

# OWNERS MANUAL

4.2 KW BCDT 60Hz

3.5 KW BCDT 50Hz

## MARINE DIESEL GENERATORS SINGLE PHASE

PUBLICATION NO. 44284  
1st Edition/March 2000



WESTERBEKE CORPORATION • AVON INDUSTRIAL PARK  
AVON, MA 02322 • TEL: (508) 588-7700 • FAX: (508) 559-9323  
WEBSITE: WWW.WESTERBEKE.COM



Member National Marine Manufacturers Association





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**CALIFORNIA  
PROPOSITION 65 WARNING**

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

 **WARNING**

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

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

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



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

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



## Declaration of Conformity

**Application of Council Directive(s)** EMC 89/336/EEC  
92/31/EEC & 93/68/EEC

**Standard(s) to Which Conformity is declared** CISP 12 (1990-01)  
EN50082-1 (1992)  
IEC 801 - 2 (1991), +/- 8kv AD  
IEC 801 - 3 (1984), 3 V/M

**Manufacturers Name** Westerbeke Corporation

**Manufacturers Address** 41 Ledin Drive  
Avon Industrial Park  
Avon, Ma. 02322, USA

**Type of Equipment** Marine Diesel Generator

**Product Name** Westerbeke Marine  
Diesel Generator

**Model(s)** 3.5BCDT-512  
4.2BCDT-612

**Product Options** All

### Supplementary Information

- 1.) The equipment listed is only for use in Marine Applications aboard boats.
- 2.) The equipment listed must be located below decks on the vessel and permanently installed in its location.
- 3.) The equipment listed must be wired to the grounding system of the vessel.

I the undersigned, hereby declare that the equipment specified above conforms to the above Directive(s) and Standard(s).

Place Avon, Massachusetts, U.S.A.

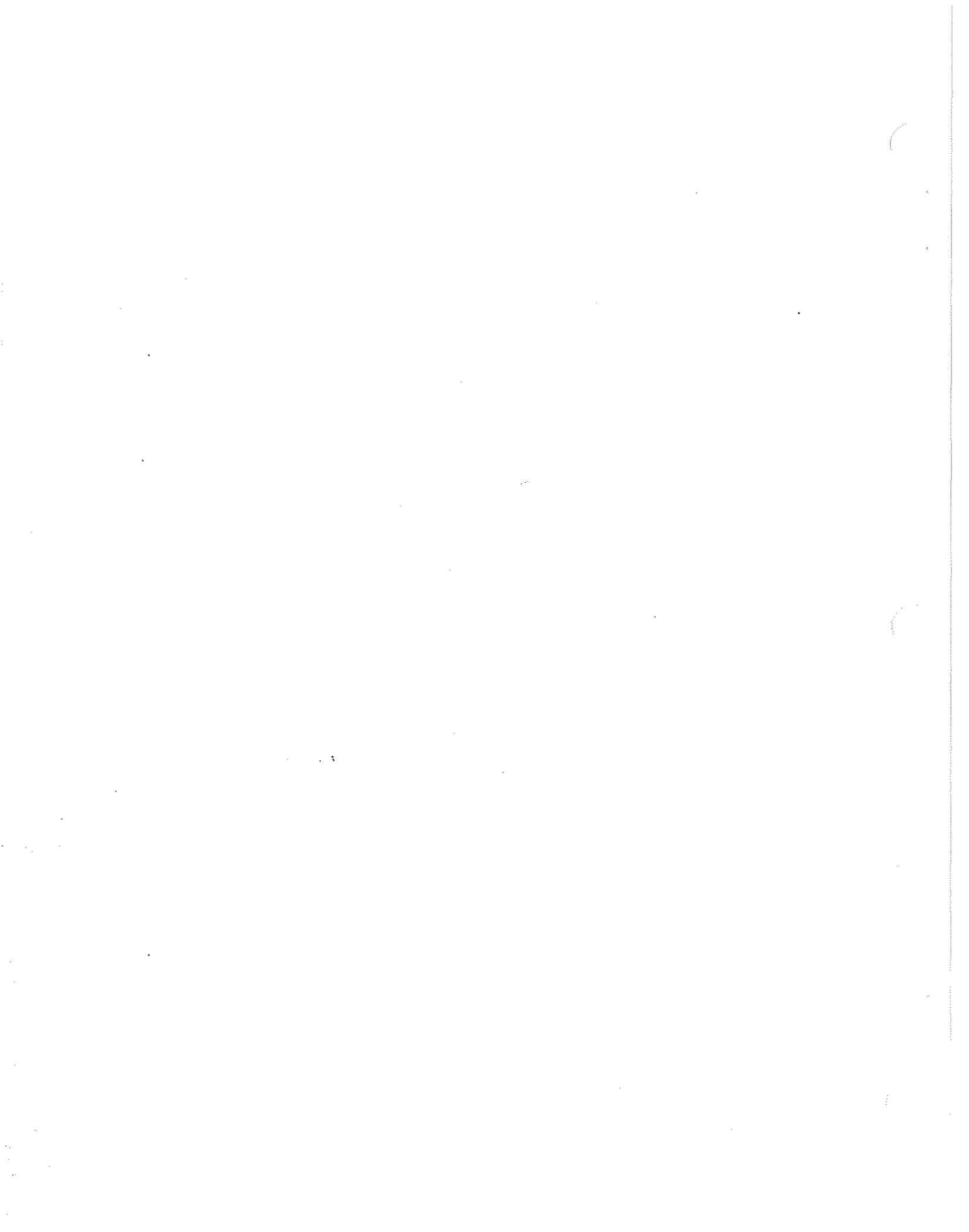
  
(Signature)

Date August 1, 1999

Carleton F. Bryant  
(Full Name)

Chief Operating Officer  
(Title)

042021



# SAFETY INSTRUCTIONS

## INTRODUCTION

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

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

## PREVENT ELECTRIC SHOCK

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

- Do not operate this machinery without electrical enclosures and covers in place.
- Shut off electrical power before accessing electrical equipment.
- Use insulated mats whenever working on electrical equipment.
- Make sure your clothing and skin are dry, not damp (particularly shoes) when handling electrical equipment.
- Remove wristwatch and all jewelry when working on electrical equipment.
- Do not connect utility shore power to vessel's AC circuits, except through a ship-to-shore double throw transfer switch. Damage to vessel's AC generator may result if this procedure is not followed.
- Electrical shock results from handling a charged capacitor. Discharge capacitor by shorting terminals together with an insulated tool.

## PREVENT BURNS — HOT ENGINE

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

**⚠ 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 line, filter, fuel pump, or other potential sources of spilled fuel or fuel vapors. Use a suitable container to catch all fuel when removing the fuel line or fuel filters.
- Keep the compartment and the engine/generator clean and free of debris to minimize the chances of fire. Wipe up all spilled fuel and engine oil.
- Be aware — diesel fuel will burn.

## PREVENT BURNS — EXPLOSION

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

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

# SAFETY INSTRUCTIONS

## ACCIDENTAL STARTING

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

- 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.
- Avoid contacting the terminals with tools, etc., to prevent burns or sparks that could cause an explosion. Remove wristwatch, rings, and any other jewelry before handling the battery.
- Always turn the battery charger off before disconnecting the battery connections. Remove the negative lead first and reconnect it last when servicing the battery.

## BATTERY ACID

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

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

## TOXIC EXHAUST GASES

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

- Ensure that the exhaust system is adequate to expel gases discharged from the engine. Check the exhaust system regularly for leaks and make sure the water-injected exhaust elbow is securely attached.
- Be sure the unit and its surroundings are well ventilated.
- In addition to routine inspection of the exhaust system, install a carbon monoxide detector. Consult your boat builder or dealer for installation of approved detectors.
- For additional information refer to ABYC T-22 (educational information on Carbon Monoxide).

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

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

## HAZARDOUS NOISE

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

- Never operate an engine without its muffler installed.
- Do not run engines for long periods with their enclosures open.

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

## GENERATOR INSTALLATIONS

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

Sections of the ABYC standards of particular interest are:

- H-2 Ventilation
- P-1 Exhaust systems
- E-9 DC Electrical systems

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

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

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

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

Order from:

ABYC  
3069 Solomons Island Rd.  
Edgewater, MD 21037

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

Order from:

NFPA  
11 Tracy Drive  
Avon Industrial Park  
Avon, MA 02322

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

Order from:

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

# INSTALLATION

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

## **CODES AND REGULATIONS**

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 in (51 cm) 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 any of the vessel's various operating conditions or when the vessel is not underway, *install a siphon-break*. This precaution is necessary to protect your engine.

**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 a proper maintenance schedule.*

## **EXHAUST SYSTEM**

The exhaust hose must be certified for marine use. The system must be designed to prevent water from entering the exhaust under any sea conditions and at any angle of the vessel's hull.

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# INTRODUCTION

This WESTERBEKE Diesel Generator is a product of WESTERBEKE'S many 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.

This owner's manual contains information and instructions for the installation, operation, maintenance and service of your generator. For additional installation information, see WESTERBEKE'S *INSTALLATION MANUAL FOR MARINE ENGINES & GENERATORS*, Publication #43268.

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.

## WARRANTY PROCEDURES

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

### Customer Identification Card



#### Customer Identification

WESTERBEKE OWNER  
MAIN STREET  
HOMETOWN, USA

Model 4.2 KW BCDT    Ser. #V0001-D910  
Expires 3/16/02

Your WESTERBEKE 4.2 KW Generator's serial number is an alphanumeric number that indicates the date of manufacture. The date code is at the end of the serial number, and consists of a character followed by three numbers. The character indicates the decade (D=1990s, E=2000s), the first number after the character represents the year in the decade, and the second and third numbers after the character represent the month of manufacture.

## PRODUCT SOFTWARE

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

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

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## NOTES, CAUTIONS AND WARNINGS

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

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

# INTRODUCTION

## MODEL NO./ SERIAL NO. LOCATIONS

Owners may find it convenient to enter the information on the generator decal and engine identification plate shown below. These will provide quick references when seeking technical information and/or ordering parts.

### Generator Serial Number

The generator Model Number, Serial Number and specifications are on a decal located on the generator housing.

SPECIFICATION	50 HZ.	60 HZ.
MODEL	3.5 BCDT	4.2 BCDT
RPM	3000	3600
KW	3.5	4.2
KVA	3.5	4.2
VOLTS	230	120
AMPS	15.2	35
ENG. HP	4.6	5.6
ENG. SER. NO.		
GEN. SER. NO.		
PF/PHASE	1 / 1	
WIRES	2	
RATING	CONT	
INSUL. CLASS	H	
TEMP. RISE	105C @ 40C	
BATTERY	12 VDC	
C.I.D.	17.7	

GENERATOR DECAL

### Engine Serial Number

The engine model number and serial number are found on an identification plate located on the control box cover.



ENGINE IDENTIFICATION PLATE

## COMPONENT LOCATIONS

Component locations in this manual are referenced from the front of the engine which is the end at which the raw water pump is located. Left and right sides are determined as follows: imagine straddling the engine, facing the front of the engine: the left side is at your left, the right side is at your right. The left side is the service side of the generator. The engine and generator controls are located in an air-cooled air intake/control box.

## UNDERSTANDING THE DIESEL ENGINE/GENERATOR

The diesel engine closely resembles the gasoline engine, since the mechanism is essentially the same. The cylinder is arranged above a closed crankcase. The crankshaft is of the same general type as on a gasoline engine, and the diesel engine has the same type of valves, camshaft, piston, connecting rod and lubricating system.

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

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

## ORDERING PARTS

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

## SPARES AND ACCESSORIES

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

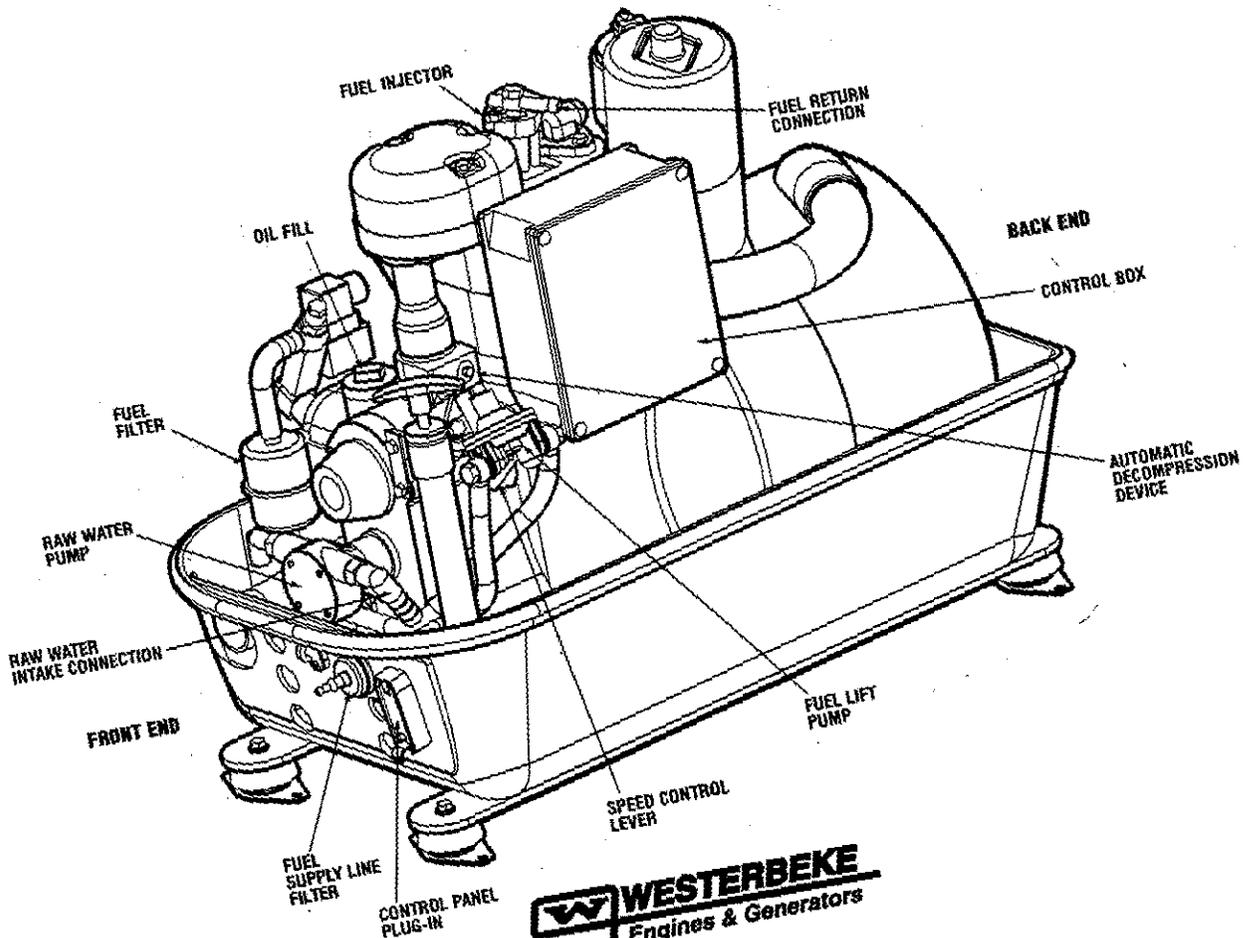
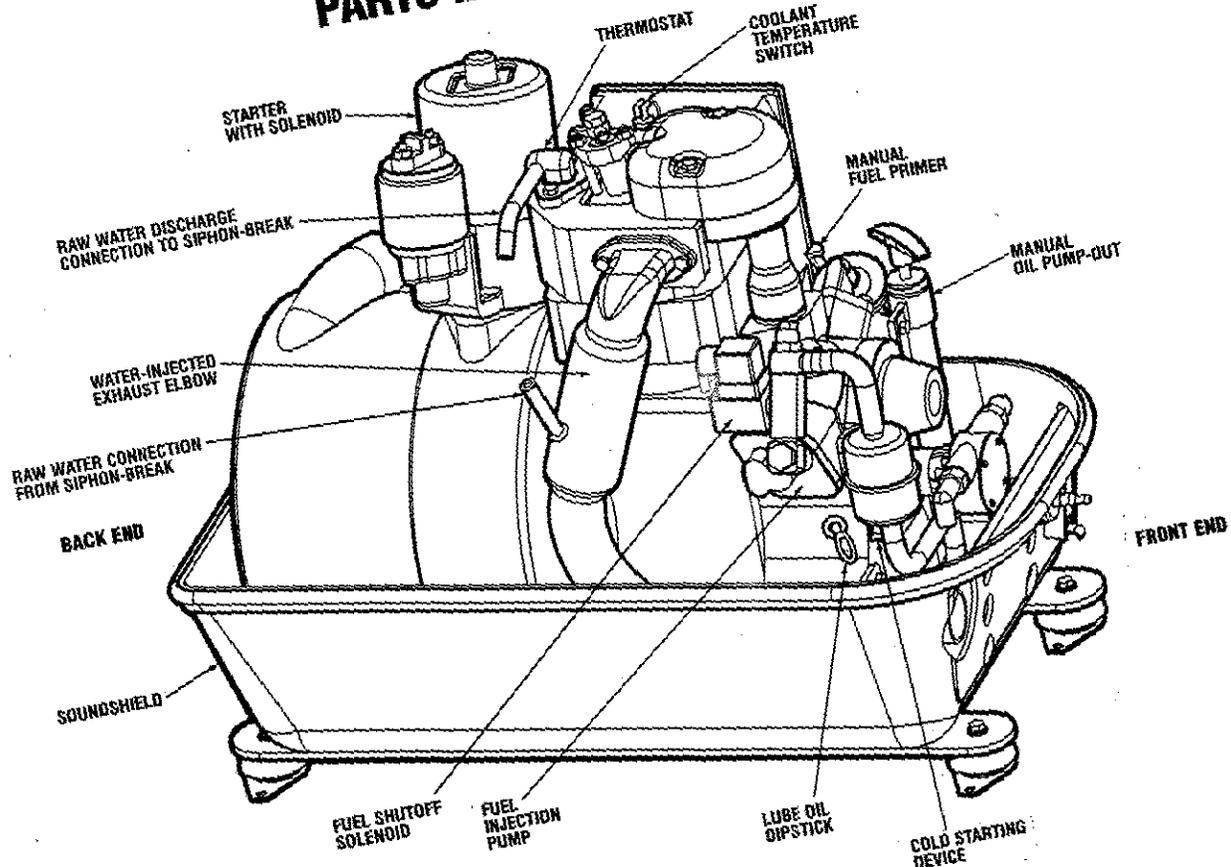
## PROTECTING YOUR INVESTMENT

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.
- An efficient well-designed exhaust system that includes an anti-siphon break to prevent water from entering the engine.
- Changing the engine oil every 100 operating hours.
- Proper maintenance of all engine and generator components according to the maintenance schedule in this manual.
- Use clean, filtered diesel fuel.
- Winterize your engine according to the *LAY-UP AND RECOMMISSIONING* section in this manual.

# PARTS IDENTIFICATION



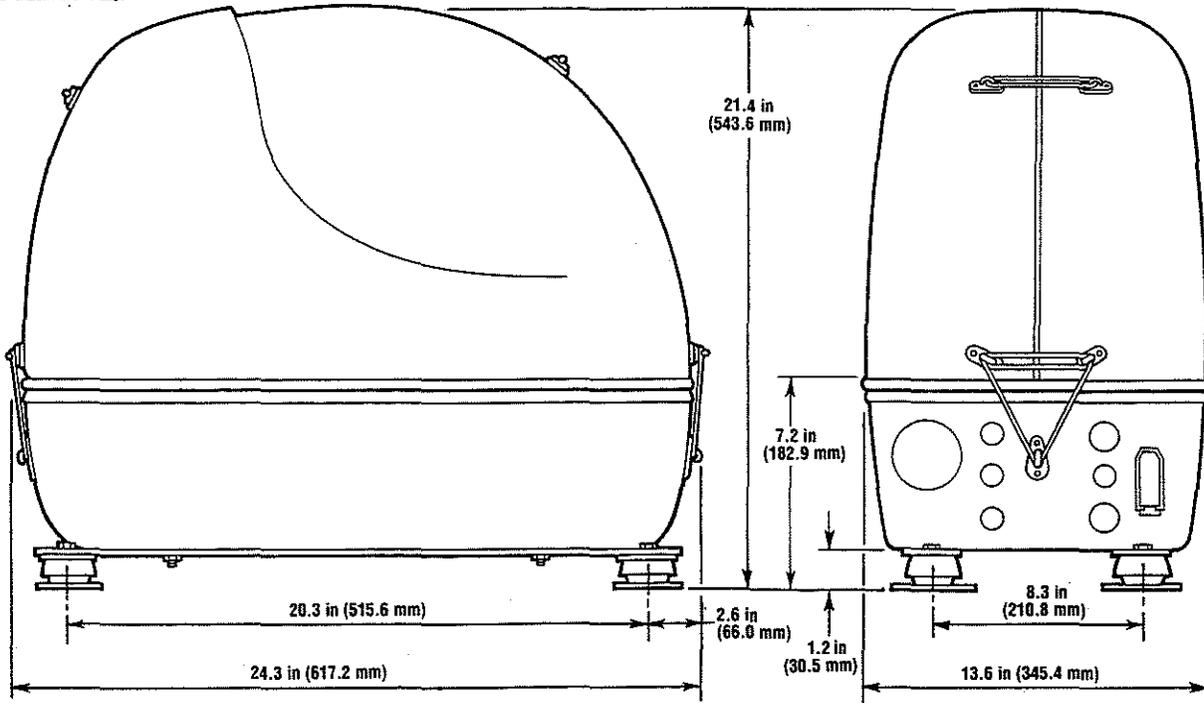
# INSTALLATION

The following installation instructions cover the Westerbeke 4.2 kw Diesel Generator. Additional general information may be found in Westerbeke's *INSTALLATION MANUAL for MARINE ENGINES and GENERATORS*, Publication #43268.

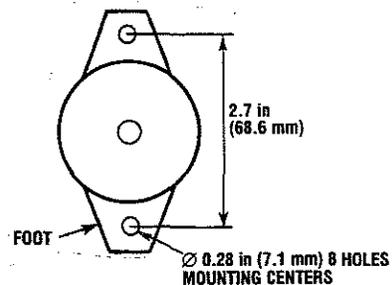
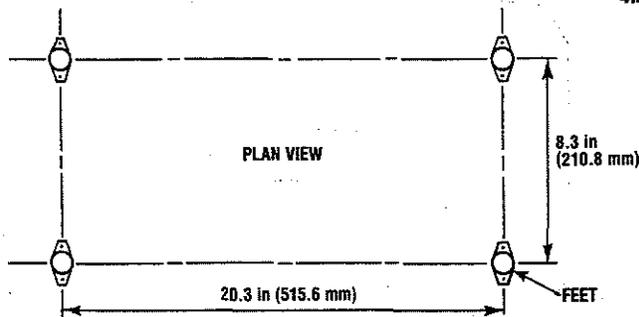
The following factors should be considered when planning the installation of your Westerbeke 4.2 kw generator:

1. Size and weight of the generator.
2. Location and mounting surface.
3. Ventilation.
4. Exhaust system.
5. Fuel supply and return.
6. Raw water inlet and outlet.
7. Oil fill and oil drain hose.
8. Electrical connections.
9. Maintenance and service accessibility.
10. Hand-cranking.
11. Accessories.

Refer to the following illustrations for the generator's overall dimensions.



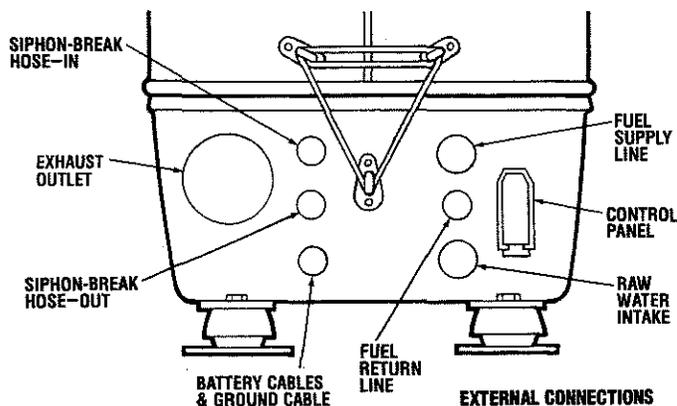
4.2 KW GENERATOR DIMENSIONS



# INSTALLATION

## EXTERNAL CONNECTIONS

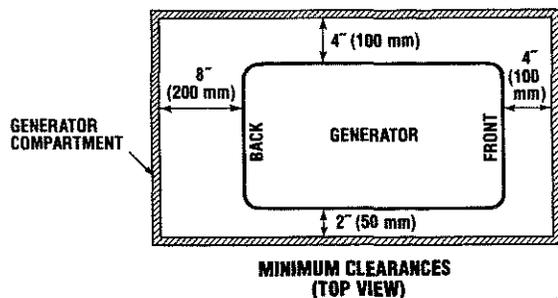
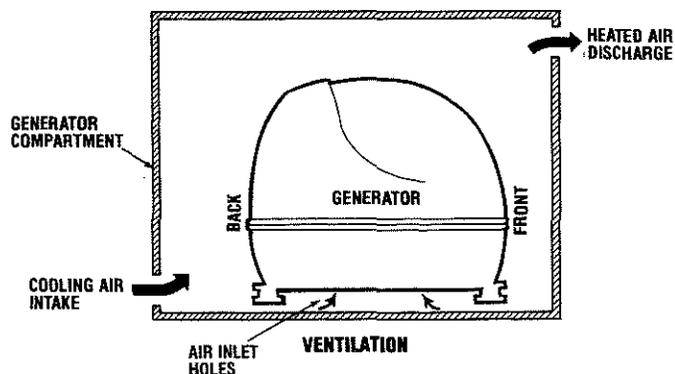
The locations of the external connections are shown on the following illustration. The various lines should be of the specified gauges/diameters, not only to avoid loosening or leakage, but also because using the correct sizes will prevent unnecessary gaps in the soundshield that could emit noise.



## VENTILATION

Allow for the sufficient intake of cool air for proper engine combustion and the discharge of the heated air while the generator is running. Since heated air rises, the intake of cool air should be directed into the lower area of the generator compartment and the heated air should be discharged from the upper area of the compartment. Minimum clearances of the generator's soundshield hood from the generator compartment's bulkheads are shown in the illustration. These are the minimum clearances required to provide adequate ventilation.

**NOTE:** Engine combustion air enters the generator's enclosure through holes in the base of the enclosure. This area *must* be kept clear of obstructions to help insure air entry.

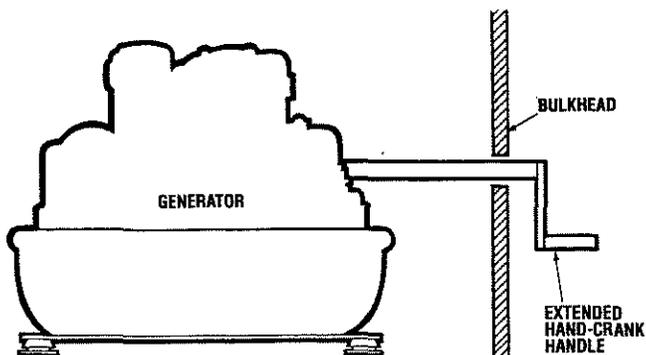
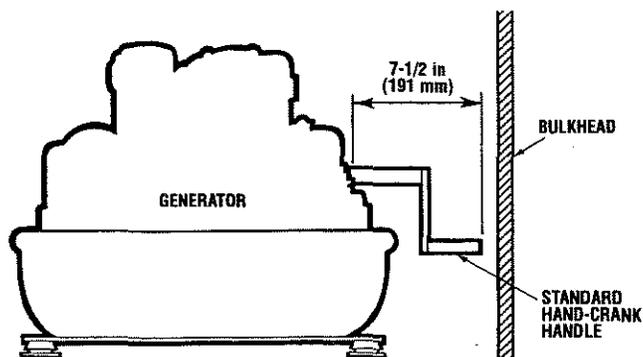


## HAND CRANKING

It is important to provide enough space at the front end of the generator to allow for manual starting (hand cranking) in case of an emergency or when the starting battery has become too low to allow an electrical start.

The upper illustration shows the distance that the standard hand-crank handle protrudes from the crank-handle guide on the engine.

If hand cranking must be done from outside the generator compartment (see lower illustration), then the standard hand-crank handle must be extended to the required length. This modification to the handle must be done by the owner.

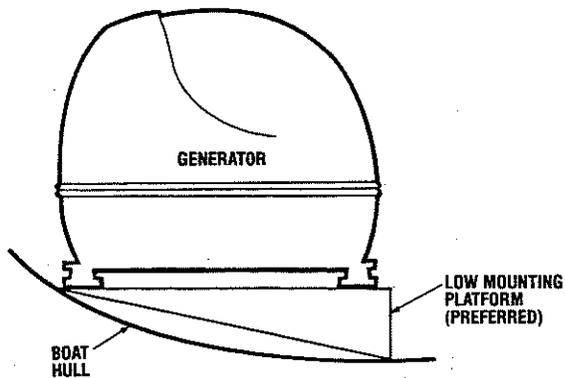
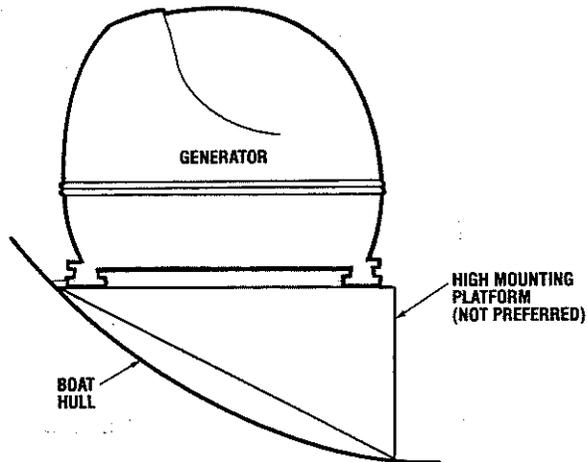


# INSTALLATION

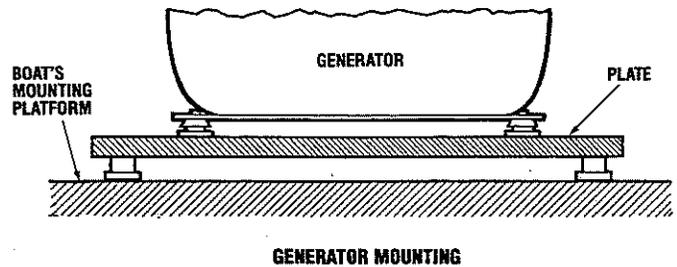
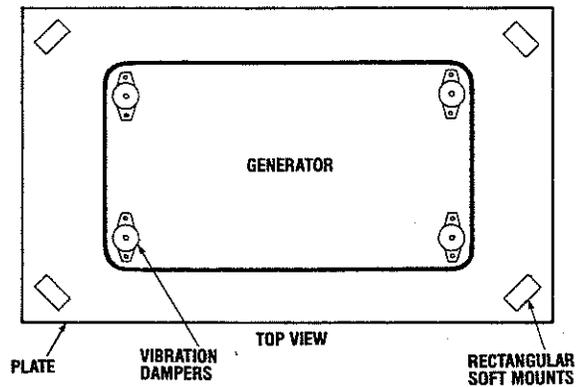
## LOCATION AND MOUNTING

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

The mounting platform may be of wood, metal or fiberglass. It must be horizontal and should be as small as possible to minimize vibrations. A low mounting platform is preferred because it will be stable and easy to build; a higher mounting platform must be very sturdy to avoid resonance and vibrations (see illustrations).



If the vibration-dampening mounts furnished with the generator are not adequate to muffle vibration or resonance in an installation where the mounting surface is not ideal, then adding a plate between the generator and the boat's mounting platform is a possible solution. This will also improve the sound insulation. For this plate, use 1" (2.54 cm) thick wood that weighs 22 – 33 lbs (10 – 15 kg), and soft mounts (45 durometer rating) that are rectangular. Position these mounts so they are on the diagonal and not aligned with the generator's mounts (see illustration). The generator's mounts may be turned in any direction. Mount the plate to the boat's platform, then mount the generator to the plate.



## FUEL LINES

### Fuel Supply Line

In most installations, the generator would use the same fuel tank as the vessel's propulsion engine. If this is the case, the fuel supply line to the generator should come from its own pickup in the common fuel tank and not tee off the supply line to the propulsion engine.

To assure proper suction, the generator's fuel pump should not be more than 39" (1m) above the bottom of the fuel pickup tube. There is no limit to the length of the fuel supply line.

### Fuel Return Line

The fuel return line at the fuel tank should extend down to the bottom of the tank in the same manner as the fuel pickup tube. This **must** be done in an installation where the fuel tank is located below the engine's fuel system. This precaution insures against hard starting due to air displacing fuel siphoning out of the engine's fuel system through the return line when the generator is shut down.

# INSTALLATION

## EXHAUST SYSTEM

It is important to install a proper exhaust system to avoid engine flooding. The system must be designed to prevent water from entering the exhaust line under any sea conditions and at any angle of the vessel's hull. Exhaust system failures are not covered by Westerbeke's warranty. The installer should have a basic knowledge of marine installation requirements.

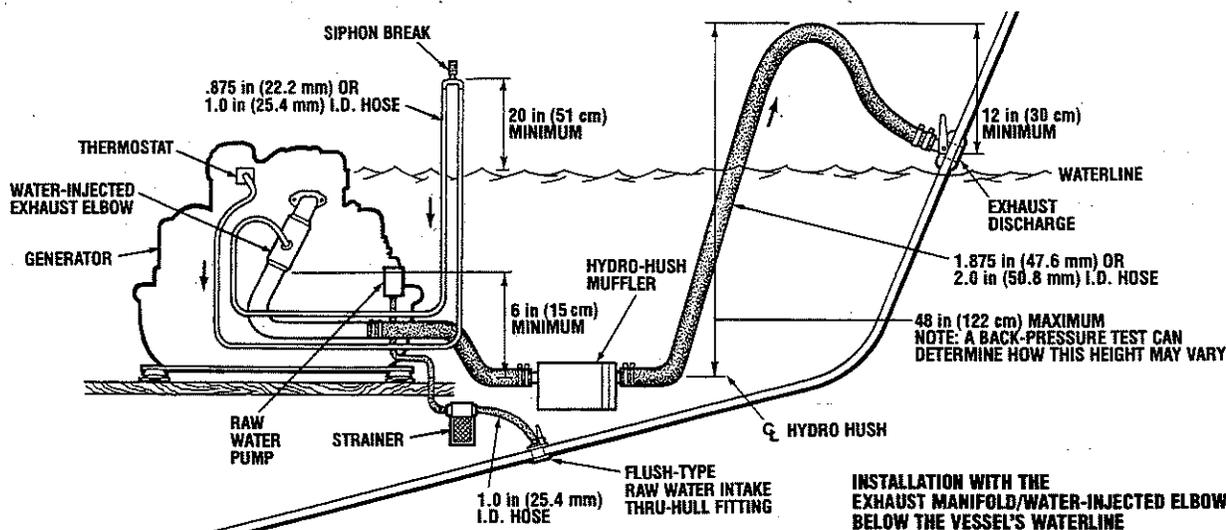
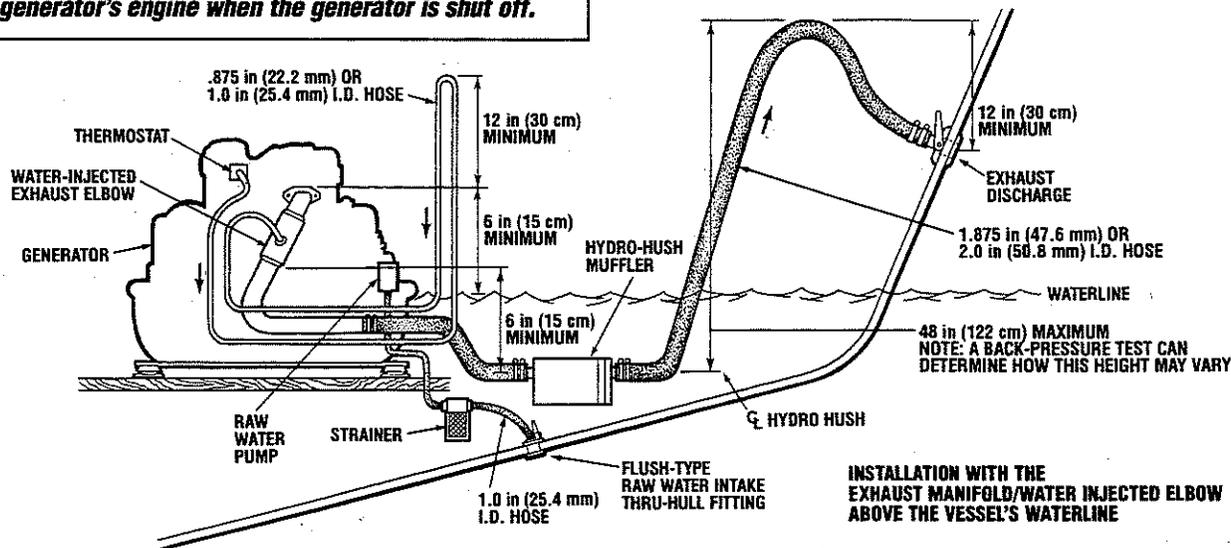
Westerbeke recommends installing an exhaust system having an in-line muffler (see illustration). The in-line muffler should be located below the engine's exhaust elbow. It must accumulate any water that runs back down the exhaust line after the engine is shut down. Design the system so there is an adequate drop in the line between the exhaust elbow and the through-hull discharge end of the line. The exhaust hose must be certified for marine use. Use the following illustrations as a general guide when installing an exhaust system.

**WARNING:** The exhaust system must be tight and free of leaks. Exhaust gasses are deadly. Display the Carbon Monoxide warning decal near your engine/generator, on your cabin bulkhead, or in some other prominent location.

For more information about exhaust system design, see Westerbeke's *INSTALLATION MANUAL for MARINE ENGINES and GENERATORS*, Publication # 43268.

Westerbeke Corporation presumes that the installer of this marine diesel generator is familiar with the safeguards a water-cooled marine exhaust system will provide for the engine. Failure to design and layout a proper exhaust system can result in catastrophic damage to the diesel engine, and possibly result in the sinking of the vessel in which the unit is installed.

**CAUTION:** An exhaust line that is too long and/or has a poor gradient can cause water to return back to the generator's engine when the generator is shut off.



# INSTALLATION

## RAW WATER COOLING SYSTEM

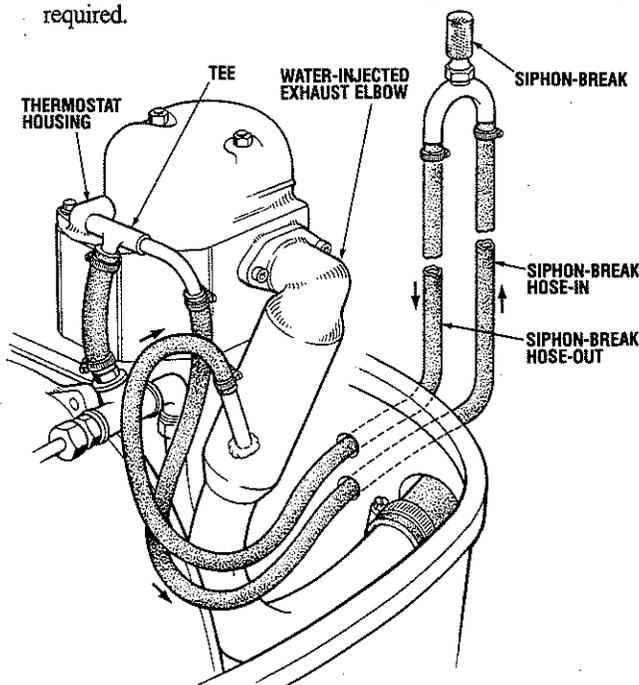
### Siphon-Break

For installations where the water-injected exhaust elbow is close to or below the vessel's waterline, provisions must be made to install a siphon-break in the raw water supply hose to the exhaust elbow. The siphon-break provides an air vent in the raw water cooling system to prevent raw water from filling the exhaust system and the engine's cylinder when the engine is shut down.

**CAUTION:** Failure to use a siphon-break when the exhaust elbow is located 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 any of the vessel's various operating conditions or when the vessel is not under way, *install a siphon-break*. This precaution is necessary to protect your engine.

The siphon-break must be installed in the high point of a hose that is looped a minimum of 20 inches (51cm) above the vessel's waterline. This siphon-break *must always* be above the waterline during all angles of vessel operation to prevent siphoning from occurring. WESTERBEKE has provided two siphon-break hoses (these are tagged). The hose *to* the siphon-break connects to the raw water line at the tee on the thermostat housing. The hose *from* the siphon-break attaches to the water-injected exhaust elbow (see illustration). The owner must furnish the siphon-break, and any additional lengths of hose that may be required.



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

## Raw Water Intake

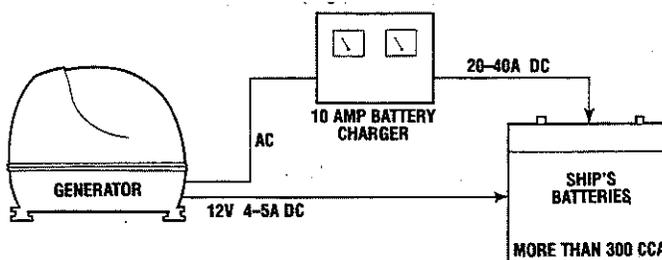
A flush-type through-hull fitting is recommended for the raw water intake. It should be located on the boat's hull where it will be below the waterline during all angles of the boat's operation. See Westerbeke's *INSTALLATION MANUAL for MARINE ENGINES and GENERATORS* for complete installation guidelines.

**WARNING:** Do not use a scoop-type through-hull fitting for supplying raw water to this generator. A scoop-type raw water inlet can develop substantial pressure and force water past the raw water pump, flooding the exhaust system and allowing the water to enter the engine's cylinder. Damage caused by raw water entry into the engine's cylinder via the exhaust system is not covered by Westerbeke's warranty.

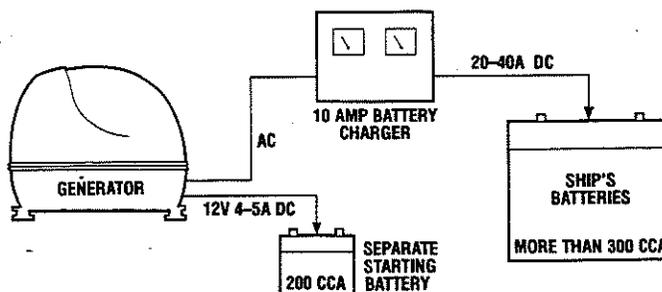
Flooding of the exhaust system due to water pressure can also occur with a flush-type raw water intake on a powerboat that has its bow up. This pressure can be caused by the boat's decreased waterline before the boat reaches its final trim, or by the angle of the boat to the sea surface when it is underway.

## STARTING BATTERY CONNECTIONS

The Westerbeke 4.2 KW Generator is negative grounded. For electric starting, it can be connected to the ship's 12V batteries or to a separate small 12V battery of about 200 CCA rating. In the latter case, the generator's battery charger will charge this separate battery with about 4-5 amps. If the generator is connected to the ship's batteries, this 4-5 amp charge is available as well, but may not be required if an inverter is installed that is operating on the AC output of the generator.



ELECTRIC STARTING USING SHIP'S BATTERIES

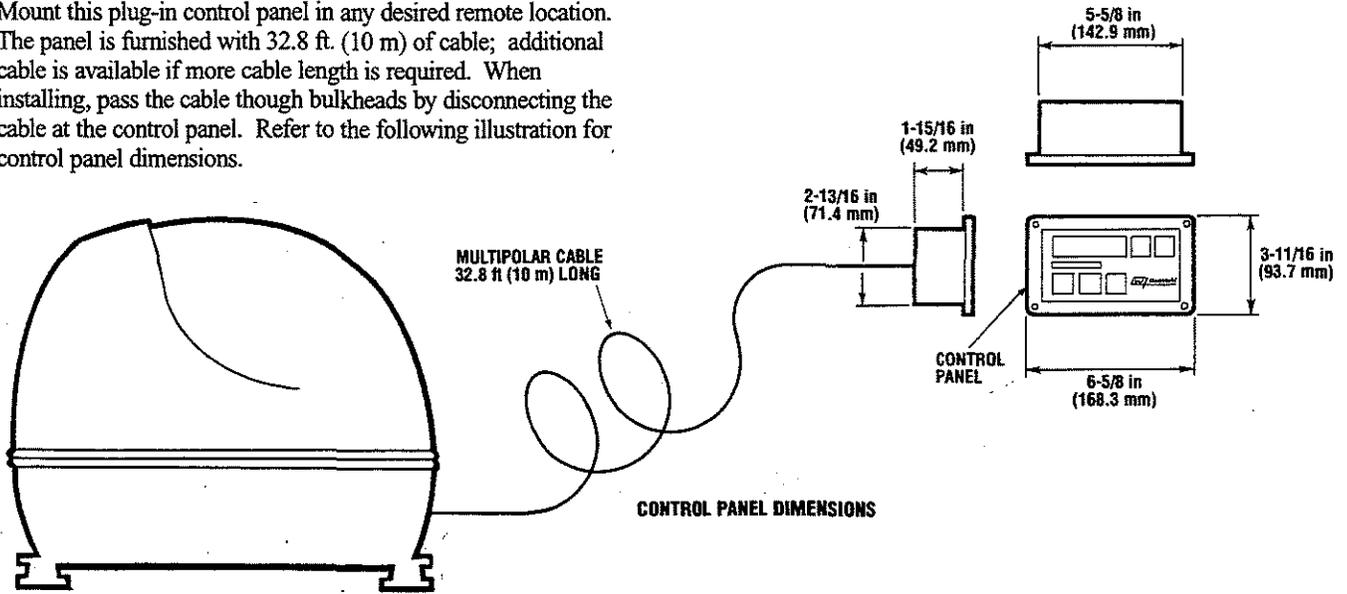


ELECTRIC STARTING USING A SEPARATE SMALL BATTERY

# INSTALLATION

## CONTROL PANEL

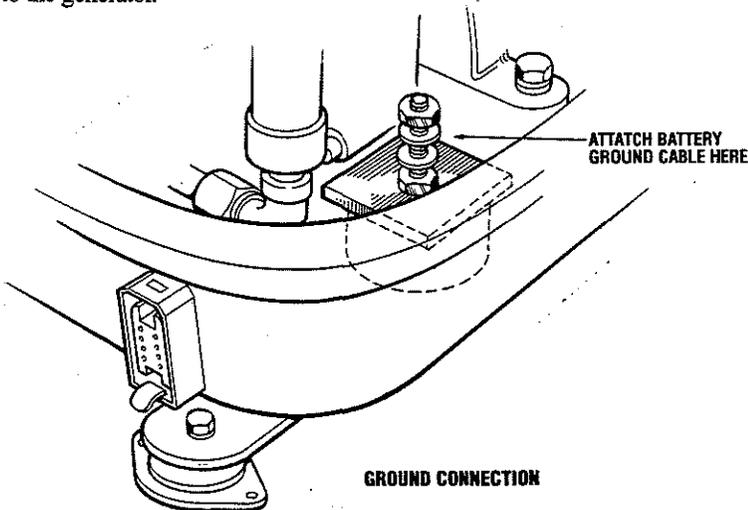
Mount this plug-in control panel in any desired remote location. The panel is furnished with 32.8 ft. (10 m) of cable; additional cable is available if more cable length is required. When installing, pass the cable through bulkheads by disconnecting the cable at the control panel. Refer to the following illustration for control panel dimensions.



## GROUNDING

The DC electrical system is ungrounded except during preheating and cranking from an electric start. A relay connects the ground during these two functions.

The generator is grounded through the negative pole of the battery charger. Do not add any other ground to any of the main phases because a short circuit may occur that could cause severe damage to the generator.



# PREPARATIONS FOR INITIAL START-UP

## DIESEL FUEL

Use No. 2 diesel fuel with a cetane rating of 45 or higher. Do not use kerosene or home heating fuel.

## Fuel Additives

If fungus or bacteria is causing fuel problems, you should have an authorized dealer correct these problems. Then use a diesel fuel biocide to sterilize the fuel (follow the manufacturer's instructions).

## Care of the Fuel Supply

Use only clean diesel fuel! The clearance of the components in your fuel injection pump is very critical; invisible dirt particles which might pass through the filter can damage these finely finished parts. It is important to buy clean fuel, and keep it clean. The best fuel can become 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, purchase a well-known brand of fuel. Also install and regularly service a good, Coast Guard approved fuel filter/water separator between the fuel tank and the engine.

## ENGINE OIL

**CAUTION:** *This generator was shipped from the factory without lubricant in the engine. Before operating, fill with the proper engine oil.*

Use a heavy duty engine oil with an API classification of CF or CG-4. Change the engine oil after an initial 50 hours of break-in operation, and every 100 hours of operation thereafter. For recommended oil viscosity, see the following chart:

Operating Temperature	Oil Viscosity
Above 68° F (20° C)	SAE 30, 10W-30 or 15W-40
41° – 68° F (5° – 20° C)	SAE 20 or 10W-30
Below 41° F (5° C)	SAE 10W-30

**CAUTION:** *Do not allow two or more brands of engine oil to mix. Each brand contains its own additives; additives of different brands could react in the mixture to produce properties harmful to your engine.*

## PRE-START INSPECTION

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

Check the engine oil level. Add oil to maintain the level at the high mark on the dipstick.

Turn on the fuel supply, then check the fuel supply and examine the fuel filter/water separator bowl for contaminants.

**NOTE:** *Refer to the specifications pages in this manual for the proper diesel fuel and lubricating oil types and quantities.*

- Check the DC electrical system. Inspect wire connections and battery cable connections. Make certain the positive (+) battery cable is connected to the starter solenoid and the negative (-) cable is connected to the engine ground stud (this location is tagged).
- The shore power safety switch must be OFF.
- The shore power transfer switch must be in the GENERATOR mode.
- Open the raw water intake.
- Visually examine the generator. Look for loose or missing parts, disconnected wires, and unattached hoses. Check the threaded connections. Check for fuel leaks.
- Make sure the exhaust system is secure and all the connections are tight.
- Make sure there is good ventilation and an ample air supply. These are necessary for proper engine performance.
- Make sure the mounting installation is secure.
- Check load leads for correct connections as specified in the wiring diagrams.
- 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.

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

# STARTING/STOPPING PROCEDURE

## ELECTRIC START

**CAUTION:** All AC loads must be switched off before starting. This precaution will prevent damage caused by unanticipated operation of AC machinery and will prevent a cold engine from stalling.

This generator has a 12 VDC electric starter. To start the generator, push the START button on the control panel. The yellow start indicator light will come on and start to blink. Once the engine fires and runs, the yellow start indicator light will go out and the green run indicator light will come on.

**NOTE:** If a start attempt is aborted, the yellow indicator light will continue to blink. To reset the circuit, depress the stop button.

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

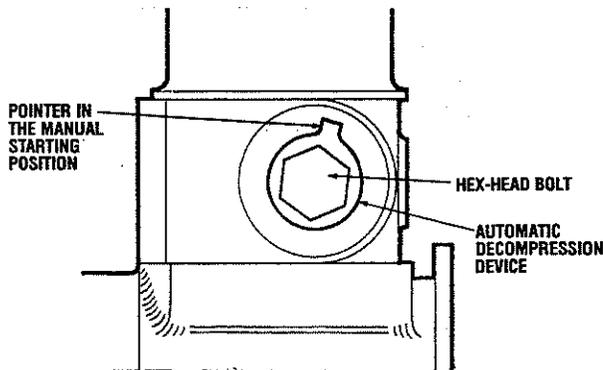
**NOTE:** Some unstable running may occur in a cold engine. This condition should smooth out as the engine warms up and when the generator loads are applied.

### Low Battery Electric Starting

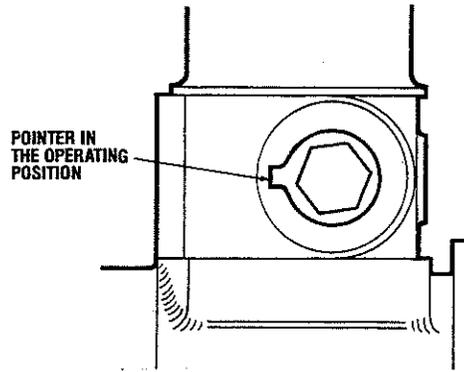
If the battery is discharged and too low for a normal electric start but not completely dead, an attempt at an electric start can be made by using the Automatic Decompression Device. This device works by holding the exhaust valve open, and is normally used when manually starting (hand-cranking) the engine.

**NOTE:** The Automatic Decompression Device is not used for normal electric starting. During engine operation, the pointer on this device is in the operating (9 o'clock) position.

1. Using a 10mm wrench, turn the hex-head bolt on the device so the pointer is in the manual starting position (see illustration).



2. Press the Start button on the control panel. This will energize the fuel solenoid and light up the fuel solenoid indicator on the control panel. After the engine starts, the pointer on the Automatic Decompression Device will automatically move clockwise to the operating (9 o'clock) position.



If this attempt at an electric start does not start the engine, then a manual start by hand-cranking will be necessary.

### MANUAL STARTING (HAND CRANKING)

The generator may be started by hand-cranking in an emergency or when the starting battery has become too low to allow an electric start. There must be, however, enough battery power to activate the fuel solenoid (the fuel solenoid indicator on the control panel will light up). A manual start is not possible with a completely dead battery.

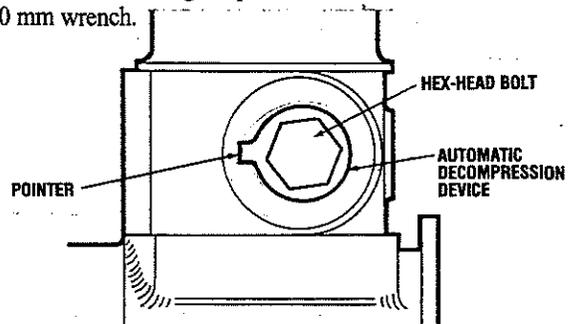
For easy and safe manual starting, the engine is fitted with an Automatic Decompression Device and a Cold Starting Device. Use both of these devices when hand-cranking.

Before using the hand-crank handle, an attempt at a normal electric start could be made by using the Automatic Decompression Device (see Low Battery Electric Starting under ELECTRIC START); the electrical power required for the start would then be considerably less, so that a discharged battery, if not completely dead, might allow the start.

**NOTE:** Oil will be supplied to all the bearing points when hand-cranking.

#### Automatic Decompression Device

The Automatic Decompression Device works by holding the exhaust valve open. The device has three positions, as indicated by the pointer. When setting the pointer, turn the hex-head bolt with a 10 mm wrench.



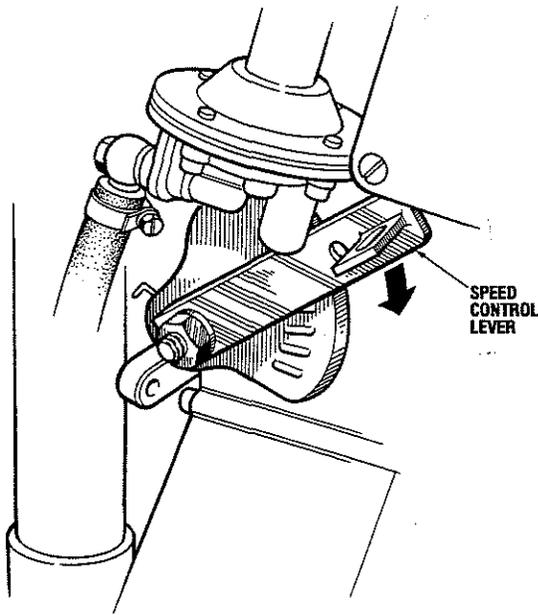
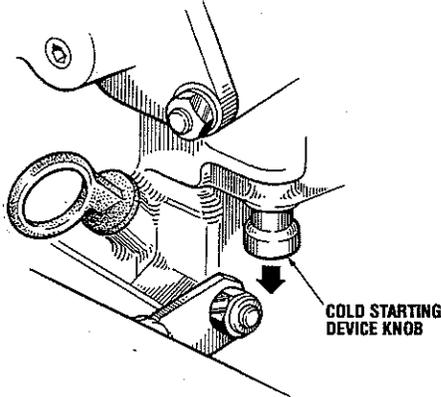
**CAUTION:** Never use the Automatic Decompression Device to stop the engine.

# STARTING/STOPPING PROCEDURE

## Cold Starting Device

This device provides more fuel from the injection pump. There are two positions for the knob: *up* (off) and *down* (activated).

When activating this device, pull the knob down (see illustration). To release this device, move the speed control lever down, then release it (see illustration).

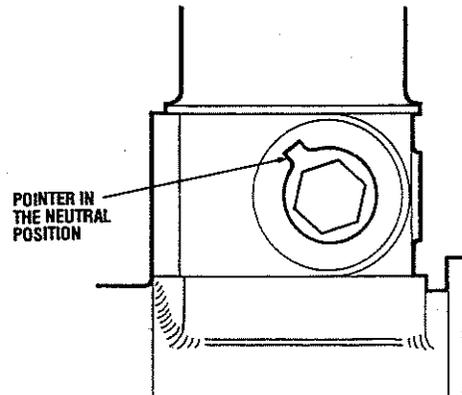


## Manual Start

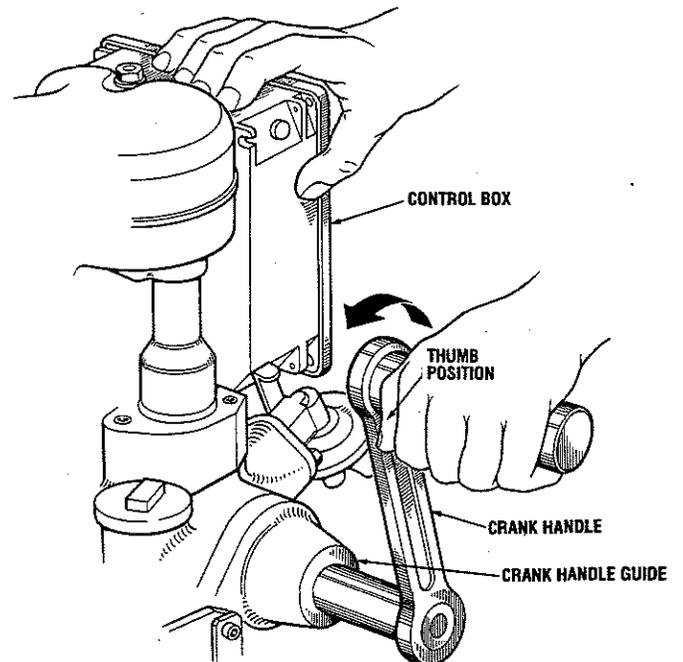
To manually start the engine, follow the procedure described below. When starting after cold nights or freezing temperatures when the engine must first be turned over with no compression, follow all of the steps, beginning with Step 1. If cold weather is not a factor, bypass Steps 1–3, and begin with Step 4.

**WARNING:** Always keep hands and feet clear of moving parts. Disconnect all external loads. Do not use starting aids.

1. Set the Automatic Decompression Device pointer to the *Neutral* position (see illustration). Compression is released when the pointer is in this position.



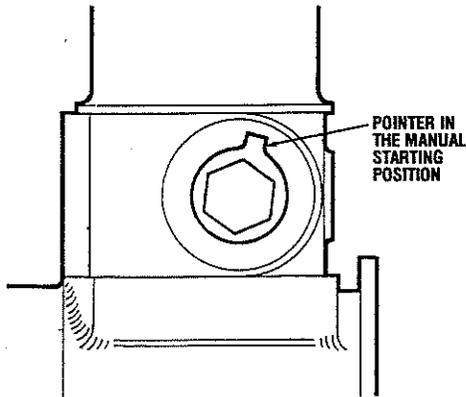
2. Insert the crank handle into the crank handle guide (see illustration). Standing to the right of the crank handle, put your right hand on top of the control box and grip the crank handle with your left hand, with the thumb on your left hand in the position shown in the illustration.



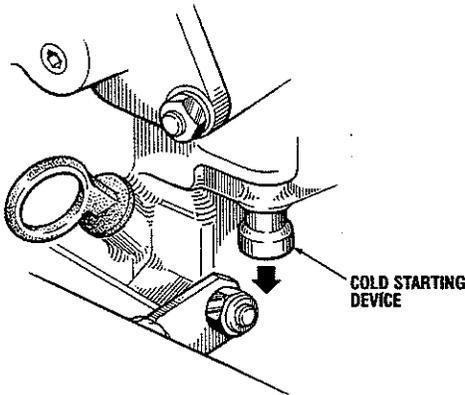
3. Crank the engine counterclockwise approximately 10 to 20 times until the engine turns freely. Then remove the crank handle.
4. Push the START button.
5. Check if the fuel solenoid ON indicator is lit on the control panel. If it is lit, it indicates there is sufficient voltage for a manual start.

# STARTING/STOPPING PROCEDURE

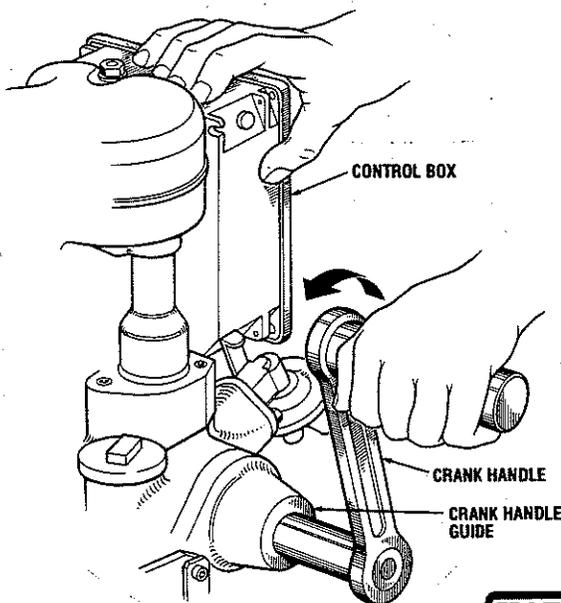
6. Set the Automatic Decompression Device pointer to the *manual starting* position (see illustration). When hand-cranking in this position, automatic decompression will occur.



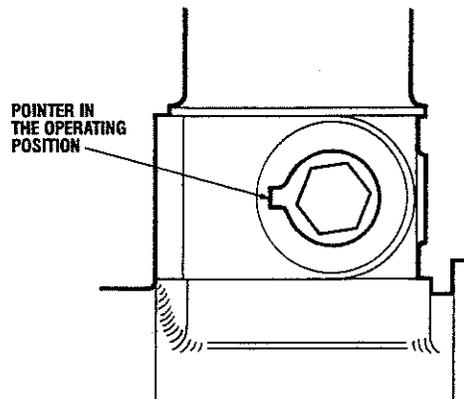
7. Pull down the Cold Starting Device. **Note:** Do *not* pull down this device when restarting a hot engine.



8. Insert the crank handle into the crank handle guide (see illustration). Standing to the right of the crank handle, put your right hand on top of the control box and grip the crank handle with your left hand, with the thumb on your left hand in the position shown in the illustration.



9. Slowly crank the engine counterclockwise 4 times, then crank the engine as fast as possible. The pointer on the Automatic Decompression Device will automatically move clockwise with each crank. Compression will occur after 8 cranks. Continue to crank after compression occurs until the engine starts firing. As decompression ends and compression occurs, the pointer will automatically stop at the *operating* (9 o'clock) position. After the engine starts, the crank handle will automatically disengage. Then remove the crank handle.



10. If the engine has not started, repeat Steps 5–9 above, and consider cranking at a higher speed.

**CAUTION:** Prolonged cranking intervals without the engine starting can result in the engine exhaust system filling with raw water. This may happen because the pump is pumping raw water through the raw water cooling system during cranking. This raw water can enter the engine's cylinder once the exhaust system fills. Prevent this from happening by closing the raw water supply through-hull shutoff, draining the exhaust muffler, and correcting the cause of the excessive engine cranking. Remember that engine damage resulting from raw water entry is not covered by Westerbeke's warranty.

## Starting Under Cold Conditions

Make sure the lubricating oil is appropriate for the prevailing temperature. Use oil with an API Specification of CF or CG-4, SAE 30, 10W-30, or 15W-40. The battery should be fully charged to minimize voltage drop.

# STARTING/STOPPING PROCEDURE

## OPERATING THE GENERATOR

After the generator has started, run it with a medium load for warmup. If possible, apply the load in stages.

**CAUTION:** Never operate the engine for long periods of time without an amperage load being applied, otherwise carbon build-up may occur which can cause severe damage to the engine.

**CAUTION:** Never pull the cold starting device knob when the engine is operating.

### Initial Start-Up Check List

- Check for possible leaks from all the connections inside the soundshield.
- Make sure the cooling water is discharging properly, outboard from the exhaust outlet.
- Make certain that the generator is mounted securely.
- Listen for unusual sounds and vibrations.

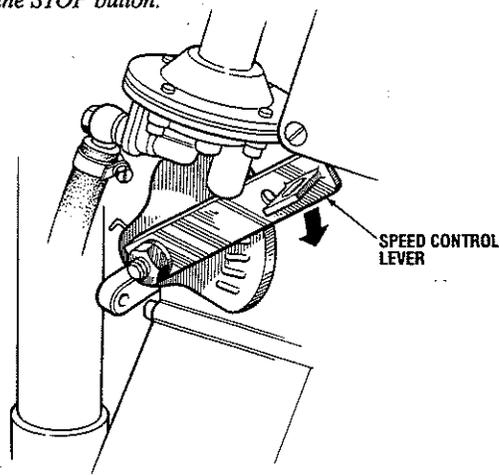
## STOPPING THE GENERATOR

Remove the AC loads from the generator one at a time and allow the generator to run for an additional 3 to 5 minutes (this stabilizes its operating temperature).

To stop the generator, press the STOP button on the control panel; shutdown is automatic.

If the engine should fail to stop after pressing the STOP button, use the speed control lever: move the lever all the way down (see illustration) and hold it down until the engine comes to a stop, then release it.

**NOTE:** Only use this lever when the engine doesn't stop after pressing the STOP button.



**CAUTION:** Never stop the generator with the automatic decompression device, or when the generator is under a full load.

Check the lube oil level a few minutes after stopping the engine, because lube oil from the bearings etc. continues to drain down into the oil sump. Disregarding this fact and not maintaining the proper oil level may lead to overfilling, causing overheating and the possibility of engine runaway.

After shutdown, carefully inspect the generator. Check for possible leaks from all the connections inside the soundshield.

# 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 generator's operation, the load can be increased to the full-load rated output; then periodically vary the load.

Avoid overload at all times. An overload is signaled by 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 3600 rpm to produce 60 hertz, or at 3000 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 check list each day before starting your generator.

- Record the hourmeter reading in your log (engine hours relate to the maintenance schedule).
- Visually inspect the engine for fuel, oil or water leaks.
- Check the oil level (dipstick).
- Check your diesel fuel supply.
- Check the starting batteries (weekly).
- Check for abnormal noise such as knocking, vibration and blowby 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.
- Make sure the cooling water is discharging properly, outboard from the exhaust outlet.

**NOTE:** After the first 20 hours of generator operation, check the maintenance schedule for the 20 hour service check.

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

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

## STOPPING THE GENERATOR

Remove the AC loads from the generator one at a time. Allow the generator to run for 3–5 minutes to stabilize the operating temperature, then press the STOP button; shutdown is automatic.

# MAINTENANCE SCHEDULE

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

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

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

COMPONENT	FREQUENCY						MAINTENANCE
	AFTER FIRST 50 HRS	DAILY OR EVERY 8 HOURS	WEEKLY	EVERY 100 HOURS	EVERY 600 HOURS	EVERY 2100 HOURS	
Engine oil level		■					Oil level should be between the full and low indicating marks on the dipstick. Top up if necessary.
Engine oil	■			■			Change the oil: see <i>LUBRICATION SYSTEM</i>
Crankcase oil and strainer					■		Remove the oil strainer and clean it with diesel fuel. Flush the crankcase with the proper lube oil.
Fuel supply		■					Check the fuel supply. Top up if necessary.
Fuel filter/water separator		■		■			Check for water and dirt in the fuel. Drain and replace the filter if necessary.
Fuel lift pump					■		Change the two filters. See <i>FUEL LIFT PUMP</i> under <i>FUEL SYSTEM</i> .
Fuel filter				■			Change the filter.
Fuel injector*					■		Check and adjust the injection opening pressure and spray condition (see <i>ENGINE ADJUSTMENTS</i> ).
Raw water pump					■		Remove the pump cover and inspect the impeller, gasket, cam and cover for wear. Check the bearings and seals (the shaft can turn, but not wobble). Lubricate when reassembling.
Thermostat						■	Check the functioning of the thermostat; see <i>THERMOSTAT</i> under <i>COOLING SYSTEM</i> .
Engine hoses			■				Hoses should be hard and tight. Replace if soft and spongy. Check and tighten all hose clamps.
Exhaust system*	■		■				Inspect for leaks. Check the anti-siphon valve operation. Check that all connections are tight. Check the exhaust elbow for carbon and/or corrosion buildup on inside passages; clean and replace as necessary. Warning: A defective exhaust elbow can cause carbon monoxide leakage!
Starting batteries and house batteries			■				Check electrolyte levels and make sure connections are very tight. Clean off excessive corrosion.
Starter motor*					■		Check the solenoid and motor for corrosion. Remove and lubricate. Clean and lubricate the starter motor pinion drive.

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

(continued)

# MAINTENANCE SCHEDULE

COMPONENT	FREQUENCY						MAINTENANCE
	AFTER FIRST 50 HRS	DAILY OR EVERY 8 HOURS	WEEKLY	EVERY 100 HOURS	EVERY 600 HOURS	EVERY 2100 HOURS	
Valve clearances*	■				■		Adjust the valve clearances; (see <i>ENGINE ADJUSTMENTS</i> ).
Cylinder compression*					■		Check the compression pressure (see <i>ENGINE ADJUSTMENTS</i> ).
Cylinder head nuts	■				■		Retorque the nuts (see <i>TIGHTENING THE CYLINDER HEAD</i> under <i>ENGINE ADJUSTMENTS</i> ).
Visual inspection		■					Check for oil, fuel and water leaks.
Hardware fastenings and electrical connections	■			■			Inspect and tighten all fastenings and accessible screws, bolts and nuts. Inspect all wiring and electrical connections.
Generator connections			■				Check that AC connections are clean and secure with no chafing. See <i>GENERATOR INFORMATION</i> for additional information.
Generator no-load speed				■			Check the no-load speed.
Cleaning the generator			■				Keep the generator's surface clean. Surface dirt and oil will inhibit the generator's ability to remain cool.

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

# EXHAUST SYSTEM

## EXHAUST SYSTEM PRECAUTIONS

### Carbon Monoxide

The best protection against carbon monoxide poisoning is a daily inspection of the complete exhaust system. Check for leaks around manifolds, gaskets, and welds. Make sure exhaust lines are not heating surrounding areas excessively. If excessive heat is present, correct the situation immediately. If you notice a change in the sound or appearance of the exhaust system, shut down the unit immediately and have the system inspected and repaired at once by a qualified mechanic.

#### **▲ 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
- Vomiting
- Throbbing in Temples
- Muscular Twitching
- Weakness and Sleepiness
- Inability to Think Coherently

**IF YOU OR ANYONE ELSE EXPERIENCE ANY OF THESE SYMPTOMS, GET OUT INTO 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 carbon monoxide warning decal has been provided by Westerbeke. Display this decal near your engine or generator, on your cabin bulkhead, or in some other prominent location.



**NOTE:** It is extremely important that a carbon monoxide detector(s) be installed in your boat's living and/or sleeping quarters. Make sure it is manufactured for the marine industry. They are inexpensive and easily available at your marine supplier.

### Insulation

Inspect insulated portions of the exhaust system to ensure there is no deterioration of the insulation.

### Overcranking

**▲ CAUTION:** Prolonged cranking intervals without the engine starting can result in the engine exhaust system filling with raw water. This may happen because the pump is pumping raw water through the raw water cooling system during cranking. This raw water can enter the engine's cylinder once the exhaust system fills. Prevent this from happening by closing the raw water supply through-hull shutoff, draining the exhaust muffler, and correcting the cause of the excessive engine cranking. Remember that engine damage resulting from raw water entry is not covered by Westerbeke's warranty.

# COOLING SYSTEM

## RAW WATER COOLING SYSTEM

The engine/generator is designed for direct raw water cooling. The engine's oil cooler allows the engine to operate with a raw water coolant temperature up to 90° F (32° C).

The raw water flow is created by a positive displacement impeller pump that is gear-driven by the camshaft. This pump draws cooling water directly from the raw water source (ocean, lake or river) through a hose.

The raw water is pumped to the oil cooler in the sump. The water flows from the oil cooler to a stainless steel water jacket that encloses the generator, cooling the generator. From the generator, the water enters a tee which splits the flow. The tee directs some of the flow to the engine and the remainder to a bypass. The flow to the engine circulates around the cylinder and through the cylinder head, then discharges into the water-injected exhaust elbow where it mixes with and cools the exhaust gasses. This mixture of exhaust gas and raw water is discharged overboard by the engine's exhaust gas discharge pressure. The flow through the bypass goes directly to the exhaust elbow, and is at its greatest when the engine is warming up and the thermostat is not yet open. Flow through the bypass also occurs after the thermostat is open.

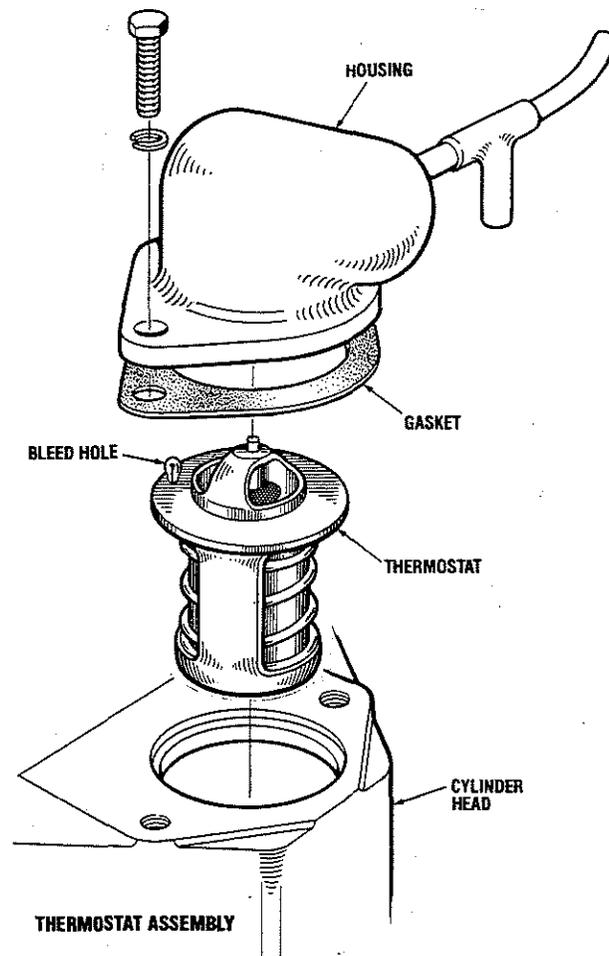
## AIR INTAKE COOLING

The raw water that cools the generator also cools the intake air. The air is drawn in through openings in the generator's back end by the engine's intake stroke. This air cools the rotor as it circulates around the rotor shaft. The air for combustion is cooled as it is drawn through the water-cooled generator. It is then drawn through a hose to the inside of the control box, where it cools the engine/generator's control system. The cool air then passes through a grille in the back of the control box into the combustion chamber. This air intake system is maintenance-free.

## THERMOSTAT

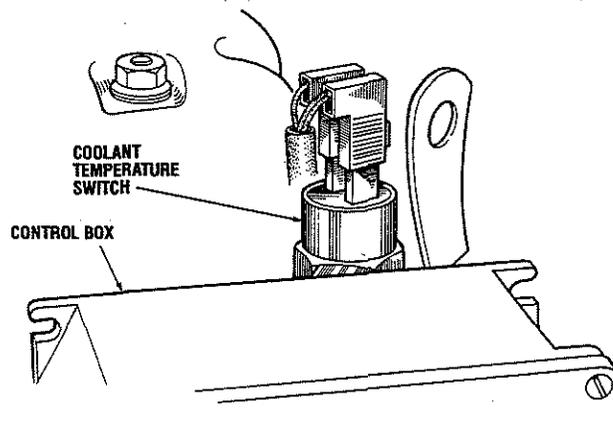
The temperature of the cooling water circuit is controlled by a thermostat. The thermostat is set to the maximum temperature of 140° F (60° C).

To check the condition of the thermostat, unbolt the thermostat housing and remove the thermostat from the cylinder head (see illustration). Then immerse the thermostat in warm water that is approximately 140° F (60° C). The thermostat's cone must then be fully open – this indicates the thermostat is in good condition.



## COOLANT TEMPERATURE SWITCH

The coolant temperature switch is located near the thermostat housing (see illustration). If the coolant's operating temperature reaches approximately 210° F (99° C) this switch will light up the red (LED) engine overheat indicator on the control panel and shut down the generator.



# COOLING SYSTEM

## RAW WATER PUMP

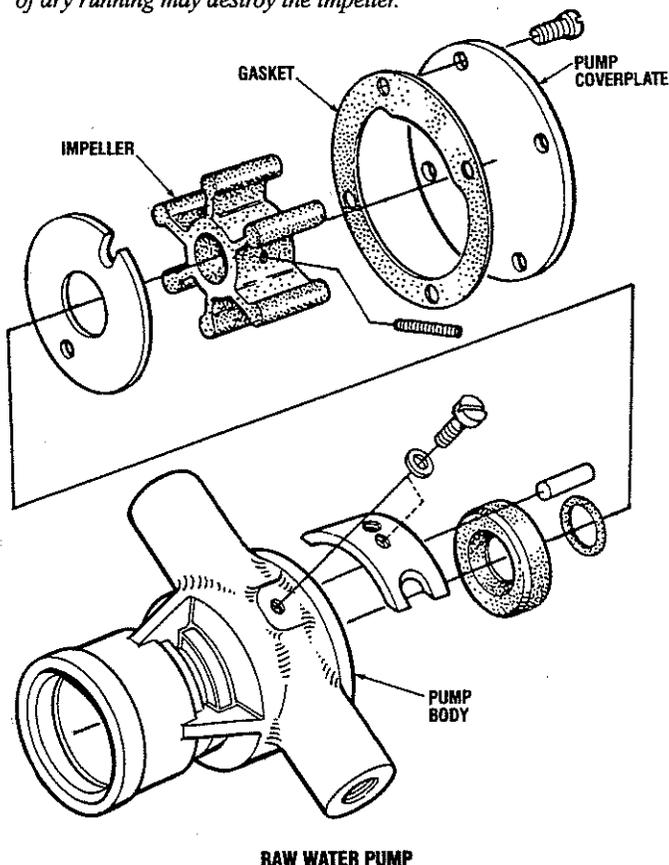
The raw water pump is a self-priming, rotary pump with a non-ferrous housing and a neoprene impeller. The impeller has flexible vanes which wipe against a curved cam plate within the impeller housing, producing the pumping action. On no account should this pump be run dry as water acts as a lubricant for the impeller. There should always be a spare impeller and impeller cover gasket (an impeller kit) onboard. 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 neoprene impeller has a limited lifetime and must be inspected regularly.

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

## Inspecting/Changing the Raw Water Pump Impeller

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

**NOTE:** *Never allow the pump to run dry. Even a short period of dry running may destroy the impeller.*



## RAW WATER INTAKE STRAINER

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

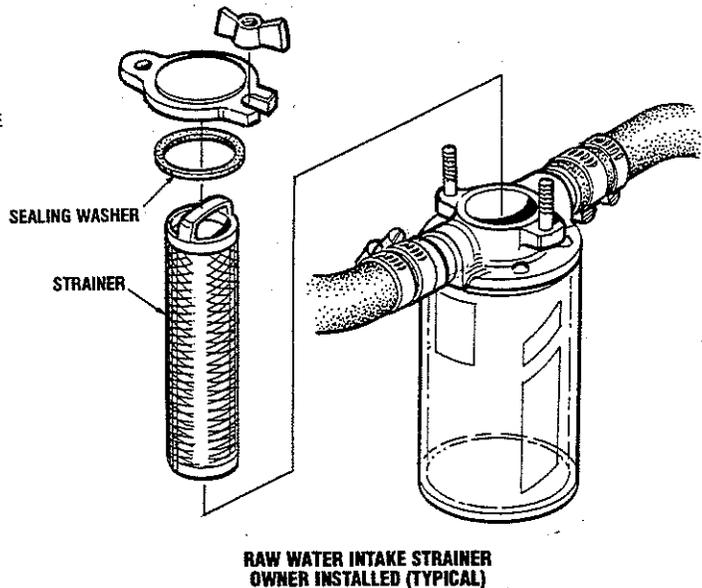
A clean raw water intake strainer is a vital component of the engine's cooling system. Include a visual inspection of this strainer when making your periodic engine check. The water in the glass should be clear.

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 sealing 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 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.



## DRAINING THE COOLING SYSTEM

When freezing temperatures are expected, the cooling system can be drained by unscrewing the pump cover. The raw water coolant will then flush back down the inlet line.

# LUBRICATION SYSTEM

## ENGINE OIL

Use a heavy duty engine oil with an API classification of CF or CG-4 or better. The SAE grade depends on the ambient temperature. For the recommended oil viscosity, see the following chart:

Operating Temperature	Oil Viscosity
Above 68°F (20°C)	SAE 30, 10W-30 or 15W-40
41° – 68°F (5° – 20°C)	SAE 20, 10W-30 or 15W-40
Below 41°F (5°C)	SAE 10W-30 or 15W-40

**CAUTION:** Do not allow two or more brands of engine oil to mix. Each brand contains its own additives; additives of different brands could react in the mixture to produce properties harmful to your engine.

## OIL PRESSURE

There is a low-oil pressure automatic emergency shutdown indicator on the control panel (red LED).

## OIL PUMP

There is gear-driven oil pump built into the oil sump.

## OIL COOLER

The engine oil is cooled by a plate-type oil cooler that is located in the oil sump. The oil cooler is connected to the engine's raw water cooling system and does not require maintenance.

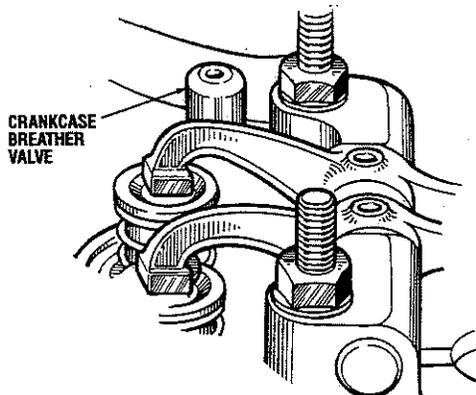
## OIL STRAINER

There is an oil strainer in the crankcase. See *Crankcase/Oil Strainer* in the *MAINTENANCE SCHEDULE* for maintenance information.

**NOTE:** This model generator does not have an oil filter.

## CRANKCASE BREATHER VALVE

The crankcase breather valve is integrated into the cylinder head's inlet channel and is maintenance-free.

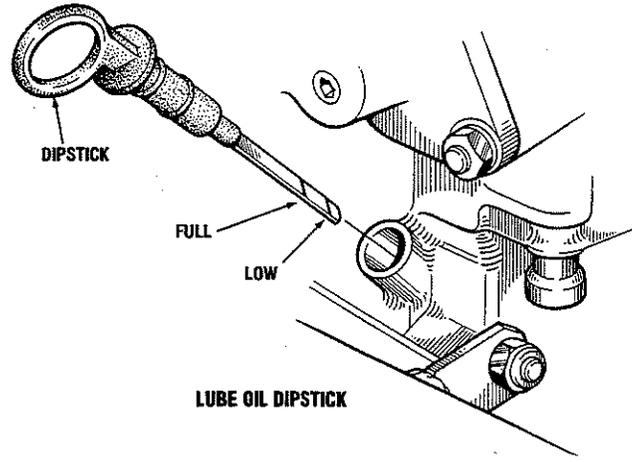


## CHECKING THE OIL

Check the lube oil level (see illustration) daily, prior to starting. With continuous operation, check the oil level every 8 – 10 hours.

Check the lube oil level a few minutes after stopping the engine because lube oil from the bearings etc. continues to drain down into the oil sump. Disregarding this fact and not maintaining the proper oil level may lead to overfilling, overheating and engine runaway.

If a top-up is necessary, clean the area around the oil filler to prevent dirt from entering the engine.



## CHANGING THE OIL

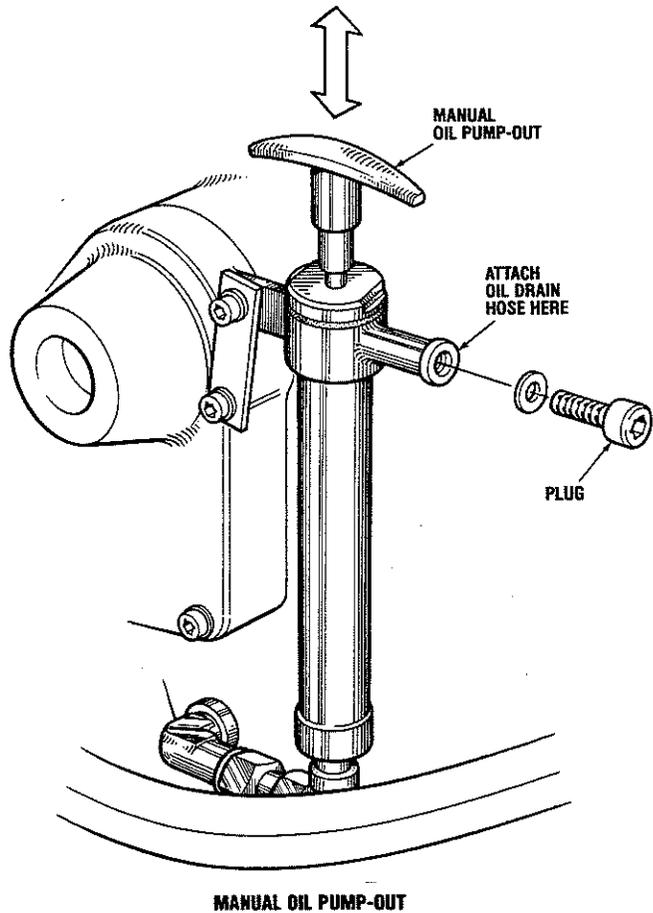
Change the oil after an initial 50 hours of break-in operation and every 100 hours of operation thereafter. Change the oil only when the engine is warm.

### Draining the Used Oil

Use the manual oil pump-out to empty the used oil (see illustration). This pump is connected to the bottom of the sump by a flexible metallic hose. Remove the plug on the pump and pump out the oil into a suitable container; use a piece of hose if necessary. Completely drain the used oil.

**NOTE:** Do not replace the plug on the manual oil pump-out until after the new oil has been added and its level has been checked. This will allow the operator to pump out any excess oil in case of an overfill.

# LUBRICATION SYSTEM



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

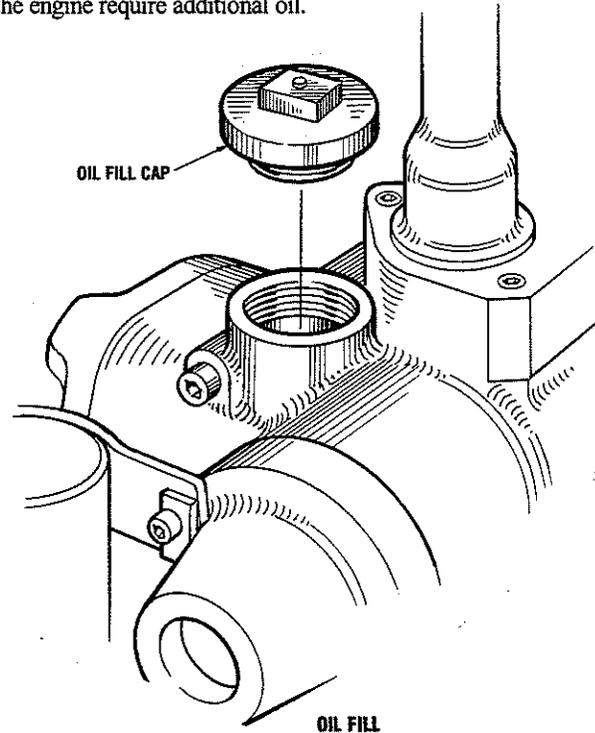
**CAUTION:** *Used engine oil contains harmful contaminants. Avoid prolonged skin contact. Clean skin and nails thoroughly using soap and water. Launder or discard clothing or rags containing used oil. Discard used oil properly.*

## Adding New Oil

Add new oil through the oil filler (see illustration). To remove the filler cap, use a 13mm open-end spanner. When tightening, do not use too much force, otherwise the plastic plug may break.

After adding the new oil, replace the plug on the manual oil pump. The lubrication system must be closed after an oil change, otherwise crankcase pressure may eject some oil.

After refilling with new oil, run the engine for a few moments. Make sure there is no leakage around the manual oil pump, then stop the engine. Then check the quantity of oil with the lube oil dipstick. Fill to, but not over the full mark on the dipstick, should the engine require additional oil.



# FUEL SYSTEM

## DIESEL FUEL

Use No. 2 diesel fuel with a cetane rating of 45 or higher. Do not use kerosene or home heating fuel.

## FUEL ADDITIVES

If fungus or bacteria is causing fuel problems, you should have an authorized dealer correct these problems. Then use a diesel fuel biocide to sterilize the fuel (follow the manufacturer's instructions).

## CARE OF THE FUEL SUPPLY

Use only clean diesel fuel! Purchase a well-known brand of fuel. The clearance of the components in your fuel injection pump is very critical; invisible dirt particles which might pass through the filter can damage these finely finished parts. It is important to buy clean fuel and keep it clean. The best fuel can become unsatisfactory by careless handling or improper storage facilities. To assure that the fuel going to your engine is clean and pure, be sure to filter it properly. Use a good fuel filter/water separator having a filter element with a micron rating of #2 or #10.

## FUEL LIFT PUMP

Periodically check the fuel connections to and out of the pump and make sure that no leakage is present and that the fittings are tight and secure.

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

## FUEL FILTER

The frequency of a fuel filter change depends on the degree of contamination of the fuel, however it should be performed at least after every 100 hours of generator operation. A clogged filter results in reduced generator output.

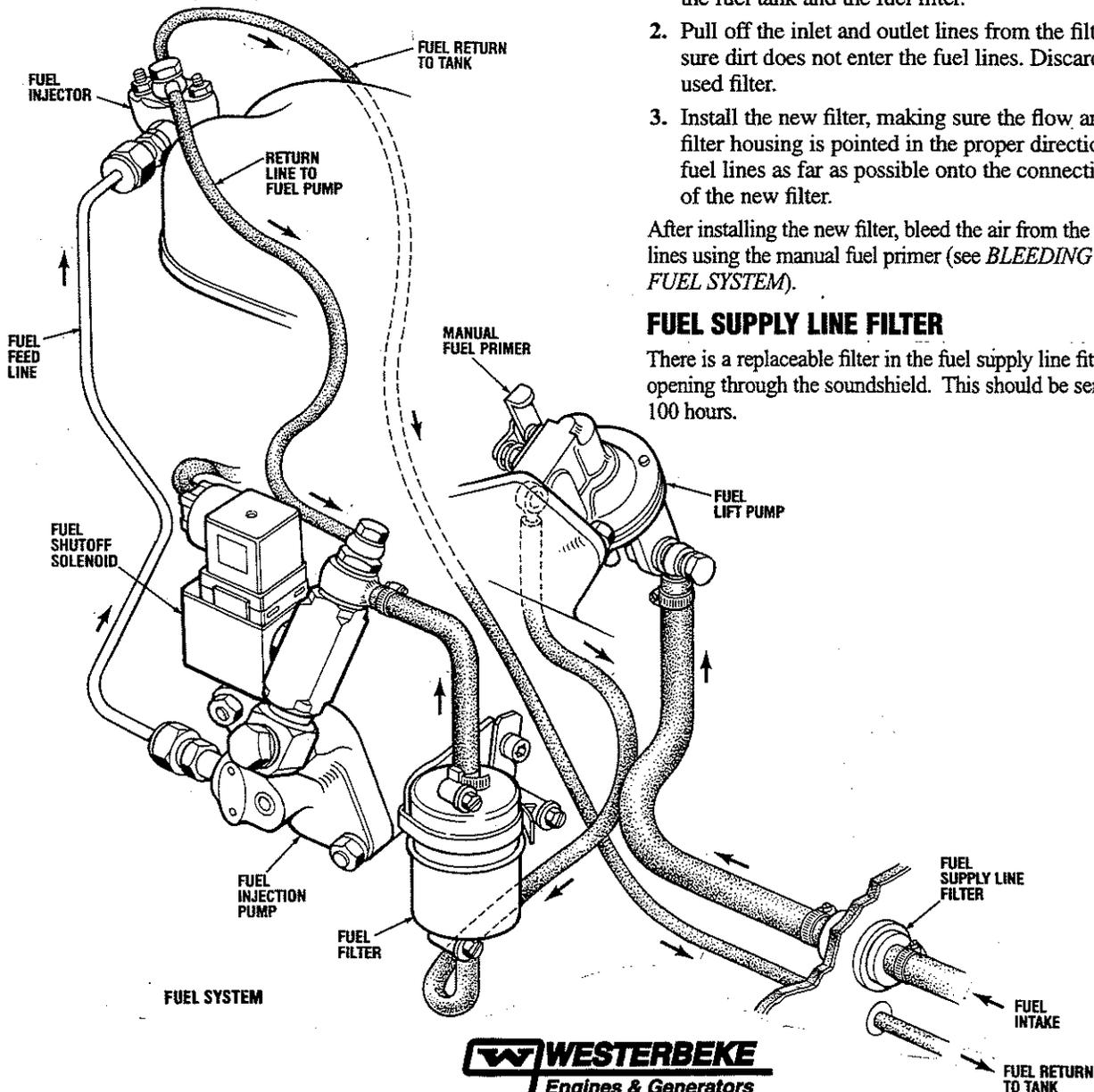
### Replacing the fuel filter

1. Clean the fuel line with a rag and clamp it off between the fuel tank and the fuel filter.
2. Pull off the inlet and outlet lines from the filter. Make sure dirt does not enter the fuel lines. Discard the used filter.
3. Install the new filter, making sure the flow arrow on the filter housing is pointed in the proper direction. Push the fuel lines as far as possible onto the connection nipples of the new filter.

After installing the new filter, bleed the air from the fuel lines using the manual fuel primer (see *BLEEDING THE FUEL SYSTEM*).

## FUEL SUPPLY LINE FILTER

There is a replaceable filter in the fuel supply line fitting at the opening through the soundshield. This should be serviced every 100 hours.



# FUEL SYSTEM

## FUEL SUPPLY LINE

Refer to *FUEL LINES* in the *INSTALLATION* section of this manual for information about the fuel supply.

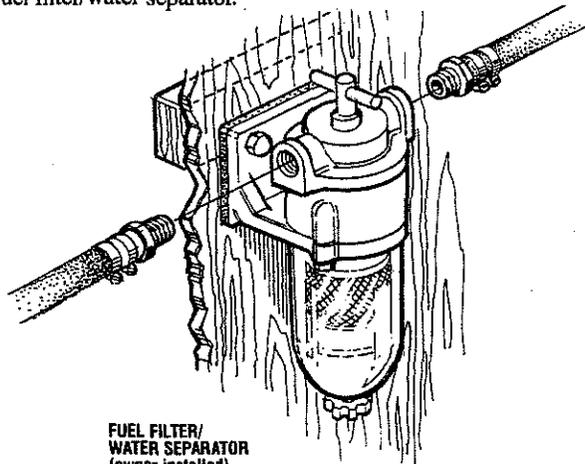
**⚠ WARNING:** Shut off the fuel valve at the tank when servicing the fuel system. Take care in catching any fuel that may spill. DO NOT allow any smoking, open flames or other sources of fire near the fuel system when servicing. Ensure proper ventilation exists when servicing the fuel system.

## FUEL FILTER/WATER SEPARATOR

Westerbeke recommends that you install and regularly service a good quality Coast Guard approved visual-type primary fuel filter of the water-separating type. This fuel filter/water separator must be installed between the fuel tank and the engine to prevent any contaminants or water that may be in the fuel from reaching the fuel lift pump and causing damage to the fuel system components. It may also prolong the life of the fuel filter that comes installed on the fuel line. It is the responsibility of the owner-operator to install this fuel filter/water separator. It must be located outside the soundshield. Select a filter that has a #2 or #10 micron rating.

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

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



FUEL FILTER/  
WATER SEPARATOR  
(owner installed)

## FUEL INJECTION PUMP

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

## FUEL SHUTOFF SOLENOID

The fuel shutoff solenoid is deactivated when the STOP button on the control panel is pushed. This will stop the fuel flow and shut down the engine; the fuel solenoid indicator on the control panel will go out. This shutoff solenoid is factory-set and will not require adjustment.

## BLEEDING THE FUEL SYSTEM

The fuel injection pump is self-bleeding; any air in the fuel lines will bleed out through the fuel return line. Bleeding can also be done by using the manual fuel primer on the fuel lift pump (see illustration). In case the generator is shut down due to lack of fuel, use the manual fuel primer to bleed the system after refilling the fuel tank; it will not be necessary to disconnect the fuel lines to bleed the air. Also use the manual fuel primer to bleed the system after changing the fuel filters.

Bleeding the fuel system will also be necessary before the generator is layed-up during the off-season or for prolonged periods of inactivity. See *LAY-UP AND RECOMMISSIONING*.

To use the manual fuel primer, work the lever back and forth with slow complete strokes. If pressure isn't felt, rotate the engine 1/2 turn; this will reposition the fuel pump to improve the pumping action.

## SPARE PARTS

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

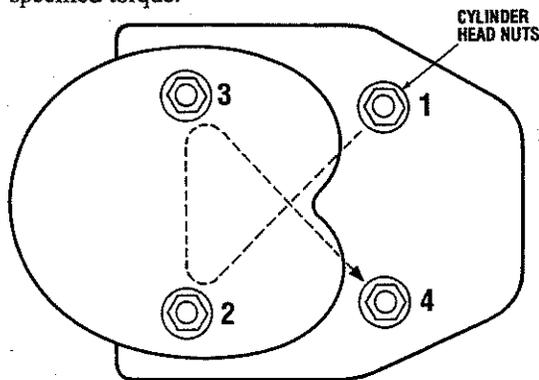
# ENGINE ADJUSTMENTS

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

## TIGHTENING THE CYLINDER HEAD

After the initial break-in period (approximately 50 hours), the cylinder head nuts should be retorqued. Do this when the engine is cold.

1. Remove the cylinder head cover and gasket.
2. Retighten the four cylinder head nuts in an X-pattern sequence as shown in the illustration. Start with any nut. Before applying the torque to a nut, loosen it 1/4 to 1/2 a turn, then apply the torque. See **TORQUE SPECIFICATIONS** for the proper torque.
3. Reinstall the cylinder head cover and gasket. Insert new plastic washers under the two nuts and tighten to the specified torque.



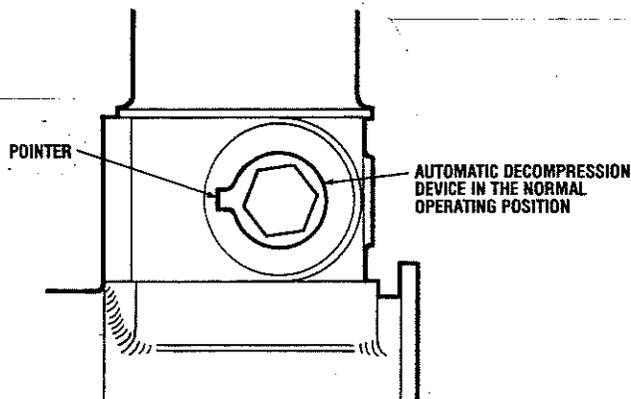
## VALVE CLEARANCE ADJUSTMENT

Check the valve clearances after the first 50 hours of operation and every 600 hours thereafter.

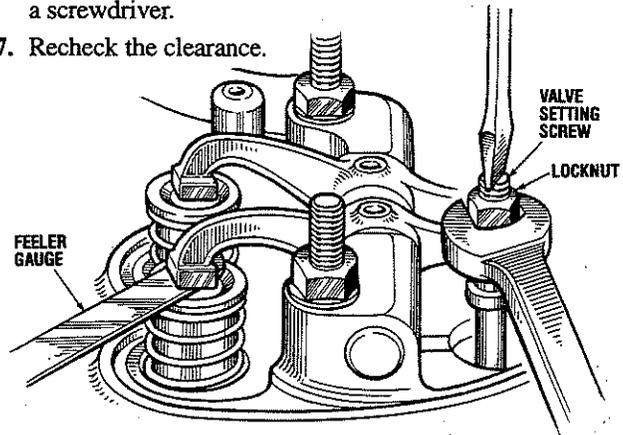
**NOTE:** Tighten the cylinder head bolts to their specified torque before adjusting the valve clearances (see **TIGHTENING THE CYLINDER HEAD**).

Adjust the valve clearances when the engine is cold. The clearance is 0.2 mm (0.008 in.) for both intake and exhaust valves.

1. Remove the rocker cover.
2. Check to make sure the automatic decompression device is in its normal operating position, i.e. not activated (see illustration).



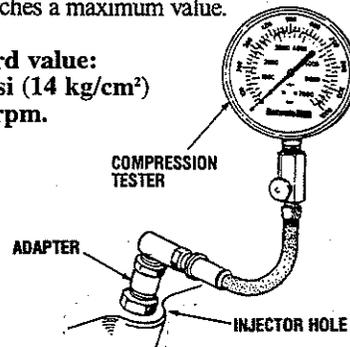
3. Set the piston at the TDC of the compression stroke.
4. Loosen the locknuts on the valve setting screws (see illustration).
5. For each valve, insert a 0.2 mm (0.008 in) feeler gauge between the valve stem and the rocker arm, and adjust the clearance until a slight drag is felt on the gauge when it is pulled out.
6. Tighten the locknut while holding the setting screw with a screwdriver.
7. Recheck the clearance.



## ENGINE COMPRESSION TEST

To check the engine's compression pressure, warm up the engine, shut off the raw water through-hull, remove the fuel injector, disable the fuel shut-off solenoid wire, and install a compression adapter in the injector hole. Connect a compression tester on the adapter and crank the engine with the starter motor until the pressure reaches a maximum value.

**Standard value:**  
198.1 psi (14 kg/cm<sup>2</sup>)  
at 400 rpm.



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

An abnormally high reading indicates heavy carbon accumulation, a condition that might be accompanied by high pressure and noise.

**NOTE:** In case of severe vibrations and detonation noise, have the injector checked and overhauled by an authorized fuel injection service center. Poor fuel quality, contaminants and loss of positive fuel pressure to the injection pump will result in injector faults.

# ENGINE ADJUSTMENTS

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

## TESTING THE FUEL INJECTOR

**NOTE:** The fuel injector must be serviced in a clean room environment.

### Removing the Fuel Injector

1. Disconnect the high pressure fuel line from the injector, then loosen the line at its attachment to the injection pump and move it out of the way of the injector. Avoid bending the line.
2. Remove the fuel return line in its entirety from the top of the injector. Take care not to lose the two sealing washers and banjo bolt that attaches the fuel return line to the injector.
3. Remove the fuel injector holder bracket mounting nuts, then remove the holder bracket.
4. Remove the fuel injector.

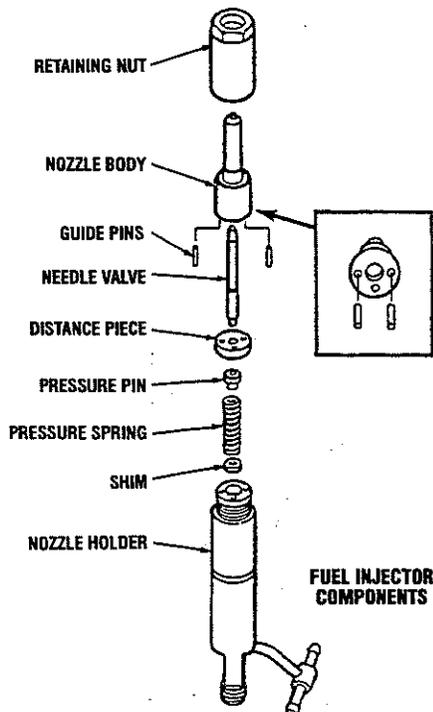
**NOTE:** Clean the area around the base of the injector prior to lifting it out of the cylinder head to help prevent any rust or debris from falling down into the injector hole. If the injector will not lift out easily and is held in by carbon build-up or the like, work the injector side-to-side with the aid of a socket wrench to free it, and then lift it out.

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

5. Remove the gaskets.
6. Remove the O-rings.

### Fuel Injector Components

The fuel injector consists of the following parts:



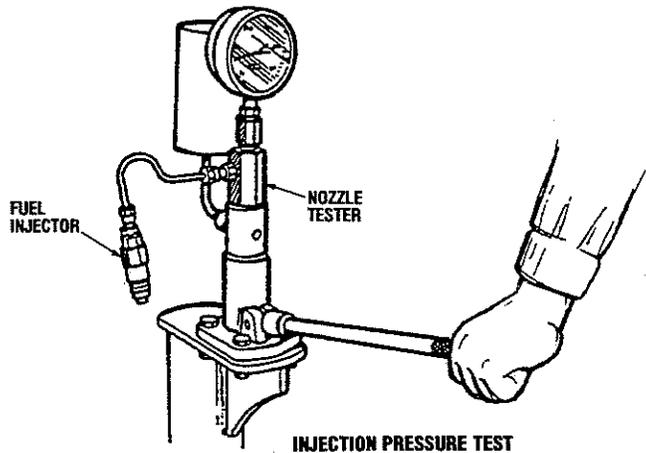
### Checking The Injection Starting Pressure

1. Set the nozzle tester in a clean place where there is no dust or dirt.
2. Mount the nozzle and the nozzle holder on the nozzle tester.
3. Use new fuel that has an approximate temperature of 68°F (20°C).
4. Bleed the air in the nozzle line by pumping the nozzle tester handle several times.
5. Slowly lower the nozzle tester handle and check the reading on the pressure gauge when the injection starts.

Injection starting pressure:

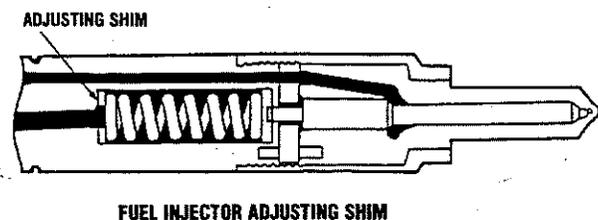
2417 – 2489 lb/in<sup>2</sup> (170 – 175 kg/cm<sup>2</sup>)

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



6. If the injection starting pressure is not within the specified range, adjust it by replacing the shim with one of a more appropriate thickness.

The shims have 21 different thicknesses at intervals of 0.002 in (0.05 mm), from 0.0197 in (0.50 mm) to 0.059 in (1.50 mm). If the thickness of a shim is increased 0.002 in (0.05 mm), the injection pressure increases approximately 71.1 lb/in<sup>2</sup> (5.0 kg/cm<sup>2</sup>).

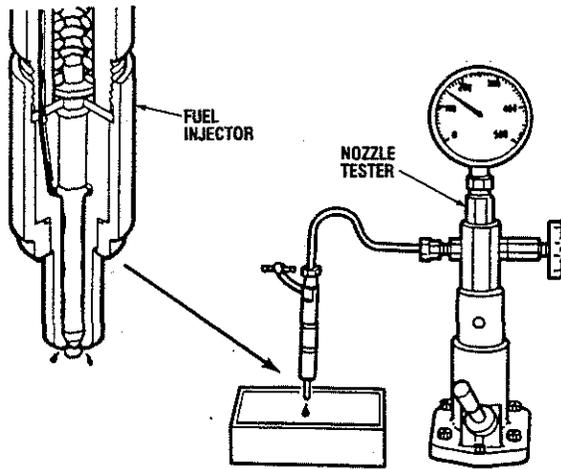


# ENGINE ADJUSTMENTS

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

## Tightness of the Valve Seat

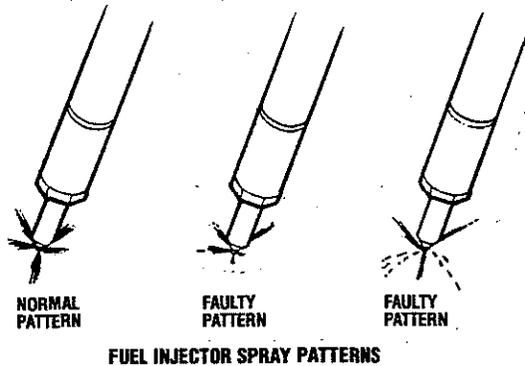
Apply a pressure of 2133 lb/in<sup>2</sup> (150 kg/cm<sup>2</sup>) and check if fuel leaks from the injection nozzle holes. If fuel leaks, disassemble, wash and recheck the injector nozzle or replace it.



CHECKING THE TIGHTNESS OF THE VALVE SEAT

## Inspecting the Spray Pattern.

1. Mount the nozzle and nozzle holder on the nozzle tester.
2. Bleed the air in the nozzle line by pumping the nozzle tester handle several times.
3. Keep the reading on the pressure gauge of the nozzle tester just below the injection starting pressure while pumping the handle of the nozzle tester as quickly as possible so that a pulsating whistling sound is heard. Check the atomization of the fuel injected from the nozzle (see illustration).



**Normal Pattern:** The fuel is sprayed uniformly and finely from all five injection nozzle holes.

**Faulty Pattern:** The number of fuel sprays and fineness of the injected fuel is substandard. If the condition of the injected fuel is substandard, disassemble, wash and recheck the injection nozzle or replace it.

## Checking the Nozzle Body and Needle Valve

1. Check for damage to the valve seat of the needle valve and check for damage to other parts.
2. Check for damage to the nozzle body. Hold the nozzle body upright and insert four-fifths of the needle valve. Then release the needle valve and check that it drops into the valve seat under its own weight.

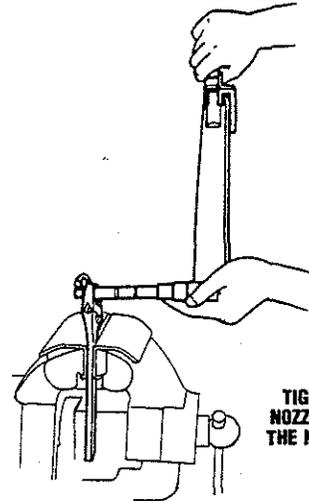
## Reassembly

Be sure to do the following when reassembling the fuel injector:

1. Tighten the nozzle body onto the nozzle holder to the specified torque.

Nozzle torque:

29 – 36 ft-lb (4.0 – 5.0 kg-m)



2. After assembling the fuel injector, check the injection starting pressure and the spray pattern.

## Injector Installation

The fuel injector installation sequence is the reverse of the removal sequence. Make sure to include the following:

1. Use new gaskets – do not reuse the old gaskets.
2. Replace the copper sealing washer for each injector.
3. Tighten the fuel injector holder bracket mounting nuts to the specified torque.

Bracket mounting nuts torque:

34.0 – 40.0 ft-lb (4.7 – 5.5 kg-m)

# ENGINE TROUBLESHOOTING

The following troubleshooting chart provides information based upon certain problem indicators, the probable causes of these problems, and the recommendations to overcome them.

## 1. Engine will not start

Problem	Probable Cause	Remedy
Fuel supply failure (check by cranking engine and listening for the characteristic squirting in the fuel injector).	<p><b>If squirting cannot be heard:</b></p> <ol style="list-style-type: none"> <li>1. No fuel in tank.</li> <li>2. Vent hole in tank cap plugged.</li> <li>3. Fuel filter clogged.</li> <li>4. Vapor lock (fuel too hot).</li> <li>5. Fuel too thick (No. 2 in winter).</li> <li>6. Faulty injector nozzle.</li> <li>7. Faulty injection pump.</li> <li>8. Fuel line blocked.</li> <li>9. Broken fuel line or leaking connection.</li> </ol> <p><b>If squirting can be heard:</b></p> <ol style="list-style-type: none"> <li>1. Starting fuel button not pulled.</li> <li>2. Gasoline instead of diesel in tank.</li> <li>3. Air intake blocked.</li> </ol>	<ol style="list-style-type: none"> <li>1. Fill tank.</li> <li>2. Replace cap.</li> <li>3. Replace filter.</li> <li>4. Cool the fuel.</li> <li>5. Drain and flush system, fill with proper fuel.</li> <li>6. Check/replace nozzle.</li> <li>7. Check/repair/replace pump.</li> <li>8. Check fuel lines and remove blockage.</li> <li>9. Replace fuel line/tighten connections.</li> </ol> <ol style="list-style-type: none"> <li>1. Pull button.</li> <li>2. Drain gasoline, flush system, fill with diesel.</li> <li>3. Check system for blockage.</li> </ol>
Poor compression	<ol style="list-style-type: none"> <li>1. Automatic decompression device malfunction.</li> <li>2. Incorrect valve clearance.</li> <li>3. Valves not seating properly.</li> <li>4. Cylinder head loose.</li> <li>5. Piston rings stuck in grooves.</li> <li>6. Worn cylinder and piston.</li> <li>7. Rusty exhaust valve.</li> <li>8. Valves sticking.</li> </ol>	<ol style="list-style-type: none"> <li>1. Check/replace automatic decompression device.</li> <li>2. Adjust valve clearance.</li> <li>3. Check/repair/replace valves.</li> <li>4. Tighten cylinder head nuts.</li> <li>5. Check rings and clean the piston.</li> <li>6. Overhaul the engine.</li> <li>7. Spray lubricating oil into the cylinder, activate the automatic decompression device, then start.</li> <li>8. Free valves.</li> </ol>
Difficult to crank the engine	<ol style="list-style-type: none"> <li>1. Starting load too high.</li> <li>2. Lube oil too thick.</li> <li>3. Bearings seized.</li> <li>4. Piston seized.</li> </ol>	<ol style="list-style-type: none"> <li>1. Reduce load.</li> <li>2. Change to correct viscosity.</li> <li>3. Overhaul the engine.</li> <li>4. Overhaul the engine.</li> </ol>

## 2. Engine starts but fires intermittently or soon stops

Faulty fuel supply	<ol style="list-style-type: none"> <li>1. Fuel filter clogged.</li> <li>2. Water in fuel.</li> <li>3. Faulty injector nozzle.</li> <li>4. Faulty injection pump.</li> <li>5. Fuel line clogged.</li> <li>6. Fuel lines or connections leak.</li> </ol>	<ol style="list-style-type: none"> <li>1. Replace filter.</li> <li>2. Drain fuel; fill with clean fuel.</li> <li>3. Check/replace nozzle.</li> <li>4. Check/repair/replace pump.</li> <li>5. Check the fuel lines and remove the blockage.</li> <li>6. Replace fuel line/tighten connections.</li> </ol>
Faulty air intake and/or exhaust system.	<ol style="list-style-type: none"> <li>1. Restricted/blocked exhaust system.</li> <li>2. Restricted/blocked air intake.</li> </ol>	<ol style="list-style-type: none"> <li>1. Check/clean exhaust system.</li> <li>2. Check/clean air intake system.</li> </ol>
Poor compression	See <i>Poor compression</i> under <i>Engine will not start</i>	

# ENGINE TROUBLESHOOTING

## 3. Engine lacks power and/or makes black smoke

Problem	Probable Cause	Remedy
Operating conditions	<ol style="list-style-type: none"> <li>1. Engine overloaded.</li> <li>2. Power reduction due to altitude and/or ambient temperature has not been considered.</li> </ol>	<ol style="list-style-type: none"> <li>1. Reduce the load.</li> </ol>
Faulty fuel supply	<ol style="list-style-type: none"> <li>1. Gasket under injector missing or too many gaskets are installed.</li> <li>2. Fuel filter clogged.</li> <li>3. Faulty injection nozzle.</li> <li>4. Faulty injection pump.</li> </ol>	<ol style="list-style-type: none"> <li>1. Correct the number of gaskets.</li> <li>2. Replace filter.</li> <li>3. Check/replace nozzle.</li> <li>4. Check/repair/replace pump</li> </ol>
Engine condition	<ol style="list-style-type: none"> <li>1. Excessive carbon on piston and cylinder head.</li> <li>2. Faulty piston rings.</li> <li>3. Worn out piston and cylinder.</li> <li>4. Worn out bearings.</li> </ol>	<ol style="list-style-type: none"> <li>1. Decarbonize.</li> <li>2. Check/replace piston ring set.</li> <li>3. Overhaul engine.</li> <li>4. Overhaul engine.</li> </ol>

## 4. Faulty running

Engine overheats	<ol style="list-style-type: none"> <li>1. Engine overloaded.</li> <li>2. Faulty raw water pump impeller.</li> <li>3. Faulty thermostat.</li> <li>4. Clogged raw water intake strainer.</li> <li>5. Lube oil level too high.</li> <li>6. Faulty injector nozzle.</li> </ol>	<ol style="list-style-type: none"> <li>1. Reduce load.</li> <li>2. Replace impeller.</li> <li>3. Check/replace thermostat.</li> <li>4. Clean the strainer.</li> <li>5. Drain to proper level.</li> <li>6. Check/replace nozzle.</li> </ol>
Knocking	<ol style="list-style-type: none"> <li>1. Injector needle sticking.</li> <li>2. Fuel timing too far advanced.</li> <li>3. Broken piston ring.</li> <li>4. Worn piston.</li> <li>5. Worn bearings.</li> <li>6. Loose flywheel.</li> </ol>	<ol style="list-style-type: none"> <li>1. Replace nozzle.</li> <li>2. Adjust timing.</li> <li>3. Replace piston ring set.</li> <li>4. Replace piston and liner.</li> <li>4. Replace bearings.</li> <li>6. Tighten flywheel nut.</li> </ol>
Engine is hunting	<ol style="list-style-type: none"> <li>1. Engine is overheating.</li> <li>2. Air in fuel lines.</li> <li>3. Governor sticking or defective.</li> <li>4. Fuel filter clogged.</li> </ol>	<ol style="list-style-type: none"> <li>1. See <i>Engine Overheats</i>, above.</li> <li>2. Check fuel system for leaking connections.</li> <li>3. Free the governor or replace.</li> <li>4. Replace filter.</li> </ol>
Engine stops suddenly	<ol style="list-style-type: none"> <li>1. Fuel tank is empty.</li> <li>2. Vent hole in fuel tank cap is plugged.</li> <li>3. Vapor lock (fuel is too hot).</li> <li>4. Clogged injector.</li> <li>5. Fuel line is broken.</li> <li>6. Seized piston.</li> <li>7. Seized crankshaft.</li> </ol>	<ol style="list-style-type: none"> <li>1. Fill tank.</li> <li>2. Replace tank cap.</li> <li>3. Cool the fuel.</li> <li>4. Replace nozzle.</li> <li>5. Replace.</li> <li>6. Replace piston and liner.</li> <li>7. Repair/replace crankshaft and bearings.</li> </ol>

(continued)

# ENGINE TROUBLESHOOTING

<b>Problem</b>	<b>Probable Cause</b>	<b>Remedy</b>
Blue smoke	<ol style="list-style-type: none"><li>1. Breather valve is clogged.</li><li>2. Oil seal at intake valve is defective.</li><li>3. Worn valves/valve guides.</li><li>4. Worn piston/cylinder.</li></ol>	<ol style="list-style-type: none"><li>1. Replace breather.</li><li>2. Replace oil seal.</li><li>3. Replace valves and guides.</li><li>4. Replace piston and cylinder.</li></ol>
White smoke	<ol style="list-style-type: none"><li>1. Fuel timing is too late.</li><li>2. Injector nozzle is worn out.</li></ol>	<ol style="list-style-type: none"><li>1. Adjust timing.</li><li>2. Replace nozzle.</li></ol>
Oil in exhaust discharge	<ol style="list-style-type: none"><li>1. Rings not seated.</li><li>2. Low compression – bad valve.</li></ol>	<ol style="list-style-type: none"><li>1. Initial 50 hours of operation required to seat rings.</li><li>2. Check/repair/replace valves.</li></ol>

# DC ELECTRICAL SYSTEM

## CONTROL PANEL

This plug-in remote control panel provides the operator with all the necessary information and controls to use the generator. The panel has START and STOP buttons, an LED proportional load indicator, a coolant/oil pressure warning light, a low battery warning light, a fuel shutoff solenoid light, and an hourmeter.

The load indicator is designed to avoid an excessive current draw from the generator due to too many loads having been applied at the same time. The indicator will begin to show the load after the first half of the required current is supplied, and it will indicate that an acceptable load is being provided up to the point where all the LED's except the last one are lit (5 green LED's are lit). If the last LED (red) becomes lit, it indicates an overload. The load that caused this red LED to light up must be switched off to return the indicator to a normal position.

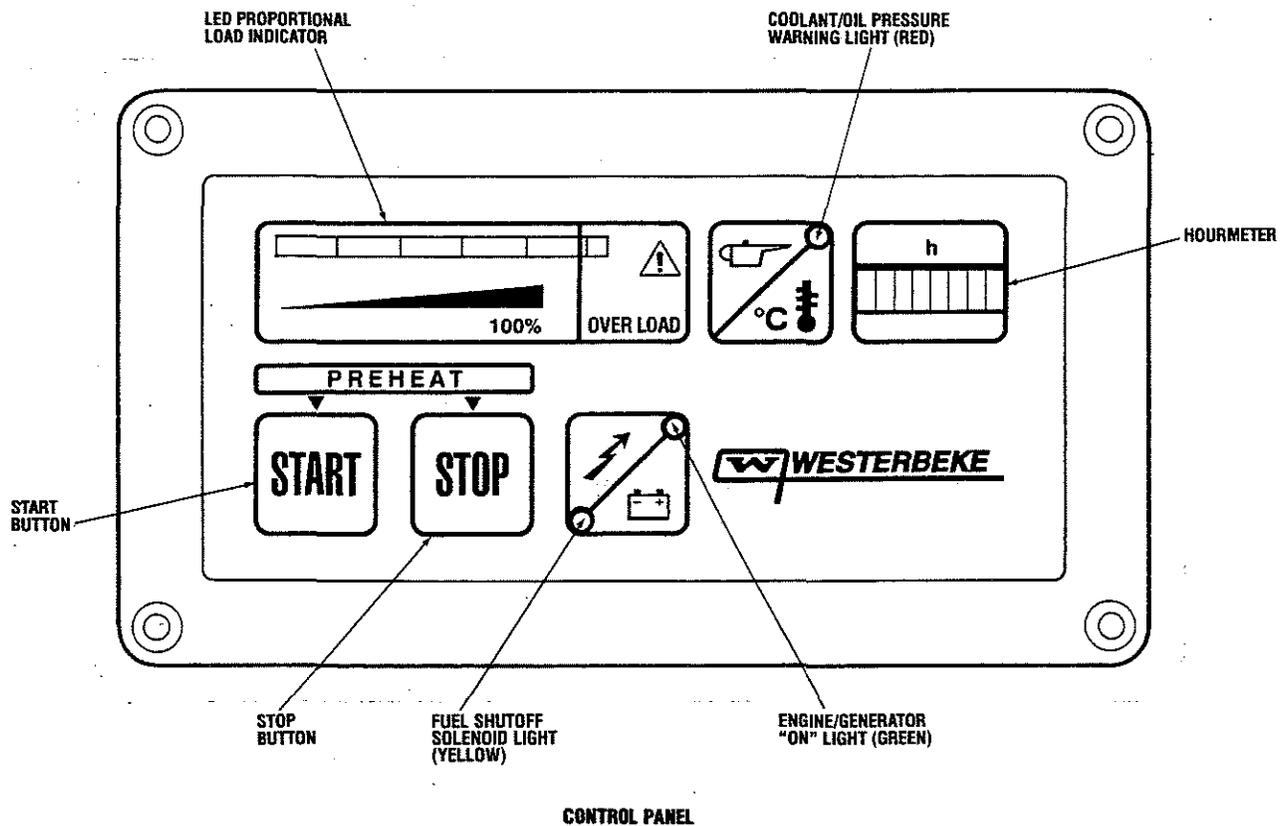
The oil pressure/coolant temperature warning light (red) lights up when either the oil pressure is too low or the engine is overheated. The engine will shut down if it overheats or there is an oil pressure failure.

The fuel shutoff solenoid light (yellow) blinks when the START button is pushed and goes off after the engine starts. If it continues to blink and the engine doesn't start, it means the starting battery is too low.

The engine/generator "ON" light (green) will be lit during normal operation.

**NOTE:** If the engine is not running and the shutoff solenoid is energized (yellow LED is blinking), the starting battery is supplying unneeded power to the engine. Reset by pushing the STOP button.

**NOTE:** If the START button is pushed by mistake while the engine is running, an electrical safety device protects the starter motor by preventing its solenoid from energizing.



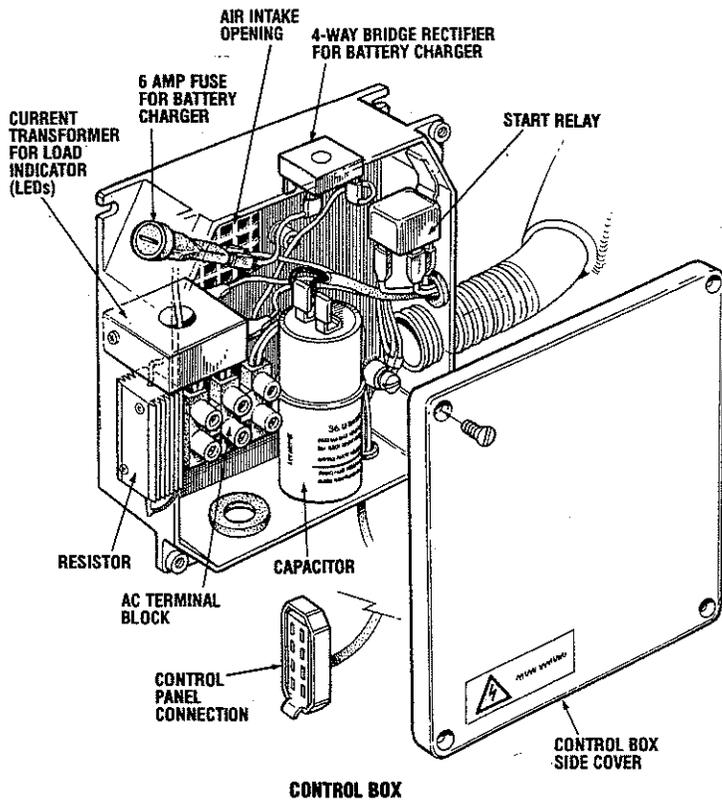
# DC ELECTRICAL SYSTEM

## 12 VOLT DC CONTROL CIRCUIT

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. Electrical control box components are shown in the illustration below.

**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.

**WARNING:** Do not remove the control box cover when the generator is running. Dangerous high voltage is present at this location.



## BATTERY

The minimum recommended capacity of the battery used in the engine's 12 volt DC control circuit is 200 Cold Cranking Amps (CCA).

### Battery Care

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

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

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

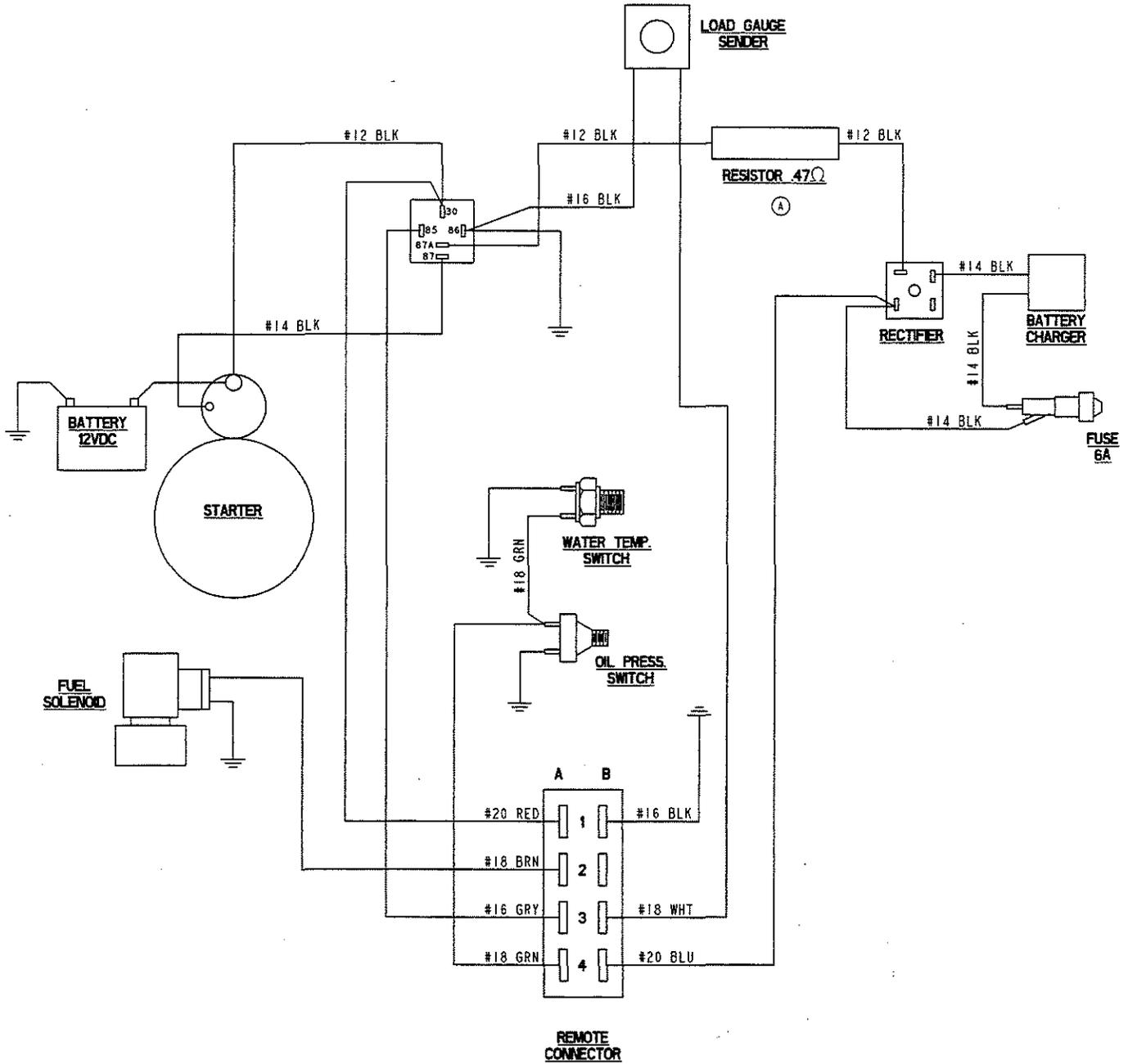
### Checking the Service Battery

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

A 6 amp fuse located in the control box protects the battery charging circuit. No panel lights means a blown fuse.

# DC ELECTRICAL SYSTEM

WIRING DIAGRAM #44163





# 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 ammeter is not installed to monitor voltage and load, check it with a portable meter and amprobe.

**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

Frequency is a direct result of engine/generator speed.

- When the 4.2 KW BCDT generator is run at 3600 rpm, the AC voltage output frequency is 60 Hertz.
- When the 3.5 KW BCDT generator is run at 3000 rpm, the AC voltage output frequency is 50 Hertz.

Field conversions cannot be made with these two generator models.

## 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 reduce life of windings.
- For unusually severe conditions, thin rust-inhibiting petroleum based 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 generator's 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 the bearing at periodic intervals. No side movement of the 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 the generator.

## Carbon Monoxide Detector

WESTERBEKE recommends mounting a carbon monoxide detector in the vessel's 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!

# GENERATOR TROUBLESHOOTING

Problem	Probable Cause	Remedy
Alternator excitation failure	<ol style="list-style-type: none"> <li>1. Low engine speed.</li> <li>2. Faulty capacitor.</li> <li>3. Faulty windings.</li> </ol>	<ol style="list-style-type: none"> <li>1. Check rpm and set at a nominal value of 3700 rpm without a load for 60 Hertz (3100 rpm for 50 Hertz).</li> <li>2. Check and replace.</li> <li>3. Check the windings' resistance as follows: Stator 0.65 ohms Rotor 3.90 ohms Excitation 2.60 ohms</li> </ol>
High no-load voltage (over 135V)	<ol style="list-style-type: none"> <li>1. Engine speed too high.</li> <li>2. Capacitor rating is too high.</li> </ol>	<ol style="list-style-type: none"> <li>1. Check and adjust rpm.</li> <li>2. Check/replace capacitor.</li> </ol>
Low no-load voltage (under 110V)	<ol style="list-style-type: none"> <li>1. Engine speed too low.</li> <li>2. Faulty rotating diodes.</li> <li>3. Break down in windings.</li> <li>4. Capacitor rating is too low.</li> </ol>	<ol style="list-style-type: none"> <li>1. Check and adjust rpm.</li> <li>2. Check/replace.</li> <li>3. Check windings resistance as follows:</li> <li>4. Check and replace from 16 to 25 mF.</li> </ol>
Proper no-load voltage but low voltage under load.	<ol style="list-style-type: none"> <li>1. Low loaded engine speed.</li> <li>2. Overload.</li> <li>3. Rotating diodes short-circuited.</li> </ol>	<ol style="list-style-type: none"> <li>1. Dirty fuel filter; replace.</li> <li>2. Check the load indicator.</li> <li>3. Check/replace.</li> </ol>
Unstable voltage	<ol style="list-style-type: none"> <li>1. Loose contacts.</li> <li>2. Uneven rotation.</li> </ol>	<ol style="list-style-type: none"> <li>1. Check connections.</li> <li>2. Check for uniform rotation speed (dirty fuel filter).</li> </ol>
Noisy generator	<ol style="list-style-type: none"> <li>1. Broken bearings.</li> <li>2. Loose coupling.</li> </ol>	<ol style="list-style-type: none"> <li>1. Replace bearings.</li> <li>2. Check and repair coupling.</li> </ol>

# SHORE POWER TRANSFER SWITCH

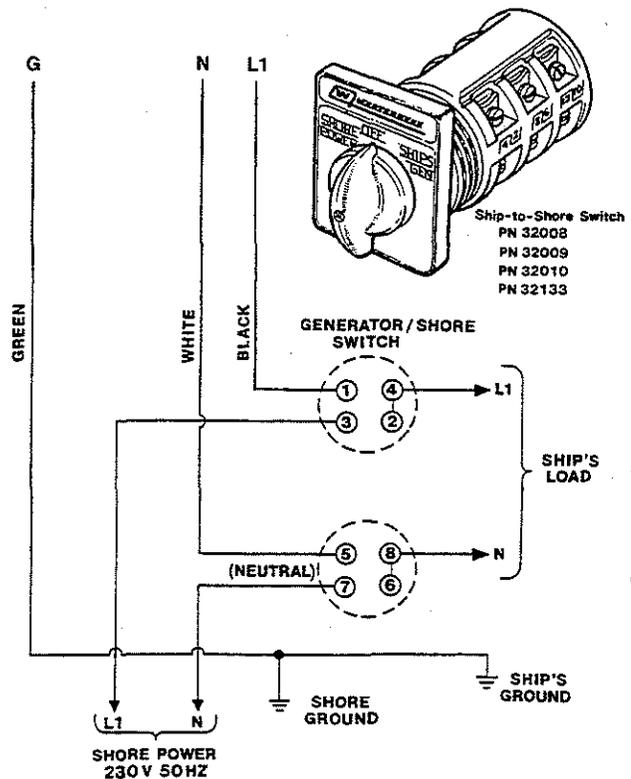
If the installer connects shore power to the vessel's AC circuit, this must be done by means of the Shore Power Transfer Switch. Set the transfer switch shown in the diagrams to the OFF position. This switch prevents simultaneous connection of shore power to generator output.

**⚠ 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.

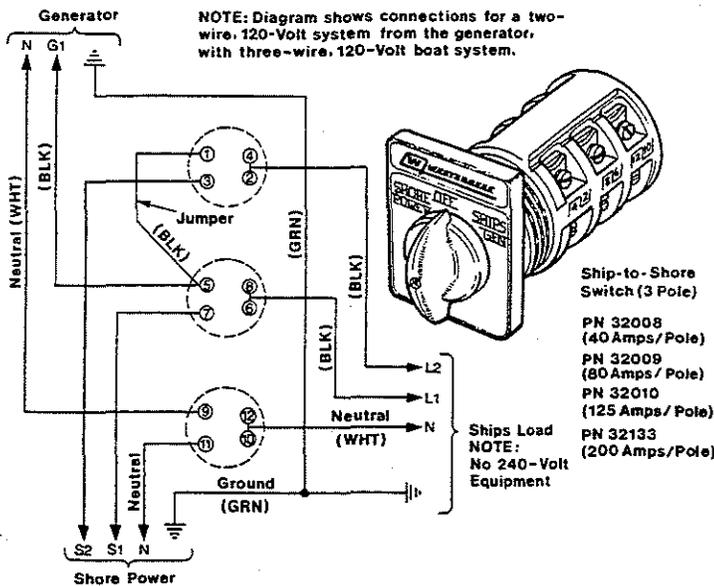
## Switching Shore Power to Generator Power

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

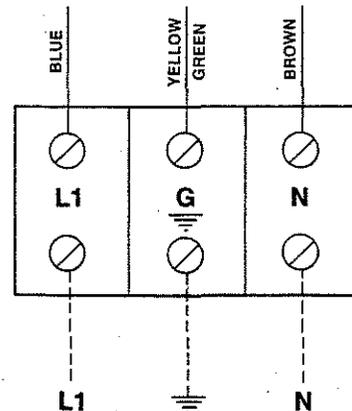
## 230 VOLT/50 HERTZ TWO WIRE CONFIGURATION



## 120 VOLT/60 HERTZ TWO WIRE CONFIGURATION



## 4.2/3.5 AC OUTPUT TERMINAL BLOCK



# LAY-UP AND 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 lay-up and also help familiarize you with the maintenance needs of your engine/generator.

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

## LUBRICATING SYSTEM

With the engine warm, drain all the engine oil from the oil sump. Fill the sump with the correct amount of oil for your engine (refer to the *SPECIFICATIONS* section of this manual). Use an oil with an API specification of CF or CG-4. 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. Engine oil and combustion deposits combine to produce harmful chemicals which can reduce the life of your engine's internal parts.

## FUEL SYSTEM

Top off your fuel tanks with No. 2 diesel fuel. Fuel additives such as *Biobor* and *Sta-Bil* 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 filter element in your primary fuel filter/water separator, if the fuel system has one, and clean the separator sediment bowl. Reinstall and make certain there are no leaks. Clean up any spilled fuel.

Change the fuel filter elements on the engine (see *FUEL SYSTEM*) and bleed the fuel system, as needed. Start the engine and allow it to run for 5–10 minutes to make sure there is no air 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. Operate the engine for 5–10 minutes. This will allow movement of the treated fuel through the injection equipment of the engine.

## Long-Term Lay-Up Procedure (over 12 months)

For a long-term lay-up, follow the fuel system lay-up procedures described above, then do the following:

Disconnect the fuel supply line from the fuel tank at the fuel lift pump. Fill a suitable container with a 0.132 U.S. gallon (0.5 litre) mixture of 9/10 diesel fuel and 1/10 anti-corrosion oil. Connect a short suction pipe between the container and the fuel lift pump. Set the speed control lever to full load, set the automatic decompression device to its neutral position, then hand-crank the engine approximately 20 times. Put the speed control lever back to the idle position.

## RAW WATER COOLING CIRCUIT

Close the through-hull fitting. Remove the raw water intake hose from the fitting. Place the end of this hose into a bucket of clean fresh water. Clean the raw water strainer.

Start the engine and allow the raw water pump to draw 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.

## THROUGH-HULL EXHAUST

Place a clean cloth, lightly soaked in lubricating oil, in the opening of the through-hull exhaust 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.

## CYLINDER AND VALVES

To protect the cylinder and valves, remove the control box side cover. Then spray fogging oil into the cylinder head air intake opening. Rotate the engine two revolutions using the hand crank. Spray fogging oil into the air intake again. Replace the control box side cover.

# LAY-UP AND RECOMMISSIONING

## STARTER MOTOR

Lubrication and cleaning of the starter drive pinion is advisable. 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

If you anticipate a long lay-up period (12 months or more) Westerbeke recommends removing the fuel injector for access to the cylinder, then squirting light lubricating oil into the cylinder to prevent the piston rings from sticking to the cylinder walls. After squirting the oil, move the piston by a quick electric start or the hand crank to distribute the oil. Make sure you have replacements for the injector and return line sealing washers.

## GENERATOR END

Remove the control box cover. Check all wire connections on the AC terminal block and those running to the bridge rectifier, making sure they are secure. Should these connections appear corroded, they should be removed, cleaned and reconnected. Make sure all AC leads are properly cleaned and reconnected. Make sure all AC leads are properly supported and not chafing as they exit the generator housing.

## SPARE PARTS

Lay-up time provides a good opportunity to inspect your Westerbeke generator to see if external items such as the drive belt 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. See *SPARE PARTS*.

## 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 is any doubt the batteries will not remain full charged, or that they will be subjected to severe environmental conditions, remove the batteries and store them in a warmer, more compatible environment.

## STORAGE

Thoroughly clean the outside of the generator, then store the generator in a dry place, protected against the weather.

## RECOMMISSIONING

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

1. Remove the oil-soaked cloth from the through-hull exhaust port.
2. Remove the raw water pump cover and gasket and discard the old gasket.

**NOTE:** *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 effects.*

Install the raw water pump impeller removed during lay-up (or a replacement, if required). Install the raw water pump cover with a new cover gasket.

3. Reinstall the batteries that were removed during the lay-up, and reconnect the battery cables, making sure the terminals are clean and that the connections are tight. Check to make sure that the batteries are fully charged.

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

4. Start the engine in accordance with the procedures described in the *PREPARATIONS FOR INITIAL START-UP* section of this manual.

# 4.2 KW BCDT/3.5 KW BCDT GENERATOR SPECIFICATIONS

## ENGINE SPECIFICATIONS

Engine Type	Diesel, four-cycle, one cylinder, raw water cooled, vertical, in-line overhead valve mechanism
Governor	Mechanical
Combustion System	Direct Injection
Bore and Stroke	3.23" x 2.17" (82.0 mm x 55.0 mm)
Piston Displacement	17.7 cu. in. (290 cm <sup>3</sup> )
Direction of Rotation	Clockwise, when viewed from the front
Compression Ratio	20:1
Maximum Torque	10.22 ft/lbs (1.41 kg-m)
Rated rpm	60Hz - 3600 rpm; 50Hz - 3000 rpm
Dimensions	Height: 21.4" (543.6 mm) Width: 13.6" (345.4 mm) Length: 24.3" (617.2 mm)
Dry Weight with Sound Guard	183.0 lbs (83.0 kg)
Max. Angle of Operation	Not to exceed 25° in all directions

## TUNE-UP SPECIFICATIONS

Compression Pressure	902.1 psi (63.4 kg/cm <sup>2</sup> ) minimum 1141.5 psi (80.2 kg/cm <sup>2</sup> ) standard
Valve Seat Angle	Intake 45°; Exhaust 45°
Valve Clearance	Intake 0.008 in (0.2 mm) Exhaust 0.008 in (0.2 mm)
Engine Timing	39.0 mm BTDC static
Injector Pressure	2900 psi (203.9 kg/cm <sup>2</sup> )

## LUBRICATION SYSTEM

Lubrication System	Forced pump
Lubricant Capacity	0.33 U.S. gal. (1.25 liters)
Sump Capacity	1.06 qts. (1 litre)
Operating Oil Pressure (engine hot)	25.6-56.9 psi (1.8-4.0 kg/cm <sup>2</sup> )
Oil Grade	API specification CF or CG-4 SAE 30, 10W-30, 15W-40

## FUEL SYSTEM

Fuel System	Open flow, self-priming
Fuel	No. 2 diesel oil, cetane rating of 45 or higher
Fuel Lift Pump	4 ft. (1.22 m) lift max
Fuel Injection Pump	Bosch
Fuel Injection Timing	3.9 mm BTDC static
Nozzle	2900 psi (203.9 kg/cm <sup>2</sup> )
Fuel Consumption (full load)	0.46 U.S. gal./hr. (1.76 liter/hr.)
Fuel Filter	Replaceable filter
Fuel Supply and Return Lines	5/16 in (7.9 mm) I.D.
Air Flow (engine combustion)	18.75 cfm (0.53 cmm)

## COOLING SYSTEM

Cooling System	Raw water-cooled block, thermostatically controlled
Operating Temperature	130-150°F (55-66°C)
Raw Water Pump	Positive displacement, rubber impeller, gear-driven, self-priming
Raw Water Flow, at 3600 rpm	7.399-8.456 gpm (7-8 lpm)
Raw Water Connection	1/2 in (12.7 mm) I.D.

## EXHAUST SYSTEM

Emission Control Systems	Meets U.S.C.G. Regulation 33 CFR 183
Exhaust Manifold	Stainless steel with water-cooled jacket
Exhaust Elbow Connection	1-1/2 in (38.1 mm) I.D.

## ELECTRICAL SYSTEM

Electrical System	12 volts DC, negative ground (except when starting)
Battery Charging	4-5 amps
Starting Motor	12 volt solenoid, actuated shift
Cold Cranking Amps	76 amps @ 70°F (21°C)
Manual Starting System	Hand-crank, with automatic decompression device
Electromagnetic Interference Level	Exceeds requirements for most marine radiotelephones and standard TVs
DC No-Load Current	± 2 % of rated amps

## AC GENERATOR

General	Brushless two pole, revolving field. Sealed lubricated single bearing design. Single phase, capacitor regulation.
Voltage	120 volts - 60 hertz (3600 rpm) 230 volts - 50 hertz (3000 rpm)
Voltage Regulation	Standard ± 7% no-load to full-load
Frequency Regulation	3Hz (5%) no-load to full-load
Rating (Volts AC)	60Hz - 120 volts; 35.0 amps 50Hz - 230 volts; 15.2 amps
Insulation	Class H as defined by NEMA MGI-1.66

## GENERATOR COOLING

Cooling	Raw water cooled
Air Requirements (60 Hertz at 3600 rpm)	450 cfm (12.74 cmm)
<b>Note:</b> Increase air supply 15% for Hertz operation 3000 rpm	
Engine Combustion Air Requirements	60 Hz - 15.397 ft <sup>3</sup> /min (0.436 m <sup>3</sup> /min) 50 Hz - 12.819 ft <sup>3</sup> /min (0.363 m <sup>3</sup> /min)
Generator Compartment Ambient Temperature Recommendations	<b>Note:</b> Forced ventilation should be provided to maintain generator compartment temperatures below 140°F (40°C)
Temperature Rise	Within NEMA MGI-22.40 operating at full load

# TORQUE SPECIFICATIONS

Component	Spanner Size (mm)	Tightening Torque (Nm)	
		min	max
Cylinder head	13	30	33
Connecting rod	13	27	31
Cylinder head cover	13	8	12
Main bearing plate	13	29	34
Fuel lift pump	13	30	33
Fuel injection pump	13	28	34
Delivery valve holder-injection pump	14	34	39
High pressure fuel line-injection pump	17	18	22
High pressure fuel line-fuel injector	17	25	30
Injector clamp	10	8	12
Governor on crankshaft	14	55	60
Flywheel	36	216	226
Gear end cover	6	34	38
Push rod guide	4	8	10
Crank handle guide	10	8	12
Oil pump	5	16	20
Sump plate	cross-slotted	9	11
Banjo bolt on fuel lift pump	17	25	35
Plastic nipple on injector	10	6	8
Banjo bolt on tank	12	8	10

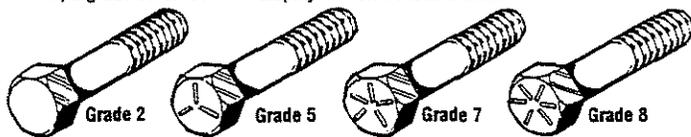
**Note:** Formula to convert Ft-Lbs to Nm (Newton Meters) multiply Ft-Lbs x 1.356

# STANDARD HARDWARE

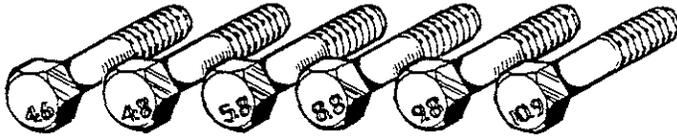
## BOLT HEAD MARKINGS

Bolt strength classes are embossed on the head of each bolt.

**Customary (inch) bolts** are identified by markings two to grade eight (strongest). The marks correspond to two marks less than the actual grade, i.e., a grade seven bolt will display five embossed marks.



**Metric bolt** class numbers identify bolts by their strength with 10.9 the strongest.



- NOTES:**
1. Use the torque values listed below when specific torque values are not available.
  2. These torques are based on clean, dry threads. Reduce torque by 10% when engine oil is used.
  3. Reduce torques by 30% or more, when threading capscrews into aluminum.

STANDARD BOLT & NUT TORQUE SPECIFICATIONS			
Capscrew Body Size (Inches) - (Thread)	SAE Grade 5 Torque Ft-Lb (Nm)	SAE Grade 6-7 Torque Ft-Lb (Nm)	SAE Grade 8 Torque Ft-Lb (Nm)
1/4 - 20 -28	8 (11) 10 (14)	10 (14)	12 (16) 14 (19)
5/16 - 18 -24	17 (23) 19 (26)	19 (26)	24 (33) 27 (37)
3/8 - 16 -24	31 (42) 35 (47)	34 (46)	44 (60) 49 (66)
7/16 - 14 -20	49 (66) 55 (75)	55 (75)	70 (95) 78 (106)
1/2 - 13 -20	75 (102) 85 (115)	85 (115)	105 (142) 120 (163)
9/16 - 12 -18	110 (149) 120 (163)	120 (163)	155 (210) 170 (231)
5/8 - 11 -18	150 (203) 170 (231)	167 (226)	210 (285) 240 (325)
3/4 - 10 -16	270 (366) 295 (400)	280 (380)	375 (508) 420 (569)
7/8 - 9 -14	395 (536) 435 (590)	440 (597)	605 (820) 675 (915)
1 - 8 -14	590 (800) 660 (895)	660 (895)	910 (1234) 990 (1342)

METRIC BOLT & NUT TORQUE SPECIFICATIONS					
Bolt Dia.	Wrench Size	Grade 4.6 Ft-Lb (Nm)	Grade 4.8 Ft-Lb (Nm)	Grade 8.8 - 9.8 Ft-Lb (Nm)	Grade 10.9 Ft-Lb (Nm)
M3 M4 M5	5.5 mm 7 mm 8 mm	0.3 (0.5) 0.8 (1.1) 1.5 (2.5)	0.5 (0.7) 1 (1.5) 2 (3)	1 (1.3) 2 (3) 4.5 (6)	1.5 (2) 3 (4.5) 6.5 (9)
M8 M9 M10	10 mm 13 mm 16 mm	3 (4) 7 (9.5) 14 (19)	4 (5.5) 10 (13) 18 (25)	7.5 (10) 18 (25) 37 (50)	11 (15) 35 (26) 55 (75)
M12 M14 M16	18 mm 21 mm 24 mm	26 (35) 37 (50) 59 (80)	33 (45) 55 (75) 85 (115)	63 (85) 103 (140) 159 (215)	97 (130) 151 (205) 232 (315)
M18 M20 M22	27 mm 30 mm 33 mm	81 (110) 118 (160) 159 (215)	118 (160) 166 (225) 225 (305)	225 (305) 321 (435) 435 (590)	321 (435) 457 (620) 620 (840)
M24 M27 M30	36 mm 41 mm 46 mm	203 (275) 295 (400) 402 (545)	288 (390) 417 (565) 568 (770)	553 (750) 811 (1100) 1103 (1495)	789 (1070) 1154 (1565) 1571 (2130)
M33 M36	51 mm 55 mm	546 (740) 700 (950)	774 (1050) 992 (1345)	1500 (2035) 1925 (2610)	2139 (2900) 2744 (3720)

## SEALANTS & LUBRICANTS

### GASKETS/SEALANTS

Oil based PERMATEX #2 and it's HIGH TACK equivalent are excellent all purpose sealers. They are effective in just about any joint in contact with coolant, raw water, oil or fuel.

A light coating of OIL or LIQUID TEFLON can be used on rubber gaskets and O-rings.

LOCTITE hydraulic red sealant should be used on oil adapter hoses and the oil filter assembly.

Coat both surfaces of the oil pan gasket with high temp RED SILICONE sealer.

When installing gaskets that seal around water (coolant) passages, coat both sides with WHITE SILICONE grease.

High-copper ADHESIVE SPRAYS are useful for holding gaskets in position during assembly.

Specialized gasket sealers such as HYLOMAR work well in applications requiring non-hardening properties. HYLOMAR is particularly effective on copper cylinder-head gaskets as it resists fuel, oil and water.

Use LIQUID TEFLON for sealing pipe plugs and fillings that connect coolant passages. **Do not use tape sealants!**

### BOLTS & FASTENERS/ASSEMBLIES

Lightly oil head bolts and other fasteners as you assemble them. Bolts and plugs that penetrate the water jacket should be sealed with PERMATEX #2 or HIGH TACK.

When assembling the flywheel, coat the bolt threads with LOCTITE blue.

Anti-seize compounds and thread locking adhesives such as LOCTITE protect threaded components yet allows them to come apart when necessary. LOCTITE offers levels of locking according to the job.

LITHIUM based grease is waterproof, ideal for water pump bearings and stuffing boxes.

Heavily oil all sliding and reciprocating components when assembling. **Always use clean engine oil!**

# SUGGESTED SPARE PARTS

Carry only Genuine Westerbeke Spare Parts

## SPARE PARTS KITS

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

Kit "A" includes the basic spares.

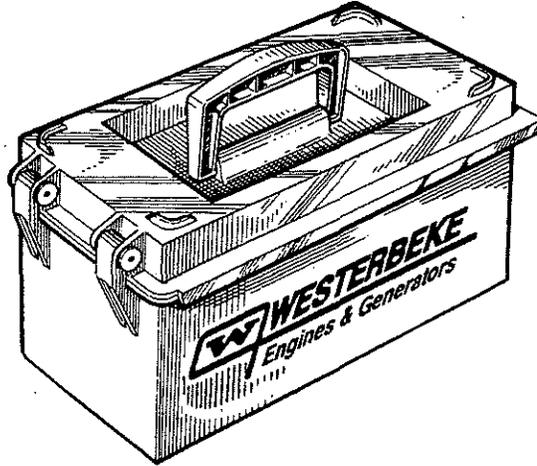
Kit "B" is for more extensive off-shore cruising.

### Kit "A" includes:

- Raw Water Pump Impeller and Gasket
- Fuel Filter
- Fuel Lift Pump Screens (2) and Gasket
- Fuel Supply Line Filter
- Fuel Hardware Kit (to fix a leak)

### Kit "B" includes:

- Raw Water Pump Impeller and Gasket
- Raw Water Pump Repair Kit
- Fuel Filter
- Fuel Lift Pump Screens (2) and Gasket
- Fuel Supply Line Filter
- Fuel Hardware Kit (to fix a leak)
- Thermostat Kit
- Complete Gasket Kit
- Fuel Injector



# METRIC CONVERSIONS

## INCHES TO MILLIMETERS

## MILLIMETERS TO INCHES

Inches	mm	Inches	mm	mm	Inches	mm	Inches
1	25.40	15	381.00	1	0.0394	15	0.5906
2	50.80	20	508.00	2	0.0787	20	0.7874
3	76.20	25	635.00	3	0.1181	25	0.9843
4	101.60	30	762.00	4	0.1575	30	1.1811
5	127.00	35	889.00	5	0.1969	35	1.3780
10	254.00	40	1016.00	10	0.3937	40	1.5748

10 MILLIMETERS = 1 CENTIMETER, 100 CENTIMETERS = 1 METER = 39.37 INCHES (3.3 FEET)

## INCHES TO METERS

## METERS TO INCHES

Inches	Meters	Inches	Meters	Meters	Inches	Meters	Inches
1	0.0254	7	0.1778	0.1	3.937	0.7	27.559
2	0.0508	8	0.2032	0.2	7.874	0.8	31.496
3	0.0762	9	0.2286	0.3	11.811	0.9	35.433
4	0.1016	10	0.2540	0.4	15.748	1.0	39.370
5	0.1270	11	0.2794	0.5	19.685	1.1	43.307
6	0.1524	12	0.3048	0.6	23.622	1.2	47.244

TO CONVERT METERS TO CENTIMETERS, MOVE DECIMAL POINT TWO PLACES TO THE RIGHT

## YARDS TO METERS

## METERS TO YARDS

Yards	Meters	Yards	Meters	Meters	Yards	Meters	Yards
1	0.91440	6	5.48640	1	1.09361	6	6.56168
2	1.82880	7	6.40080	2	2.18723	7	7.65529
3	2.74320	8	7.31520	3	3.28084	8	8.74891
4	3.65760	9	8.22960	4	4.37445	9	9.84252
5	4.57200	10	9.14400	5	5.46807	10	10.93614

MOVE DECIMAL POINT FOR HIGHER VALUES — e.g. 6,000 METERS = 6,561.68 YARDS

## POUNDS TO KILOGRAMS

## KILOGRAMS TO POUNDS

lb	kg	lb	kg	kg	lb	kg	lb
1	0.454	6	2.722	1	2.205	6	13.228
2	0.907	7	3.175	2	4.409	7	15.432
3	1.361	8	3.629	3	6.614	8	17.637
4	1.814	9	4.082	4	8.818	9	19.842
5	2.268	10	4.536	5	11.023	10	22.046

## GALLONS TO LITERS

## LITERS TO GALLONS

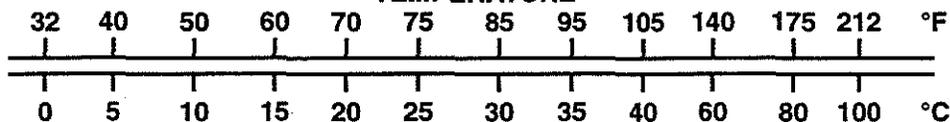
Gallons	Liters	Gallons	Liters	Liters	Gallons	Liters	Gallons
1	3.79	10	37.86	1	0.26	60	15.66
2	7.57	20	75.71	2	0.53	90	23.77
3	11.36	30	113.57	5	1.32	120	31.32
4	15.14	40	151.42	10	2.64	150	39.62
5	18.93	50	189.28	20	5.28	180	47.54

## PINTS TO LITERS

## LITERS TO PINTS

Pints	Liters	Pints	Liters	Liters	Pints	Liters	Pints
1	0.47	6	2.84	1	2.11	6	12.68
2	0.95	7	3.31	2	4.23	7	14.79
3	1.42	8	3.79	3	6.34	8	16.91
4	1.89	9	4.26	4	8.45	9	19.02
5	2.37	10	4.73	5	10.57	10	21.13

## TEMPERATURE



# STANDARD AND METRIC CONVERSION DATA

## LENGTH-DISTANCE

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

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

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

## VOLUME

Cubic Inches (in<sup>3</sup>) x 16.387 = Cubic Centimeters x .061 = in<sup>3</sup>

Imperial Pints (IMP pt) x .568 = Liters (L) x 1.76 = IMP pt

Imperial Quarts (IMP qt) x 1.137 = Liters (L) x .88 = IMP qt

Imperial Gallons (IMP gal) x 4.546 = Liters (L) x .22 = IMP gal

Imperial Quarts (IMP qt) x 1.201 = US Quarts (US qt) x .833 = IMP qt

Imperial Gallons (IMP gal) x 1.201 = US Gallons (US gal) x .833 = IMP gal

Fluid Ounces x 29.573 = Milliliters x .034 = Ounces

US Pints (US pt) x .473 = Liters (L) x 2.113 = Pints

US Quarts (US qt) x .946 = Liters (L) x 1.057 = Quarts

US Gallons (US gal) x 3.785 = Liters (L) x .264 = Gallons

## MASS-WEIGHT

Ounces (oz) x 28.35 = Grams (g) x .035 = Ounces

Pounds (lb) x .454 = Kilograms (kg) x 2.205 = Pounds

## PRESSURE

Pounds Per Sq In (psi) x 6.895 = Kilopascals (kPa) x .145 = psi

Inches of Mercury (Hg) x .4912 = psi x 2.036 = Hg

Inches of Mercury (Hg) x 3.377 = Kilopascals (kPa) x .2961 = Hg

Inches of Water (H<sub>2</sub>O) x .07355 = Inches of Mercury x 13.783 = H<sub>2</sub>O

Inches of Water (H<sub>2</sub>O) x .03613 = psi x 27.684 = H<sub>2</sub>O

Inches of Water (H<sub>2</sub>O) x .248 = Kilopascals (kPa) x 4.026 = H<sub>2</sub>O

## TORQUE

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

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

## VELOCITY

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

## POWER

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

## FUEL CONSUMPTION

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

Kilometers Per Liter (Km/L) x 2.352 = IMP MPG

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

Kilometers Per Liter (Km/L) x 2.352 = US MPG

## TEMPERATURE

Degree Fahrenheit (°F) = (°C X 1.8) + 32

Degree Celsius (°C) = (°F - 32) x .56

