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OPERATOR'S MANUAL

for

WESTERBEKE MARINE GASOLINE

GENERATOR SETS

6.5 KW — 8 KW — 11 KW

J. H. WESTERBEKE CORP.
AVON INDUSTRIAL PARK, AVON, MASS. 02322 · (617) 588-7700
CABLE: WESTCORP, AVON · TELEX: 92-4444

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

WESTERBEKE™

Engines & Generators

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GENERAL SPECIFICATIONS

Type	Gasoline, four cycles
# and arrangement of cylinders	4 cylinders in line, vertical type
Valve system	Single overhead cam (OHC), chain drive
Total piston displacement	
6.5 & 8 KW	1071 cc (65.30 cubic inches)
11 KW	1490 cc (90.92 cubic inches)
Inner diameter X stroke	
6.5 & 8 KW	70.0 mm X 69.6 mm (2.76 X 2.74 in)
11 KW	77.0 mm X 80.0 mm (3.03 X 3.15 in)
Compression ratio	
6.5 & 8 KW	9.2:1
11 KW	9.0:1
Compression pressure	
6.5 & 8 KW	12.0 kg/cm^2 (170 psi) - 300 RPM
11 KW	14.0 kg/cm^2 (198 psi) - 300 RPM
Valve timing: 6.5 & 8 KW	
Intake open	15° BTDC
Intake closed	44° ABDC
Exhaust open	53° BBDC
Exhaust closed	6° ATDC
Valve timing: 11 KW	
Intake open	15° BTDC
Intake closed	58° ABDC
Exhaust open	58° BBDC
Exhaust closed	15° ATDC
Valve clearance (warm engine)	
Valve side: Intake	0.25 mm (0.010 in)
Exhaust	0.30 mm (0.012 in)
Cam side: Intake	0.18 mm (0.007 in)
exhaust	0.22 mm (0.009 in)
Engine speed	1800 RPM (mechanically governed)
Ignition timing	8° $\pm$ 1° BTDC @ 600 RPM 14° $\pm$ 1° BTDC @ 1800 RPM
Firing order	1 - 3 - 4 - 2

Dimensions (approximate in inches)		
6.5KW	Height	23.13
	Width	19.63
	Length	37.50
8 KW	Height	23.13
	Width	19.63
	Length	39.00
11 KW	Height	23.13
	Width	19.63
	Length	41.00

Weight	
6.5 KW	510 lbs.
8 KW	533 lbs.
11 KW	563 lbs.

Raw water flow (1800 RPM)	
6.5 & 8 KW	6.7 G.P.M.
11 KW	7.0 G.P.M.

Fuel pump lift (maximum)	
6.5 & 8 KW	6 feet
11 KW	6 feet

TABLE OF TIGHTENING TORQUES

	Kg-m	lb-ft
Cylinder head	7.8 - 8.2	56 - 59
Manifold		
Intake	1.9 - 2.6	14 - 19
Exhaust	1.9 - 2.3	14 - 17
Main bearing caps	6.6 - 7.1	48 - 51
Connecting rod caps	3.0 - 3.5	22 - 25
Camshaft sprocket	7.0 - 8.0	51 - 58
Crankshaft pulley	11.0 - 12.0	80 - 87
Flywheel	8.3 - 9.0	60 - 65
Backplate	7.0 - 10.0	51 - 72
Spark plugs	1.5 - 2.3	11 - 17
Timing chain cover	1.9 - 3.1	14 - 22
Oil filter	By hand	
Oil pan	0.7 - 1.2	5 - 9
Oil pump	1.9 - 3.1	14 - 22
Thermostat cover	1.9 - 3.1	14 - 22
Fresh water pump	1.9 - 3.1	14 - 22

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

SYSTEM SPECIFICATIONS

FUEL SYSTEM

1.	Fuel	Unleaded or leaded gasoline
2.	Carburetor	Down draft - single barrel
3.	Governor	Mechanical type - belt driven
4.	Lift pump	12 volt electric
5.	Air cleaner	Metal screen type

COOLING SYSTEM

1.	General	Fresh water cooled block through raw water cooled exchanger system
2.	Fresh water pump	Centrifugal type, metal impeller, belt driven
3.	Raw water pump	Positive displacement, rubber impeller, belt driven
4.	Fresh water cooling system capacity	
	6.5 & 8 KW	5 U.S. quarts
	11 KW	7 U.S. quarts

LUBRICATION SYSTEM

1.	General	Pressure type with trochoid type pump
2.	Oil filter	Paper type, spin-on (P/N 30220)
3.	Sump capacity	3.2 U.S. quarts (3.0 litres)
4.	Total capacity	3.9 U.S. quarts (3.7 litres) (including filter)
5.	Oil pressure (engine hot)	25 - 35 psi $\pm$ 5 psi at 1800 RPM ($3.5 - 4.5$ kg/cm^2 $\pm$ 0.7 kg/cm^2)
5.	Oil grade	A.P.I. Spec. SE or SE/CC

ELECTRICAL SYSTEM

1. Alternator	12 volt, 51 amp rated regulator internal, non-isolation diode type
2. Starter	12 volt, solenoid mounted

IGNITION SYSTEM

1. General	12 volt, negative ground, distributor type with solid state ignition, coil and spark plugs

AC GENERATOR

1. General	Four pole, revolving armature, stationary field coils, inherently regulated, self limiting, rectifier field excitation, AC output through slip rings and brushes. 120/240 volt single phase, reconnectable
2. Ratings 1800 RPM, 60 Hertz	
a. 6.5 KW	6500 watts
b. 8 KW	8000 watts
c. 11 KW	11000 watts
3. Generator Cooling Air Requirements (1800 RPM)	
a. 6.5 KW	200 C.F.M.
b. 8 KW	220 C.F.M.
c. 11 KW	250 C.F.M.
4. Engine Combustion Air Requirements (1800 RPM)	
a. 6.5 KW	40 C.F.M.
b. 8 KW	40 C.F.M.
c. 11 KW	53 C.F.M.

TUNE-UP SPECIFICATIONS

1. Spark Plug Gap	.031 $\pm$ .002 inch
2. Cylinder head bolt torque	56 - 59 lb-ft

3. Valve Clearance (warm engine)

a.	Valve side	Intake	0.010 inches
b.	Valve side	Exhaust	0.012 inches
c.	Cam side	Intake	0.007 inches
d.	Cam side	Exhaust	0.009 inches

4. Timing — 8° ± 1° BTDC @ 600 RPM
14° ± 1° BTDC @ 1800 RPM

5. Compression Pressure

(Engine cold and all plugs removed) — 170 psi at 300 RPM (12.0 kg/cm^2)

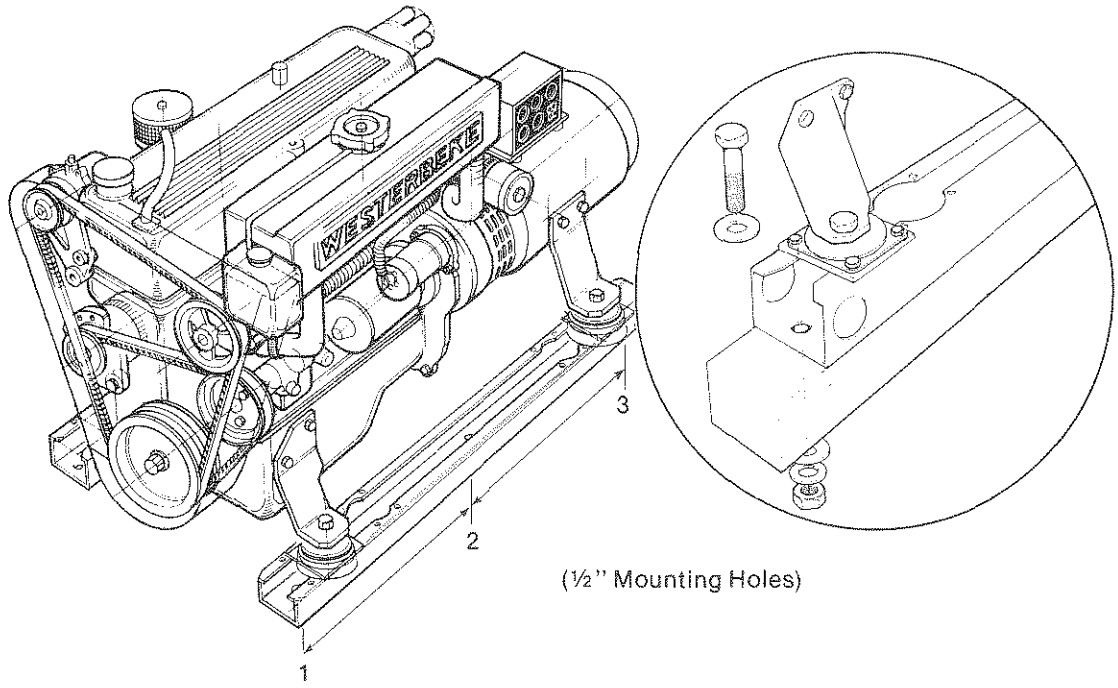
6. Firing order — 1 - 3 - 4 - 2

General

Proper installation and location of the generator set in the vessel are of prime importance.

Factors in the installation that must be considered are: Ventilation for the generator for proper cooling and engine combustion air, exhaust system to properly discharge raw cooling water, quiet the exhaust and expel exhaust gasses, cooling water supply, fuel supply and electrical connections.

Factors in the location that must be considered are proper support and access for servicing and repairs. These factors will be discussed in this manual.



Three 1/2 inch bolt holes are in each generator mounting rail to be used in properly securing the generator to its mounting platform. These holes are on 15 inch mounting centers.

Location

The location should be such that it is dry and 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. The platform on which the generator is mounted should be strong enough to support the generator and securely hold the mounting rails fastened to it at all angles of vessel operation.

Ventilation

The generator set needs fresh cool air for combustion within the engine cylinders, for generator cooling and to remove harmful or flammable gasses from around the generator set. Air requirements are:

Model	Engine	Generator
6.5 KW	40 cu.ft./min	200 cu.ft./min
8 KW	40 cu.ft./min	220 cu.ft./min
11 KW	53 cu.ft./min	250 cu.ft./min

Exhaust System

All exhaust systems should be such that the entry of water into the engine exhaust manifold and cylinders is prevented while the vessel is under power or sail, healing, from following seas, when backing down or any other conditions.

The exhaust system must be tight and free of leaks. Exhaust gasses are deadly.

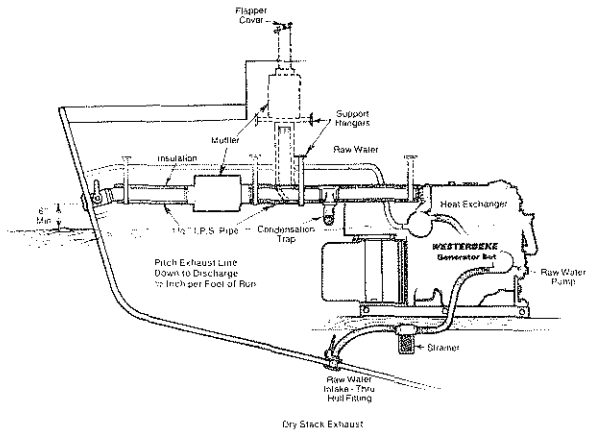
General tips on exhaust system:

(a) Dry portions of exhaust system, prior to the cooling water being injected, must be properly insulated.

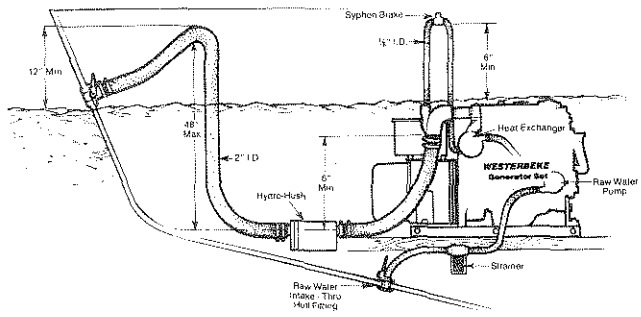
(b) The exhaust hose must be of adequate size and minimal run to help prevent excessive back pressure. The use of fittings and elbows should be limited as these create back pressure.

(c) The generator exhaust system must be separate from any other engine exhaust system.

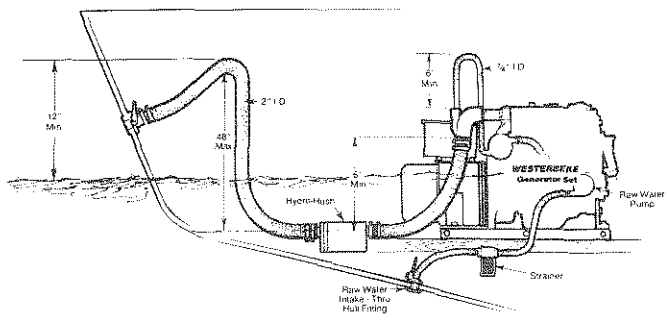
(d) Dry stack type exhaust systems must be flexibly attached to the engine manifold, properly supported, have a spark arrestor and be protected against water entry.



Dry Stack Exhaust



Generator Below Water Line



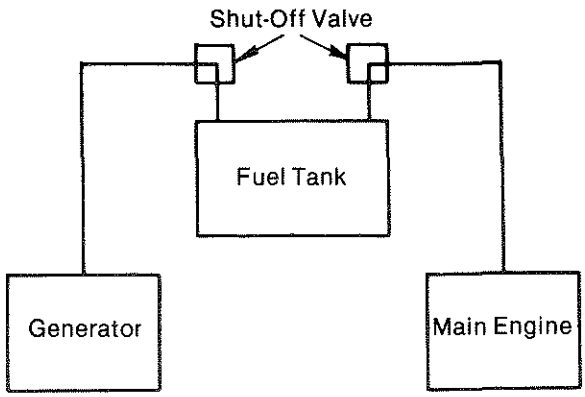
Generator Above Water Line

(e) Hydro hush mufflers should be mounted as close to the generator as possible and the exhaust/cooling water mixture from the exhaust injected elbow should drop down into the muffler.

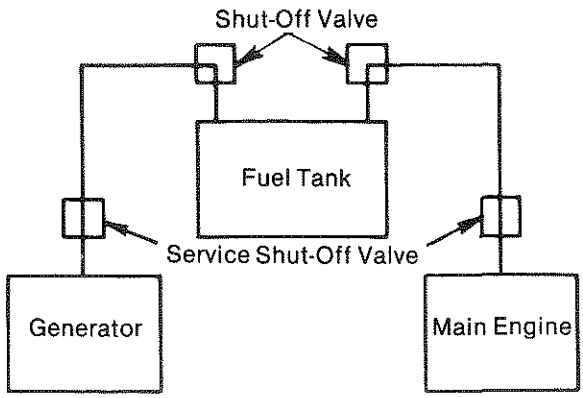
Fuel System

The fuel supply to the generator should be from its own pick-up in the fuel tank and NOT teed off the supply to another engine.

Installations with fuel tanks at or above the generator should have a means of shutting the fuel off to the generator engine when the engine is not running. This is to guard against the possibility of gasoline syphoning through the carburetor and into the engine should the carburetor needle valve not seal properly. This shut-off valve can be electrically operated (with manual override) to open when the generator starts and close when it shuts down. A manually operated valve can be used also and should be able to be operated from the generator start and stop panel area or from the vessel's deck.



Installations where the generator is located above the fuel tanks should have a shut-off located at the fuel connection to the tank and also a service shut-off valve at the fuel connection to the generator.



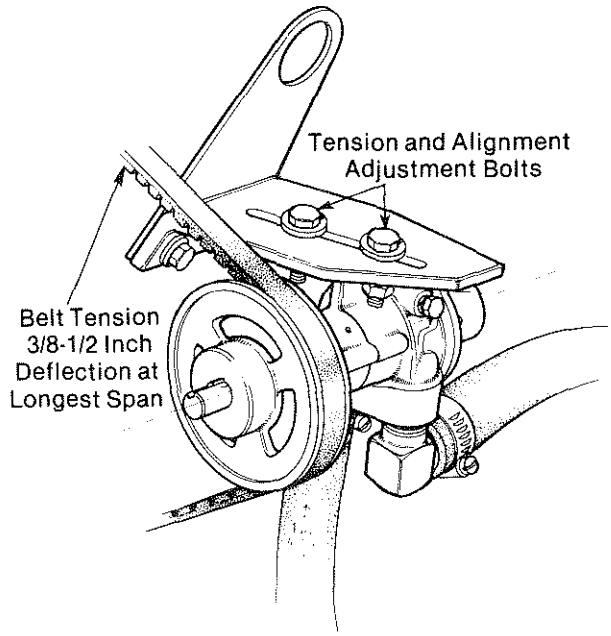
Fuel lines should be routed and supported to prevent leaks from vibration and chaffing. The line should be supported every 12 - 14 inches. Use as few connections as possible.

WARNING: Gasoline leakage in or around the generator compartment is a potential for fire and/or explosion. Repair leaks promptly and insure the compartment is properly ventilated.

Cooling System

The generator engine is fresh water cooled through an engine mounted exchanger system using raw water as a cooling medium brought into the exchanger by a raw water pump and expelled with the exhaust discharge, carrying with it the heat removed from the fresh water.

The sea water pump is belt driven and sea water should be supplied to it through a flush type hull fitting. This sea water should be brought through a visual type sea water strainer and then delivered to the pump. Hoses routed from the through hull to the strainer and to the sea water pump should be wire reinforced to prevent collapse from the suction of the sea water pump during generator operation.



WARNING: Do not use scoop type through hull fitting for the raw water supply to the generator. Water pressure against this type fitting while the vessel is underway can push water past the raw water pump impeller and into the generator exhaust system filling it and the engine as well. Flush type clear through hull fittings are recommended and should be located on the hull so as to be below the water during all angles of boat operation.

Raw water strainers should be mounted at or below the water line so as to always be self primed.

WARNING: The use of common type street elbows is not recommended in plumbing the raw water circuit. These generally have a very restrictive inside diameter. The use of machine type fittings is preferred.

Automatic Shutdown

High Exhaust Temperature Shutdown Switch (normally closed)

An exhaust temperature switch is located on the exhaust elbow and will open the ignition circuit should the switch sense an excessive temperature, indicating a lack of proper raw water coolant flow.

High Water Temperature Shutdown Switch (normally closed)

A high water temperature switch is located in the area of the thermostat housing to sense fresh water coolant temperature and shut down the generator should the operating engine fresh water coolant temperature reach approximately 205° F ± 5°.

Low Oil Pressure Shutdown Switch (normally open)

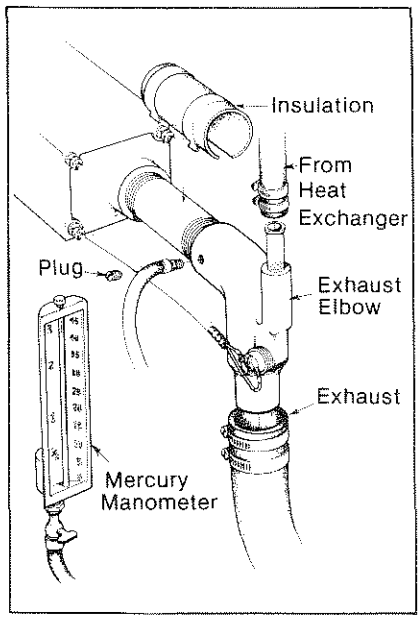
A low oil pressure shutdown switch is located off the engine oil gallery and is closed when engine oil pressure reaches 20 - 25 psi maintaining the electrical run circuit. This switch will open and shut the generator down when engine oil pressure drops to 20 - 25 psi.

Exhaust Back Pressure

Exhaust back pressure should be checked prior to a generator being put into service. (Refer to the illustration.) Excessive back pressure will affect generator performance and engine power output.

Measure back pressure at the exhaust elbow with generator under full load. Back pressure should not exceed 3 inches of Mercury (manometer), 39 inches of water column, or 22 ounces per square inch (1-1/2 psi).

Excessive back pressure can be caused by small diameter exhaust hose, small muffler, sharp bends, fittings, water pockets and high volume of water in the exhaust system.



Oil Drain

An oil sump drain hose is provided and the discharge end is secured on a bracket at the front of the engine. Oil may be drained from this hose by removing it from its support bracket, opening the cap and lowering the hose into a container. The hose cap fitting is 1/4 NPT and can be extended or a pump added for easy and/or efficient removal of oil at change intervals.

DC Electrical Connections

A common ground for (-) negative DC is found at the bellhousing of the generator next to the starter in the form of a threaded grounding stud. It is recommended that the battery ground be connected here.

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

WARNING: Do not disconnect battery while the engine is running. Alternator damage will result.

Grounding

The generator set must be grounded to comply with United States Coast Guard regulations 33CFR-183.

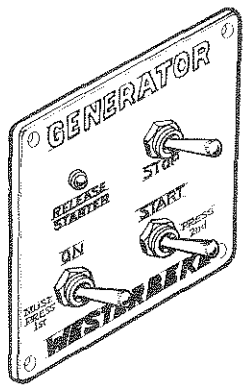
The regulation specifies that a common conductor be connected between the generator set and the vessel's main propulsion engine grounded starter motor circuit.

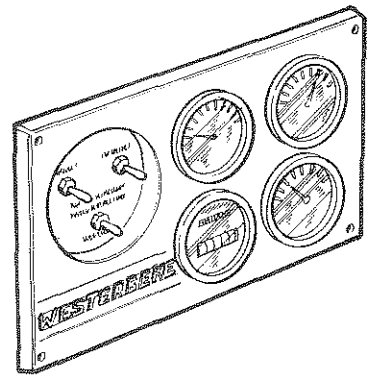
This conductor (common ground) prevents accidental passage of cranking current through fuel systems and smaller electrical conductors common to the engines. This conductor must be the same size as the largest battery cable.

Optional Remote Start Stop Panel and Instrument Panel

An optional remote start stop panel is available containing three switches and a run indicator light (green). This panel can be wired into the terminal strip in the main control panel on the generator and mounted in a location such as the vessel wheelhouse.

An optional instrument panel is available which is supplied with an engine oil pressure gauge, water temperature gauge, engine mounted alternator voltage gauge, engine operating hourmeter and control switches. This panel can be wired into the terminal strip in the main control panel on the generator and mounted in a location where the instruments can be monitored and the switches activated.





Load Connections

The generator data plate gives the voltage, amperage and hertz rating of the generator. The generator set wiring decal located on the cover of the generator mounted control panel shows the electrical connections for 115 or 230 volt AC output.

This is a single phase, 4 lead reconnectable generator with voltage combinations of 115 volt, two wire, or 115/230 volt, three wire.

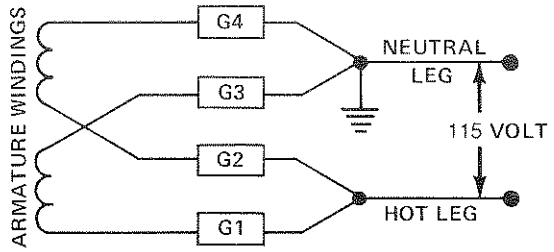
All 115 volt devices must be connected to one of the two 115 volt sources and all 230 volt devices must be connected to the 230 volt source.

For all 115 volt loads, half of the generator's rated capacity may be taken from leads G1 and G2/G3 and half from G4 and G2/G3.

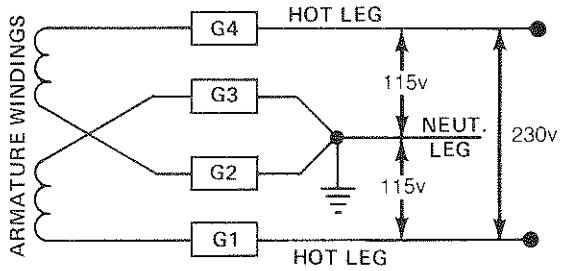
230 volt loads are connected to G1 and G4 at full generator rated capacity.

4 WIRE

1. WHEN THE ELECTRICAL SYSTEM IS A TWO WIRE TYPE REQUIRING ONLY 120 VOLTS:



2. WHEN THE ELECTRICAL SYSTEM IS A THREE WIRE TYPE REQUIRING 120V. OR 120/240 VOLTS:



CAUTION: ALL 115 VOLT LOADS MUST BE DIVIDED UP AND CONNECTED IN SUCH A MANNER THAT CURRENT FLOWING IN ANY OF THE THREE LEGS (G1, G4, G2/G3) DOES NOT EXCEED THE LOWEST AMPERAGE RATING ON THE DATA PLATE.

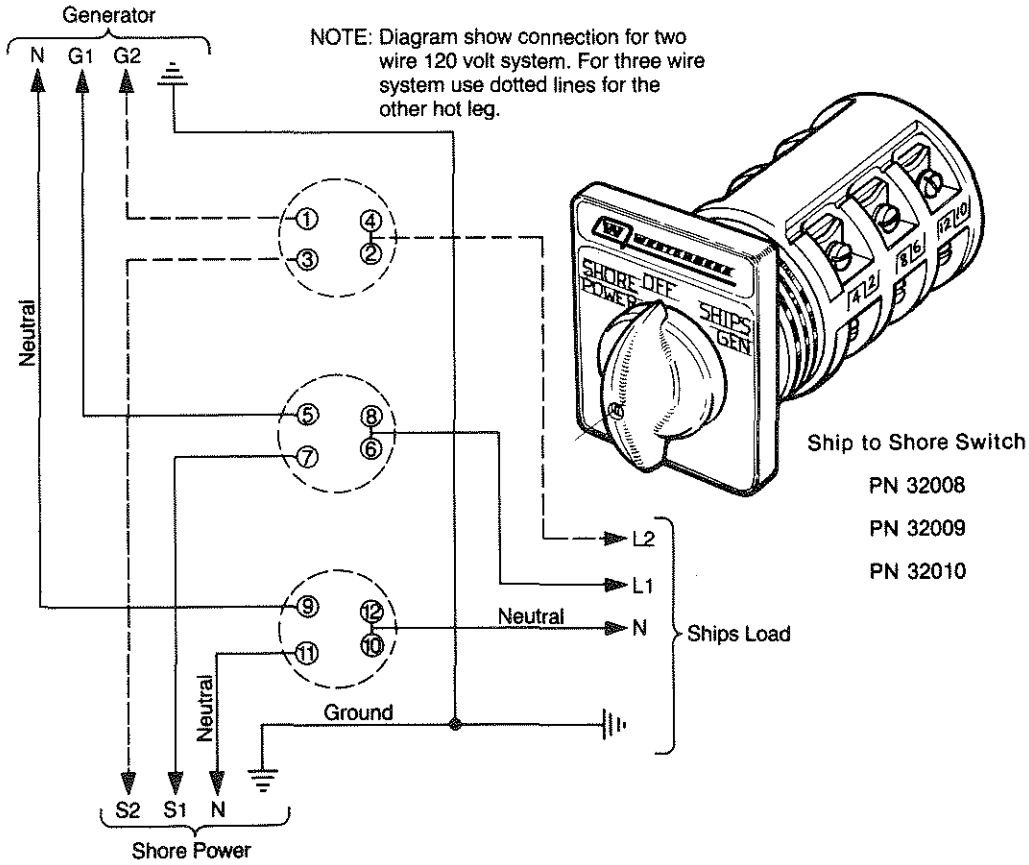
NOTE: It is recommended that the installer offer instrumentation (optional) that the operator can monitor and determine the load being taken off the generator (i.e., AC ammeter).

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

Shore Power Connections

If the installer connects shore power into the vessel's AC circuit, this must be done through a ship-to-shore double throw transfer switch. This is to prevent the combining of utility shore power with that of the generator.

WARNING: Damage to the generator can result if utility shore power and generator output are joined.



Prior to starting the generator, check the following.

1. Oil level
2. Coolant (fresh water)
3. Fuel to engine
4. Raw water connections
5. Battery connections
6. Generator AC electrical connections
7. Exhaust connections

Engine Oil

Use a good grade of detergent oil SE or SE/CC.

Refer to the specification section of this manual for oil sump capacity. Use the proper SAE number for the ambient temperature the unit will be operating in.

WARNING: Do not use oils designated API Spec DS.

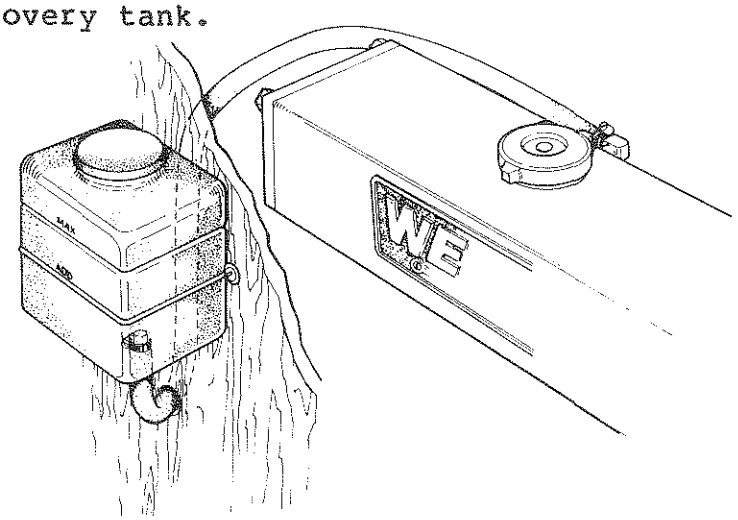
Fresh Water Coolant

Fill the fresh water cooling system with a mixture of fresh water and antifreeze 50/50.

The mixture will afford the fresh water system freeze protection, reduce corrosion and aid in cooling.

A coolant recovery tank is supplied with each engine and must be installed to allow coolant expansion and contraction without creating or introducing air to the cooling system. It should be used for monitoring and adding coolant.

WARNING: Never remove engine manifold filler cap when the engine is hot.
Coolant should always be added to the system via the remote coolant recovery tank.



Fuel

Use clean, filtered unleaded gasoline when available. Regular gasoline may be used when unleaded is not available.

WARNING: Do not fill the fuel tank while the engine is running. Vapors and spilled fuel may ignite causing a fire and/or explosion.

WARNING: GASOLINE ENGINE EXHAUST - CARBON MONOXIDE IS DEADLY.

Gasoline engine exhaust gasses contain deadly carbon monoxide. This is a poisonous gas that can cause unconsciousness and eventual death.

The symptoms of carbon monoxide poisoning are:

1. Headache
2. Dizziness
3. Relaxed - sleepy feeling
4. Vomiting
5. Muscle spasms
6. Throbbing temples

If any of the symptoms are evident while operating the generator, immediately get out into fresh air. Shut the generator down and inspect the exhaust system.

Regular inspection of the exhaust system for the generator is a must to prevent and correct potentially deadly exhaust leaks.

Starting

Ventilate the generator compartment for a minimum of 5 minutes before attempting to start the engine. The ventilating blowers remove potentially explosive fumes from the generator compartment and bilge.

Starting sequence:

1. Depress the ON switch and hold. (No load on generator)

2. Depress the START switch. When the enine starts, release the START switch only. Allow a few seconds for oil pressure to come up and then release the ON switch.
   Check exhaust discharge for raw water coolant flow.

Allow the generator to warm up to 150°F - 170°F before applying a heavy load. Apply only light loads during warm-up.

Break In

Run the generator at varying loads for the first 25 hours of operation to help seat the engine piston rings properly.

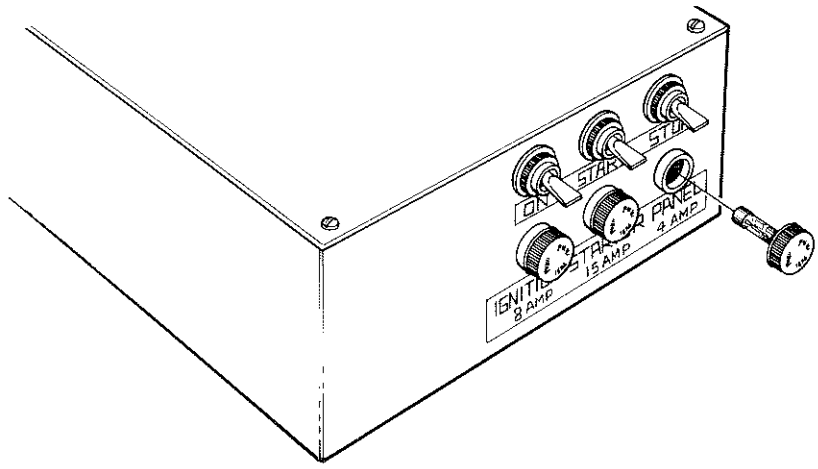
Avoid light loads for the first 100 hours of operation. Load the generator 50 percent or better during this time period.

Light loads repeatedly during break-in can cause improper seating of the piston rings, resulting in blow-by and high oil consumption.

Stopping Generator

1. Remove the load and allow generator to run unloaded for 5 minutes. Dissipate heat and stabilize temperature.

2. Depress STOP switch and hold until generator is completely stopped, then release.



Regular servicing and inspection of the engine and generator can go a long way toward increasing the service life of the unit, reducing repair costs and down time.

Table of Scheduled Servicing

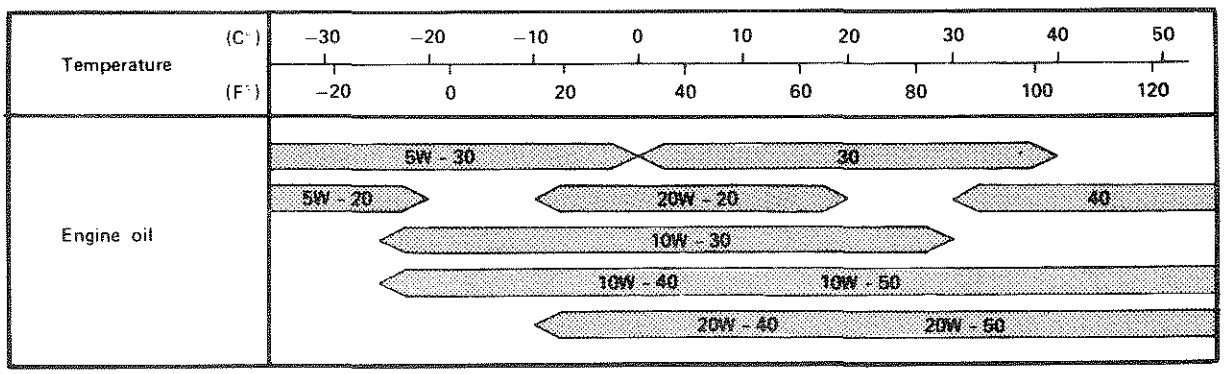
	Daily	50 Hrs.	100 Hrs.	300 Hrs.	500 Hrs.
Visually inspect unit	X				
Check lube oil level	X				
Check coolant level	X				
Check fuel supply	X				
Clean air screen (flame arrestor)		X-1	X		
Check spark plugs		X-1		X	
Change lube oil and filter		X-1	X		
Check valve clearance		X-1			X
Torque cylinder head bolts		X-1			X
Check generator brushes				X	X-2
Clean and lube governor linkage		X-1	X		
Check exhaust system	X				
Check starting battery		X-1	X		
Check fuel filters		X-1	X		
Check belts		X-1	X		
Check zinc anode		X-1	X		
Check raw water pump		X-1			X

X-1 Initial 50 hour break in check

X-2 Initially 100 hours.

Engine Lube Oil

Check lube oil level prior to each day's use. Maintain the sump oil level at the full mark on the dipstick. Change oil and filter regularly. Use a good brand of oil that meets API Spec. SE or SE/CC. Select the proper SAE numbered oil for the temperature condition of operation.



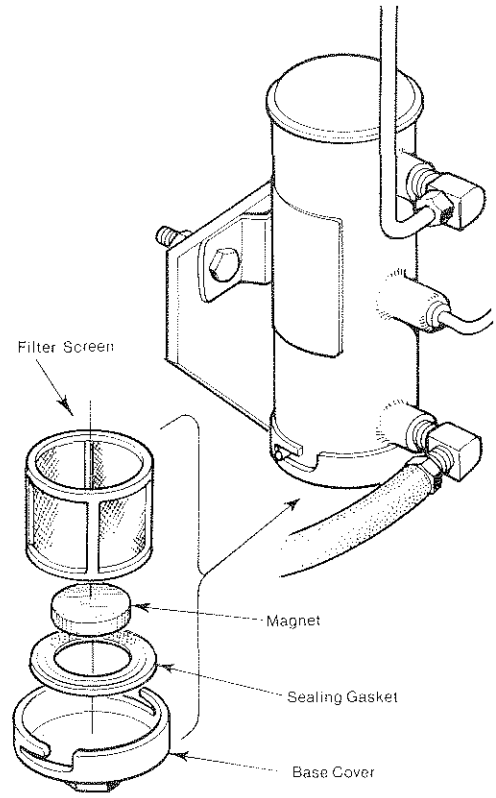
Electric Fuel Pump

The engine mounted electric fuel pump supplies fuel to the engine carburetor during engine operation. A cleanable filter screen is contained in its base.

Remove the base cover by placing a wrench on the hex nut and twisting it loose from the bayonet fittings. Clean the screen as needed. Replace the base gasket (#34706) each time the base cover is removed or reinstalled.

NOTE: Be careful of gasoline spillage when removing the base cover.

WARNING: Shut off fuel service valve at engine when servicing fuel system. Take care to catch fuel when opening filter elements. DO NOT allow any smoking, open flames, sparks or other sources of fire near the fuel system when servicing. Insure proper ventilation when servicing the fuel system.



Spark Plugs

Service spark plugs, clean gap or replace as needed.

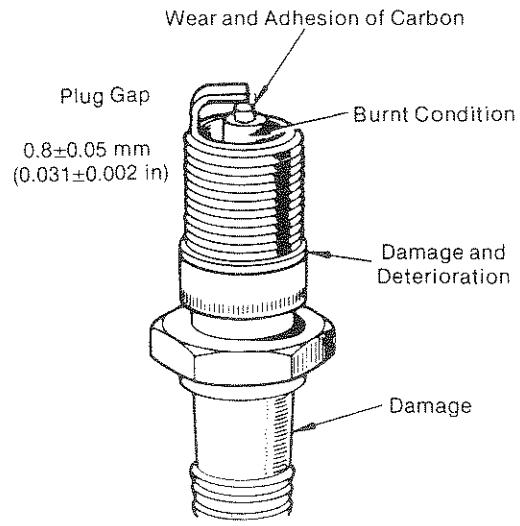
Spark plug gap:

0.031 ± 0.002 inches

Spark plug torque:

10.8 - 16.6 lb/ft

Check plugs for damage and/or wear.



Cooling System

Monitor system coolant (50/50 antifreeeze mixture) and, if rust or scale are evident, flush and clean system and replenish the antifreeze mixture.

Maintain proper belt tension on the fresh water circulating pump and raw water pump, three-eights to one-half inch deflection between the belts longest span. Replace if cracked or frayed.

Check the impeller in the raw water pump. Insure the vanes are flexible and not cracking.

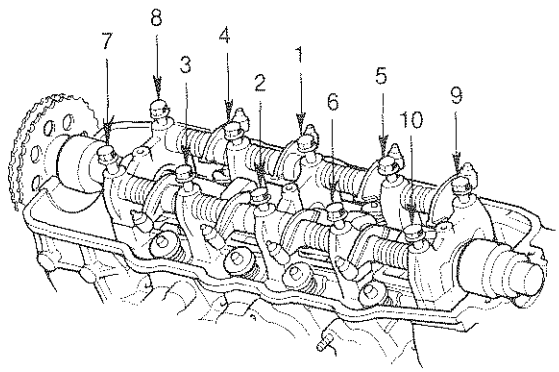
Check the raw water pump for wear on the front cover, cam plate and inner wear plate.

An excessively worn pump will not pump efficiently resulting in improper cooling.

Cylinder Head and Valves

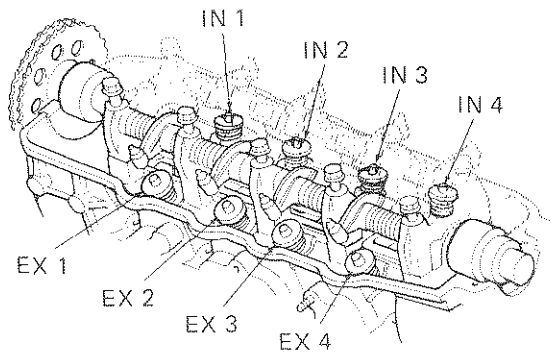
Tighten cylinder head bolts in the sequence shown. The engine should be cold. Loosen each bolt one-eighth to one-quarter turn before tightening.

Adjust the valves Exhaust #1 and #3 Intake #1 and #2 with piston #1 at TDC of compression stroke. Rotate the crankshaft 360° and adjust Exhaust Valves #2 and #4 and Intake #3 and #4.



Head bolt tightening torque:

7.8 - 8.2 kg/m (when cool)
(56 - 59 lb/ft)



	Intake Valve	Exhaust Valve
Valve side	0.25 mm (0.010in)	0.30 mm (0.012in)
Cam side	0.18 mm (0.007in)	0.23 mm (0.009in)

Governor Linkage

Remove governor linkage from carburetor throttle arm and governor arm by popping the linkage end of the ball connector on these arms. Clean and lubricate the linkage socket and arm ball (graphite lube) and reassemble.

Do not disturb linkage length.

Generator Maintenance

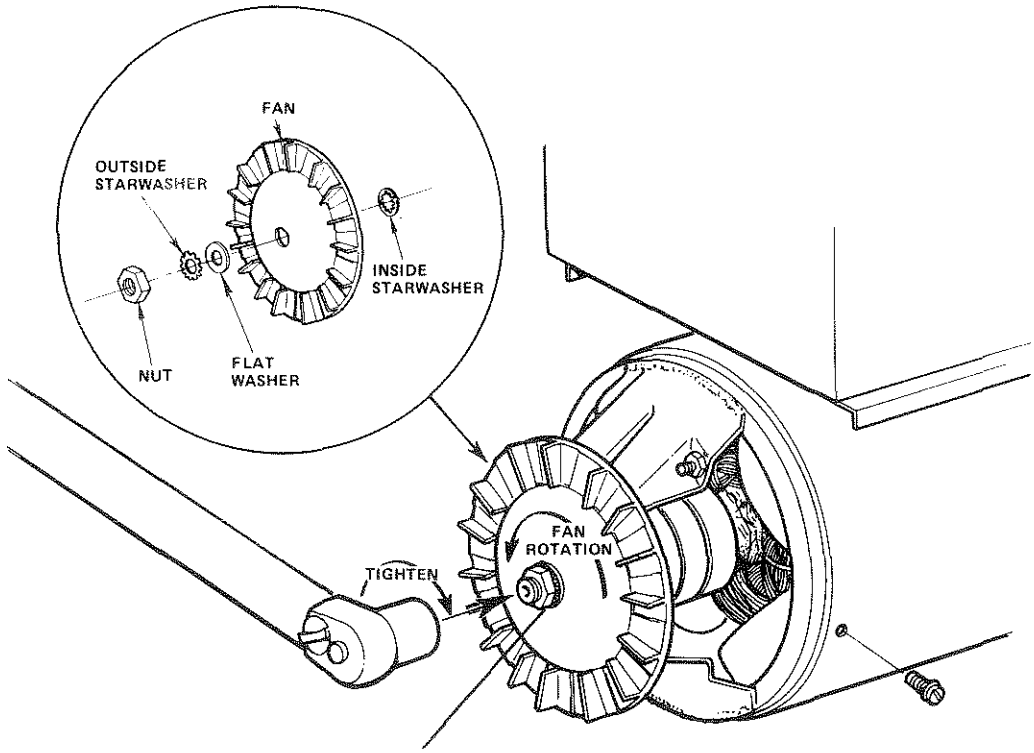
Little maintenance is required on the generator other than periodic inspection of the brushes, slip rings, cooling fan and connections.

Check generator brushes for wear and insure they move freely in their holders. Replace when worn to three-eights to one-half inch in length. New brushes are shaped to fit the contour of the slip ring.

A slip ring in good condition has a glossy finish and is brownish in color. Keep the slip rings free from dirt, grease and sea water. Clean the slip rings using a very fine sandpaper.

The cooling fan securing nut torque should be checked periodically.

Securing nut torque: 23 - 25 lb/ft



Cooling Fan
Securing Nut
(Torque 25 Ft. Lbs.)

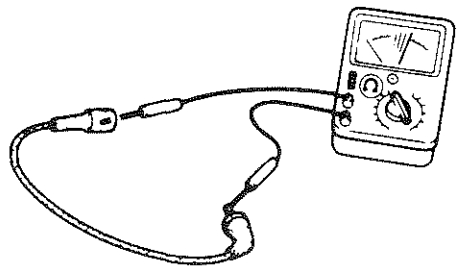
Distributor

The distributor breaker points are solid state type and require no adjustment. The distributor cap and rotor should be examined when servicing the spark plugs and checked for cracks and that the terminals are clean and free of corrosion.

High Tension Leads

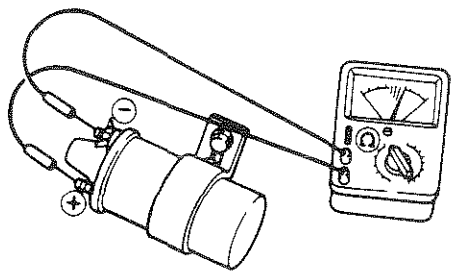
Check leads for clean and secure terminal ends. Resistance value of high tension lead wire is 410 ohms per inch of wire.

NOTE: When removing leads from spark plugs, be sure to pull at the plug cap, not at the high tension lead.

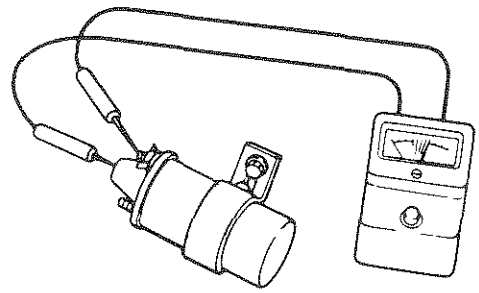


Ignition Coil (Resistance Check)

1. Resistance value of primary coils is .8 ±.2 ohms. (Ohmmeter RX1 scale)



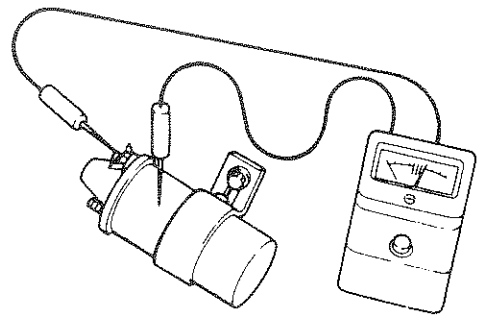
Checking Primary Coil



Checking Secondary Coil

2. Resistance value of secondary coils is 80 ±10 ohms. (Ohmmeter RX1000 scale)

3. Checking the insulation resistance between the primary terminal and the coil case. (Megohmmeter 500 volt)



Normal Resistance:
10 megohms +

The coil should be replaced should it not meet the resistance values given above.

Ignition Timing

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

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

3. Disconnect the throttle linkage arm from the governor control arm and reduce engine speed to the idle stop screw; this should be set at 850 RPM. Adjust the idle mixture screw. Do this by screwing in the screw until engine skips. Back screw out slowly until engine smooths then skips again. Turn screw in one-quarter to one-half turn. Idle mixture should be satisfactory.

4. Manually move throttle to 1800 RPM and then return to idle. 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 front cover. Do this by loosening and slowly rotating the distributor body.

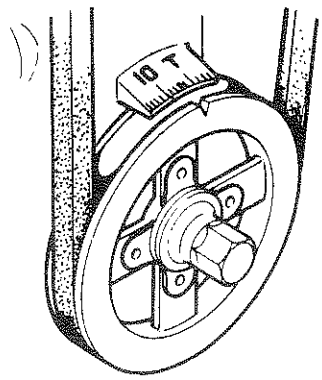
   NOTE: Oil pressure switch must be bypassed when checking timing at idle speed to prevent engine shutdown due to the low oil pressure at idle.

5. Once timing is set, tighten the distributor holding clamp bolt. Reconnect the throttle linkage arm to the governor arm and test the generator by loading it.

Timing:

8° BTDC ±1° @ 600 RPM

14° BTDC ±1° @ 1800 RPM



NOTE: Timing marks are in 2 degree increments.

Electric Choke

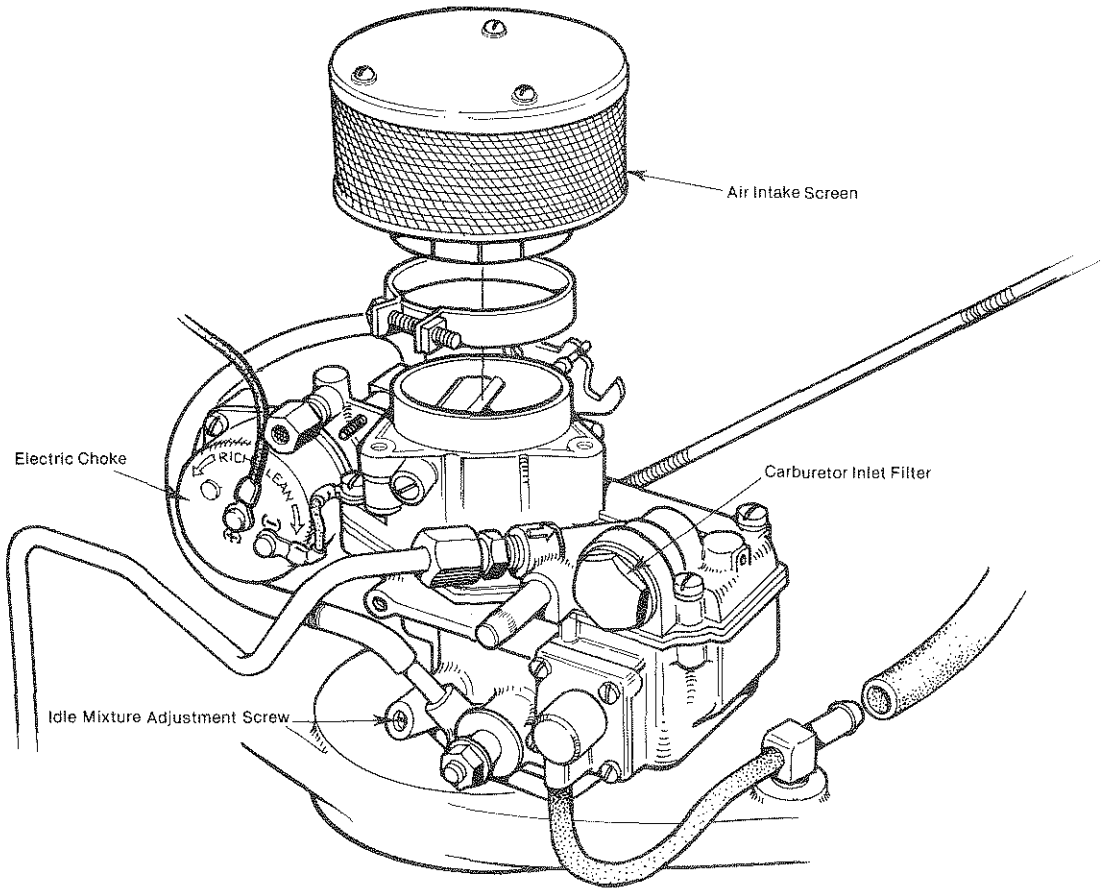
The electric choke uses a 12 volt heating element which opens the choke automatically once the engine starts and is running.

NOTE: Some hunting will be present when the generator is started and on choke with no load on the generator.

The choke is adjusted with the engine off and at room temperature. Adjust the choke by loosening the three cover securing screws and rotating the cover clockwise to LEAN the choke and counterclockwise to ENRICH the choke. The choke is initially set at the factory for an average of 70° F room temperature.

The choke may need readjustment at engine commissioning for the ambient temperature of the area the engine is operating in.

CAUTION: The choke housing will normally get hot during engine operation.



NOTE: Choke index mark is located on the choke cover lower right inboard side.

Governor and Governor Adjustment

The governor maintains engine RPM under varying conditions of generator load.

The governor will maintain engine RPM to within 3 Hertz of generator frequency output from NO load to full rated load of the generator. (Generator Data Plate)

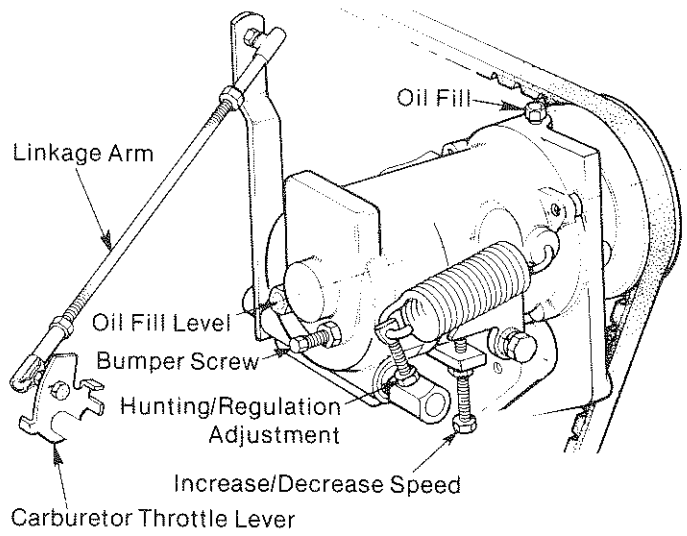
Operate the generator set to bring the unit up to operating temperature before attempting an adjustment.

NOTE: If the governor is severely out of adjustment, manually adjust the linkage at no load to obtain a safe output voltage before proceeding with the adjustment.

The engine speed determines the Hertz and voltage output of the generator.

There are three adjusting points on the governor. (Refer to the illustration.)

1. Increase/Decrease Speed
This adjusting bolt is used to set 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.) Insure this linkage moves freely and that the ball joint connectors are properly lubricated. Use graphite lube for this purpose. Disconnect the ball joint and apply graphite lube to the inside of the joint.



2. Hunting/Regulation
If 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 under load, adjust this eye bolt to move the spring away from the lever hub. (check speed adjustment.)

3. Bumper Scres
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.

Governor Maintenance

1. Periodically lubricate linkage arm attaching points at governor arm and throttle lever. Use a graphite lubricant or equivalent.

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

2. Governor oil capacity - 3 ounces 10/30 engine oil.

   NOTE: Do not overfill governor.

3. Change governor oil every 2000 hours of operation.

   To change oil, remove governor from engine and remove oil fill and fill level plug and drain all oil. Reinstall on engine and fill with 3 ounces of 10/30 engine oil. Replace plugs.

DC CIRCUIT DESCRIPTION: 6.5KW, 8KW & 11KW

GASOLINE MARINE GENERATOR SETS

Safety Information

This circuit is designed and manufactured in compliance with United States Coast Guard Standards (33 CFR PART 183). No modifications may be made to it by the installer or user. It is the installer's responsibility to assure that the installation of the generator set and any remote start panels or remote instrument panels are installed in compliance with the above Coast Guard Standards. Failure to observe these requirements could be the cause of injury.

Electrical System Characteristics

The generator is started by a conventional, separate cranking motor including its self-contained positive engaging starter solenoid. The starter is internally grounded to the engine block.

Battery recharging capacity is provided by an alternator with approximately 50 amps output capacity. The alternator is internally grounded to the engine block.

Within 7 inches of the battery connection to the starter solenoid is located a circuit breaker which protects all subsequent wiring. This is a manually resettable circuit breaker.

Three manually operated momentary toggle switches are used to start and stop the generator set. No control relays are present in the design in the interests of simplicity and reliability in the marine environment.

Three panel mounted fuses are installed to protect the starter circuit, the running B+ circuit through the protective switches, and the remote panel circuit.

The choke is automatic and electrically operated.

The ignition system is electronic and does not require conventional breaker points.

There is an overspeed shutdown which, when it senses engine RPM's at approximately 2175 RPM, shuts off the generator set by grounding out the ignition system. This shutdown consumes 25 milliamps (.025 or 1/40th 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 operation. If the generator set were to be unattended for many months, the two easiest ways to stop this slight drain are to turn off the main battery switch providing 12 volts to the generator set or to remove the ignition fuse on the generator mounted control panel.

An optional remote start panel is available for controlling the generator from a remote location. Remote start panels include a green LED which shines at approximately 600 engine RPM. The purpose of the LED is to alert the operator to release the starter toggle switch and 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.

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 operated to cause the starter to crank the engine. If starting at the generator set, release the start switch when the generator is running. If starting at a remote location, release the start switch when the green LED shines.

Continue depressing the ON switch. It is only necessary to continue holding the ON switch after releasing the start switch until 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 one again operates the ON switch first.

While operating, the overspeed shutdown module monitors engine RPM and will ground the ignition system if it senses engine RPM at approximately 2175 RPM.

Should the generator shut down from an overspeed condition, the overspeed circuit MUST be reset before attempting to restart the generator. This is done by simply depressing the STOP switch momentarily and then proceeding with the normal starting procedure.

SAFETY WARNING

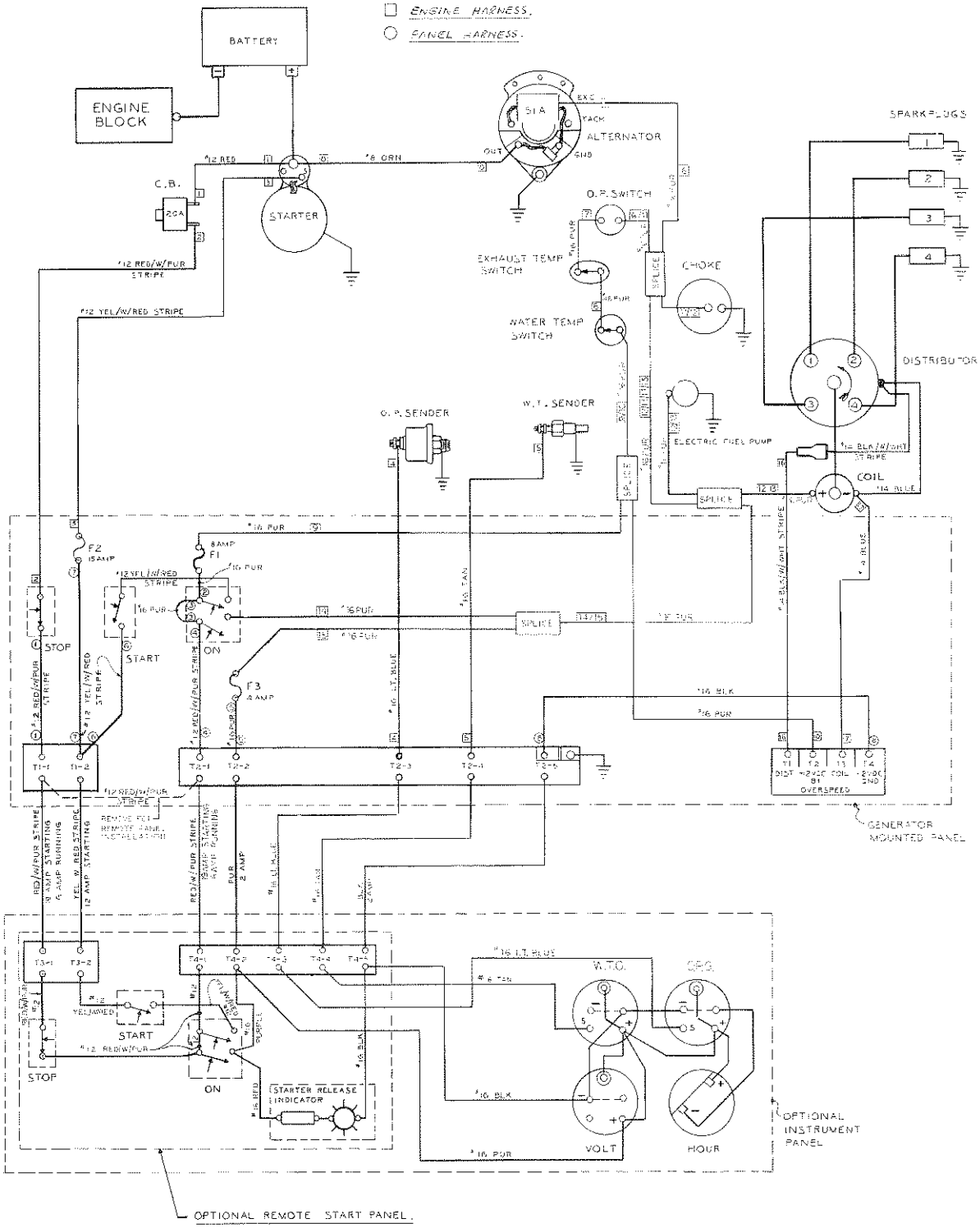
It is very important that the overspeed shutdown always be installed and functioning. Any tampering with the overspeed shutdown module, which would cause it to malfunction, could be a cause of injury should the generator belt-driven governor fail and cause the generator to "run away".

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 stop. Remote start panels may be connected to the generator set as indicated. A jumper has to be removed between T1 and T2 at the panel connection terminal board.

SAFETY 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.

Schematic Wiring



REMOTE PANEL INSTALLATION

INSTALLER'S/OWNER'S RESPONSIBILITY

1. Wiring between the generator set and either a remote start panel or remote instrument panel must comply with U.S. Coast Guard Safety Regulations 33 CFR-183.

2. The mimimum voltage required at the starter solenoid is 9 volts. Therefore, wire gauges from TB1-1 to TB3-1 and from TB1-2 to TB3-2 should be selected to give a maximum voltage drop of 1 volt or less. This will provide 9 volts at the starter solenoid when battery terminal voltage is down to 10 volts, indicative of a deeply discharged battery.

3. Where #16 wire is shown in the table of Minimum Wire Gauges below, we recommend using #14 wire for greater strength and/or lower voltage drops.

MINIMUM WIRE GAUGES (AWG)

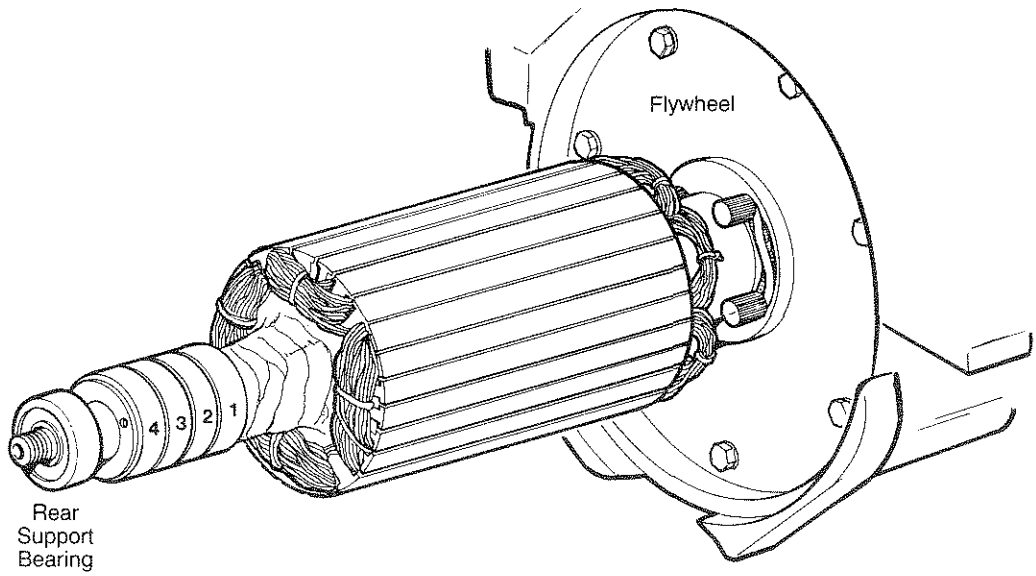
	Wire Length from Generator to Remote Panel						
Terminals	0-16'	16-20'	20-25'	25-32'	32-40'	40-50'	50-65'
TB1-1 to TB3-1	#12	#10	#10	# 9	# 8	# 7	# 6
TB1-2 to TB3-2	14	12	12	10	10	9	8
TB2-1 to TB4-1	12	10	10	9	8	7	6
TB2-2 to TB4-2	16	16	16	16	16	16	16
TB2-3 to SENDER	16	16	16	16	16	16	16
TB2-4 to SENDER	16	16	16	16	16	16	16
TB2-5 to TB4-3	16	16	16	16	16	16	16

No Electrical Output

1. Remove load from generator and verify no output directly at generator output leads with voltmeter.

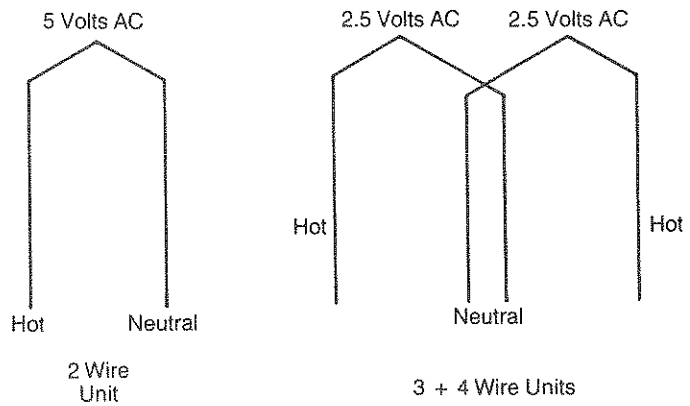
2. Check for proper electrical connections. Refer to Internal Wiring diagrams.

   NOTE: Generator armature slip rings and brush rigs are numbered from inboard at the windings or flywheel end outward toward the rear support bearing.



2A. Residual Voltage Check

Disconnect field leads from bridge rectifier. (Note position of leads on rectifier (+) to (+) and (-) to (-).) Operate the generator and check AC output (no load on generator). Measure voltage between neutral lead and hot lead(s).



2-wire unit	5 Volts AC (Hot lead to neutral)
3 and 4 wire unit	2.5 volts AC (each hot lead to neutral approximate)

Residual Voltage checks O.K. You can assume the rotating armature and brush rig are O.K. The generator problem lies in the rectifier and/or field coils.

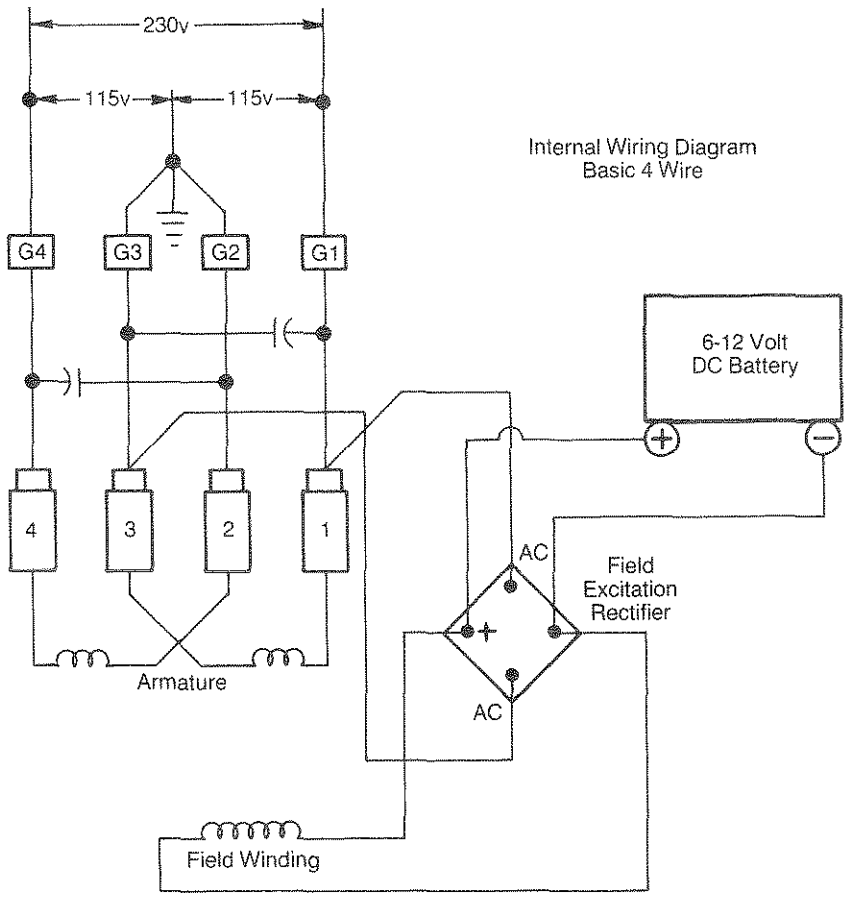
Residual voltage not present. Check brush rig and static capacitors. Check rotating armature resistance values and continuity check found elsewhere in this manual.

3. Test operation of generator by bypassing bridge rectifier. Apply 12 volts DC to field leads on bridge rectifier (+) to (+) and (-) to (-). Run generator (no load). Measure voltage output at generator leads. Generator output with 12 volts DC excitation to the field coils should be 50 to 70 Volts AC. If 50 to 70 volts AC is produced, this should indicate that the generator is O.K., and that the bridge rectifier is defective.

4. If no voltage is produced, check the static capacitor(s) that it is not shorted to ground. If found faulty, remove connection from output terminal at brush rig and repeat Step #3.

5. <u>Flash Field Coils</u>

Units may lose their residual magnetism from extended storage, rough handling during installation or disassembly and assembly for installation, etc., requiring the field coils to be excited with 6 to 12 volts DC to restore the magnetism to the generator. This is done in the following manner:



Stop the engine and remove the generator end bell cover. This will expose the cooling fan, brush rig assembly and rectifier. Check internal wiring; refer to figure. The positive (+) lead from the field coils is connected

to the positive marked terminal on the rectifier and the negative (-) lead from the field coils is connected to the opposite UNMARKED terminal on the rectifier. Using jumper leads with insulated alligator clips, connect 6 to 12 volts DC battery positive to the positive of the rectifier and negative to the UNMARKED terminal of the rectifier for approximately 10 seconds. This should restore magnetism to the stationary field coils. (Be careful not to connect DC voltage to the AC terminals on the rectifier, as this will damage the rectifier.)
Remove the alligator clip connections; replace the end bell cover and operate the generator and check AC output voltage.

6. Check for a short or open in the rotating armature or in the stationary field coils.

ROTATING ARMATURE (RESISTANCE VALUES)

6.5, 8.0, 11.0	1 ohm or less between slip rings (1 & 3) and (2 & 4).

NOTE: 3- and 4-wire units: There should be no continuity found between slip rings (1 & 2), (2 & 3) and (3 & 4). If continuity is found, an internal short exists between these windings and the armature should be replaced.

NOTE: All units: There should be no continuity found between any of the slip rings and the armature's central steel shaft. If continuity is found, the windings are shorted to the shaft and the armature should be replaced.

Rotating armature slip rings are numbered from inboard of the generator flywheel end outward to the rear support bearing.
When referring to 2, 3 and 4-wire units, these are the number of generator output leads being connected to the load. You will find on the 11.0 units that there are 8 leads coming from the brush rig and are combined for a total of 4 output leads. The number of wires can also be related to the number of slip rings on the rotating armature.

FIELD COIL RESISTANCE (TOTAL)

6.5 & 8.0KW	22.2 ohms	$\pm$5%
11.0	14.2 ohms	$\pm$5%

NOTE: There should be no continuity found between the field coils and the generator body.

7. Replacement of Field Coil(s)

Field coils are connected in series and the resistance value given in this text is the total of the four field coils. To determine the resistance value of one, divide by four. Each field coil has

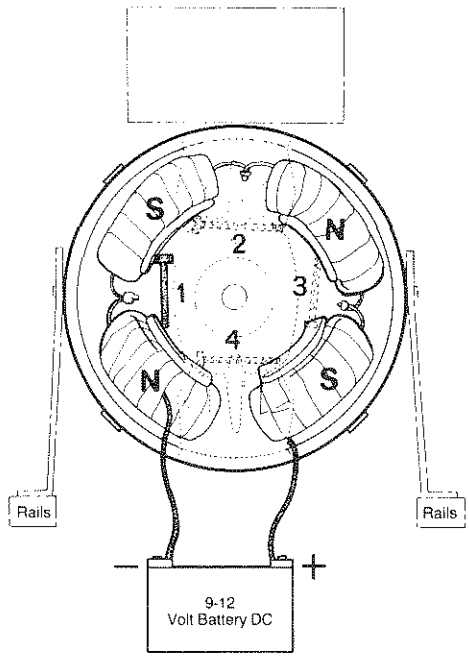
a mounting position on the generator housing and cannot be interchanged with another field coil.

When installing a replacement field coil(s), the installer must insure that the coil is correct for the mounting position in the housing and will have the correct polarity when excited with 9 - 12 volts DC.

The field coil shoes that hold the coil securely to the generator housing are held in place by bolts that must be properly tightened when the coil and shoe are installed to the generator housing. When connecting the coils in series, insure the butt connections are good and secure and positioned away from rotating parts.

To insure the field coils have been positioned properly in the generator housing and will have the correct polarity, the following test must be made before reassembly of the generator.

(1) Connect a 9 - 12 volt DC battery to the leads off the coils that would normally be connected to the (+) and (-) connectors of the bridge rectifier. These leads are unmarked and the polarity in their connection to the DC battery is not important. NOTE: When removing the leads from the battery and reconnecting them to the bridge rectifier, you should maintain the same polarity as used in this test, plus lead to (+) on rectifier and negative to unmarked (-) connection on rectifier.



(2) With a 3 inch iron bolt or its equivalent, place this bolt between each adjoining field coil shoe. It should be held in place by the magnetic attraction set up between the coil/shoes by the 9 - 12 volts excitation of the field coils. Should this fail to happen between any of the four adjoining coils/shoes, then an incorrect coil is installed and must be removed and the correct one installed; otherwise the generator when assembled will not produce proper voltage.

Low Voltage Output

1. Verify voltage output at generator output leads with load applied to generator; check no load condition also. Check voltage at the load. Check rating for generator and verify load with amp probe at output leads. Check all connections to insure they are clean and secure. Insure that the wire size carrying the voltage to the load is of sufficient size so as not to produce a voltage drop.

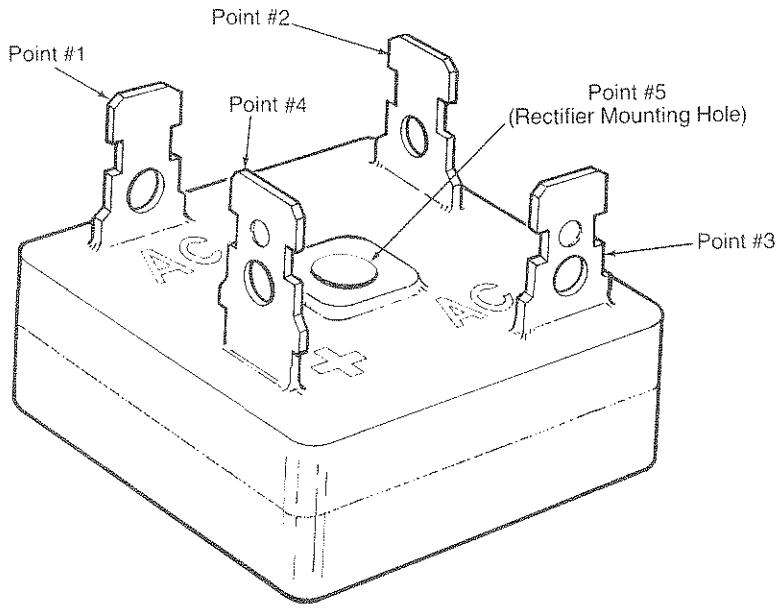
NOTE: Beware of motor starting loads and the amperage draw placed on the generator from these types of loads. Generally, the amperage draw of a motor at start up will be 3 - 5 times the amperage needed when running.

2. Check generator with Hertz meter:

No Load Hertz	61 - 61.5 (51 - 51.5)
No Load Voltage	131 - 135 Volts (Generator Cold)
No Load Voltage	126 - 130 Volts (Generator Hot)

3. Test Bridge Rectifier:

Bridge rectifier may be faulty and should be checked as follows.



(A) Set ohmmeter scale on Rx1 (+DC). Zero the meter.

(B) Connect the (+) lead from the meter to Point #4. With the (-) lead from the meter, momentarily contact points #1, #2, #3 and #5. No deflection of the needle should occur showing infinite resistance.

(C) Remove the (+) lead from Point #4 and connect the (-) lead to Point #4 and with the (+) lead, momentarily touch Points #1, #2 and #3. Points #1 and #3 should show an 8-ohm resistance $\pm$2 ohms. Point #2 should show a 40-ohm resistance $\pm$5 ohms.

(D) Touch Point #5 with the (+) lead. No deflection of the needle should occur.

(E) Place the (+) lead of the meter on Point #1 and the (-) on Point #3. No deflection of the needle should occur (infinite resistance). Reverse the connections and the same should occur. IF THE RECTIFIER FAILS ANY OF THE ABOVE TESTS, IT IS DEFECTIVE AND SHOULD BE REPLACED.

4. Check field coil resistance as per specification given in A-6.

5. Insufficient cooling of the generator. Ambient air entering the generator should not exceed 104°F (40°C).
Operating efficiency of the generator decreases as the ambient air

temperature entering the generator end bell increases above 104°F. Generators in confined areas may require the ducting of cool outside air into the compartment directed toward the inlet at the generator end bell.

6. Check condition of brushes for wear and contact with slip rings on armature. Insure brushes are not sticking in holders, that none of the brushes are broken in their holders and that the correct number of brushes for each slip ring is present.

High Voltage Output

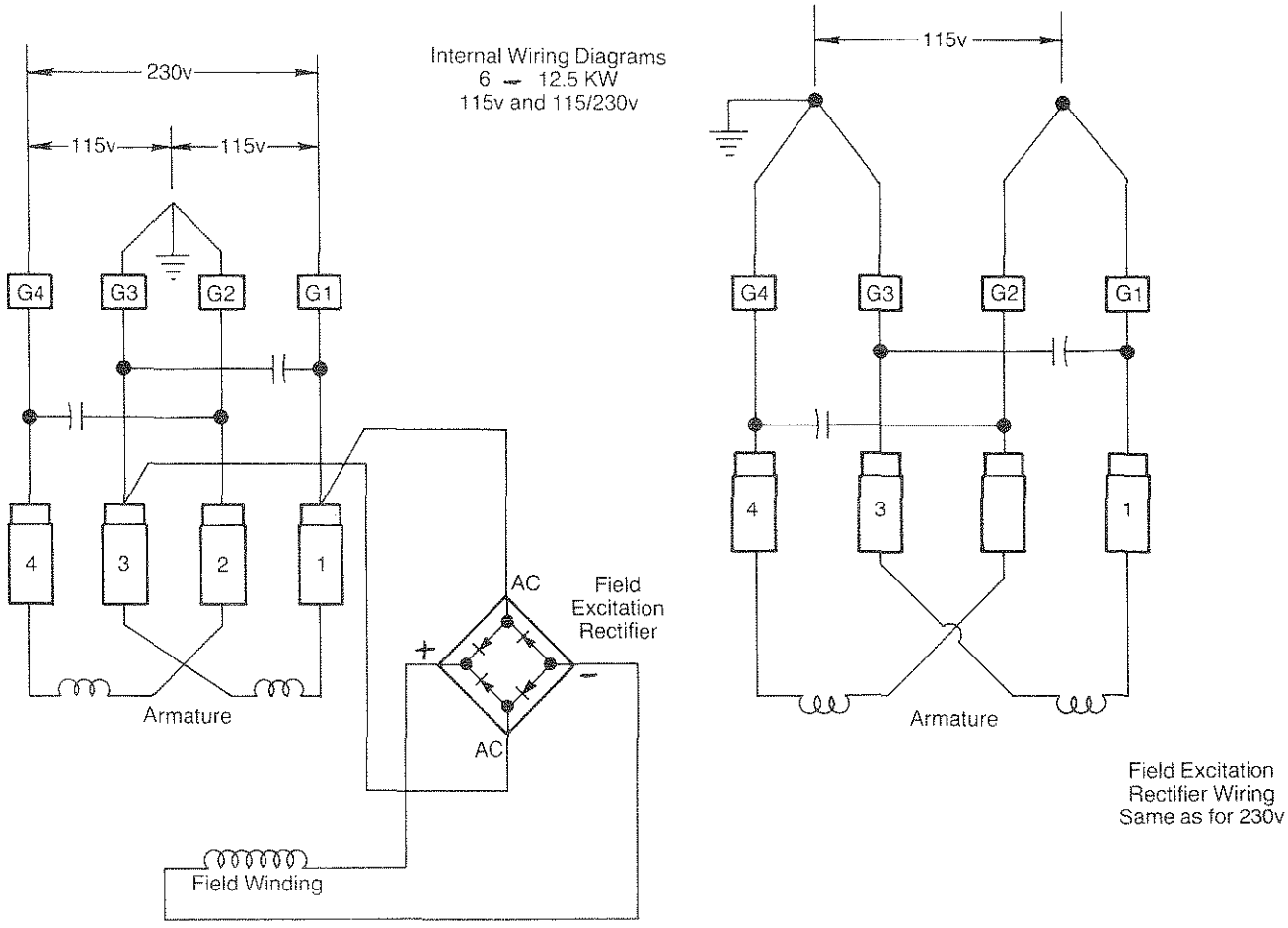
1. Verify voltage at generator output leads.

   No load voltage 126 - 130 volts (Generator Hot)

   61 - 61.6 Hertz

   (51 - 51.5 Hertz)

2. Check internal wiring of generator leads attached to brush rig and leads from brush rig feeding AC to bridge rectifier. Refer to Internal wiring schematics. These internal wiring diagrams are applicable to related 50 Hertz units as well.



ENGINE TROUBLESHOOTING

1.	Engine fails to start	A. Out of fuel B. Engine flooded C. Loose battery terminal D. Battery off or low E. Bad starter or solenoid F. Worn or faulty spark plugs G. Bad ignition coil H. High tension leads grounding (system wet) I. Automatic shutdown switch faulty J. Fuel pump inoperative, filter clogged K. Filter in carburetor clogged L. Faulty overspeed switch (reset and start) M. Engine circuit breaker tripped
2.	Engine starts, runs and shuts down	A. Faulty automatic shutdown switch B. Faulty overspeed switch (reset and start) C. Faulty fuel pump D. Faulty stop switch E. Engine circuit breaker tripping F. Dirty fuel filters G. Low oil level in sump
3.	Backfire through carburetor	A. Ignition timing wrong B. Engine flooding C. Choke stuck closed D. Plug wires wrong E. Distributor cap cracked F. Dirty air cleaner
4.	Engine overheating	A. Coolant loss B. Belts loose or broken C. Sea water pump impeller faulty D. Sea water pump worn E. Faulty hoses F. Thermostat stuck closed G. Exchanger clogged H. Faulty gauge (check with thermometer)
5.	Engine hunting	A. Throttle linkage binding B. Dirty fuel filter C. Defective fuel pump D. Governor out of adjustment E. Valves out of adjustment

6.	Engine misfires	A. Ignition timing wrong B. Spark plug worn C. Valve clearance incorrect D. Dirty carburetor E. Dirty air cleaner F. Poor quality fuel
7.	High oil pressure	A. Faulty gauge B. Relief valve stuck C. Dirty or wrong SAE oil
8.	Low oil pressure	A. Low oil level B. Faulty gauge C. Wrong SAE oil D. Stuck relief valve E. Faulty oil pump
9.	No battery alternator output	A. No 12 volt excitation to regulator B. Faulty connections C. Defective regulator D. Faulty alternator
10.	Black exhaust smoke	A. Dirty air intake B. Choke stuck closed C. Carburetor flooding
11.	Blue exhaust smoke	A. Worn or misadjusted valves B. Worn or unseated piston rings C. Lube oil diluted D. Crankcase breather hose clogged