchanger. The engine operating temperature rises and the thermostat reacts to this and starts to open allowing more coolant to flow through the heat exchanger. The thermostat opening will change as it gains control of the engine operating temperature by allowing more or less coolant flow through it.

## ENGINE COOLANT

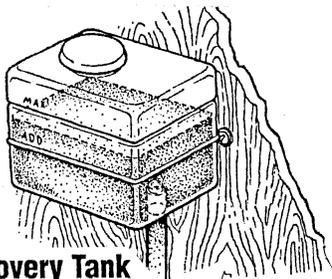
WESTERBEKE recommends a mixture of 50% antifreeze and 50% distilled water. Distilled water is free from the chemicals that can corrode internal engine surfaces.

The antifreeze performs a 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.

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

The recommended 50/50 mixture will protect the engine against the most extreme temperature. The antifreeze mixture will also retard rust within the engine and add to the life of the circulating pump impeller and seals.

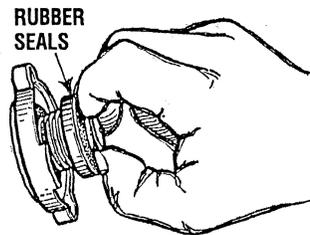
A proper 50/50 mixture as recommended will protect the engine coolant to temperatures of  $-40^{\circ}\text{F}$ .



## Coolant Recovery Tank

The coolant recovery tank allows for the expansion and contraction of the engines coolant during engine operation without introducing air into the system. This recovery tank 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.



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

## CHANGING COOLANT

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

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

Drain the engine coolant by loosening the drain plug on the heat exchanger and opening pressure cap. Also loosen the air bleed petcock on the top of the heat exchanger

**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  $190^{\circ}\text{F}$ .

## Refilling the Coolant

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

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

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

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

# COOLING SYSTEM

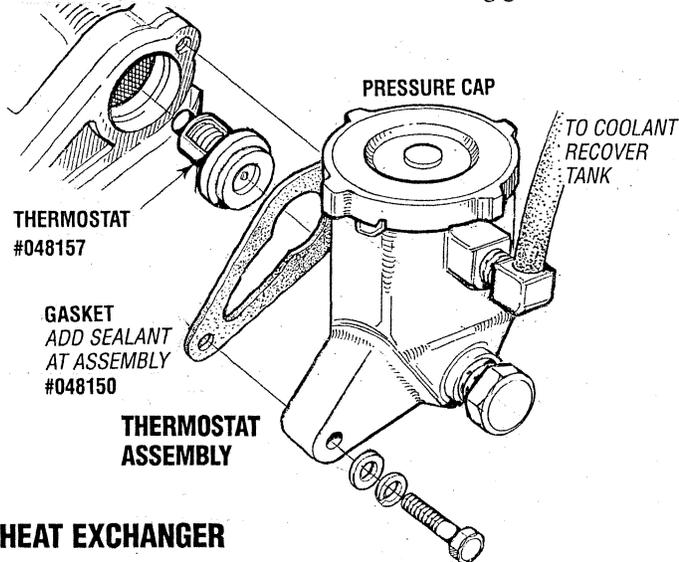
## THERMOSTAT

A thermostat, located in the coolant filler cap housing (illustrated below), controls the coolant's temperature by allowing more or less coolant through it to the engine's heat exchanger. When the engine is first started, the closed thermostat prevents coolant from flowing through it to the heat exchanger. Some coolant is by-passed via a by-pass hose on the sump plate to the exchanger. This provides for coolant circulation in the engine and for coolant temperature rise. As the coolant warms up, the thermostat gains control of the engine operating temperature by allowing more or less coolant flow to the exchanger. The thermostat is accessible and can be replaced easily. Carry a spare thermostat and housing gasket.

### Replacing the Thermostat

Remove the cap screws and disassemble the thermostat housing as shown. When installing the new thermostat and gasket, apply a thin coat of sealant on both sides of the gasket before pressing it into place.

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



## HEAT EXCHANGER

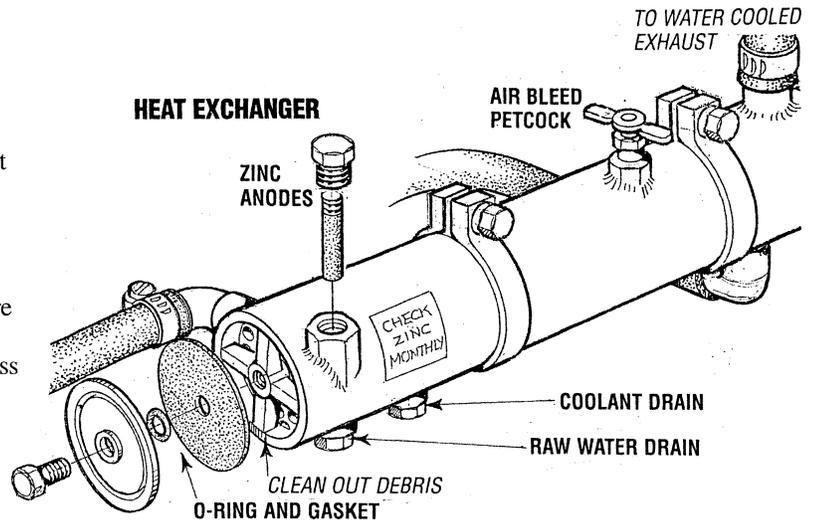
Cool raw water flows through the inner tubes of the heat exchanger. As the engine coolant passes around these tubes, the heat of the internal engine is conducted to the raw water which is then pumped into the exhaust system and discharged. The engine coolant (now cooled) flows back through the engine and the circuit repeats itself.

The engine coolant and raw water are independent of each other; this keeps the engine's water passages clean from the harmful deposits found in raw water.

### Heat Exchanger Service

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

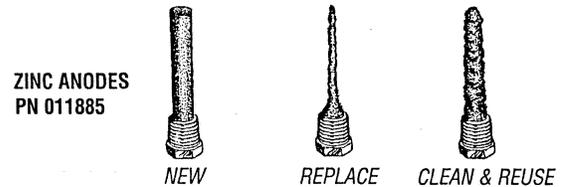
**NOTE:** Operating in silty and/or tropical waters may require that a heat exchanger cleaning be performed more often than every 1000 hours.



## ZINC ANODE

A zinc anode, or pencil, is located in the raw water cooling circuit within the heat exchanger. The purpose of 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 is the result of each particular installation and vessel location; not that of the engine.



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 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 anode.

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

# COOLING SYSTEM / WATER PUMPS

## DESCRIPTION

The fresh water cooling system has the raw water pump mounted above the fresh water (coolant) pump as illustrated. These pumps are self-priming, rotary pumps, with non-ferrous housings and Neoprene impellers. The impellers have flexible blades that wipe against a curved cam plate within the impeller housing, producing the pumping action. *These pumps can not be allowed to run dry.* There should always be a spare impeller and impeller cover gasket aboard (an impeller kit). Water pump impeller failures occur when lubricant (water) is not present during engine operation. Such failures are not warrantable, and operators are cautioned to make sure water flow is present at start-up. Water pumps should be inspected periodically for broken or torn impeller blades. See *MAINTENANCE SCHEDULE*.

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

## CHANGING THE WATER PUMP IMPELLERS

Remove the cover screws and the cover will separate the upper pump (raw water) from the fresh water (coolant) pump as shown in the illustration. Close the raw water thru hull seacock. This will prevent water syphoning out of the pump while the impeller is being changed.

1. Remove the wear plate to expose the impeller. Notice the direction the impeller blades are working in so as to install the replacement impeller with blades working in the same direction.
2. Using pliers, grab the impeller hub and withdraw the impeller from the pump. Inspect the inside of the pump, the cam, the inner wear plate, and the inside surface of the cover plate for wear. Replace any worn components.
3. Wipe the inside surface of the pump dry. Apply a film of glycerin supplied in the impeller kit to the inside pump surfaces and to the exposed area of the shaft lip seal.
4. Install the new impellers with a rotating motion so the blades are working in the same direction as those of the removed impeller.
5. Apply glycerin to the O-ring, impeller, gasket, the wear plate and assemble into the pump housing. Reassemble the upper pump (raw water) making certain the fasteners are tight. Re-install any hoses that were removed.
6. Run the engine to make certain both pumps are operating properly. The engine should run at proper temperature. raw water should discharge from the exhaust and there should not be any leaks around the pumps.

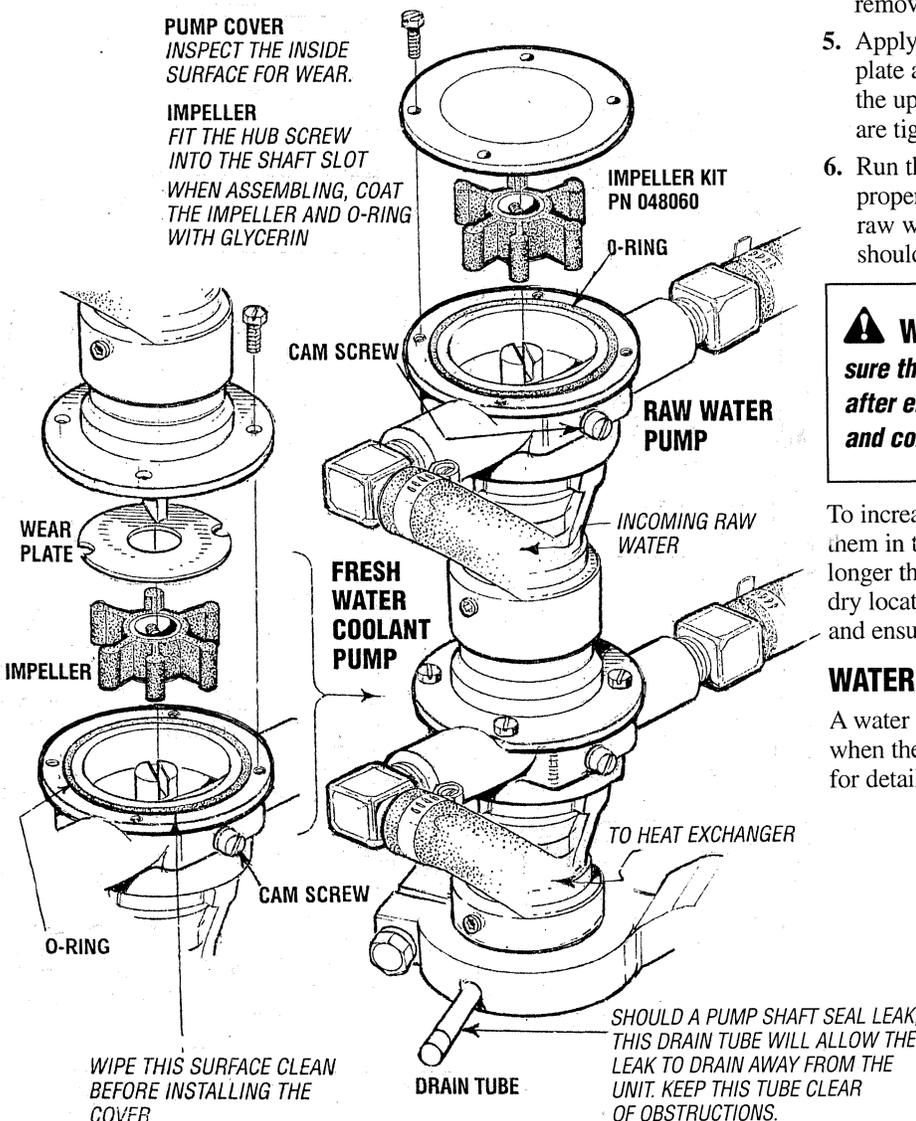
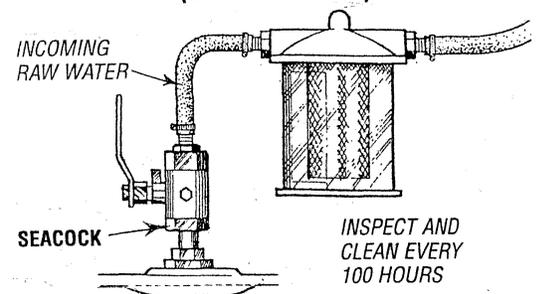
**WARNING:** When the engine is started, make sure that the pumps are pumping within 30 seconds after engine start. If not, "stop" the engine at once and correct the problem.

To increase the service life of the impeller, do not install them in the pump if the engine will be in storage for longer than 3 months. Store the impellers in a dark, cool, and dry location. Replace the cover plate on the pumps securely and ensure the thru hull seacock is closed.

## WATER INTAKE STRAINER

A water intake strainer (raw water) is a required component when the generator is installed. Refer to the previous page for details.

### TYPICAL RAW WATER STRAINER (OWNER INSTALLED)



# DC CIRCUIT/BATTERY

## DESCRIPTION

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

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

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

## Specifications

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

## Battery Charging Circuit

The engine supplies a continuous 6 amp charge from the voltage regulator to the engine's battery. This charge passes thru an 8 amp fuse (and the ships battery switch).

## Testing the Circuit

If the battery is not charging, check the fuse. To test the circuit, remove the fuse and test with a voltmeter between the fuse holder connection and ground. With the engine running, it should indicate 13.0 - 13.1 volts. If only battery voltage is indicated, check the terminal connections at the battery.

## Battery Maintenance

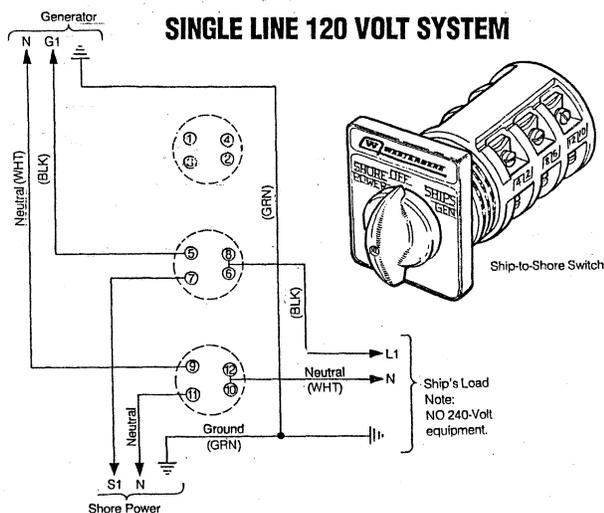
Review the manufacturer's recommendations and then establish a systematic maintenance schedule for your engine's starting batteries and house batteries.

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

**NOTE:** Ensure that the B+ battery cable connected to the remote mounted starter solenoid is properly supported to prevent unwanted stress on the solenoid.

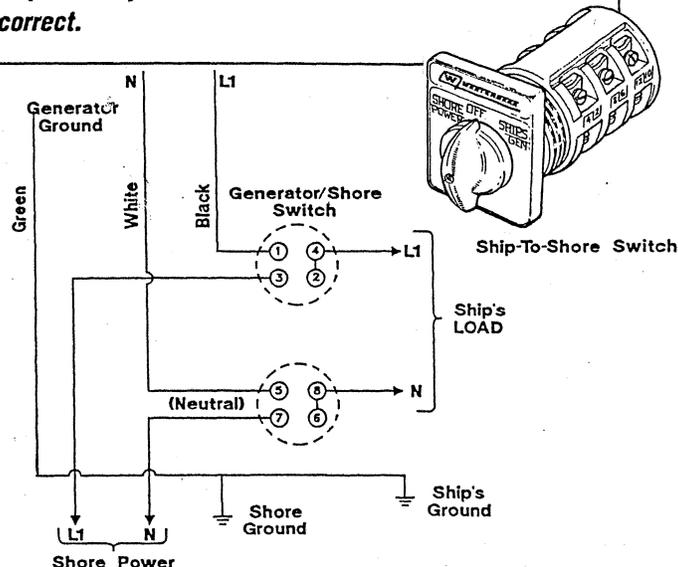
# SHORE POWER TRANSFER SWITCH

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



Shore Power Transfer Switches are available from your WESTERBEKE dealer.

**⚠ 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.



# ENGINE COMPONENTS

## SPARK PLUGS

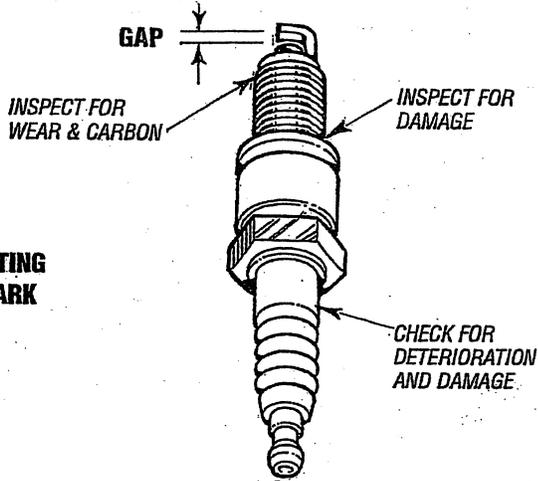
The spark plugs should be cleaned and re-gapped after the first 50 hour break-in period, then inspected every 250 hours thereafter and replaced as needed.

**⚠ WARNING:** Do not remove the spark plugs while the engine is hot. Allow the engine to cool before removing them.

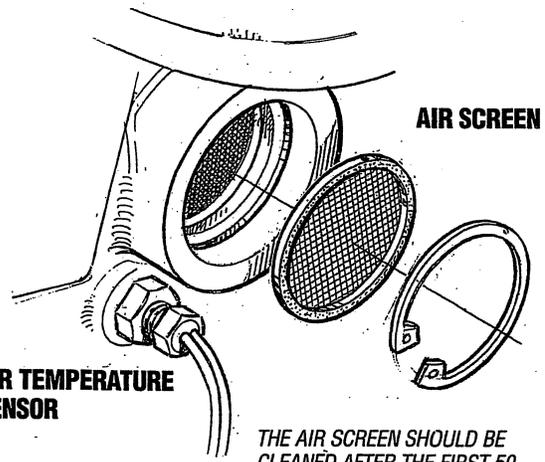
SPARK PLUG GAP: 0.032 – 0.035in. (0.8 - 0.9mm).

SPARK PLUG TORQUE: 11 – 15 lb-ft (15 – 26 Nm).

**NOTE:** Loctite Anti-Seize applied to the threaded portion of the spark plugs will retard corrosion, making future removal of the spark plugs easier.



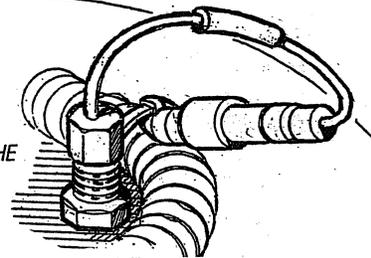
## INSPECTING THE SPARK PLUGS



THE AIR SCREEN SHOULD BE CLEANED AFTER THE FIRST 50 HOURS OF OPERATING, AND EACH 100 HOURS FROM THEN ON. CLEAN WITH A WATER SOLUBLE CLEANER SUCH AS GUNK.

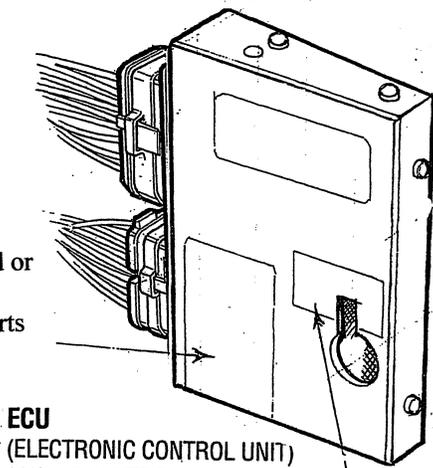
## CAM SENSOR

LOCATED ON TOP OF THE FLYWHEEL HOUSING

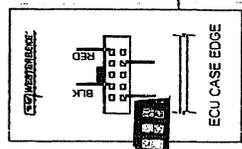


To Adjust: Remove the sensor and rotate the engine observing through the opening for a raised round disc. Position this under the opening. Thread the sensor in until it touches the disc, then back it out 1/4 - 1/2 turn and lock it in position.

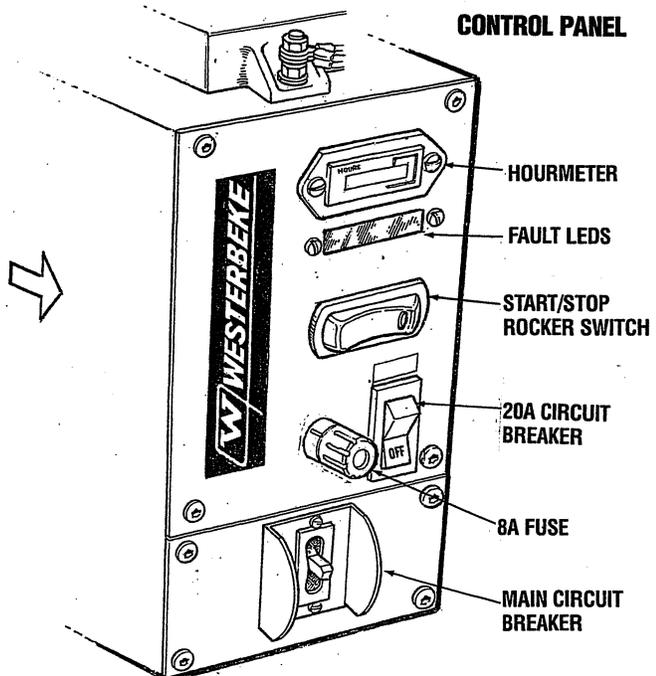
**Warranty Void**  
If label is damaged or cover is removed.  
No Serviceable Parts Inside.



ECU  
(ELECTRONIC CONTROL UNIT)  
(INSIDE CONTROL BOX)



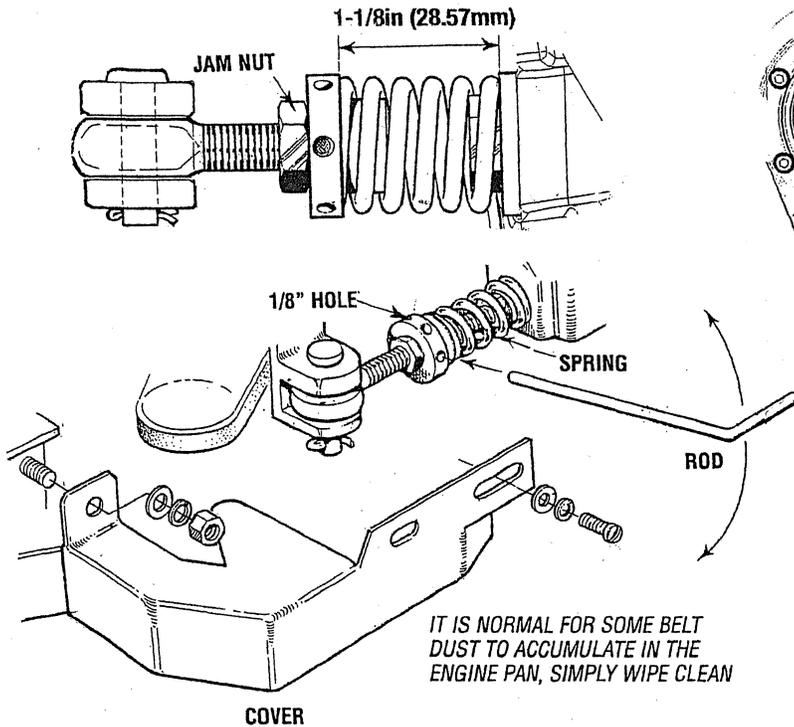
## CONTROL PANEL



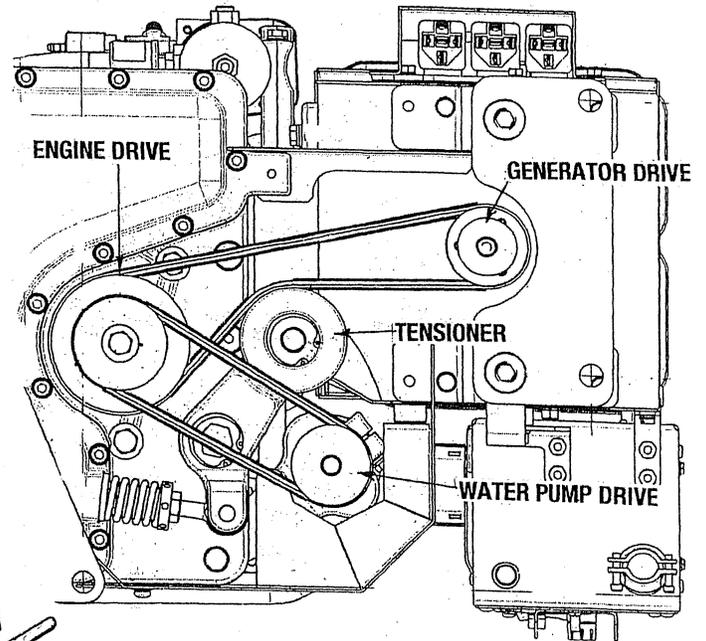
# ENGINE ADJUSTMENTS

## GENERATOR DRIVE BELT (ADJUSTING)

Generator models built prior to April 2015 (OC date code and older). The generator's drive belt is located under the engine. To access the belt for inspection and/or adjustment, remove the cover as shown. Follow the recommended inspection/adjustment periods found in the **Maintenance Schedule** of this manual. The proper belt tension can be checked by carefully measuring the spring length.



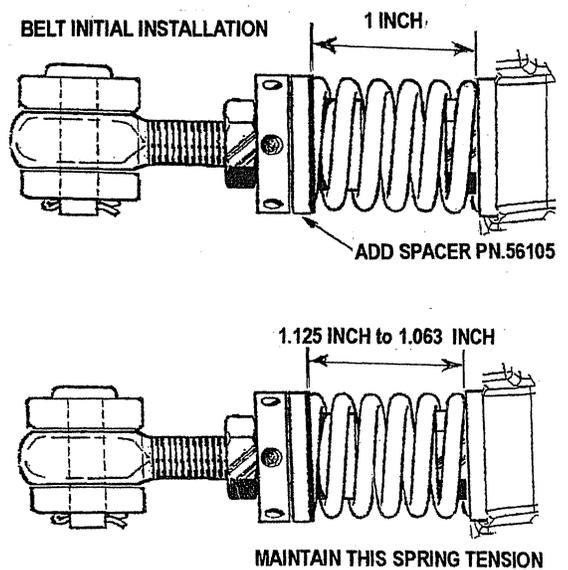
## BELT ASSEMBLY (viewed from underneath)



The Idler Arm/Spring should not **BOUNCE** more than 1/8-3/16 of an inch during normal, steady state operation. Excessive Idler bounce can be caused by insufficient drive belt tension. Operating with an insufficient drive belt tension and Idler bounce can result in premature drive belt wear and resulting failure. This applies to both older and current models.

## GENERATOR DRIVE BELT (ADJUSTING)

Generator models built after April 2015 on (OD date code and newer). The generator's drive belt is located under the engine and is accessed by removing the cover as shown in the illustration above. Drive belt tension is adjusted at the factory with a spring length of 1 inch (1.00"). It is important that the spring length be re-adjusted at the 50 hour break-in period to 1 1/8" - 1 1/32" (1.125" - 1.063"). this re-adjustment at the 50 hour break-in is very important with regards to drive belt service life. Failure to perform the re-adjustment can result in premature drive belt failure and possible warranty denial on belt replacement. Reference Service Bulletin #276 dated May 6, 2015. Follow the recommended inspection/adjustment periods found in the **Maintenance Schedule** of this manual.



# ENGINE ADJUSTMENTS

## ENGINE COMPRESSION TEST

To check the engine's compression pressure, warm up the engine, then shut it down.

1. Remove both spark plug caps and both spark plugs.
2. Install a compression adapter and gauge in a spark plug hole.
3. Close the thru hull valve (seacock).
4. Crank the engine several times quickly so that the gauge pointer reaches it's maximum.

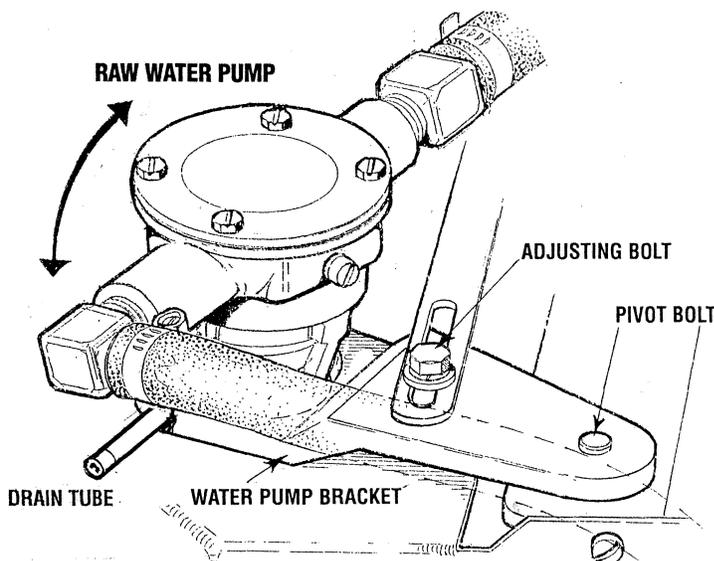
### STANDARD COMPRESSION PRESSURE AT 500 RPM:

71 PSI ( $5 \pm 1$  Kg/cm<sup>2</sup>) ( $0.4 \pm 0.1$  MPa)

5. Test the compression pressure on the other cylinder. If either cylinder is below the standard try adding a small amount of engine oil through the spark plug hole and repeat the test.
  - (a) If additional oil causes an increase of pressure, the piston ring and/or cylinder may be worn or damaged.
  - (b) If additional oil does not increase compression pressure suspect poor valve contact, valve seizure or valve wear.
6. Reinstall the two plugs, connect the wires and open the thru hull valve (seacock).

## WATER PUMP BELT

To remove, replace or adjust the belt, loosen the pivot bolt and release the adjusting bolt. Slide the water pump bracket to slacken the belt for removal. When replacing or adjusting the belt, tighten so to have a 3/8" - 1/2" deflection at its widest span.



## OIL PRESSURE

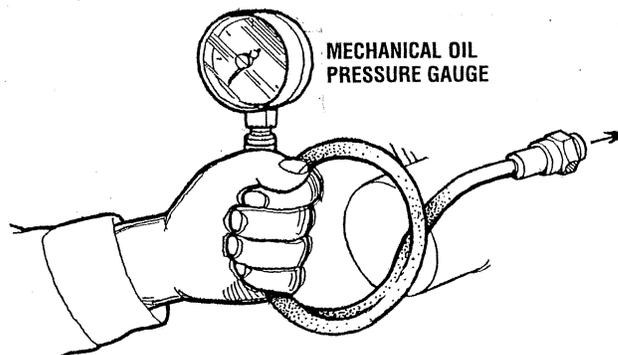
The lubricating system is a pressure feeding system using an oil pump. The engine oil is drawn from the oil sump by the oil pump, which drives the oil, under pressure, through the oil filter and various lubricating parts in the engine. The oil then returns to the oil sump to repeat the continuous cycle. 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 it's specified range.

**NOTE:** A newly starter (cold) engine may have an oil pressure up to 40 psi. A warmed engine can have an oil pressure as low as 30 psi. Oil pressure will vary depending on the load placed on the generator.

## TESTING OIL PRESSURE

To test the oil pressure, remove the oil switch and install a mechanical oil pressure gauge, in it's place, it will be necessary to connect the two switch wires together for the engine to run. After warming up the engine, with the engine speed at 2200 rpm, read the oil pressure gauge.

**OIL PRESSURE:** between 30 and 40 psi at 2200 rpm



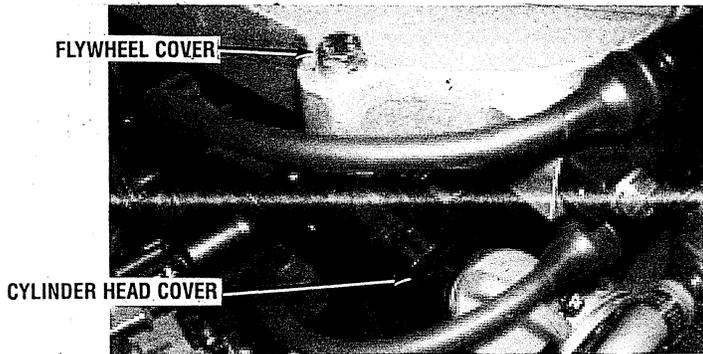
# ENGINE ADJUSTMENTS

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

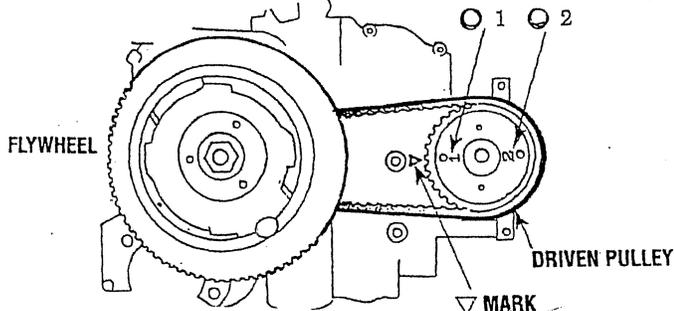
## VALVE CLEARANCE

It is routine maintenance to adjust the valve clearance after the first fifty hours of operation. Valve clearance adjustment must be performed when the engine is cool and the piston must be at the top dead center of the compression stroke. Perform the following adjustment steps:

1. Remove the fuel pump and filter assembly from the cylinder head cover. Unbolt the coil and move it out of the way. This should give good access to the valves behind the cover.
2. Remove the cylinder head cover.



3. Remove the flywheel cover to access the flywheel and driven pulley.
4. Turn the driven gear and align the "I and O" mark on the driven pulley with the "∇" mark on the cylinder head.



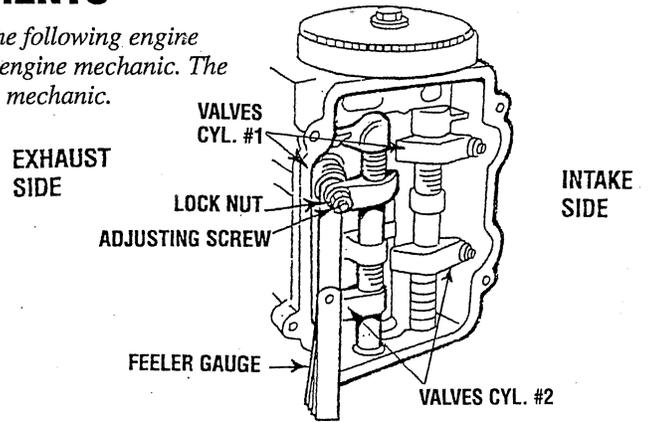
5. Adjust the intake and exhaust valve clearance for cylinder #1.
  - a. Loosen the lock nut.
  - b. Insert a feeler gauge between the valve end and the adjusting screw.
  - c. Set the valve clearance by the adjusting screw.

### VALVE CLEARANCE:

INTAKE: 0.13 - 0.17mm (0.005 - 0.007in)

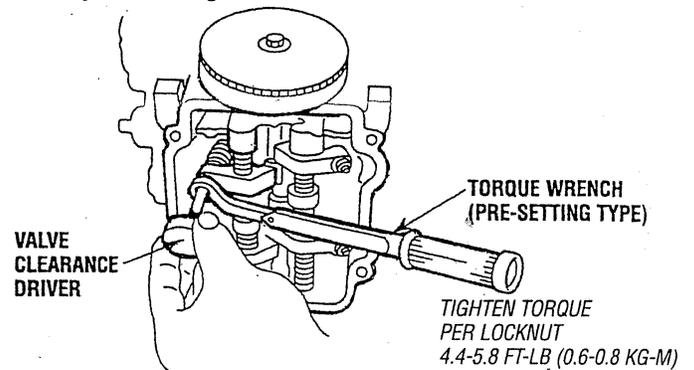
E EXHAUST: 0.18 - 0.22mm (0.007 - 0.009in)

- d. Tighten the lock nut.
  - c. Again, check the valve clearance.
6. Turn the driven gear and align the "2 and O" mark on the driven pulley with the "∇" mark on the cylinder head.



7. Adjust the intake and exhaust valve clearance for cylinder #2 using the same sequence.

**NOTE:** When loosening and tightening the lock nut, hold the adjusting screw with a valve clearance driver to prevent it from moving.

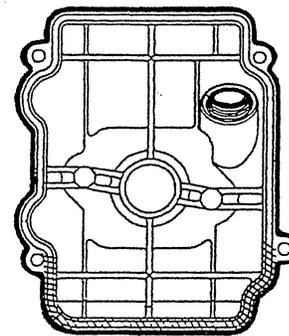


8. Install the cylinder head cover. Apply sealant to the inside rim of the cover as indicated by the shaded area of the drawing.

### BOLT TORQUE:

8 - 10 Nm (0.8 - 1.0 kg-m) 5.8 - 7.2 lb-ft

9. Install the flywheel cover and re-attach any wires removed.



# ENGINE ADJUSTMENTS

## INSPECTION/REPLACING OF THE TIMING BELT

If cracks, wear, lengthening or other damage is found, replace the timing belt.

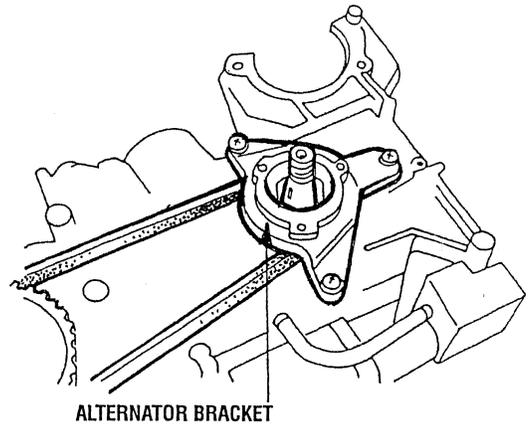
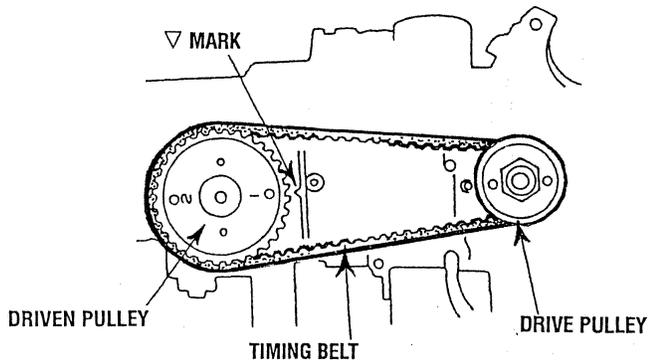
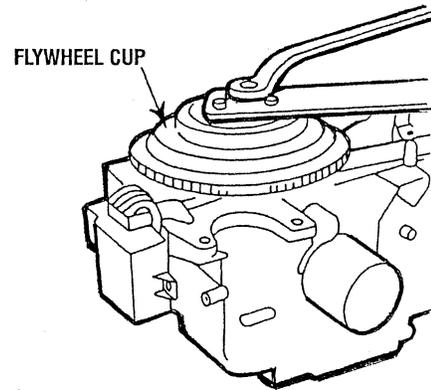
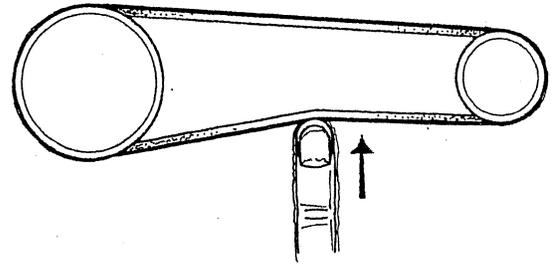
**LIMIT OF ELONGATION: MORE THAN 10mm (0.4 IN) DEFLECTION BY PUSHING WITH YOUR FINGER**

### Replacement of the Timing Belt

1. Remove the parts in the following order:
  - a. Spark plugs
  - b. Recoil starter
  - c. Magneto flywheel cup
  - d. Alternator assembly
  - e. Alternator bracket
2. Turn the crankshaft and align "○" mark on the drive pulley and the "○" mark on the cylinder head.
3. Remove the timing belt from the driven pulley side.
4. Install the timing belt from the drive pulley side.

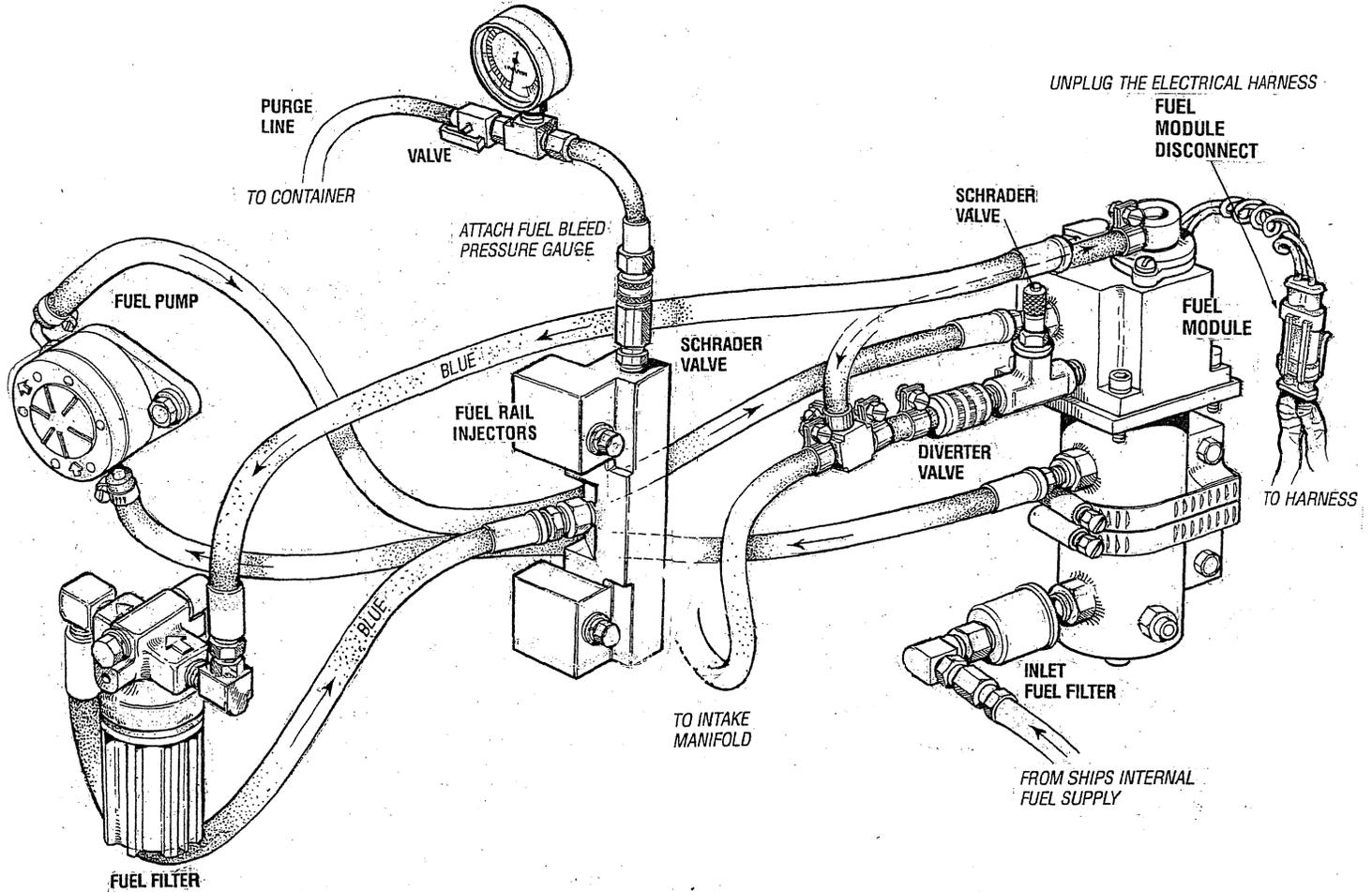
**NOTE:** After installing the timing belt, when the aligning "○" mark on the drive pulley with "○" on the cylinder block. Please confirm that the "1 & ○" or "2 & ○" mark on the driven pulley are aligned with the "▽" mark on the cylinder head.

**NOTE:** Always keep the timing belt away from any oil and grease.



# FUEL SYSTEM

## BLEEDING THE FUEL SYSTEM



**NOTE:** The following procedure must be performed whenever the fuel system is serviced (filter changes, etc) and at least once a season to ensure that any air that may have entered the fuel system is dispelled.

### INSTRUCTIONS

1. Connect a Snap-On #EEFI-500 or equivalent fuel bleed/pressure gauge set to the schrader valve on the fuel rail at the injectors and direct its purge line into a container.
2. Unplug the electrical harness attached to the fuel module. Shut the thru-hull that supplies sea water to the unit.
3. Disconnect the coil wire from the coil so the engine will not attempt to start.
4. Close the raw water thru-hull that supplies the generator. Put the generator through two to three crank cycles and monitor the purge line going into the container. When airated-fuel is seen flowing through this hose into the container, stop initiating crank cycles. **NOTE:** The unit will crank without starting for approximately 8 seconds then stop. You will be able to initiate three start cycles before the ECU will terminate a start cycle and trigger an LED fault light,. The underspeed LED will flash. Reset the ECU to remove the fault by opening and closing the 20 amp DC breaker on the control panel.

5. Open the raw water thru-hull that supplies the generator. Reconnect the engine harness to the fuel module harness.
6. Close the valve to the purge line and depress the STOP switch and hold it. Monitor pressure at the fuel rail. It should reach approximately 40 psi. Release the STOP switch. Open the thru-hull that supplies sea water to the unit. Start the engine. Pressure should remain at approximately 39-40 psi while the engine is running. Connect a gauge set to the schrader valve on the fuel module. Purge air from the module while the engine is running. Then connect the gauge set to the schrader valve on the fuel rail and purge any air from it while the engine is running.
7. Stop the engine. Carefully release pressure at the fuel rail through the purge line and remove the tool from the schrader valve. Replace the cap on the valve.
8. Start the engine and check for any fuel leaks.

**CAUTION:** Fuel and fuel vapors are explosive! Do not allow any smoking, open flames or other source of fire near the fuel system. be certain that fuel lines are tight and free of leaks. Wipe up any spilled fuel and properly dispose of soiled rags.

# RAW WATER PUMP

## DESCRIPTION

Coolant (fresh water) cooled generators have dual water pumps while the raw water cooled models use a single water pump. The pumps are essentially the same. The upper pump mounts to the top of the lower pump and has a tang on the shaft that fits into the shaft of the lower pump. Both pumps are driven simultaneously by the engines drive belt.

The following instructions apply to either pump:

## PUMP OVERHAUL

### Disassembly

The pump when removed from the engine will have the hose attachment nipple threaded into the inlet and outlet ports of the pump along with a drive pulley attached to the shaft of the pump. remove these attachments noting their positions before starting the pump disassembly.

1. Remove the four cover plate screws, cover plate, and sealing O-ring.

### Dual Pumps

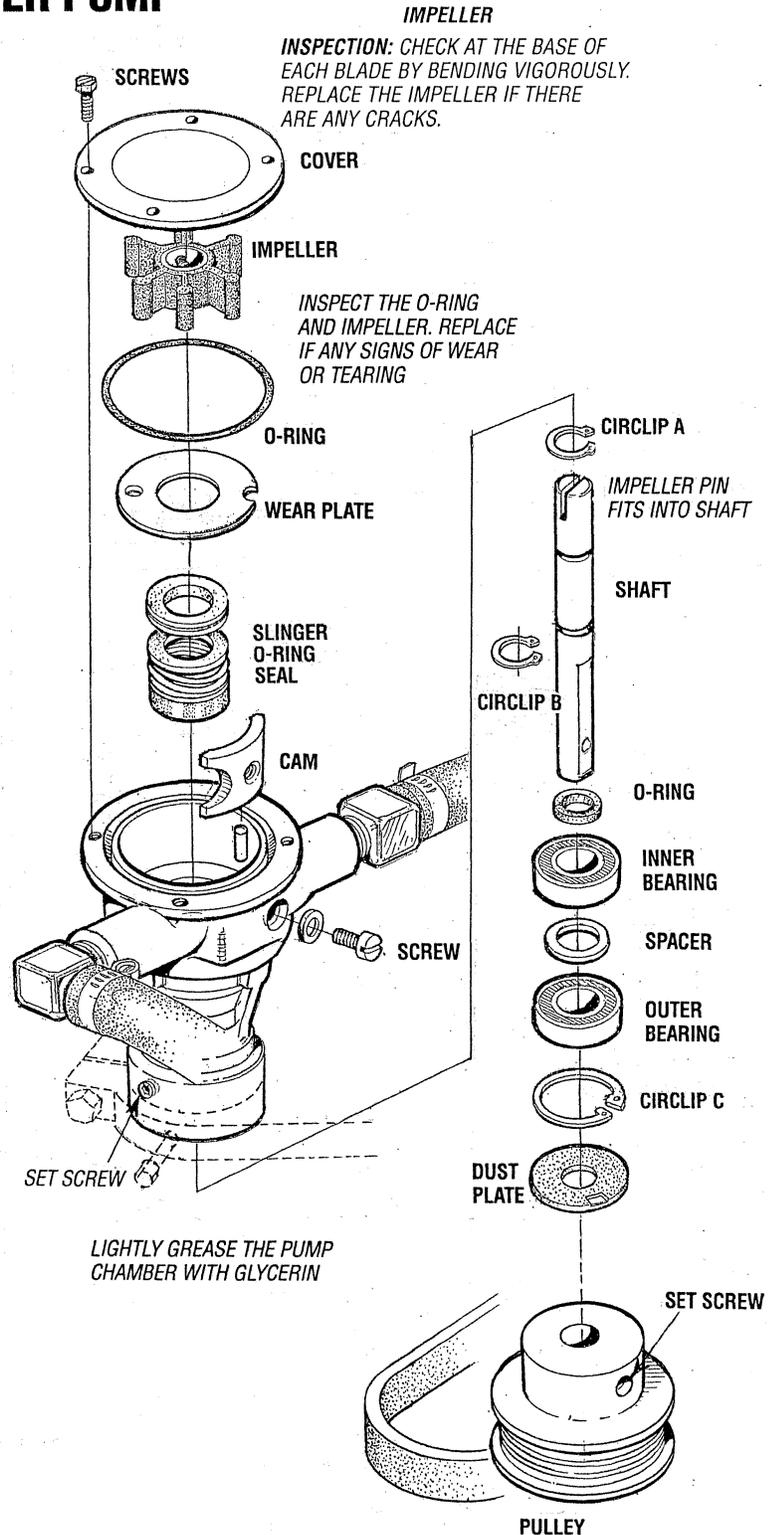
Remove the cover screws and the cover will separate the upper pump (raw water) from the fresh water (coolant) pump as shown in the illustration.

Remove the wear plate to expose the impeller. Notice the direction the impeller blades are working in so as to install the replacement impeller with blades working in the same direction.

2. Remove the impeller using a pair of pliers, grasping the hub and pulling it out of the pump with a twisting motion.
3. Remove the screw and sealing washer that hold the cam in place. remove the cam and inner wear plate behind it.
4. Remove the dust plate and circlip.
5. Support the pump body on an arbor press and with a drift, press the shaft and bearing assembly out of the pulley end of the pump.
6. Remove the O-ring from the shaft.
7. Support the outer bearing and push the shaft out of the bearing.
8. Remove the spacer and circlip .

### Inspection

Inspect all parts and replace those showing wear and corrosion.



# RAW WATER PUMP

## Reassembly

Wipe the inside surface of the pump dry. Apply a film of glycerin supplied in the impeller kit to the inside pump surfaces and to the exposed area of the shaft lip seal.

1. Install the circlip shaft. Support the outer bearing and push the shaft into the bearing until the bearing contacts the circlip.
2. Install the spacer against the circlip. Support the inner bearing and push the shaft into the bearing until it contacts the spacer.
3. Apply some glycerin onto the O-ring and install it on the shaft approximately 1/8" away from the inner bearing.
4. Warming the pump body should aid in installing the shaft and bearing assembly. Support the pump body on an arbor press. With a twisting motion, install the shaft and bearing assembly into the pump until the inner bearing seats and the outer bearing should just clear the boss for circlip B. Rotate the shaft. It should turn freely.
5. Install circlip B and push the shaft assembly until the outer bearing just contacts circlip B and install the dust plate. Rotate the shaft. It should turn freely.
6. Put some glycerin on the outer surface of the ceramic seal seat and slide it over the shaft white ceramic facing out and seat it in the body of the pump. Place some glycerin on the inner area and with a twisting motion slide it over the shaft until the ceramic of the spring seal touches the white ceramic face.
7. Install the brass plate and circlip A.
8. Install the wear plate, locking it in position on the dowel pin.

### Dual Pumps

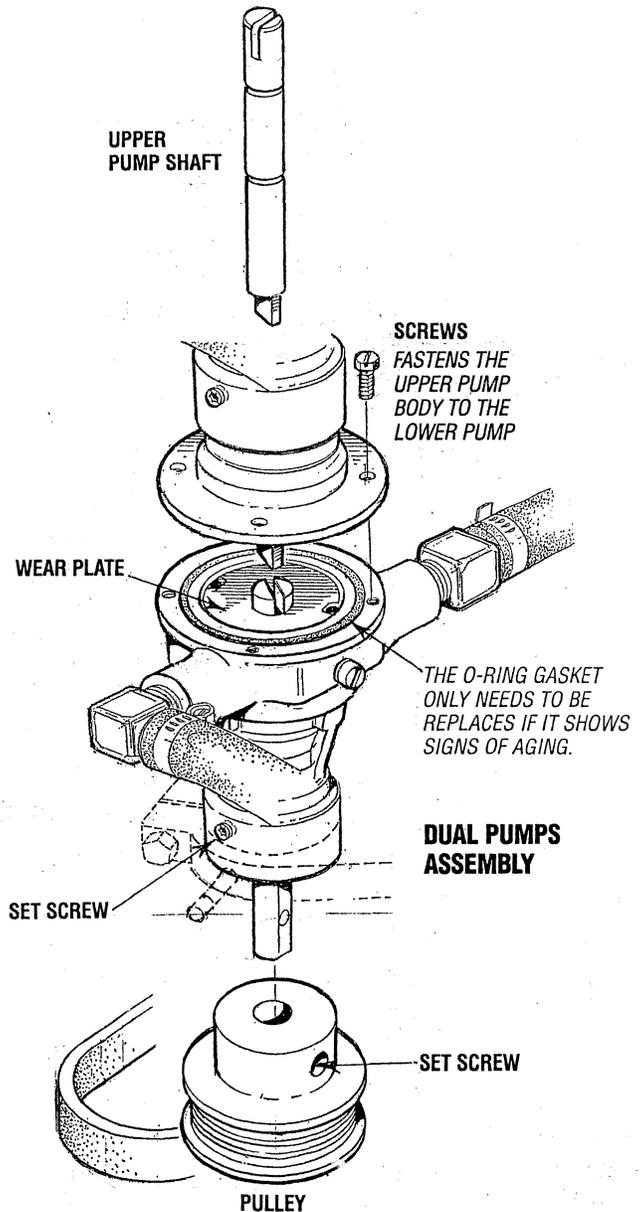
The wear plate is assembled above the impeller.

9. Install the cam and place some gasket cement on the threads of the screw that secures it in place.
10. Place some glycerin on the inner surface of the pump, the inner surface of the cover and the cover sealing O-ring and with a twisting motion install the impeller on the shaft of the pump. Install the covers O-ring and cover and secure the cover with the four cover screws.

**NOTE:** Install the new impellers with a rotating motion so the blades are working in the same direction of those of the removed impeller.

### Dual Pumps

Assemble the upper pump to the lower pump as illustrated making sure the mounting screws are tight.



# ENGINE TROUBLESHOOTING

The following troubleshooting chart describes certain problems and causes relating to engine service. Also note there is a Diagnostic Troubleshooting section that follows.

**Note:** When servicing the engine/generator, the main circuit breaker (control panel) disconnects all AC power and can be switched off and reset manually.

Problem	Possible Cause
Engine does not crank.	<ol style="list-style-type: none"> <li>1. DC panel breaker OFF.</li> <li>2. DC battery OFF.</li> <li>3. K2 relay faulty.</li> <li>4. Starter solenoid faulty.</li> <li>5. DC battery low/dead.</li> <li>6. Faulty starter solenoid.</li> <li>7. Water filled cylinder.</li> </ol>
Engine cranks, does not start (engine will crank 8 seconds)	<ol style="list-style-type: none"> <li>1. Fuel starvation.</li> <li>2. Air in fuel system.</li> <li>3. Fouled spark plugs.</li> <li>4. Faulty ignition coil.</li> </ol>
Engine starts, runs and the shuts down.	<ol style="list-style-type: none"> <li>1. Fuel starvation.</li> <li>2. Air in fuel system.</li> <li>3. Faulty shutdown switch/sensor.</li> <li>4. Faulty fuel pump.</li> </ol>
Engine hunts.	<ol style="list-style-type: none"> <li>1. Air in fuel system.</li> <li>2. Faulty fuel pump.</li> <li>3. Low octane fuel (lower than 89).</li> <li>4. Faulty MAG pick-up.</li> </ol>
Engine misfires/back firing.	<ol style="list-style-type: none"> <li>1. Low octane fuel (lower than 89).</li> <li>2. Dirty air intake screen screen.</li> <li>3. High tension ignition wires.</li> <li>4. Flywheel loose.</li> <li>5. Exhaust restriction.</li> <li>6. Worn/fouled spark plug.</li> <li>7. Faulty ignition module.</li> </ol>
Engine overheats/engine temp LED is illuminated.	<ol style="list-style-type: none"> <li>1. Raw water coolant flow obstruction.</li> <li>2. Coolant level low.</li> <li>3. Faulty impeller.</li> <li>4. Pump belt loose/broken.</li> <li>5. Obstructed by-pass hose.</li> <li>6. Stuck thermostat.</li> </ol>
Exhaust temp LED is illuminated.	<ol style="list-style-type: none"> <li>1. Loss of coolant flow/faulty pump.</li> <li>2. Faulty exhaust temperature switch.</li> </ol>
Low oil pressure/oil pressure LED is illuminated.	<ol style="list-style-type: none"> <li>1. Oil level low.</li> <li>2. Faulty oil pressure sendor.</li> <li>3. Faulty oil pressure switch.</li> <li>4. Oil viscosity incorrect.</li> </ol>
No DC charge to starting battery.	<ol style="list-style-type: none"> <li>1. Circuit fuse faulty/blown.</li> <li>2. Faulty circuit connection.</li> <li>3. Faulty regulator.</li> </ol>
Engine cranks, stops. Check engine LED comes on.	<ol style="list-style-type: none"> <li>1. Data Log needed to determine cause.</li> <li>2. Oxygen Sensor.</li> <li>3. Low charge in starting battery.</li> </ol>

# ENGINE TROUBLESHOOTING

Problem	Possible Cause
Starter stays energized after start.	<ol style="list-style-type: none"> <li>1. Faulty K1 relay.</li> <li>2. Faulty starter solenoid.</li> </ol>
Poor performance at generator speed.	<ol style="list-style-type: none"> <li>1. Low octane fuel.</li> <li>2. Contaminated fuel pump.</li> </ol>
Black exhaust smoke.	<ol style="list-style-type: none"> <li>1. Dirty air screen.</li> <li>2. Generator is overfilled.</li> </ol>
Blue exhaust smoke.	<ol style="list-style-type: none"> <li>1. Lube oil is diluted.</li> <li>2. Crankcase breather tube is clogged.</li> <li>3. High lube oil level.</li> </ol>
Check engine LED's are illuminated.	<ol style="list-style-type: none"> <li>1. Diagnostic software required.</li> </ol>
Speed LED's are illuminated-no flashing.	<ol style="list-style-type: none"> <li>1. Throttle shaft sticking.</li> <li>2. Intake manifold vacuum leak.</li> </ol>
Pair of Speed LED LED's are illuminated-flashing.	<ol style="list-style-type: none"> <li>1. AC generator overload.</li> <li>2. Fuel starvation.</li> </ol>
Exterior alarm LED is illuminated.	<ol style="list-style-type: none"> <li>1. Loose connection.</li> <li>2. Faulty fire suppression shutdown devise.</li> </ol>
Engine runs for 15 +/- seconds, then shuts down. The SPEED LED illuminates <b>AFTER</b> the engine shuts down.	<ol style="list-style-type: none"> <li>1. Oil Pressure Switch (#037323)</li> <li>2. Time-Relay (053555)</li> </ol>
All fault LEDs on generator panel ON. Check Engine LED on remote ON. Engine is not running.	<ol style="list-style-type: none"> <li>1. DEAD Battery.</li> </ol>
Engine starts, runs for 20-30 seconds then Overspeeds. Shuts down with Overspeed LEDs ON.	<ol style="list-style-type: none"> <li>1 Air in Fuel System.</li> </ol>

# ENGINE TROUBLESHOOTING/SOFTWARE DIAGNOSTICS

## PC INTERFACE SOFTWARE

The software is available in a kit pn#055410 and can be purchased from a local Westerbeke Distributor or Dealer.

The EC10 diagnostics found in the software kit is used with the 3.5SBCG model.

The software kit contains a needed communications cable to connect between the generator's ECU and ones laptop.

This Diagnostic Software is designed to aide the technician in monitoring the Low CO generator's operation and the ECU (Electronic Control Unit) functions.

Once downloaded, this new improved software provides Idle Mode diagnostics, Failure Record and Run Time Data Logging to EXCEL.

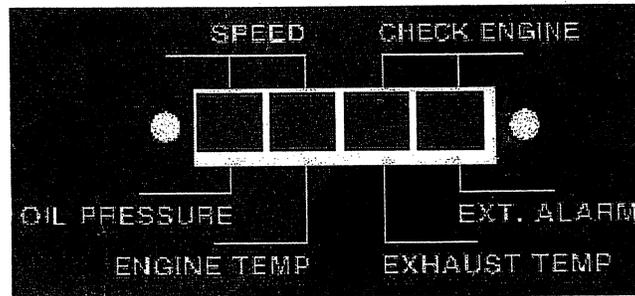
The Diagnostic Software will run on Windows 98, XP, Vista and Windows 7 laptop. These must have a minimum of 128 megabytes of RAM (Random Access Memory). The communications cable plugs into a serial connection or a USB port. When using serial to USB adapters, the communication port that the adapter is using MUST be known in order to configure the Diagnostic Software.

The Westerbeke communication cable is unique to this Diagnostic Software and must be used or otherwise damage to the ECU will occur if any communications cable is substituted. The Diagnostic Software is designed with multiple screens, tabs and pull down menus to aide the user in the diagnostic process.

The Diagnostic Software is for monitoring ONLY. It is read only so none of the values can be changed.

When running diagnostics. Start a Data Log 20-25 seconds before starting the generator.

## LED DISPLAY PANEL



# SOFTWARE DIAGNOSTICS

## Engine IDLE State Warnings:

Engine IDLE state is:- DC circuit breaker on, generator not running

In the IDLE state only *Ambient Air Temperature Low* and *MAP Sensor Possible Fault* are logged. If the fault persists after the generator is started, the CRANK state and RUN state warnings and shutdowns will apply. There are NO shutdowns in the IDLE state, only warnings. Shutdowns can occur in both the CRANK and RUN states.

	Warning Description	Parameters	Possible cause
1	Engine Coolant Temp Shorted	Short circuit (0 ohms)	<ul style="list-style-type: none"> <li>◦ faulty temperature sensor</li> <li>◦ pinched or bare wire in harness</li> </ul>
2	Engine Coolant Temp Open	Open circuit	<ul style="list-style-type: none"> <li>◦ faulty ECT sensor</li> <li>◦ loose connection or corroded wiring</li> </ul>
3	Engine Coolant Temp Low	Reading less than -25°C (-13°F)	<ul style="list-style-type: none"> <li>◦ excessively cold weather</li> <li>◦ faulty temperature sensor</li> </ul>
4	Engine Coolant Temp High	Reading more than 95°C (203°F)	<ul style="list-style-type: none"> <li>◦ faulty temperature sensor</li> <li>◦ engine heat soak after normal shutdown</li> </ul>
5	External Alarm	Open circuit	<ul style="list-style-type: none"> <li>◦ external alarm fault (i.e. Fireboy)</li> <li>◦ loose connection or corroded wiring</li> </ul>
6	Exhaust Temperature High	Open circuit	<ul style="list-style-type: none"> <li>◦ faulty exhaust temperature switch</li> <li>◦ loose connection or corroded wiring</li> </ul>
7	Battery Voltage Low	Less than 11 volts	<ul style="list-style-type: none"> <li>◦ weak or dead battery</li> <li>◦ blown fuse in charging circuit</li> <li>◦ faulty regulator or charging circuit</li> <li>◦ loose connection or corroded wiring</li> </ul>
8	Battery Voltage High	More than 15 volts	<ul style="list-style-type: none"> <li>◦ faulty regulator or charging circuit</li> </ul>
9	Ambient Air Temp Shorted	Short circuit (0 ohms)	<ul style="list-style-type: none"> <li>◦ faulty air temperature sensor</li> <li>◦ pinched or bare wire in harness</li> </ul>
10	Ambient Air Temp Open	Open circuit	<ul style="list-style-type: none"> <li>◦ faulty air temperature sensor</li> <li>◦ loose connection or corroded wiring</li> </ul>
11	Ambient Air Temp Low	Reading less than -25°C (-13°F)	<ul style="list-style-type: none"> <li>◦ excessively cold weather</li> <li>◦ faulty air temperature sensor</li> </ul>
12	Ambient Air Temp High	Reading more than 63°C (145°F)	<ul style="list-style-type: none"> <li>◦ excessively hot weather</li> <li>◦ bilge venting system faulty or inadequate</li> <li>◦ engine heat soak after normal shutdown</li> <li>◦ faulty temperature sensor</li> </ul>
13	Oil Pressure Sender Shorted	Short circuit (0 ohms)	<ul style="list-style-type: none"> <li>◦ faulty oil pressure sender</li> <li>◦ pinched or bare wire in harness</li> </ul>
14	MAP Sensor Possible Fault	MAP reading out of range (<10 kPa or >115 kPa)	<ul style="list-style-type: none"> <li>◦ faulty MAP sensor</li> <li>◦ pinched or bare wire in harness</li> <li>◦ loose connection or corroded wiring</li> </ul>
15	Check Engine LED	Emission Issue	<ul style="list-style-type: none"> <li>* Diagnostic Software needed.</li> <li>* Low DC battery voltage (below 11 volts).</li> <li>* Map Sensor out of range.</li> </ul>

# ENGINE TROUBLESHOOTING/SOFTWARE DIAGNOSTICS

## Engine CRANK State Shutdowns:

Engine CRANK state is - DC circuit breaker on, generator start switch has been pushed but engine is not up to running speed yet. This state only lasts for a few seconds on a typical engine before the engine starts and transitions to the RUN state.

In the CRANK state, warnings are not indicated on the LED display, and they are not logged. All shutdowns are logged.

Shutdown Description		Parameters	Possible cause
1	Cam Sensor failure	No CAM speed sensor signal detected by ECU	<ul style="list-style-type: none"> <li>◦ cam sensor adjusted improperly</li> <li>◦ loose connection or corroded wiring</li> <li>◦ sensor tip contaminated with metal filings</li> </ul>
2	Over-Crank Timeout	Exceeds 8 second crank duration	<ul style="list-style-type: none"> <li>◦ faulty battery</li> <li>◦ loose connection or corroded wiring</li> <li>◦ fuel supply insufficient</li> </ul>
3	External Alarm	Open circuit	<ul style="list-style-type: none"> <li>◦ external alarm fault (i.e. Fireboy)</li> <li>◦ loose connection or corroded wiring</li> </ul>
4	Battery Voltage Low	Less than 8 volts	<ul style="list-style-type: none"> <li>◦ faulty battery</li> <li>◦ faulty charging circuit</li> <li>◦ blown fuse</li> <li>◦ loose connection or corroded wiring</li> </ul>
5	Speed Signal Not Detected	No speed signal detected by ECU	<ul style="list-style-type: none"> <li>◦ loose connection or corroded wiring</li> <li>◦ speed conditioning module faulty</li> <li>◦ sensor tip contaminated with metal filings</li> </ul>
			<ul style="list-style-type: none"> <li>◦ Out of fuel or fuel system not bled properly</li> </ul>
6	MAP Sensor Fault	MAP reading out of range (<10 kPa or >115 kPa)	<ul style="list-style-type: none"> <li>◦ faulty MAP sensor</li> <li>◦ pinched or bare wire in harness</li> <li>◦ loose connection or corroded wiring</li> </ul>

# SOFTWARE DIAGNOSTICS

## Engine RUN State Warnings:

Engine RUN state is - DC circuit breaker on, generator successfully started and running

In the RUN state all warnings are logged and a light will be illuminated on the control panel. The light(s) will go out when the warning condition is no longer present. Warnings will be indicated as follows:

Oil Pressure warnings illuminate the **OIL PRESSURE** light.

Engine Coolant Temperature warnings illuminate the **ENGINE TEMP** light.

Exhaust Temperature High illuminates the **EXHAUST TEMP** light.

External Alarm warning illuminates the **EXT. ALARM** light.

OverSpeed and UnderSpeed warnings illuminate the pair of **SPEED** lights.

All other warnings illuminate the pair of **CHECK ENGINE** lights.

Warning Description		Parameters	Possible cause
1	Engine Coolant Temp Low	Reading less than -25°C (-13°F)	<ul style="list-style-type: none"> <li>◦ excessively cold weather</li> <li>◦ faulty temperature sensor</li> </ul>
2	Engine Coolant Temp High	Reading more than 95°C (203°F)	<ul style="list-style-type: none"> <li>◦ faulty temperature sensor</li> <li>◦ engine heat soak after normal shutdown</li> </ul>
3	UnderSpeed	Under 1760 rpm for 8+ seconds	<ul style="list-style-type: none"> <li>◦ excessive load on generator</li> <li>◦ fuel supply insufficient</li> </ul>
4	OverSpeed	Over 2375 rpm for 8+ seconds	<ul style="list-style-type: none"> <li>◦ vacuum leak in intake manifold or hoses</li> <li>◦ throttle shaft sticking</li> </ul>
5	OverLoad	Throttle wide open and RPM <2200 for 8+ sec	<ul style="list-style-type: none"> <li>◦ excessive load on generator</li> </ul>
6	Crank Sensor Possible Fault	Internal ECU parameter	<ul style="list-style-type: none"> <li>◦ loose connection or corroded wiring</li> <li>◦ sensor tip contaminated with metal filings</li> <li>◦ speed conditioning module faulty</li> </ul>
7	Oil Pressure Sender Shorted	Short circuit (0 ohms)	<ul style="list-style-type: none"> <li>◦ faulty oil pressure sender</li> <li>◦ pinched or bare wire in harness</li> </ul>
8	Oil Pressure Sender Open	Open circuit (∞ ohms)	<ul style="list-style-type: none"> <li>◦ faulty oil pressure sender</li> <li>◦ loose connection or corroded wiring</li> </ul>
9	Oil Pressure Low	Reading less than 12 psi for 5 sec	<ul style="list-style-type: none"> <li>◦ check oil level</li> <li>◦ insure proper oil viscosity</li> <li>◦ check lubrication system for leaks</li> </ul>
10	Battery Voltage Low	Less than 11 volts	<ul style="list-style-type: none"> <li>◦ blown fuse</li> <li>◦ dead battery</li> <li>◦ faulty regulator or charging circuit</li> <li>◦ loose connection or corroded wiring</li> </ul>
11	Battery Voltage High	More than 15 volts	<ul style="list-style-type: none"> <li>◦ faulty regulator or charging circuit</li> </ul>
12	Ambient Air Temp Shorted	Short circuit (0 ohms)	<ul style="list-style-type: none"> <li>◦ faulty air temperature sensor</li> <li>◦ pinched or bare wire in harness</li> </ul>
13	Ambient Air Temp Open	Open circuit	<ul style="list-style-type: none"> <li>◦ faulty air temperature sensor</li> <li>◦ loose connection or corroded wiring</li> </ul>
14	Ambient Air Temp Low	Reading less than -25°C (-13°F)	<ul style="list-style-type: none"> <li>◦ excessively cold weather</li> <li>◦ faulty air temperature sensor</li> </ul>
15	Ambient Air Temp High	Reading more than 95°C (203°F)	<ul style="list-style-type: none"> <li>◦ excessively hot weather</li> <li>◦ bilge venting system faulty or inadequate</li> <li>◦ faulty temperature sensor</li> </ul>

# SOFTWARE DIAGNOSTICS

## Engine RUN State Shutdowns:

Engine RUN state is - DC circuit breaker on, generator successfully started and running

In the RUN state all shutdowns are logged and a light will be illuminated on the control panel. The generator will be shut down and the light(s) will stay illuminated until the 12VDC power to the generator is cycled.

Oil Pressure shutdowns illuminate the **OIL PRESSURE** light.

Engine Coolant Temperature shutdowns illuminate the **ENGINE TEMP** light.

Exhaust Temperature High shutdown illuminates the **EXHAUST TEMP** light.

External Alarm shutdown illuminates the **EXT. ALARM** light.

OverSpeed and UnderSpeed shutdowns illuminate the pair of **SPEED** lights.

All other shutdowns illuminate the pair of **CHECK ENGINE** lights.

	Shutdown Description	Parameters	Possible cause
1	Engine Coolant Temp Shorted	Short circuit (0 ohms)	<ul style="list-style-type: none"> <li>◦ faulty temperature sensor</li> <li>◦ pinched or bare wire in harness</li> </ul>
2	Engine Coolant Temp Open	Open circuit	<ul style="list-style-type: none"> <li>◦ faulty ECT sensor</li> <li>◦ loose connection or corroded wiring</li> </ul>
3	Engine Coolant Temp High	Reading more than 100°C (212°F)	<ul style="list-style-type: none"> <li>◦ faulty temperature sensor</li> <li>◦ engine heat soak after normal shutdown</li> </ul>
4	UnderSpeed	Under 1620 rpm for 4 secs	<ul style="list-style-type: none"> <li>◦ excessive load on generator</li> <li>◦ fuel supply insufficient</li> </ul>
5	OverSpeed	Over 2340 rpm for 0.5 seconds Over 2160 rpm for 1.0 seconds Over 2070 rpm for 2.0 seconds Over 1980 rpm for 4.0 seconds	<ul style="list-style-type: none"> <li>◦ vacuum leak in intake manifold or hoses</li> <li>◦ throttle shaft sticking</li> </ul>
6	Crank Sensor Fault	Internal ECU parameter, speed signal intermittent	<ul style="list-style-type: none"> <li>◦ loose connection or corroded wiring</li> <li>◦ sensor tip contaminated with metal filings</li> <li>◦ crank speed sensor faulty</li> <li>◦ speed conditioning module faulty</li> </ul>
7	Crank Signal Loss	No speed signal to ECU for 3+ seconds	<ul style="list-style-type: none"> <li>◦ loose connection or corroded wiring</li> <li>◦ sensor tip contaminated with metal filings</li> <li>◦ crank speed sensor faulty</li> <li>◦ speed conditioning module faulty</li> </ul>
8	Throttle Loss of Home	Internal ECU parameter	<ul style="list-style-type: none"> <li>◦ throttle shaft sticking</li> <li>◦ battery weak</li> </ul>
9	Oil Pressure Sender Shorted	Short circuit (0 ohms)	<ul style="list-style-type: none"> <li>◦ faulty oil pressure sender</li> <li>◦ pinched or bare wire in harness</li> </ul>
10	Oil Pressure Sender Open	Open circuit (∞ ohms)	<ul style="list-style-type: none"> <li>◦ faulty oil pressure sender</li> <li>◦ loose connection or corroded wiring</li> </ul>
11	Oil Pressure Low	Reading less than 8 psi for 5 sec	<ul style="list-style-type: none"> <li>◦ check oil level</li> <li>◦ insure proper oil viscosity</li> <li>◦ check lubrication system for leaks</li> </ul>

# SOFTWARE DIAGNOSTICS

## Engine RUN State Shutdowns: (Continued from previous page)

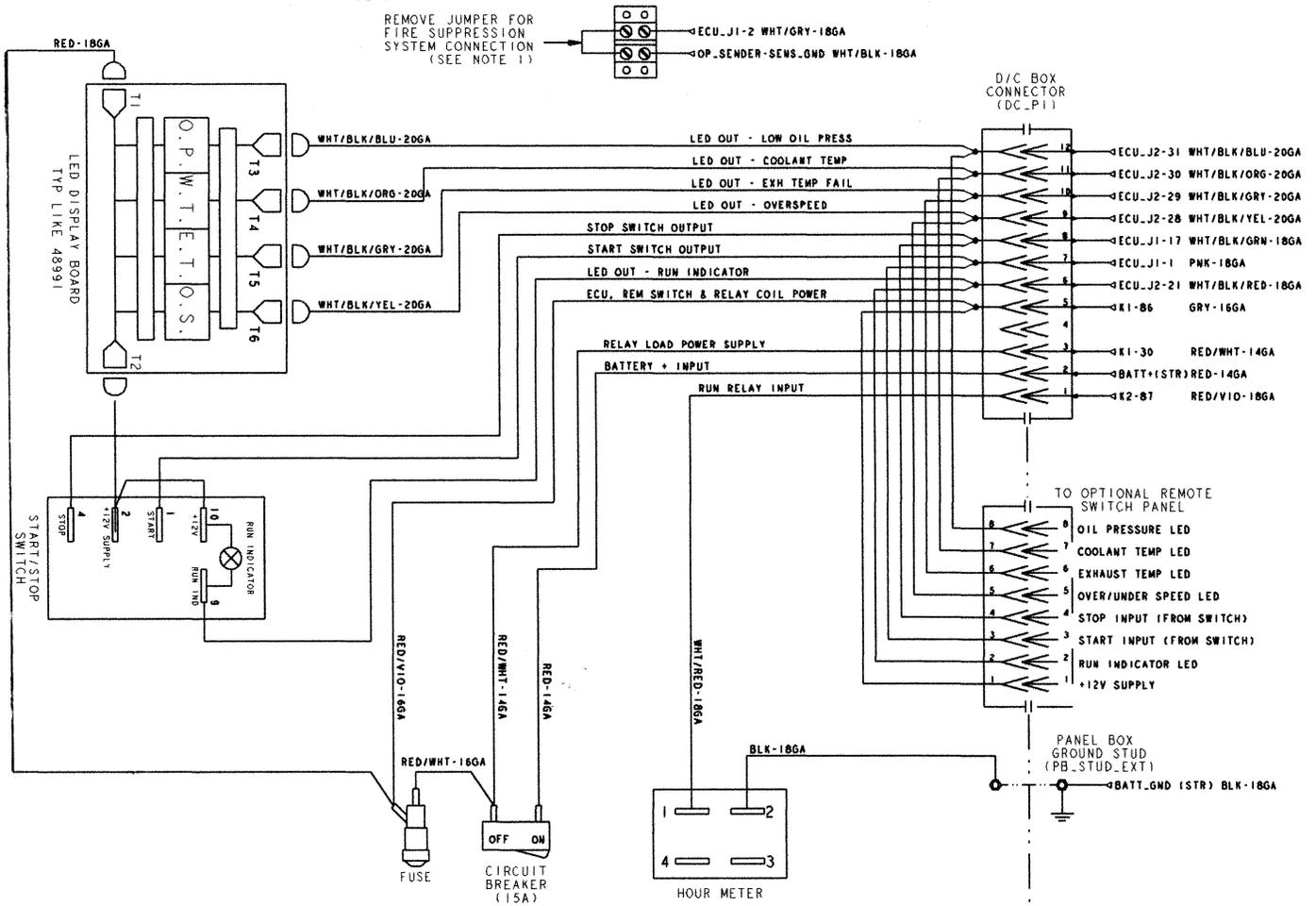
Warning Description		Parameters	Possible cause
12	Battery Voltage Low	Less than 10 volts	<ul style="list-style-type: none"> <li>◦ dead battery</li> <li>◦ blown fuse</li> <li>◦ faulty regulator or charging circuit</li> <li>◦ loose connection or corroded wiring</li> </ul>
13	Exhaust Temperature High	Open circuit	<ul style="list-style-type: none"> <li>◦ faulty exhaust temperature switch</li> <li>◦ loose connection or corroded wiring</li> <li>◦ seawater flow blocked</li> </ul>
14	External Alarm	Open circuit	<ul style="list-style-type: none"> <li>◦ external alarm fault (i.e. Fireboy)</li> <li>◦ loose connection or corroded wiring</li> </ul>
15	Wideband O <sub>2</sub> Sensor (WBO <sub>2</sub> ) Reading Out of Table	ECU measures $\lambda < .70$ or $\lambda > 2.00$ , which is out of the table range	<ul style="list-style-type: none"> <li>◦ excessively rich or lean combustion</li> <li>◦ loose connection or corroded wiring</li> <li>◦ oxygen sensor faulty</li> </ul>
16	Wideband O <sub>2</sub> Sensor (WBO <sub>2</sub> ) Failure to Cross Stoich	$\lambda$ reading not crossing above and below $\lambda=1.00$ at least once per minute	<ul style="list-style-type: none"> <li>◦ excessively rich or lean combustion</li> <li>◦ dirty or clogged fuel injector(s)</li> <li>◦ insufficient fuel supply or pressure</li> </ul>
17	Wideband O <sub>2</sub> Sensor (WBO <sub>2</sub> ) Heater failure	Heater current out of normal range	<ul style="list-style-type: none"> <li>◦ loose connection or corroded wiring</li> <li>◦ oxygen sensor faulty</li> </ul>

# WIRING DIAGRAM #54609

## DC CONTROL PANEL

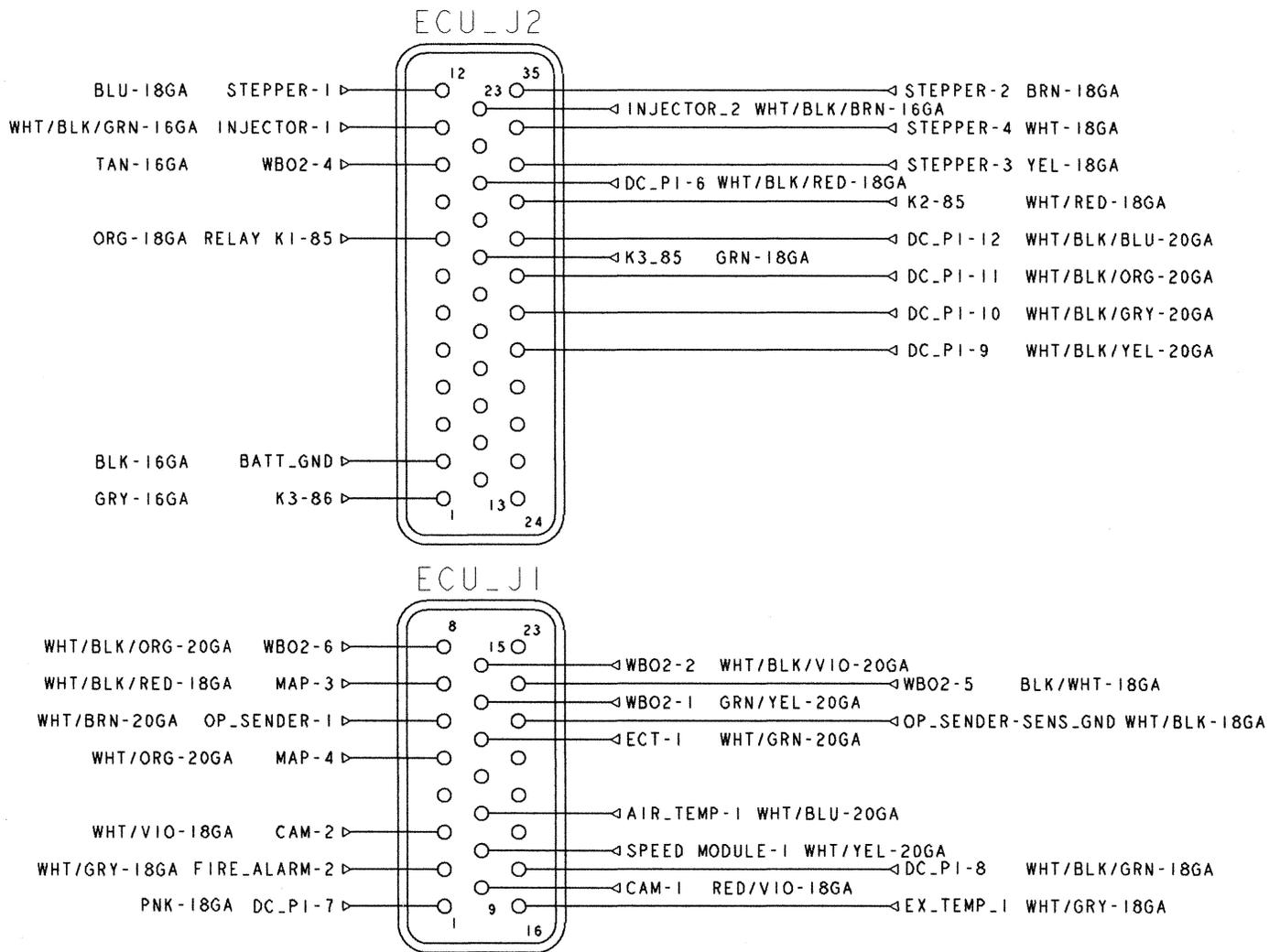
NOTES:  
 1. FIRE SUPPRESSION SYSTEM CONNECTION IS NOT A POWER SOURCE. THIS CIRCUIT MUST BE CLOSED TO RUN. AN OPEN CIRCUIT WILL STOP THE GENSET.

REMOVE JUMPER FOR FIRE SUPPRESSION SYSTEM CONNECTION (SEE NOTE 1)



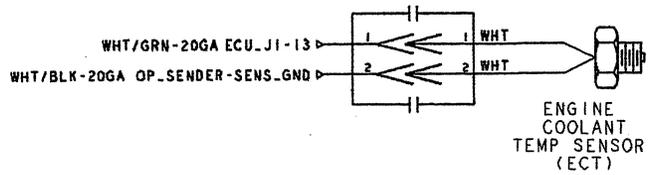
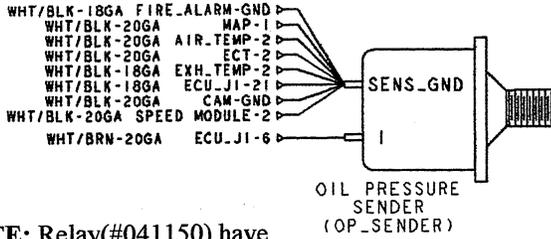
# WIRING DIAGRAM #54609

## ECU COMPONENTS

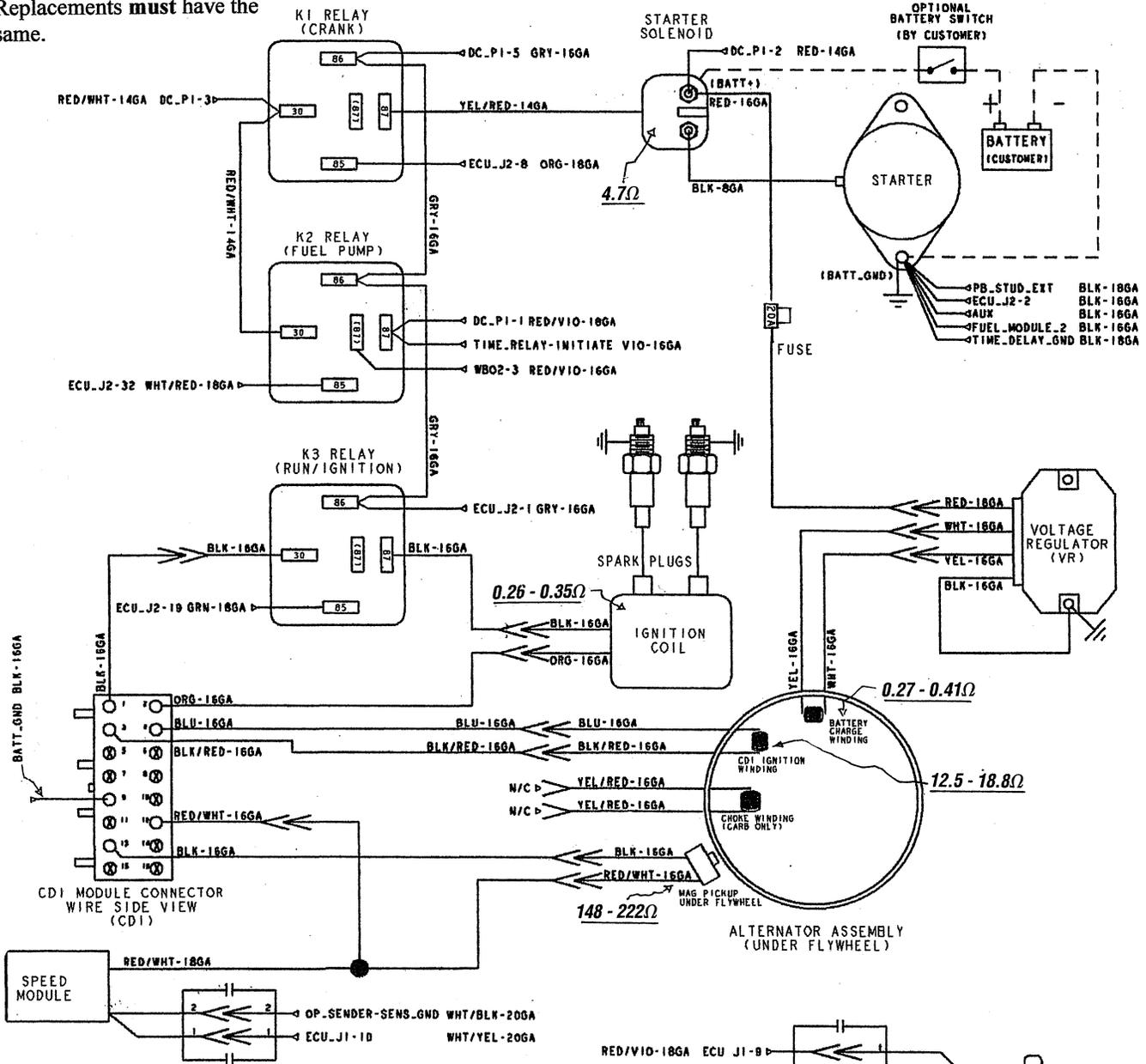


# WIRING DIAGRAM #54609

## ENGINE BLOCK COMPONENTS



**NOTE:** Relay(#041150) have a surge protection diode.  
Replacements **must** have the same.



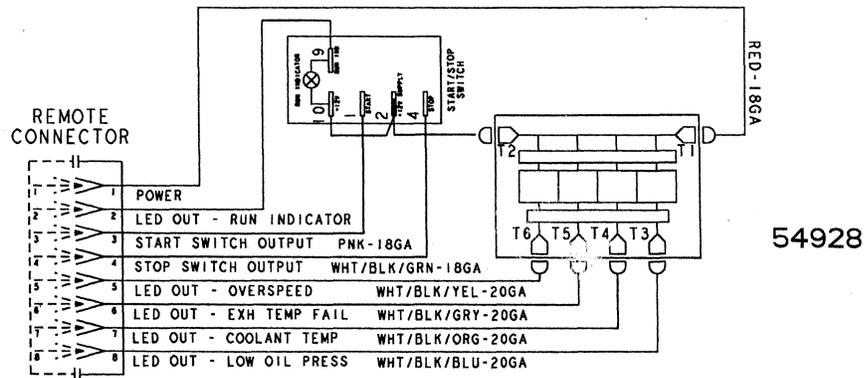
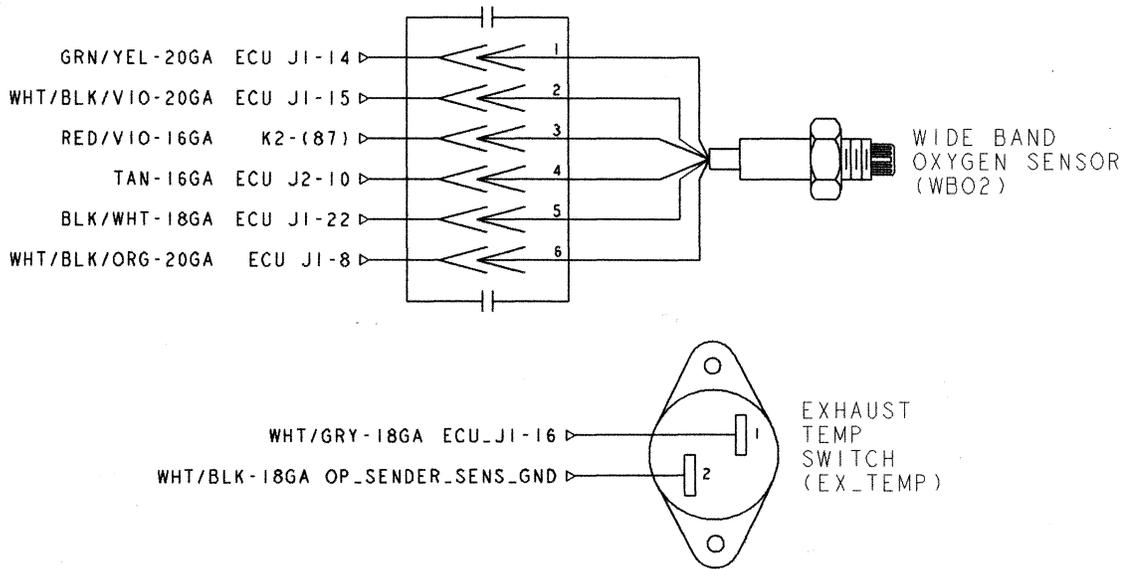
### RESISTANCE VALUES IN OHMS

CDI IGNITION WINDING	12.5 - 18.8
MAGNETIC PICK-UP	148 - 222
BATTERY CHARGE WINDING	0.27 - 0.41
IGNITION COIL (PRIMARY)	0.26 - 0.35
START SOLENOID	4.7
HIGH TENSION LEADS	6.800 - 10.000
CAM SENSOR	3.6 - 3.8

**NOTE:** TESTER USED-FLUKE MULTIMETER  
TOLERANCE ± 20%.

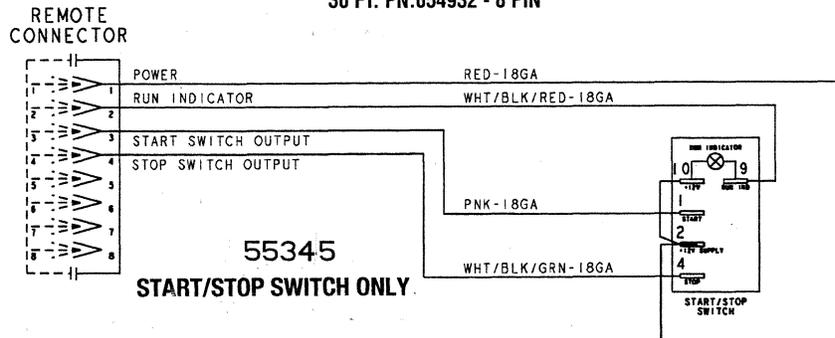
# WIRING DIAGRAM #54609

## EXHAUST SYSTEM COMPONENTS



### AVAILABLE EXTENSION HARNESSES

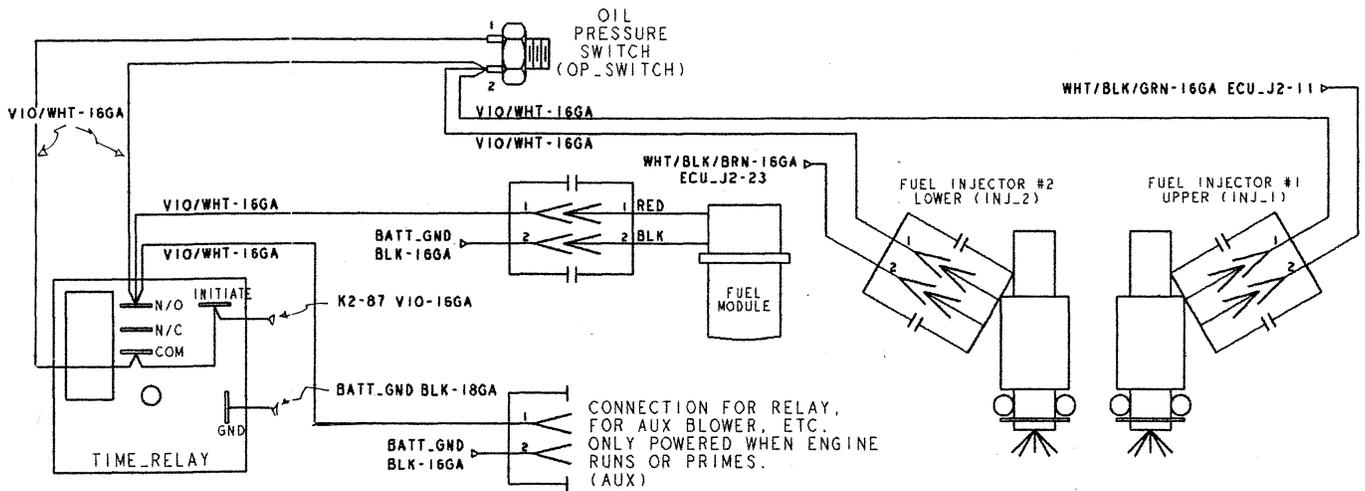
- 15 FT. PN.054931 - 8 PIN
- 30 FT. PN.054932 - 8 PIN



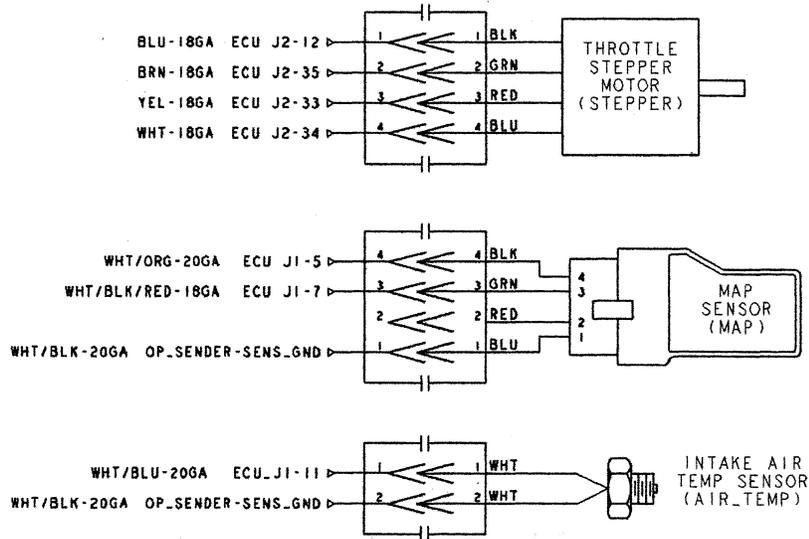
## REMOTE PANELS

# WIRING DIAGRAM #54609

## FUEL SYSTEM

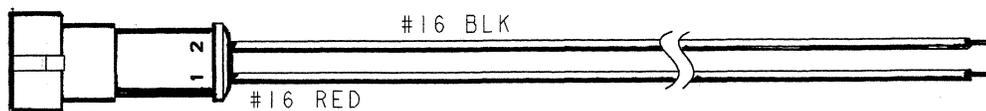


## INTAKE THROTTLE BODY



## AUXILIARY RELAY HARNESS #055489

This harness plugs into an AUX connection located below the Fuel Cell. It provides DC power only when the engine is running or is being primed. MAXIMUM DC power is 400 milliamps, sufficient to open or close a relay.



# GENERATOR INFORMATION

## USE OF ELECTRIC MOTORS

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

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

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

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

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

## Required Operating Speed

Run the generator first with no load applied, then at half the generator's capacity, and finally loaded to its full capacity as indicated on the generators data plate. The output voltage should be checked periodically to ensure proper operation of the generating plant and the appliances it supplies. To monitor voltage and load, check it with a portable meter and amp probe.

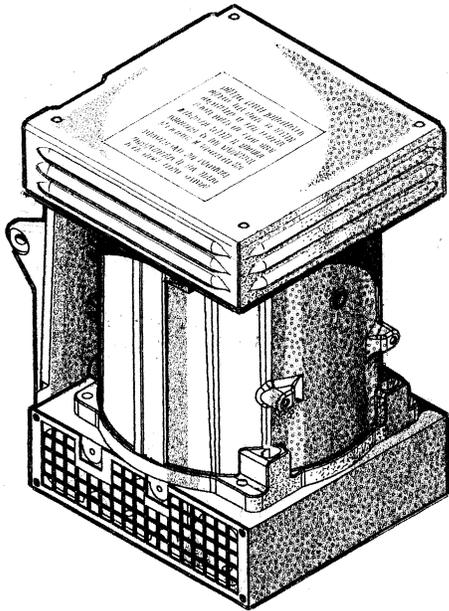
## Generator Maintenance

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.

In addition to periodic cleaning, the generator should be inspected for tightness of all connections, evidence of overheated terminals and loose or damaged wires.

# SBCG DESCRIPTION and TROUBLESHOOTING

REFER ALSO TO THE SPECIFICATION PAGE



## BRUSHLESS CAPACITOR GENERATOR

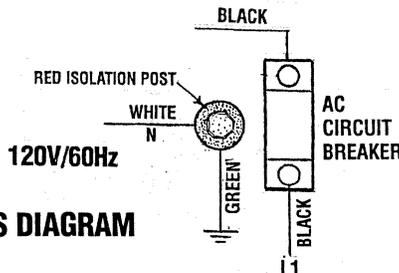
Engine RPM at 2200 generator turns at 3600 (60Hz) 3000 (50Hz)  
 60Hz 120 Volts 30 Amps for SBCG  
 50Hz 230 Volts 15 Amps for SBCG

## TROUBLESHOOTING CHART

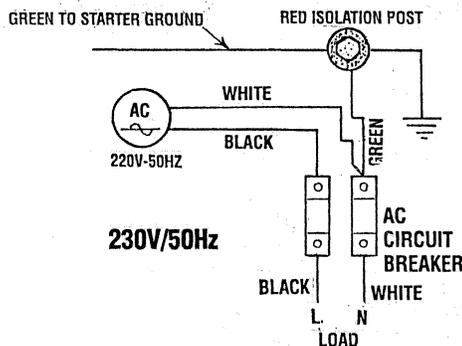
Refer to the following page for the BCG Internal Wiring Schematic and the BCG Winding Resistances.

CAUSE	FAULT
No AC Output Voltage	1. Shorted Stator.
	2. Open Stator.
	3. Shorted Rotor Diode.
	4. Shorted Rotor Thermister.
	5. Shorted Rotor Capacitor.
	6. Open Rotor Diode.
Residual Voltage Line - Neutral at No Load (6-8 VAC)	1. Faulty Capacitor.
	2. Open Exciter Winding.
	3. Shorted Exciter Winding.
Low AC Output Voltage 60 - 100 Volts	1. Faulty Rotor Diode.
	2. Faulty Rotor Winding.
	3. Faulty Exciter Capacitor.
AC Voltage Drop with Inductive Load	1. Faulty Rotor Diode.
	2. Faulty Exciter Capacitor.
	3. Amperage Overload.

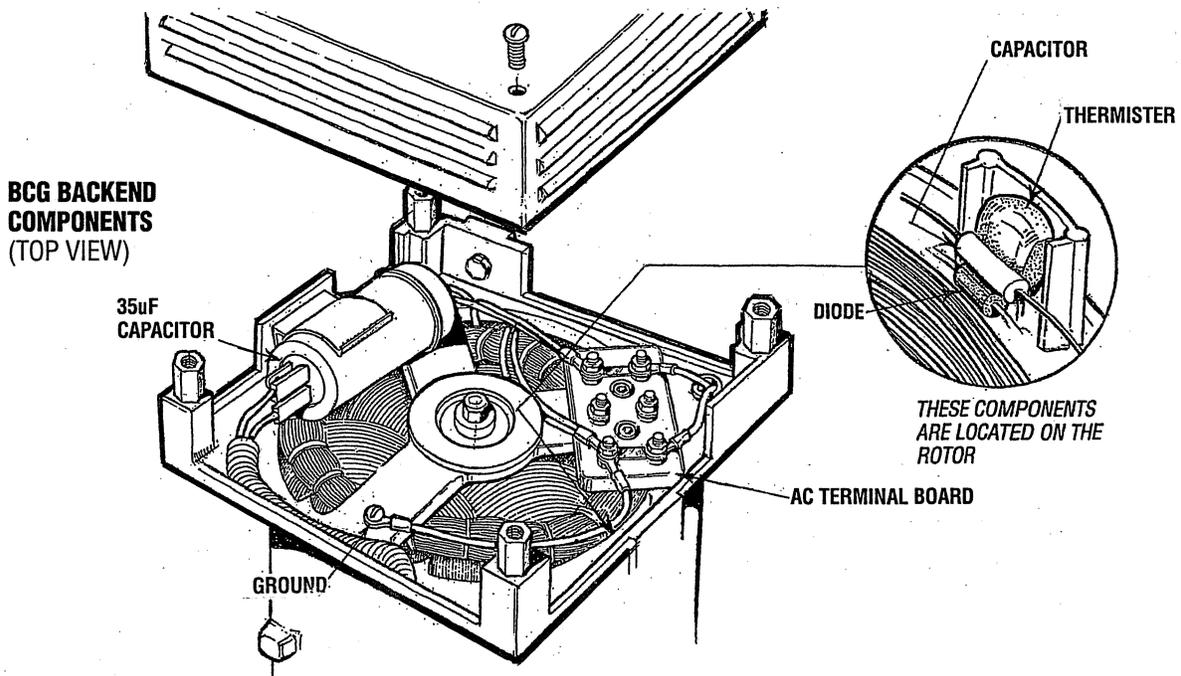
**NOTE:** It would be important to inspect the pulley and drive belt under the generator base frame.



## AC OUTPUT CONNECTIONS DIAGRAM



# SBCG WINDING RESISTANCES/INTERNAL WIRING DIAGRAM

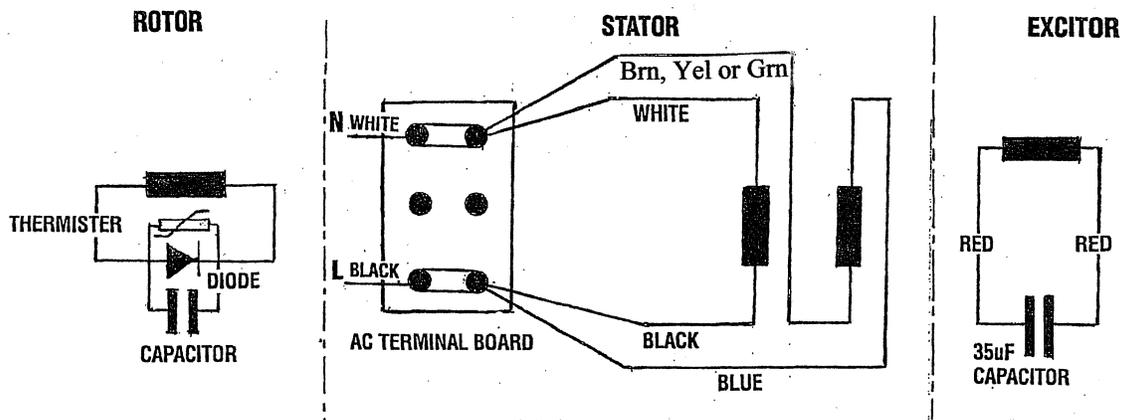


## WINDING RESISTANCE (Measured at 20°C/68°F)

60 Hertz Models : Stator Winding 0.93 Ohm/winding.  
 Rotor Winding - 4.0 Ohm  
 Excitor Winding - 2.0 Ohm  
 Capacitor Rating - 35  $\mu$ F

50 Hertz Models : Stator Winding 1.35 Ohm/winding.  
 Rotor Winding - 4.0 Ohm  
 Excitor Winding - 2.5 Ohm  
 Capacitor Rating - 31.5  $\mu$ F

## SBCG INTERNAL WIRING DIAGRAM



# 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.

## CYLINDER/SPARK PLUGS

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

**NOTE:** *At re-commissioning, remove the spark plugs and clean and gap them. Rotate the engine by hand two complete revolutions. Re-install the spark plugs and tighten securely and firmly attach the high tension leads.*

## LUBRICATION SYSTEM

With the engine warm, drain all the lubricating 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 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.*

## INTAKE MANIFOLD

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!

## FUEL SYSTEM

Top off your fuel tanks with unleaded gasoline of 89 octane or higher. A fuel conditioner such as stabil 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 oil.

## STARTER MOTOR

Lubrication and cleaning of the starter drive pinion is advisable, the pinion is accessible when the flywheel cover is removed. 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.

## 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.

## 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.

## 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 any rags that were placed in the exhaust, intake manifold, or flame arrester.
2. 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, remove the spark plugs, wipe clean, re-gap, and install to proper tightness.
3. Make certain the cooling system intake hose is attached and the thru-hull valve is open.

4. Check the condition of the heat exchanger zinc, clean or replace as needed.
5. Make certain all electrical connections and switches are in the correct position and there are no-loads on the generator at start-up (see *GENERATOR*).
6. Inspect the fresh water pump impeller, replace if necessary.
7. Start the engine in accordance with the procedures described in the *PREPARATIONS FOR STARTING* section of this manual.

# 3.5 KW SBCG GENERATOR SPECIFICATIONS

## ENGINE SPECIFICATIONS

Engine Type	Two cylinder, four stroke gasoline engine.
Bore & Stroke	2.40 x 2.36 inches (61 x 60 mm)
Total Displacement	21.4 Cubic Inches (.35 liter)
Bearings	Two main bearings.
Valve System	Overhead cam-cross flow.
Compression Ratio	9.2:1
Firing Order	1 - 2
Aspiration	Naturally aspirated.
Direction of Rotation	Counterclockwise viewed from the back end.
Inclination	25° maximum angle of operation
Dry Weight	188 lbs (8.55 Kg)
Governor	Electronic ECU

## FUEL SYSTEM

Fuel Pump	Mechanical fuel pump.
Fuel	Unleaded 89 octane or higher gasoline.
Fuel System	Multi-port EFI
Ignition Timing	12-Volt flywheel magneto.
Ignition Coil	12 Volt.
Flame Arrester	Metal screen type.
Fuel Consumption (Full Load)	0.5 GPH @ 2200 RPM.

## ELECTRICAL SYSTEM

Start Motor	12-Volt, 0.6 Kw.
Starting Battery	12-Volt, (-) negative ground
Battery Capacity	600-900 Cold Cranking Amps (CCA)
Battery Charging	11 Amp
DC Amperage Draw	70 Amps DC cranking

## LUBRICATION SYSTEM

Type	Wet sump system trochoid type pump.
Oil Filter	Full flow, paper element, spin-on disposals.
Oil Capacity	1.5 qts. (1.4 L)
Oil Grade	API specifications SJ, SL, SM or better. SAE 10W-30, 10W-40, 15W-40

## COOLING SYSTEM

General	Fresh water cooled via raw water pump. Thermostatically controlled heat exchanger.
Raw Water Pump	Positive displacement type, rubber impeller, belt driven.
Raw Water Flow	2.5 - 3.0 GPM (9.5 - 11.3 LPM)

## AC GENERATOR (SINGLE PHASE)

Type	Brushless Capacitor
Speed	3600 RPM / 60Hz. 3000 RPM/50Hz
3.5 Kw	3.5 KW - 60 Hz single phase, 120 volts 2 wire, 29 amp.  3.5 KW - 50 Hz single phase, 230 volts 2 wire, 15 amp.

## TUNE-UP SPECIFICATIONS

Spark Plug Gap	0.032 - 0.035in (0.8 - 0.9mm)
Spark Plug Torque	11 - 15 lb-ft (15 - 20 Nm)
Bolt Torque	See <i>TORQUING THE CYLINDER HEAD.</i>

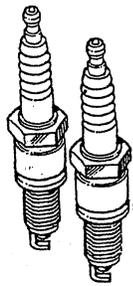
## AIR REQUIREMENTS

Engine Combustion	13 CFM (0.287 cmm)
Generator Cooling	200 CFM (5.66 cmm)
Engine Compartment Ambient Temperature Recommendations	122° F (50° C) maximum

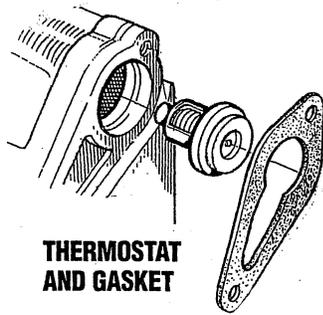
# SUGGESTED SPARE PARTS

## WESTERBEKE MARINE GASOLINE GENERATORS

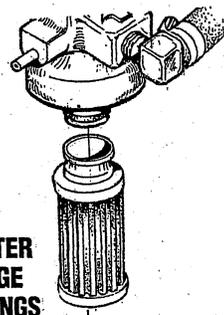
CONTACT YOUR WESTERBEKE DEALER FOR SUGGESTIONS AND ADDITIONAL INFORMATION



SPARK PLUGS



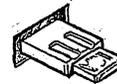
THERMOSTAT AND GASKET



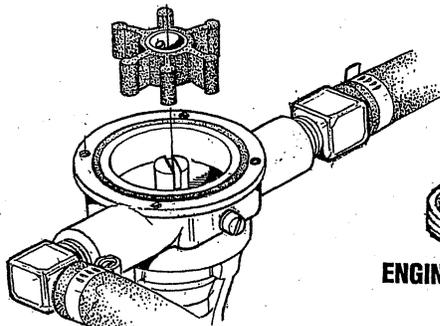
FUEL FILTER CARTRIDGE AND O-RINGS



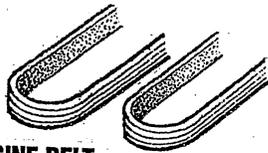
GASOLINE FUEL/WATER FILTERS



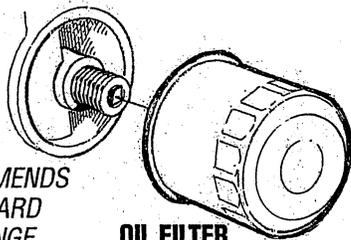
ATM 20A FUSE



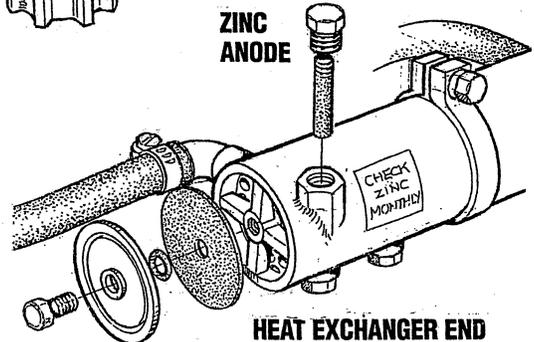
WATER PUMP IMPELLERS, O-RINGS AND GLYCERIN TUBE



ENGINE BELT  
WATER PUMP BELT



OIL FILTER



ZINC ANODE

HEAT EXCHANGER END GASKET AND O-RING

WESTERBEKE ALSO RECOMMENDS HAVING ENOUGH OIL ON-BOARD FOR AT LEAST ONE OIL CHANGE

## SPARE PARTS KITS

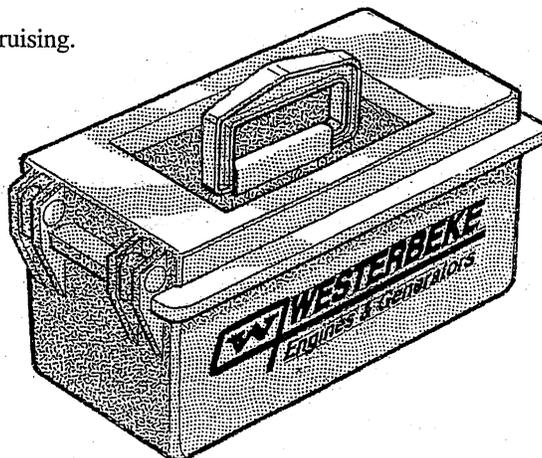
WESTERBEKE also offers two Spare Parts Kits, each packaged in a rugged hinged toolbox.

Kit A includes the basic spares.

Kit B is for more extensive off-shore cruising.

### KIT A

- IMPELLER KIT
- OIL FILTER
- GENERATOR DRIVE BELT
- ZINC ANODE
- SPARK PLUGS
- 20A FUSE
- WATER PUMP BELT
- FUEL FILTER KIT
- HEAT EXCHANGER ZINC



### KIT B

- IMPELLER KIT
- OIL FILTER
- GENERATOR DRIVE BELT
- ZINC ANODE
- SPARK PLUGS
- 20A FUSE
- WATER PUMP BELT
- FUEL FILTER KIT
- COMPLETE GASKET SET
- THERMOSTAT KIT
- WATER PUMP REPAIR KIT
- OIL PRESSURE SWITCH
- HEAT EXCHANGER ZINC





WESTERBEKE CORPORATION • 150 INDUSTRIAL ROAD  
MILES STANDISH INDUSTRIAL PARK • TAUNTON MA 02780  
WEBSITE: [WWW.WESTERBEKE.COM](http://WWW.WESTERBEKE.COM)