

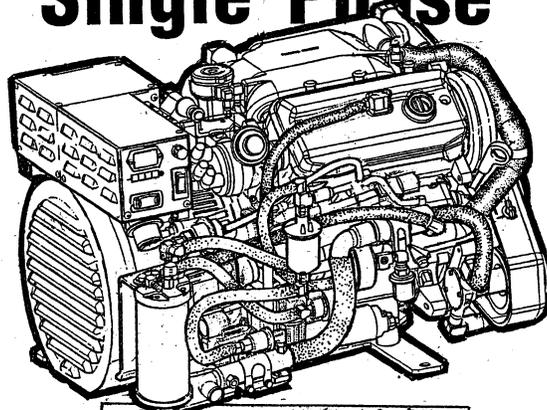


OPERATORS MANUAL

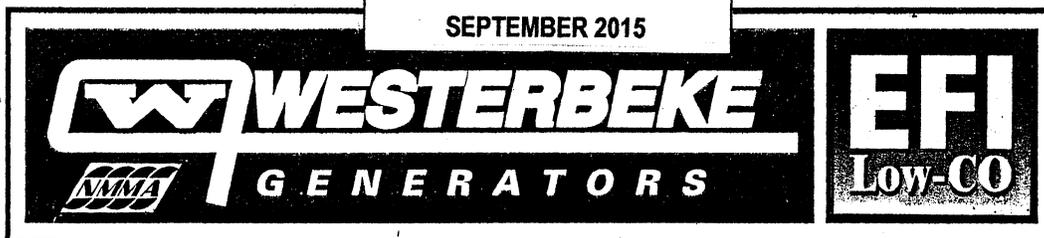
MARINE GASOLINE GENERATORS

6.5 SBCG-60HZ 5.4 SBCG-50HZ
5.0 SBCG-60HZ 4.2 SBCG-50HZ

Single Phase



PUBLICATION NO. 049740
REVISION 4
SEPTEMBER 2015



Ultra-Low Carbon Monoxide Emissions

**CALIFORNIA PROPOSITION 65
WARNING**

Exhaust gas from diesel and gasoline engines (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.

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

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



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



WESTERBEKE™
Engines & Generators

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SAFETY INSTRUCTIONS

INTRODUCTION

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

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

PREVENT ELECTRIC SHOCK

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

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

PREVENT BURNS — HOT ENGINE

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

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

PREVENT BURNS — EXPLOSION

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

- Follow re-fueling safety instructions. Keep the vessel's hatches closed when fueling. Open and ventilate the cabin after fueling. Check below for fumes/vapor before running the blower. Run the blower per 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 while it is running.
- Shut off the fuel service valve at the engine when servicing the fuel system. Take care in catching any fuel that might spill. DO NOT allow any smoking, open flames, or other sources of fire near the fuel system or engine when servicing. Ensure proper ventilation exists when servicing the fuel system.
- Do not alter or modify the fuel system.
- Be sure all fuel supplies have a positive shutoff valve.
- Be certain fuel line fittings are adequately tightened and free of leaks.
- Make sure a fire extinguisher is installed nearby and is properly maintained. Be familiar with its proper use. Extinguishers rated ABC by the NFPA are appropriate for all applications encountered in this environment.

SAFETY INSTRUCTIONS

ACCIDENTAL STARTING

⚠ WARNING: Accidental starting can cause injury or death!

- To prevent accidental starting when servicing the generator, remove the 8 amp fuse from the control panel.
- Disconnect the battery cables before servicing the engine/generator. Remove the negative lead first and reconnect it last.
- Make certain all personnel are clear of the engine before starting.
- Make certain all covers, guards, and hatches are re-installed before starting the engine.

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.

BATTERY ACID

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

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

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

- Ensure that the exhaust system is adequate to expel gases discharged from the engine. Check the exhaust system regularly for leaks and make sure the exhaust manifolds/water-injected elbow is securely attached.
- Be sure the unit and its surroundings are well ventilated. Run blowers when running the generator set or engine.
- Do not run the generator set or engine unless the boat is equipped with a functioning marine carbon monoxide detector that complies with ABYCA-24. Consult your boat builder or dealer for installation of approved detectors.
- For additional information, refer to ABYC 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 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
 - Muscular twitching
 - Dizziness
 - Intense headache
 - Throbbing in temples
 - Weakness and sleepiness

AVOID MOVING PARTS

⚠ WARNING: Rotating parts can cause injury or death!

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

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).

www.abycinc.org

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

NFPA - No.302 (National Fire Protection Association)
"Pleasure and Commercial Motor Craft"

Order from:

National Fire Protection Association
Battery March Park
Quincy, MA 02269

USCG (United States Coast Guard)
"regulations are under titles CFR33 and CFR46 of the Code of Regulations"

Order from:

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

INSTALLATION

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

CODES AND REGULATIONS

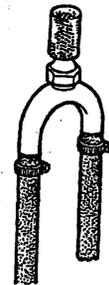
Strict federal regulations, ABYC guidelines, and safety codes must be complied with when installing engines and generators in a marine environment.

SIPHON-BREAK

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

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

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



AVAILABLE FROM
YOUR WESTERBEKE
DEALER

SIPHON-BREAK WITH STAINLESS
LOOP

EXHAUST SYSTEM

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

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

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 1,000 hours (which ever occurs first). Verification involves actual sampling of exhaust gas with an appropriate CO analyzer.

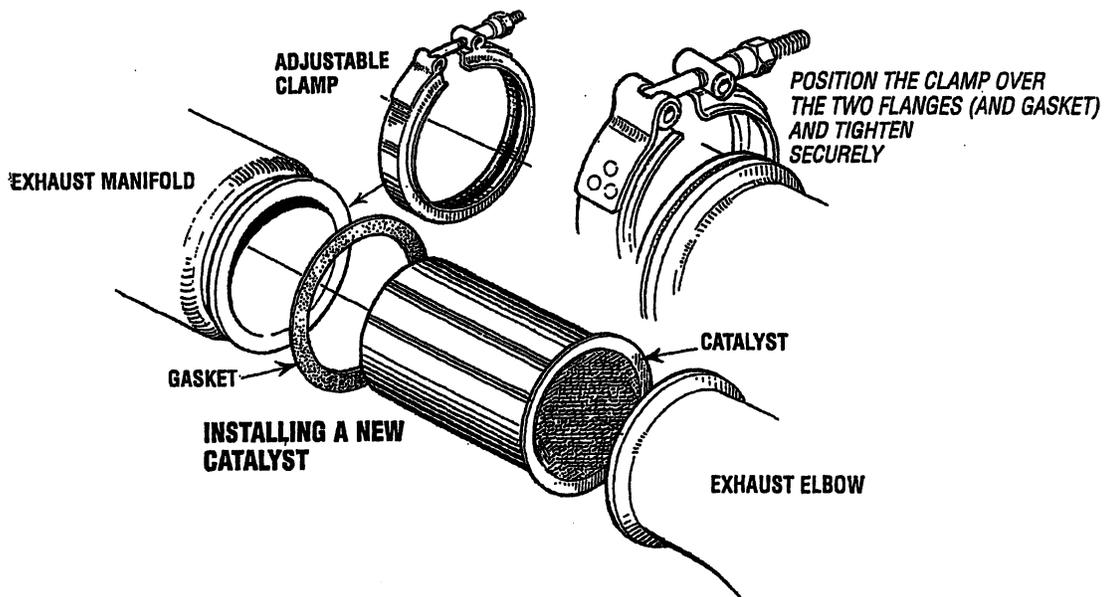
There are two locations where exhaust gas can be sampled. Dry, but hot, exhaust can be sampled at the plugged tapped hole in the exhaust elbow intended for back pressure measurements. Measurements at this location may not be practical in all instances due to the high exhaust temperature, temperature 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.

Whenever taking the time to verify proper CO concentration 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 head to the exhaust manifold, the exhaust manifold to the water injected exhaust elbow, and all subsequent downstream exhaust components and hoses. Remember, exhaust gas that has not yet passed through the catalyst is raw, untreated exhaust 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.



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.

Catagory C= 250 hrs, B=500 hrs,m A =1000.hrs.

You should carefully review the Operators Manual and Installation Manual and any other 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 approval from your 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.

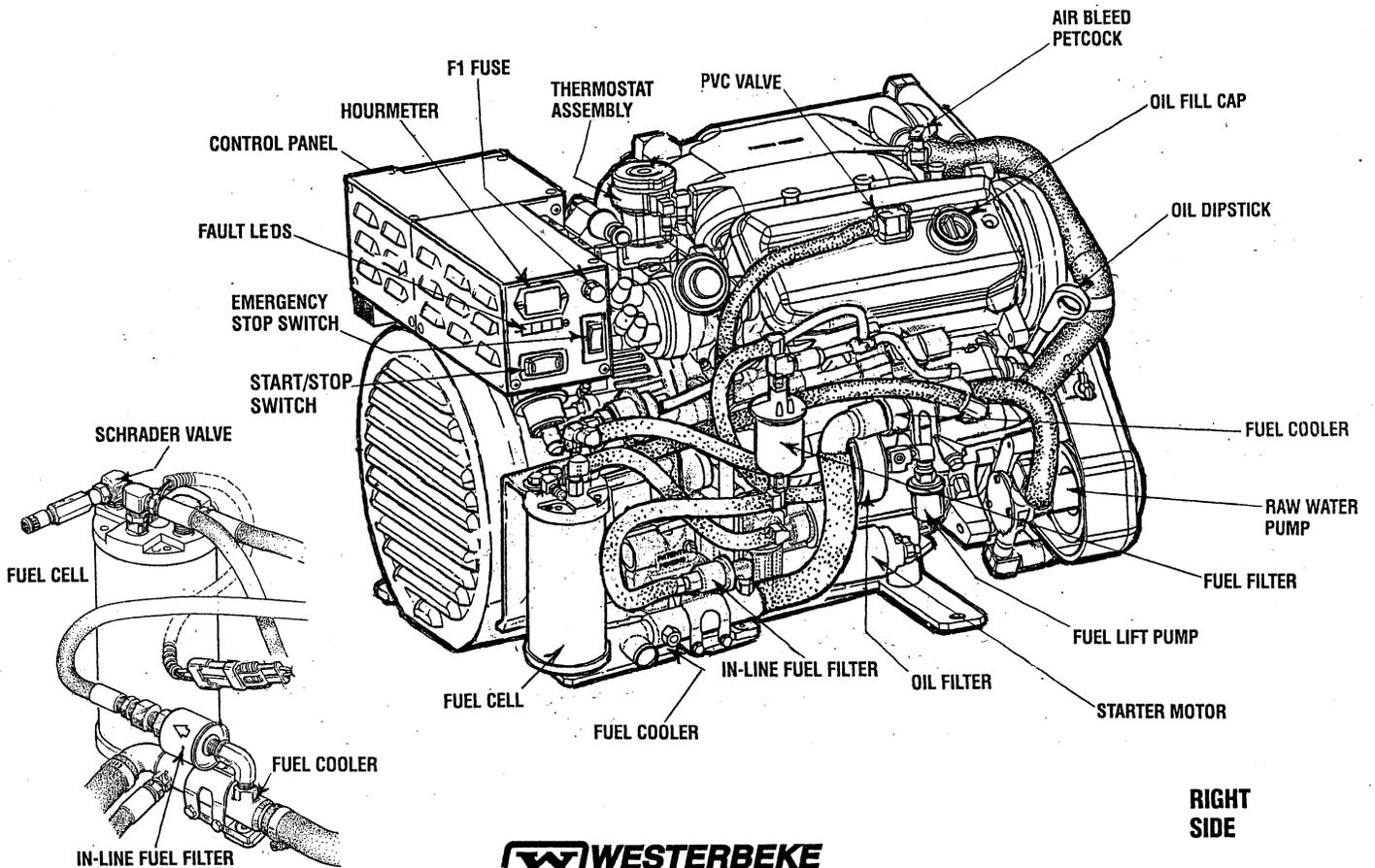
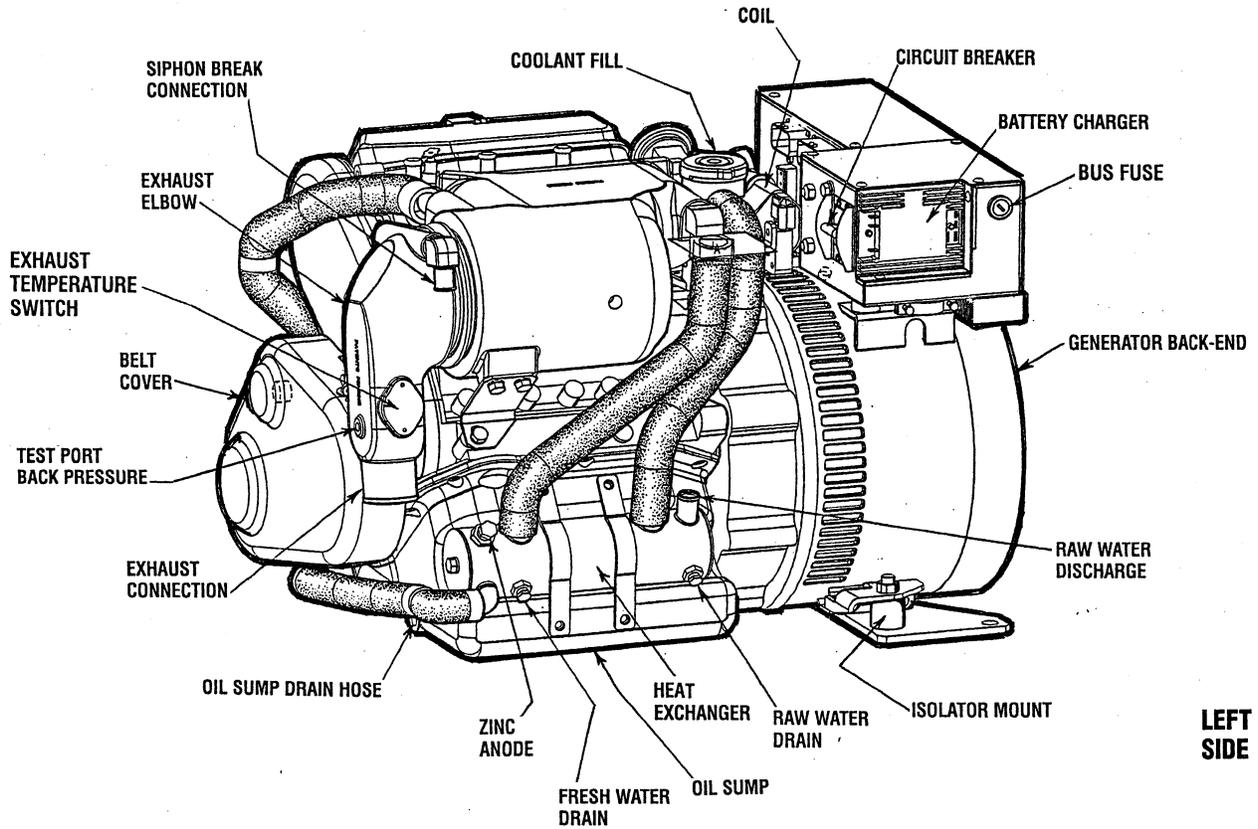
EMISSIONS CONTROL INFORMATION TABLE

Emissions Warranty Information	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.
Engine Fuel Requirements	The engine is certified to operate on unleaded gasoline. See <i>FUEL RECOMMENDATIONS</i> .
Engine Valve Adjustment	See <i>MAINTENANCE SCHEDULE</i> .
Engine Ignition Timing	See <i>MAINTENANCE SCHEDULE</i> .
Engine Lubricating Oil Requirements	See <i>ENGINE OIL RECOMMENDATIONS</i> .
Engine Adjustments	ECU.
Engine Emission Contol System	The engine emission control system consists of engine design and precision manufacture.
Catalyst	See <i>MAINTENANCE SCHEDULE</i> .
Oxygen Sensor	See <i>MAINTENANCE SCHEDULE</i> .
Back Pressure	See <i>MAINTENANCE SCHEDULE</i> .

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SBCG PARTS IDENTIFICATION



INTRODUCTION

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

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

This is your Operators Manual. Along with this manual there is an Installation Manual and a Parts Information. A service Manual is available and can be ordered from your local WESTERBEKE/UNIVERSAL dealer.

WARRANTY PROCEDURES

Your WESTERBEKE Warranty Statement is included in the product documentation package. There is a warranty registration card you can fill out and mail to Westerbeke Corporation or go to our website www.westerbeke.com and register your product's warranty on line. You should receive a customer warranty identification card in the mail within 60 days of registering. If you do not, please contact the factory and have your product model number, serial number and in service date available.



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

NOTES, CAUTIONS AND WARNINGS

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

NOTE: An operating procedure essential to note.

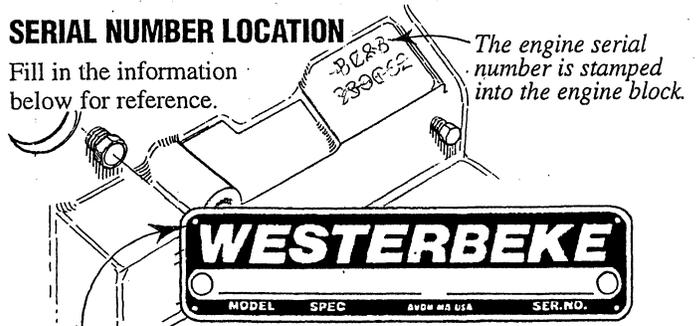
CAUTION: Procedures, which if not strictly observed, can result in the damage or destruction of your engine.

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

WESTERBEKE customers should also keep in mind the time span between printings of WESTERBEKE product. Westerbeke frequently updates manuals and software. Please insure that you will have the latest information by consulting your WESTERBEKE representative or visit our website at www.westerbeke.com

SERIAL NUMBER LOCATION

Fill in the information below for reference.



The engine model number and serial number are printed on a decal on the engine manifold.

The generator serial number is stamped on the top of the generator housing.

The generator specifications are printed on a decal on the side of the generator.

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.

NOTE: Technical information is provided in our Manuals for your reference and convenience. Westerbeke recommends that your engine, generator or climate control system is serviced and/or installed only by a qualified Westerbeke distributor or dealer.

The 5.0/6.5 SBCG Service Manual (#055051) is available as a PDF download at www.westerbeke.com. This Service Manual can also be purchased from your WESTERBEKE DEALER as a book.

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 filter 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: *Six important steps to ensure long generator life:*

- *Proper engine and generator installation and alignment.*
- *An efficient well-designed exhaust system that includes an anti-siphon break to 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, filtered unleaded fuel.*
- *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 verticle in-line, and the engine's cylinder head has an overhead camshaft which is chain-driven. The engine utilizes a solid-state distributor which is horizontally mounted and camshaft-driven. The engine incorporates a pressure type lubrication system, and a fresh water-cooled engine block which is thermostatically-controlled. 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, cooling system and the generator backend.

FUEL, ENGINE OIL AND ENGINE COOLANT

CARE OF FUEL SUPPLY

CAUTION: *Only use unleaded gasoline with an Octane rating of 89 or higher. The use of a lower Octane gasoline will result in a loss of engine power and performance. Ethanol blended gasoline must not exceed E10 (10%). Use of a higher blend is not acceptable for use in these models and may void the warranty.*

Care Of The Fuel Supply

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

Purchase a well-known brand of fuel.

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

ENGINE OIL

Use a good brand of engine oil with an API and SAE designations as listed in the SPECIFICATION Section of this manual.

Change the engine oil and filter after an initial 50 hours of engine break-in operation. Then follow the oil and filter change intervals as specified in the MAINTENANCE SCHEDULE in this manual.

Westerbeke Corporation does not approve or disapprove 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 in this manual and not to be extended if synthetic oils are used.

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

ENGINE COOLANT

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

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

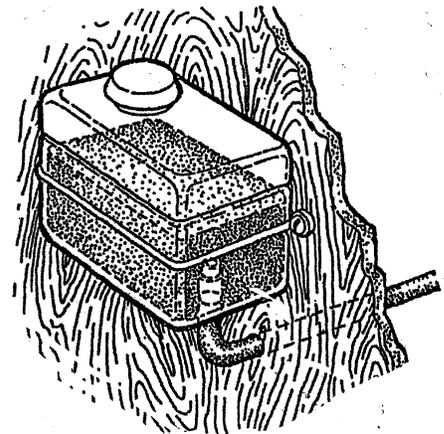
The distilled water and antifreeze should be pre-mixed before being poured into the cooling circuit.

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

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

COOLANT RECOVERY TANK

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



NOTE: *This tank, with its short run of plastic hose, is best located at or above the level of the engine's exhaust manifold.*

PREPARATIONS FOR INITIAL START-UP

PRESTART INSPECTION

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

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

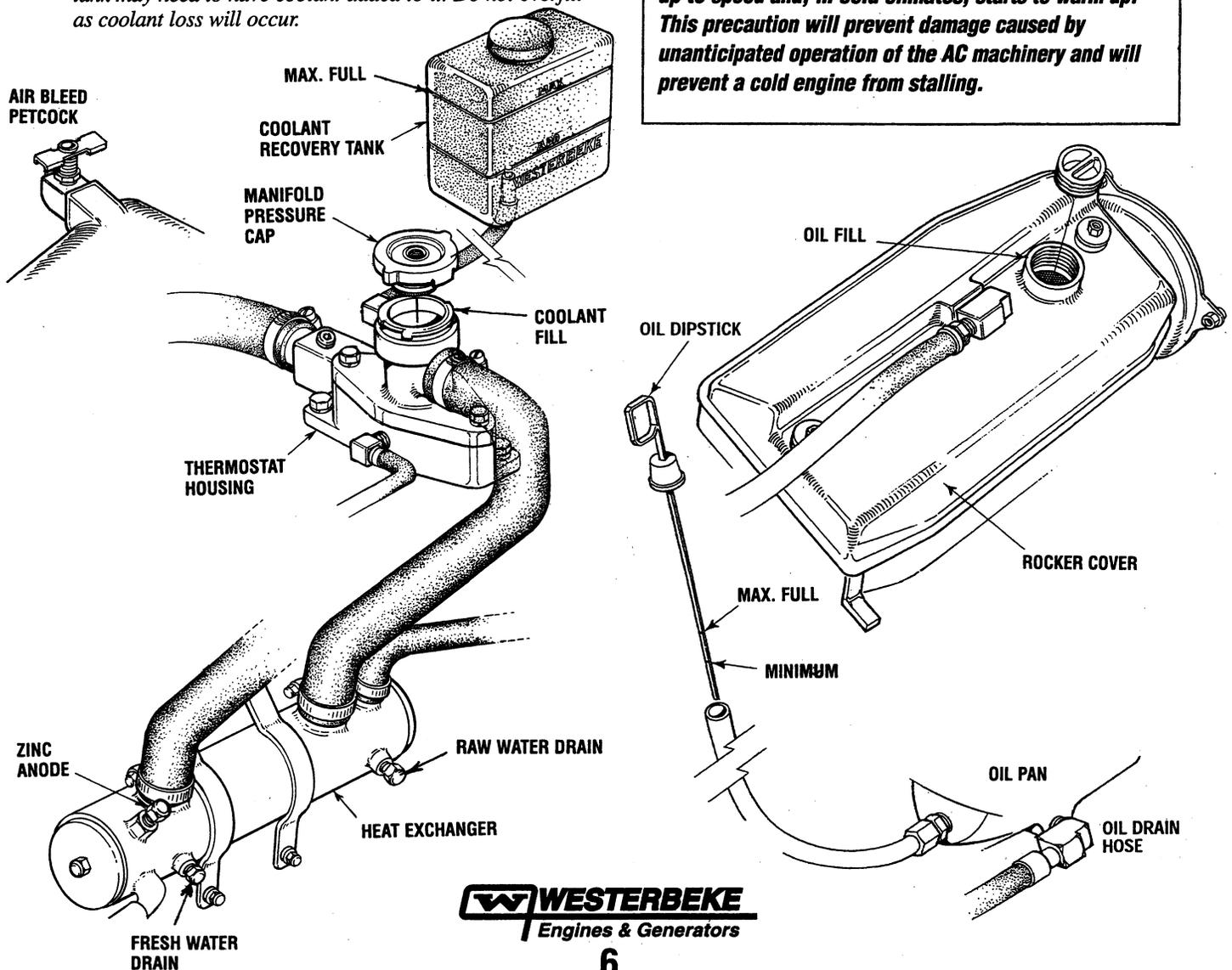
NOTE: During the initial filling of the cooling system, the air bleed petcock on the manifold should be opened to purge air from the engine block. Once coolant, free of air bubbles, flows from the petcock - close the petcock.

After shutdown and after the engine has cooled, the coolant from the recovery tank will be drawn into the engine's cooling system to replace the purged air.

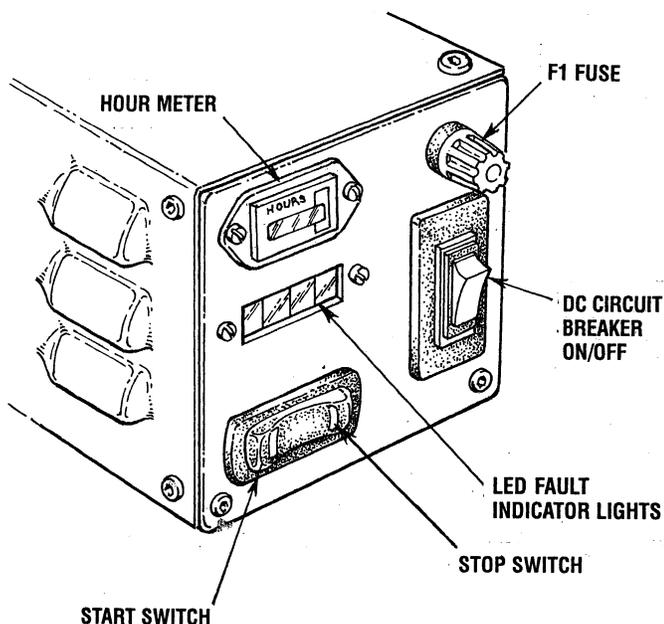
Before subsequent operation of the generator, the engine's manifold should be topped off, and the coolant recovery tank may need to have coolant added to it. Do not overfill as coolant loss will occur.

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

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



OPERATING INSTRUCTIONS



GENERATOR CONTROL PANEL

The start/stop rocker switch is the only functional component on the generator control panel used to start and stop the generator.

The start/stop rocker switch is a three position switch with momentary contacts in the (START) and (STOP) position and a stationary contact function in the center (NORMAL) this position allows the generator to run once started and also enables the remote start/stop panel(s) to control the start/stop functions of the generator.

The (START) position starts the generator and once released reverts to the center position. The (STOP) position stops the engine in normal operation as well as in an emergency situation. This position opens the K2 run relay which de-energizes the engine's run circuit and shuts down the engine.

Starting

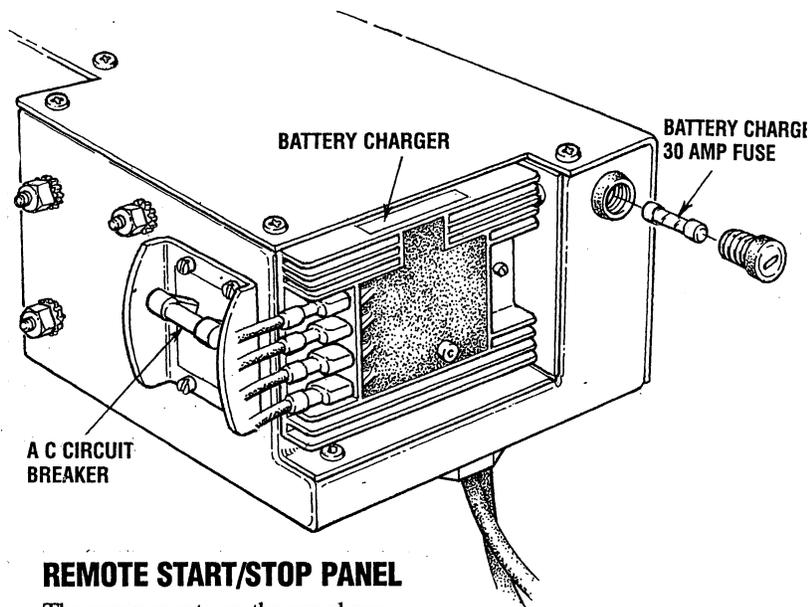
Simply press the (START) switch momentarily. The ECU will take the command and start the generator. The green LED on the start switch will illuminate and dim as the engine cranks and glow bright once the engine starts.

Stopping

Depress the (STOP) switch momentarily and release. The ECU will receive the (STOP) command and shut the generator down.

Failure to Start

The start cycle will automatically terminate if the unit fails to start after 6 seconds (approximately) of cranking time. The fault LED for "Underspeed" will illuminate and flash. To initiate another another crank cycle, the panel DC breaker must be turned OFF and then back ON.



REMOTE START/STOP PANEL

The components on the panel are:

1. A three position start/stop rocker switch.
2. A green LED run indicator light on the rocker switch.
3. A four position LED fault shut down display board.

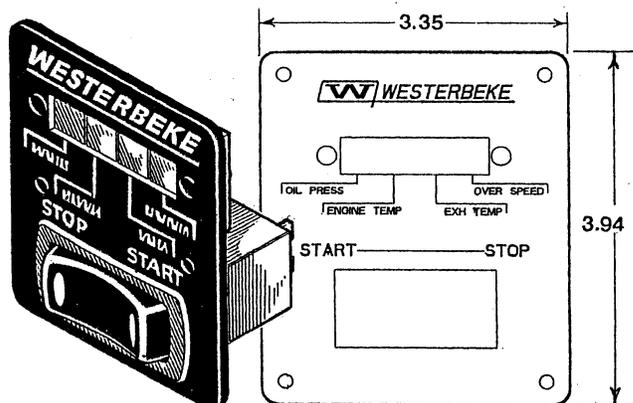
The start/stop rocker switch functions the same as the start/stop rocker switch on the generator's control panel as previously explained.

The green LED run indicator light on the rocker switch will illuminate when the start circuit is energized. It will go dim as the engine cranks and will brighten as the engine starts indicating the generator is running.

The LED fault shut down display board has four separate LED lights to display to the operator the cause of the generators automatic shut down. The four LED displays are: low oil pressure, high engine operating temperature, high exhaust temperature and engine over-speed/under-speed (flashes).

Should the generator shut down from one of these faults, the fault LED will remain illuminated. To reset the LED, the DC breaker must be turned OFF and then back ON.

The remote start/stop panel is a plug-in accessory and has extension harnesses available in varying lengths from 15 feet up to 100 feet in length.



BREAK-IN PROCEDURE/DAILY OPERATION

BREAK-IN PROCEDURE

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

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

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

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

To protect against unintentional overloading of the generator, the generator's output leads should be routed through a circuit breaker that is rated at the rated output of the generator.

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

CHECK LIST

Follow this checklist each day before starting your generator.

- Record the hourmeter reading in your log (engine hours relate to the maintenance schedule).
- Visually inspect the engine for fuel, oil, or water leaks.
- Check the oil level (dipstick).
- Check the coolant level in the coolant recovery tank.
- Check your fuel supply.
- Check the starting batteries (weekly).
- Check the drive belts for wear and proper tension (weekly).
- Check for abnormal noise such as knocking, vibration and blow-by sounds.
- Confirm exhaust smoke:
 - When the engine is cold – white smoke.
 - When the engine is warm – almost smokeless.
 - When the engine is overloaded – some black smoke.

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

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

GENERATOR ADJUSTMENTS

Once the generator has been placed in operation, there may be governor adjustments required for engine speed (hertz) during the engine's break-in period (first 50 hours) or after this period (see *ENGINE SPEED (HERTZ) ADJUSTMENT* under *ENGINE ADJUSTMENTS*).

NOTE: After the first 50 hours of generator operation check the maintenance schedule for the 50 hour service check.

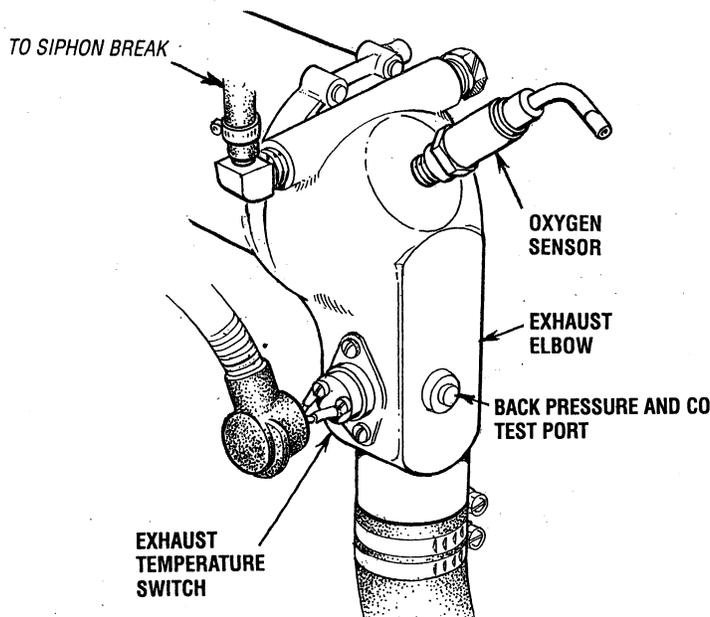
SAFETY SHUTDOWN SENSORS AND SWITCHES

SAFETY SHUTDOWN SENSORS AND SWITCHES

The engine is protected by a variety of shutdown sensors and switches that signal the ECU (Electronic Control Unit) when a fault occurs. Should an automatic shutdown occur from a fault, one of the four fault LED lights on the control panel will illuminate to indicate the cause. Correct the cause of the shutdown. To reset the ECU and turn off the fault LED, momentarily turn off the panel DC breaker. The following are descriptions of these safety shutdown sensors and switches.

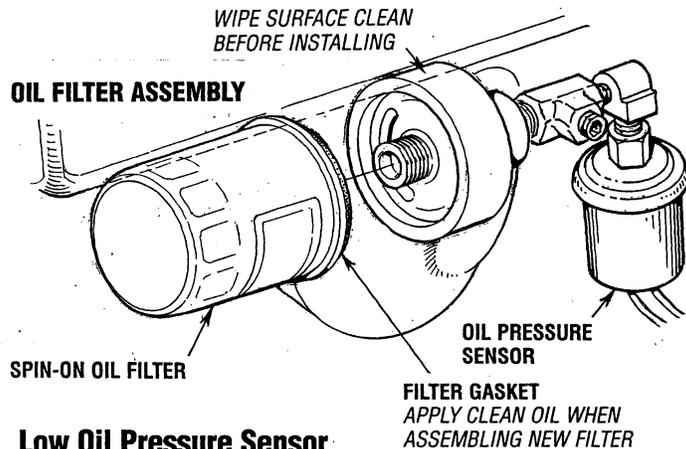
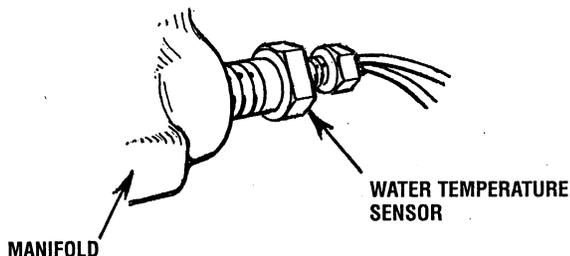
Exhaust Temperature Switch

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



Water Temperature Sensor

A water temperature sensor is located on the water jacketed intake manifold to monitor engine antifreeze coolant temperature. The sensor is sending a DC voltage to the ECU that interprets this as engine coolant temperature. Should the DC voltage reach an overheat threshold, the ECU will shut the engine down and will illuminate the over temp fault LED light on the control panel.

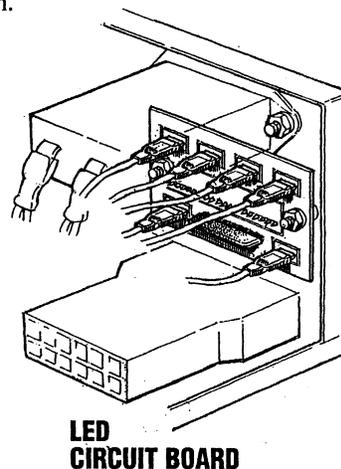


Low Oil Pressure Sensor

A low oil pressure sensor is located adjacent to the lube oil filter. It sends a DC voltage to the ECU that is interpreted as oil pressure. Should this DC voltage drop to a preset threshold. The ECU will shut the engine down and will illuminate the low oil pressure fault LED on the control panel.

Overspeed shutdown

The ECU is monitoring engine rpm from an AC signal sent to it from the MPU (Magnetic Pick-up) positioned over the flywheel ring gear teeth. Should the engine speed cause the MPU to generate an AC voltage indicating an overspeed condition. The ECU will shut the engine down and illuminate the overspeed fault LED on the control panel. Likewise with an under-speed, the ECU will shut the unit down and the LED will flash.



Engine DC Circuit Breaker

The generator's engine is protected by a panel mounted manual reset circuit breaker. Excessive DC current draw or electrical overload anywhere in the instrument panel wiring or engine wiring will cause the breaker to trip. In this event the generator will shutdown because the opened breaker interrupts the DC circuit to the the ECU. If this should occur, check and repair the source of the problem. After repairing the fault, reset the breaker and restart the generator.

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 DC circuit breaker on the control panel, or turn off the battery switch.*

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 every 250 operating hours or once a year.
Fuel Supply	Fresh unleaded gasoline with an octane rating of 89 or higher. Lower octane will affect engine performance. 10% ethanol maximum.
*Visual Inspection of Engine	Check for fuel, oil and water and exhaust leaks. Check that the water injected exhaust elbow securing v-clamp is tight. Insure there are no exhaust leaks around the elbow. Inspect wiring and electrical connections. Look for loose bolts/hardware and possible corrosion.

INITIAL 50 HOURS OF OPERATION

*Spark Plugs	Clean/re-gap.
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 or once a year. Carefully inspect for leaks. Check that the exhaust hoses are properly attached and that the securing clamps are tight. Check the integrity/mounting security of the water injected exhaust elbow.
*Air Screen/Flame Arrestor	Remove, clean and re-install screen pack. Inspect rubber sealing ring and replace if necessary, then once a year.
*Valve Adjustment	Check adjustment of valves. Check again at 500 hours.
*Inlet Fuel Filter	Initial change, then every 250 hours or once a year.
*Fuel Filter and "O" Rings	Initial change, then every 250 hours or once a year.

EVERY 50 OPERATING HOURS OR MONTHLY

*Drive Belts (Fresh Water/Raw Water Pumps)	Inspect for proper tension (3/8" to 1/2" deflection) and adjust if needed. Check belt for slipping, cracking and wear. Adjust tension or replace as needed. Replace cover.
Starting Batteries	Check electrolyte levels Make sure cables and connections are in good order. Clean off corrosion if needed. Apply petroleum jelly to terminals for corrosion protection.
Electric Fuel Pump	Inspect for leaks, ensure fuel and electrical connections are clean and tight.
Zinc Anode	Inspect and clean zinc anode. Replace if necessary. Note the condition, then determine your own inspection schedule.

EVERY 100 OPERATING HOURS OR YEARLY

Engine Oil and Filter	Change engine oil and filter.
*Air Screen/Flame Arrestor	Remove, clean and re-install screen pack. Inspect rubber sealing ring and replace if necessary.

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

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 charge. Turn **OFF** either the panel DC breaker or the starting battery switch when the unit will not be operated for a period of time.

MAINTENANCE SCHEDULE

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

SCHEDULED MAINTENANCE

EXPLANATION OF SCHEDULED MAINTENANCE

EVERY 250 OPERATING HOURS OR YEARLY

*Exhaust Elbow/Exhaust System	Check the structural integrity of the water injected exhaust elbow casting. Check the integrity of the exhaust system attached to the elbow. All hose connections should be secure. No chafing. No exhaust leaks. Hoses and muffler are in good serviceable condition. NOTE: An exhaust leak will cause exposure to diesel exhaust!
*Fuel Filter and O-Rings	Remove and replace fuel filter and all sealing O-rings.
*Inlet Fuel Filter	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 as needed.
Vibration Isolators/Engine Mounts	Check vibration isolators, brackets and mounting hardware. Replace as needed.
*Heat Exchanger	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 pump cover and inspect the pump assembly for wear, especially cam and wear plates. Replace the impeller and gasket. Lubricate the impeller when re-assembling.
*Exhaust System Catalyst	Inspect for proper operation. Replace at 2000 operating hours.

EVERY 500 OPERATING HOURS OR EVERY TWO YEARS

*Ignition System	Inspect for deterioration. Test resistance.
*Coolant System	Drain, flush and re-fill the cooling system with appropriate antifreeze mix. Replace the thermostat and coolant pressure cap.
*Valve Clearances	Adjust valves. (Incorrect valve clearance will result in poor engine performance.)
*Starter Motor	Check solenoid and motor for corrosion. Remove and lubricate. Clean and lubricate the starter motor pinion drive

EVERY 1000 OPERATING HOURS OR OR EVERY FIVE YEARS

*Engine Timing Belt	Remove and replace the timing belt. NOTE: Failure to replace the timing belt at the recommended interval could result in timing belt failure resulting in major damage to the engine.
*Heat Exchanger	Remove the heat exchanger for professional cleaning and pressure testing.
*Diverter Valve #054500	Remove and replace.

EVERY 2000 OPERATING HOURS

*Oxygen Sensor	Remove and replace exhaust oxygen sensor.
*Catalyst	Remove and replace exhaust catalyst.

⚠ 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 DC circuit breaker on the control panel.

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

The 5.0/6.5 SBCG Service Manual (#055051) is available as a PDF download at www.westerbeke.com. This Service Manual can also be purchased from your WESTERBEKE DEALER as a book.

COOLING SYSTEM

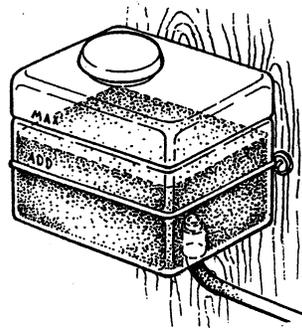
FRESH WATER COOLING CIRCUIT

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

Fresh water coolant is pumped through the engine by a circulating pump, absorbing heat from the engine. The coolant then passes through the thermostat into the manifold, to the heat exchanger where it is cooled, and returned to the engine block via the suction side of the circulating pump. When the engine is started cold, external coolant flow is prevented by the closed thermostat (although some coolant flow is bypassed around the thermostat to prevent the exhaust manifold from overheating). As the engine warms up, the thermostat gradually opens, allowing full flow of the engine's coolant to flow unrestricted to the external portion of the cooling system.

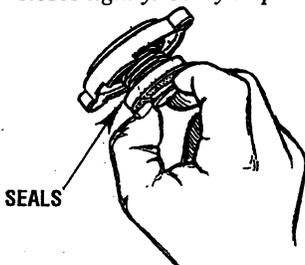
Coolant Recovery Tank

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

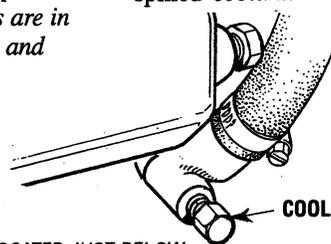


COOLANT RECOVERY TANK

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

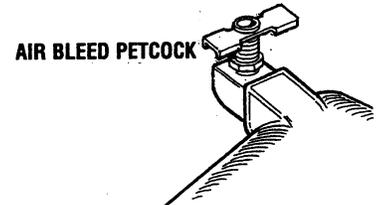


CHECKING THE PRESSURE CAP

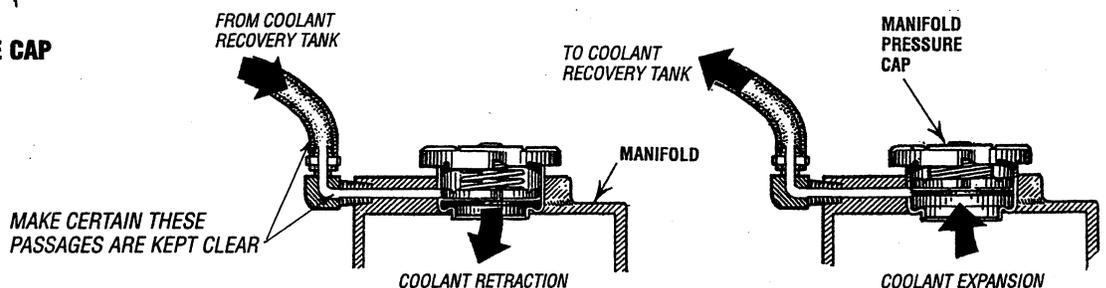


COOLANT DRAIN PLUG

LOCATED JUST BELOW THE INTAKE MANIFOLD



AIR BLEED PETCOCK



CHANGING COOLANT

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

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

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

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

Refilling the Coolant

After replacing the engine drain plug, open the air bleed petcock on the exhaust manifold and slowly pour clean, premixed coolant into the manifold.

Monitor the coolant in the manifold and add as needed. Fill the manifold neck. Once coolant begins flowing from the air bleed petcock free of air bubbles, close the petcock and install the manifold 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.

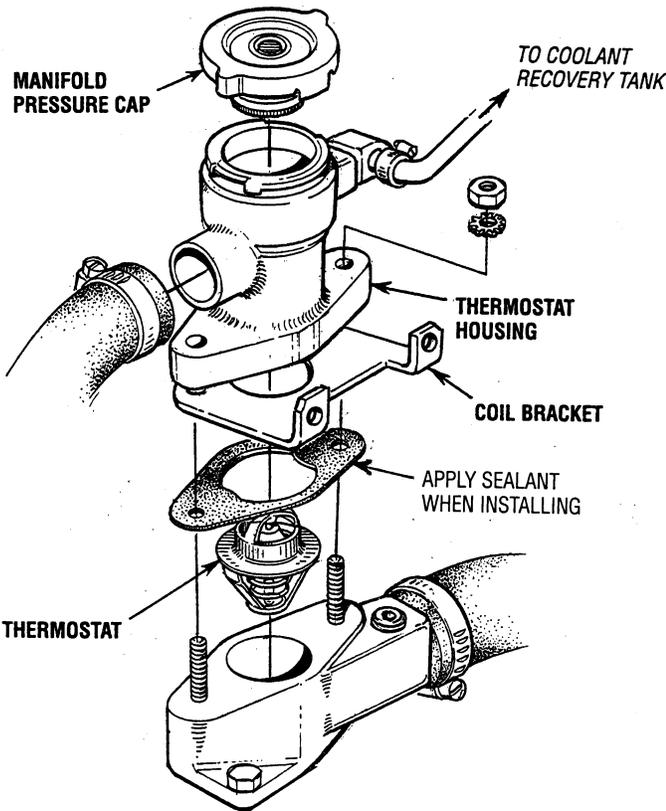
After checking for leaks, stop the engine and allow it to cool. Coolant should draw back into the cooling system as the engine cools down. Add coolant to the recovery tank if needed and check the coolant in the manifold. Clean up any spilled coolant.

COOLING SYSTEM

THERMOSTAT

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

If you suspect a faulty thermostat, place it in a pan of water and bring to a boil. A working thermostat should open about 1/2"



HEAT EXCHANGER

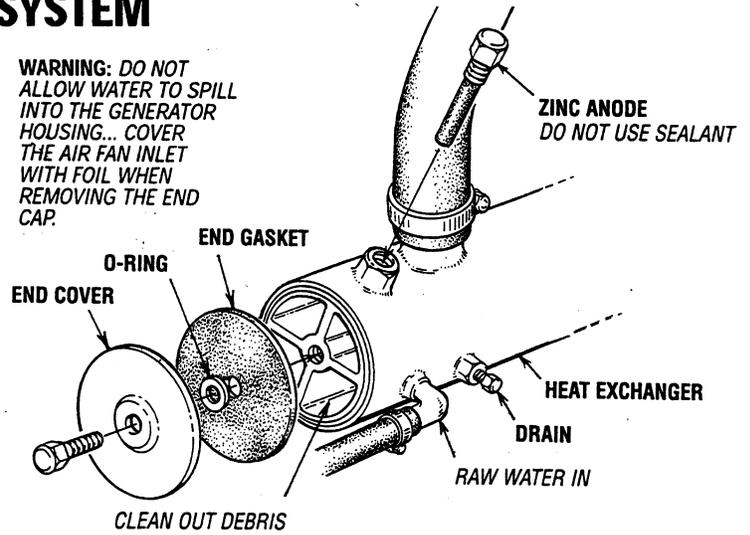
Cool raw water flows through the inner tubes of the heat exchanger. As the engine coolant passes around these tubes the heat of the internal engine is conducted to the raw water which is then pumped into the exhaust system and discharged. The engine coolant (now cooled) flows back through the engine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

WARNING: DO NOT ALLOW WATER TO SPILL INTO THE GENERATOR HOUSING... COVER THE AIR FAN INLET WITH FOIL WHEN REMOVING THE END CAP.



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

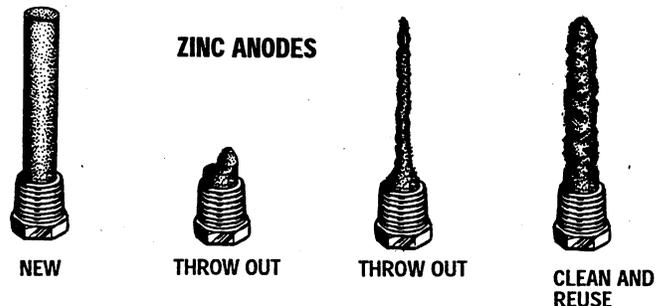
ZINC ANODE

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 onboard.

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

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

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



COOLING SYSTEM

2 RAW WATER INTAKE STRAINER

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

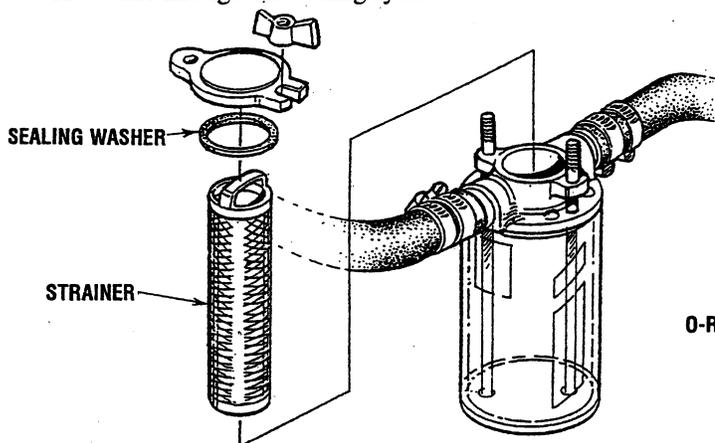
A clean raw water intake strainer is a vital component of the engine's cooling system. Include a visual inspection of this strainer when making your periodic engine check. The water in the glass should be clear.

Perform the following maintenance after every 100 hours of operation:

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

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

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



**RAW WATER INTAKE STRAINER
OWNER INSTALLED (TYPICAL)**

RAW WATER COOLING CIRCUIT

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

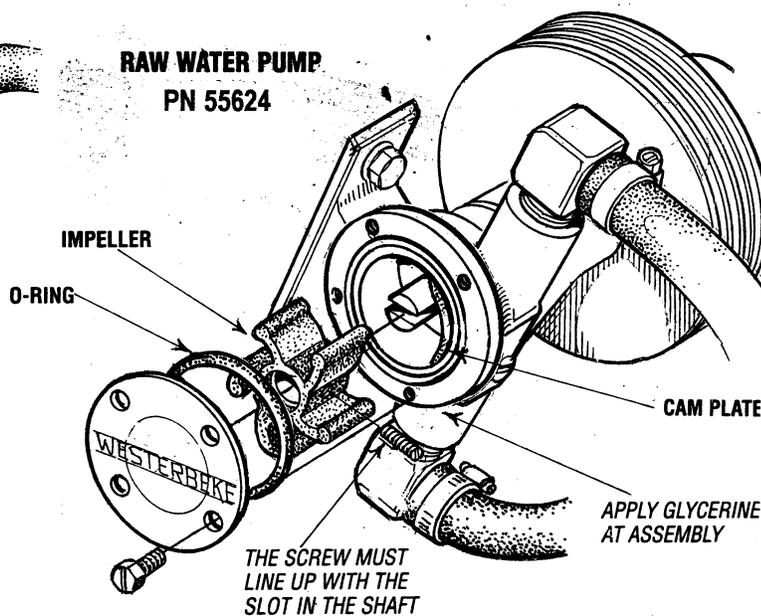
RAW WATER PUMP

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

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

Changing the Raw Water Pump Impeller

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



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

FUEL SYSTEM

GASOLINE

Only use **unleaded** gasoline with an Octane rating of 89 or higher. The use of a lower Octane gasoline will result in a loss of engine power and performance. Ethanol blended gasoline **must not** exceed E10 (10%). Use of a higher blend is not acceptable for use in these models and can void the warranty.

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



When fueling, follow the U.S. Coast Guard regulations. Close off all hatches and companionways to prevent fumes from entering the vessel and ventilate properly after fueling.

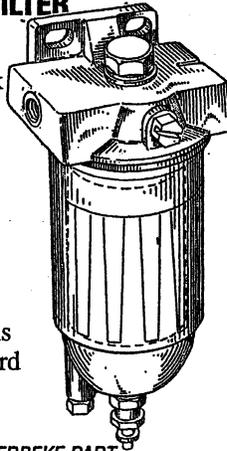
NOTE: The generator compartment should have a gasoline fume detector/alarm properly installed and working.

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.

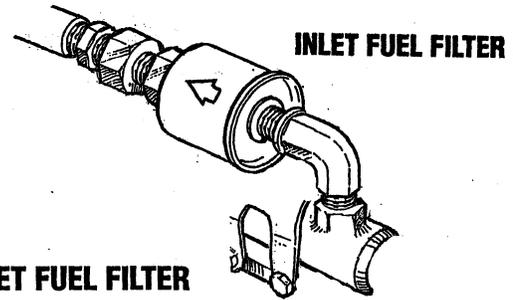
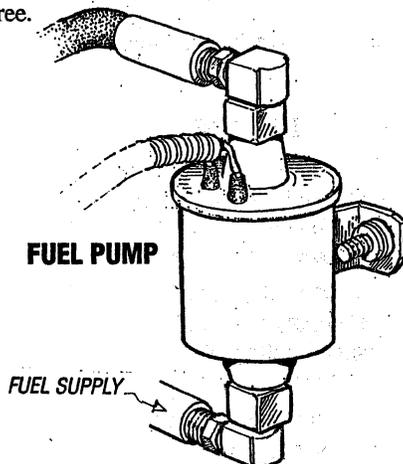
These gasoline filters must have **metal** bowls (not "see-through") to meet U.S. Coast Guard requirements. The metal bowls have drain valves to use when checking for water and impurities.



WESTERBEKE PART NUMBER (49602)
OWNER INSTALLED

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

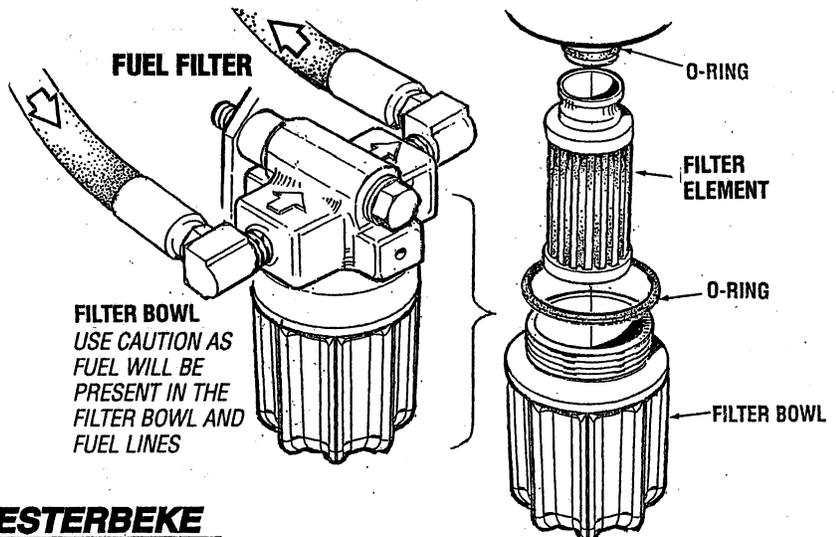
1. Shut off the fuel supply to the generator. Disconnect the fuel supply line to the inlet filter and unscrew the filter from the pump inlet. Take care to catch any fuel that may be present.
2. Thread on the replacement inlet filter and connect the fuel supply line. Use care when connecting and tightening 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 there is no pressure in the fuel system by bleeding off any existing pressure using a Schrader valve on the throttle body and fuel cell. Use a pressure testing kit as shown on the next page.
3. Unscrew the fuel bowl from the housing and allow the bowl to come away from the housing.
4. Remove and replace the filter element and clean the bowl.
5. Inspect both "O" rings. Replace if necessary.
6. Press on a new filter and replace the filter bowl.
7. Open the fuel supply. Inspect for leaks.



FUEL SYSTEM

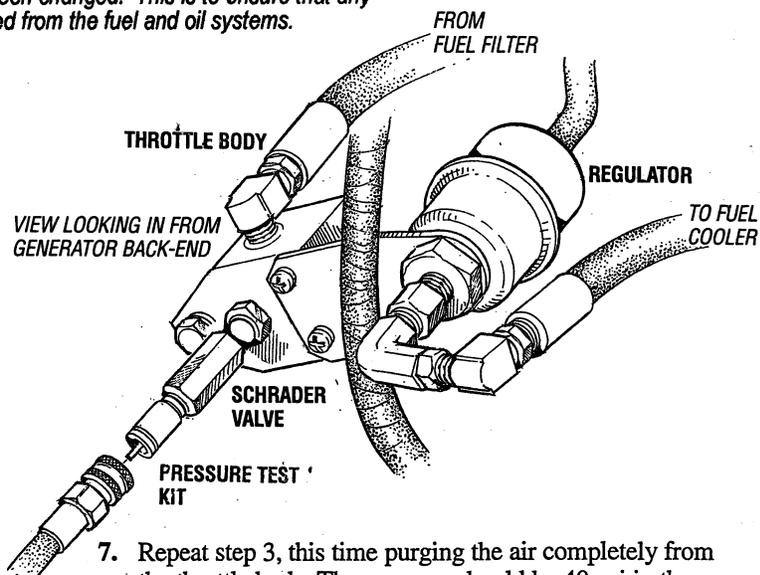
NOTE: Bleeding the fuel system is recommended after servicing, and also when the oil and oil filter have been changed. This is to ensure that any accumulated air has been purged from the fuel and oil systems.

BLEEDING THE FUEL SYSTEM

1. Insure that the fuel cell *is not* connected to the wiring harness, and that the lift pump *is* connected.
2. Attach Snap On MT337B, OTC 7211 or equivalent fuel pressure gauge set to the Schrader valve on fuel cell.

CAUTION: Follow manufacturer's instructions for safe use of the gauge sets to purge a high-pressure fuel system.

3. While holding the stop switch in the *prime* (depress) position, purge the air from the fuel cell. The fuel cell is purged when no air bubbles are visible escaping from the drain line attached to the Schrader valve. The pressure should typically be 3 - 4 psi.
4. Remove the pressure gauge set from the fuel cell and connect it to the Schrader valve on the throttle body.
5. Connect the fuel cell to the wiring harness.
6. Open the valve on the fuel pressure gauge purge line. Do not prime the system without the fuel gauge purge valve open or air can be forced back into the fuel cell. If this happens, repeat steps 1, 2, and 3 to remove the trapped air from the fuel cell.

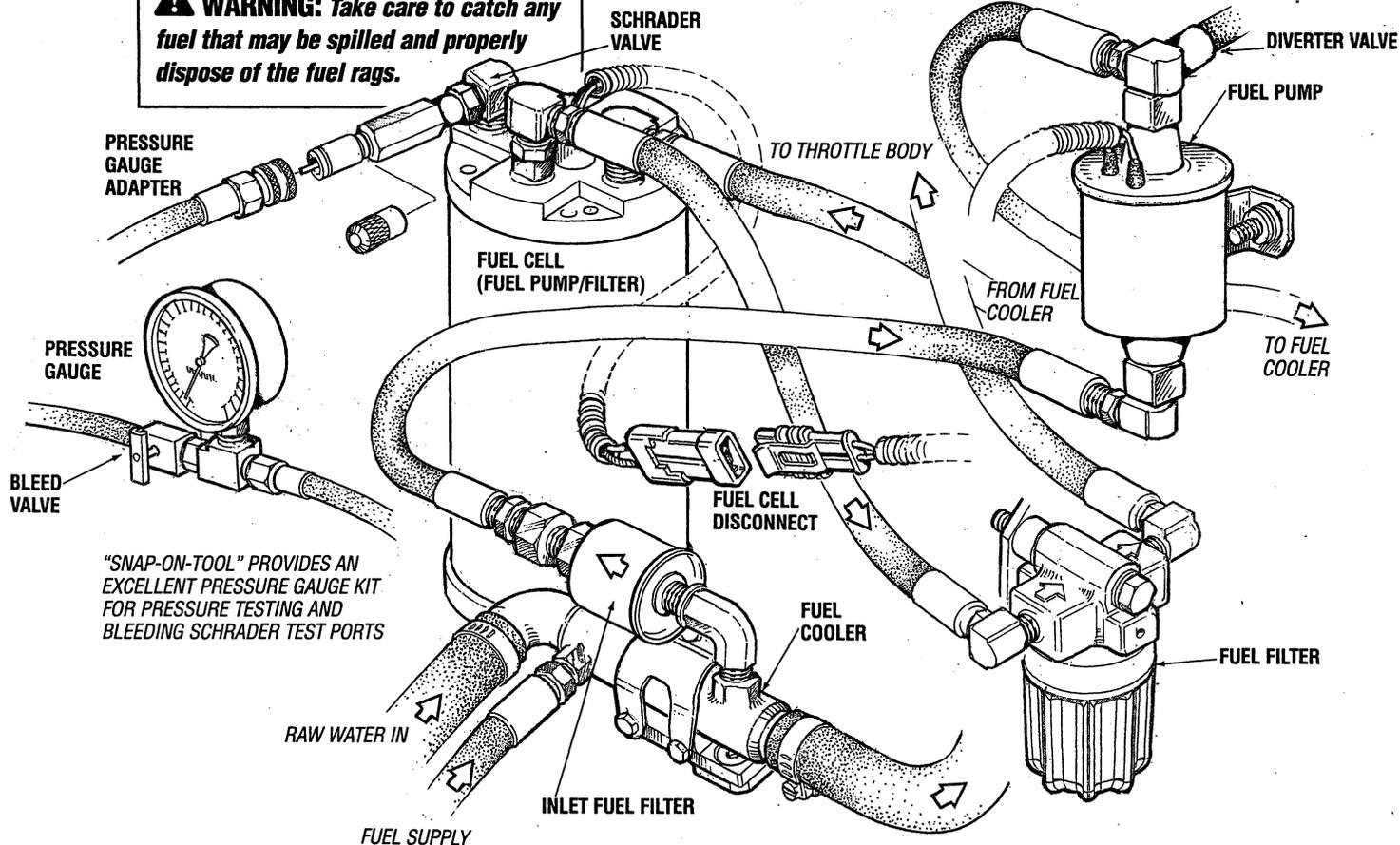


7. Repeat step 3, this time purging the air completely from the throttle body. The pressure should be 40 psi in the throttle body after purging the system.

NOTE: The system can develop 40 psi without being fully purged. The system is fully purged when no bubbles are visible in the purge line.

8. Remove the pressure gauge set, and cap all Schrader valves.
9. Insure that all wire connections are secure and that there are no leaks in the fuel system.

WARNING: Take care to catch any fuel that may be spilled and properly dispose of the fuel rags.



"SNAP-ON-TOOL" PROVIDES AN EXCELLENT PRESSURE GAUGE KIT FOR PRESSURE TESTING AND BLEEDING SCHRADER TEST PORTS

ELECTRONIC FUEL INJECTION

DESCRIPTION

The illustration shows the throttle body assembly that attaches to the intake manifold.

An electronic control unit (ECU) controls the fuel injector and the throttle actuator.

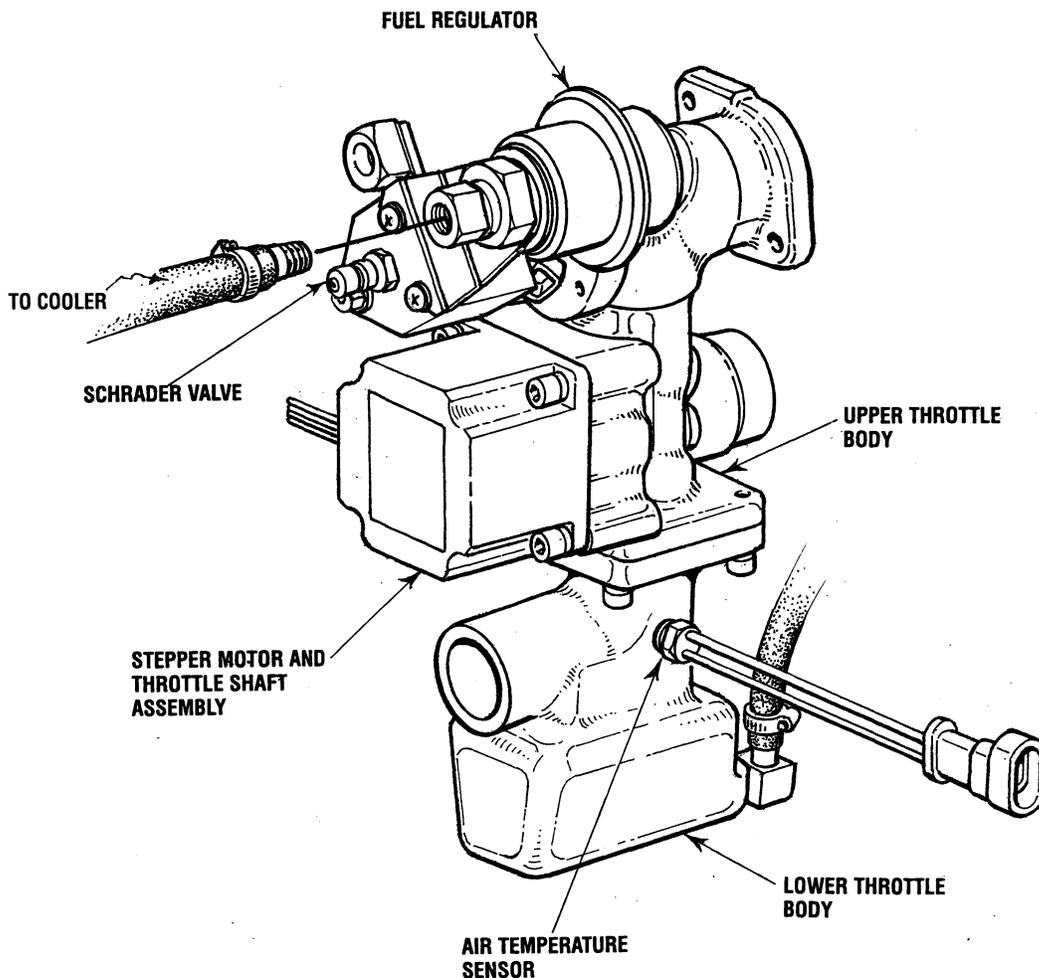
The ECU is supplied with engine operating conditions from sensors that monitor intake air temperature, engine coolant temperature, map sensor (intake manifold absolute pressure), engine rpm and battery voltage.

The ECU interprets this information to determine the appropriate injector pulse rate and throttle opening position.

A high pressure fuel pump supplies fuel to the area around the injector and the regulator maintains the fuel pressure in that area at 35 - 40 PSI maximum.

The injector is a solenoid operated pintle valve that meters fuel into the intake manifold depending on engine operating conditions and generator amperage load as determined by the ECU.

Air flow into the intake manifold is controlled by the ECU operation of the throttle plate via the actuator. Throttle plate positioning for proper air flow into the engine is accomplished through the ECU interpretation of engine operating conditions. The Schrader valve is used to monitor/check fuel pressure around the fuel injector.



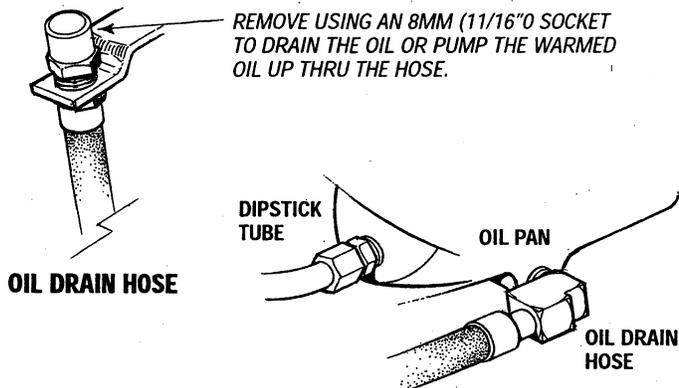
ENGINE OIL

ENGINE OIL CHANGE

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

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

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

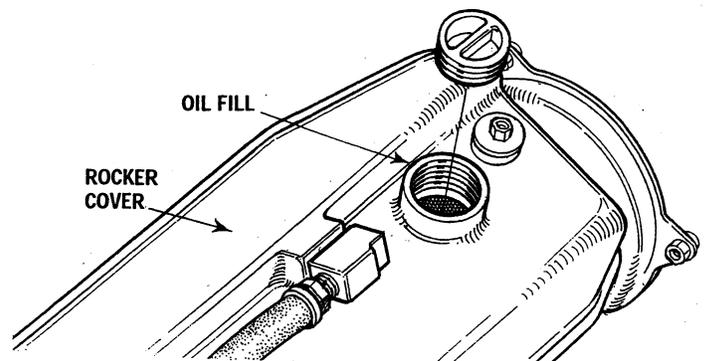
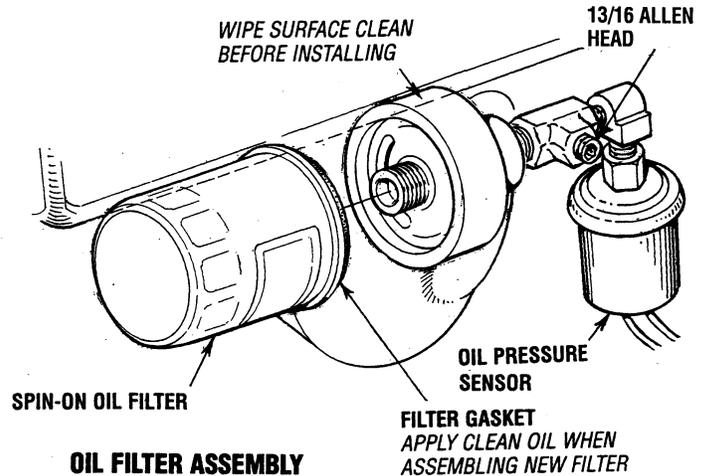


2. **Replacing the Oil Filter.** When removing the used oil filter, you may find it helpful and cleaner to punch a hole in the upper and lower portion of the old filter to drain the oil from it into a container before removing it. This helps to lessen spillage. A small automotive filter wrench should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

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

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

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



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

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

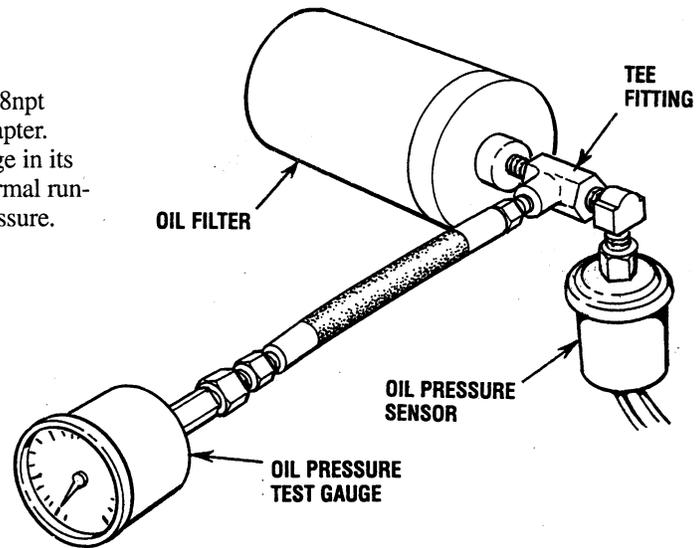
CAUTION: Used engine oil contains harmful contaminants. Avoid prolonged skin contact. Clean skin and nails thoroughly using soap and water. Launder or discard clothing or rags containing used oil. Discard used oil properly.

ENGINE OIL PRESSURE

TESTING OIL PRESSURE

To test engine oil pressure, remove the hex plug (1/8npt threads) in the tee fitting located on the oil filter adapter. Install an accurate mechanical oil pressure test gauge in its place. Start the engine and allow it to operate at normal running RPM(1800/1500). Observe and record the pressure.

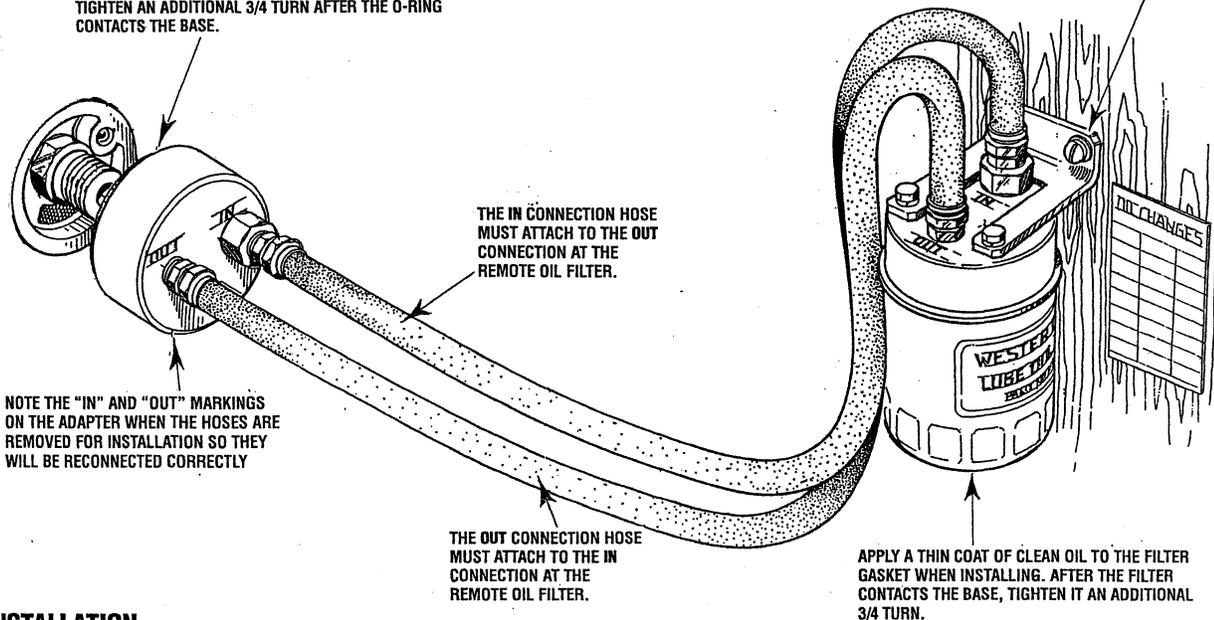
OIL PRESSURE AT 1800/1500: 35-45 PSI OR MORE



REMOTE OIL FILTER (OPTIONAL) PN #052537

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

FASTEN SECURELY TO A BULKHEAD (SCREWS ARE OWNER SUPPLIED)



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

THE IN CONNECTION HOSE MUST ATTACH TO THE OUT CONNECTION AT THE REMOTE OIL FILTER.

THE OUT CONNECTION HOSE MUST ATTACH TO THE IN CONNECTION AT THE REMOTE OIL FILTER.

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

INSTALLATION

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

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

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

Contact your WESTERBEKE dealer for more information

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

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

BATTERY CHARGING CIRCUIT

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

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

BATTERIES

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

Specifications

The minimum recommended capacity of the battery used in the engine's 12 volt DC control circuit is 800-1000 CCA. This MUST be a dedicated battery.

BATTERY CHARGING

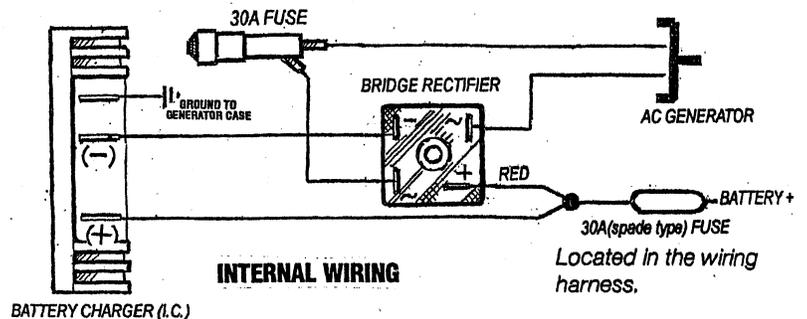
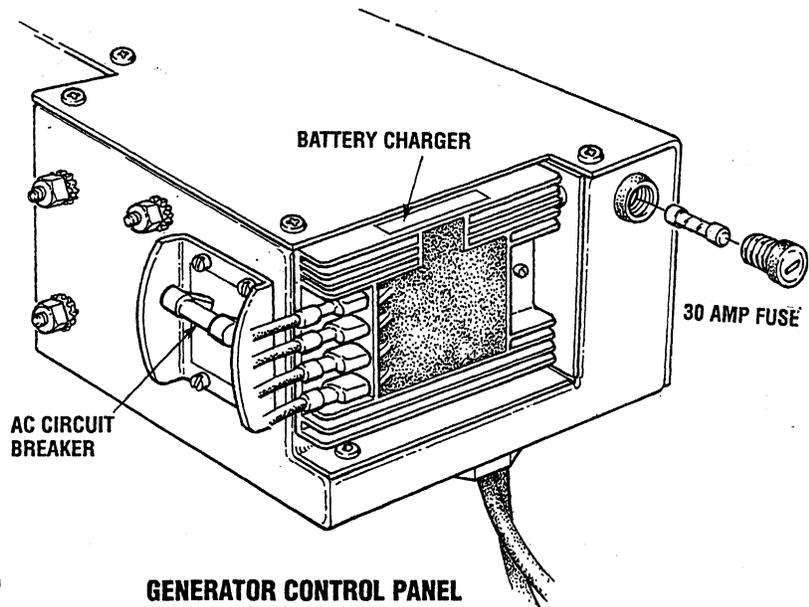
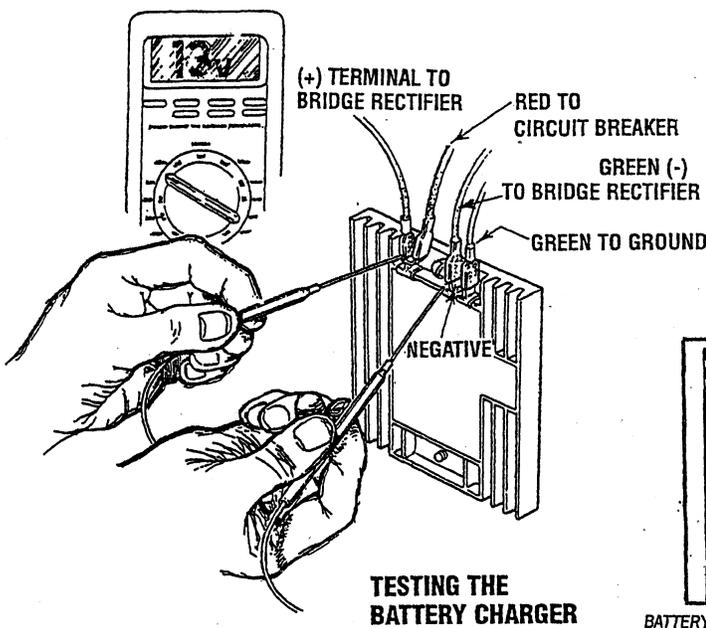
The generator supplies a continuous 12 amp (maximum) charge from its battery charger to the starting battery. To test the battery charger, put a multimeter between the positive (+) and negative (-) leads to the battery. It should indicate 13.0V to 13.4V with the engine running. If only the battery voltage is indicated, check that the battery charger terminal connections are tight. With the unit running, test between the (+) and (-) terminals for 13.0V to 13.4V. If no charge is indicated, replace the charger.

Battery Maintenance

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

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

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



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.

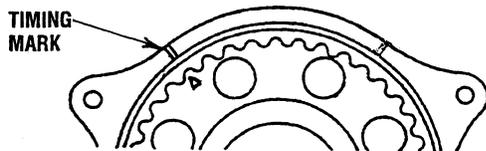
TIMING BELT INSPECTION AND REPLACEMENT

Timing Belt Removal

CAUTION: Water or oil on the timing belt severely reduces the service life of the belt. Keep the timing belt sprocket and tensioner free of oil and grease. These parts should never be cleaned. Replace if seriously contaminated with dirt or oil. If oil is evident on these parts, check the front case, oil pump oil seals, and camshaft oil seals for a possible oil leak.

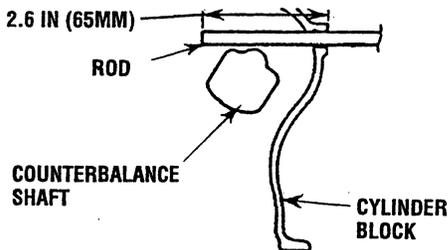
1. Turn the crankshaft clockwise to align the timing mark on the camshaft sprocket and timing belt rear cover.

NOTE: always turn the crankshaft clockwise.

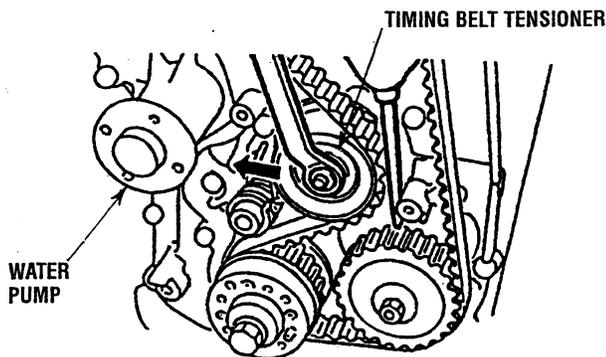


2. Remove the plug on the left surface of the cylinder block and insert a rod with a diameter of 8mm (0.31 in.) to lock the counterbalance shaft.

NOTE: Be sure to use an inserting rod with a diameter of 8mm (0.31 in.).

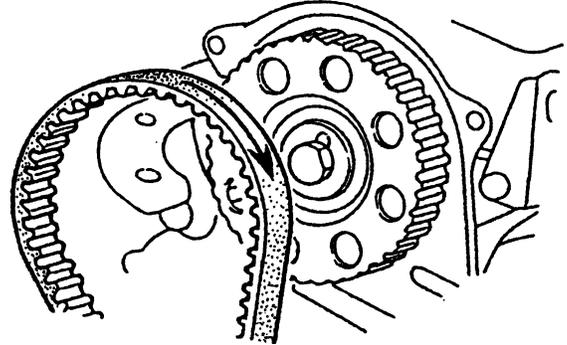


3. Loosen the timing belt tensioner nut.
4. Move the timing belt tensioner toward the water pump, and temporarily tighten the nut to hold the tensioner in that position.



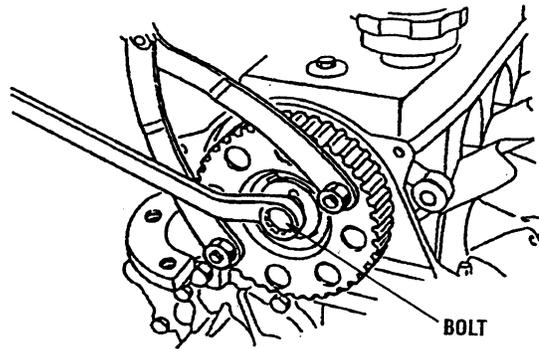
5. Remove the timing belt.

NOTE: If the timing belt is to be reused, draw an arrow on the belt back to indicate the direction of rotation (clockwise).



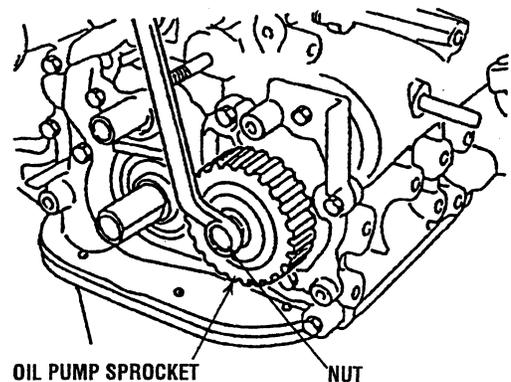
Camshaft Sprocket Removal

1. Remove the bolt without turning the camshaft.



Oil Pump Sprocket Flange Nut Removal.

1. Remove the plug from the left side of the cylinder block.
2. Insert an 8 mm (0.31 in.) diameter round bar to lock the counterbalance shaft.
3. Remove the nut.



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.

Crankshaft Bolt Removal

1. Lock the crankshaft in position.

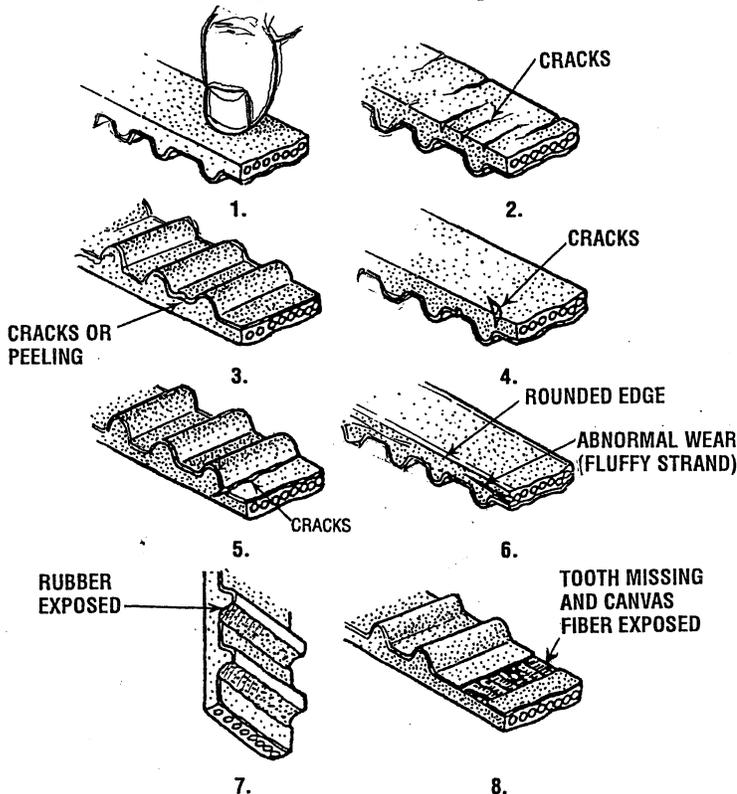
NOTE: Do not turn the crankshaft.

2. Remove the crankshaft bolt.

Timing Belt Inspection

Replace the belt if any of the following conditions exist:

1. Hardening of back rubber-back side is glossy, without resilience, and leaves no indent when pressed with fingernail.
2. Cracks on rubber back.
3. Cracks or peeling of canvas.
4. Cracks on tooth bottom.
5. Cracks on belt.
6. Abnormal wear of belt sides. The sides are normal if they are sharp as if cut by a knife.
7. Abnormal wear on teeth.
8. Tooth missing and canvas fiber exposed.

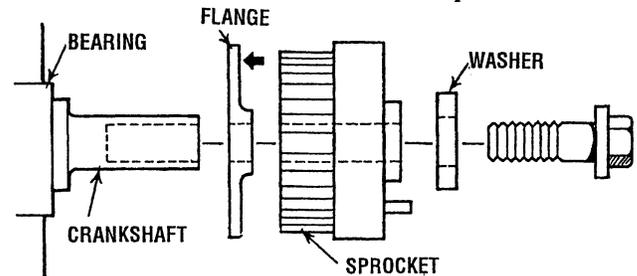


Tensioner Inspection

1. Replace the tensioner if the pulley binds, rattles or is noisy when turned.

Flange Installation

1. Mount the flange so that its side shown by the heavy arrow in the illustration faces toward the sprocket.



Crankshaft Bolt Installation

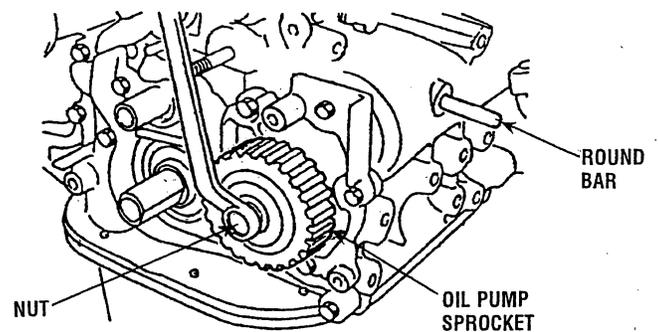
1. Lock the crankshaft.

NOTE: Do not turn the crankshaft.

2. Tighten the crankshaft bolt to the specified torque.

Oil Pump Sprocket Flange Nut Installation

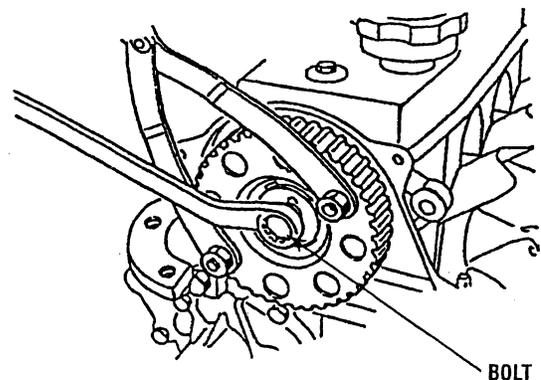
1. Insert a round bar into the plug hole in the left side of the cylinder block to keep the counterbalance shaft from turning.
2. Install the oil pump sprocket.
3. Tighten the nut to the specified torque.



Camshaft Sprocket Bolt Installation

1. Tighten the bolt to the specified torque.

Bearing Cap Bolt Torque 36 40 ftlbs (50 -55 Nm)

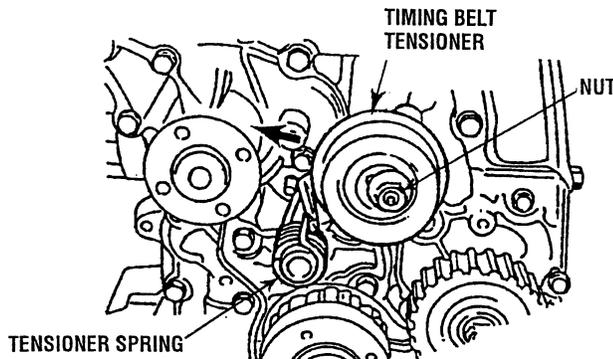


ENGINE ADJUSTMENTS

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

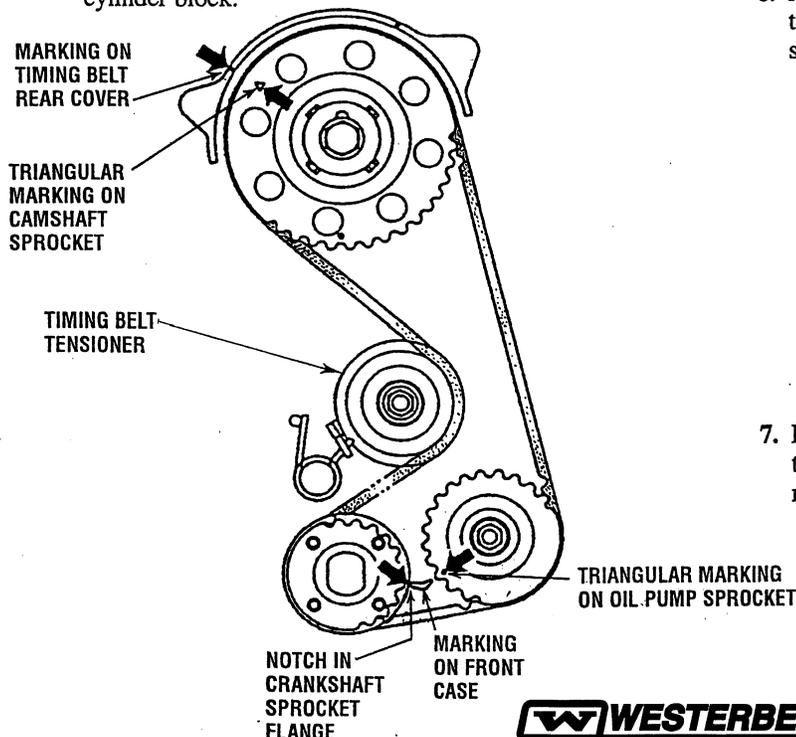
Tensioner Spring/Timing Tensioner Installation

1. Install the tensioner spring and timing belt tensioner.
2. Hook the tensioner spring onto the bend of the timing belt tensioner bracket and the stopper pin on the cylinder block.
3. Move the timing belt tensioner as close as possible to the water pump; temporarily tighten the tensioner nut.



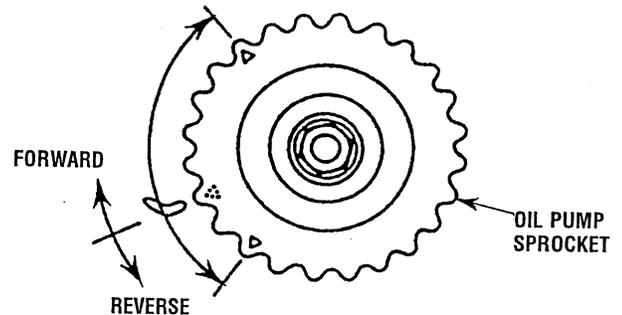
Timing Belt Installation

1. Align the triangular marking on the camshaft sprocket with a marking on the timing belt rear cover.
2. Align the notch in the crankshaft sprocket flange with the marking on the front case.
3. Align the triangular marking on the oil pump sprocket with the marking on the front case, and then insert a 65 mm (2.56 in.) or longer, 8 mm (0.31 in.) diameter round bar into the plug hole in the left side of the cylinder block.



At this time, check that the moveable range of teeth on the oil pump sprocket is according to specifications.

Standard value: 4 to 5 teeth in forward direction.
1 to 2 teeth in reverse direction.

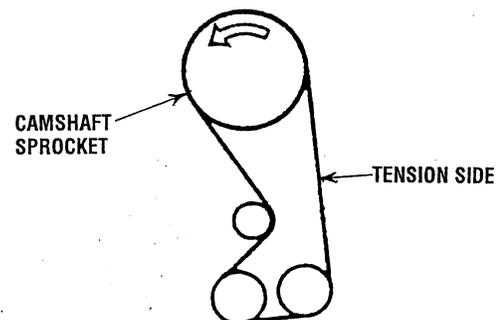


4. If the movable range of the oil pump sprocket exceeds the specified range, correct as follows:
 - a. Pull out the round bar from the plug hole in the left side of the cylinder block.
 - b. Turn the oil pump sprocket one turn at a time until the round bar can again be inserted.
 - c. Check that the movable range of the oil pump sprocket is in the specified value.

5. Set the timing belt over the crankshaft sprocket and then over the oil pump sprocket and camshaft sprocket, in that order.

NOTE: Ensure that the tension side of the timing belt is not slack. Keep the round bar inserted until the timing belt has been placed. After this step, be sure to remove the round bar.

6. Apply counterclockwise force to the camshaft sprocket to make the belt taut on the tension side, and make sure that all timing marks are lined up.



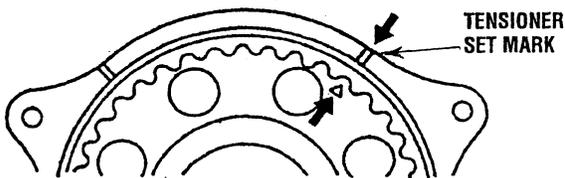
7. Loosen the temporarily tightened tensioner nut on the water pump side 1 or 2 turns, and tension the belt making use of spring force.

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.

8. Turn the crankshaft *clockwise* by nine camshaft sprocket teeth (817) to align the timing mark on the camshaft sprocket with the tensioner set mark on the timing belt rear cover.

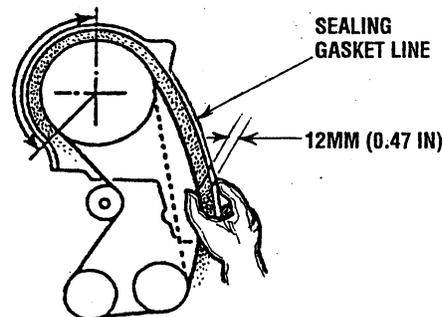
CAUTION: This operation is performed to give a proper tension to the timing belt, so do not turn the crankshaft counterclockwise and push the belt to check the tension.



9. Make sure that the timing belt teeth are engaged with the camshaft sprocket teeth along the portion of the sprocket shown by the curved arrow in the illustration. Then tighten the tensioner nut.

10. Pull the timing belt in the center of the tension side toward the sealing gasket line for the belt cover, as illustrated. Make sure that the clearance between the back of the belt and the sealing line is the standard value.

Standard Value: 12mm (0.47in.)



11. Pull out a rod from the plug hole on the left surface of the cylinder block and apply the specified sealant. Then tighten the plug to the specified torque.

Specified sealant value: 3M ATD Part No. 8660 or equivalent

Tightening torque: 15-22 Nm (11-16 ft.lbs.)

BATTERY CARE

Battery Maintenance

The minimum recommended capacity of the battery used in the engine's 12 volt DC control circuit is 800-1000 Cold Cranking Amps (CCA).

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

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

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 13-14 volts. If only battery voltage is indicated, check the terminal connections at the battery.

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

NOTE: Refer to BATTERY CHARGING CIRCUIT in this manual.

ENGINE ADJUSTMENTS

NOTE: WESTERBEKE recommends that the following engine adjustments be performed by a competent engine mechanic.

VALVE CLEARANCE ADJUSTMENT

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

1. Remove the rocker cover and gasket.
2. Remove the spark plugs to observe the piston position in each cylinder head when positioning that piston at TDC.
3. Adjust the intake and exhaust valves in the firing order of the engine (1-3-2) as follows:

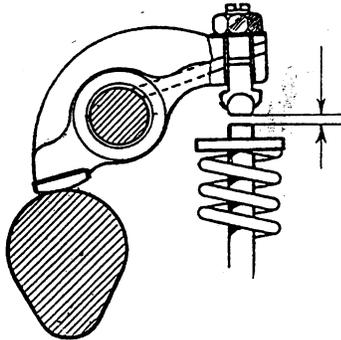
Rotate the crankshaft in its normal direction of rotation, observing valve movement and piston location placing No.1 piston at TDC (Top Dead Center) of its compression stroke with the intake and exhaust valves completely closed. Then adjust the intake and exhaust valve clearances.

Rotate the crankshaft 120 degrees to position the piston in cylinder #3 at TDC of its compression stroke and adjust this cylinder's exhaust and intake valves. Rotate the crankshaft another 120 degrees to position the piston in cylinder #2 at TDC of its compression stroke and adjust this cylinder's intake and exhaust valves.

4. Replace the rocker cover and the rocker cover gasket.

ROCKER COVER TORQUE: 2.9 - 5.1 lb-ft (0.4 - 0.7 kg-m)

VALVE CLEARANCE

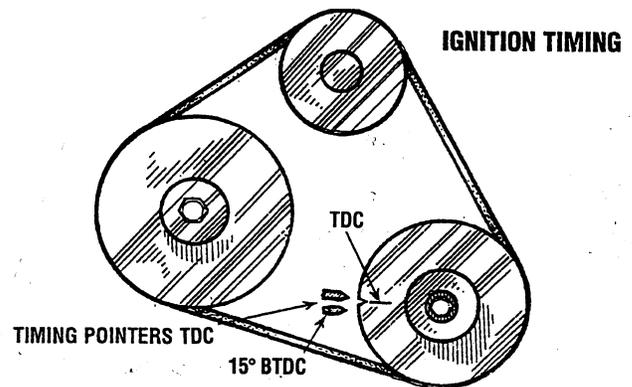


Valve Clearance:	Intake	0.20mm (.008 inches)
	Exhaust	0.30mm (.012 inches)

IGNITION TIMING

1. Attach a timing light to the #1 spark plug and mark the front timing pointer to indicate 15°. Locate the timing mark on the crankshaft pulley and mark it with white chalk or a crayon.
2. Start the engine and warm the engine to its normal operating temperature. Make sure the generator is operating *without a load on it*.
3. Using the timing light, align the timing mark in the front crankshaft pulley so it is just slightly before the first timing pointer. Do this by loosening and slowly rotating the distributor body. Use the following timing specifications:

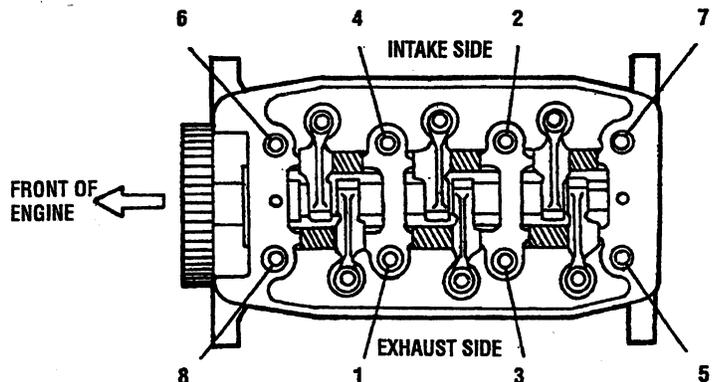
TIMING SPECIFICATIONS: 15° ± 1° BTDC at 1800 rpm
(no load on generator)



TORQUING THE CYLINDER HEAD BOLTS

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

Tighten the cylinder head bolts according to the sequence shown. Make sure the engine is cold when this is done, and loosen one head bolt one-half turn and then tighten it between 43 - 51 lb-ft (60 - 70 Nm). Then proceed to the next head bolt in the sequence. Tighten the RS (rocker cover stud) securely.



ENGINE ADJUSTMENTS

SPARK PLUGS

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

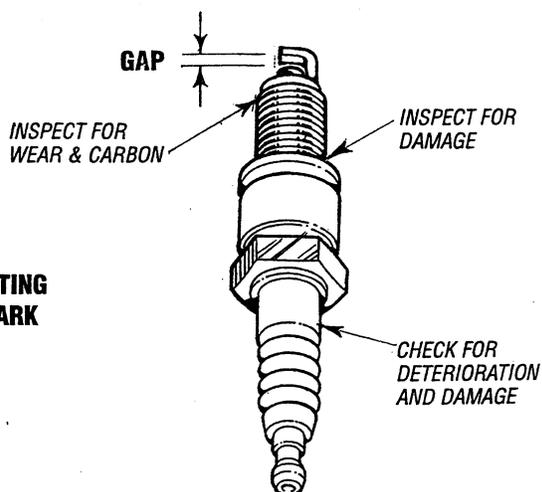
WARNING: Do not remove the spark plugs while the engine is hot. Allow the engine to cool down before removing them.

Spark plug gap: $0.031 \pm .002$ in. (0.8 – 0.05 mm).

Spark plug torque: 10 – 15 lb-ft (1.5 – 2.31 kg-m).

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



HIGH TENSION CORDS (IGNITION WIRES)

Check the ignition wires every 500 operating hours as engine compartment heat can deteriorate the wires.

Check the resistance of each wire. Do not pull on the wire because the wire connection inside the cap may become separated or the insulator may be damaged. When removing the wires from the spark plugs, grasp and twist the moulded cap, then pull the cap off the spark plug.

THE RESISTANCE VALUE IS 410 OHM PER INCH OF WIRE.

TESTING FUEL PRESSURE

Poor engine performance and/or hard starting may be an indicator of improper fuel pressure. To test the fuel pressure, connect a fuel pressure gauge at the throttle body. With the generator running, the fuel pressure should indicate 35 to 40 PSI.

DRIVE BELT ADJUSTMENT

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

The generator have two drive belts, one drives the governor and alternator and the other drives the raw water pump. The tension adjustment procedure for both belts is as follows:

1. Remove the belt guard.
2. To adjust the governor drive belt, loosen the two governor mounting bolts.

To adjust the raw water pump/fresh water pump drive belt, loosen the two raw water pump mounting bolts.

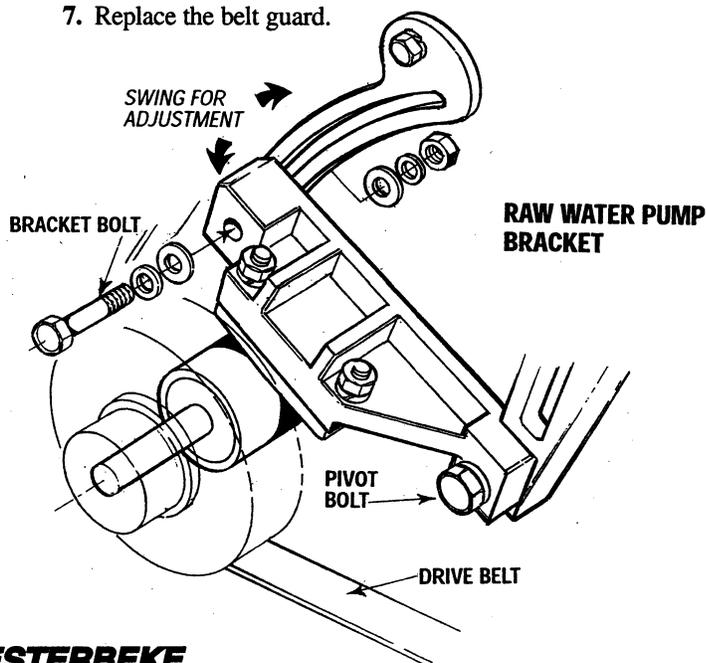
3. With the belt(s) loose, inspect for wear, cracks and frayed edges, and replace if necessary.
4. To loosen or tighten the governor drive belt, slide the governor in or out as required, then retighten its mounting bolts.

To loosen or tighten the raw water pump/fresh water pump drive belt, slide the raw water pump in or out as required, then retighten its mounting bolts.

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

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

6. Operate the generator for about 5 minutes, then shut down the generator and recheck the belts tension.
7. Replace the belt guard.



STARTER MOTOR

DESCRIPTION

The *starter* can be roughly divided into the following sections:

- A motor section which generates a drive power.
- An overrunning clutch section which transmits an armature torque, preventing motor overrun after starting.
- A switch section (solenoid) which is operated when actuating the overrunning clutch through a lever and which supplies load current to the motor.

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

ADJUSTMENT AND REPAIR

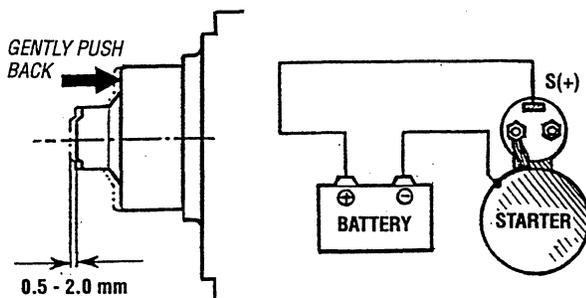
If any abnormality is found by the following tests, the starter should be disassembled and repaired.

Pinion Gap Inspection

1. Connect a battery (12V) between the starter terminal S and the starter body, and the pinion drive should rotate out and stop.

CAUTION: Never apply battery voltage for over 10 seconds continuously.

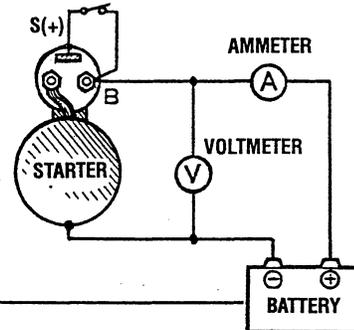
2. Lightly push the pinion back and measure the return stroke (called pinion gap).
3. If the pinion gap is not within the standard range, (0.5 to 2.0 mm), adjust it by increasing or decreasing the number of shims on the solenoid. The gap is decreased as the number of shims increases.



PINION GAP

No-Load Test

1. Connect the ammeter, voltmeter, and battery to the starter as illustrated.
2. When the switch is closed, the pinion must protrude and the starter must run smoothly (at 3000 rpm or more). If the current or starter speed is out of specification, disassemble the starter and repair it.

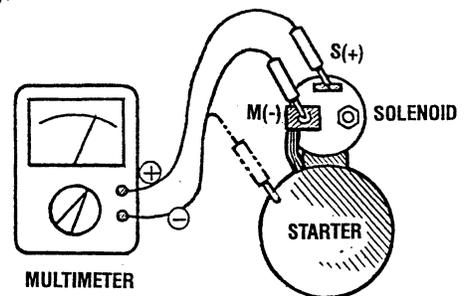


CAUTION: Use thick wires as much as possible and tighten every terminal securely. This is a solenoid shift-type starter which makes a rotating sound louder than that of a direct-drive type starter. When detecting starter rotation at the pinion tip, be careful not to come in contact with the pinion gear when it protrudes.

SOLENOID

Perform the following tests. If any test result is not satisfactory, replace the solenoid assembly.

1. Inspect the solenoid for continuity between terminals (+) and (-) and between terminals S and the body and M and the body. There should be no continuity found between terminals S and M. Continuity will be found between terminals S and the body and terminal M and the body.

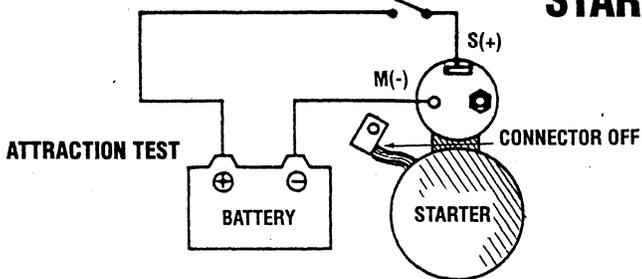


NOTE: Disconnect the wire from terminal M.

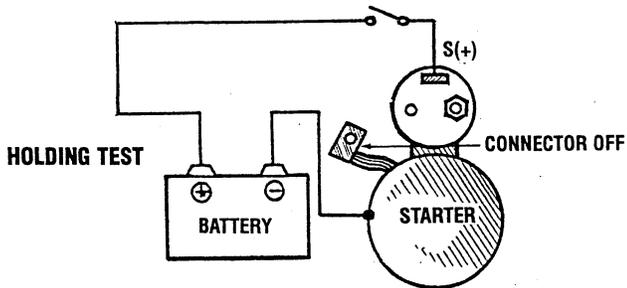
2. Connect a battery to the solenoid's terminal S for (+) and M for (-). Have a switch in the + lead and close it. The pinion drive should extend fully out.

CAUTION: Do not apply battery current for more than 10 seconds when testing the solenoid.

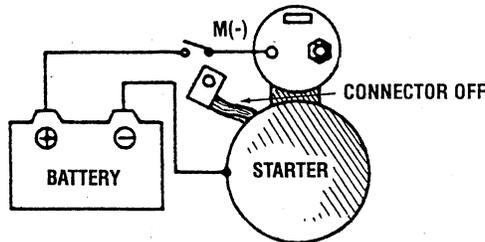
STARTER MOTOR



3. *Holding test.* With a battery connected to the solenoid terminal S (+) and to the starter body, manually pull out the pinion fully. The pinion must remain at that position even when released from holding with your hand.



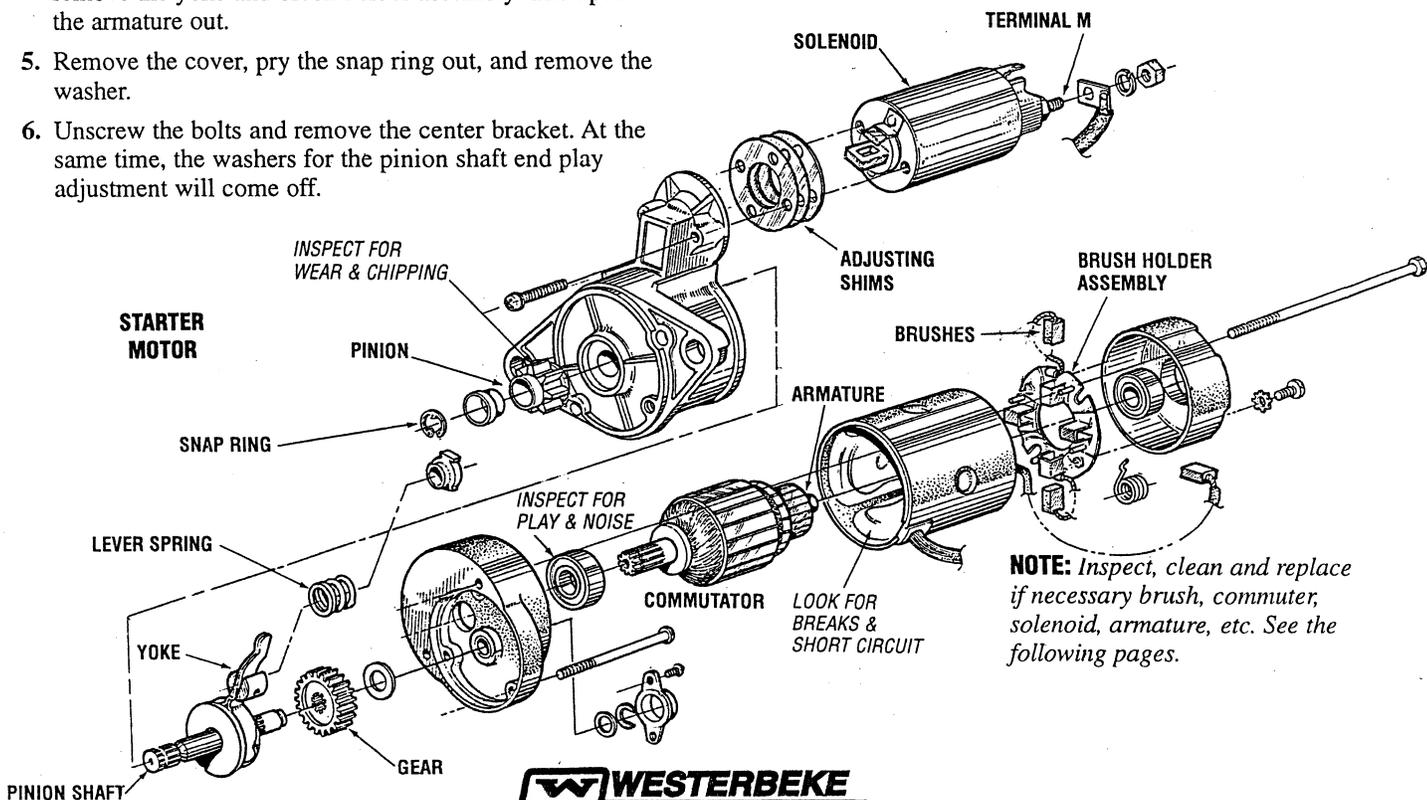
4. *Return test.* With a battery connected to the solenoid terminal M (-) and to the starter body, manually pull out the pinion fully. The pinion must return to its original position when released from holding by hand.



STARTER DISASSEMBLY

1. Disconnect the wire from the solenoid terminal M (-).
2. Loosen the two screws fastening the solenoid. Remove the solenoid assembly.
3. Remove the two long through bolts and two screws fastening the brush holder. Remove the rear bracket.
4. With the brushes pulled away from the armature, remove the yoke and brush holder assembly. Then pull the armature out.
5. Remove the cover, pry the snap ring out, and remove the washer.
6. Unscrew the bolts and remove the center bracket. At the same time, the washers for the pinion shaft end play adjustment will come off.

7. Pull out the reduction gear lever and lever spring from the front bracket.
8. On the pinion side, pry the snap ring out, and pull out the pinion and pinion shaft.
9. At each end of the armature, remove the ball bearing with a bearing puller. It is impossible to replace the ball bearing press-fitted in the front bracket. If that bearing has worn off, replace the front bracket assembly.



ENGINE TROUBLESHOOTING

PROBLEM	PROBABLE CAUSE
Engine backfires.	<ol style="list-style-type: none"> 1. Spark plug wires are connected wrong. 2. Incorrect timing. 3. Dirty flame arrester. 4. Cracked distributor cap. 5. High exhaust back-pressure.
Engine overheats.	<ol style="list-style-type: none"> 1. Coolant loss. Pressure test cooling system. 2. Faulty raw water pump impeller. 3. Belts are loose or broken. 4. Raw water pump worn. 5. Faulty thermostat.
Low oil pressure.	<ol style="list-style-type: none"> 1. Low oil level. 2. Wrong SAE type oil in the engine. 3. Wrong type oil filter. 4. Relief valve is stuck. 5. Faulty oil pump. 6. Faulty engine bearings. 7. Faulty oil filter.
High oil pressure.	<ol style="list-style-type: none"> 1. Dirty oil or wrong SAE type oil in the engine. 2. Relief valve is stuck.

PROBLEM	PROBABLE CAUSE
No DC charge to the starting battery.	<ol style="list-style-type: none"> 1. Faulty 30 amp buss fuse or 30 amp AGM fuse. Ref. DC wiring diagram. 2. Faulty connections to battery charging control. 3. Faulty battery charging control. 4. Faulty bridge rectifier. 5. Faulty generator charger windings.
Blue exhaust smoke discharge from the engine.	<ol style="list-style-type: none"> 1. Lube oil is diluted. 2. High lube oil level. 3. Crankcase breather hose is clogged. 4. Valves are worn or adjusted incorrectly. 5. Piston rings are worn or unseated.
Black exhaust smoke discharge from the engine.	<ol style="list-style-type: none"> 1. Dirty flame arrester. 2. Lube oil is diluted. 3. Valves are worn or incorrectly adjusted. 4. Piston rings are worn or unseated. 5. Crankcase breather hose is clogged.
Poor Performance at generator speed.	<ol style="list-style-type: none"> 1. Fuel injector not functioning properly. 2. Fuel pump clogged. Remove and replace. 3. Throttle body filter screen dirty. Remove and clean.

ENGINE TROUBLESHOOTING/SOFTWARE DIAGNOSTICS

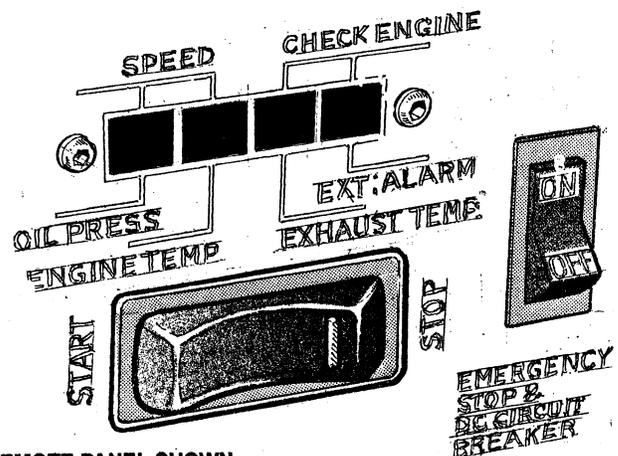
DIAGNOSTIC SOFTWARE KIT #055410

This Diagnostic Software Kit is designed to aide the technician in monitoring and troubleshooting the generator's operation and ECU functions (EC10 Software).

The Diagnostic Software will run on WINDOWS 98 and newer based operating systems. These must have a minimum of 128 megabytes of RAM and the communication cable supplied with the kit plugs into a serial connection or an adapter to convert from serial to USB. 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 communications cable provided in the kit is unique to this Diagnostic Software and must be used or otherwise damage to the ECU will occur if any other communications cable is substituted.

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



REMOTE PANEL SHOWN

TEST PROCEDURE FOR DATA LOGGING USING THE GASOLINE DIAGNOSTIC SOFTWARE PC INTERFACE

DIAGNOSTIC SOFTWARE IS A VALUABLE TOOL IN SOLVING ENGINE PROBLEMS. IT SHOULD NOT REPLACE BASIC TROUBLESHOOTING OR COMMON SENSE.

GENERATOR INFORMATION

USE OF ELECTRIC MOTORS

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

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

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

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

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

REQUIRED OPERATING SPEED

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

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

GENERATOR FREQUENCY ADJUSTMENT

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

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

Therefore, to change the generator's frequency, the generator's drive engine's speed must be changed along with a reconfiguring of the AC output connections at the generator.

Generator Maintenance

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

Carbon Monoxide Detector

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

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

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

CHANGING GENERATOR VOLTAGE/HERTZ OPERATION

1. Select the correct rated AC circuit breaker for the model converting to. Remove the existing breaker and install the new AC breaker.
2. Reconfigure the AC terminal connections to the new AC breaker and RED isolation post.
3. Reconfigure the output connections to the AC circuit breaker.
4. Change the hertz connection on the Battery Charge Circuit's bridge rectifier.
5. Change the hertz connection on the Exciter Winding capacitor(s).

NOTE: Models 6.5 SBCG-614 AND 5.4 SBCG-514 require a capacitor change. 6.5 SBCG-614 uses capacitor pn#049627 and the 5.4 SBCG-514 uses pn#046639.

Reference Service Bulletin #263.

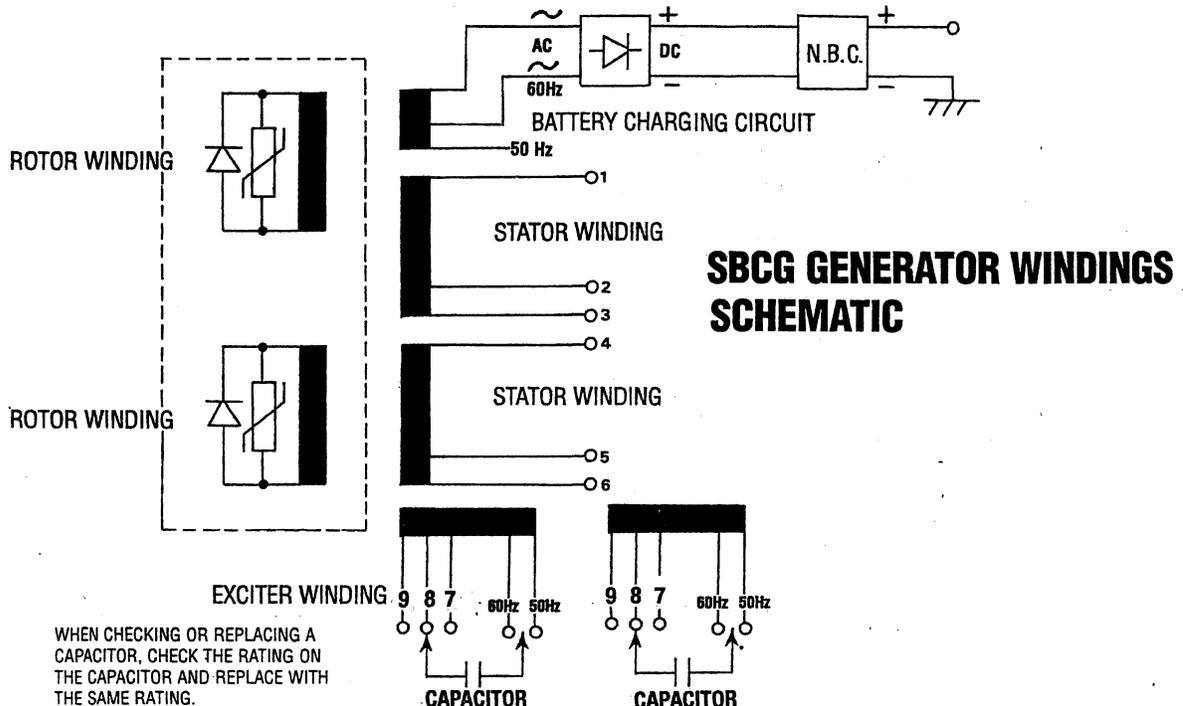
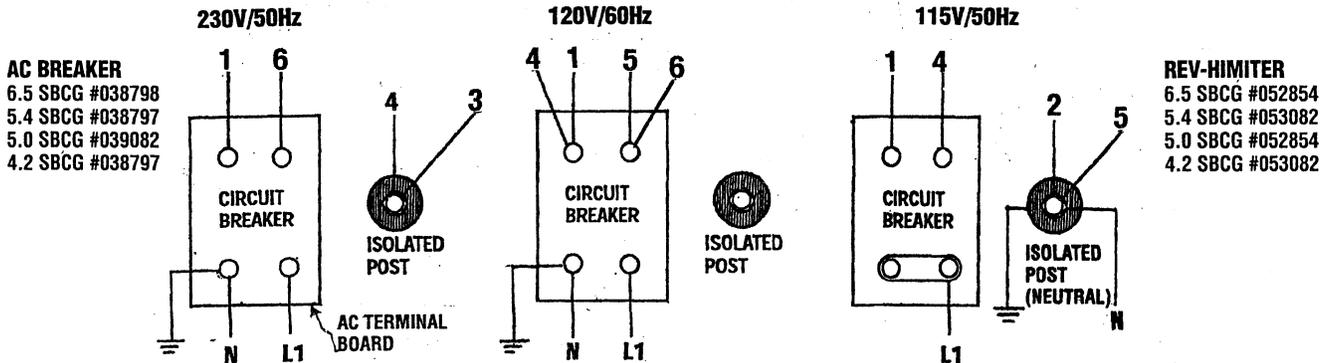
6. Shut off the 20 amp panel DC breaker. In the control box move the #1 dipswitch on the ECU (Electronic Control Unit) to the corresponding position for the operating hertz desired. **ON for 50 hertz, OFF for 60 hertz.** Dipswitches 2, 3, and 4 have no function.
7. The DC circuit Rev-Limiter must be changed. 60 hertz models use pn#052854 and 50 hertz models use pn#053082.
8. Open the generators AV breaker and start the engine. Monitor the AC voltage and hertz.

NOTE: No-Load AC voltage output can be adjusted using the capacitor connections #7, #8, or #9. One of either on each capacitor. Change these connections only with the generator **STOPPED**.

9. Close the AC breaker and load test the generator.

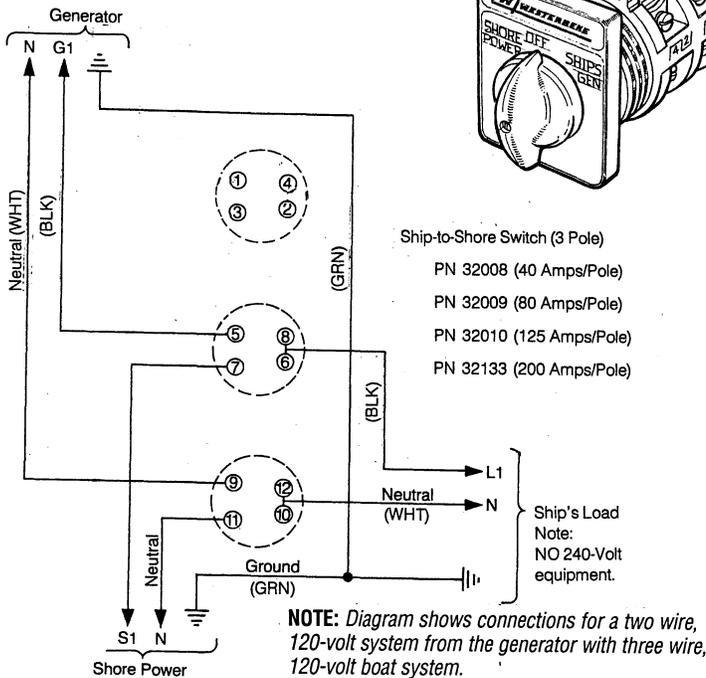
AC TERMINAL CONNECTIONS

NOTE: Correctly position the case ground wire (white/green) onto the neutral/ground terminal.



SHORE POWER TRANSFER SWITCH

SINGLE LINE 120 VOLT SYSTEM



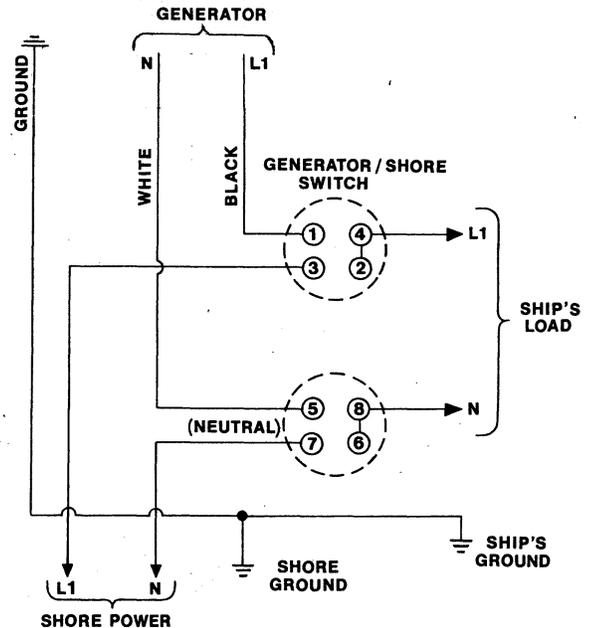
If the installer connects shore power to the vessel's AC circuit, this must be done by means of the Shore Power Transfer Switch. Set the transfer switch shown in the diagrams to the OFF position. This switch prevents simultaneous connection of shore power to generator output.

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

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

230 VOLT/50 HERTZ TWO WIRE CONFIGURATION

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

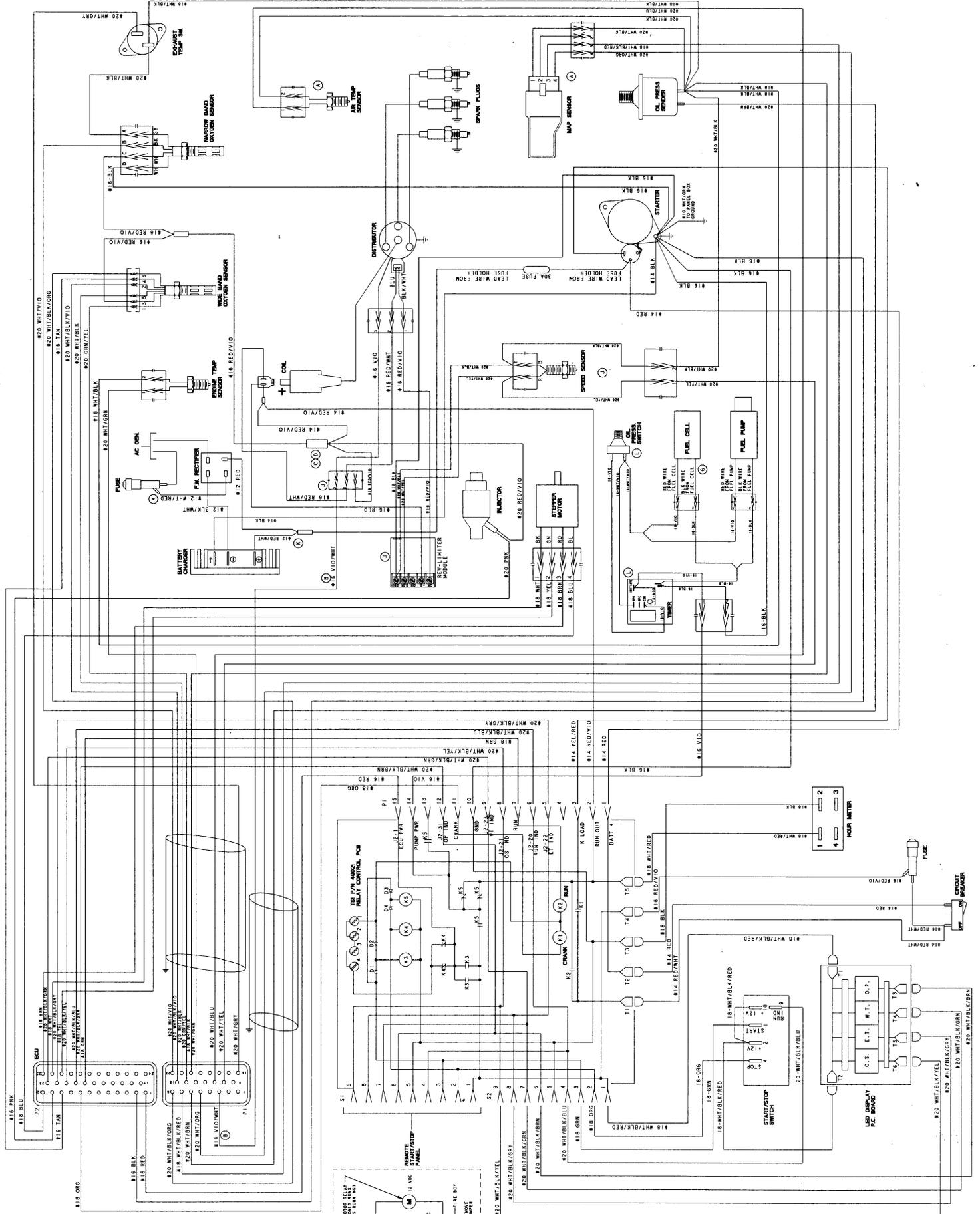


Switching Shore Power to Generator Power

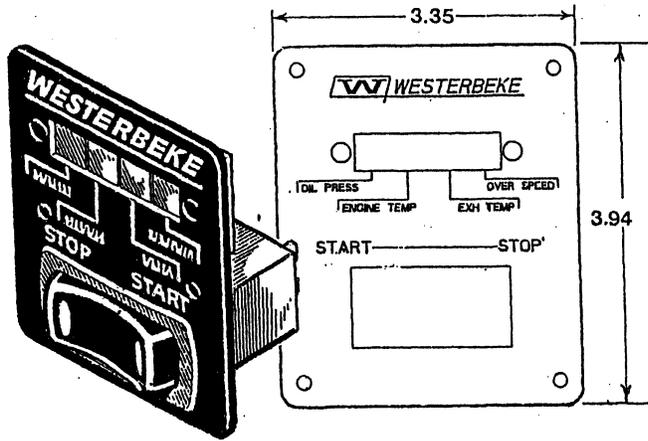
CAUTION: Heavy motor loads should be shut off before switching shore power to generator power or vice-versa because voltage surges induced by switching with heavy AC loads on the vessel being operated may cause damage to the exciter circuit components in the generator.

WIRING SCHEMATIC #49166

WIRING SCHEMATIC #49166

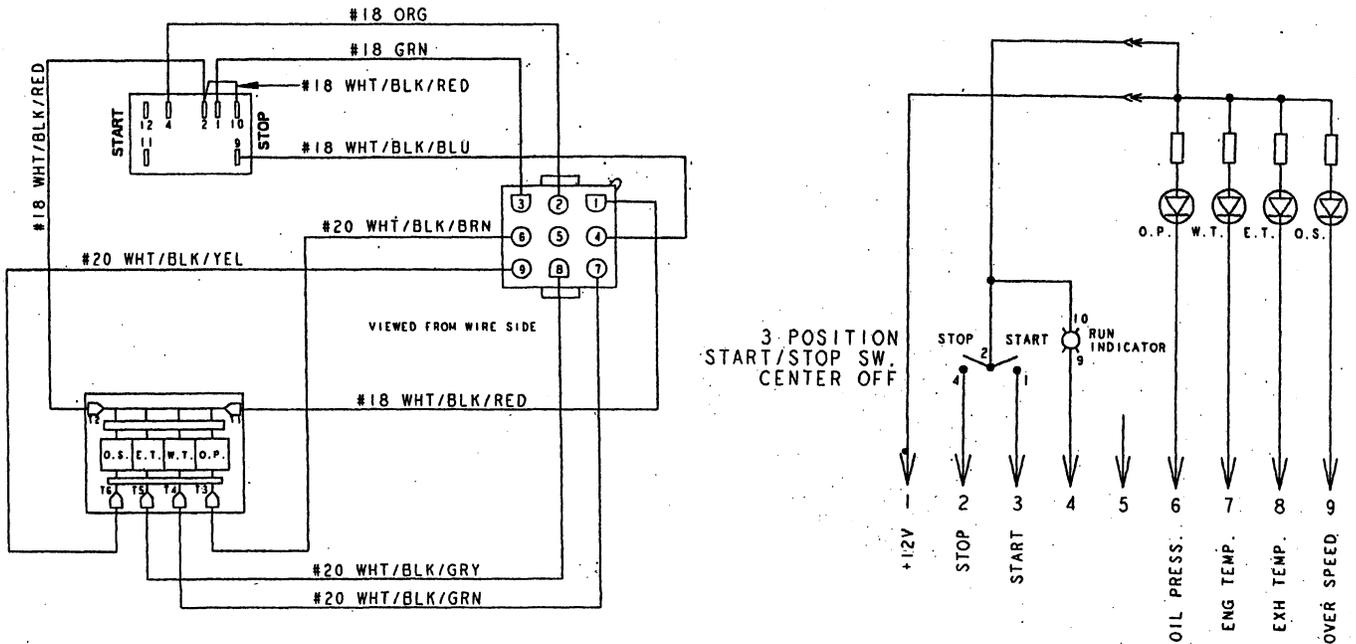


REMOTE STOP/START PANEL PN 049148



REMOTE PANEL HARNESS: 15' Pn 049210
 30' Pn 049211
 50' Pn 049667
 75' Pn 049668
 100' Pn 049669

REMOTE STOP/START PANEL WIRING DIAGRAM SCHEMATIC #49209



4.2KW and 5.0KW SBCG GENERATOR SPECIFICATIONS

ENGINE SPECIFICATIONS	
Engine Type	3-cylinder, 4-cycle, overhead camshaft w/counterbalance shaft, water cooled gasoline engine
Bore & Stroke	2.56 x 2.61 inches (65.0 x 66.3 mm)
Total Displacement	40.3 cubic inches (0.66 liters)
Bearings	Four main bearings
Compression Chamber	Semi-spherical
Compression Ratio	9.8:1
Hp@1800/1500 rpm	10.0
Firing Order	1 - 3 - 2
Aspiration	Naturally aspirated
Direction of Rotation	Counterclockwise viewed from the back end
Inclination	25° continuous, all directions
Dry weight	351 lbs (159.2 Kgs)
Governor	Electronic
FUEL SYSTEM	
General	Throttle body fuel injection
Fuel	Unleaded gasoline with an octane rating of 89 or higher
Fuel Consumption (full load)	.6 GPH @ 1800 rpm .5 GPH @ 1500 rpm
Fuel Hose Size (supply and return)	1/4" I.D. minimum - 3/8" I.D. maximum
Fuel Pump	12 volt electric (high pressure)
Fuel Filter (on engine)	Replaceable cartridge-canister type
Air Cleaner (flame arrester)	Metal screen type - cleanable
ELECTRICAL SYSTEM	
Start Battery	12-Volt, (-) negative ground Battery must be totally dedicated to the generator and maintained only by the DC charge controller system in the AC generator
Battery Capacity	800 - 1000 Cold Cranking Amps rated (CCA) (minimum)
Starter	120 Volt, reduction-solenoid mounted
DC Charging	Solid state controller, 12 Amp rated
DC Cold Cranking Amps	150 - 176 Amps
AIR REQUIREMENTS	
Generator Cooling	225 -250 CFM (6.3 - 7.0 cmm)
Engine Combustion (all models)	21 CFM (0.6 cmm)
Engine Cooling	100 CFM (2.8 cmm)
Note: Forced ventilation should be provided to maintain generators compartment temperature below 120°F (50°C).	

COOLING SYSTEM	
General	Fresh water-cooled block through raw water-cooled heat exchanger circuit
Fresh Water Pump	Centrifugal type, metal impeller, belt-driven.
Raw Water Pump	Positive displacement, rubber impeller, belt-driven.
Raw Water Flow,	4.9 US gpm (18.5 liters) @ 1800 rpm (approx. measure before discharging into exhaust elbow).
Cooling Water Capacity	3.5 qts (3.3 liters).
Operating Temperature	170° - 190° F (77° - 88° C)
LUBRICATION SYSTEM	
General	Forced lubrication by gear pump.
Oil Filter	Full flow, paper element. spin-on disposals.
Oil Capacity	3.0 qts. (2.8 liters).
Operating Oil Pressure	30 - 50 psi (2.1 - 3.5 kg/cm ²).
Oil Grade	API Specification SJ class or better. SAE 40.
AC GENERATOR (Single Phase)	
Single Phase	Brushless, four-pole capacitor, regulated. 1800 rpm/60Hz, 1500 rpm/50Hz
Ratings:	
4.2KW	230 volts, 18.2 amps, 50Hz single phase, 4 wire, 1.0 power factor
5.0KW	120 volts, 41.6 amps, 60Hz single phase, 4 wire, 1.0 power factor
TUNE-UP SPECIFICATIONS	
Spark Plugs	14mm
Ignition Coil	12 volt
Distributor	Breakerless with ignitor and pick-up assembly
Spark Plug Gap	0.031 ± .002 inches (0.8 ± 0.05mm)
Spark Plug Torque	10.8 - 15.2 lb-ft
Cylinder Head Torque	60-70 Nm (43-51 ft-lbs)
Bolt Torque	See <i>TORQUING THE CYLINDER HEAD</i>
IGNITION SYSTEM	
General	Battery ignition 12 volts negative ground. Distributor with ignition module and ignitor. Ignition coil and spark plugs.
Distributor	Solid state type with signal generator and ignitor.
Spark Plug Thread Gap	11mm x 1.25 pitch
Spark Plug Gap	0.028 - 0.031 inches (0.7 - 0.8mm)
Ignition Timing.	15° BTDC at 1800 RPM ± 1° (Vacuum advance hose disconnected)

5.4KW and 6.5KW SBCG GENERATOR SPECIFICATIONS

ENGINE SPECIFICATIONS

Engine Type	3-cylinder, 4-cycle, overhead camshaft w/counterbalance shaft, water cooled gasoline engine
Bore & Stroke	2.56 x 2.61 inches (65.0 x 66.3 mm)
Total Displacement	40.3 cubic inches (0.66 liters)
Bearings	Four main bearings
Compression Chamber	Semi-spherical
Compression Ratio	9.8:1
Hp@1800/1500 rpm	10.0
Firing Order	1 - 3 - 2
Aspiration	Naturally aspirated
Direction of Rotation	Counterclockwise viewed from the back end
Inclination	25° continuous, all directions
Dry weight	381 lbs (172.8 Kgs)
Governor	Electronic

FUEL SYSTEM

General	Throttle body fuel injection
Fuel	Unleaded gasoline with an octane rating of 89 or higher
Fuel Consumption (full load)	.7 GPH @ 1800 rpm .6 GPH @ 1500 rpm
Fuel Hose Size (supply and return)	1/4" I.D. minimum - 3/8" I.D. maximum
Fuel Pump	12 volt electric (high pressure)
Fuel Filter (on engine)	Replaceable cartridge-canister type
Air Cleaner (flame arrester)	Metal screen type - cleanable

ELECTRICAL SYSTEM

Start Battery	12-Volt, (-) negative ground Battery must be totally dedicated to the generator and maintained only by the DC charge controller system in the AC generator
Battery Capacity	800 - 1000 Cold Cranking Amps rated (CCA) (minimum)
Starter	120 Volt, reduction-solenoid mounted
DC Charging	Solid state controller, 12 Amp rated
DC Cold Cranking Amps	150 - 176 Amps

AIR REQUIREMENTS

Generator Cooling	225 - 250 CFM (6.3 - 7.0 cmm)
Engine Combustion (all models)	21 CFM (0.6 cmm)
Engine Cooling	100 CFM (2.8 cmm)

Note: Forced ventilation should be provided to maintain generator compartment temperature below 120°F (50°C).

COOLING SYSTEM

General	Fresh water-cooled block through raw water-cooled heat exchanger circuit
Fresh Water Pump	Centrifugal type, metal impeller, belt-driven.
Raw Water Pump	Positive displacement, rubber impeller, belt-driven.
Raw Water Flow,	4.9 US gpm (18.5 liters) @ 1800 rpm (approx. measure before discharging into exhaust elbow).
Cooling Water Capacity	3.5 qts (3.3 liters).
Operating Temperature	170° - 190° F (77° - 88° C)

LUBRICATION SYSTEM

General	Forced lubrication by gear pump.
Oil Filter	Full flow, paper element. spin-on disposals.
Oil Capacity	3.0 qts. (2.8 liters).
Operating Oil Pressure	30 - 50 psi (2.1 - 3.5 kg/cm ²).
Oil Grade	API Specification SJ class or better. SAE 40.

AC GENERATOR (Single Phase)

Single Phase	Brushless, four-pole capacitor, regulated. 1800 rpm/60Hz, 1500 rpm/50Hz
Ratings: 5.4KW	230 volts, 23.4 amps, 50Hz single phase, 4 wire, 1.0 power factor
6.5KW	120 volts, 54.1 amps, 60Hz single phase, 4 wire, 1.0 power factor

TUNE-UP SPECIFICATIONS

Spark Plugs	14mm
Ignition Coil	12 volt
Distributor	Breakerless with ignitor and pick-up assembly
Spark Plug Gap	0.031 ± .002 inches (0.8 ± 0.05mm)
Spark Plug Torque	10.8 - 15.2 lb-ft
Cylinder Head Torque	60-70 Nm (43-51 ft-lbs)
Bolt Torque	See <i>TORQUING THE CYLINDER HEAD</i>

IGNITION SYSTEM

General	Battery ignition 12 volts negative ground. Distributor with ignition module and ignitor. Ignition coil and spark plugs.
Distributor	Solid state type with signal generator and ignitor.
Spark Plug Thread Gap	11mm x 1.25 pitch
Spark Plug Gap	0.028 - 0.031 inches (0.7 - 0.8mm)
Ignition Timing	15° BTDC at 1800 RPM ± 1° (Vacuum advance hose disconnected)

GENERATOR HARDWARE TORQUES

Timing Belt	Nm	ft. lbs.
Crankshaft bolt	135-145	98-105
Timing belt cover bolts	10-12	7-9
Camshaft sprocket bolts	80-100	58-72
Oil pump sprocket nuts	50-57	36-41
Timing tensioner nuts	22-30	16-22
Timing belt rear cover bolts	10-12	7-9
Rocker Arms and Rocker Shaft		
Rocker cover shaft	29-35	21-25
Camshaft thrust plate bolt	10-12	7-9
Rocker arm adjust nut	8-10	6-7
Cylinder Head, Valve		
Cylinder head bolt (cold engine)	60-70	43-51
Spark plug	15.2	10.8
Rocket cover	12-13	9-10
Miscellaneous		
Coolant temperature sender	12-18	9-13
Coolant temperature switch	12-18	9-13
Generator mounts	34-47	23-34
Exhaust manifold	16-23	12-17
Thermostat housing	8-11	6-8
Flywheel bolts	88	65

Front Case, Counterbalance Shaft	Nm	ft. lbs.
Front case bolts	8-10	6-7
Oil pump cover bolts	8-10	6-7
Oil pan bolts	10-12	7-9
Oil drain plug	35-45	25-33
Oil screen bolts	15-22	11-16
Oil pump driven gear bolt	34-40	25-29
Rear cover bolts	10-12	7-9
Piston and Connecting Rod		
Connecting rod cap nut	15 + 90° turn	11 + 90° turn
Crankshaft, Bearing		
Oil seal case bolts	10-12	7-9
Bearing cap bolts	50-55	36-40
Cylinder Block		
Taper plug 1/16	8-12	6-9
Taper plug 1/8	15-22	11-16
Water drain plug	35-45	25-33
Taper plug 1/4 NPT	35-45	25-33
Oil pressure switch	12-18	9-13
Oil pressure sender	12-18	9-13
Water Pump		
Water pump	8-10	6-7

LAY-UP & RECOMMISSIONING

GENERAL

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

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

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

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

Propeller Shaft Coupling [Propulsion Engine]

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

Fresh Water Cooling Circuit

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

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

Lubrication System

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

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

Fuel System [Gasoline]

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

Fuel System [Diesel]

Top off your fuel tanks with No. 2 diesel fuel. Fuel additives such as *BioBor* and *Diesel Kleen* + *Cetane Boost* should be added at this time to control algae and condition the fuel. Care should be taken that the additives used are compatible with the primary fuel filter/water separator used in the system. Change the element in your primary fuel filter/water separator, if the fuel system has one, and clean the separator sediment bowl.

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

Raw Water Cooling Circuit

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

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

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

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

Cylinder Lubrication [Gasoline]

With the engine running, remove the flame arrester and spray fogging oil into the open air intake. The fogging oil will stall out the engine and coat the valves, cylinders and spark plugs for winter protection.

LAY-UP & RECOMMISSIONING

Starter Motor

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

Cylinder Lubrication *[Diesel]*

If you anticipate a long lay-up period (12 months or more) WESTERBEKE recommends removing the glow plugs or fuel injectors for access to the cylinders. Squirt light lubricating oil into the cylinders to prevent the piston rings from sticking to the cylinder walls. Rotate the engine by hand two revolutions then replace the glow plugs or injectors.

Make sure you have a replacement if removing the injector sealing washer for the injector and fuel line return.

NOTE: *If engine storage is going to be a lengthy one, 12 months or beyond, it is wise to rotate the engine by hand two complete turns every additional 4 months to allow the injection pump components to move. This will help prevent their sticking during extended storage periods.*

Intake Manifold and Thru-Hull Exhaust *[Diesel]*

Place a clean cloth, lightly soaked in lubricating oil, in the opening of the intake manifold to block the opening. Do not shove the cloth out of sight. (If it is not visible at recommissioning, and an attempt is made to start the engine, you may need the assistance of a servicing dealer.) Make a note to remove the cloth prior to start-up. The through-hull exhaust port can be blocked in the same manner.

Intake Manifold *[Gasoline]*

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

Transmission *[Propulsion Engine]*

Check or change fluid in the transmission as required. If the engine is to be layed up 12 months or more, fill the transmission to the very top to prevent corrosion. **Lower the fluid to its normal at recommissioning.** Wipe off grime and grease and touch up unpainted areas. Protect coupling and output flange with an anticorrosion coating. Refer to the **TRANSMISSION SECTION** in this manual for additional information.

Batteries

If batteries are to be left on board during the lay-up period, make sure they are fully charged, and will remain that way, to prevent them from freezing. If there exists 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.

SPARE PARTS

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

RECOMMISSIONING

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

1. Remove any rags that were placed in the exhaust, intake manifold, or flame arrester.
2. Remove the raw water pump cover and gasket and discard the old gasket. Install the raw water pump impeller removed during lay-up (or a replacement, if required). Install the raw water pump cover with a new cover gasket.
3. Reinstall the batteries that were removed during the lay-up, and reconnect the battery cables, making sure the terminals are clean and that the connections are tight. Check to make sure that the batteries are fully charged.
4. Remove the spark plugs, wipe clean, re-gap, and install to proper tightness. *[Gasoline]*
5. Check the condition of the zinc anode in the raw water circuit and clean or replace the anode as needed. Note that it is not necessary to flush the antifreeze/fresh water solution from the raw water coolant system. When the engine is put into operation, the system will self-flush in a short period of time with no adverse affects. Also open up the heat exchanger ends and clear out any accumulated debris.
6. Check the transmission fluid, if it had been topped off during the lay-up, lower the level of the fluid to normal. *[Propulsion Engine]*
7. Make certain all electrical connections and switches are in the correct position and there are no-loads on the generator at start up. *[Generator]*
8. Start the engine in accordance with the procedures described in the **PREPARATIONS FOR STARTING** section of this manual.

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 Safe-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 Safe-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 Safe-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 exhaust system will likely quickly compromise the proper operation of the catalyst. Westerbeke's exhaust system installation instructions dated on or after February 2004 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.*

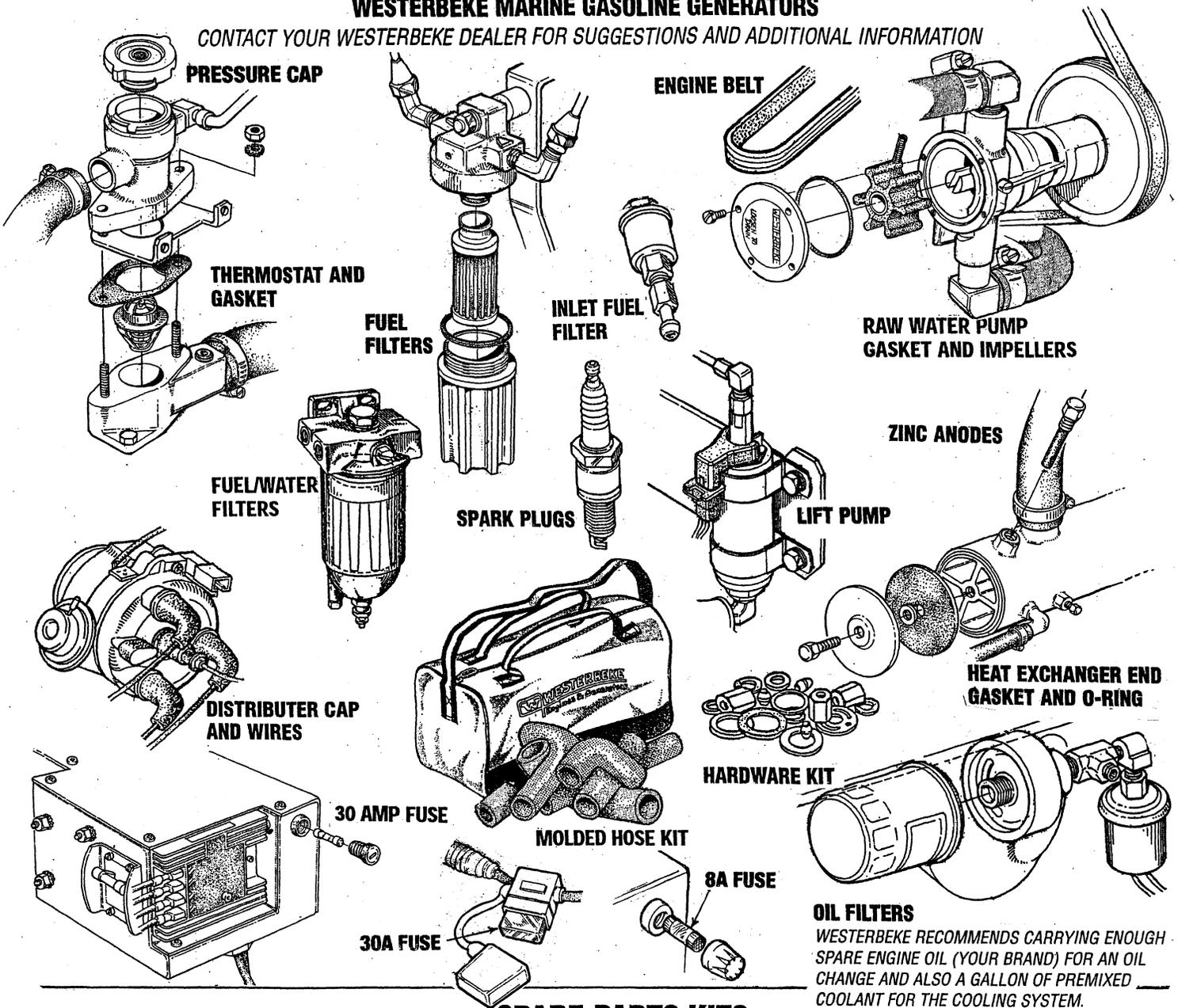
Maintenance of any components affecting the flow of air or the flow of fuel to the engine is critically important, such as fuel filters and air filters (if any).

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 gasket must be replaced. Upon careful reassembly of the catalyst, exhaust elbow gasket, and exhaust elbow, check for the presence of CO while the engine is running. This must be performed with a CO analyzer.

SUGGESTED SPARE PARTS

WESTERBEKE MARINE GASOLINE GENERATORS

CONTACT YOUR WESTERBEKE DEALER FOR SUGGESTIONS AND ADDITIONAL INFORMATION



SPARE PARTS KITS

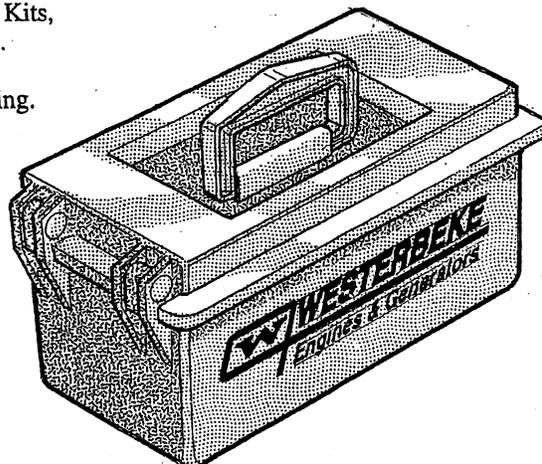
WESTERBEKE also offers two Spare Parts Kits, each packaged in a rugged, rust free toolbox.

KIT A includes the basic spares.

KIT B is for more extensive off-shore cruising.

Kit A

- Impeller Kit
- Heat Exchanger Gasket
- Oil Filter
- Drive Belt
- Zinc Anodes
- Spark Plugs
- Fuel Filters



Kit B

- Impeller Kit
- Water Pump Repair Kit
- Thermostat Kit
- Zinc Anodes
- Complete Gasket Kit
- Heat Exchanger Gasket
- Fuel Filter with Gasket
- Oil Filter
- Drive Belt
- Spark Plugs
- Fuel Filters

WESTERBEKE
Engines & Generators



Low Carbon Monoxide Emissions

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