OPERATOR'S MANUAL

WESTERBEKE

BTG 8.5KW, BTG 12.5KW, BTG 15.0KW

MARINE GASOLINE

GENERATOR SETS

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WESTERBEKE

WESTERBEKE CORPORATION
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FOREWORD

Thank you for selecting a Westerbeke marine product for your use. We at Westerbeke are pleased to have you as a customer.

Read this manual carefully and observe all safety precautions included throughout. Operating procedures, periodic preventive maintenance procedures, installation checks, system descriptions and minor adjustment procedures are included herein so you can operate your equipment safely and properly, maintain the equipment at a high level of efficiency, and expect dependable performance and long service life in return.

Should your unit require special attention, contact your Westerbeke dealer for assistance. The Westerbeke Service Organization is trained to provide the support necessary to ensure long-term dependable performance.

If, within 60 days of submitting the Warranty Registration Form for your unit, you have not received a Customer Identification Card (see below) registering your warranty, please contact the factory in writing with Model information, including the unit's serial number and commission date.

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CUSTOMER IDENTIFICATION

Adam Smith
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Model BTG 8.5KW Ser. # 1234C706

Expires 7/7/88

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Engine parts from Torrsen Marine - www.torresen.com - 231-759-8596

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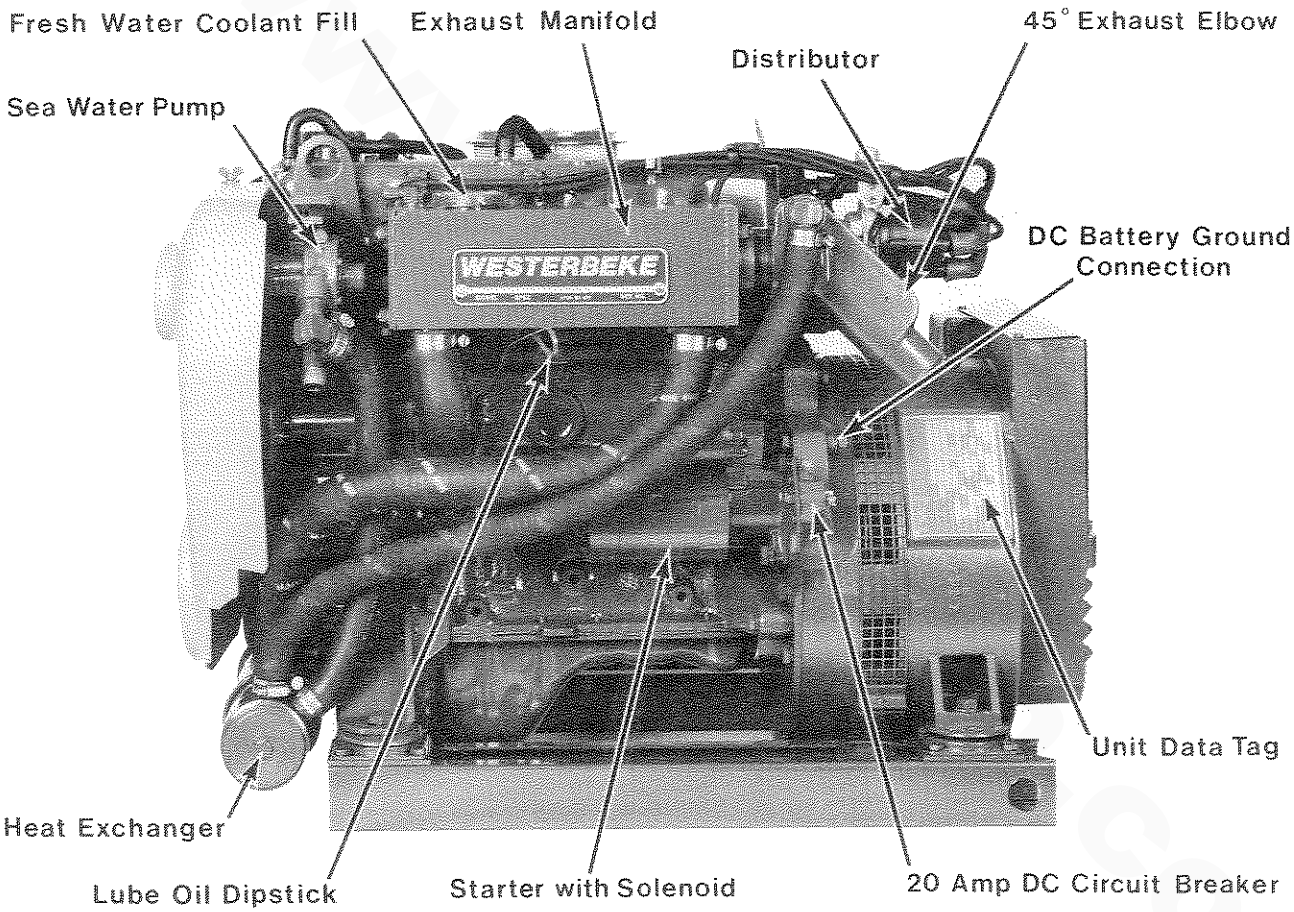

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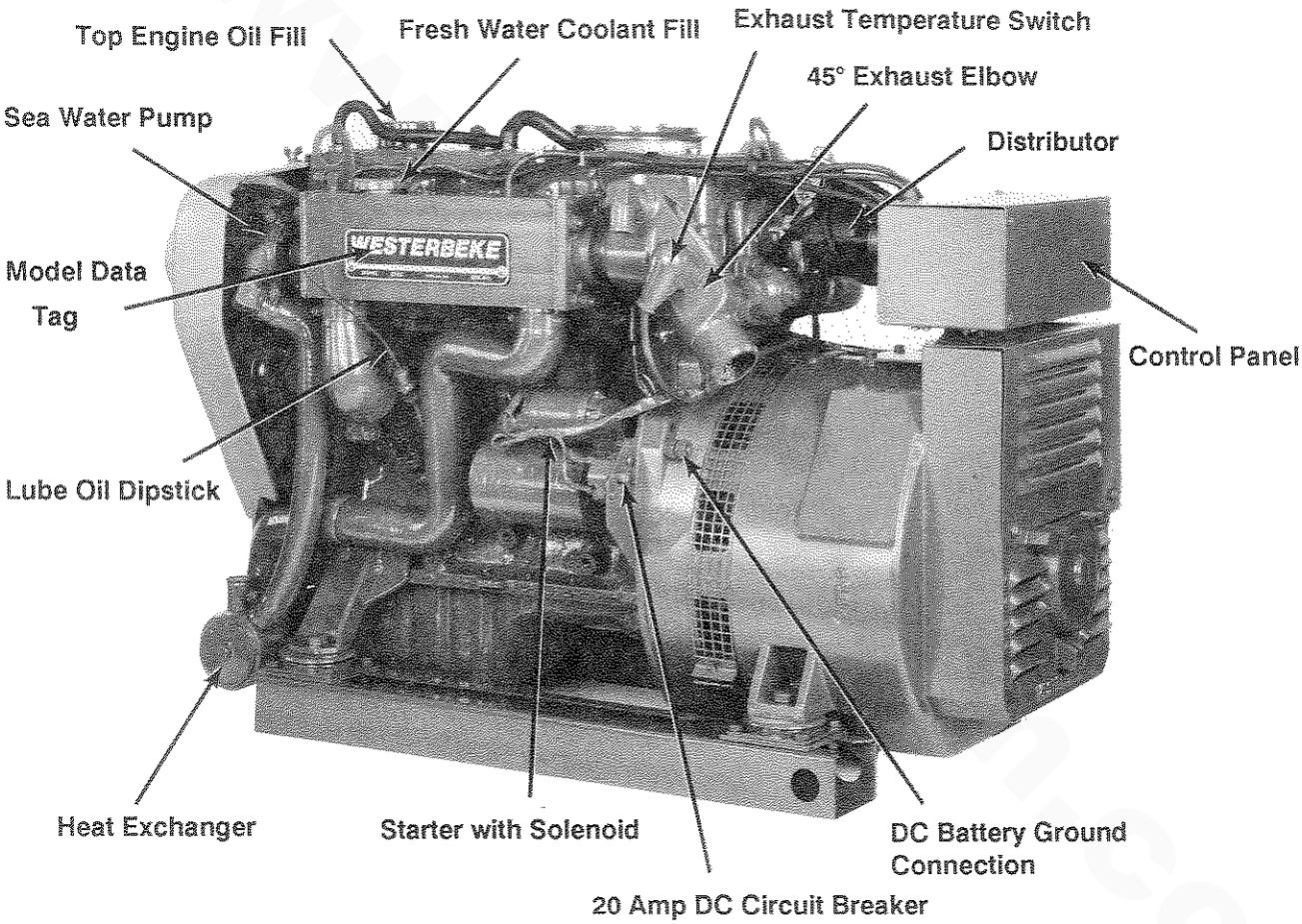

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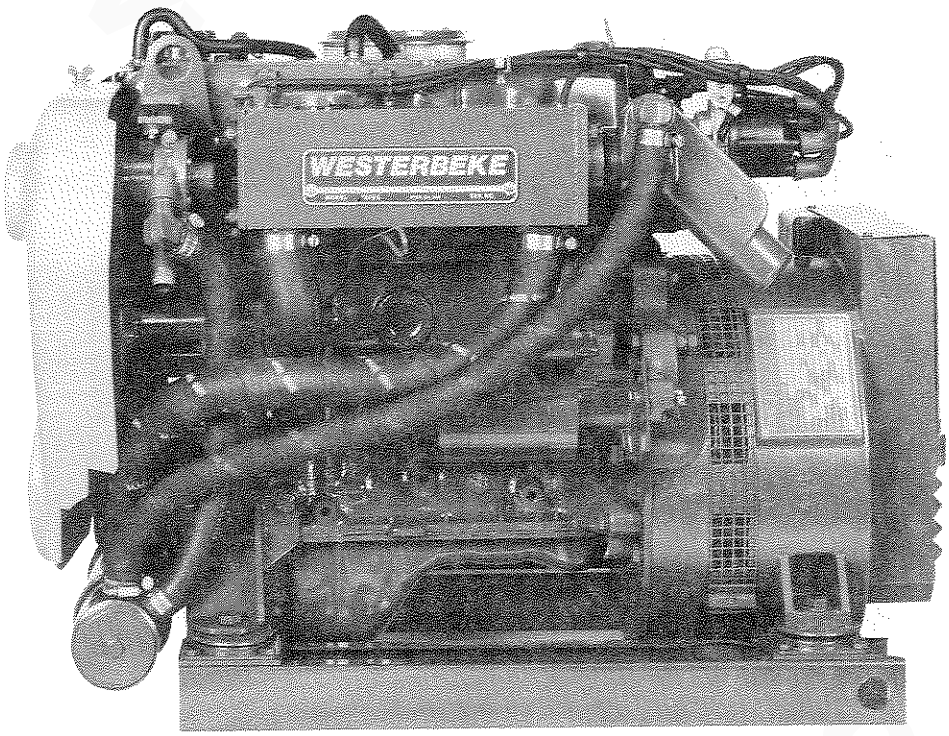
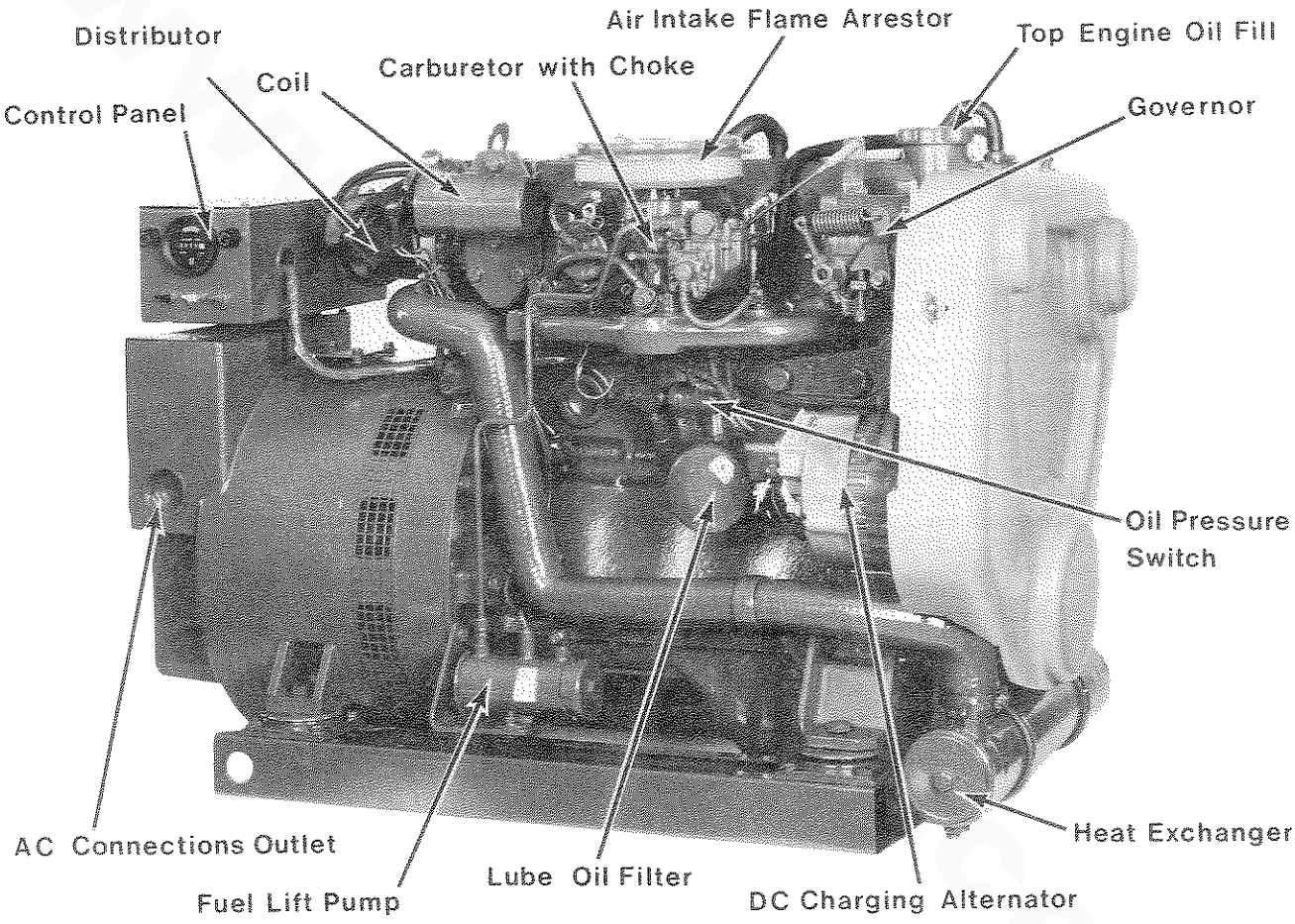
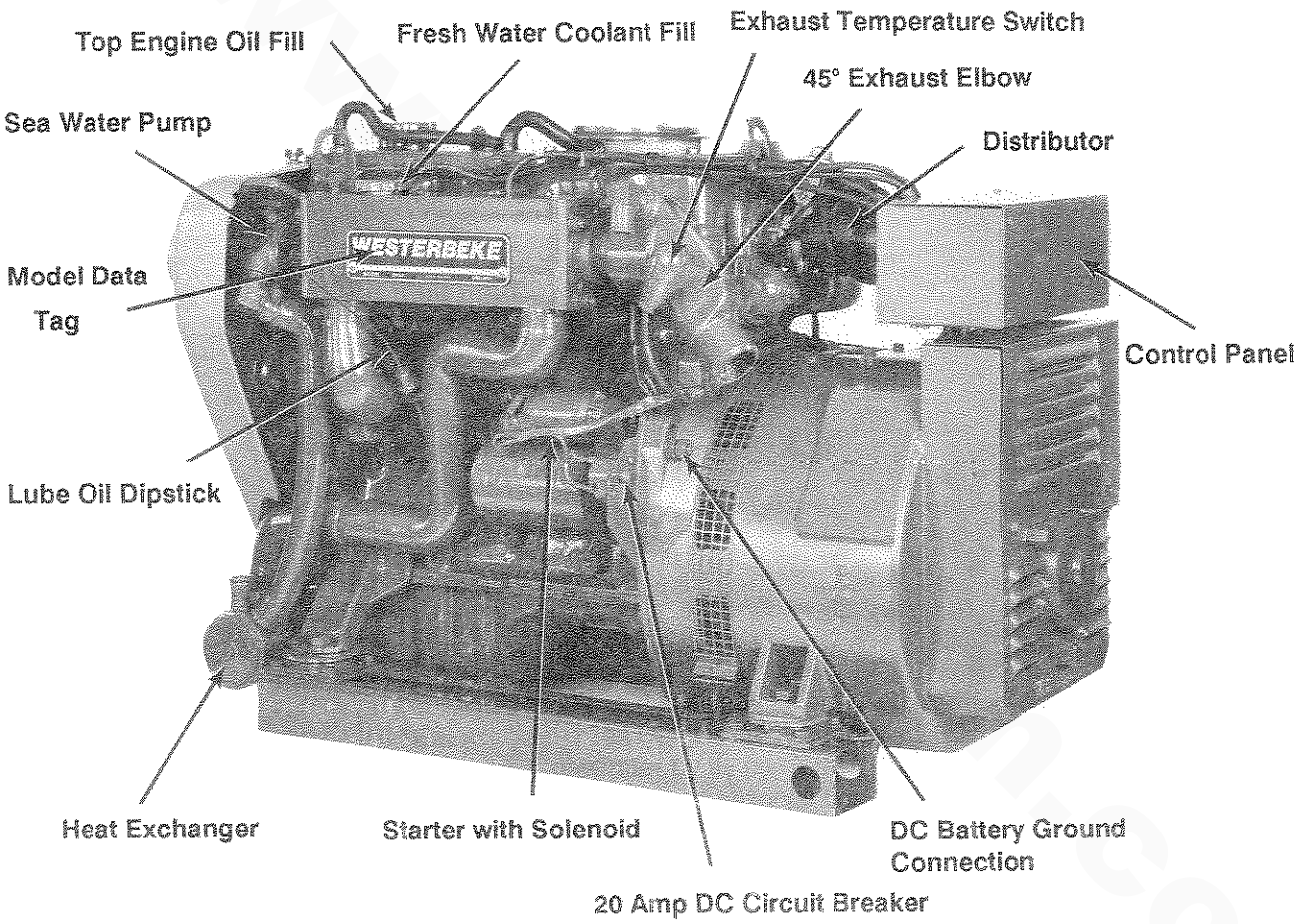


NOTE: At the time of printing, a right-side photograph of the BTG 8.5KW generator set was not available. The BTG 12.5KW generator is similar to the BTG 8.5KW in construction. Please refer to page 8 for a right-sided view of the BTG 12.5KW generator set which illustrates the various generator components.

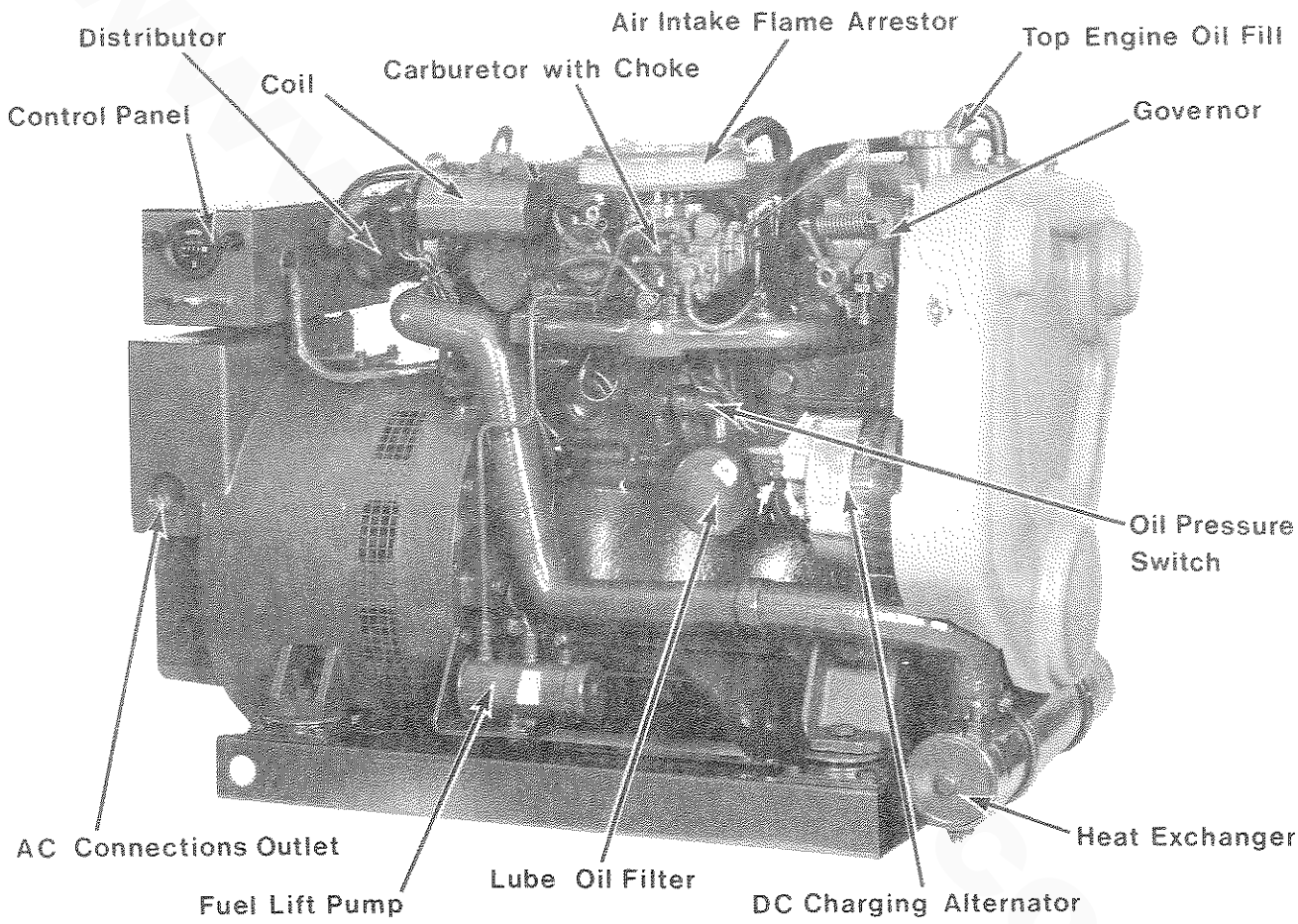
BTG 12.5KW Marine Gasoline Generator



BTG 15.0KW Marine Gasoline Generator



BTG 15.0KW Marine Gasoline Generator



GENERAL

Introduction

This manual contains the equipment operating procedures as well as additional information needed to help the operator keep the marine equipment in proper working order. Study and follow the instructions carefully. A planned maintenance program is included in this manual; adhering to the program will result in better equipment performance and longer equipment life. Proper diagnosis of a problem is the most important step to satisfactory repair; therefore, a troubleshooting table is included.

Understanding the Gasoline Driven Generator

The gasoline engine driving an AC generator is in many ways similar to a gasoline automobile engine. The cylinders are vertical in-line, and the engine's cylinder head has an overhead camshaft which is chain-driven. The engine utilizes a solid-state distributor which is horizontally mounted and camshaft-driven. The engine incorporates a pressure type lubrication system, and a fresh water-cooled engine block which is thermostatically -controlled. To a large degree, the generator's engine requires the same preventive maintenance that is required of a gasoline automobile engine. The most important factors to the generator's longevity are proper ventilation, maintenance of the fuel system, ignition system, cooling system and the generator end.

Ordering Parts

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

Note that component locations in the manual are referenced from the front of the engine which is the pulley/drive belt end. (The flywheel/generator end is the rear end.) Left and right sides are determined by the engine; imagine straddling the engine and facing in the same direction as the front of the engine: the left side is at your left, the right side at your right.

Westerbeke generators sets are thoroughly checked and given a final run under various load conditions before leaving the factory. This is done to ensure dependable operation, long service, and a satisfied owner.

Care at the factory during assembly and thorough testing have resulted in a Westerbeke gasoline engine-driven generator capable of many thousands of hours of dependable service. However, the manufacturer cannot control is the treatment the unit receives in the field. That part is up to the owner/operator.

BTG 8.5 KW MARINE GASOLINE GENERATOR SET

GENERAL SPECIFICATIONS

Engine Type	Gasoline, four-cycle, two-cylinder, fresh water-cooled Vertical, in-line overhead valve mechanism (18.5 hp at 1800 rpm maximum).
Governor	Hoof, flyball type, 5% speed regulation
Combustion Chamber	Multi-sphere type
Bore & Stroke	2.76 x 2.74 inches (70 x 69.6 mm)
Piston Displacement	65.4 cubic inches (1.07 liters)
Firing Order	1-3-4-2
Direction of Rotation	Clockwise, when viewed from the front
Maximum Torque (at 1800 rpm)	51.3 lb-ft (7.1 kg-m)
Compression Ratio	9.2:1
Compression Pressure (Limit of difference between cylinders)	170 psi (12 kg/cm^2) at 300 rpm (2 8 psi [2.0 kg/cm^2])
Valve Timing	Intake Opens 15° BTDC Intake Closes 44° ABDC Exhaust Opens 53° BBDC Exhaust Closes 6° ATDC
Valve Seat Angle	Intake 45° Exhaust 45°
Valve Clearance (engine cold)	Intake 0.0098 inches (0.25 mm) Exhaust 0.0098 inches (0.25 mm)
Engine Speed	1800 rpm 60 Hertz 1500 rpm 50 Hertz
Dimensions	Height: 23.63 inches (600.20 mm) Width: 18.75 inches (476.25 mm) Length: 31.50 inches (800.10 mm)
Weight	513 lbs (232.7 kgs)
Fuel Consumption	1.10 gph (4.16 lph) at full rated output (approximate)
Inclination	Continuous 15° Temporary 20° (not to exceed 20 min.)

BTG 8.5 KW SYSTEM SPECIFICATIONS

INTAKE SYSTEM

Carburetor (STD type)	Down draft type, single barrel with U.S.C.G. approved flame arrester.

IGNITION SYSTEM

General	Battery ignition, 12-Volts, negative ground, distributor with points, ignition coil and spark plugs.
Distributor	Solid state type with signal generator and igniter
Spark Plug Thread Size	14 mm x 1.25 pitch
Spark Plug Type	Westerbeke part number 033805

FUEL SYSTEM

General	Conventional carburetor type with fuel lift pump
Fuel	Regular or unleaded gasoline with an octane rating of 89 or better.
Lift Pump	12-Volt DC; lift capacity 6 ft (1.8 m)
Fuel Screens (on engine)	Reusable screen type (one in Carburetor and one in electric fuel pump).
Air cleaner	Metal screen type - cleanable
Air Flow (engine combustion)	35 cfm (1.0 cmm)

COOLING SYSTEM

General	Fresh water-cooled block, thermostatically-controlled with heat exchanger.
Operating Temperature	130 - 150° F (55 - 66° C)
Fresh Water Pump	Centrifugal type, metal impeller, belt-driven
Sea Water Pump	Positive displacement, rubber impeller, belt-driven.

BTG 8.5 KW SYSTEM SPECIFICATIONS

Sea Water Flow, at 1800 rpm (measured before discharging into exhaust elbow)	6.7 gpm (25.3 lpm)
System Capacity (fresh water)	5 qts (4.7 liters)

LUBRICATION SYSTEM

General	Pressure type by Trochoid pump, chain-driven by crankshaft.
Oil Filter	Full flow, paper element, spin-on type
Sump Capacity (not including filter)	3.9 qts (3.7 liters)
Operating Oil Pressure (engine hot)	25 - 35 psi (1.75 - 2.50 kg/cm^2)
Oil Grade	API specification of SE or SE/CC

ELECTRICAL SYSTEM

Starting Battery	12-Volt, 26 A-H, (-) negative ground (recommended) (35 A-H in cold areas)
Battery Capacity	90 - 125 (Ampere-Hours)
DC Battery Charger	Internal regulator 13 Volts, 0 - 10 Amps.
Starter	12-Volt, 1.2KW, reduction type, solenoid-mounted
DC No-Load Current	90 Amp (max.) at 11.5 Volts.
DC Cranking Current	175 - 200 Amps (engine cold)

BTG 8.5 KW SYSTEM SPECIFICATIONS

AC GENERATOR

General	Brushless, four-pole, revolving field. Pre-lubricated, single-bearing design. Reconnectable, single-phase transformer regulation (optional solid-state voltage regulation).	
Voltage	120 or 120/240 Volts - 60 Hertz 220 Volts - 50 Hertz. Voltage regulation: ±5% no load to full load. Frequency regulation: ± 3 Hertz (5%) no-load to full-load.	
Rating (Volts AC)		
60 Hertz (1800 rpm)	120 Volts 120/240 Volts	70 Amps 70/35 Amps
50 Hertz (1500 rpm)	220 Volts	31 Amps
AC Circuit Breaker	To be rated at 120% of the generator's rated amperage output and voltage	
Generator Cooling Air Requirements, (60 Hertz), at 1800 rpm	200 - 225 cfm (5.7 - 6.4 cmm)	

NOTE: Increase air supply 15% for 50 Hertz operation (1500 rpm).

Engine Combustion Air Requirements, (60 Hertz), at 1800 rpm	35 cfm (1.0 cmm)

TUNE-UP SPECIFICATIONS

Spark Plug Gap	0.031 ± 0.002 inches (0.80 ± 0.05 mm)
Timing	14° ± 1° BTDC at 1800 rpm

BTG 12.5 KW MARINE GASOLINE GENERATOR SET

GENERAL SPECIFICATIONS

Engine Type	Gasoline, four-cycle, two-cylinder, fresh water-cooled Vertical, in-line overhead valve mechanism (22.5 hp at 1800 rpm maximum).
Governor	Hoof, flyball type, 5% speed regulation
Combustion Chamber	Multi-sphere type
Bore & Stroke	3.03 x 2.74 inches (77 x 69.6 mm)
Piston Displacement	79.1 cubic inches (1.296 liters)
Firing Order	1-3-4-2
Direction of Rotation	Clockwise, when viewed from the front
Maximum Torque (at 1800 rpm)	63.6 lb-ft (8.8 kg-m)
Compression Ratio	9.2:1
Compression Pressure (Limit of difference between cylinders)	170 psi (12 kg/cm^2) at 300 rpm (2 8 psi [2.0 kg/cm^2])
Valve Timing	Intake Opens 15° BTDC Intake Closes 44° ABDC Exhaust Opens 53° BBDC Exhaust Closes 6° ATDC
Valve Seat Angle	Intake 45° Exhaust 45°
Valve Clearance (engine cold)	Intake 0.0098 inches (0.25 mm) Exhaust 0.0098 inches (0.25 mm)
Engine Speed	1800 rpm 60 Hertz 1500 rpm 50 Hertz
Dimensions	Height: 23.63 inches (600.10 mm) Width: 18.75 inches (476.25 mm) Length: 33.63 inches (854.20 mm)
Weight	533 lbs (241.7 kgs)
Fuel Consumption	1.25 gph (4.73 lph) at full rated output (approximate)
Inclination	Continuous 15° Temporary 20° (not to exceed 20 min.)

BTG 12.5 KW SYSTEM SPECIFICATIONS

INTAKE SYSTEM

Carburetor (STD type)	Down draft type, single barrel with U.S.C.G. approved flame arrester.

IGNITION SYSTEM

General	Battery ignition, 12-Volts, negative ground, distributor with points, ignition coil and spark plugs.
Distributor	Solid state type with signal generator and igniter
Spark Plug Thread Size	14 mm x 1.25 pitch
Spark Plug Type	Westerbeke part number 033805

FUEL SYSTEM

General	Conventional carburetor type with fuel lift pump
Fuel	Regular or unleaded gasoline with an octane rating of 89 or better.
Lift Pump	12-Volt DC; lift capacity 6 ft (1.8 m)
Fuel Screens (on engine)	Reusable screen type (one in Carburetor and one in electric fuel pump).
Air cleaner	Metal screen type - cleanable
Air Flow (engine combustion)	41.1 cfm (1.16 cmm)

COOLING SYSTEM

General	Fresh water-cooled block, thermostatically-controlled with heat exchanger.
Operating Temperature	130 - 150° F (55 - 66° C)
Fresh Water Pump	Centrifugal type, metal impeller, belt-driven
Sea Water Pump	Positive displacement, rubber impeller, belt-driven.

BTG 12.5 KW SYSTEM SPECIFICATIONS

Sea Water Flow, at 1800 rpm (measured before discharging into exhaust elbow)	6.7 gpm (25.3 lpm)
System Capacity (fresh water)	5 qts (4.7 liters)

LUBRICATION SYSTEM

General	Pressure type by Trochoid pump, chain-driven by crankshaft.
Oil Filter	Full flow, paper element, spin-on type
Sump Capacity (not including filter)	3.9 qts (3.7 liters)
Operating Oil Pressure (engine hot)	25 - 35 psi (1.75 - 2.50 kg/cm^2)
Oil Grade	API specification of SE or SE/CC

ELECTRICAL SYSTEM

Starting Battery	12-Volt, 26 A-H, (-) negative ground (recommended) (35 A-H in cold areas)
Battery Capacity	90 - 125 (Ampere-Hours)
DC Battery Charger	Internal regulator 13 Volts, 0 - 10 Amps.
Starter	12-Volt, 1.2KW, reduction type, solenoid-mounted
DC No-Load Current	90 Amp (max.) at 11.5 Volts.
DC Cranking Current	175 - 200 Amps (engine cold)

BTG 12.5 KW SYSTEM SPECIFICATIONS

AC GENERATOR

General	Brushless, four-pole, revolving field. Pre-lubricated, single-bearing design. Reconnectable, single-phase transformer regulation (optional solid-state voltage regulation).	
Voltage	120 or 120/240 Volts - 60 Hertz 220 Volts - 50 Hertz. Voltage regulation: ±5% no load to full load. Frequency regulation: ± 3 Hertz (5%) no-load to full-load.	
Rating (Volts AC)		
60 Hertz (1800 rpm)	120 Volts 120/240 Volts	104 Amps 104/52 Amps
50 Hertz (1500 rpm)	220 Volts	47 Amps
AC Circuit Breaker	To be rated at 120% of the generator's rated amperage output and voltage	
Generator Cooling Air Requirements, (60 Hertz), at 1800 rpm	220 cfm (6.23 cmm)	

NOTE: increase air supply 15% for 50 Hertz operation (1500 rpm).

Engine Combustion Air Requirements, (60 Hertz), at 1800 rpm	41.1 cfm (1.16 cmm)

TUNE-UP SPECIFICATIONS

Spark Plug Gap	0.031 ± 0.002 inches (0.80 ± 0.05 mm)
Timing	18° ± 1° BTDC at 1800 rpm

BTG 15.0 KW MARINE GASOLINE GENERATOR SET

GENERAL SPECIFICATIONS

Engine Type	Gasoline, four-cycle, two-cylinder, fresh water-cooled Vertical, in-line overhead valve mechanism (27 hp at 1800 rpm maximum).
Governor	Hoof, flyball type, 5% speed regulation
Combustion Chamber	Multi-sphere type
Bore & Stroke	3.03 x 3.15 inches (77 x 80 mm)
Piston Displacement	90.0 cubic inches (1.48 liters)
Firing Order	1-3-4-2
Direction of Rotation	Clockwise, when viewed from the front
Maximum Torque (at 1800 rpm)	76.6 lb-ft (10.6 kg-m)
Compression Ratio	9.0:1
Compression Pressure (Limit of difference between cylinders)	170 psi (12 kg/cm^2) at 300 rpm (2 8 psi [2.0 kg/cm^2])
Valve Timing	Intake Opens 15° BTDC Intake Closes 58° ABDC Exhaust Opens 58° BBDC Exhaust Closes 15° ATDC
Valve Seat Angle	Intake 45° Exhaust 45°
Valve Clearance (engine cold)	Intake 0.0098 inches (0.25 mm) Exhaust 0.0098 inches (0.25 mm)
Engine Speed	1800 rpm 60 Hertz 1500 rpm 50 Hertz
Dimensions	Height: 23.63 inches (600.10 mm) Width: 18.75 inches (476.25 mm) Length: 33.63 inches (854.20 mm)
Weight	560 lbs (254 kgs)
Fuel Consumption	1.6 gph (6.05 lph) at full rated output (approximate)
Inclination	Continuous 15° Temporary 20° (not to exceed 20 min.)

BTG 15.0 KW SYSTEM SPECIFICATIONS

INTAKE SYSTEM

Carburetor (STD type)	Down draft type, single barrel with U.S.C.G. approved flame arrester.

IGNITION SYSTEM

General	Battery ignition, 12-Volts, negative ground, distributor with points, ignition coil and spark plugs.
Distributor	Solid state type with signal generator and igniter
Spark Plug Thread Size	14 mm x 1.25 pitch
Spark Plug Type	Westerbeke part number 033805

FUEL SYSTEM

General	Conventional carburetor type with fuel lift pump
Fuel	Regular or unleaded gasoline with an octane rating of 89 or better.
Lift Pump	12-Volt DC; lift capacity 6 ft (1.8 m)
Fuel Screens (on engine)	Reusable screen type (one in Carburetor and one in electric fuel pump).
Air cleaner	Metal screen type - cleanable
Air Flow (engine combustion)	47 cfm (1.3 cmm)

COOLING SYSTEM

General	Fresh water-cooled block, thermostatically-controlled with heat exchanger.
Operating Temperature	130 - 150° F (55 - 66° C)
Fresh Water Pump	Centrifugal type, metal impeller, belt-driven
Sea Water Pump	Positive displacement, rubber impeller, belt-driven.

BTG 15.0 KW SYSTEM SPECIFICATIONS

Sea Water Flow, at 1800 rpm (measured before discharging into exhaust elbow)	7 gpm (26.5 lpm)
System Capacity (fresh water)	7 qts (6.6 liters)

LUBRICATION SYSTEM

General	Pressure type by Trochoid pump, chain-driven by crankshaft.
Oil Filter	Full flow, paper element, spin-on type
Sump Capacity (not including filter)	3.9 qts (3.7 liters)
Operating Oil Pressure (engine hot)	25 - 35 psi (1.75 - 2.50 kg/cm^2)
Oil Grade	API specification of SE or SE/CC

ELECTRICAL SYSTEM

Starting Battery	12-Volt, 26 A-H, (-) negative ground (recommended) (35 A-H in cold areas)
Battery Capacity	90 - 125 (Ampere-Hours)
DC Battery Charger	Internal regulator 13 Volts, 0 - 10 Amps.
Starter	12-Volt, 1.2KW, reduction type, solenoid-mounted
DC No-Load Current	90 Amp (max.) at 11.5 Volts.
DC Cranking Current	175 - 200 Amps (engine cold)

BTG 15.0 KW SYSTEM SPECIFICATIONS

AC GENERATOR

General	Brushless, four-pole, revolving field. Pre-lubricated, single-bearing design. Reconnectable, single-phase transformer regulation (optional solid-state voltage regulation).	
Voltage	120 or 120/240 Volts - 60 Hertz 220 Volts - 50 Hertz. Voltage regulation: ±5% no load to full load. Frequency regulation: ± 3 Hertz (5%) no-load to full-load.	
Rating (Volts AC)		
60 Hertz (1800 rpm)	120 Volts 120/240 Volts	124 Amps 124/62 Amps
50 Hertz (1500 rpm)	220 Volts	60 Amps
AC Circuit Breaker	To be rated at 120% of the generator's rated amperage output and voltage	
Generator Cooling Air Requirements, (60 Hertz), at 1800 rpm	250 - 275 cfm (7.0 - 7.8 cmm)	

NOTE: Increase air supply 15% for 50 Hertz operation (1500 rpm).

Engine Combustion Air Requirements, (60 Hertz), at 1800 rpm	47 cfm (1.3 cmm)

TUNE-UP SPECIFICATIONS

Spark Plug Gap	0.031 ± 0.002 inches (0.80 ± 0.05 mm)
Timing	18° ± 1° BTDC at 1800 rpm

INSTALLATION CHECKS

General

Since the crafts in which Westerbeke generators are installed vary in design, installation procedures will vary according to your craft's specific design. The intent of this section is not to advise boatyards or installers on procedures already well-developed and well-understood. However, it is important that the owner/operator realize there are details of the installation which require periodic checks to ensure the best operating conditions for the equipment and safe operating conditions for the personnel on board. Proper location and installation of the gasoline generator in the vessel are of prime importance.

Factors in the installation that must be considered are ventilation, to aid in cooling the generator end; to provide air for engine combustion and to remove heat produced by the engine while operating; the exhaust system, to properly discharge raw cooling water (sea water), to quiet the exhaust, and to expel exhaust gas; the cooling water supply; and the electrical connections.

CAUTION

For safety reasons, the generator's engine is **NOT** filled with lubricating oil for shipment. Before leaving the factory, however, each generator set is thoroughly tested with oil in its engine. This testing, among other things, provides all internal parts with a coating of oil. This oil acts as a preservative, providing reliable protection against corrosion for at least one year if the generator is properly stored.

Inspection of Equipment

The generator is shipped from the factory securely mounted and properly crated. Accessory equipment is shipped in a separate small box, usually packed within the generator's crate.

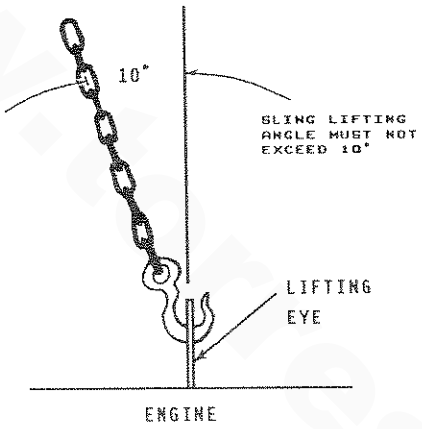
Before accepting shipment of the generator set from the transportation company, the crate should be opened and the contents inspected for concealed damage. If either visible or concealed damage is noted, you should require the delivery agent sign "Received in damaged condition" on the proper delivery receipt. Also check the contents of the shipment against the packing list and make sure that the proper notation is made if any discrepancies exist. These noted discrepancies are your protection against loss or damage. Claims concerning loss or damage *must* be made to the *carrier*, not to the Westerbeke Corporation.

Rigging and Lifting

The generator is fitted with lifting eyes. Rope or chain slings capable of supporting the generator's weight should be attached to the eyes and the generator lifted by means of tackle attached to these slings. The lifting eyes have been designed to carry the full weight of the generator; therefore, auxiliary slings are not required or desired.

CAUTION

Slings must not be so short as to place significant stress on the generator's lifting eyes. Strain placed on the generator's lifting eyes by the lifting sling must not be in excess of 10° from the vertical plain.

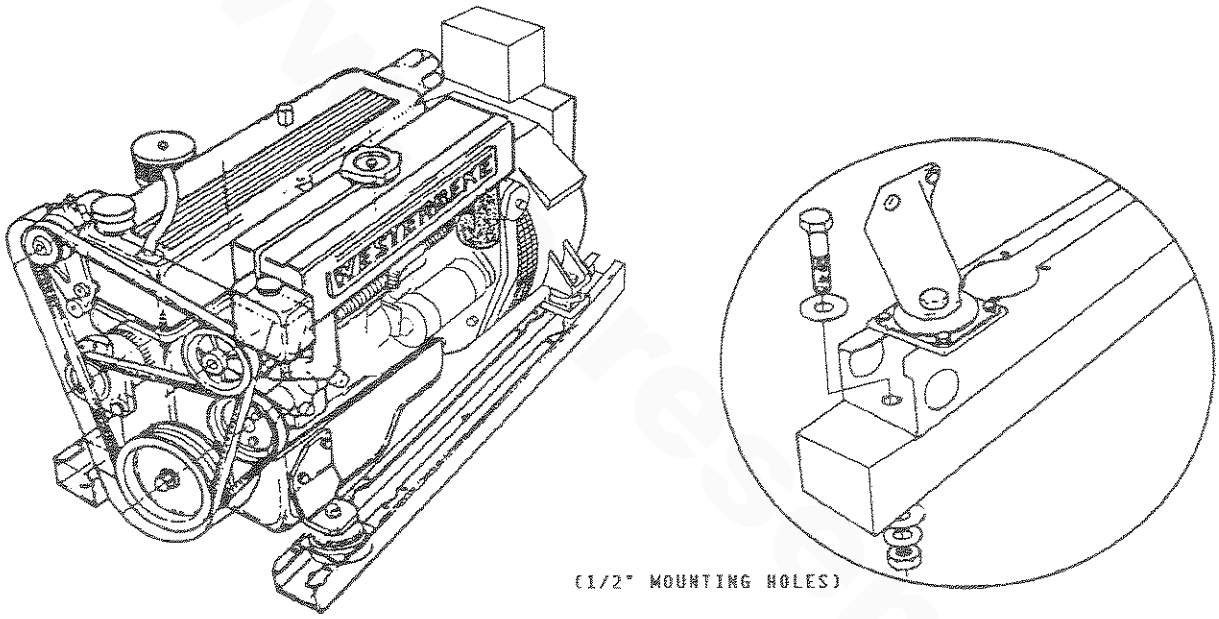


The general rule in moving generators is to see that all equipment used is amply strong and firmly fixed in place. Move the engine a little at a time and see that it is firmly supported. Eliminate the possibility of accidents by avoiding haste. Do not lift the generator by its crankshaft pulley. In certain situations it may be necessary to lift the engine in positions other than the horizontal position. Certain situations exist by which the engine must be lowered endwise through a small hatchway which cannot be made larger. Under these conditions, If the opening of the hatchway is extremely small, it is possible to reduce, to some extent, the outside dimensions of the generator by removing external components such as the alternator, the cooling system's piping, the heat exchanger, certain filters, the mounting rails and other obstructive equipment. This accessory equipment should be removed by a competent mechanic and special care should be taken to avoid damage to any exposed parts. In addition, be careful not to allow dirt from entering any opening created by the removal of equipment. Removed parts should be returned to their respective position as soon as the generator has cleared the hatchway.

In case it becomes necessary to hoist the generator front-end upwards or generator-end upwards, the attachment of lifting slings must be done carefully to avoid the possibility of damaging the parts on which the weight of the slings may bear. Special rigging work is best done by someone experienced and competent in handling heavy machinery.

Generator Mounting - Location

The complete generator unit is mounted on lightweight rails by means of four flexible isolator mounts that help prevent the transfer of vibration from the generator to the rails. Each generator mounting rail has several 1/2-inch bolt holes so bolts can be employed to properly secure the generator to its mounting platform. These holes are on 15 inch mounting centers.



The location should be dry, above low-lying vapor areas, and away from being splashed by bilge water or water from above. It should be properly ventilated and accessible for minor servicing and repairs. Access for major repairs should be given consideration as well. The location should be properly ventilated to provide fresh cooling air for the generator end, for engine combustion needs, and to remove heat produced by the engine while operating. The generator set needs fresh cool air in whatever location in the vessel it is installed. Hot generator discharge air *must* be removed from the generator area. The platform on which the generator and its mounting rails are located should be strong enough to support the generator during all angles of vessel operation.

SPECIAL SERVICE BULLETIN

(This page replaces the same page in the Operator's Manual)

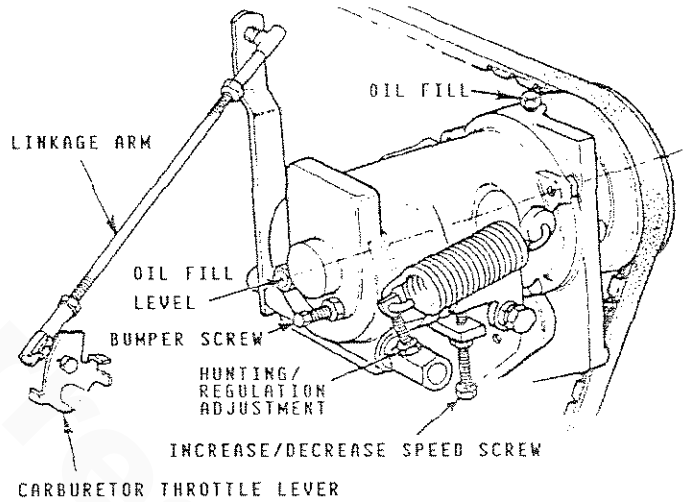
Governor Adjustments

Operate the generator set to bring the unit up to its operating temperature before attempting an adjustment.

NOTE: If the governor is severely out of adjustment, manually adjust the linkage without any load on the generator to obtain a safe output voltage before proceeding with the adjustment.

Three adjusting points are on the governor. (Refer to the illustration below.)

1. Bumper Screw This screw is used to remove a no-load surge ONLY. NEVER turn the bumper screw into the governor far enough so that it increases the no-load speed. To adjust the governor, turn the bumper screw in until the engine stops surging. Now bring the Increase/Decrease Speed Screw (on the governor) up until the generator runs between 61.5 to 62.0 cycles no-load. Apply a 1/4, a 1/2 and a 3/4 load to the generator and ensure the generator does not surge under these three load intervals.



NOTE: Only If the generator surges at any of these load intervals are you to follow steps #2 and #3 below.

2. Increase/Decrease Speed This adjusting bolt sets the no load speed of the engine. (The linkage arm between the governor arm and throttle lever should be adjusted to hold the throttle full open when the engine is not running.) Make sure this linkage moves freely and that the ball joint connectors are properly lubricated. Use graphite lubricant at this connection. Disconnect the ball joint and apply a graphite lubricant to the inside of the joint.

3. Hunting/Regulation If the variation in engine speed between no load and full load is too great, adjust this eye bolt to draw the spring closer to the lever hub. The increase/decrease speed bolt may need to be adjusted as well.

If the governor surges while under a load, adjust this eye bolt to move the spring away from the lever hub. (Check the speed adjustment.)

Special Note: On page 81, under Spark Plugs, the engine must be cold when the spark plugs are removed. Removing spark plugs from a hot engine can pull the threads out of the cylinder head.

WARNING

CARBON MONOXIDE EXHAUST GAS IS DEADLY. Carbon monoxide is a dangerous gas that can cause unconsciousness and is potentially lethal. Some of the symptoms or signs of carbon monoxide inhalation or poisoning are listed below.

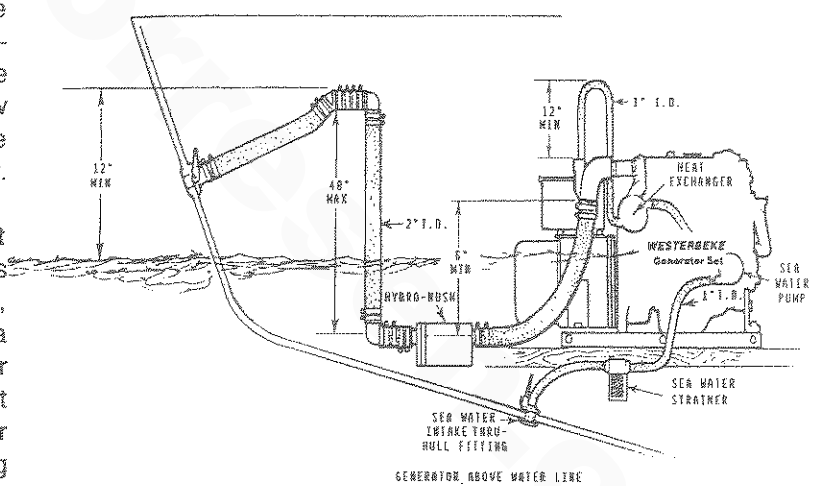
- o Dizziness
- o Intense Headache
- o Weakness and Sleepiness
- o Vomiting
- o Muscular Twitching
- o Throbbing in Temples

All exhaust systems should be such that the entry of sea water into the engine's exhaust manifold and cylinders is prevented while the engine is not running, or while the vessel is under sail or power in which case the vessel may experience healing or backing down from following seas or any other conditions. Special attention must be made to ensure that the exhaust system is secure and tight and free of leaks.

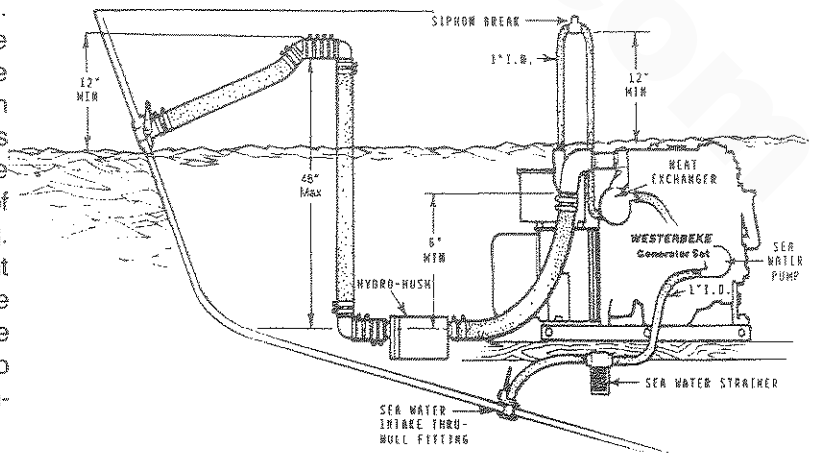
The sea water supply thru-hull sea cock fittings *must* be of the flush-hull type. High-speed scoop type fittings must not be used, as they tend to encourage siphoning.

When a water lift type exhaust system is used, the exhaust muffler should be mounted as close to the engine as practical. The exhaust discharge should always drop downward into the exhaust muffler. Loops in the exhaust hose between the water-injected exhaust elbow and the water lift muffler should be avoided, as these will trap and hold water.

For installations where the exhaust manifold/water-injected exhaust elbow is at or below the vessel's water line, provisions must be made to install a siphon-break or a vent in the sea water supply hose to the water-injected exhaust elbow. This stops the flow of sea water that runs through the sea water cooling system from filling the exhaust and engine cylinders when the engine is shut down. This sea water supply hose must be looped above the water line and the siphon-break or vent installed in the high point of the loop above the water line. This siphon-break or vent must always be above the water line during all angles of vessel operation to prevent siphoning. The vent, when used, must have its vent hose or tube routed so it can remain above the water line and empty of water when the engine is shut down. This allows air to enter through this vent to prevent siphoning.



GENERATOR ABOVE WATER LINE



GENERATOR BELOW WATER LINE

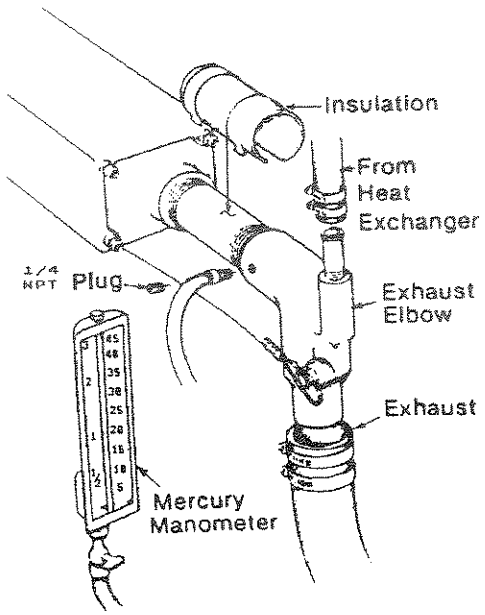
Exhaust Back-Pressure

The exhaust discharge hose must be of adequate size and minimal run to prevent excessive exhaust back-pressure. Exhaust back-pressure should be checked before a generator is put into service. (Refer to the illustration.) Excessive back-pressure will affect the engine's performance and the generator's power output.

To measure for back-pressure, use a mercury manometer, a pressure gauge, or a water column. A boatyard or marine mechanic should have a manometer or a pressure gauge.

Measure the engine's back-pressure at the exhaust elbow while the generator is under a full load.

Refer to the pressure specifications below.

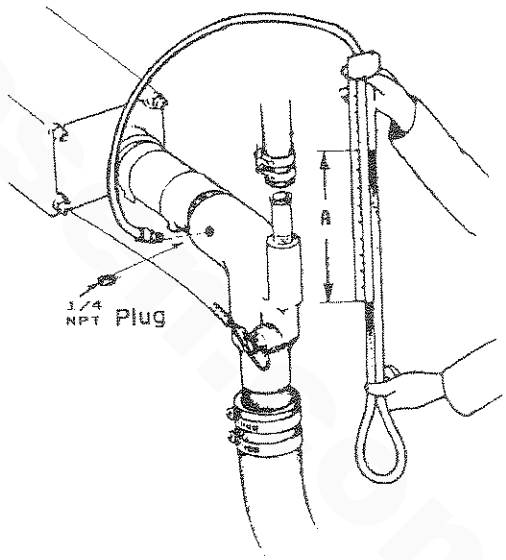


A water column can be made by taking a clear plastic tube and taping one end of the tube along a yardstick and fitting the other end of the tube with a 1/4 inch NPT (National Pipe Tap) pipe fitting.

Measure the engine's back-pressure at the exhaust elbow while the generator is under a full load.

Dimension **A** cannot exceed 39 inches of water.

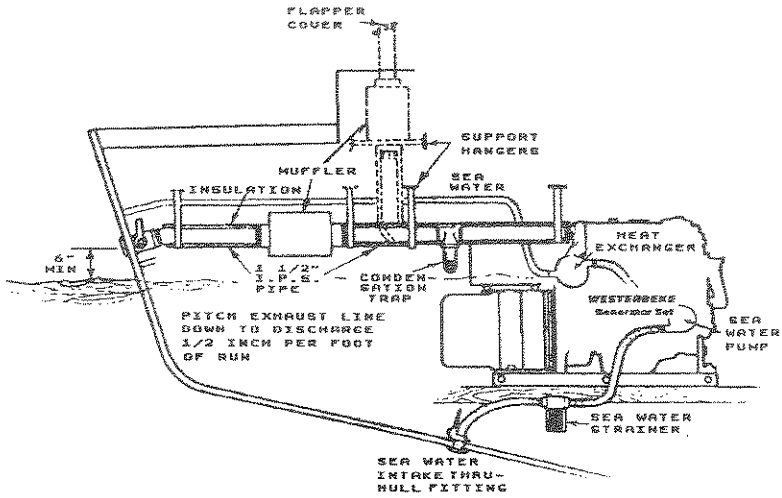
Back pressure, as measured by a gauge instrument, should not exceed the following specifications:



3 inches of mercury (0.104 kg/cm^2)
39 inches of water in a water column
(.099 kg/cm^2 at 4° C)
22 ounces psi
1 1/2 psi

Excessive back-pressure can be caused by a small diameter exhaust hose, a small muffler, sharp bends in the exhaust hose, improper fittings, water pockets, and a high volume of water in the exhaust system due to the length of the exhaust discharge hose. The use of elbows and fittings in the exhaust discharge hose's routing should be limited since these will create flow restrictions and contribute to exhaust back-pressure. The generator's exhaust system must be separate from any other engine's exhaust system. Dry portions of the exhaust system between the engine's exhaust manifold and the water injected exhaust elbow must be insulated to hold in the heat.

Dry stack-type exhaust systems (shown to the right) must be attached to the generator engine's exhaust manifold by means of a flexible connector pipe. This system must be properly supported and insulated to prevent water from entering into the engine's cylinders. Provisions must be made for discharging the engine's cooling sea water.



DRY STACK EXHAUST

Exhaust System Failures

When the engine's sea water is fed into an exhaust system so that the full stream of this water strikes a surface, erosion takes place. This erosion may cause premature failures. The proper design of either a water jacketed or water injected "wet" exhaust system to prevent this problem requires that the sea water inlet be positioned so that the entering stream of sea water does not directly strike a surface. In addition, the velocity of the entering sea water stream should be as low as possible, which can be achieved by having inlet fittings as big in diameter as possible.

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.

Make sure there are no unnecessary objects suspended from any portion of the exhaust lines. Excessive weight could cause deflection or distortion of the lines, resulting in damage or leaks. Inspect insulated portions of the exhaust system to ensure there is no deterioration of the insulation.

CAUTION

Prolonged cranking intervals without the engine starting can result in filling the engine-mounted exhaust system with sea water coolant. This may happen because the sea water pump is pumping sea water through the sea water cooling system during cranking. This sea water can enter the engine's cylinders by way of the exhaust manifold once the exhaust system fills. Prevent this from happening by closing the sea water supply thru-hull shut-off, drain the exhaust muffler, and correct the cause for the excessive engine cranking needed to obtain a start. Engine damage resulting from this type of sea water entry is not a warrantable issue; the owner/operator should keep this in mind.

Fuel System

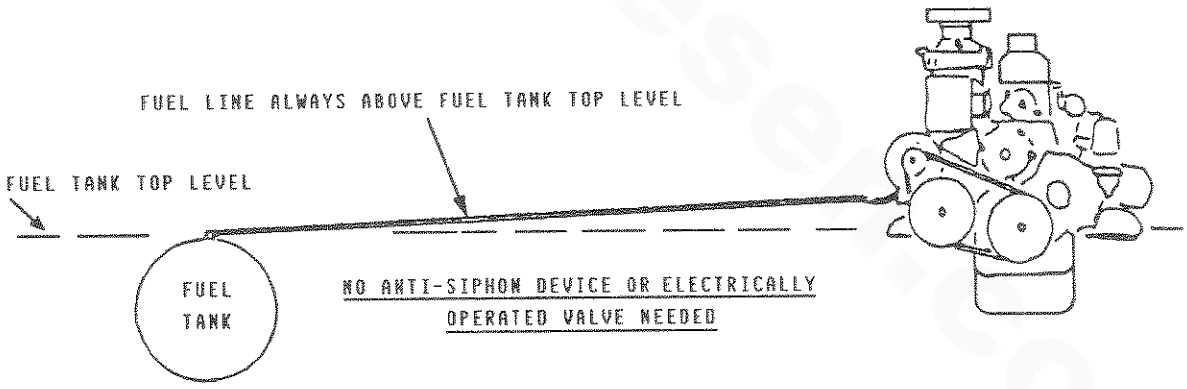
The generator must have its own fuel supply line; in other words, it must have its own pickup tubes and primary filter/water separator. **DO NOT** tee off another engine's fuel supply. Installations where the fuel tank(s) are at or above the generator, with the fuel supply lines to the engine's carburetor routed below the level of the fuel tank's top, must have a means of shutting off the fuel to the generator's engine when the engine is not running. This installation procedure helps guard against the possibility of gasoline siphoning through the supply line into the engine through the carburetor, should the carburetor float needle valve stick in the open position or not seat properly, or should the fuel line rupture between the engine and fuel tank.

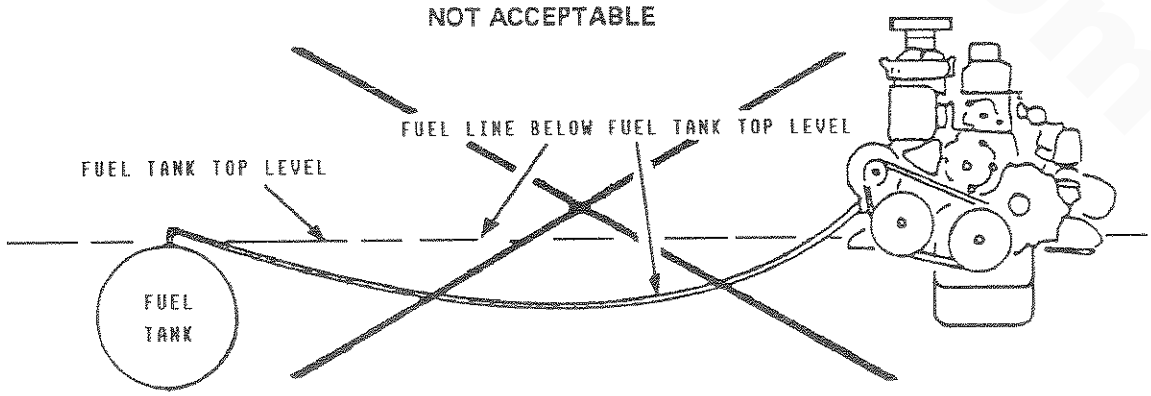
This (anti-siphon) shut-off valve can be electrically-operated (with a manual override) to open when the generator's engine is started, and closed down. A manually-operated valve can also be installed and should be operational from the generator's start/stop panel or from the vessel's deck. Installations where the generator is located above the fuel tank(s), whereby the routing of the fuel supply line to the generator's carburetor remains above the top level of the fuel tank, do not require this (anti-siphon) shut-off valve. A manually-operated service shut-off valve should be located between the fuel pickup at the tank and the service shut-off valve located at the fuel connection to the generator.

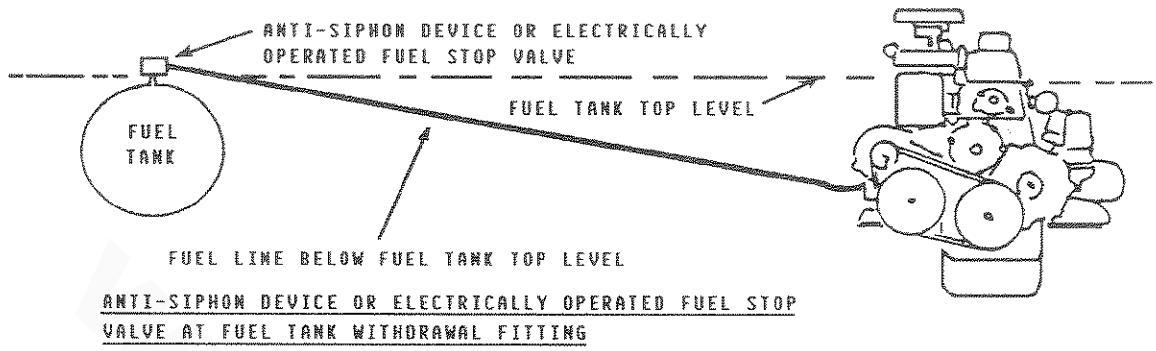
The two illustrations that follow were taken from the Coast Guard publication *Fuel System Compliance Guideline*. These illustrations show basic fuel system layouts that incorporate anti-siphon protection.

All fuel lines should be routed and supported to prevent leaks from vibration and chaffing. The line should be supported every 12 - 14 inches. Use as few connections as possible.

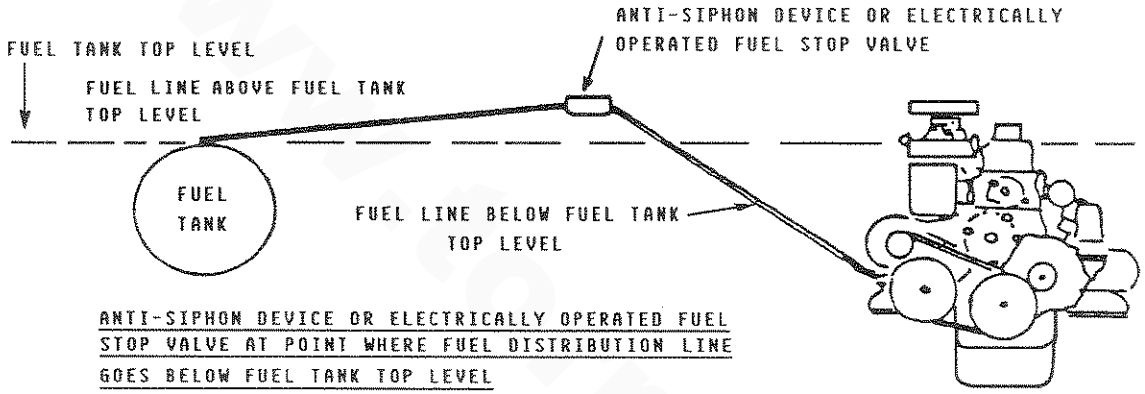
The fuel tank's vent should be located so that its discharge route cannot allow water to enter through to the fuel tank(s). Moisture must not be allowed to accumulate in the vent's line.







ANTI-SIPHON DEVICE OR ELECTRICALLY OPERATED FUEL STOP VALVE AT FUEL TANK WITHDRAWAL FITTING



ANTI-SIPHON DEVICE OR ELECTRICALLY OPERATED FUEL STOP VALVE AT POINT WHERE FUEL DISTRIBUTION LINE GOES BELOW FUEL TANK TOP LEVEL

NOTE: The use of mechanical spring type check valves instead of a solenoid shut-off valve is not recommended, as these may tax the fuel lift pump's ability to draw fuel through a check valve. A check valve can trap debris under its seat which inhibits the valve's ability to close. In addition, if a check valve's cracking pressure is too high, it may cause vapor lock.

Should a mechanical type, spring-loaded check valve be used, it should be of an adjustable type (that is, a Weatherhead #43 x 6). This adjustable type of valve should be adjusted to have a cracking pressure so as to prevent siphoning when the generator is not operating.

Strongly recommended is the installation of an approved filter/separator in the fuel supply between the fuel tank and the generator's engine to help remove contaminants in the fuel before the fuel reaches the engine-mounted fuel lift pump and carburetor.

WARNING

Gasoline leakage in or around the generator compartment is a potential cause of fire and/or explosion. Repair leaks promptly and ensure that the compartment is properly ventilated.

Oil Drain

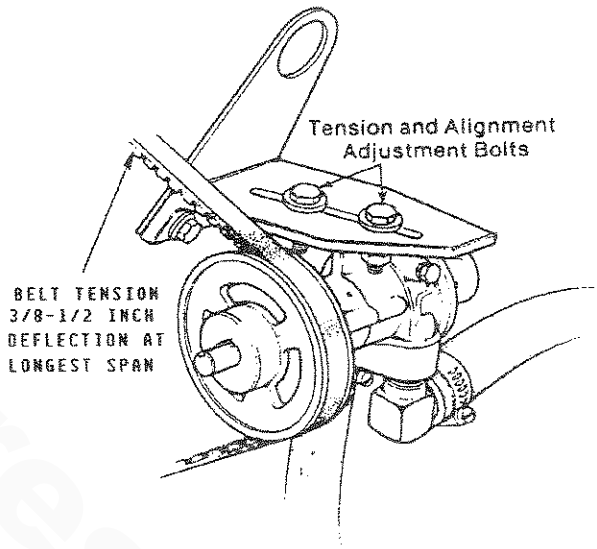
An oil sump drain hose is installed on the engine with the discharge end secured by a bracket at the front of the engine. Oil may be drained from this hose by removing the cap and the discharge end of the hose from the support bracket and lowering the hose into a container. The hose cap fitting is 1/4 inch NPT (National Pipe Tap) and can be extended, or have a pump added, for easier removal of the old oil, if desired.

Intake System

Make sure the intake system (sea water cooling system) is in proper order. Check that the hull inlet, sea cock and strainer are unobstructed. Sea cocks and strainers should be at least one size greater than the inlet thread of the sea water pump. The strainer should be of the type that may be withdrawn for cleaning while the vessel is at sea and should be mounted below the water line to ensure self-priming. Inspect the sea water lines to ensure there are no collapsed sections, which would restrict water flow. Make sure there are no air leaks at any of the connections.

Cooling System

The generator's engine is fresh water cooled by an engine-mounted heat exchanger. Sea water is used as the heat exchange's cooling medium. Sea water is pumped into the exchanger by a sea water pump and is then injected into the exhaust discharge, carrying with it the heat removed from the engine's fresh water cooling system.



Sea water should be supplied to the sea water pump through a flush-type hull fitting using a wire-reinforced hose between the thru-hull fitting and the sea water pump. This sea water should be directed through a visual-type sea water strainer and then delivered to the pump. Hoses routed from the thru-hull fitting to the strainer and to the sea water pump should be wire-reinforced to prevent the hose from collapsing during the generator's operation (suction from the pump may collapse a non-reinforced hose). Sea water strainers should be mounted at or below the water line to make sure the sea water line remains primed.

CAUTION

Do not use a scoop-type thru-hull fitting as a means of supplying sea water to the generator. Water pressure against this type fitting, while the vessel is under way, can push sea water past the sea water pump's impeller into the generator's exhaust system, filling it and the engine as well. Flush-type, clear, thru-hull fittings are recommended and should be located on the hull so as to be below the waterline during all angles of boat operation.

The use of common-type street elbows is not recommended for plumbing the sea water circuit. These generally have very restrictive inside diameters. Machined fittings are preferred.

Electrical System

The electrical system should be checked to ensure that all wiring harnesses are properly tied down with clamps or plastic ties and that all wiring harnesses are spaced at intervals close enough to prevent chafing from vibration. Check to ensure that all engine harness connections are tight and that they are made to the appropriate terminals.

DC Electrical Connections

A common ground for the negative (-) DC terminal connection is found at the bellhousing of the generator, next to the starter, in the form of a threaded grounding stud. The battery ground should be connected at this stud.

Connect the battery's positive (+) connection to the starter solenoid tagged for this connection.

CAUTION

To avoid an overcharging condition, and a possible equipment failure, **DO NOT** disconnect the DC battery source while the engine is running.

Grounding

The generator set must be grounded to comply with United States Coast Guard regulation 33CFR-183 which specifies that a common conductor be connected between the generator set and the vessel's main propulsion engine's grounded starter motor circuit. This conductor (the common ground) prevents accidental passage of cranking current through fuel systems and smaller electrical conductors common to the engines. This conductor must be the same size as the largest battery cable.

Automatic Shutdown

High Exhaust Temperature Shutdown Switch (normally closed)

An exhaust temperature switch is located on the exhaust elbow. This switch will open and interrupt the DC voltage to the ignition coil (which turns OFF the engine), should the switch's sensor indicate an excessive exhaust temperature (an inadequate supply of sea water coolant causes high exhaust temperatures). This switch opens at 260 - 270° F (127 - 132° C). This switch resets at approximately 225° F (107° C).

High Water Temperature Shutdown Switch (normally closed)

A high water temperature switch is located on the thermostat housing. This switch will open and interrupt the DC voltage to the ignition coil (which turns OFF the engine), should the fresh water coolant's operating temperature reach approximately 205° F (96° C). This switch resets at 195° F (107° C).

Low Oil Pressure Shutdown Switch (normally open)

A low oil pressure shutdown switch is located off the engine's oil gallery. The switch's sensor monitors the engine's oil pressure. Should the engine's oil pressure fall to 10 - 15 psi, the switch will open grounding out the ignition system by interrupting the DC voltage to the ignition coil (which turns OFF the engine).

High RPM Shutdown Switch

An overspeed shutdown switch shuts off the generator set by grounding out the ignition system should the engine's speed reach approximately 2175 rpm.

Generator (AC Output)

Make sure that the AC output connections within the generator's distribution box are tight and in accordance with the specific AC Load Connections diagram found later in this manual. (See the "BT GENERATOR" section of this manual, page 56.)

WARNING

Do not smoke or allow an open flame near batteries. Lead acid batteries emit hydrogen, a highly-explosive gas.

Batteries

Make sure the positive (+) battery connection is connected to the battery connection of the starting solenoid. The negative (-) battery connection should be connected to the system ground (the engine block).

WARNING

When servicing the battery or checking the electrolyte level, wear rubber gloves, a rubber apron, and eye protection. Battery acid may splash on the skin or into the eyes inadvertently when removing the electrolyte caps.

Check the battery's electrolyte level and specific gravity to ensure maximum engine starting efficiency. Make sure the battery's terminals are clean and tight.

Ventilation

The ventilation requirements of the generator sets include the following: combustion air is required for the engine cylinders; cooling air is required for the generator end and also for removing the heat produced by the generator's engine during operation; and ventilating air is required to clear the bilges below the generator, as well as the compartment in which the generator is located, of potentially toxic and flammable diesel fumes. Refer to the "SYSTEM SPECIFICATIONS" section of this manual for the airflow requirements of the generator sets, page 13 for the BTG 8.5KW, page 17 for the BTG 12.5KW, and page 21 for the BTG 15.0KW.

PREPARATIONS FOR STARTING

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

Take the steps described below in starting your engine for the first time or after a prolonged shutdown or lay-up.

Fill your engine with oil up to or near the upper limit on the dipstick (the installation angle of your generator set may have an effect on the dipstick reading). Select a readily available lubricating oil with an API specification of SC or SD and an SAE number suitable for the temperature in your operating area (see page 54). For the quantity of oil needed in your generator's engine, refer to the "SYSTEM SPECIFICATION" section of this manual, page 14 for the BTG 8.5KW, page 18 for the BTG 12.5KW, and page 22 for the BTG 15.0KW.

Each unit is supplied with a coolant recovery kit (part #24977) as standard equipment, to which the following applies:

A. Remove the pressure cap from the engine's exhaust manifold and slowly fill the engine's cooling system with a mixture of water and antifreeze suitable for your temperature zone. (See the "COOLING SYSTEM" section of this manual, page 50.) Replace the pressure cap on the manifold.

B. Make sure the plastic recovery tank is properly mounted near the unit (with the bracket provided) in a location where it can be monitored and filled easily (see page 50). The recovery tank should be mounted at manifold level or above.

C. Coolant should be added to the plastic recovery tank after the engine has been filled and started. After its operating temperature has been reached, ensure that all air is expelled out of the engine's manifold and the engine's cooling system. With the manifold filled and the pressure cap installed, fill the plastic recovery tank half full. Monitor this recovery tank daily and add coolant as needed.

Fill the fuel tank with unleaded or leaded gasoline that has an octane rating of 89 or better.

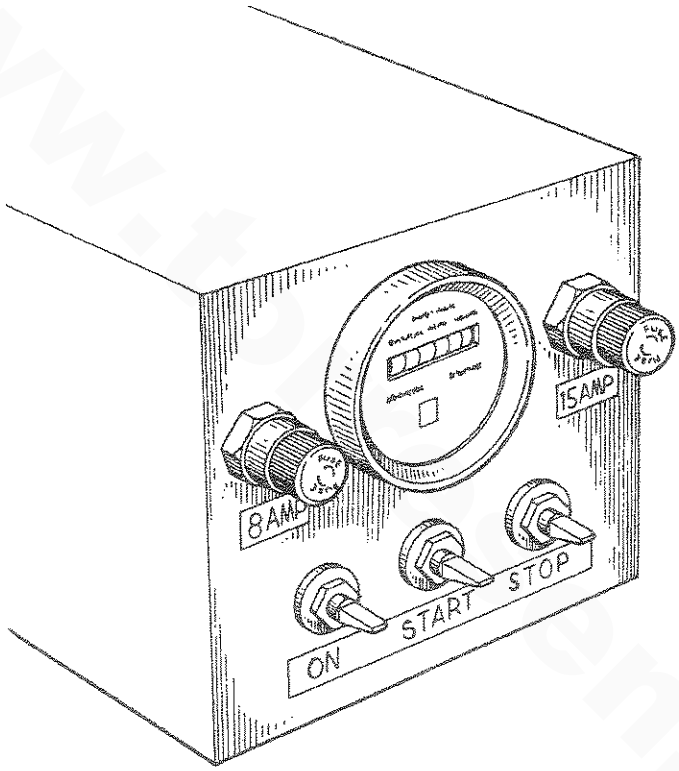
Ensure that the Installation Checks have been made in accordance with those specified in the "INSTALLATION CHECKS" section of this manual (refer to page 24) and that there is no AC load on the generator.

STARTING PROCEDURE

WARNING

CARBON MONOXIDE EXHAUST GAS IS DEADLY

Ventilate the generator compartment for a minimum of 5 minutes prior to starting the generator. The ventilating blowers remove potentially explosive gasoline fumes from the generator compartment and bilge.



Standard Instrument Panel,
Switches and Gauges

1. Depress the ON switch and hold it depressed for 5 to 15 seconds to ensure that the fuel system on the engine is primed to the carburetor. Continuing to depress the ON switch, proceed to step #2.

2. Depress the START switch. When the generator starts, release only the START switch. Keep the ON switch depressed for a few seconds longer. (Keeping the ON switch depressed bypasses the oil pressure shutdown circuit until the oil pressure rises enough to override the circuit and maintain the ignition circuit.)

3. Release the ON switch.

NOTE: The engine has an electric choke which is automatically operated when the engine is started.

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 the unanticipated operation of AC machinery and will prevent a cold engine from stalling.

CAUTION

Prolonged cranking intervals without the engine starting can result in filling the engine-mounted exhaust system with sea water coolant. This may happen because the sea water pump is pumping sea water through the sea water cooling system during cranking. This sea water can enter the engine's cylinders by way of the exhaust manifold once the exhaust system fills. Prevent this from happening by closing the sea water supply thru-hull shut-off, drain the exhaust muffler, and correct the cause for the excessive engine cranking needed to obtain a start. Engine damage resulting from this type of sea water entry is not a warrantable issue; the owner/operator should keep this in mind.

Once the engine starts, check instruments (if instruments are installed) for proper oil pressure and battery charging voltage. Never attempt to engage the starter while the engine is running. Apply a light load to the generator and allow the engine's operating temperature to come up to 110 - 120° F (44 - 49° C) before applying any heavy loads.

NOTE: Some unstable running may occur in a cold engine, but this condition should smooth out as the operating temperature is reached (130 - 150° F [55 - 66° C]) and when a load is applied to the generator.

STOPPING PROCEDURE

1. Remove the AC electrical load from the generator and allow the generator to run for 3 to 5 minutes to stabilize its operating temperatures.

2. Depress the STOP switch and hold it until the generator is completely stopped.

3. Now release the STOP switch.

Break-In Precautions

Because the generator set operates at 1800 rpm to produce 60 Hertz, or at 1500 rpm to produce 50 Hertz, control of the generator's engine break-in is governed by the current drawn from the generator.

Do not attempt to break-in your generator set by running it without a load.

Upon starting the generator set, check for proper operation and then encourage a fast warm-up. For the first 10 hours of the generator's operation, run the generator set between 20 and 60 percent of full-load.

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

Avoid overload at all times. An overload is signalled 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.

Be aware of motor starting loads and the high current draw required for starting motors (see page 65 for an "Amps for Starting" chart).

Starting Under Normal Conditions

Follow the procedure below for routine starting of the generator:

Check the engine's lubricating oil level prior to each day's use. Add oil as needed and maintain the oil level at the high mark on the dipstick.

Check the coolant level in the plastic recovery tank.

> NOTE: Excessive loss of fresh water coolant from the plastic recovery tank indicates a cooling system leak. Check the entire cooling system; pressurize the system to locate the leak. In cases of excessive coolant loss, the system must be refilled as outlined under the "PREPARATIONS FOR STARTING" section of this manual, page 35.

Visually examine the unit; look for any abnormalities and correct them as needed.

Check to ensure that there is sufficient fuel in the tank and examine the filter/separator bowls for contaminants. Clean and drain the bowls as needed.

Start the generator, following the procedure outlined in the "STARTING PROCEDURES" section on the previous page, and allow the engine's operating temperature to reach 130 - 150° F (55 - 66° C) before placing the generator under a heavy load.

Starting Under Cold Conditions

Under extremely cold temperatures, the following conditions can occur. Follow the instructions listed below when operating your generator set in cold weather.

LUBRICATING OIL TURNS VISCOUS - Make certain that the lubricating oil used conforms with the ratings for the prevailing atmospheric temperature. Refer to the "LUBRICATION SYSTEM" section of this manual, page 54, for an atmospheric/oil viscosity specification table.

VOLTAGE ACROSS BATTERY TERMINALS DROPS - Make certain that the battery is fully charged to minimize voltage drop across the battery terminals.

Engine parts from Torrsen Marine - www.torresen.com - 231-759-8596

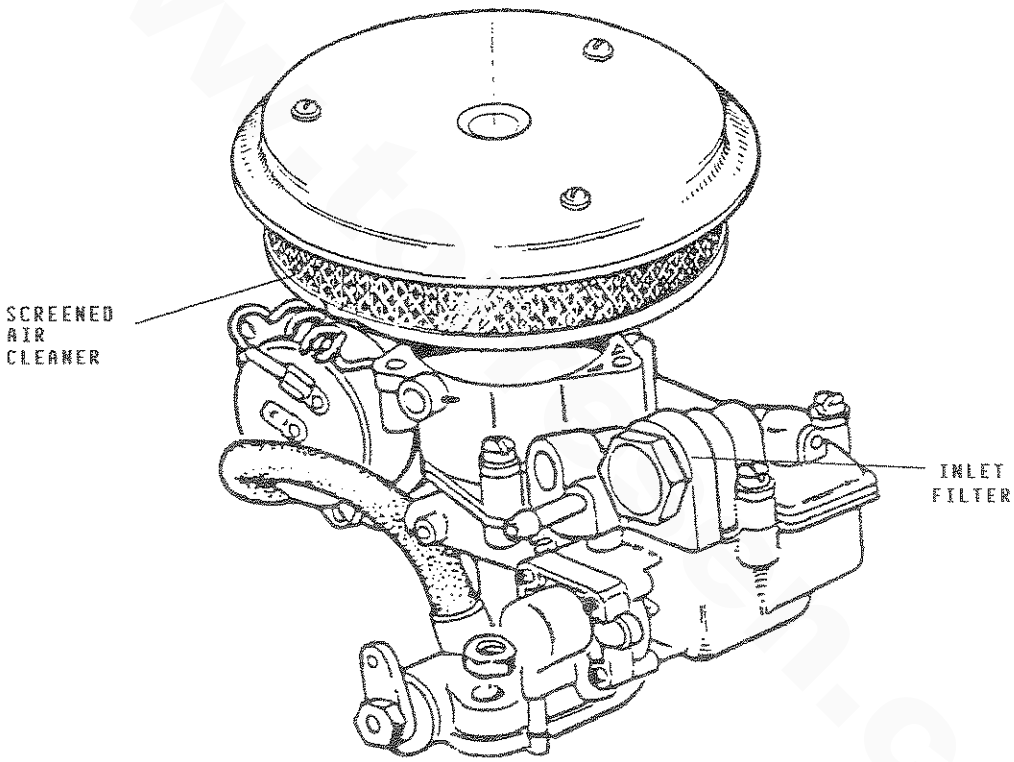
CARBURETOR AND FUEL SYSTEM

Gasoline

Use unleaded or leaded gasoline with an octane rating of 89 or better.

In cold weather particularly, water vapor is produced by condensation when air is present in the fuel tank. Keep fuel tank(s) full and completely free of dirt and water.

The carburetor is a single barrel down draft type with a metal screened air intake filter which is cleanable.

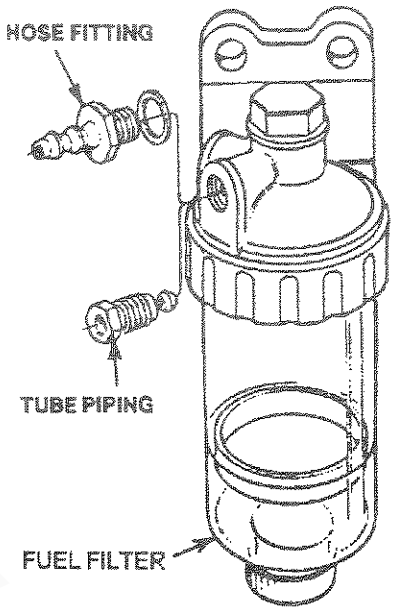


Optional Fuel Filter

A primary fuel filter of the water entrapment type should be installed between the fuel tank and the engine. Such a filter, shown here, is available from your local Westerbeke representative or your boatbuilder. This filter, adapted for the boatbuilder's use, comes complete with fittings for either hose or metal tubing. Mount it in an accessible place, inspect it often, and drain off water accumulation frequently.

If a water trap type filter is not installed between the fuel tank and the engine-mounted fuel system, any water in the fuel system will tend to inhibit proper starts. In addition, particles will pass on to the lift pump's filter, clogging it in time.

Although most boatbuilders supply a water trap/filter, some do not. Westerbeke offers a sedimenter/water trap/filter as an optional extra at moderate cost. The filter is supplied with fittings for either hose or metal tubing fuel lines.



INSTALLATION INSTRUCTIONS

1. BOLT SEDIMENT/WATER TRAP SECURELY TO AN ACCESSIBLE STRUCTURE SO POSITIONED THAT A RECEPTICLE TO CATCH DRAINAGE CAN BE PLACED UNDER IT.
2. IF FUEL IS TO BE PIPED WITH COPPER, OR BUNDY TUBING, USE NUTS AND FERRULES PROVIDED. BE SURE THE TUBING PROJECTS 1/4 INCH THROUGH THE FERRULE BEFORE TIGHTENING THE NUT.
3. IF FUEL IS TO BE PIPED WITH HOSE, USE THE TWO BRASS BARBED FITTINGS AND WASHERS SUPPLIED. BE CERTAIN THAT THE HOSE SELECTED HAS DIAGONAL BRAID INSERTED (TO CLING ON THE BARB), THAT IT IS NEOPRENE LINED, AND THAT IT IS USCG APPROVED.
4. IF WATER IS PRESENT IN THE FUEL, IT WILL COLLECT SLOWLY IN THE BOTTOM OF THE SEDIMENTER. WHEN THE RED FLOAT RING REACHES THE DRAIN LINE ON THE PLASTIC BOWL, LOOSEN THE BOTTOM DRAIN PLUG UNTIL ALL WATER RUNS OUT.
5. TIGHTEN DRAIN PLUG SECURELY SO NO AIR CAN ENTER THE SYSTEM.
6. ENERGIZE THE FUEL PUMP TO REFILL THE BOWL.

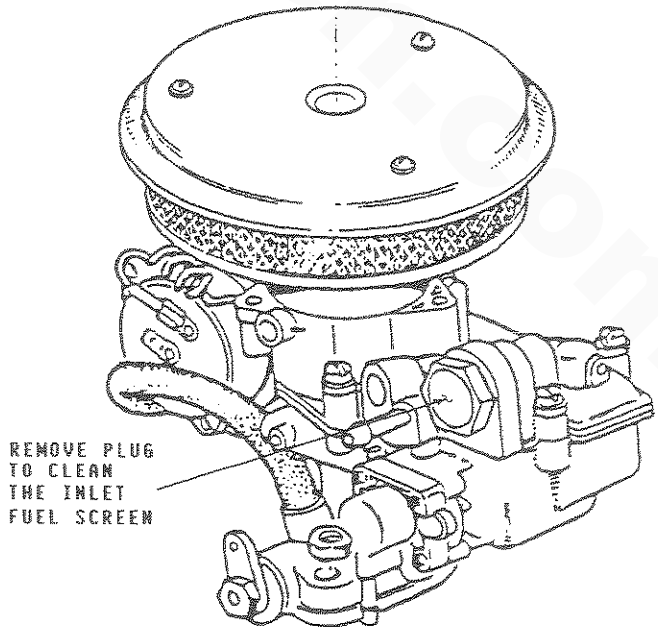
Replacing Filter Elements

Generator models covered by this manual have two fuel filter screens. One is in the carburetor (this filter is referred to as the inlet filter screen).

To remove this filter screen, unscrew the filter plug and remove the fuel filter screen behind the plug.

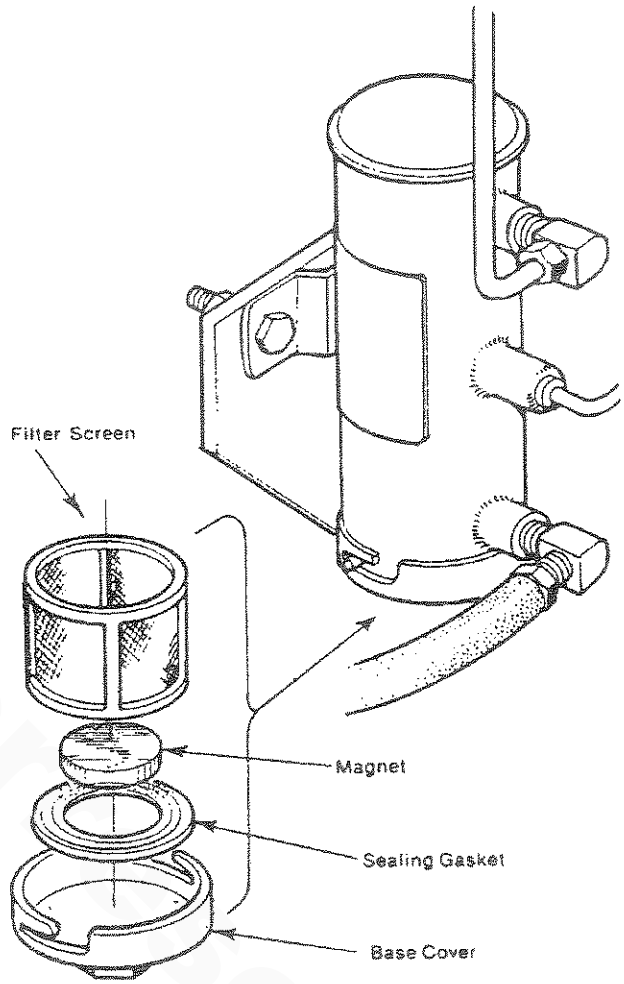
Clean the filter screen or replace it with a new one.

Periodically check this filter screen.



The engine-mounted electric lift pump contains the second fuel filter screen. This pump supplies fuel to the engine's carburetor during engine operation. A cleanable filter screen is contained in the pump's base.

Remove the base by placing a wrench on the hex nut and twisting it loose from the bayonet fittings. Clean the screen as needed. A new base gasket *must* be installed each time the pump base is removed and reinstalled. Ensure a good seal when replacing the base cover.



WARNING

Shut off the fuel service valve at the engine when servicing the fuel system. Take care in catching any fuel that may spill from within the pump when the base is removed. **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.

Engine parts from Torrsen Marine - www.torresen.com - 231-759-8596

Engine 12-Volt DC Control Circuit

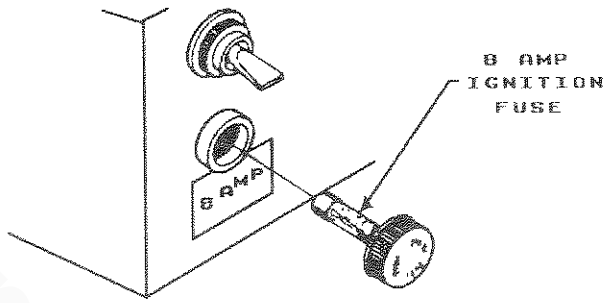
The engine that drives the generator end has a 12-Volt DC electrical control circuit, as shown on the wiring diagrams which follow on pages 46 and 47. Refer to these diagrams when troubleshooting or servicing electrical components on the engine.

CAUTION

To avoid damage to the battery's charging circuit, never shut off the engine's battery switch while the engine is running.

However, shut off the engine's battery switch to avoid electrical shorts when working on the engine's electrical circuit with the engine stopped.

An overspeed shutdown switch shuts off the generator set should the engine's speed reach approximately 2175 rpm. This shutdown circuit consumes 25 milliamps (.25 or 1/4th of an Amp) at all times once the generator is connected to its battery. As this only amounts to about 18 Amp-hours in a month, it is unnecessary to be concerned with this slight discharge during normal seasonal operation. If the generator set were to be unattended for many months, the two easiest ways to stop this slight drain is to first turn off the main battery switch providing 12 volts to the generator set. The second way to stop this slight drain is to remove the ignition fuse on the generator-mounted control panel.



Should the generator shutdown from an overspeed condition, the overspeed circuit must be reset in order to restart the generator. If the overspeed switch itself is faulty and resetting it by depressing the STOP switch will not reset it, lift the T-1 coil connection from the overspeed switch and connect it together with the T-2 connection on the switch. (DO NOT connect these wires together as loose ends. Make sure that both the T-1 and T-2 terminal wires are connected to the T-2 terminal.) DO NOT operate the generator with the overspeed switch bypassed. Bypass the overspeed switch only for testing purposes. Replace the overspeed switch to maintain this safety circuit's integrity.

Battery Specification

The minimum recommended capacity of the battery used in the engine's 12-Volt DC control circuit is 90 - 125 Ampere-Hours (minimum) for the generator sets covered by this manual.

CAUTION

When quick-charging the battery with an external charger, be sure to disconnect the battery cables from the battery. Leaving the charging circuit connected while quick-charging will damage the alternator's diodes.

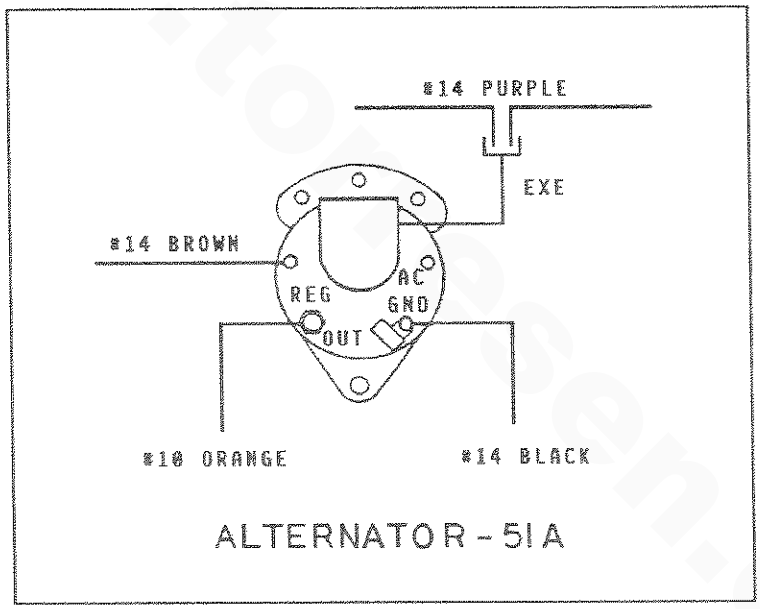
CAUTION

When testing the alternator circuit (charging circuit), do not use a high-voltage tester such as a megger; damaged diodes could result. When operating the generator, do not disconnect the positive terminal of the battery from the (**OUT**) output terminal of the alternator, nor disconnect the negative terminal of the battery from the ground. When cleaning the engine/generator with a steam cleaner, be careful to keep steam away from the alternator.

The charging system consists of an alternator with an internal voltage regulator, an engine-mounted circuit breaker, and a battery and connecting wires. Because of the use of IC's (integrated circuits), the electronic voltage regulator is very compact and is built into the rear bracket of the alternator.

Charging Voltage Test

If you suspect that the alternator is not producing enough voltage to charge the engine's battery, perform the following voltage test.



Interconnections for Charging Voltage Test

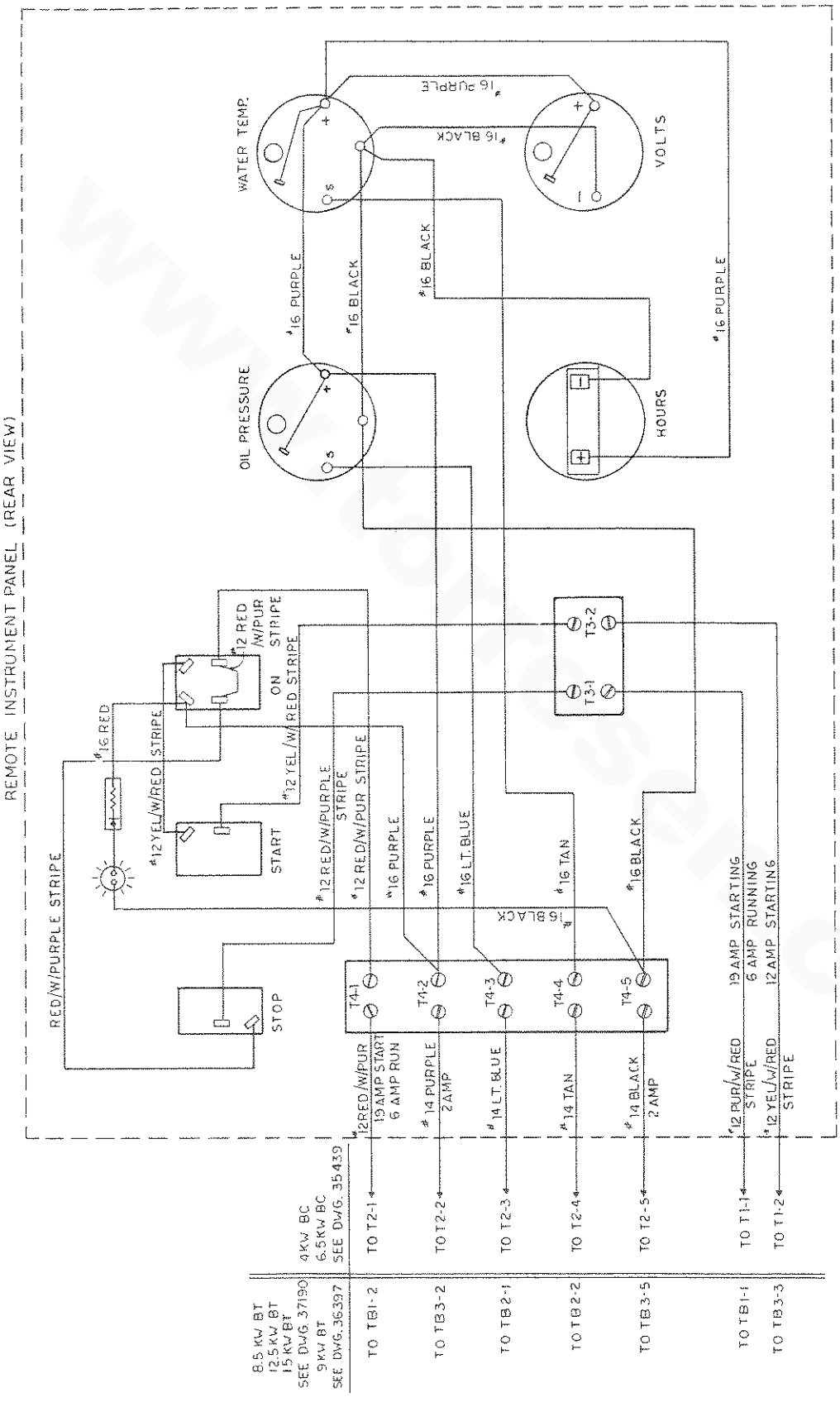
1. Using a voltmeter, connect the voltmeter's red wire clip to the (**OUT**) output terminal on the alternator. Refer to the schematic shown above.

2. Connect the other voltmeter wire clip to a ground on the engine.

3. Start the generator and record the reading given by the voltmeter.

The voltage reading for a properly operating alternator should be between 13.5 to 14.5 volts. If your alternator is over or under charging, have it replaced or rebuilt by a reliable service shop. Before removing the alternator for repair or replacement, ensure that 12-Volts excitation is present at the **EXC** connection with the ON switch depressed, should the above test show only battery voltage at the (**OUT**) output terminal. The **EXC** connection must have 12-Volts present while the ON switch is depressed, since this constitutes excitation voltage for the alternator's regulator.

OPTIONAL REMOTE INSTRUMENT PANEL WIRING DIAGRAM # 35698



DC WIRING DIAGRAM #37190

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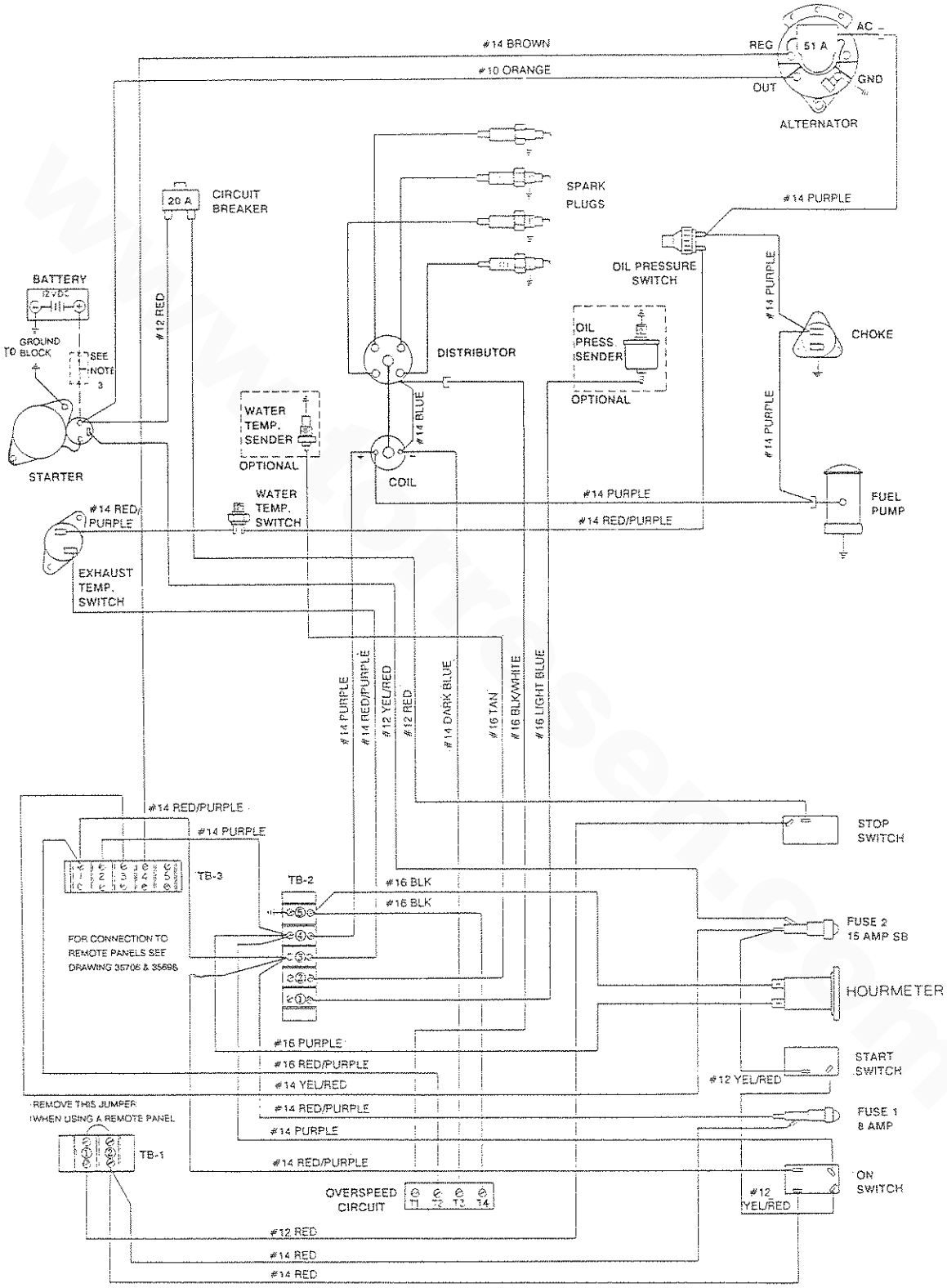
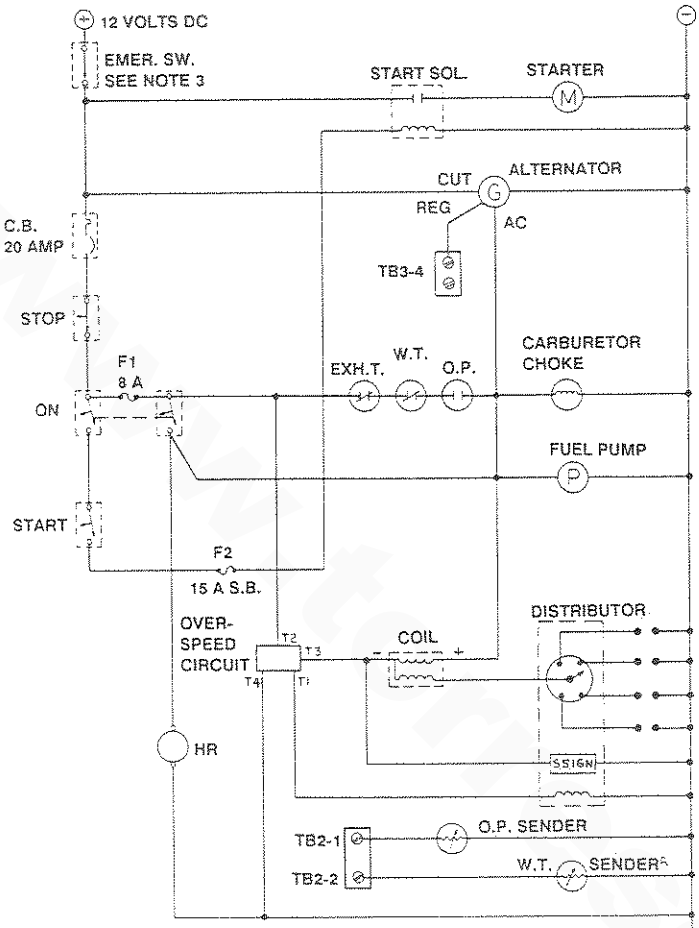


DC WIRING DIAGRAM #37190



NOTES:

1. WESTERBEKE GASOLINE MARINE GENERATORS AS SHIPPED FROM THE FACTORY AND EXCLUSIVE OF OPTIONAL REMOTE INSTRUMENT OR CONTROL PANELS COMPLY WITH U.S. COAST GUARD 33CFR-183. ACCESSORY INSTRUMENT AND CONTROL PANELS DO NOT NECESSARILY SO COMPLY AND ARE INTENDED TO BE INSTALLED ABOVE THE DECK AND ISOLATED FROM GASOLINE SOURCES IN ACCORDANCE WITH 33CFR-183.410(B).

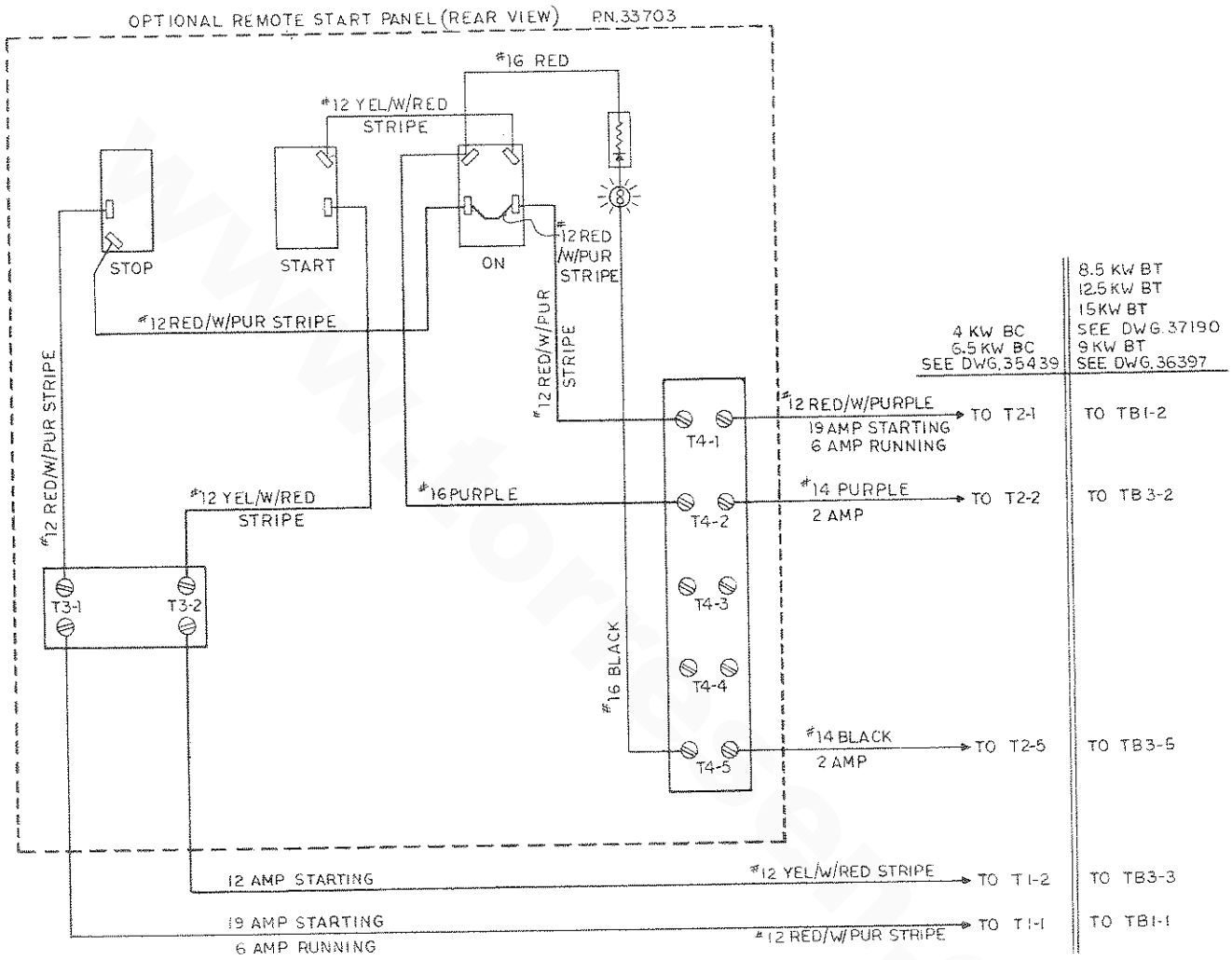
   IT IS THE RESPONSIBILITY OF THE BOAT MANUFACTURER TO ENSURE THAT THE INSTALLATION OF THESE GENERATORS, AND OPTIONALLY THEIR REMOTE INSTRUMENT PANELS, COMPLY WITH 33CFR-183.

2. THIS PRODUCT IS PROTECTED BY A MANUAL RESET CIRCUIT BREAKER LOCATED NEAR THE STARTER AND AS CLOSE AS POSSIBLE TO THE SOURCE OF CURRENT. EXCESSIVE DRAIN ANYWHERE IN THE INSTRUMENT PANEL, WIRING OR ENGINE WILL CAUSE THE BREAKER TO TRIP. IN THIS EVENT, THE ENGINE WILL SHUT DOWN BECAUSE THE OPEN BREAKER WILL DISCONNECT THE FUEL SUPPLY. THEREFORE, THE BUILDER/OWNER MUST BE SURE THAT THE INSTRUMENT PANEL, WIRING AND ENGINE ARE INSTALLED TO PREVENT CONTACT BETWEEN ELECTRICAL DEVICES AND SEA WATER.

3. AN ON-OFF SWITCH MUST BE INSTALLED TO DISCONNECT THE STARTER FROM THE BATTERY IN AN EMERGENCY AND WHEN LEAVING THE BOAT. TWELVE VOLT STARTERS TYPICALLY DRAW 200 TO 300 AMPS WHEN CRANKING. THE DURATION OF INDIVIDUAL CRANKING CYCLES SHOULD NOT EXCEED 30 SECONDS. A SWITCH WITH A CONTINUOUS RATING OF 175 AMPS AT 12 VOLTS WILL NORMALLY SERVE THIS FUNCTION, BUT A SWITCH MUST NOT BE USED TO MAKE THE CIRCUIT.

4. SENDERS ARE SUPPLIED WITH AN OPTIONAL INSTRUMENT PANEL.

OPTIONAL REMOTE START PANEL WIRING DIAGRAM # 35706



MINIMUM WIRE GAUGES (AWG)

WIRE LENGTH FROM GENERATOR TO REMOTE PANEL

Terminals	0-16'	16-20'	20-25'	25-32'	32-40'	40-50'	50-65'
TB1-1 to TB3-1	#12	#10	#10	#8	#8	#6	#6
TB1-2 to TB3-2	14	12	12	10	10	8	8
TB2-1 to TB4-1	14	14	12	10	10	8	8
TB2-2 to TB4-2	14	14	14	14	14	14	14
TB2-3 to TB4-3	14	14	14	14	14	14	14
TB2-4 to TB4-4	14	14	14	14	14	14	14
TB2-5 to TB4-3	14	14	14	14	14	14	14

COOLING SYSTEM

Description

Westerbeke marine gasoline engines are designed and equipped for fresh water cooling. Heat produced in the engine by combustion and friction is transferred to the fresh water which circulates throughout the engine. This circulating fresh water cools the engine block and its internal moving parts. The heat is transferred externally from the fresh water to sea water by means of a heat exchanger, similar in function to an automotive radiator. Sea water flows through the tubes of the heat exchanger while fresh water flows around the tubes; engine heat transferred to fresh water is conducted through the tube walls to the sea water which is pumped into the exhaust system and discharged overboard. In basic terms, the engine is cooled by fresh water, the fresh water is cooled by sea water, and the sea water carries the transferred heat over the side through the exhaust system. The fresh water and sea water circuits are independent of each other. Using only fresh water within the engine allows the cooling water passages to stay clean and free from harmful deposits. The two independent circuits and their components are discussed in the following paragraphs.

Fresh Water Circuit

> NOTE: Refer to paragraphs **A** and **B** in this section on the recommended antifreeze and water mixture to be used as the fresh water coolant, and for information on filling the fresh water system.

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

A. Fresh Water Coolant (Antifreeze) Mixture.

It is recommended that a freshwater and antifreeze mixture be used year-round. Water, when it freezes, expands sufficiently to split the heat exchanger and crack the engine block. A water/antifreeze mixture of proper concentration will prevent freezing (see page 50 for an antifreeze/water mixture chart).

Use soft water with few impurities, such as tap water (potable water) or rainwater. Never use hard or foul water. Use of hard water or water containing impurities will lead to the collection of scale in the engine and heat exchanger which will reduce the cooling system's efficiency.

Antifreeze of poor quality or without rust inhibitors will cause corrosion within the cooling system. Always use antifreeze which is compatible with aluminum cooling system components and which is made by a reliable manufacturer. Never mix different brands of antifreeze.

Make sure that the cooling system of the engine is well cleaned before adding antifreeze.

Recommended antifreeze for year round use is ZEREX or PRESTONE with rust inhibitors.

In order to control the concentration of the mixture, mix the antifreeze and fresh water thoroughly before adding it to the cooling system.

ANTIFREEZE ADDITION DATA

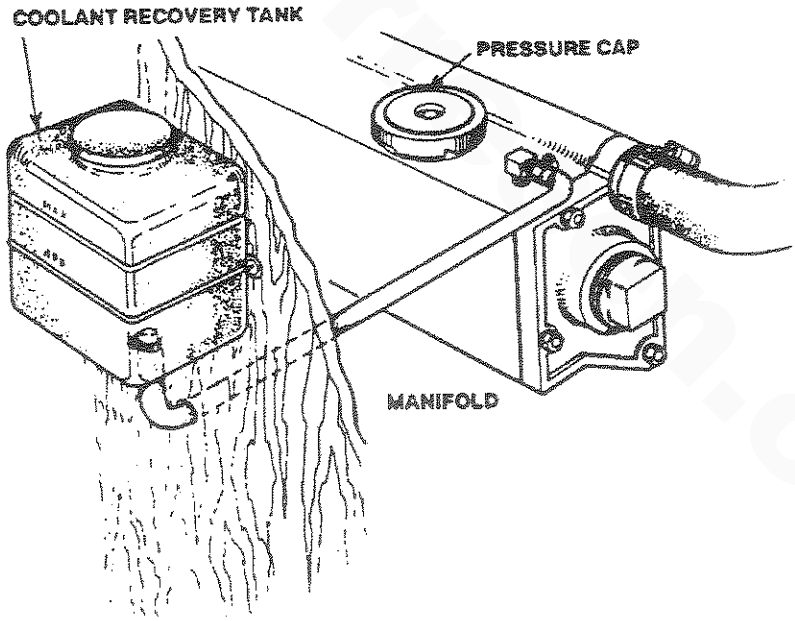
Antifreeze Concentration	%	13	23	30	35	45	50	60
Freezing Temperature	° F	23	14	5	-4	-22	-40	-58
	(° C)	(-5)	(-10)	(-15)	(-20)	(-30)	(-40)	(-58)

NOTE: It is advisable that the antifreeze concentration be selected on the basis of a temperature which is about 10° F (5° C) lower than the actual atmospheric temperature expected.

B. Filling the Fresh Water System

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

This coolant recovery tank should be installed at, or above, the engine's manifold level, in a location where it can be easily monitored and where coolant can be easily added if needed (see the figure below). A stainless steel mounting bracket is supplied with each kit along with a 30-inch length of clear plastic hose and clamps to connect the hose between the engine's manifold fitting to the hose spud on the base of the recovery tank.



Coolant Recovery Tank, Recommended Installation

Coolant from the engine, when heated during the engine's operation, will expand, lift the spring-loaded manifold pressure cap, and enter the recovery tank via the hose connecting the recovery tank to the manifold.

When the engine is shut down and cools, a small check valve in the pressure cap is opened by the contraction of the engine's coolant, allowing some of the coolant in the recovery tank to be drawn back into the engine's cooling system, free of air and without loss.

Fill the fresh water system as follows:

1. Remove the pressure cap from the manifold.

2. Pour a clean, fresh water coolant mixture into the manifold and allow enough time for the coolant to fill the fresh water cooling system and expel all air.

3. Replace the pressure cap on the manifold.

4. Remove the plastic cap from the coolant recovery tank and fill the tank with coolant halfway between the **ADD** mark and the **MAX** mark. Replace the cap on the manifold.

5. Start and run the engine long enough for the engine to warm up so that the thermostat will open, allowing the coolant to flow through the engine block and to the rest of the fresh water cooling system.

6. Add coolant to the recovery tank, as required, to top off the fresh water cooling system.

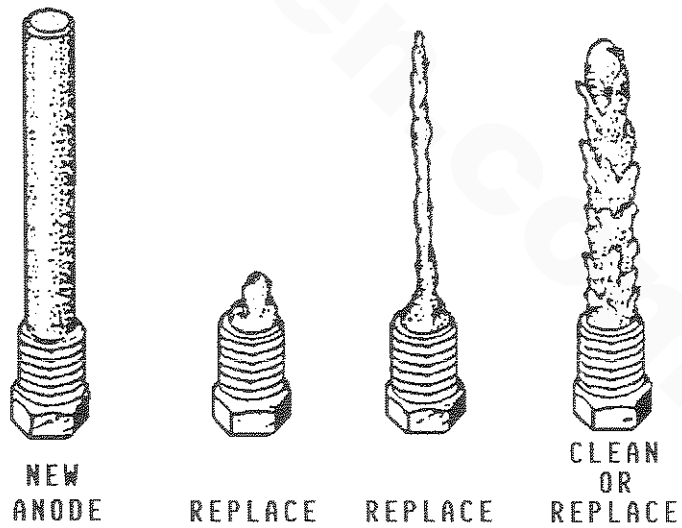
Thermostat

Generally, thermostats are of two types. One is simply a choking device which opens and closes as the engine's temperature rises and falls. The second type has a bypass mechanism. Usually this is a disc on the bottom of the thermostat which moves downward to close off an internal bypass passage within the head. Since 1980, each type of thermostat has a hole punched through it. The hole is a bypass to prevent the exhaust manifold from overheating during the engine's warm-up. Replacement thermostats must have this design characteristic.

Sea Water Circuit

The sea water flow is created by a belt-driven, positive displacement, neoprene impeller pump. The pump draws sea water directly from the ocean through the sea cock and sea water strainer and passes the water to the heat exchanger's sea water inlet. The sea water passes through the heat exchanger's tubes, from which heat from the fresh water system is absorbed and then is discharged from the cooling system overboard through the water-injected wet exhaust system.

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



Zinc Anode Conditions

Sea Water Pump

The sea water pump is a self-priming, belt-driven 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. There should always be a spare impeller and impeller cover gasket on board (an impeller kit).

Alternator (DC) and Water Pump Drive Belt Tension

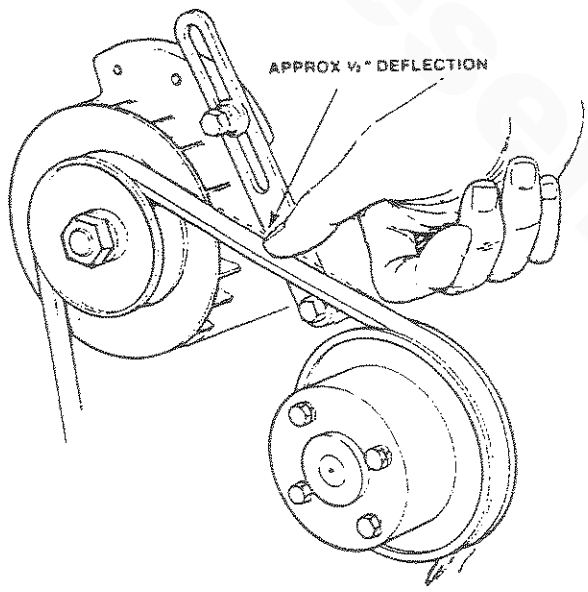
WARNING

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

CAUTION

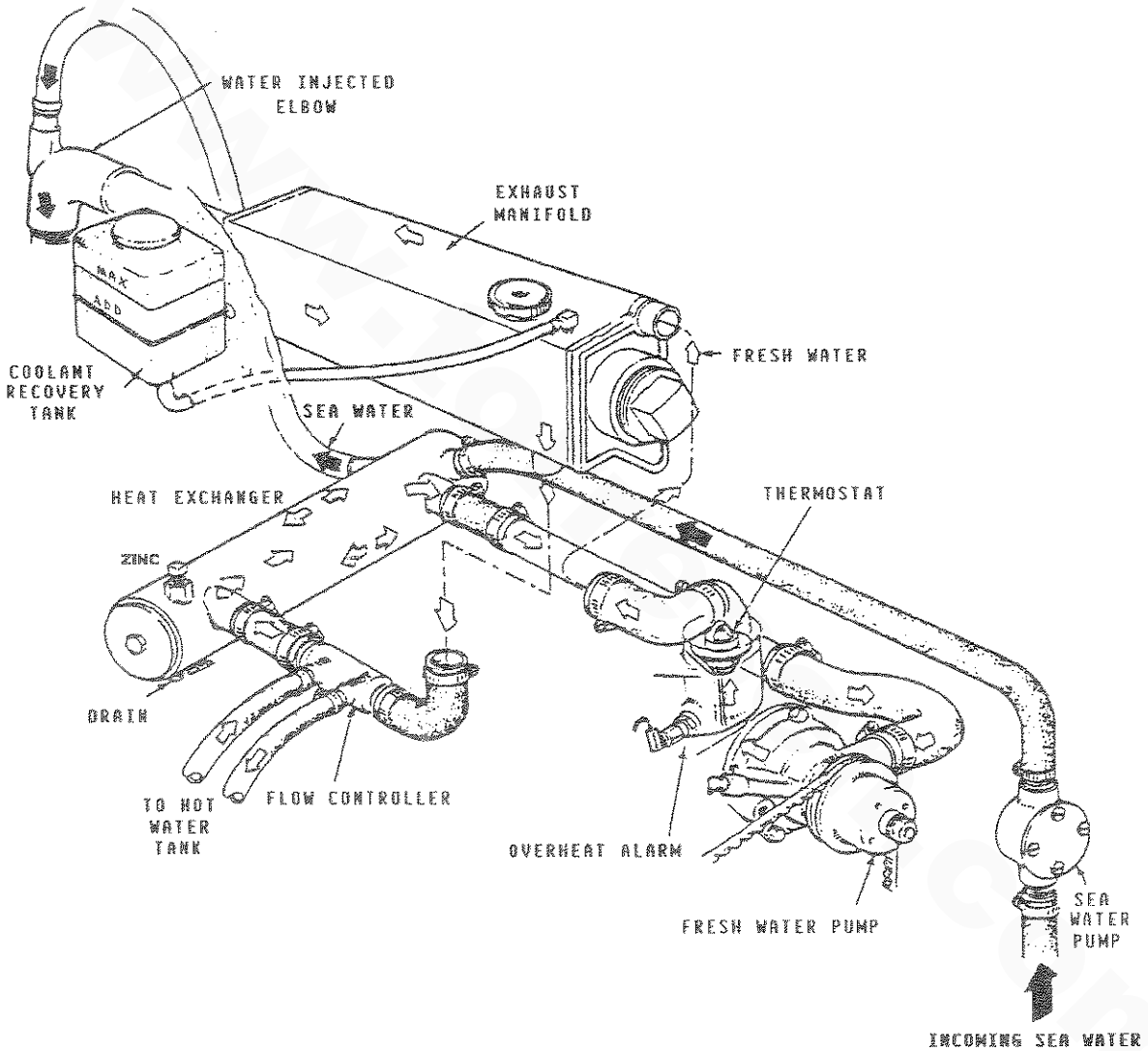
Excessive alternator and water pump drive belt tension can cause rapid wear of the belt and reduce the service life of the fresh water pump and alternator shaft bearings. Excessive slack or the presence of oil on the belt can cause belt slipping, resulting in high operating temperatures, as well as insufficient alternator output.

The alternator and water pump drive belt is properly adjusted if the belt can be deflected no less than 3/8 inch and no more than 1/2 inch (10 mm, 12 mm) as the belt is depressed with the thumb at the midpoint between the two pulleys on the longest span of the belt. (See the figure below.) A spare drive belt should be carried on board.



Alternator and Water Pump Belt Tension

Illustrated below is a typical Westerbeke engine's cooling system. Both fresh water and sea water flow through their independent cooling circuits. Please refer to the Parts List for individual part numbers and descriptions for your specific cooling system.



Typical Cooling System

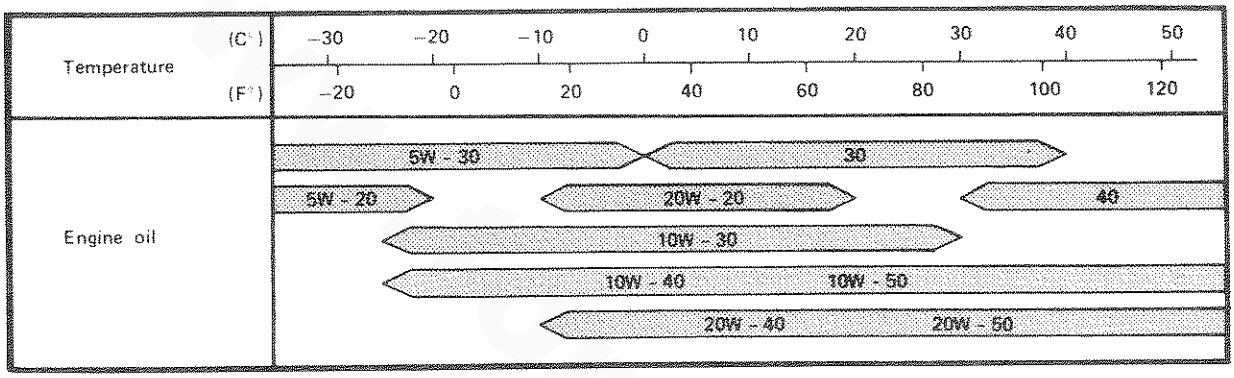
LUBRICATION SYSTEM

Engine Oil

For the engine's lubrication, use a lubricating oil designated for gasoline service. Use a good grade of oil having an API specification of SD or SE, preferably SE. DO NOT use oils designated DS.

Engine Oil Viscosity (SAE Number)

Use oil having a viscosity best suited to the atmospheric temperature. Refer to the oil viscosity chart below.



Oil Pressure

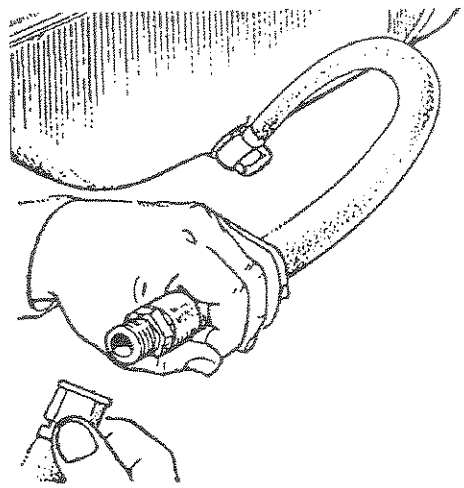
The engine's oil pressure is indicated by the oil pressure gauge (when equipped with one) or is monitored by the standard oil pressure switch.

During normal operation, the engine's oil pressure will range between 35 and 55 psi (engine hot).

> NOTE: A newly started, cold engine can have an oil pressure reading upwards of 60 to 80 psi. A warmed engine can have an oil pressure reading as low as 35 psi. These readings may also vary depending upon the load that is placed on the generator.

Your generator set is fitted with an oil pressure sensing switch as standard equipment. Should your engine's oil pressure drop below a safe operating pressure, the sensor will shut the engine OFF to prevent any internal damage to your generator's engine from occurring by interrupting the DC voltage to the ignition coil.

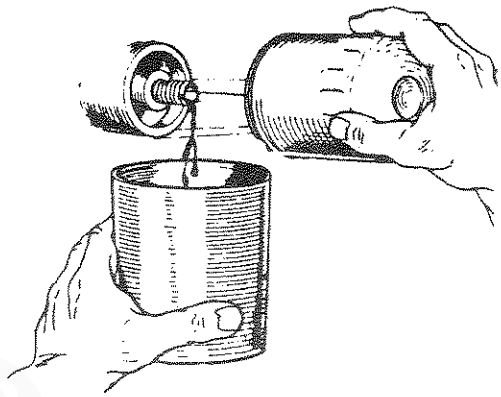
Engine Oil Change (to include filter)



1. Draining the Oil Sump

Discharge the old oil through the sump drain hose (attached at the front of the engine) while the engine is still warm. Drain the old oil completely, replace the hose in its bracket, and replace the end cap securely.

Always observe the old oil as it is removed. A yellow/gray emulsion indicates the presence of water in the oil. Although this condition is rare, it does require prompt attention to prevent serious damage. Call a competent mechanic should water be present in the oil. Sea water present in the oil can be the result of a fault in the exhaust system attached to the engine, and/or water siphoning through the sea water cooling circuit into the exhaust, filling it up into the engine (refer to the exhaust illustrations on pages 27 and 29).



2. Replacement of the Oil Filter

When removing the used oil filter, you may find it helpful and cleaner to punch a hole in the upper and lower portion of the old filter to drain the oil from it into a container before removing it. This helps to lessen spillage. A small style automotive filter wrench should be helpful in removing the old oil filter. Place some paper towels and a plastic bag around the filter when unscrewing it to catch any oil left in the filter. (Oil or any other fluid on the engine reduces the engine's cooling ability. Please keep your generator's engine clean.) Inspect the old oil filter as it is removed to make sure that the rubber sealing gasket came off with the old oil filter. If this rubber sealing gasket remains sealed against the engine block, gently remove it. The replaceable cartridge-type oil filter requires no cleaning inside, so it may be properly disposed of.

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

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

3. Filling the Oil Sump

Add fresh oil through the oil filler cap on the valve cover. After refilling the oil, run the engine for a few moments while checking the engine's oil pressure. Ensure there is no leakage around the new oil filter or from the oil drain system, and then stop the engine. Then check the quantity of oil with the dipstick. Fill to, but not over, the high mark on the dipstick, should the engine require additional oil.

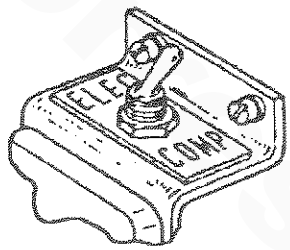
BT GENERATOR

This generator is a brushless self-excited generator, which requires only the driving force of the engine to produce AC output. The copper and laminated iron in the exciter stator are responsible for the self-exciting feature of this generator. The magnetic field produced causes an AC voltage to be induced into the related exciter rotor windings during rotation. Diodes located in the exciter rotor rectify this voltage to DC and supply it to the windings of the rotating field. This creates an electromagnetic field which rotates through the windings of the main stator, inducing an AC voltage which is supplied to a load. A transformer is connected in parallel to the AC output of the main stator. An AC voltage is produced in the auxiliary windings of the transformer and main stator and is, in turn, supplied to a full-wave bridge rectifier. The rectifier produces a DC voltage to further excite the exciter stator windings, enabling the generator to produce a rated AC output.

An optional solid-state voltage regulator is available to work in tandem with the transformer regulator to produce a more stable AC output (see the top of page 57).

No-Load Voltage Adjustment

A voltage adjustment is made with the compound transformer governing generator regulation.



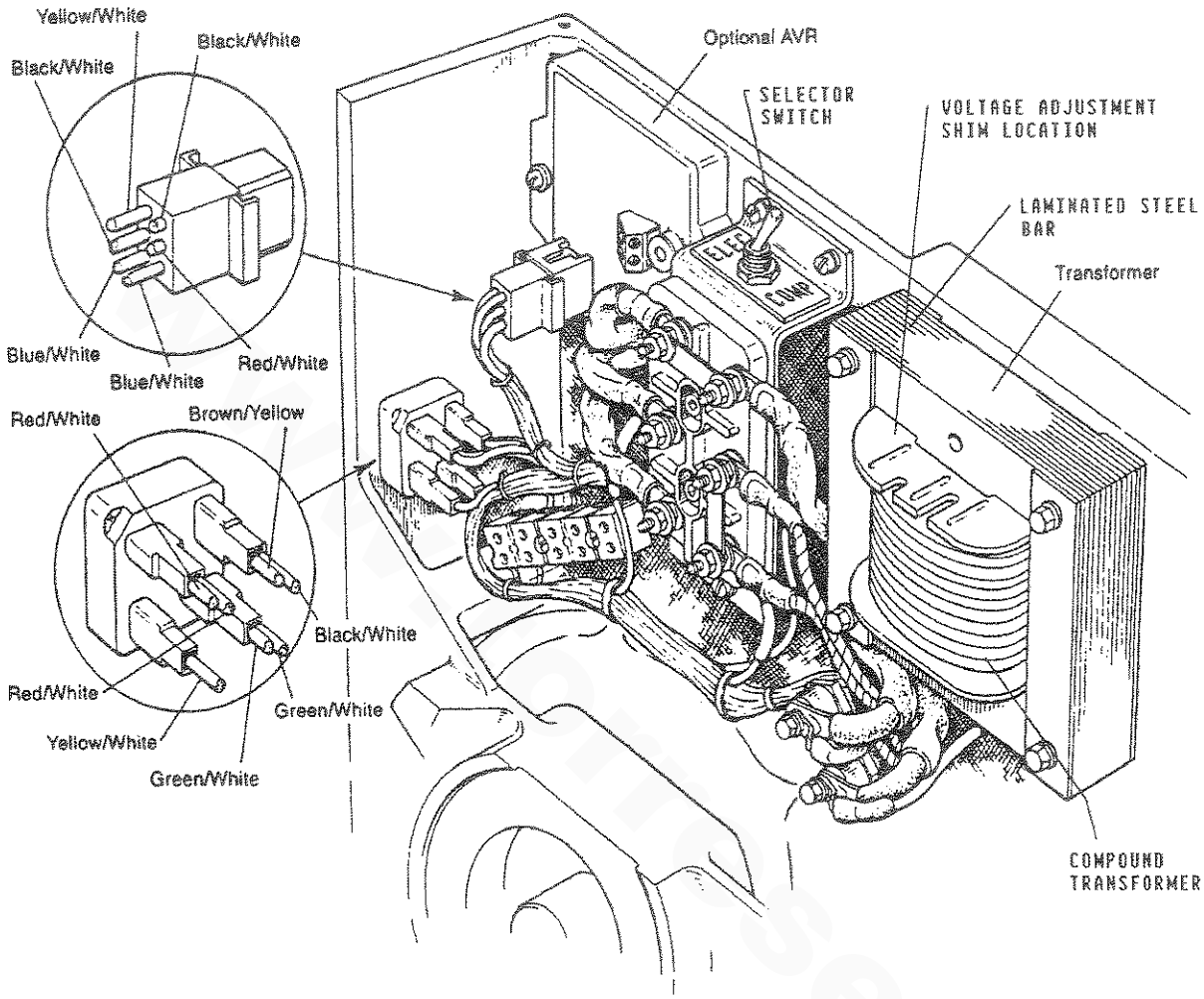
1. The selector switch must be in the **COMP** position.

2. Operate the generator and apply a moderate load momentarily; then remove the load. Note the voltage output from the generator's 120-Volt leg(s) (110 Volts at 50 Hertz). The no-load voltage should be between 121 - 123 Volts at 61.5 - 62 Hertz (111 - 113 Volts at 51.5 - 52 Hertz).

   NOTE: The No-Load voltage should be adjusted to the voltage produced by the generator when: the generator is started, a momentary load is applied to excite the transformer, and then removed. The voltage produced by the generator after this momentary load is removed is the no-load voltage.

3. To raise or lower the voltage, non-conductive shims of varying thickness are inserted or removed from under the laminated steel bar that is situated on top of the compound transformer. The material used for shimming should not soften at temperatures in the 176° F (80° C) range. A small reduction in the no-load voltage (1 to 3 Volts) sometimes can be accomplished by gently tapping the top of the laminated steel bar to reduce the air gap between the existing shims and the transformer core.

See the next page for an illustration of the generator's AC distribution box.



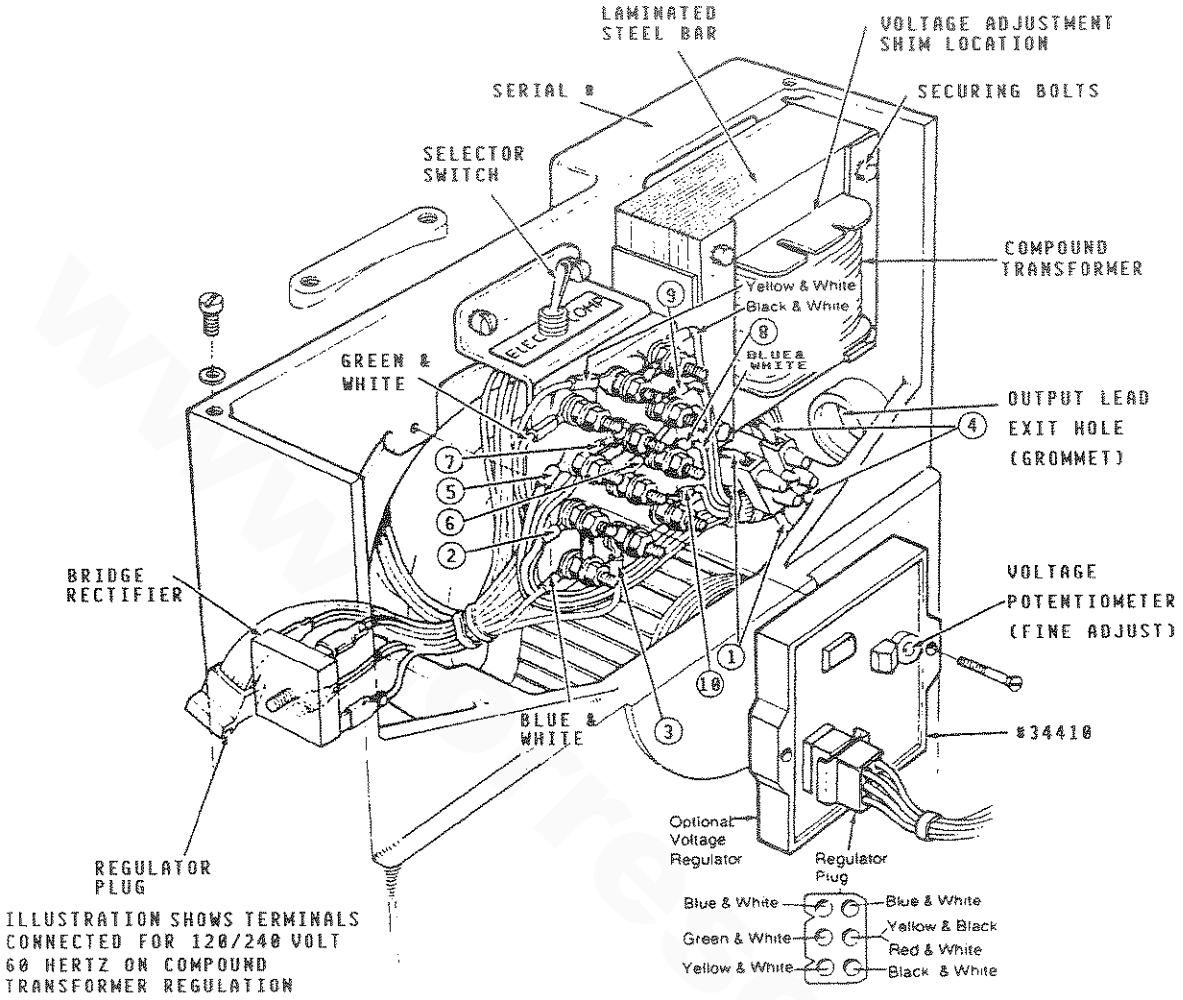
Generator AC Distribution Box
BTG 12.5KW and BTG 15.0KW

CAUTION

Under no circumstances attempt to increase the no-load voltage by increasing the gap between the laminated steel bar and the transformer core without the use of shims. Magnetic forces created within the transformer during the generator's operation may close the air gap and reduce the no-load voltage output.

4. To remove the laminated steel bar, remove the two upper securing bolts from the compound transformer and lift the bar from the transformer. The addition of shim thickness will raise the no-load voltage and, conversely, the removal of shim thickness will lower the no-load voltage.

Varying shim thickness by .001 inch (0.025 mm) will change the no-load voltage by 4 to 6 Volts. (Shim material should be non-conductive; that is, it should be transparent or colored stationary store material.)



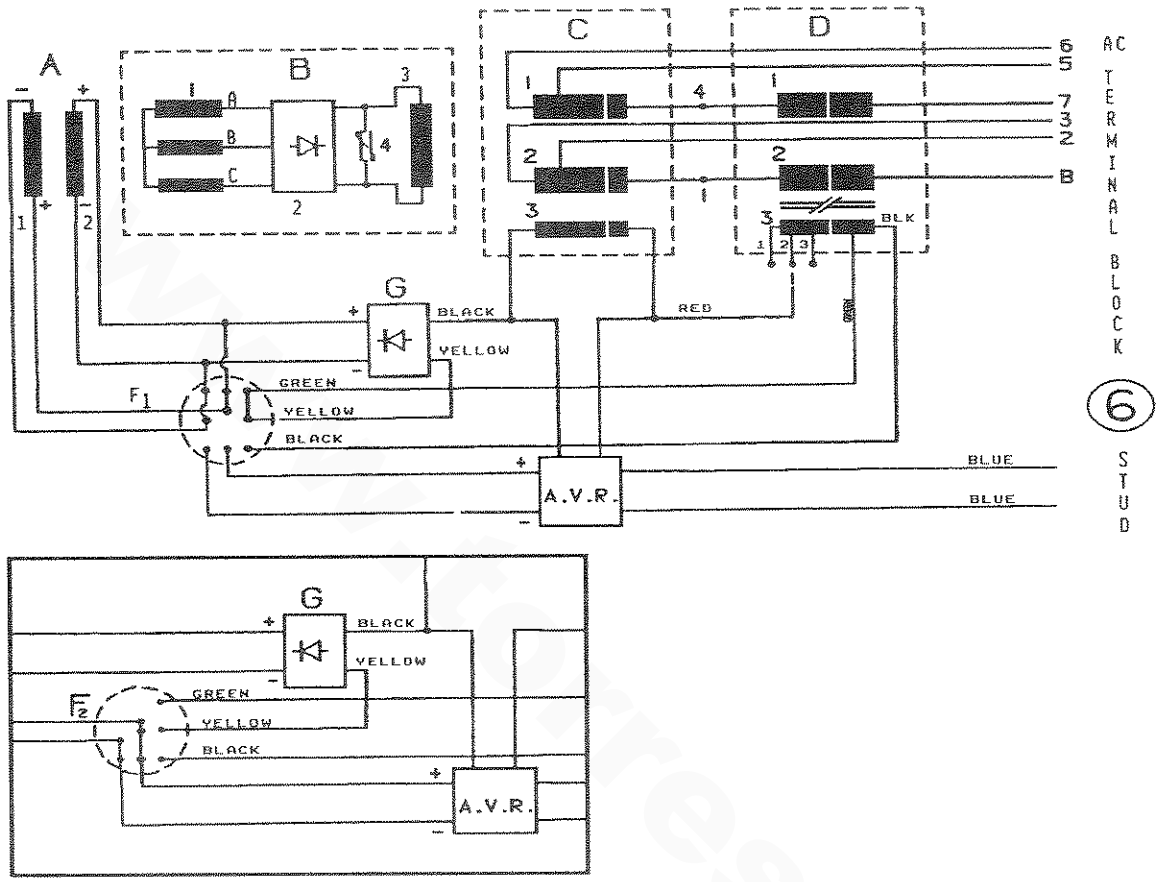
Generator AC Distribution Box
BTG 8.5KW

CAUTION

Under no circumstances attempt to increase the no-load voltage by increasing the gap between the laminated steel bar and the transformer core without the use of shims. Magnetic forces created within the transformer during the generator's operation may close the air gap and reduce the no-load voltage output.

4. To remove the laminated steel bar, remove the two upper securing bolts from the compound transformer and lift the bar from the transformer. The addition of shim thickness will raise the no-load voltage and, conversely, the removal of shim thickness will lower the no-load voltage.

Varying shim thickness by .001 inch (0.025 mm) will change the no-load voltage by 4 to 6 Volts. (Shim material should be non-conductive; that is, it should be transparent or colored stationary store material.)



BTG 12.5KW and BTG 15.0KW Generators' Internal Wiring Diagram

A. EXCITER STATOR WINDINGS
- 1. Exciter Stator Windings
- 2. Exciter Stator Windings

B. EXCITER ROTOR
- 1. Auxiliary Windings (a - b - c)
- 2. Diodes (6)
- 3. Rotating Field Windings
- 4. Pozi Resistor

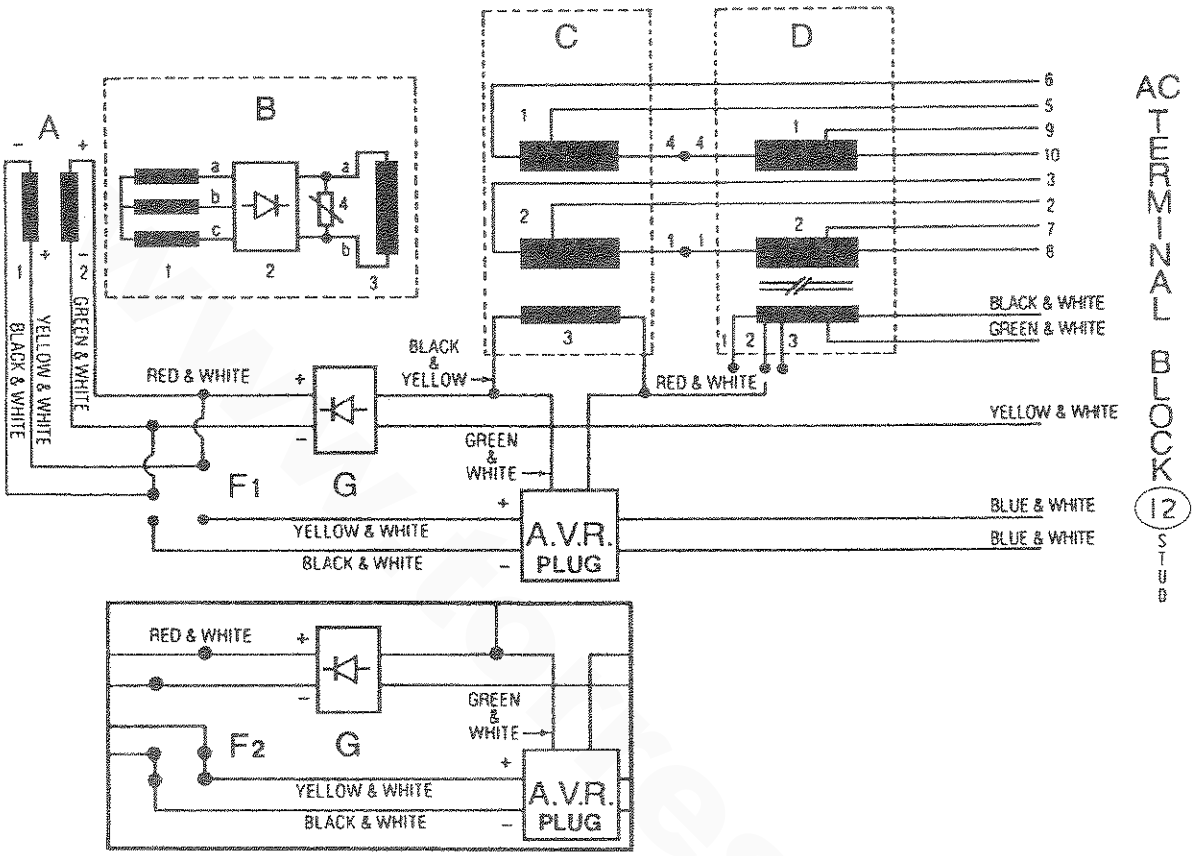
C. MAIN STATOR
- 1. Main Stator Windings
- 2. Main Stator Windings
- 3. Main Stator Auxiliary Windings

D. COMPOUND TRANSFORMER
- 1. Compound Transformer Windings
- 2. Compound Transformer Windings
- 3. Compound Transformer Auxiliary Windings

F. SELECTOR SWITCH
- 1. Compound
- 2. Electronic and Compound

G. BRIDGE RECTIFIER

(Optional A.V.R. - Automatic Voltage Regulator)



BTG 8.5KW Generator's Internal Wiring Diagram

A. EXCITER STATOR WINDINGS
1. Exciter Stator Windings
2. Exciter Stator Windings

B. EXCITER ROTOR
1. Auxillary Windings (a - b - c)
2. Diodes (6)
3. Rotating Field Windings
4. Pozi Resistor

C. MAIN STATOR
1. Main Stator Windings
2. Main Stator Windings
3. Main Stator Auxiliary Windings

D. COMPOUND TRANSFORMER
1. Compound Transformer Windings
2. Compound Transformer Windings
3. Compound Transformer Auxiliary Windings

F. SELECTOR SWITCH
1. Compound
2. Electric and Compound

G. BRIDGE RECTIFIER

(Optional A. V. R. - Automatic Voltage Regulator)

Optional Voltage Regulator

An optional solid-state voltage regulator (board #34410) is available for use with the BT series generators. When installed, and the regulation switch is moved to the **ELEC** position, the regulator works together with the standard compound transformer regulator to regulate the generator's voltage output. In the **ELEC** mode, the regulator provides excitation to the group 1 exciter windings, and the transformer provides excitation to the group 2 exciter windings.

Installation

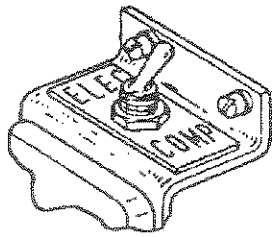
1. The regulator is mounted using existing tapped holes in the generator's case. Use two (2) M4 x 0.7-mm screws, each 15 mm long, with lock washers to mount the regulator board.

2. Connect the 6-prong generator plug to the receptacle on the regulator board.

   NOTE: The plug is keyed to engage the regulator receptacle in one direction. Check this and insert it correctly.

3. Before moving the selector switch to the **ELEC** position, make sure that the no-load voltage is adjusted to 115 volts with the selector switch in the **COMP** position. Follow the procedures for the "No-Load Voltage Adjustment," page 56.

4. With the generator's no-load voltage now set at 115 volts, move the selector switch into the **ELEC** position. Adjust the regulator board's potentiometer to set the no-load voltage at 120 Volts, 61.5 - 62 Hertz (110 Volts, 51.5 - 52 Hertz). The generator's voltage output should be within ± 5 percent from no-load to full-load.



Generator Frequency

Frequency is a direct result of engine/generator speed:

1800 RPM - 60 Hertz
1500 RPM - 50 Hertz

To change the generator's frequency, refer to the "MAINTENANCE AND ADJUSTMENTS" section of this manual, page 74.

Load Connections

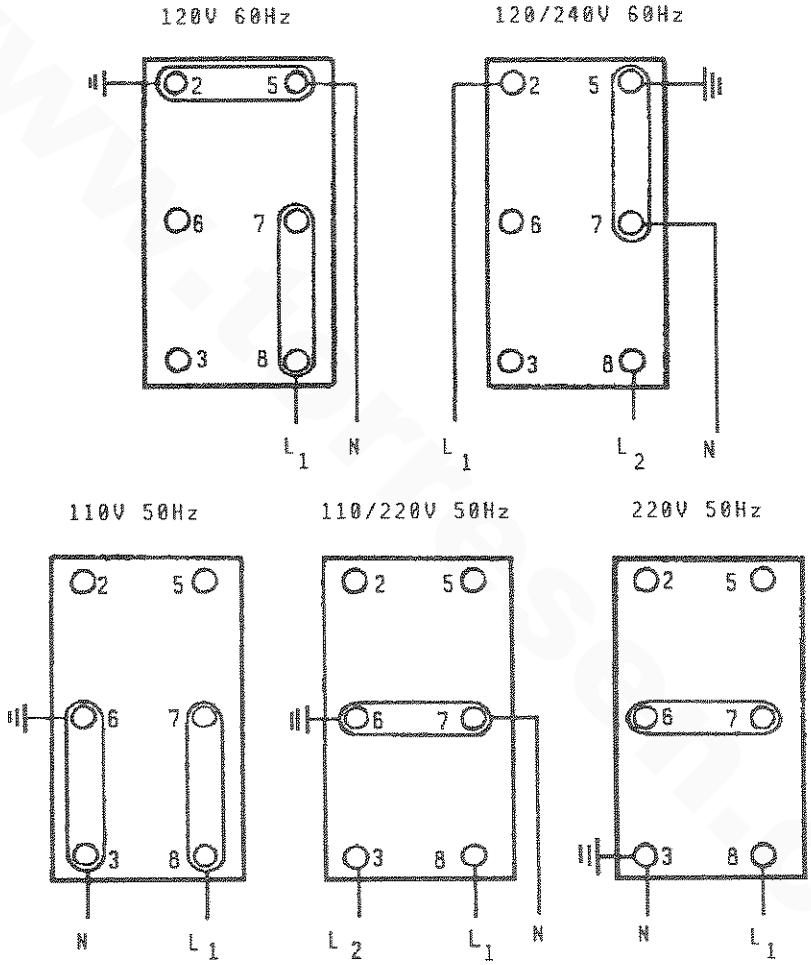
The generator's data plate gives the voltage, current and frequency rating of the generator. An AC wiring decal is affixed to the inside of the louvered cover on the generator end. A diagram of the various AC voltage connections is provided on the decal. The information on the decal is similar to the figure shown on the following page.

The generator is a single-phase, reconnectable 120 Volts AC two-wire or 120/240 Volts AC three-wire, at 60 Hertz; or 110 Volts AC two-wire, 110/220 Volts AC three-wire, or 220 Volts AC two-wire, at 50 Hertz. Refer to

the "SYSTEM SPECIFICATIONS" section of this manual for generator ratings, page 15 for the BTG 8.5KW, page 19 for the BTG 12.5KW, and page 23 for the BTG 15.0KW.

NOTE: We recommend that the installer provide AC amp-meters (optional) so that the operator can observe the load being taken off each leg of the generator.

A circuit breaker should be installed between the generator and the AC load. This circuit breaker should be rated at 120% of the generator's AC output and be able to react quickly to overloads, subject to motor starting considerations.



AC Voltage Connections **(6 Stud Terminal Block)**
(Used with the BTG 12.5KW and BTG 15.0KW Generator Sets.)

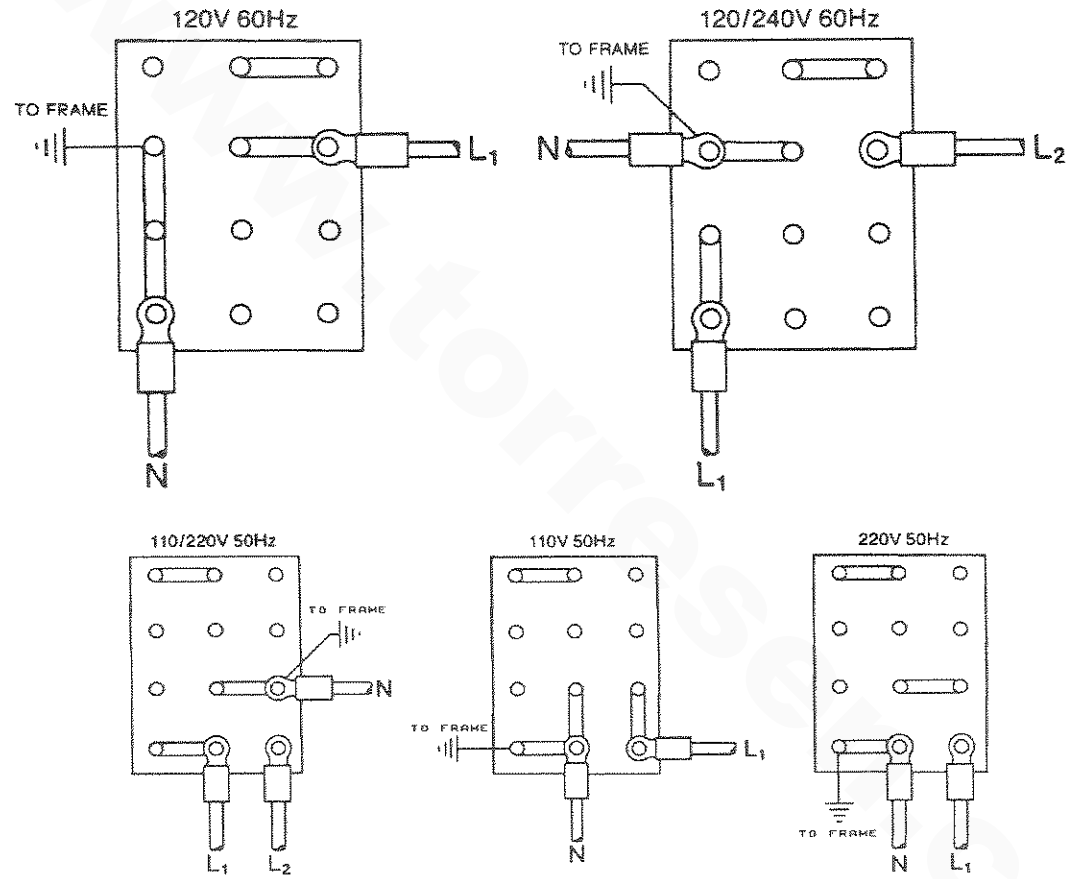
NOTE: The frame ground wire must be moved when changing from 110 Volts, 50 Hertz to 220 Volts, 50 Hertz.

For making connections to the AC terminal block, use 1/4 inch terminal ends that will accept multi-strand wire sized for the number of conductors in the bundle, the rating of the conductor's insulation, and amperage that will be drawn through the conductor(s). (Refer to the generator's data plate for generator amperage ratings.)

Refer to the "SYSTEM SPECIFICATIONS" section of this manual for generator ratings, page 15 for the BTG 8.5KW, page 19 for the BTG 12.5KW, and page 23 for the BTG 15.0KW.

NOTE: We recommend that the installer provide AC amp-meters (optional) so that the operator can observe the load being taken off each leg of the generator.

A circuit breaker should be installed between the generator and the AC load. This circuit breaker should be rated at 120% of the generator's AC output and be able to react quickly to overloads, subject to motor starting considerations.



AC Voltage Connections **(12 Stud Terminal Block)**
(Used only with the BTG 8.5KW Generator Set.)

NOTE: The frame ground wire must be moved when changing from 110 Volts, 50 Hertz to /220 Volts, 50 Hertz.

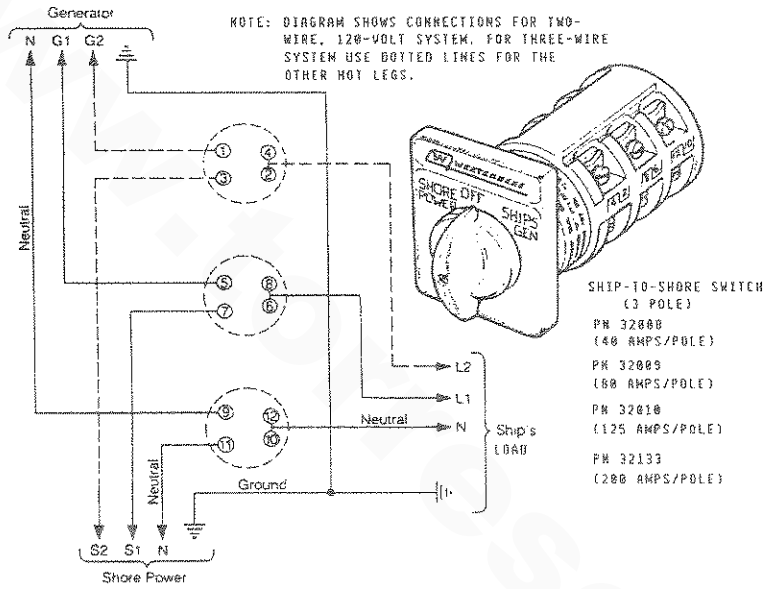
For making connections to the AC terminal block, use terminal ends for #10 studs which will accept multi-strand wire sized for the number of conductors in the bundle, the rating of the conductor's insulation, and amperage that will be drawn through the conductor(s). (Refer to the generator's data plate for the generator's amperage and voltage ratings.)

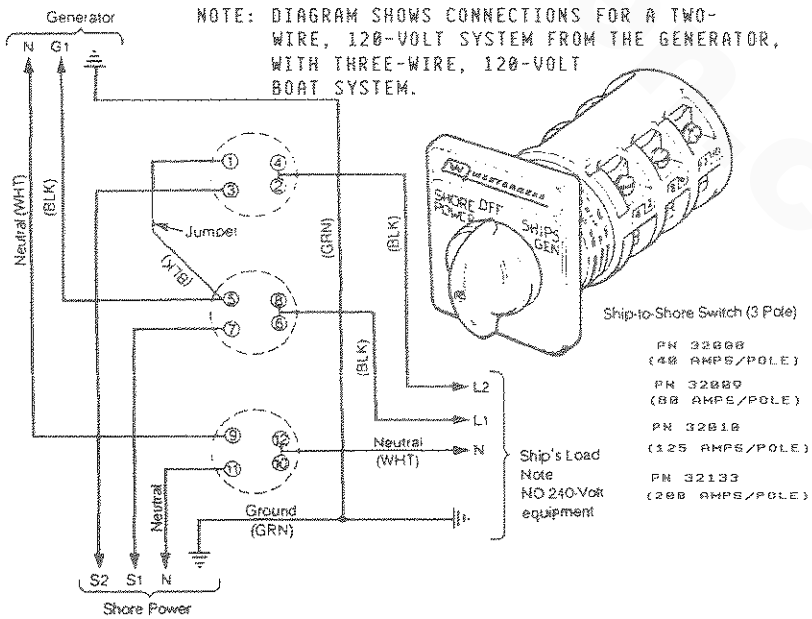
Shore Power Connections

If the installer connects shore power to the vessel's AC circuit, this must be done by means of the SHORE POWER/OFF/SHIPS GEN., center position-off transfer switch shown below. Use of 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 ensure that all AC connections are correct.





Shore Power Switch Connection Diagrams

GENERAL INFORMATION AND CARE OF THE GENERATOR

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 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 that 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

Although individual units may vary slightly, the normal voltage and frequency of typical 60-(50-)Hertz engine-driven generators described in this manual are approximately as follows: run 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.

See the rpm/Hertz/frequency chart on the next page.

Load Applied	4-Pole Speed (rpm)	Frequency (Hertz)	Generator 120V (110) Plants	Voltage 240V (220) Plants
None	1830 (1530)	62 (52)	122 (112)	240 (224)
Half	1800 (1500)	60 (50)	120 (110)	240 (220)
Full	1755 (1455)	59 (49)	110 (100)	220 (200)

The output voltage should be checked periodically to ensure proper operation of the generating plant and the appliances it supplies.

If an AC voltmeter or ampmeter is not installed to monitor voltage and load, check it with a portable meter and amp-probe.

Preventive Maintenance (Generator)

Maintenance on the generator is minimal.

1. Keep the generator **clean, dry** and **well-ventilated**.

2. Ensure that all connections are clean and tight and that cables carrying AC voltage are properly supported and protected against chafing.

3. The rear armature bearing is lubricated and sealed; therefore, no maintenance is required. If the bearing becomes rough or noisy, replace it.

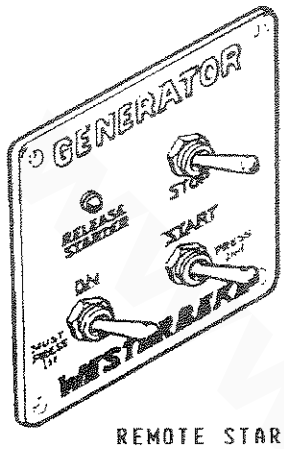
Generator Troubleshooting

A complete and illustrated text on troubleshooting the BTG series of generators is furnished in the Technical Manual which is available through your local dealer.

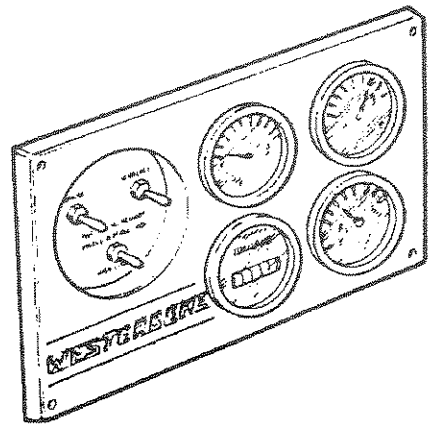
ENGINE CONTROL PANEL

General

An optional remote start panel is available for controlling the generator from a remote location.



REMOTE START PANEL



REMOTE GAUGE PANEL

Remote start panels include a green LED which lights when the engine runs at approximately 600 rpm. The purpose of the LED is to alert the operator to release the starter toggle switch in addition to continue indicating that the generator set is running.

An optional remote instrument panel is available, which includes starting controls. This panel also includes a water temperature gauge, oil pressure gauge, battery voltmeter, operating hourmeter and start-stop control switches.

DC Circuit Description

The two-pole ON switch is operated to bypass the protective shutdown switches during starting. The second pole provides a source of B + to the START toggle switch. While continuing to hold the ON switch, to provide B + to the start switch and to bypass the protective shutdown switches, the START switch is pressed to energize the starter to crank the engine. If you are starting the generator at the generator set, release the START switch when the generator is running. If starting the generator at a remote location, release the START switch when the green LED lights, but continue depressing the ON switch. After releasing the START switch, continue holding the ON switch until the oil pressure is sufficient to close the oil pressure safety switch, providing the normal B + path to the ignition system. Note that it is now impossible to energize the starter while the generator is running until someone again operates the ON switch first. Should the generator shut down from an overspeed condition, the overspeed circuit *must* be reset before attempting to restart the generator. Resetting the overspeed switch is done by simply depressing the STOP switch momentarily and then proceeding with the normal starting procedure. See page 43 for performing test procedures on the overspeed switch.

WARNING

It is very important that the overspeed shutdown always be installed and functioning. Any tampering with the overspeed shutdown module, which would cause it to malfunction, could be a cause of injury should the generator's belt-driven governor fail and cause the generator to run away.

To STOP the generator, depress the STOP switch, which opens the normally closed B+ path on the ON and START switches. The STOP switch must be held open until the generator comes to a complete stop. Remote start panels may be connected to the generator set as indicated. A jumper has to be removed between the T-1 and T-2 connections at the panel connection terminal board. (Refer to the wiring diagram in the "ELECTRICAL SYSTEM" section of this manual, page 46, lower left-hand corner.)

WARNING

When installing the optional remote start panel or the optional remote instrument panel, it is the installer's responsibility to comply with U.S. Coast Guard Standards 33 CFR PART 183.

Connecting Pressure Sensing Devices to Oil Galleries

Oil pressure sensing devices, such as senders and switches, must never be connected directly to any oil gallery of an engine. The reason is simply that continued engine vibration causes fatigue of the fittings used to make such a connection. If these fittings fail, the engine loses its oil pressure and quickly seizes.

Such pressure sensing devices must be bulkhead-mounted and connected to the oil gallery using an appropriate grade of lubricating oil hose. Any fittings used to connect the hose to the gallery must be of steel or malleable iron composition. Brass must not be used for this application.

ENGINE TROUBLESHOOTING

Introduction

The tables which follow indicate troubleshooting procedures based upon certain problem indicators, the probable causes of the problems, and the recommendations to overcome these problems.

Note that the engine's control system (electrical system) is protected by a 20-Ampere manual reset circuit breaker located next to the starter motor and the (-) ground terminal. Refer to the model photographs at the beginning of this manual for a photograph showing the exact position of this reset circuit breaker.

ENGINE TROUBLESHOOTING

Trouble	Possible Cause
Engine cranks but fails to start.	1. Out of fuel. 2. Engine is flooded. 3. Filters are clogged by contaminated fuel. 4. Voltage drop at (+) at overspeed switch. 5. Worn or faulty spark plugs. 6. Bad ignition coil. 7. High-tension leads grounding (wet system). 8. Automatic shutdown switch is faulty. 9. Fuel pump inoperative because filter is clogged. 10. Filter in carburetor is clogged. 11. Faulty overspeed switch (reset and start).
Engine dose not crank.	1. Battery is low or dead. 2. Engine's DC 20-Amp breaker has tripped. 3. Sea water filled cylinders. 4. Loose battery connections. 5. Voltage drop at starter solenoid terminal. 6. Bad started solenoid. 7. Faulty START switch.
Engine starts, runs and then shuts down.	1. Faulty automatic shutdown switch. 2. Faulty overspeed switch (reset and start; bypass switch to test).

Engine parts from Torrsen Marine - www.torresen.com - 231-759-8596

Trouble	Possible Cause
Engine starts, runs and then shuts down (continued).	3. Faulty fuel pump. 4. Faulty STOP switch. 5. Engine circuit breaker is tripping. 6. Dirty fuel filters 7. Low oil level in sump. 8. Check the valve in the fuel supply line -- the fuel pump is unable to draw fuel through.
Back firing through carburetor.	1. Ignition timing is wrong. 2. Engine is flooded. 3. Choke is stuck closed. 4. Spark plug wires are connected wrong -- check firing order. 5. Distributor cap is cracked. 6. Dirty air cleaner.
Engine overheats.	1. Coolant loss (pressure test the cooling system. 2. Belts are loose or broken. 3. Sea water pump's impeller is faulty. 4. Sea water pump is worn. 5. Faulty hose. 6. Thermostat is stuck closed. 7. Heat exchanger is clogged. 8. Faulty gauge (check with a thermometer).

Trouble	Possible Cause
Engine hunts.	1. Throttle linkage is binding. 2. Dirty fuel filters. 3. Defective fuel pump. 4. Governor is out of adjustment. 5. Valves are out of adjustment. 6. Generator is overloaded. 7. Cracked distributor. 8. Faulty high-tension leads.
Engine misfires.	1. Ignition timing is wrong. 2. Spark plugs are worn. 3. Valve clearances are incorrect. 4. Dirty carburetor. 5. Dirty air cleaner. 6. Poor quality fuel.
High oil pressure.	1. Faulty gauge 2. Relief valve is stuck. 3. Dirty oil or wrong SAE type oil is in the engine.
Low oil pressure.	1. Low oil level. 2. Faulty gauge. 3. Wrong SAE type oil is in the engine. 4. Relief valve is stuck. 5. Faulty oil pump.

Trouble	Possible Cause
No DC charge to the starting battery.	1. Connections to the alternator are loose or faulty. 2. Faulty alternator. 3. No excitation to the regulator's yellow lead.
Black exhaust smoke is discharged from the engine.	1. Dirty air intake. 2. Choke is stuck closed. 3. Carburetor is flooding.
Blue exhaust smoke is discharged from the exhaust.	1. Valves are worn or adjusted incorrectly. 2. Piston rings are worn or unseated. 3. Lubrication oil is diluted. 4. Crankcase breather hose is clogged.

MAINTENANCE AND ADJUSTMENTS

Introduction

This section contains a scheduled preventive maintenance program and several adjustment procedures the owner/operator can perform without the benefit of sophisticated and expensive tools and instruments.

Preventive Maintenance (Engine)

Perform the preventive maintenance in accordance with the schedules listed in the following paragraphs. Adherence to these schedules will ensure the equipment is maintained in the best possible condition and that it will perform to expectations. Those items marked by an asterisk (*) are recommended to be performed by an authorized dealer or distributor.

Daily (before each use)

1. Check the oil sump level. Maintain the oil level at or near the upper level mark on dipstick.
2. Check the coolant level in the plastic recovery tank. Maintain the coolant level halfway between the **MAX** and **ADD** marks.
3. Visually inspect the unit; check for loose belts, chafed or broken wires, loose brackets and fittings, damaged hoses, loose clamps, and other equipment not properly secured.
4. Check the fuel supply. Fill the tank(s) with a good grade of unleaded or leaded gasoline that has an octane rating of 89 or better.
5. Check the primary filter/water separator. Drain and service this filter as required. (A primary filter/water separator is optional, but strongly recommended. See page 41.)
6. If an optional instrument panel is installed, check the engine's gauges for proper oil pressure, operating temperature, and starting battery charging voltage once the engine is operating.
7. If AC gauges are installed, check the generator's output meters for proper AC voltage and output frequency.

Monthly

Check the condition of the zinc anode in the heat exchanger's sea water circuit. Clean or replace the anode, as required. Keep the area inside the heat exchanger clean of zinc anode debris.

Servicing After Initial 50 Hours of Operation

1. Change the engine's lubrication oil and oil filter.
2. Clean or replace the fuel filter screen in the carburetor and in the electric fuel lift pump.
3. Retorque the cylinder head bolts.

4. Adjust valve clearances.

5. Adjust the alternator and water pump drive belt tension, if required.

6. Adjust the engine's no-load speed, if required (Hertz). Please note that this adjustment is not a warrantable adjustment during or after the unit's break-in.

Servicing After Every 100 Hours of Operation

1. Change the engine's lubrication oil and oil filter.

2. Adjust the alternator and water pump drive belt tension, if required.

Servicing After Every 250 Hours of Operation

Clean or replace the fuel filter element in the carburetor and in the electric fuel lift pump.

Servicing After Every 500 Hours of Operation

*1. Adjust the valve clearances.

3. Drain, flush, and refill the fresh water cooling system

*4. Check the condition of the starter motor drive pinion; lubricate pinion.

5. Check the outside of the engine. Make sure that any oil on the engine's surface is cleaned. Any dirt or oil on the engine inhibits the engine's ability to cool. Please keep the engine clean.

Servicing After Every 800 Hours of Operation

*1. Check the battery-charging alternator for proper operation.

*2. Check the tightness of bolts, nuts, and clamps.

Servicing After Every 1000 Hours of Operation

1. Remove, clean, and pressure test the primary heat exchanger. (A local automotive radiator shop should be able to clean and test the heat exchanger.)

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

Preventive Maintenance (Generator)

Maintenance on the generator end is minimal:

1. Keep the generator **clean, dry**, and **well-ventilated**.

2. Ensure that all connections are clean and tight, and that cables carrying AC voltage are properly supported and protected against chafing.

*3. The rear armature bearing is lubricated and sealed; no maintenance is required. However, if the bearing becomes noisy or rough-sounding, have it replaced.

Generator Frequency Adjustment

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

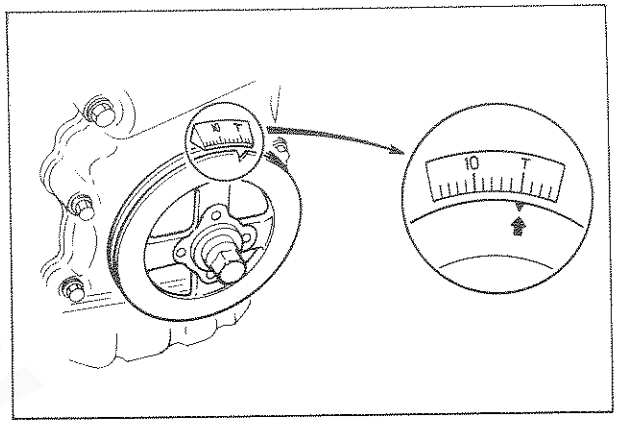
When the generator is run at 1800 rpm, the AC voltage output frequency is 60 Hertz. When the generator is run at 1500 rpm, the AC voltage output frequency is 50 Hertz.

Therefore, to change the generator's frequency, the generator's speed must be changed. To accomplish the frequency change, connect the AC output leads to the AC terminal block in accordance with the "AC Voltage Connections" diagram specified for your generator set, which appears in the "BT GENERATOR" section of this manual, page 56.

Ignition Timing

1. Attach a timing light to the #1 spark plug and mark the front crankshaft timing groove and the timing mark on the scale embossed on the engine's front cover.

NOTE: Each timing mark represents 2°



2. Start the engine and warm it up to its normal operating temperature.

3. Using the timing light, align the timing groove in the front crankshaft pulley with the proper timing mark on the ignition timing scale embossed on the engine's front cover. Do this by loosening and slowly rotating the distributor body. Refer to the timing specifications below.

Timing Specifications:		
	BTG 8.5KW	14° ±1° BTDC at 1800 rpm
	BTG 12.5KW	18° ±1° BTDC at 1800 rpm
	BTG 15.0KW	18° ±1° BTDC at 1800 rpm

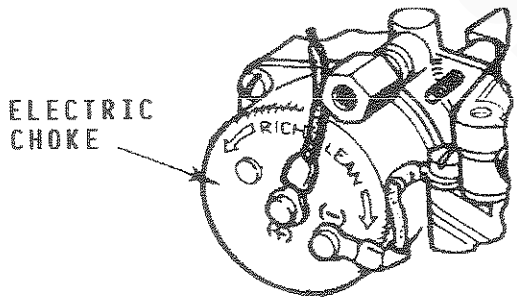
Electric Choke

The electric choke uses a 12-Volt heating element which opens the choke automatically once the engine starts and remains running. Some hunting will be present when the generator is started, is on choke, and is running without a load on the generator.

WARNING

To avoid burns on fingers or hands, **DO NOT** touch the choke housing while the engine is operating. Allow the engine to cool before making choke adjustments.

Adjust the choke by loosening the three cover-securing screws and by rotating the cover clockwise to set the choke **LEAN** and counterclockwise to set the choke **RICH**. The choke is initially set at the factory.

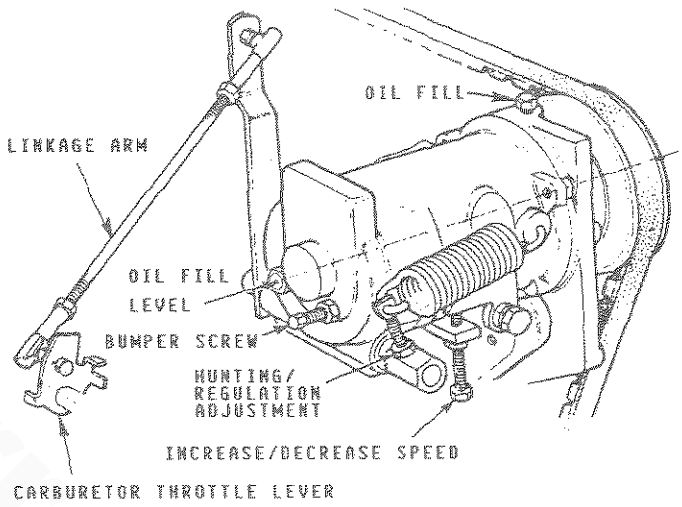


Governor Adjustments

Operate the generator set to bring the unit up to its operating temperature before attempting an adjustment.

> NOTE: If the governor is severely out of adjustment, manually adjust the linkage without any load on the generator to obtain a safe output voltage before proceeding with the adjustment.

Three adjusting points are on the governor. (Refer to the illustration below.)



1. Bumper Screw This screw is used to remove a no-load surge ONLY. NEVER turn the bumper screw into the governor far enough so that it increases the no-load speed. To adjust the governor, turn the bumper screw in until the engine stops surging. Now bring the idle screw (on the carburetor) up until the generator runs at 60 cycles no-load. Apply a 1/4, a 1/2 and a 3/4 load to the generator and ensure the generator does not surge under these three load intervals.

   > NOTE: Only if the generator surges at any of these load intervals are you to follow steps #2 and #3 below.

2. Increase/Decrease Speed This adjusting bolt sets the no load speed of the engine. (The linkage arm between the governor arm and throttle lever should be adjusted to hold the throttle full open when the engine is not running.) Make sure this linkage moves freely and that the ball joint connectors are properly lubricated. Use graphite lubricant at this connection. Disconnect the ball joint and apply a graphite lubricant to the inside of the joint.

3. Hunting/Regulation If the variation in engine speed between no load and full load is too great, adjust this eye bolt to draw the spring closer to the lever hub. The increase/decrease speed bolt may need to be adjusted as well.

If the governor surges while under a load, adjust this eye bolt to move the spring away from the lever hub. (Check the speed adjustment.)

Governor Maintenance

1. Periodically lubricate the attaching points at both ends of the governor arm. Use a graphite lubricant or an equivalent.

   > NOTE: Free movement of this linkage arm is important for proper governor/throttle operation.

2. The governor's oil capacity is 3 ounces (98 milliliters) of SAE #10/30 motor oil.

   > NOTE: Do not overfill the governor.

3. Change the governor's oil every 2000 hours of operation.

4. The drive belt should be maintained in good condition. Replace the belt if it becomes worn or shows signs of cracking.

To change the oil, remove the governor from engine and remove the oil fill and fill level plug and drain all the oil from the governor. Reinstall the governor on the engine and fill it with 3 ounces (89 milliliters) of SAE 10/30 engine oil, and replace the plugs.

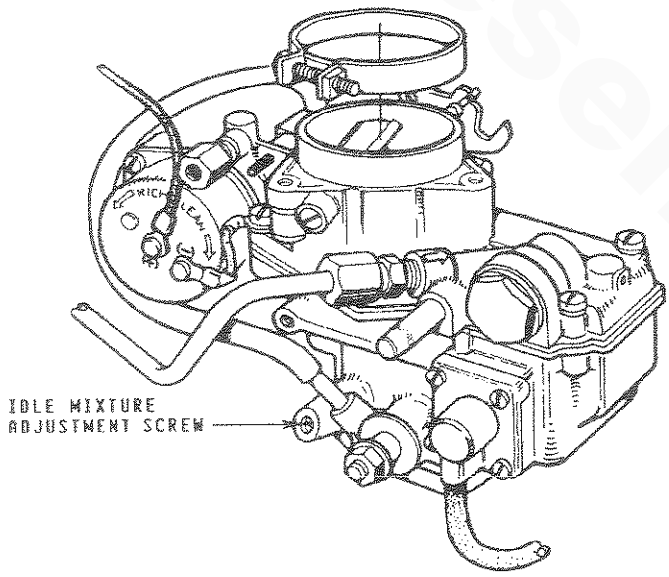
Carburetor Adjustment

1. Idle Mixture Jet

Disconnect the throttle linkage arm from the governor control arm and reduce the engine's speed with the idle stop screw. Turn the idle mixture screw clockwise (in) until the engine skips; back the screw out (counterclockwise) slowly until the engine smooths then skips again; then turn the screw clockwise (in) one-quarter to one-half of a turn. The idle mixture should be satisfactory at this setting.

2. Run Mixture Jet

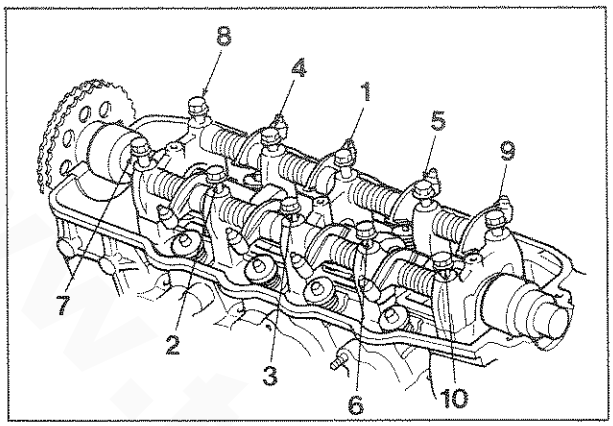
This mixture jet is pre-sized at the factory and is not adjustable. An adjustment to the idle jet screw, while the unit is operating at 1800 rpm, will have an affect on the unit's performance. Refer to the "Governor Adjustments" section of this manual for instructions on how to adjust the engine's speed, page 78.



Carburetor with flame arrestor removed.

Torquing Cylinder Head Bolts

Tighten the cylinder head bolts according to the sequence shown in the illustration below. Make sure the engine is cold when this is done. Loosen one head bold one-half turn and then tighten it between 56 to 59 lb-ft (7.8 to 8.2 kg-m). Then proceed to the next head bolt in the sequence numbering shown.

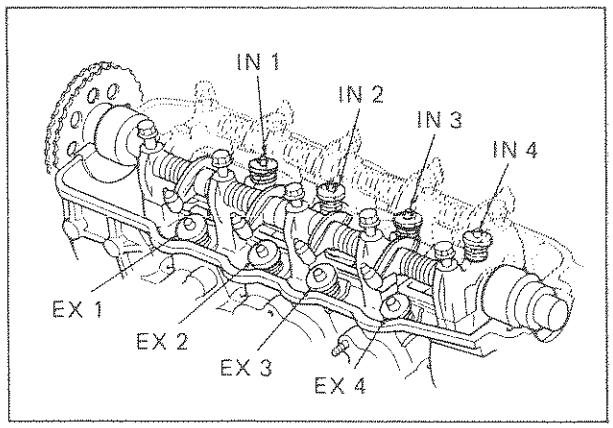


Valve Clearance Adjustment

NOTE: Retorque the cylinder head bolts before adjusting the engine's valves.

Position the No. 1 piston at Top Dead Center (TDC) of its compression stroke and adjust the # 1 and # 3 exhaust valves (see the illustration below). At this same time, adjust the # 1 and # 2 intake valves. While facing the front of the engine, rotate the crankshaft 360° clockwise and adjust the remaining valves.

Adjust all valves to 0.0098 inches (0.25 mm) with the engine cold.



Spark Plugs

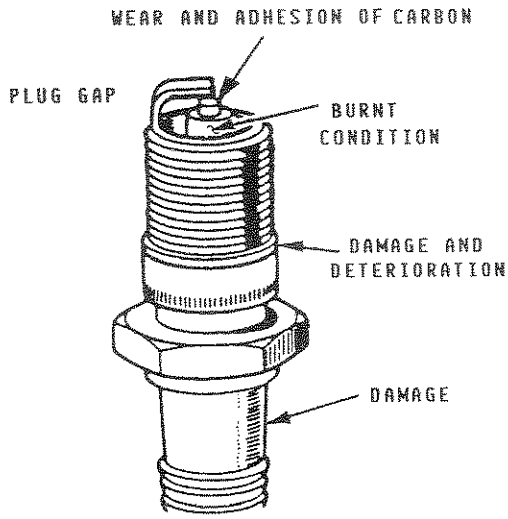
To service the spark plugs, clean, gap or replace the plugs as needed.

Spark plug gap: 0.031 ± 0.002 inches
(0.8 ± 0.05 mm)

Spark plug torque 11 - 17 lb-ft (1.5 - 2.3 kg-m)

Check each plug for damage and/or wear.

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



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 to use as a check list if others do the procedures. These procedures should afford your engine protection during a lay-up and also help familiarize you with the maintenance needs of your engine.

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

Fresh Water Cooling System

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

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

Lubrication System

With the engine warm, drain all the lubricating oil from the oil sump. Remove and replace the oil filter. (Place some paper towels and a plastic bag around the filter to catch the oil during its removal.)

When installing the new oil filter, be sure to apply a small amount of oil on the rubber sealing gasket at the base of the filter. Fill the sump with the correct amount of oil for your engine model. Use an oil with an API specification of SE or SE/CC. Run the engine and check for proper oil pressure and ensure that there are no leaks.

CAUTION

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

Fuel System

Top off your fuel tanks with regular or unleaded gasoline with an octane rating of 89 or better. Fuel additives 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 filter/water separator used in the system. Change the element in your primary fuel filter/water separator, if the fuel system contains one, and clean the separator sediment bowl. Clean the filter screen in the fuel lift pump and in the carburetor.

Sea Water Circuit

Close the thru-hull sea cock. Remove the sea water intake hose from the sea cock. Place the end of this hose into a 5-gallon bucket of clean fresh water. Before starting the engine, check the zinc anode found in the primary heat exchanger on the engine and clean or replace it as required. Clean the sea strainer, if one is installed in the inside of the hull.

Start the engine and allow the sea 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 sea water system. Once the bucket is empty, stop the engine. This antifreeze mixture should protect the sea water circuit from freezing during the winter lay-up, as well as providing corrosion protection.

Remove the impeller from your sea 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.

Intake Manifold and Through-Hull Exhaust

Place a clean cloth, lightly soaked in lubricating oil, around the air arrester. Be sure to remove this cloth before recommissioning. Make a note to remove the cloth prior to start-up. The through-hull exhaust part can be blocked in the same manner.

Starter Motor

Lubrication and cleaning of the starter drive pinion is advisable, if access to the starter permits its easy removal. Ensure that 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

Fogging the engine should be done as the last of the antifreeze mixture is drawn into the sea water circuit. Remove the air intake screen (the air filter) and spray Marvel Mystery Oil or another commercially available fogging oil into the carburetor while the engine is running. Spray enough oil to stall the engine. This will coat the walls of the cylinders, pistons, and valve surfaces with this protective oil. Remove the spark plugs and spray a small amount of this oil into each spark plug hole and turn the engine over two or three complete revolutions by hand. Reinstall, but do not tighten, the spark plugs, as these will need to be cleaned and gapped prior to recommissioning. Close off the carburetor's air filter with an oily rag.

Spares

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

Batteries

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

Recommissioning

The recommissioning of your Westerbeke unit after a seasonal lay-up generally follows the same procedures as those presented in the "PREPARATIONS FOR STARTING" section, page 35, regarding preparation for starting and normal starts. However, some of the lay-up procedures will need to be counteracted before starting the engine.

1. Remove the oil-soaked cloths from the intake manifold and from the through-hull exhaust port.

2. Remove the sea water pump cover and gasket. Discard the gasket. Install the sea water pump impeller removed during lay-up (or a replacement, if required). Install the sea water pump cover with a new cover gasket.

WARNING

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.

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 ensure that the batteries are fully-charged.

4. Check the condition of the zinc anode in the sea water circuit and clean or replace the anode as needed. Note that it is not necessary to flush the antifreeze/fresh water solution from the sea water coolant system. When the unit is put into operation, the system will self-flush in a short period of time with no adverse affects.

5. Start the unit in accordance with those procedures found in the "STARTING PROCEDURES" section of this manual, page 36.

TABLE OF STANDARD HARDWARE TIGHTENING TORQUES

Unless stated otherwise for a specific assembly, use the following torque values when tightening standard hardware.

	Pitch	lb-ft	kg-m
Grade 4T			
6mm bolt head/nut	1	2.9 - 5.1	0.4 - 0.7
8mm bolt head/nut	1.25	7.2 - 11.6	1.0 - 1.6
10mm bolt head/nut	1.25	13.7 - 22.4	1.9 - 3.1
10mm bolt head/nut	1.5	13.0 - 21.7	1.8 - 3.0
12mm bolt head/nut	1.25 (ISO)	25.3 - 39.8	3.5 - 5.5
12mm bolt head/nut	1.5	25.3 - 39.8	3.5 - 5.5
12mm bolt head/nut	1.75	21.7 - 36.2	3.0 - 5.0
13mm bolt head/nut	1.5	32.5 - 50.6	4.5 - 7.0
14mm bolt head/nut	1.5	36.2 - 57.9	5.0 - 8.0
14mm bolt head/nut	2	34.0 - 55.7	4.7 - 7.7
16mm bolt head/nut	1.5	54.2 - 79.6	7.5 -11.0
16mm bolt head/nut	2	51.4 - 76.7	7.1 -10.6
Grade 6T			
6mm bolt head/nut	1	4.3 - 6.5	0.6 - 0.9
8mm bolt head/nut	1.25	10.8 - 15.9	1.5 - 2.2
l0mm bolt head/nut	1.25	21.7 - 32.5	3.0 - 4.5
10mm bolt head/nut	1.5	19.5 - 30.4	2.7 - 4.2
12mm bolt head/nut	1.25 (ISO)	36.2 - 57.9	5.0 - 8.0
12mm bolt head/nut	1.5	36.2 - 50.6	5.0 - 7.0
12mm bolt head/nut	1.75	34.7 - 49.2	4.8 - 6.8
Grade 7T, 8T and 8.8			
6mm bolt head/nut	1	5.8 - 8.7	0.8 - 1.2
8mm bolt head/nut	1.25	14.5 - 21.7	2.0 - 3.0
10mm bolt head/nut	1.25	28.9 - 39.8	4.0 - 5.5
10mm bolt head/nut	1.5	26.8 - 37.6	3.7 - 5.2
12mm bolt head/nut	1.25 (ISO)	54.2 - 75.9	7.5 -10.5
12mm bolt head/nut	1.5	50.6 - 65.1	7.0 - 9.0
12mm bolt head/nut	1.75	43.4 - 61.5	6.0 - 8.5
13mm bolt head/nut	1.5	57.9 - 86.8	8.0 -12.0
14mm bolt head/nut	1.5	72.3 -108.5	10.0 -15.0
14mm bolt head/nut	2	68.7 -101.3	9.5 - 14.0
16mm bolt head/nut	1.5	108.5 - 166.4	15.0 - 23.0
16mm bolt head/nut	2	101.3 - 159.1	14.0 - 22.0
Grade 5 capscrew			
1/4 UNC		9 - 11	1.2 - 1.5
1/4 UNF		11 - 13	1.5 - 1.8
5/16 UNC		18 - 20	2.5 - 2.8
5/16 UNF		21 - 23	2.9 - 3.2
3/8 UNC		28 - 33	3.7 - 4.6
3/8 UNF		30 - 35	4.1 - 4.8
7/16 UNC		44 - 49	6.1 - 6.8
7/16 UNF		50 - 55	6.9 - 7.6
1/2 UNC		68 - 73	9.4 -10.1
1/2 UNF		73 - 80	10.1 -11.1

TABLE OF TIGHTENING TORQUES

	lb-ft	kg-m
Cylinder head bolts*	56 - 59	7.8 - 8.2
(*See the **Torquing Cylinder Head Bolts** section on page 80.)		
Main bearing caps	48 - 51	6.6 - 7.1
Connecting rod caps	22 - 25	3.0 - 3.5
Camshaft sprocket	51 - 58	7.0 - 8.0
Crankshaft pulley	80 - 87	11 - 12
Oil pressure switch	9 - 13	1.2 - 1.8
Oil pan	5 - 9	0.7 - 1.2
Oil filter	Firmly by hand	Firmly by hand
Oil pump	14 - 44	1.9 - 3.1
Thermostat cover	14 - 22	1.9 - 3.1
Water pump	14 - 22	1.9 - 3.1
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YOUR NOTES

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