

8KW-BT-TROUBLE SHOOTING
TECH MANUAL
3004~~1~~-EDITION/3

OPERATOR'S MANUAL

OIL FILTER
36918

WESTERBEKE

BT 8 KW

Marine Diesel

Generator Set

Publication # 35383

Edition One

October 1985



J. H. WESTERBEKE CORP.

AVON INDUSTRIAL PARK, AVON, MASS. 02322 • (617) 588-7700

CABLE: WESTCORP, AVON • TELEX: 92-4444

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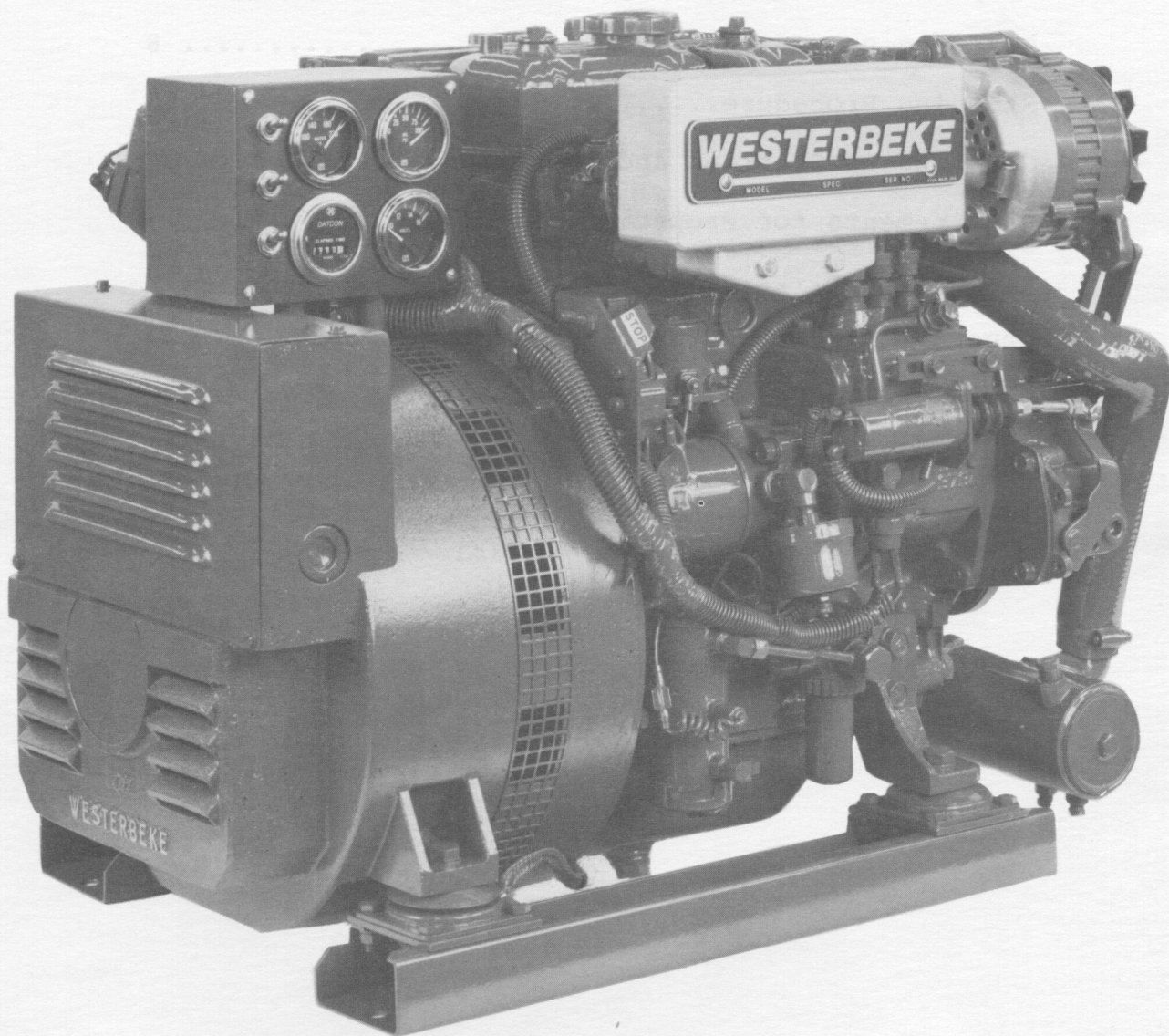
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GENERAL SPECIFICATIONS

Number of Cylinders	3 - vertical in line
Bore & Stroke	2.87 X 3.07 inches (73 X 78 mm)
Displacement	60 cubic inches (0.979 liters)
Compression Ratio	23:1
Firing Order	1 - 3 - 2
Total Dry Weight	450 pounds (204 kg)
Combustion Chamber	Swirl type
Injection Pump	Inline plunger type - cam operated
Injectors	Pintle type
Lubrication	Pressure feed - trochoid pump
Cooling System	Fresh water cooled with exchanger system
Starting Aid	Glow plugs
Electric System	12 volt DC (only)
Valve Mechanism	Rotating type - overhead
Oil Filter	Spin-on type #30220
Oil Sump Capacity	3.7 quarts (3.5 liters) including filter
Coolant Capacity	5 quarts (4.7 liters) approximately
Fuel Pump	12 volt electric with replaceable filter element
Fuel Filter (on engine)	Canister type with replaceable element
Alternator	12 VDC 50 amp rating
Starting Battery	75 amp hour rating
Raw Water Flow (measured before discharge into exhaust elbow)	8.5 gallons/minute at 1800 RPM 7.5 gallons/minute at 1500 RPM
Angle of Installation (Max.)	10°
Angle of Operation (Max.)	20° in all directions
Fuel Consumption	0.9 gallons/hour at full rated output

Governor	Mechanical centrifugal type
Operating Temperature	170 - 190°F (77 - 88°C)
Operating Oil Pressure	40 - 70 PSI (2.8 - 4.9 kg/cm ²)
Fuel System	Open flow - totally self-bleeding

GENERATOR SPECIFICATIONS

Type	Brushless, four pole, revolving field. Transformer regulation (optional electronic voltage regulator), single bearing design		
Voltage Regulation	120 or 120/240 at 60 Hertz 110 or 110/220 at 50 Hertz Voltage regulation $\pm 5\%$ no load to full rated output 3 Hertz (5%) no load to full rated load		
Ratings (single phase)	120/240 volts	68/34 amps	60 Hertz
	110/220 volts	50/25 amps	50 Hertz

CAUTIONS IN HANDLING ENGINE

- * Always use the proper grade of oil in the engine and do not overfill the sump.
- * Use a good grade of #2 diesel fuel properly filtered to remove impurities and water.
- * Keep the fuel system free of leaks and water.
- * If the starter pinion fails to engage with the flywheel ring gear, release the start switch and allow the starter to stop, then proceed to start again.
- * Maintain proper engine operating temperature.
- * Do not overload the generator and engine.
- * Change lube oil and filter at prescribed periods.
- * Change fuel filters at regular intervals.

SAFETY PRECAUTIONS

- * Install the unit in an area that will keep the generator dry. Offer proper ventilation to the generator for cooling and allow room for servicing.
- * Lethal voltages are present in a running generator. Use extreme care when servicing or troubleshooting.
- * Do not touch moving parts during operation.
- * Inspect and adjust parts of the engine only after it is stopped.
- * Do not touch hot parts such as the exhaust pipe and keep combustible materials away from the unit.
- * Check oil level, coolant and alternator belt tension with the engine stopped. (Check coolant in the manifold with the engine cold.)
- * Use the correct tool and proper sizes when performing maintenance or repairs.
- * Protect all current carrying wires from abrasion and insure all connections are clean and tight.

BREAKING IN

1. Since the generator set operates at 1800 RPM to produce 60 Hertz or 1500 RPM to produce 50 Hertz, your control in breaking in the generator engine is governed by the amperage you draw from the generator.
2. Do not ever attempt to BREAK IN your generator set by running at NO LOAD.
3. Upon starting the set, check for proper operation, then encourage a fast warm up.
4. For the first 10 hours of operation, run between 20 and 60 percent load.
5. After the first 10 hours of generator operation, load to the rated output as needed. Still try to vary the load.
6. You must avoid overload at all times. Overload is signalled by smoky exhaust with a reduction in Hertz and voltage. Watch the amperage being drawn from the generator and keep it within the generator's rating.
7. Be aware of motor starting loads and the high amperage draw required in starting motors.

PREPARATIONS FOR STARTING

Take steps as shown below in starting your engine for the first time or after a prolonged shutdown.

1. Fill your engine with oil up to or near the upper limit on the dipstick. Use a good grade of oil with API specification of CC or better. For quantity of oil, you may refer to the General Specifications page. However, it is best always to be guided by dipstick measurement as angle of installation has some effect.
2. Each unit is supplied with a coolant recovery kit #24977 as standard equipment to which the following applies:

A.) Remove the pressure cap from the engine manifold and slowly fill the engine cooling system completely full with an antifreeze mixture.

B.) Mount the plastic recovery tank with the bracket provided next to the unit in a location where it can be easily monitored and filled. Mount it preferably at manifold level or above. Connect it to the 90° fitting on the manifold using the hose and clamps provided.

C.) Coolant will be added to the plastic tank after the engine has been started and operating temperature reached to insure all air is expelled out of the manifold and the engine cooling system. Completely fill manifold and install the pressure cap. Fill plastic tank half full. Monitor daily and add coolant as needed.

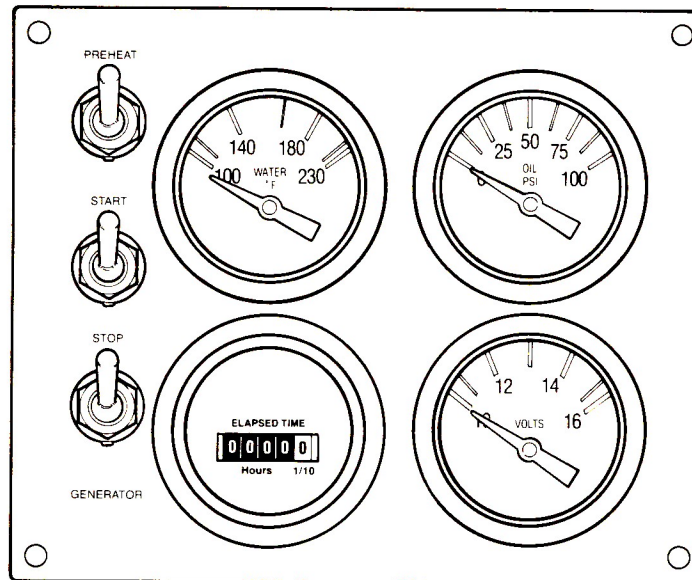
3. Fill the fuel tank with a good grade of #2 diesel fuel and prime the fuel system up to the engine. The engine fuel system is totally self-bleeding. Simply depress the preheat switch 15 - 30 seconds. Monitoring return fuel flow is a good indicator as to when all air is removed from the engine fuel system. When returning fuel is free of air, the engine fuel system is bled and the engine ready to start.

NOTE: When depressing the preheat switch we are activating the glow plugs in the cylinder head, so use the preheat intermittently so as not to overheat the glow plugs. This can be deactivated by simply depressing the emergency stop switch.

NOTE: Activating the preheat energizes the fuel run solenoid drawing the throttle arm into the preset run position. Insure this moves rapidly and smoothly.

4. Check all sea water and exhaust connections to the engine and insure they are all proper and secure.
5. Check that all electrical connections (AC) to the generator are correct and secure. An AC connection schematic is found on the inside of the generator louvered cover.
6. Before starting the generator, insure that no AC load is on it.

STARTING PROCEDURES



Note 1: When generator is stopped after use, the water temperature and oil pressure gauges may stay at their running readings.

Note 2: When generator is next used, depressing the preheat switch will cause the oil pressure and water temperature indicators to zero (deflect to the left of gauge). The voltmeter will register system voltage. The electric on engine fuel pump and glow plugs are also energized.

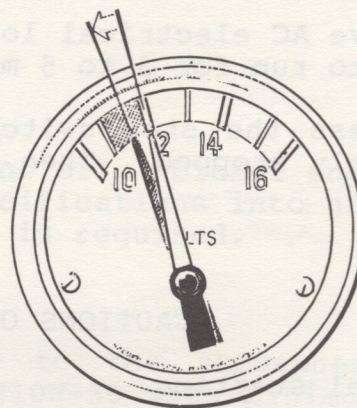
1. Depress the preheat switch and hold it. Preheat according to the chart below.

Atmospheric temperature	Preheating time
+5°C (+41°F) or higher	Approx. 10 sec.
+5°C (+41°F) to -5°C (+23°F)	Approx. 20 sec.
-5°C (+23°F) or lower	Approx 30 sec.
Limit of continuous use	1 minute

2. Proper glow plug function is indicated by voltmeter drop when key is depressed. This drop will be slight but discernible. If no voltage drop is noted, it may indicate defective glow plugs or a faulty preheat circuit (check for loose connection).

3. Starting

While still holding preheat switch depressed, depress the start switch. The starter motor will run thereby cranking the engine. As soon as the engine runs, release the start switch which will return to its normally open position. Continue holding the preheat switch depressed for 2 or 3 seconds. This defeats the low oil pressure shutdown until the engine oil pressure rises to normal running pressure. Now release the preheat switch.



Should the engine not start when start switch is depressed for 10 to 12 seconds, release both switches and wait 30 seconds and repeat Steps 1 and 3. Never run the starter motor for more than 30 seconds at a time.

4. Operation

Once the engine starts, check instruments for proper oil pressure and battery charging voltage. Never attempt to engage the starter while the engine is running.

5. Warm-up

Apply a light load to the generator and allow the engine operating temperature to come up to 140 - 150°F before applying any heavy loads.

NOTE: Some unstable running may be present in a cold engine but should smooth out as operating temperature is reached (170 - 190°F) and load is applied to the generator.

STOPPING PROCEDURE

1. Remove AC electrical load from the generator and allow the generator to run for 3 to 5 minutes to stabilize operating temperatures.
2. Depress the stop switch and hold it until the generator is completely stopped. Then release it.

CAUTIONS ON STARTING AND OPERATION

1. Normal starting

Follow the procedures below for routine starting of the generator.

- 1) Check engine lube oil level prior to each day's use. Add oil as needed and maintain oil level at the high mark on the dipstick.
- 2) Check coolant level in the plastic recovery tank.

NOTE: Excessive loss of coolant from the plastic recovery tank indicates a cooling system leak. Check system and pressure test to locate. In cases of excessive loss of coolant, the system must be refilled as outlined under "Preparations".

- 3) Visually examine unit and look for any abnormalities and correct as needed.
- 4) Check to be sure there is sufficient fuel in the tank and examine filter/separator bowls for contaminants. Clean and drain as needed.
- 5) Start the generator following the procedures previously given and allow engine operating temperature to reach 140 - 150°F (60 - 66°C) before placing under heavy load.

2. Starting under cold conditions

The following three adverse conditions concur as the atmospheric temperature drops exceedingly, and the engine must, under such conditions, be started by taking steps described below:

LUBRICATING OIL TURNS VISCOUS - Make certain that oil used is adequate for the prevailing atmospheric temperature.

VOLTAGE ACROSS BATTERY TERMINALS DROPS - Check that the battery is fully charged.

THE TEMPERATURE OF INTAKE AIR IS LOW AND COMPRESSION TEMPERATURE DOES NOT RISE ENOUGH - Allow the glow plug to operate sufficiently to aid starting during preheat period. Refer to the preheat chart under "Starting Procedures".

REQUIREMENTS FOR PROPER OPERATION

LUBRICATION SYSTEM

1. Engine oil

For engine lubrication, use diesel engine oil. Diesel engine oils are classified according to the API Specifications into grades CA, CB, CC and CD. The use of CC or better is required.

2. Engine oil viscosity

Use oil having viscosity best suited to the atmospheric temperature. Use of an all-season oil SAE10W-30 with minimum viscosity change under different temperatures is suggested.

Atmospheric temperature	Viscosity
20°C (68°F) or higher	SAE 30 or 10W-30
5°C (41°F) - 20°C (68°F)	SAE 20 or 10W-30
5°C (41°F) or lower	SAE 10W-30

3. Oil pressure

The oil pressure during operation of the engine is registered on the oil pressure gauge.

During normal operation.....Oil pressure will range between 40 and 70 PSI.

At the time of cranking.....Pressure will rise proportionately with speed.

4. Engine oil change and filter change

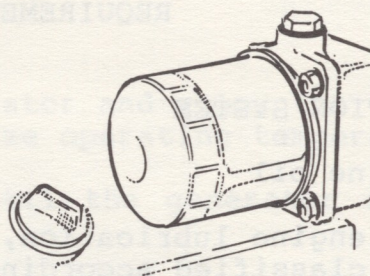
The engine lube oil and lube oil filter should be changed after every 100 hours of generator operation. Discharge dirty oil through the oil sump drain hose which is found attached to a bracket at the front of the engine. Do this only while the engine is not running and the oil is still warm so it will flow easily. Drain the dirty oil completely, reposition the drain hose in its support bracket, replace the end cap and tighten securely.

Remove the oil filter by unscrewing it from its mounting on the engine. To help avoid oil spillage, cover the filter with a plastic bag containing some paper towels. Puncture the filter housing at one high and one low point and allow it to drain into the plastic bag before removing it.

5. Replacement of oil filter

Being a replaceable cartridge type, the oil filter requires no cleaning inside.

When installing the oil filter, apply a thin coat of engine oil to the O-ring, then tighten it by hand firmly.



Add new oil through the oil fill on the valve cover or the service side fill. Add the correct amount of oil for the sump and to include the filter. Run the generator and insure proper oil pressure and check carefully for any leaks, particularly around the oil filter. Stop the generator, allow oil to settle and check oil level on the dipstick. Add oil as needed to the high mark on the dipstick.

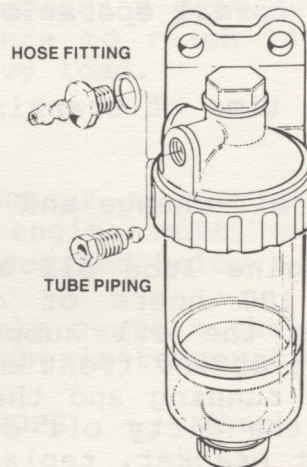
FUEL SYSTEM

1. Diesel fuel

USE #2 DIESEL FUEL. NEVER USE KEROSENE OR HEAVY OIL.

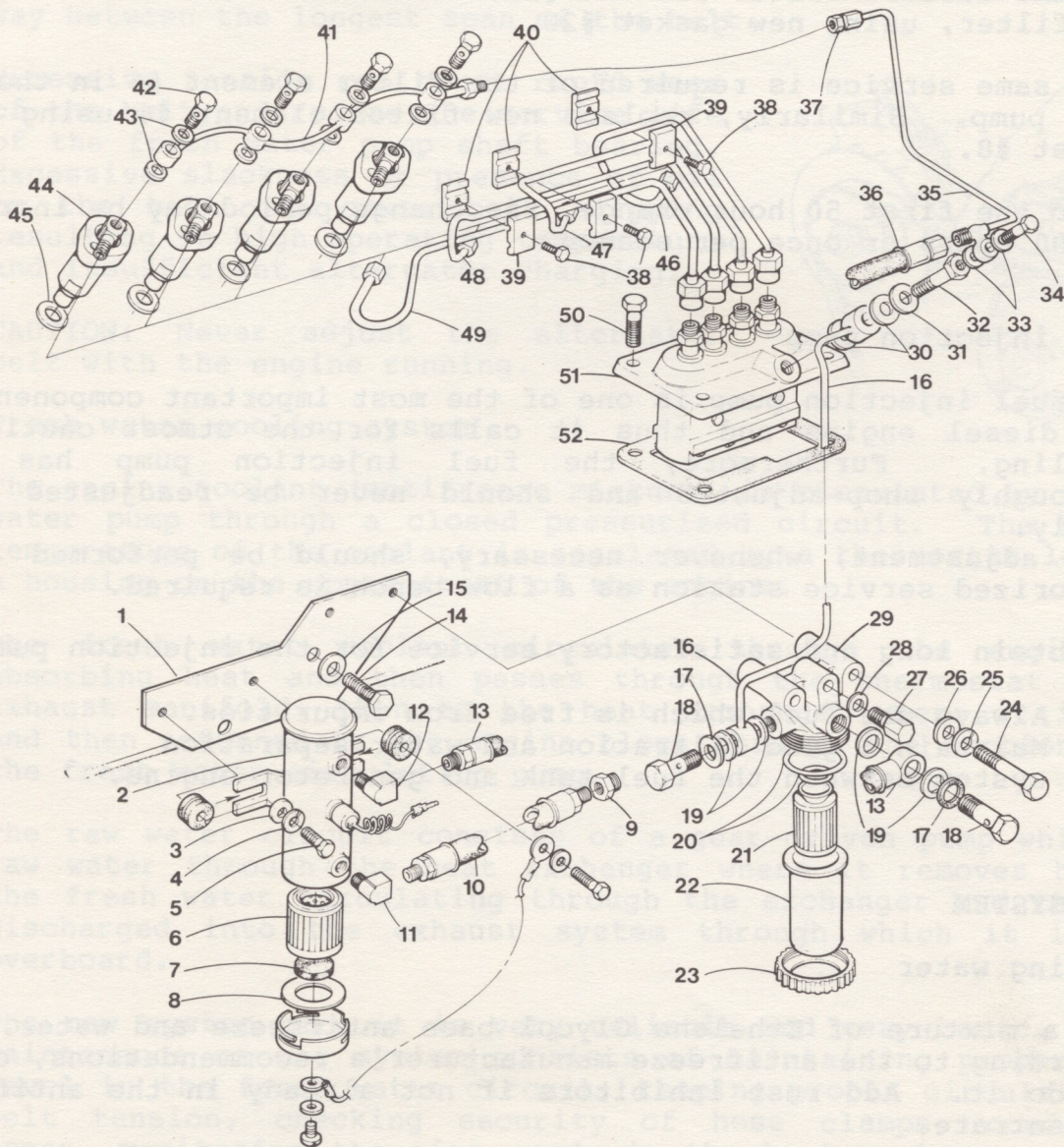
During cold weather, water is prone to accumulate in fuel tanks that are not kept full due to condensation taking place in the open area of the tank. Try to keep your fuel tank(s) as near full as possible. The fuel therefore needs to be kept as completely free of contaminants as possible.

2. It is required that a primary fuel filter of the water entrapment type 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 boatbuilder use, comes complete with fittings for either hose or metal tubing. Mount in an accessible place, inspect often and drain off water accumulation frequently.



3. Notes on fuel system

See below a typical exploded view of a fuel system.



The Westerbeke self-bleeding fuel system is automatic in operation. Therefore, it is unlikely that the operator will be forced to service the system at sea.

For that unlikely possibility, however, it is recommended that some basic repair and service spares be carried onboard such as:

Hardware kit (fuel system) Part Number 33093
Fuel filter elements with gaskets
Items #6, 8, 20, 21

Refer to the unit's Parts Manual for applicable part numbers.

When servicing or repairing fuel equipment on the engine, it is prudent to replace any of the gaskets or sealing washers involved.

4. Cleaning fuel filter and replacing filter element

After the first 50 hours of operation, loosen the retainer ring #23 and discard filter element #21. Clean bowl #22 and re-install new filter, using new gasket #20.

This same service is required of the filter element #6 in the fuel lift pump. Similarly, replace new filter element #6 using a new gasket #8.

After the first 50 hour change, the change period may be increased to 200 hours or once per season.

5. Fuel injection pump

The fuel injection pump is one of the most important components of the diesel engine and thus it calls for the utmost caution in handling. Furthermore, the fuel injection pump has been thoroughly shop-adjusted and should never be readjusted carelessly.

Such adjustment, whenever necessary, should be performed at an authorized service station as a flow bench is required.

To obtain long and satisfactory service for the injection pump:

Always use fuel which is free from impurities.
Maintain a good filtration and water separation system between the fuel tank and generator engine.

COOLING SYSTEM

1. Cooling water

Use a mixture of Ethelene Glycol base antifreeze and water. Mix according to the antifreeze manufacturer's recommendations, do not overdo it. Add rust inhibitors if not already in the antifreeze concentrate.

ANTIFREEZE ADDITION DATA

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

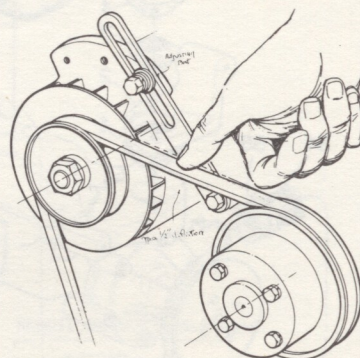
Note: It is advisable that antifreeze concentration be selected on the basis of a temperature which is about 5°C (10°F) lower than the actual atmospheric temperature in which the generator will normally operate.

3. Alternator (DC) drive belt tension

The alternator drive belt is properly adjusted if it can be deflected 3/8 to 1/2 inch (10 - 13 mm) with the thumb fringe midway between the longest span of the belt.

Excessive tension can cause rapid wear of the belt and reduce the service life of the fresh water pump shaft bearing. Excessive slackness or presence of oil on the belt can cause belt slipping resulting in high operating temperature and insufficient alternator charging.

CAUTION: Never adjust the alternator belt with the engine running.



4. Fresh water cooling system

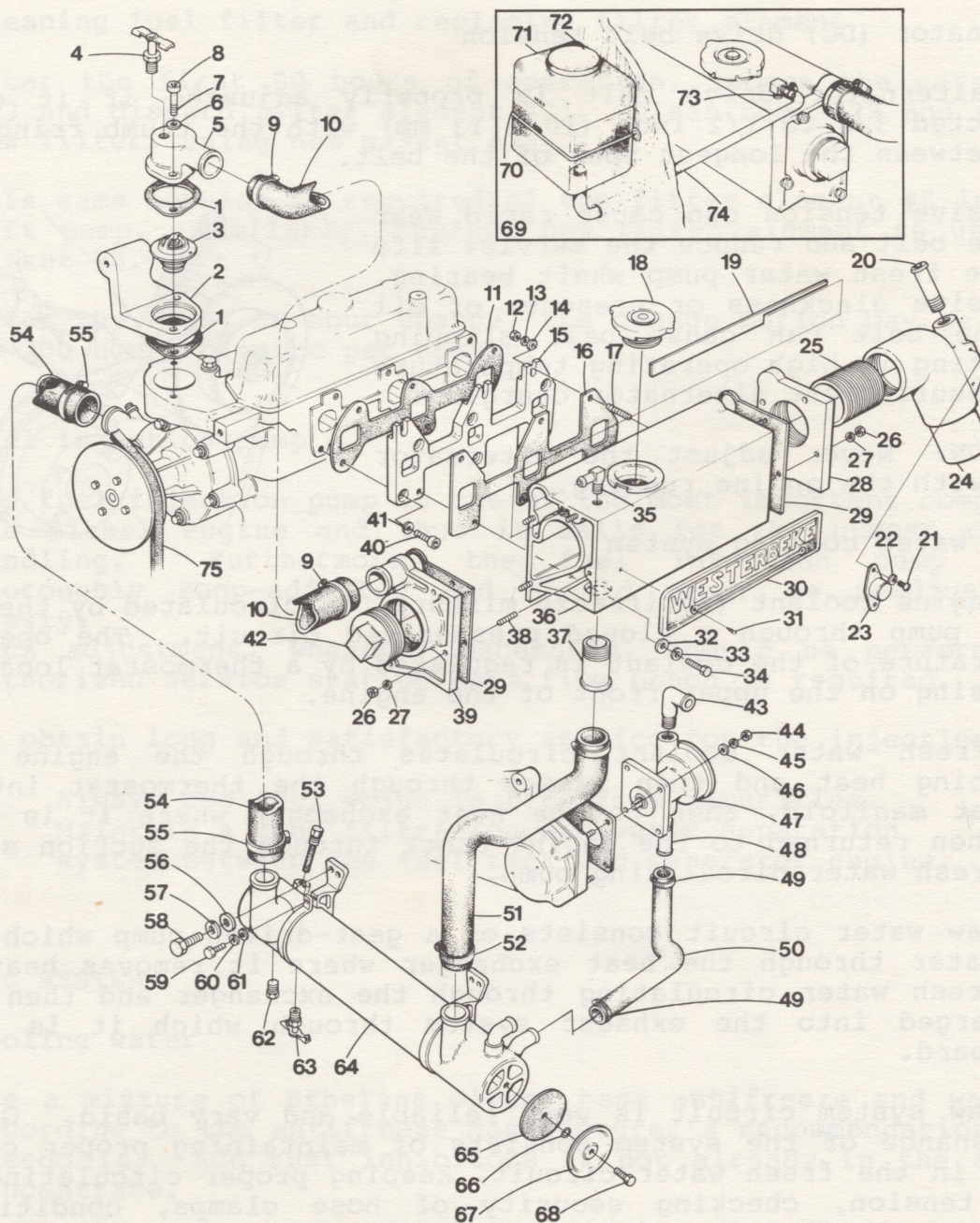
The engine coolant (antifreeze mixture) is circulated by the fresh water pump through a closed pressurized circuit. The operating temperature of the coolant is regulated by a thermostat located in a housing on the upper front of the engine.

The fresh water coolant circulates through the engine block absorbing heat and then passes through the thermostat into the exhaust manifold, then to the heat exchanger where it is cooled and then returned to the engine block through the suction side of the fresh water circulating pump.

The raw water circuit consists of a gear-driven pump which pumps raw water through the heat exchanger where it removes heat from the fresh water circulating through the exchanger and then it is discharged into the exhaust system through which it is pumped overboard.

The raw system circuit is very reliable and very basic. General maintenance of the system consists of maintaining proper coolant level in the fresh water circuit, keeping proper circulating pump belt tension, checking security of hose clamps, condition of hoses, monitoring the zinc anode in the heat exchanger and maintaining a good impeller in the raw water pump.

It is recommended that a zinc anode, impeller kit, fresh water circulating belt and thermostat kit be kept onboard as necessary spares for general repairs and servicing.

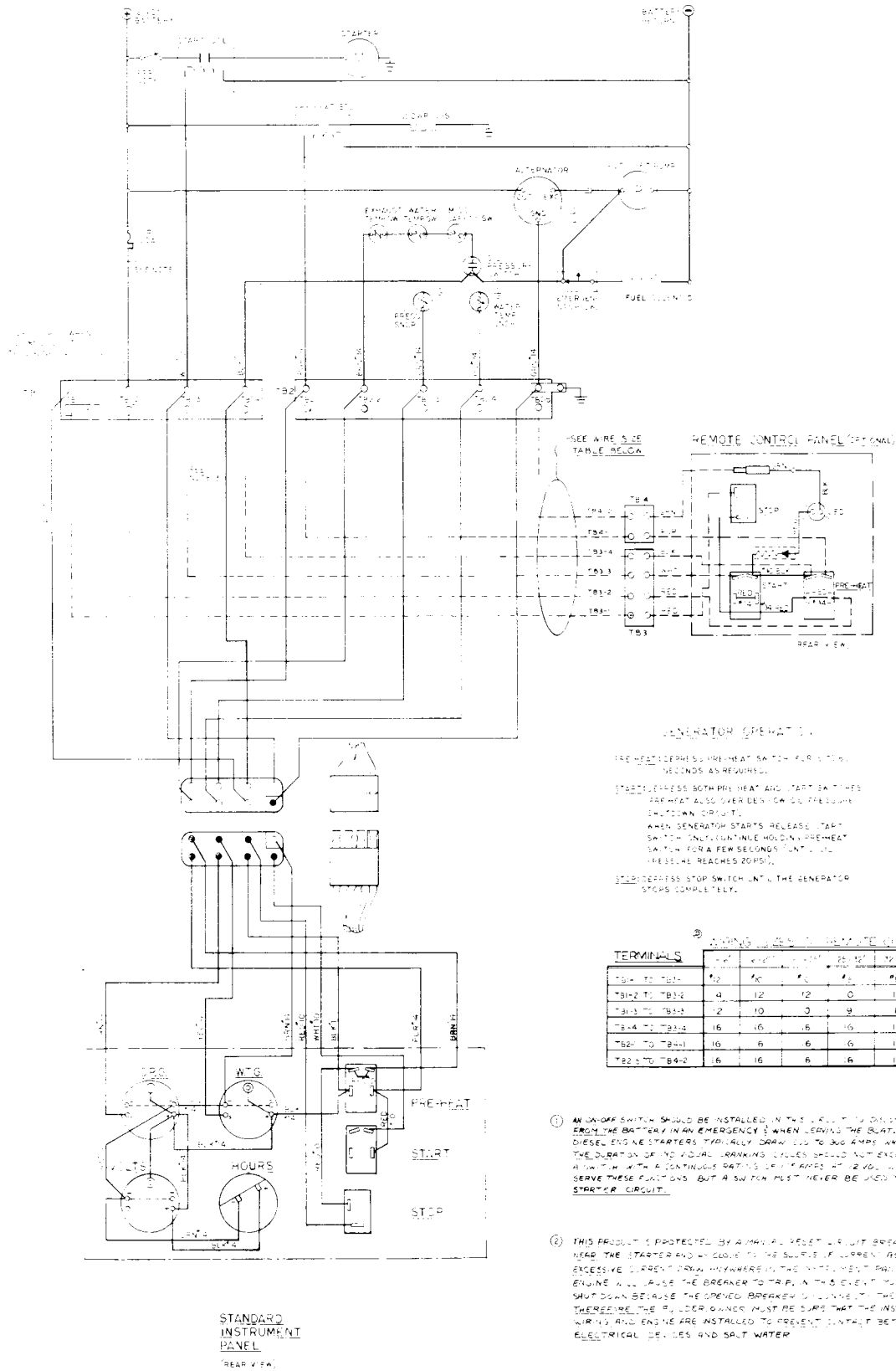


ENGINE 12 VOLT DC CONTROL CIRCUIT

This engine has a 12 volt DC electrical control circuit as shown on the accompanying electrical diagram. Refer to this diagram when troubleshooting or servicing engine electrical components.

Care should always be taken when working on the engine electrical circuit. It is recommended that when doing so the battery power to the engine be shut off to avoid electrical shorts.

NEVER shut off the engine battery switch while the engine is running. Damage to the battery charging alternator will result.



1. AN ON-OFF SWITCH SHOULD BE INSTALLED IN THE CIRCUIT TO DISCONNECT THE STARTER FROM THE BATTERY IN AN EMERGENCY. WHEN LEAVING THE BOAT, TWELVE (12) DIESEL ENGINE STARTERS TYPICALLY DRAW 100 TO 200 AMPS WHEN CRANKING. THE DURATION OF 100 AMP CRANKING CYCLES SHOULD NOT EXCEED 30 SECONDS. A BATTERY WITH A CONTINUOUS RATING OF 12 VOLTS WILL NORMALLY SERVE THESE FUNCTIONS, BUT A SWITCH MUST NEVER BE USED TO MAKE THE STARTER CIRCUIT.
2. THIS CIRCUIT IS PROTECTED BY AN OVERCURRENT BREAKER. IF THE BREAKER TRIPS, THE STARTER AND WIRING TO THE SOURCE OF CURRENT ARE DISCONNECTED. EXCESSIVE CURRENT DRAW ANYWHERE IN THE WIRING SYSTEM, INCLUDING THE ENGINE, WILL CAUSE THE BREAKER TO TRIP. IN THIS EVENT, THE GENERATOR WILL SHUT DOWN BECAUSE THE OPENED BREAKER WILL INTERRUPT THE FUEL SUPPLY. THEREFORE, THE USER OWNER MUST BE SURE THAT THE INSTRUMENT PANEL WIRING AND ENGINE ARE INSTALLED TO PREVENT CONTACT BETWEEN ELECTRICAL DEVICES AND SALT WATER.
3. MOST STARTERS DRAW 100 TO 200 AMPS. THEREFORE THE VOLTAGE DROP IN THE CONDUCTOR MUST BE NO GREATER THAN 0.5 V. IN THE WIRING FROM THE STANDARD START SWITCH TO ANY REMOTE SWITCH AND BACK TO THE STANDARD STARTER SWITCH, IF THIS REQUIRES EXCESSIVELY LARGE CONDUCTORS, THEN A RELAY MAY BE ADDED TO CONTROL THE STARTER CIRCUIT ITSELF.

BT GENERATOR

This generator is a brushless type, self-excited which requires only the driving force of the engine to produce AC output. Two permanent magnets in the exciter stator are responsible for the self-exciting feature of this generator. The magnetic field they produce 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 which is in turn supplied to a full wave bridge rectifier which produces a DC voltage to further excite the exciter stator windings to enable the generator to produce a rated AC output.

An optional solid state voltage regulator is offered for the generator to work in tandem with the transformer regulator to enable the generator to produce a more stable AC output.

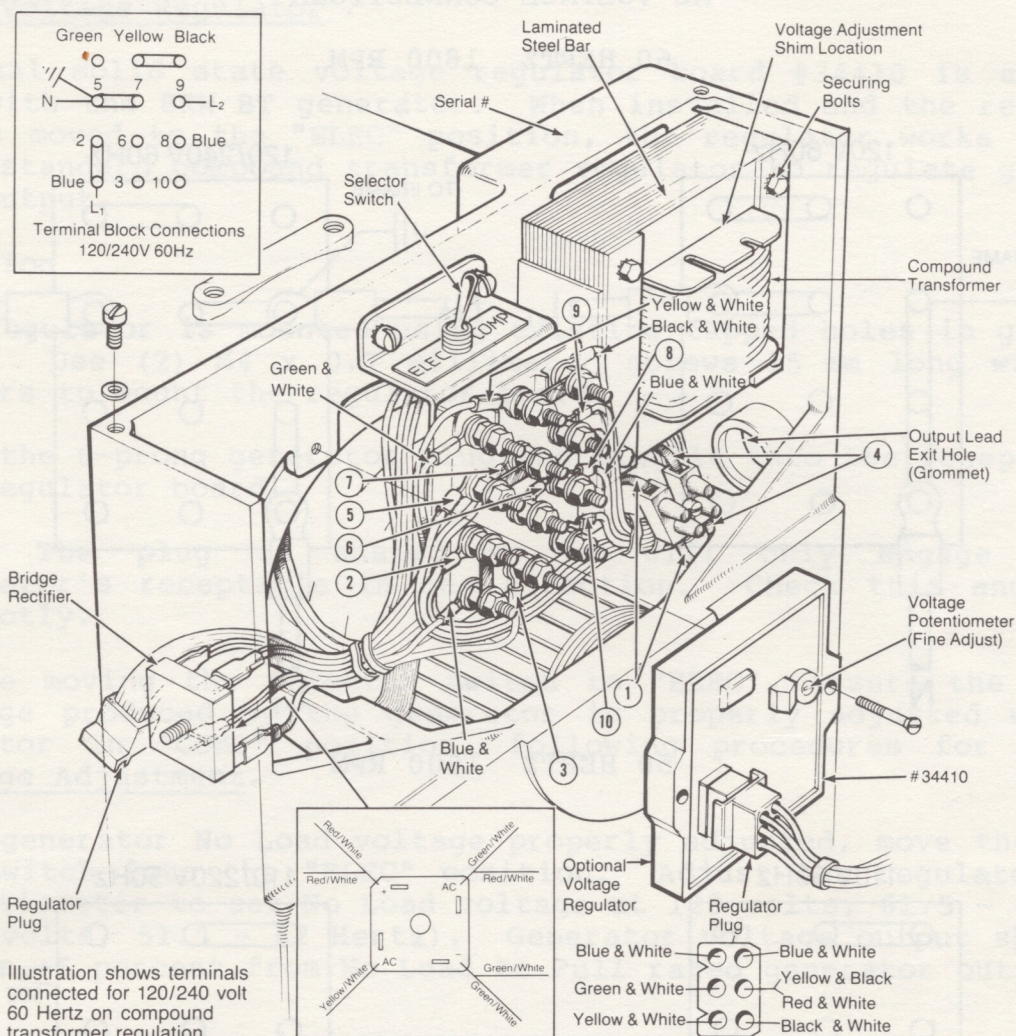
No Load Voltage Adjustment

Voltage adjustment is made with the generator regulation being governed by the compound transformer.

1. The selector switch must be in the "COMP" position.
2. Operate the generator and apply a moderate load momentarily and remove it. Note the voltage output from the generator's 120 volt leg(s) (110 volt 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 once started and a momentary load applied to excite the transformer and then removed. The voltage produced by the generator after this momentary load is removed is No Load voltage.

3. To raise or lower the voltage, shims of varying thickness (non-conductive material) are placed or removed from under the steel laminated bar on top of the compound transformer. The material used for shimming should not soften at temperatures in the 80°C range. A small reduction in No Load voltage (1 to 3 volts) can sometimes 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.



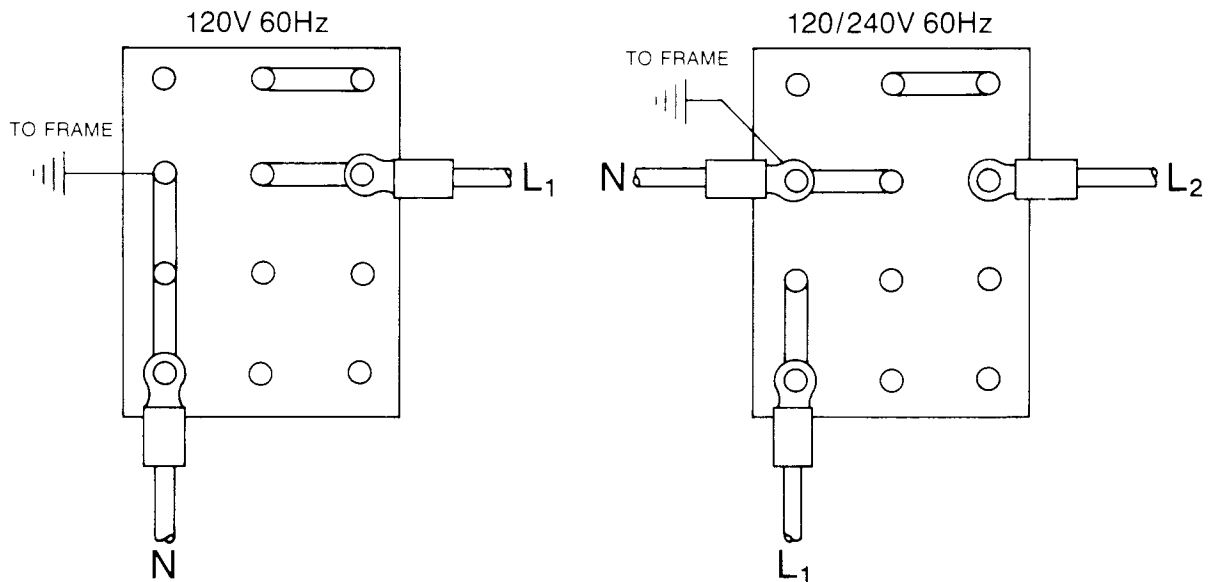
Under no circumstances attempt to increase the No Load voltage by increasing the gap between the laminated steel bar and the transformer core without the use of shims. Magnetic forces created within the transformer during generator operation may close the air gap and reduce No Load voltage output.

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.

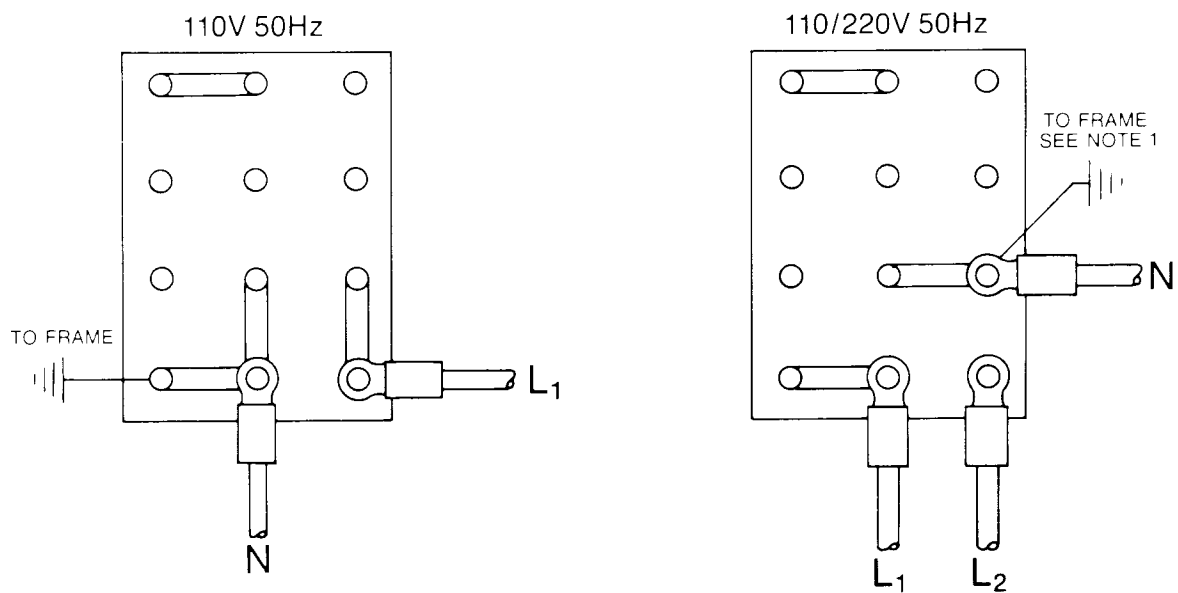
Varying shim thickness by .001 inch (0.025 mm) will change the No Load voltage by 4 to 6 volts.

AC VOLTAGE CONNECTIONS

60 HERTZ 1800 RPM



50 HERTZ 1500 RPM



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

For making connections to the AC terminal block, use terminal ends for #10 studs and that will accept #6 or #8 multi-strand wire.

Optional Voltage Regulator

An optional solid state voltage regulator board #34410 is available for use with the 8KW BT generator. When installed and the regulation switch is moved to the "ELEC" position, the regulator works together with the standard compound transformer regulator to regulate generator voltage output.

Installation

1. The regulator is mounted using existing tapped holes in generator case. Use (2) M4 x 0.7 millimeter screws 15 mm long with lock washers to mount the regulator board.
2. Take the 6-prong generator plug and plug it into the receptacle on the regulator board.

NOTE: The plug is shaped so it will only engage in the regulator's receptacle in one direction. Check this and insert correctly.

3. Before moving the selector switch to "ELEC", insure the No Load voltage produced by the generator is properly adjusted with the selector in "COMP" position, following procedures for No Load Voltage Adjustment.
4. With generator No Load voltage properly adjusted, move the selector switch into the "ELEC" position. Adjust the regulator board potentiometer to set No Load voltage at 120 volts, 61.5 - 62 Hertz (110 volts, 51.5 - 52 Hertz). Generator voltage output should be within +5 percent from No Load to Full rated generator output.

Generator Frequency

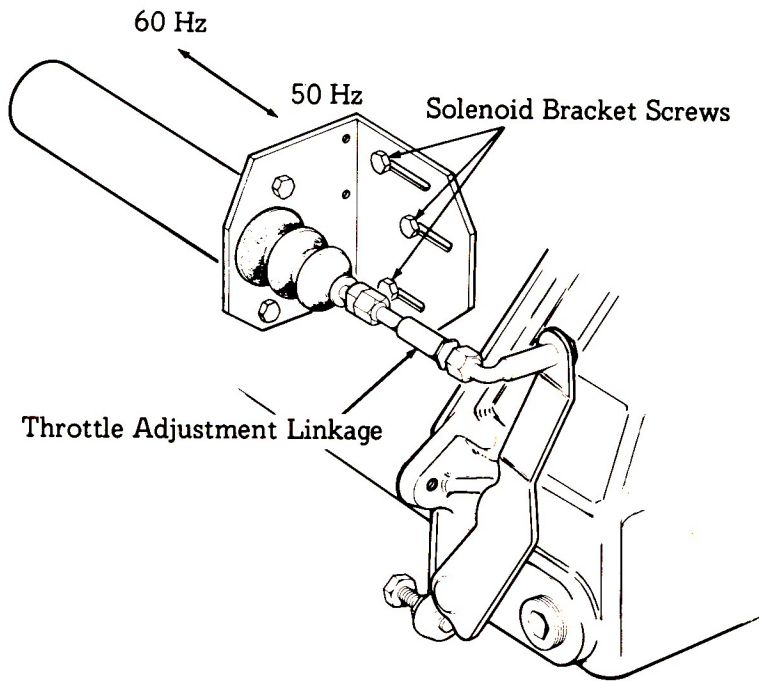
1. Frequency is a direct result of engine/generator speed:

1800 RPM - 60 Hertz
1500 RPM - 50 Hertz

2. To change generator frequency:

- A. Connect the AC output leads to the AC terminal block, following the illustrations on the preceding page.
- B. Adjust the engine speed to obtain the frequency corresponding to the voltage selected.

Engine speed is increased or decreased by adjusting the length of the linkage between the throttle arm and solenoid plunger with the plunger completely bottomed in the solenoid.



Solenoid and Throttle with Linkage

NOTE: The solenoid plunger MUST move smoothly and rapidly into the solenoid when the solenoid is electrically energized, drawing with it the engine throttle arm into the set speed run position.

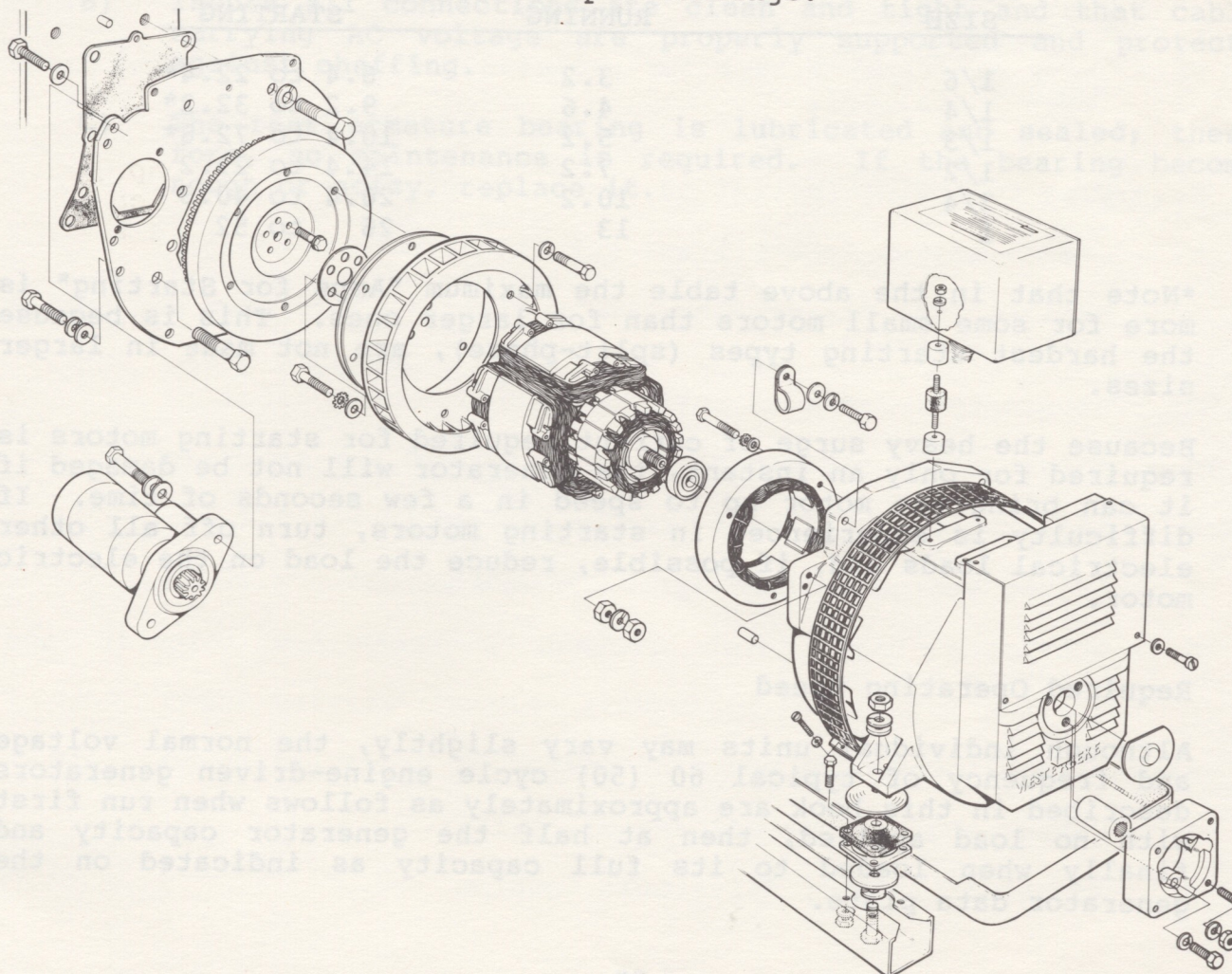
Failure of the solenoid plunger to bottom in the solenoid will result in a failed solenoid.

Generator Ratings (single phase)

Model	Volts	Amps	Hertz
BT 8.0 - 614	120/240	68/34	60
BT 6.0 - 514	110/220	50/25	50

NOTE: When changing Hertz produced by the generator, an engine speed adjustment must be made and the connections on the AC output terminal block located under the louvered cover on the back end of the generator must be changed.

When the generator is wired for 120/240 volts (110/220 volts) output and loads are applied to the 120 (110) volt legs, these loads should be as balanced as possible. Loads applied to one of the two 120 (110) volt output legs and none to the other will produce a voltage difference between the two 120 (110) volt output legs. The voltage on the loaded leg will go down and the unloaded leg will go up. The severity of this voltage difference will depend on the load applied to the one 120 (110) volt leg. Heavy loads applied to one leg will cause the generator to perform as above and also produce a rattling/growling noise from the generator end created by the unbalanced effect produced on the rotating field as its magnetic field passes through the loaded and unloaded stator 120 volt output windings.



GENERAL INFORMATION AND CARE OF THE GENERATOR

1. Use of Electric Motors

The power required to start an electric motor is considerably more than is required for keeping it running after it is once started. Some motors require much more current to start them than others. Split phase (A.C.) motors require more current to start them, 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. Since 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 them as to run them. 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 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	AMPS FOR RUNNING	AMPS FOR STARTING
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. This is because the hardest starting types (split-phase), are not made in larger sizes.

Because the heavy surge of current required 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 of time. If difficulty is experienced in starting motors, turn off all other electrical loads and, if possible, reduce the load on the electric motor.

2. Required Operating Speed

Although individual units may vary slightly, the normal voltage and frequency of typical 60 (50) cycle engine-driven generators described in this book are approximately as follows when run first with no load applied, then at half the generator capacity and finally when loaded to its full capacity as indicated on the generator data plate.

Load Applied	Speed 4 pole	Frequency	Generator	Voltage
			120v (110) Plants	240v (220) Plants
None	1830 (1530)	62 (52)	122 (112)	244 (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 insure proper operation of the generating plant and appliances.

If an AC voltmeter or ammeter is not installed to monitor voltage and load, check it with a portable meter and amprobe.

3. Preventative Maintenance

Maintenance on the generator is minimal.

- A) Keep the generator clean, dry and well ventilated.
- B) Insure all connections are clean and tight and that cables carrying AC voltage are properly supported and protected against chaffing.
- C) The rear armature bearing is lubricated and sealed; therefore, no maintenance is required. If the bearing becomes rough or noisy, replace it.

PREVENTATIVE MAINTENANCE - ENGINE

Check and service your engine at specified intervals to maintain it in its best condition and permit it to perform as it should. As for those asterisked items, it is suggested that you have them performed by an authorized distributor or dealer.

1. Daily (before each day's use)

- A. Check sump oil level. Maintain level near or at upper level on dipstick.
- B. Check coolant in plastic recovery tank. Maintain at COLD level.
- C. Visually look over unit checking for loose belts, wires, brackets, alternator belt, clamps, etc.
- D. Check fuel supply and water separator. Drain and service water separator as needed. (Water separator is optional, but recommended.)
- E. Check engine gauges for proper oil pressure, operating temperature and starting battery charging voltage once the engine is started.
- F. Check generator meters for proper AC voltage output and Hertz (when installed).

2. Servicing following initial 50 hours of operation

- A. Change engine lube oil and oil filter.
- B. Replace fuel filter elements in electric lift pump and engine filter assembly.
- *C. Torque cylinder head hold down bolts.
- *D. Adjust valve clearances (0.25 mm (0.010 in) engine cold).
- E. Adjust alternator belt tension.
- F. Adjust engine no load speed (if needed).
- G. Lubricate ball joint linkage between run solenoid and throttle arm.

3. Servicing at every 100 hours of operation

- A. Change engine lube oil and oil filter.
- B. Adjust alternator drive belt tension.

- C. Lubricate ball joint linkage between run solenoid and throttle arm.

4. Servicing at every 250 hours of operation

- A. Replace fuel filter elements in electric fuel pump and engine filter assembly.

5. Servicing at every 500 hours of operation

- *A. Torque the cylinder head hold down bolts.
- *B. Adjust the valve clearances.
- C. Drain, flush and refill the fresh water cooling system.
- *D. Check and lubricate the starter motor drive pinion.
- E. Do resistance check of glow plugs.

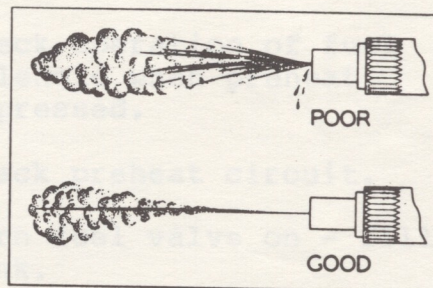
6. Servicing at every 600 hours of operation

- *A. Remove and check injectors.

Injector spray pressure:

$$1706 \text{ PSI} \pm 142 \text{ PSI} \\ (120 \text{ kg/cm}^2 \pm 10 \text{ kg/cm}^2)$$

Eliminate undesirable injection conditions including after-dripping.



- *B. Check compression pressure. Remove each glow plug and check cylinder compression pressure. Engine - cranking 2500 RPM.

Standard

Minimum

455 PSI (32 kg/cm²)

370 PSI (26 kg/cm²)

Maximum difference between cylinder:

35.5 PSI (2.5)kg/cm²)

- *C. Check battery charging alternator for proper operation.
- *D. Check tightness of bolts, nuts and clamps.

Servicing at every 1000 hours of operation

- A. Remove and clean and pressure test primary heat exchanger. (Local radiator shop should be able to clean and test.) Operating in silty and/or tropical waters may require lesser time between cleanings.

- *B. Check injection pump timing.

ENGINE TROUBLESHOOTING

Engine does not start - does not crank over

Problem	Remedy
A. Battery switch off.	Turn battery ON.
B. Circuit breaker 20 amp on engine tripped.	Push to reset.
C. Low voltage to starter "S" terminal.	Check connections and battery charge.
D. Loose or dirty ground cable.	Clean and tighten cable connection.
E. Preheat not depressed.	Start switch interlocked with preheat.
F. Water in cylinders.	Faulty exhaust - syphon break.

Engine does not start - engine cranks over

A. Fuel solenoid faulty.	Check operation of fuel solenoid when preheat depressed.
B. Preheaters not functioning.	Check preheat circuit.
C. Fuel starvation.	Turn fuel valve on - fill fuel tank.
D. Fuel contamination.	Check for water or algae in Fuel. Purge system. Change filters and bleed system.

Engine stops while in operation

A. Faulty shutdown switch or system fault (i.e. overheat, low oil pressure).	Check each switch with ohmmeter. Replace faulty switch. Check systems for proper operation.
B. Fuel starvation.	Fill fuel tank. Replace clogged fuel filter.
C. Air leak.	Check system for leak and correct. Monitor return fuel. It should be free of air bubbles: indicates no air leak.

Engine stops while in operation

D. 20 amp circuit breaker tripped.

Push in to reset. If circuit breaker trips again, check for DC short or overload in engine run circuit.

E. Fuel run solenoid.

Check for proper operation of fuel run solenoid when depressing preheat. Insure proper operation with remote panel when installed. Check for proper voltage. Refer to Service Bulletin #127 (revised June 1985).

Generator Troubleshooting

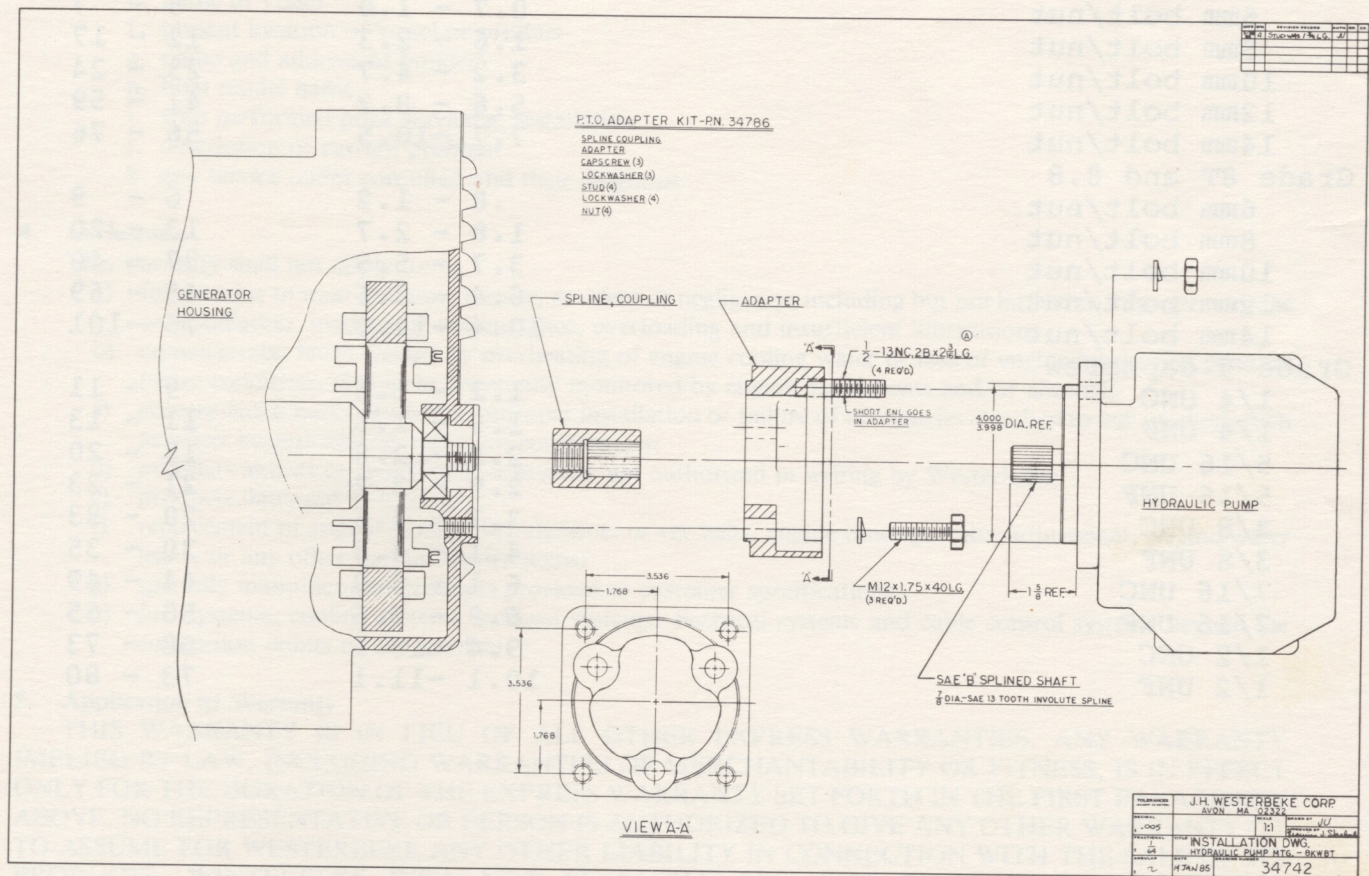
A complete and illustrated text on troubleshooting the 8 KW BT generator is furnished in the technical manual #30041, Edition #3, available through your local dealer.

POWER TAKE-OFF ADAPTER

The generator housing of the 8 KW BT is machined to accept the optional adapter kit #34786. This will allow the user to mount a hydraulic pump or similar device to operate other equipment while the generator is operating.

The operator is advised that the generator drive engine is producing 14 horsepower at 1800 RPM 60 Hertz (11 HP at 1500 RPM 50 Hertz). This horsepower can be utilized for either generator AC amperage output or to operate the P.T.O. device. It cannot do both, i.e., produce 8 KW of AC electrical power and furnish 14 HP (11 HP) to the P.T.O. device.

When mounting a P.T.O. device using the optional adapter kit #34786, insure good alignment of the device to spline coupling and that if additional support is needed, it be added. When in doubt, give extra support.



NOTE: Provisions should be made to prevent the P.T.O. device from overloading the generator engine, i.e., pressure relief valve.

TABLE OF TIGHTENING TORQUE

kg-mlb-ft.

Cylinder head bolt (M10)	7 - 8	50.7 - 57.9
(M12)	11 - 12	79.6 - 86.8
Crank pulley nut	20 - 25	108.5 - 180.8
Main bearing cap bolt	5.0 - 5.5	36.2 - 43.4
Connecting rod cap nut	3.2 - 3.5	23.1 - 25.3
Flywheel bolt - with separate washers	11.5 - 12.5	83.2 - 90.4
Flywheel bolt - washer attached	13 - 14	95.0 - 100.0
Oil pan drain plug	5 - 6	36.2 - 43.4
Oil filter	1.1 - 1.3	8.0 - 9.4
Delivery valve holder (injection pump)	4 - 5	28.9 - 36.2
Holder mounting bolt, nozzle	1.5 - 2.0	10.8 - 14.5
Holder body and retaining nut, nozzle	6 - 8	43.4 - 57.9
Glow plug	1.5 - 2.0	10.8 - 14.5

UNLESS OTHERWISE INDICATED

Grade 6T

6mm bolt/nut	0.7 - 1.0	5 - 7
8mm bolt/nut	1.6 - 2.3	12 - 17
10mm bolt/nut	3.2 - 4.7	23 - 24
12mm bolt/nut	5.6 - 8.2	41 - 59
14mm bolt/nut	7.7 - 10.5	56 - 76

Grade 8T and 8.8

6mm bolt/nut	.8 - 1.2	6 - 9
8mm bolt/nut	1.8 - 2.7	13 - 20
10mm bolt/nut	3.7 - 5.5	27 - 40
12mm bolt/nut	6.4 - 9.5	46 - 69
14mm bolt/nut	10.4 - 14.0	75 - 101

Grade 5 capscrew

1/4 UNC	1.2 - 1.5	9 - 11
1/4 UNF	1.5 - 1.8	11 - 13
5/16 UNC	2.5 - 2.8	18 - 20
5/16 UNF	2.9 - 3.2	21 - 23
3/8 UNC	3.7 - 4.6	28 - 33
3/8 UNF	4.1 - 4.8	30 - 35
7/16 UNC	6.1 - 6.8	44 - 49
7/16 UNF	6.9 - 7.6	50 - 55
1/2 UNC	9.4 - 10.1	68 - 73
1/2 UNF	10.1 - 11.1	73 - 80

WESTERBEKE LIMITED WARRANTY

1. Warranty Obligation and Duration

Westerbeke warrants to the original consumer purchaser that all standard Westerbeke marine engines and generator sets manufactured or supplied by us will be free from defects in material and workmanship for a period of one year: from date of commission, or date of purchase on repower, OR fifteen hundred (1500) hours on Commercial Generators, only (whichever occurs first).

2. Remedy

Westerbeke will elect to repair or replace free of charge to you any product or part returned to our factory transportation costs prepaid which we adjudge defective in materials or workmanship. Alternatively, we may reimburse at our discretion a portion of labor costs incurred to repair defective parts or products on site. If you request shipment of replacement parts to you prior to our determination of cause of failure, such shipment will be sent C.O.D.

3. Notification

If you encounter a problem with your Westerbeke engine or generator set within the warranty period as stated above, contact your nearest authorized Westerbeke Master Distributor directly, by telephone or letter.

Be prepared to furnish the following information:

- a. number of hours on unit
- b. date of commission, date of purchase
- c. owner's office and home telephone
- d. model number, serial number
- e. name of vessel
- f. present location of vessel or product
- g. name and address of builder
- h. boat model name
- i. who performed prior servicing, installation
- j. description of current problem
- k. any service outlet consulted and their diagnosis

4. Exclusions

This warranty shall not apply to:

- a) failures due to wear and tear, misuse, accident or negligence, including but not limited to improper storage or installation, inadequate maintenance, overloading and insufficient lubrication;
- b) consequential harm caused by overheating of engine cooling water or loss of engine lubricating pressure (these conditions should be constantly monitored by engine instruments and/or alarms);
- c) consequential harm caused by improper installation or failure of accessories attached to our product, such as water heaters and refrigeration compressors;
- d) products altered or modified in a manner not authorized in writing by Westerbeke;
- e) products damaged in transit;
- f) replacement of engine fluids, filter elements or vee belts, engine tune-up, valve adjustment, oil and water leaks, or any other normal service items;
- g) specially manufactured products provided to customer specifications;
- h) fuel systems, cooling systems, exhaust systems, electrical systems and cable control systems beyond the connection points on the product.

5. Application of Warranty

THIS WARRANTY IS IN LIEU OF ALL OTHER EXPRESS WARRANTIES. ANY WARRANTY IMPLIED BY LAW, INCLUDING WARRANTIES OF MERCHANTABILITY OR FITNESS, IS IN EFFECT ONLY FOR THE DURATION OF THE EXPRESS WARRANTY SET FORTH IN THE FIRST PARAGRAPH ABOVE. NO REPRESENTATIVE OR PERSON IS AUTHORIZED TO GIVE ANY OTHER WARRANTY OR TO ASSUME FOR WESTERBEKE ANY OTHER LIABILITY IN CONNECTION WITH THE SALE OF ITS PRODUCTS. WESTERBEKE WILL NOT BE LIABLE FOR ANY CONSEQUENTIAL DAMAGES RESULTING FROM THE USE OR INSTALLATION OF ITS PRODUCTS.

SOME STATES DO NOT ALLOW LIMITATIONS ON HOW LONG AN IMPLIED WARRANTY LASTS OR THE EXCLUSIONS OR LIMITATION OF INCIDENTAL OR CONSEQUENTIAL DAMAGES, SO THE ABOVE LIMITATIONS AND EXCLUSION MAY NOT APPLY TO YOU. THIS WARRANTY GIVES YOU SPECIFIC LEGAL RIGHTS, AND YOU MAY ALSO HAVE OTHER RIGHTS WHICH VARY FROM STATE TO STATE.

