



SERVICE MANUAL FOR KATOLIGHT ELECTRIC GENERATORS



KATOLIGHT SERVICE MANUAL

WARNING: 1. This manual is only intended for Katolight Master Reps or Distributors.
2. Only Qualified Installers.
3. Before reading this manual please read all manuals accompanying unit.

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INTRODUCTION

General Information

Read this manual carefully before operating or servicing generators to familiarize yourself with proper safety, operation and maintenance procedures. FAILURE TO COMPLY WITH INSTRUCTIONS IN THIS MANUAL COULD RESULT IN PERSONAL INJURY, PROPERTY DAMAGE AND/OR VOIDING OF THE WARRANTY. KATOLIGHT WILL NOT BE LIABLE FOR ANY DAMAGE BECAUSE OF FAILURE TO FOLLOW THESE INSTRUCTIONS.

Check the unit over for any signs of freight damage. Check item list; Transfer Switch, Literature, Battery hold down kit, Diode, and Insulated Connectors for AC and DC wires should all be included with unit.

This manual is not all inclusive. Each operating unit has a manual specific to its use.

Basic Generator Operations (Simplified)

Electric power is produced in the generators by a magnetic field rotating inside a stator. This is a brush less type generator. To start producing electricity, it is the residual magnetism in the rotor's metal core which induces a small amount of current in the stator. This current is fed back into the rotor (increasing the magnetic field and the amount of current induced) until the rotor's magnetic field reaches saturation. At this point there is sufficient energy present in the stators output windings to operate the unit at its rated capacity.

Usage

The generator is connected with the home electrical distribution panel(s), via the transfer switch. It is intended that this unit be used in the following manner.

When the normal electrical service is interrupted the automatic transfer switch (ATS) will signal the generator control circuit to start the engine. When the generator output voltage reaches a predetermined level, the ATS will automatically switch the load distribution panel to the generator output power. After utility service has been restored, the ATS switches the load back to the utility power and the generator shuts down after a short cool down period.

Once every 14 days the generator will "exercise itself". This means it will start and run for 20 minutes insuring that the unit is in a good operating condition when needed.

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GENERATOR TERMINOLOGY

ALTERNATING CURRENT

Alternating current or AC is the flow of electrons in a conductor, first in one direction then in the other.

AMPERES (AMPS)

The rate of electron flow through a conductor is measured in amperes, which is a measurement of electrons flowing past a given point at a given time.

DIRECT CURRENT

Direct current or DC is the flow of electrons in only one direction through the conductor.

HERTZ

A unit of frequency equal to one cycle per second.

OHM

One Ohm is the amount of resistance that will permit one ampere of current to flow in a conductor when one volt of electro-motive force is applied.

ROTOR

The rotor is essentially an electro-magnet, since the flow of direct current through its windings creates a magnetic field around those windings. The strength of the magnetic field can be increased by (a) forming the wires into a coil, (b) increasing the wire size, or (c) increasing the current flow through the wires

SINE WAVE

A wave diagram (sine wave) of alternating current shows that current goes from a zero value to a maximum positive value, reversing itself again and returns to zero. Then it goes to a maximum negative value, reversing itself and returns to zero.

STATOR

The number of turns of wire in a stator winding are determined when it is manufactured. A typical stator assembly may be a single-phase type, or a 3 phase type. The greater the number of turns of wire in a stator winding, the greater the induced EMF when magnetic lines of flux cut through the windings.

VOLTS

The volt is the amount of electro-motive force (EMF) that will result in a current (electron) flow of one ampere through a resistance of one Ohm.

WATTS

One watt is equal to one ampere of current flow under pressure of one volt. Calculate electrical power by using the formula: $WATTS = VOLTS \times AMPERES$.

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INSTALLATION

Site Selection and Preparation

Location:

The unit should be placed in an area that allows plenty of room around the generator for ventilation and maintenance. Approximately 3 feet on each side. Covering or restricting the air passages on the sides of the generator unit will cause the unit to overheat. Examples would be landscaping, piles of leaves, or piles of snow. Leaving a three foot open area around the unit will help in preventing any overheating. When placing the generator, the direction of the exhaust should be pointing away from windows, doors, and any ventilation systems. **Do not install indoors.**

Pad:

Holes provided in the frame are .375" diameter but we recommend a 1/4" lag bolt to allow for variance of placement in the cement. The unit should be bolted on a cement pad that is 4 to 6" thick. The cement pad for the 9kW should be 42.25" wide and 50.75" long. The cement pad for the 15kW should be 48" wide and 72" long. The unit is mounted on rubber isolaters to the frame to make the unit run as vibration free as possible.

Fuel:

For the best operation of the Lighthouse unit the fuels used should have a minimum content of 1000 BTU's per cubic foot for Natural Gas (NG) and 2520 BTU's per cubic foot for Liquid Propane (LP). Contact local supplier for local BTU content. Line pressure for the 9kW and 15kW should be a maximum of 8oz. and a minimum of 4oz. When connecting fuel supply, installation of a manual shutoff valve at the unit is recommended.

The Lighthouse 9kW at full load consumes 162 cubic feet per hour or 162,000 BTU's per hour of Natural Gas (NG) and 72 cubic feet per hour or 182,000 BTU's per hour of Liquid Propane (LP). Approximately 2 gallons of Liquid Propane per hour at full load. The Lighthouse 15kW at full load consumes 285 cubic feet per hour or 285,000 BTU's per hour of Natural Gas (NG) and 122 cubic feet per hour or 308,000 BTU's per hour of Liquid Propane (LP). Approximately 3.1 gallons of Liquid Propane per hour at full load.



WARNING



- **FIRE HAZARD**
Overheating of unit may cause fire and serious personal injury.
- Covering or restricting the air passages on the sides of the Lighthouse units will cause the unit to overheat and may create a fire hazard. Examples would be landscaping, leaves or piles of snow.
- Leaving a three foot open area around the unit will help in preventing any overheating.



WARNING



- **EXPLOSION HAZARD**
Natural gas and Liquid Propane are highly explosive.
- Natural gas is lighter than air and will collect in high places. Liquid Propane vapor is heavier than air and will collect in lower places.
- Extreme caution should be taken when working on a new installation or while performing general maintenance.
- Do not smoke or use open flame during maintenance.

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Lighthouse units are tested with Natural Gas before they leave the factory. If Natural Gas is to be used no carburetor adjustments are required. If Liquid Propane Gas is going to be used the carburetor solenoid will need to be connected, for the 9kW unit. Follow these steps to install the LP fuel orifice for LP Gas operation of the 15kW unit.

1. The main fuel line clamp will have to be loosened and the line removed from the carburetor.
2. Install the LP fuel orifice with a straight blade screwdriver. The fuel inlet to the carburetor is internally threaded to receive the LP orifice.
3. After the LP orifice is installed reattach the fuel line and retighten the clamp. The 15kW is now equipped to run off LP Gas.

The carburetor jets are factory set for LP Gas and no adjustments beyond orifice installation are necessary for LP Gas operation. Use only the vapor withdrawal type system if Liquid Propane Gas (LP) is to be used.

WARNING: The installation of this type of equipment must be done by licensed electrician's or contractors and licensed gas technician or plumbers. Installation must be in conformance with NEC and local electrical and building codes. Utility disconnect must be in the off position before you start any wiring. To insure safe installation of unit make sure Mode switch, on control box, is in the off position.

System Wiring

The installation of the Automatic Transfer Switch must be done by a qualified electrician. Under no circumstance should an unqualified person attempt to install this equipment. The instructions on the installation of the Automatic Transfer Switch are with the transfer switch and must be followed for correct installation and operation. Locate the transfer switch as close as possible to the distribution panel(s). The amperage rating of the transfer switch must be at least as large as the amperage rating of the distribution panel(s). A series 165, 100 amp ATS must be used with a distribution panel(s) up to 100 amps.

The recommended method to connect the Lighthouse system to the home desired circuits is through a Emergency Distribution Panel(s). This panel(s) must be sized to the generator amperage capability. Always follow the local codes and regulations. All selected emergency circuits are removed from main distribution panel(s) and reinstalled in the Emergency Distribution Panel(s). Total running load must not exceed generator rating or there will be a risk of overloading and damaging the generator.

Refer to the wiring diagrams contained in this manual for proper connection of the AC circuit. The two AC power leads must be connected directly to the main circuit breaker in the generator control box. The neutral wire must be connected to the neutral provided. A green ground wire from the ATS must also be connected to the ground connection in the control box. Ensure that all local codes are followed when making these connections. A ground lug is provided on the rear of enclosure to which a bare ground wire must be connected to a ground rod driven into the earth. A 120 volt circuit will need to be installed, inside the 240 volt conduit, from the utility to the control box of generator for the battery charger plug.

9kW UNIT

Refer to the wiring diagrams contained in this manual for proper connection of the DC circuit. The insulated quick connect terminals provided must be used to make these connections. A four wire cable (SJO16/4) is needed between the control panel and the transfer switch run through a different conduit from the AC leads. Remove ATS cover and locate the green connection block. Terminal Block (TB) positions 3,4,5,7 and 8 will be used. Connections at the generator are within the control panel at terminal strip positions 2,3,4, and 6. The insulated spades included must be used. Connections are:

- ATS 3 connects to Generator position 6.
- ATS 4 connects to Generator position 3.
- ATS 7 connects to Generator position 4.
- ATS 8 connects to Generator position 2.
- ATS 5 connects to ATS 7 with provided diode. Diode cathode connects to position 5.

It is important that each wire be connected to the proper terminal, otherwise the system will not operate correctly. Note page 6 for wiring diagram and preferred method of connection and installation of the DC circuit, transfer switch.

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15kW UNIT

Refer to the wiring diagrams contained in this manual for proper connection of the DC circuit. The insulated quick connect terminals provided must be used to make these connections. A four wire cable (SJO16/4) is needed between the control panel and the transfer switch run through a different conduit from the AC leads. Remove ATS cover and locate the green connection block. Terminal Block (TB) positions 3,4,5,7 and 8 will be used. Connections at the generator are within the control panel at terminal strip positions 1,2,3, and 4. The insulated spades included must be used.

Connections are:

ATS 3 connects to Generator position 4.

ATS 4 connects to Generator position 3.

ATS 7 connects to Generator position 2.

ATS 8 connects to Generator position 1.

ATS 5 connects to ATS 7 with provided diode. Diode cathode connects to position 5.

It is important that each wire be connected to the proper terminal otherwise the system will not operate correctly.

Note page 32 wiring diagram for installation of the DC circuit.

 WARNING

• ACID BURN Battery electrolyte fluids comprised of sulfuric acid that can be very dangerous and cause severe burns. • Do not allow this fluid to contact eyes, skin, clothing, etc. If contact or spillage does occur, flush the area with water immediately.

 WARNING

• EXPLOSION HAZARD Batteries contain sulfuric acid (when filled) and may emit explosive gasses. • Read and follow safety instructions accompanying the battery. • Keep sparks, flames and cigarettes away. • Hydrogen gas is generated during charging and discharging. • Always shield eyes, protect skin and clothing when working near batteries.

Battery Installation

The battery will be supplied by the customer. The battery must have at least 235 cold cranking amps for a cold start for the 9kW, and the 15kW should have a minimum of 40 amp/hours. Recommended size for the battery is U1 lawn mower tractor battery. The dimensions must be 7.5"x 5" x 6.5". To place the battery in the battery compartment, the screws on the top and side of the cover need to be removed. Place the cover and screws to the side. Once the battery has been placed and tied down, with the battery hold down bar, the leads can be connected to the respective battery post. Connect battery charger leads at the same time battery is connected. Always connect the positive cable first and the negative cable last, when disconnecting it is negative cable first and then positive cable last.

Caution: Failure to connect and disconnect in the proper sequence can cause equipment damage. Ensure there is a clean tight fit from the cables to the posts. Replace the cover and screws.

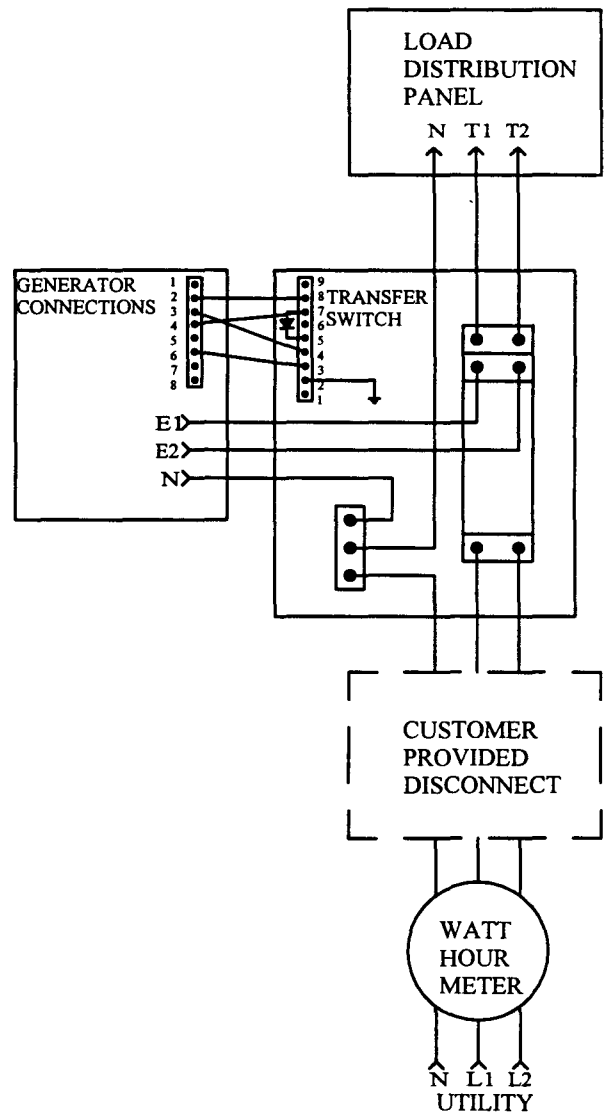
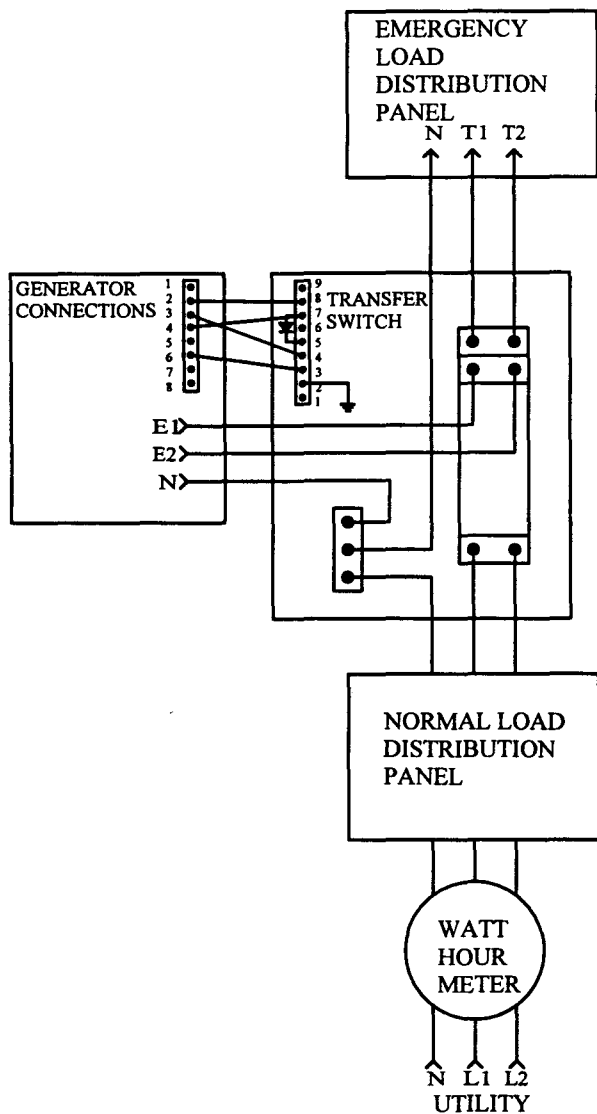
Note: At this time the main power can be turned back on. The ASCO Transfer Switch will light up with the exercise light flashing. Refer to the ATS manual for operation and settings of switch.

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Recommended Installation Method

Alternative Installation Method

Note: The system wiring on recommended and alternative install is for the 9kW unit only.

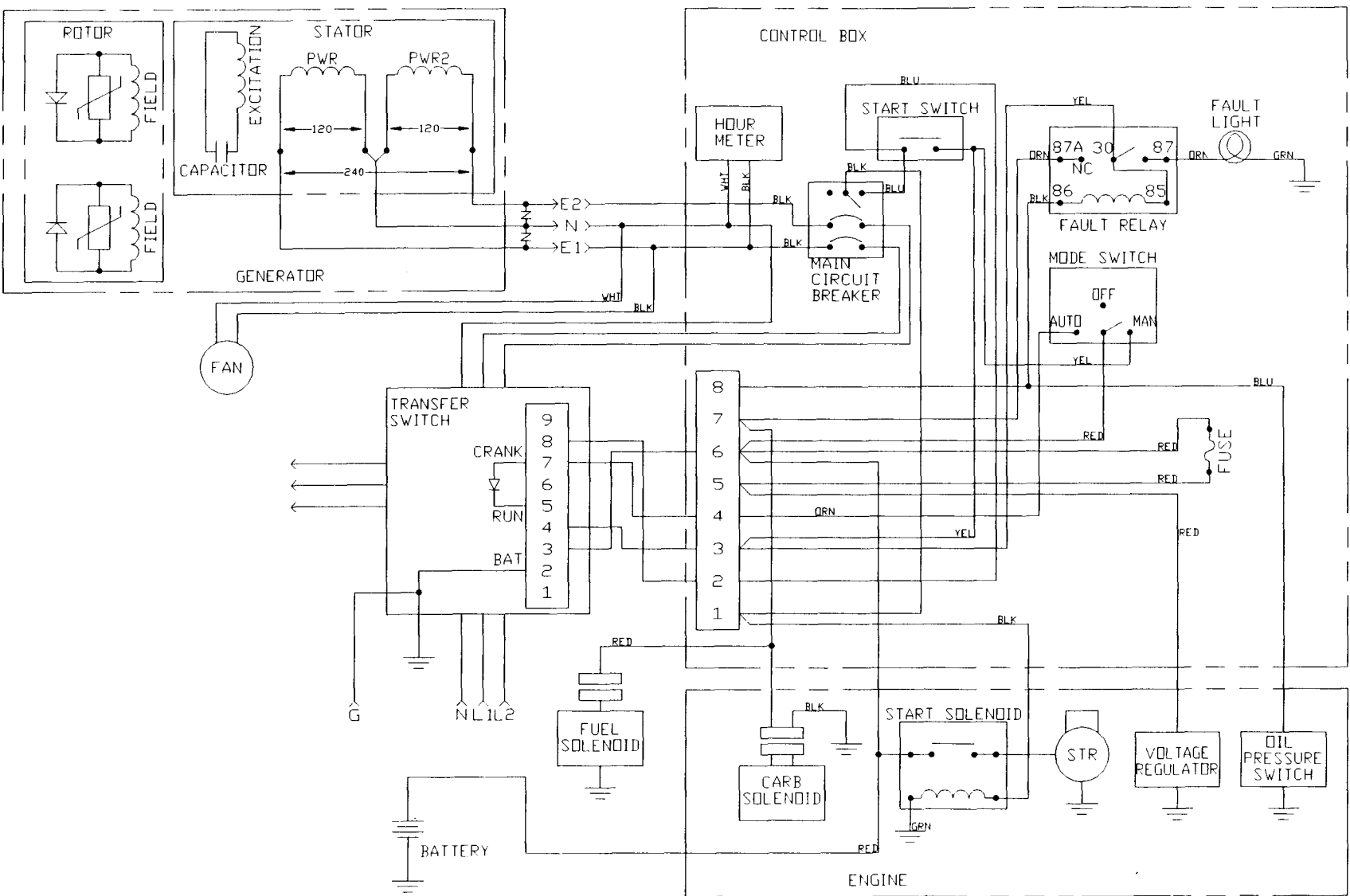


We recommend using an Emergency Distribution Panel when connecting the Lighthouse System to a house or business.

The System Interconnection Diagrams in this Generator Installation & Service Manual should be used when connecting the generator to the transfer switch. When connecting the ATS, refer to the Automatic Transfer Switch Owners/Installation Manual.

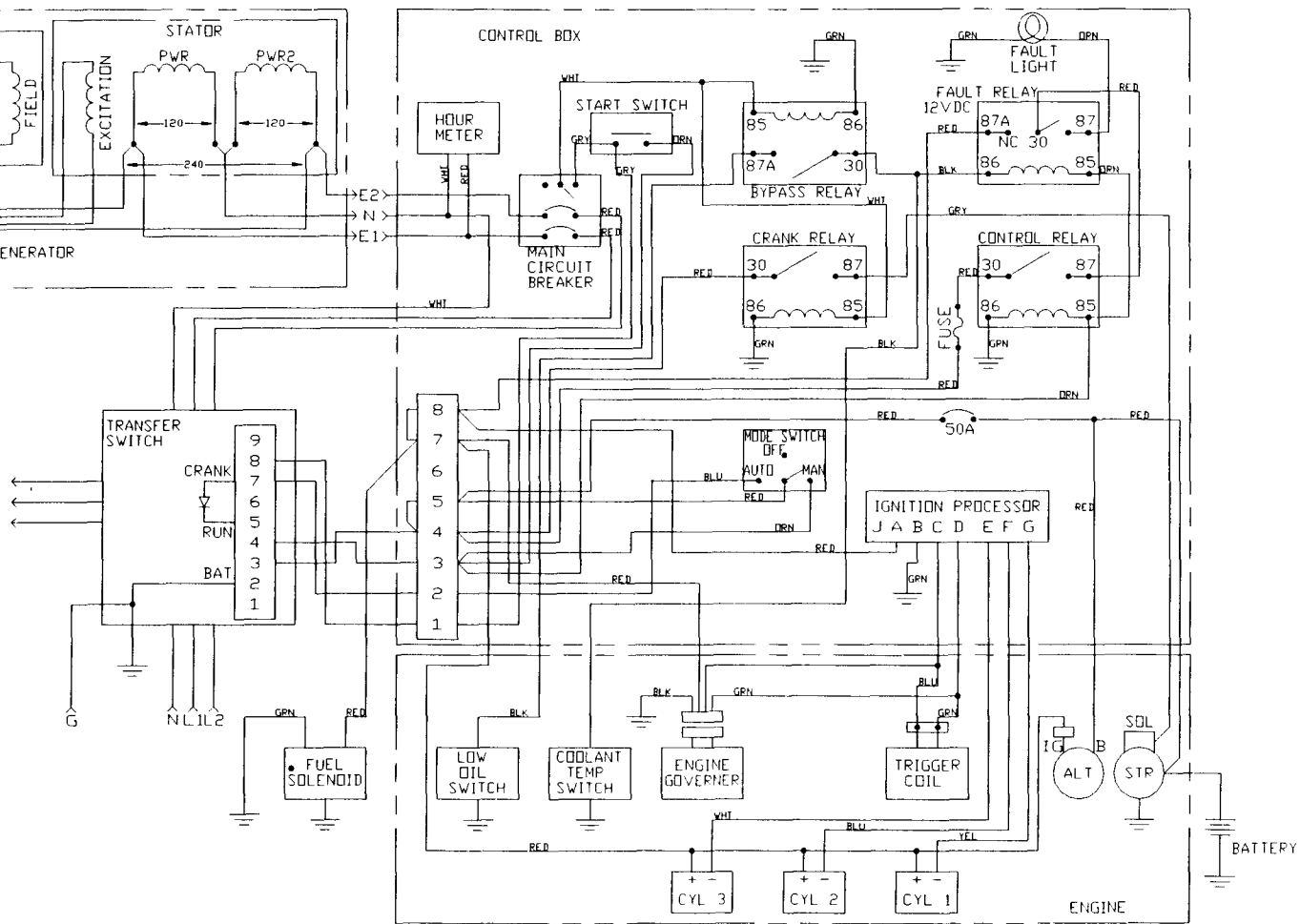
NOTICE:

When the alternative method is used. The Transfer Switch is not service entrance rated. A disconnect must be installed, per NEC code, between the transfer switch and the utility supply.



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NOTE: Wiring Schematic for 15kW unit only.



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SYSTEM START-UP CHECK

Inspect for the following:

1. Check for proper alignment of unit. Unit is square, side panels and lid. Unit is level.
2. Sufficient air space around unit, three feet on all four sides. Exhaust is pointed away from windows and doors.
3. Engine crank case is full of oil.
4. Fuel line is properly connected and routed with no leaks. Use soapy water in spray bottle to check.
5. Correct AC wire sizes and connections, and correct routing of line.
6. Correct DC wire sizes and connections, and correct routing of line.
7. Battery properly sized and mounted correctly.
8. Battery charger plugged in and wired correctly.

Start-up Procedure at Generator Location:

1. Make sure Mode switch is in the manual position. With circuit breaker on.
2. Turn the preferred source (utility) supply to the transfer switch off.
3. Connect AC volt and frequency meter to the alternator source.
4. Press the start button on the control panel and hold until engine starts, approximately 3 seconds or for 10 second intervals.
5. If unit fails to start refer to Troubleshooting Section D on page 11.

Engine Checks. No Load:

1. Adjust frequency and no load voltage if necessary.
(No load voltage range shall be between 240-245. No load frequency shall be between 60-61 Hz).
2. Adjust engine speed up or down for no load specifications, voltage is not adjustable, 9kW units only.
3. Frequency and voltage are pre-set on the 15kW unit. Should not require adjustment.

Check Operation of ATS Switch per Loaded Volts and Frequency specifications:

1. Turn on the preferred source (utility) circuit breaker.
2. Turn on the alternate source (generator) circuit breaker. Mode switch to Auto.
3. Verify that utility (preferred source) acceptable light is on.
4. Verify that the transfer switch on utility (preferred source) light is on.
5. This step will start the generator. Press and hold the Push to Test button until generator (alternate source) acceptable light comes on and stays on. Then release the button.

This light indicates that the generator is running and that its output voltage and frequency are acceptable. Under typical conditions, the light should come on after about 5 to 10 seconds. If the generator is running and fails to produce the proper voltage and frequency after 60 seconds then a malfunction has occurred, consult page 9 error codes.

6. About 15 seconds after the generator (alternate source) acceptable light comes on, the automatic transfer switch transfers the load from the utility to the generator. The transfer switch on generator (alternate source) light comes on.
7. At this time check the loaded volts and frequency at E1 and E2 (ATS). Voltage should not drop below 220 V and frequency should hold at 60 Hz. If unit does not meet specifications go to Generator Troubleshooting section. Page 15 of the manual.
8. Increase the amperage load by turning on appliances, lights, etc. Try to simulate a load which would be normal usage by the customer.
9. The transfer switch stays connected to the generator for 5 minutes. Then the load is transferred back to the utility. To bypass time delay, press and release the Push to Test button again.
10. After load retransfer to utility, the generator runs 1 minute (without load), then shuts down. The generator acceptable light goes off indicating that generator is off.

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Check Automatic Operation of ATS by Shutting off Preferred Source (Utility).

1. The generator starting controls are set for automatic. Mode switch to Auto and circuit breaker on.
2. Turn the preferred source (utility) circuit breaker off. The utility source acceptable light goes off.
3. If the utility remains unacceptable for three seconds the automatic transfer switch cranks and starts the generator.
4. Once the generator starts, the automatic transfer switch waits until the generator voltage and frequency are acceptable. Then the generator source acceptable light comes on.
5. When the generator is acceptable, the automatic transfer switch waits 15 seconds to allow the generator to warm up. Then it transfers the load to the generator. The transfer switch on generator (alternate source) light comes on.
6. Increase the amperage load by turning on appliances, lights, etc. Try to simulate a load which would be normal usage by the customer.
7. Turn the preferred source (utility) breaker back on. When the utility again becomes acceptable the utility source acceptable light comes on.
8. The automatic transfer switch then waits 5 minutes to allow the utility to stabilize. Then it retransfers the load back to the utility. The transfer switch on utility (preferred source) light comes on.
9. After load retransfer the generator will continue to run unloaded for one minute for engine cool down. Then it is stopped. The generator acceptable light goes off.

TROUBLESHOOTING AUTOMATIC TRANSFER SWITCH

DANGER HIGH VOLTAGE; ELECTROCUTION - FLASH HAZARD

Do not replace parts in the transfer switch until both the utility and generator are off. Turn OFF both circuit breakers.

A. The UTILITY acceptable light does not come on when utility power is connected to the automatic transfer switch.

1. Verify that the utility feed is 240 V AC nominal and 60 Hz.
CAUTION HIGH VOLTAGE PRESENT
2. Verify that the utility feed is wired to the terminal lugs on the bottom of the transfer switch marked L1 and L2.
3. Verify that the utility feed is connected and that its circuit breaker is ON.
4. With ALL POWER OFF, verify that the transfer switch harness is connected properly to the controller (plug at the bottom).

B. Power is connected (UTILITY acceptable light and/or GENERATOR acceptable lights are on) but both TRANSFER SWITCH position lights are off.

1. With ALL POWER OFF, verify that the transfer switch harness is connected properly to the controller (plug at the bottom).



WARNING



- **ELECTROCUTION HAZARD**
The circuit breaker shall be in the off position when servicing the system to prevent electrocution.



DANGER



- **ELECTROCUTION - FLASH HAZARD**
Do not attempt to manually switch the transfer switch while the utility or generator power is connected to it.

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C. Generator does not crank when the utility source fails or when the Push to Test button is pressed.

1. Verify that the generator starting controls are set for automatic operation and that the generator circuit breaker is on.
2. Verify engine start low voltage wiring between controller terminal block TB7 (plug on the left) and the generator. Check that TB7 plug is properly seated in TB7 receptacle.
3. Verify that the generator battery is connected and that the battery voltage meets the generator manufacturer's recommendation.
4. Verify that the correct contact (normally open or normally closed) is being utilized (See the Generator Section).

D. Generator cranks but does not start when the utility source fails or when the Push to Test button is pressed.

1. Verify engine start low voltage wiring between controller terminal block TB7 (plug on the left) and the generator. Check that TB7 plug is properly seated in TB7 receptacle.
2. Verify proper generator operation (See Generator Manual).

E. The automatic transfer switch does not transfer the load to the generator (Generator "On" LED does not illuminate at ATS).

1. Verify that the generator source acceptable light is on. The transfer switch will not retransfer the load to the generator until the generator output is acceptable. If the light is off, verify that the circuit breaker for the generator feed is ON.
2. Wait 15 seconds, there is a 15 second delay after the generator output becomes acceptable to permit the generator to warm up.
3. If the generator source acceptable light still does not come on, see above problems C and D.

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F. The automatic transfer switch does not transfer the load back to the utility (Utility "On" LED does not illuminate at ATS).

1. Verify that the utility source acceptable light is on. The transfer switch will not retransfer the load to the utility until the utility source is acceptable and the light is on. If light is off, verify that the circuit breaker from the utility feed is ON.
2. Wait 5 minutes, there is a 5 minute uninterrupted delay on retransfer to the utility.

G. The Generator source acceptable light does not go off after the automatic transfer switch retransfers the load back to the utility.

1. Wait 1 minute, after load retransfer to the utility, there is a 1 minute delay for generator cool down before shut down.
2. Verify proper operation of the generator (See the Generator Manual).

H. Both transfer switch position lights are flashing (this indicates an error condition).

1. Count the number of times the automatic generator exerciser light flashes (repeats after pause). This number is the error code.

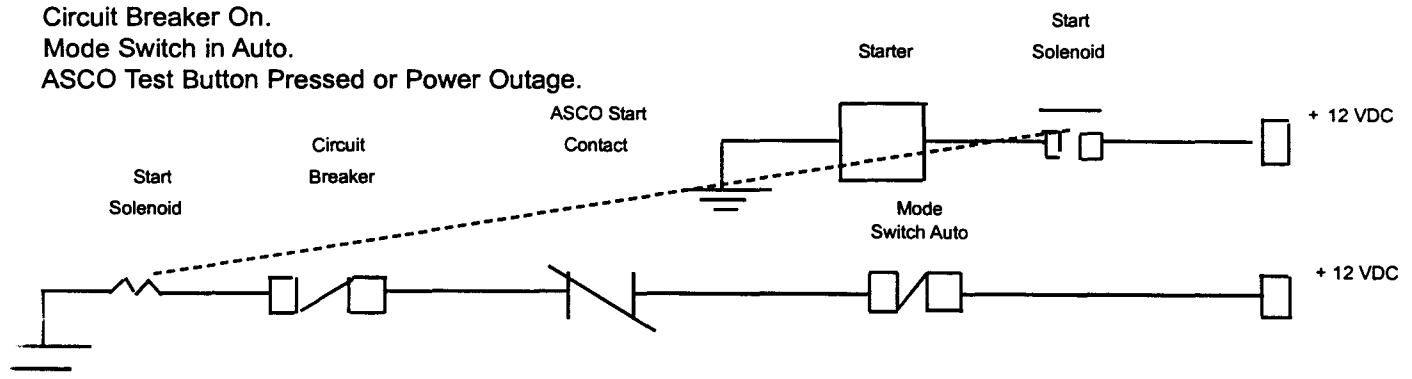
- | | |
|---|--|
| 2. Error codes: | 1 is unused / open |
| 2 Generator failed to start. | See Problems C and D. |
| 3 Generator failed after starting. | See Generator Troubleshooting Section. |
| 4 Generator over or under frequency. | See Generator Troubleshooting Section. |
| 5 Transfer Switch did not transfer the load to the generator. | Service required. |
| 6 Transfer Switch did not transfer the load to the utility. | Service required. |
| 7 Controller error. | Service required. |

To clear error code, press and release Push to Test button.

TROUBLESHOOTING INDIVIDUAL CIRCUITS

A. Auto Crank Circuit Normal Run - No Faults

1. Conditions:
Circuit Breaker On.
Mode Switch in Auto.
ASCO Test Button Pressed or Power Outage.



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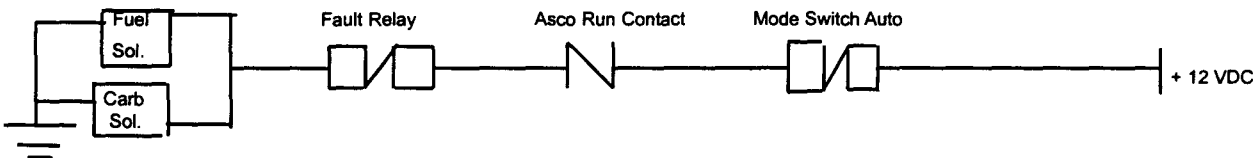
2. Operation: (Picture on page 12).

- A power failure or pressing the ASCO test button applies 12 VDC to the start solenoid coil. Either of these states causes the crank relay to activate closing the crank contact momentarily.
- The start solenoid coil closes the start solenoid contact applying 12 VDC to the starter.
- The starter engages to the engine initiating cranking.

B. Auto Run Circuit Normal run - No Faults.

1. Conditions:

- Circuit Breaker On.
- Mode Switch in Auto.

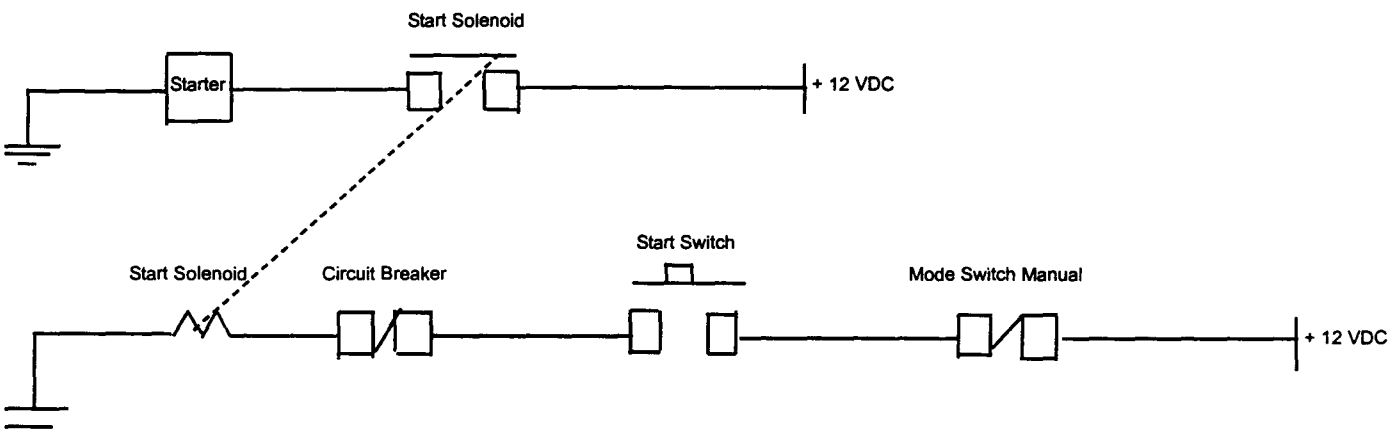


- The engine starts (see crank circuit).
- Voltage is applied to the fuel and carb solenoids as long as the ASCO run contact is closed, and there are no faults. This ASCO run contact is controlled by power outages or test sequencers initiated by the test button.
- Engine runs and generator set produces voltage to load.

C. Manual Crank Circuit Normal run - no Faults.

1. Conditions:

- Circuit Breaker On.
- Mode Switch in Manual Position.
- Start Switch Pressed.



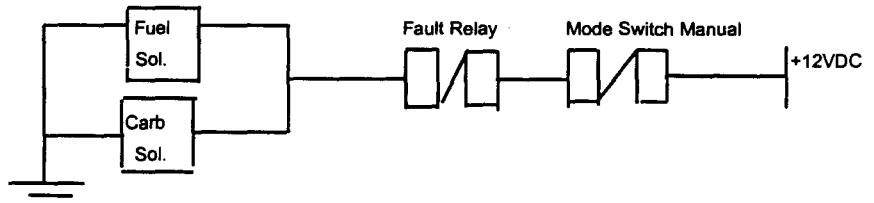
2. Operation:

- Pressing the start switch applies plus 12 VDC to the start solenoid coil.
- The start solenoid coil closes the start solenoid contact applying 12 VDC to the starter.
- The starter engages to the engine initiating cranking.

D. Manual Run Circuit Normal run - no Faults.

Conditions:

- Circuit Breakers On.
- Mode Switch in Manual.



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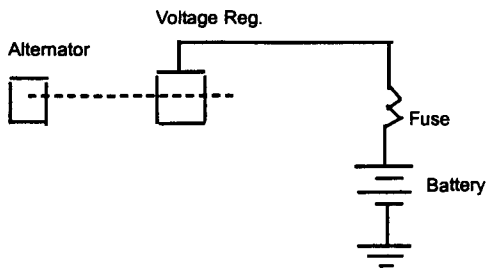
2. Operation: (Picture on page 13).

- a.) The engine starts (see crank circuit).
- b.) Voltage is applied to the fuel and carb solenoids as long as the mode switch is in manual position and there are no faults.
- c.) Engine runs and gen set produces voltage to load.

E. Charge Circuit.

1. Conditions:

- a.) Unit is in one of its operating modes and generator is running.



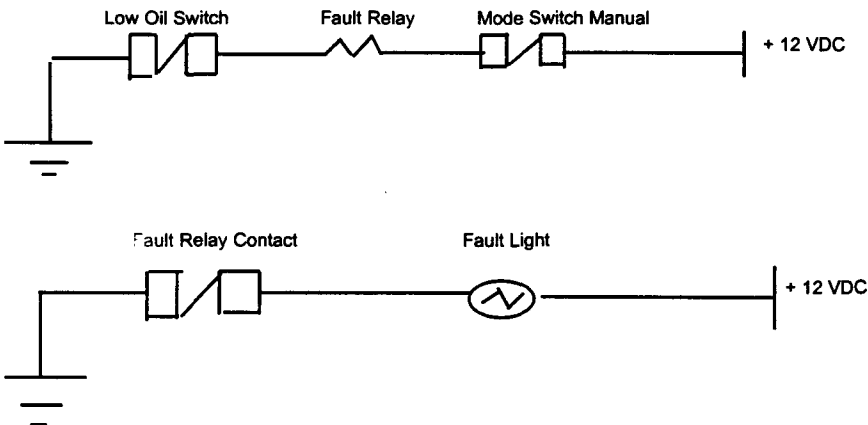
2. Operation:

- a.) The engine is on turning the alternator which produces a voltage to the voltage regulator.
- b.) The voltage regulator regulates the voltage to charge the battery.

F. Fault Circuit Manual Mode

1. Conditions:

- a.) Unit was running, Fault (low oil) occurred.



2. Operation:

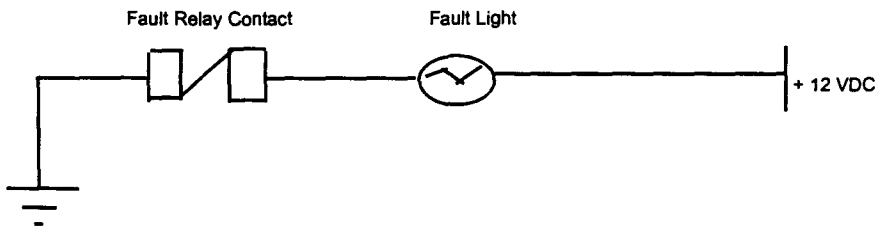
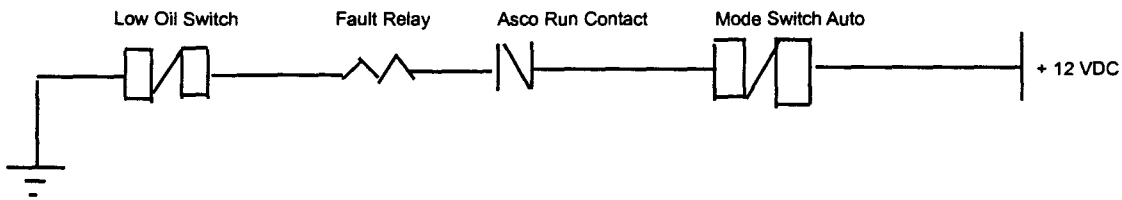
- a.) Unit is running when the low oil switch closes.
- b.) Fault relay activates shutting unit down and lighting fault light.

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G. Fault Circuit Auto Mode

1. Condition:

- a.) Unit was running, Fault (low oil) occurred.



2. Operation:

- a.) Unit is running when the low oil switch closes.
b.) Fault relay activates shutting unit down and lighting fault light.

ELECTRICAL COMPONENT SPECIFICATIONS

A. Fuel Solenoid:

10.0 - 10.6 Ohms

B. Starter Solenoid:

Small Post to Ground 3.5 - 4.0 Ohms

C. Carb Solenoid:

29 Ohms

D. Fault Relay:

Post 30 to 87a = .2 Ohms

Post 85 to 86 = 90 Ohms

When 12 volts is put through 85 and 86 you will have continuity from 30 to 87.

E. Oil Pressure Switch:

.4 to .5 Ohms

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TROUBLESHOOTING INDIVIDUAL CIRCUITS 15kW

Auto Mode Start Operation / Sequence -- Breakers Closed Fuse Good:

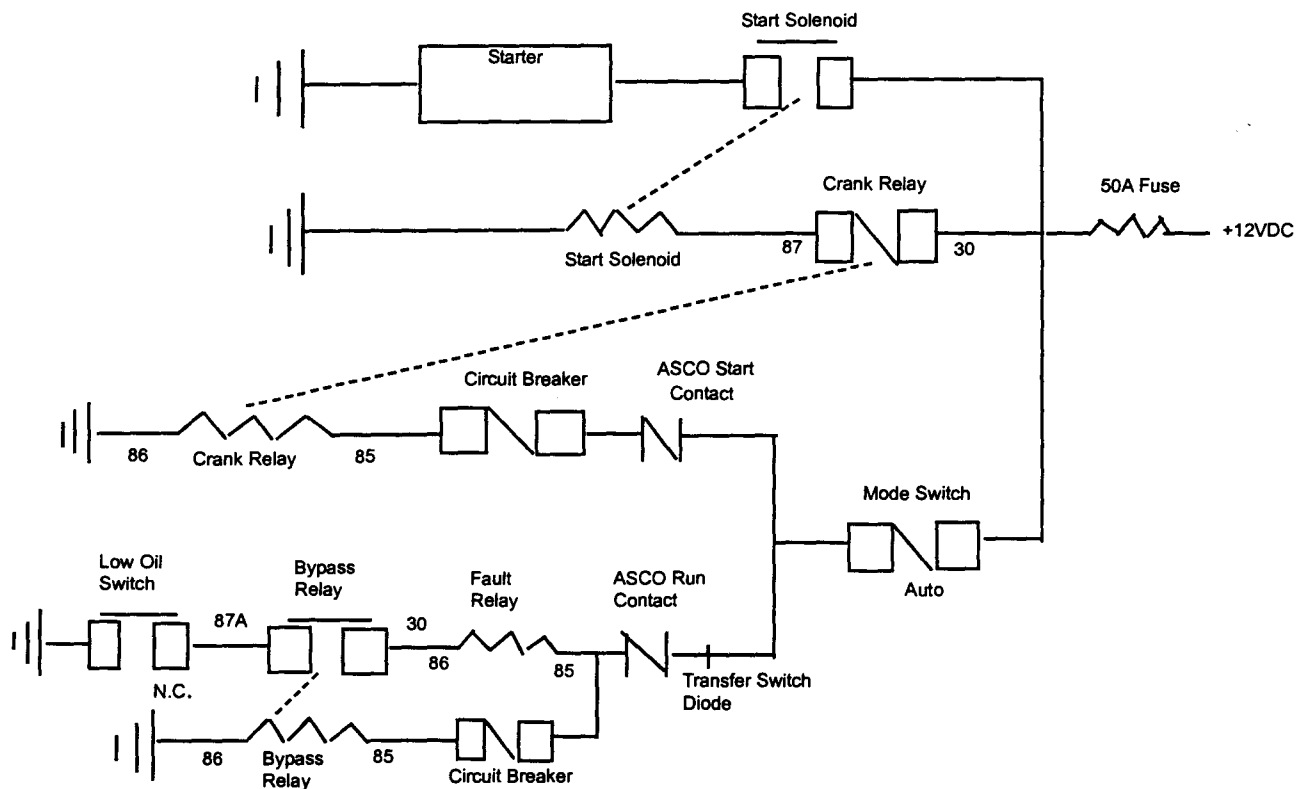
1. With battery hooked up there will be 12 volts at following locations; Starter motor terminal; "B" of Alternator, Pin 7 of transfer switch wiring harness; pin 30 of control relay, and pin 30 of crank relay.
2. When transfer switch senses a loss of power and initiates the start sequence the following things will happen:
 - A. 12 volts is applied from transfer switch crank contacts, through main breaker to pin 85 of crank relay. This energizes relay applying 12 volts to start solenoid energizing it and engaging starter.
 - B. 12 volts is applied from transfer switch crank contacts to pin 85 of bypass relay energizing it. This opens normally closed contacts 87A - 30 of bypass relay removing ground from oil pressure switch circuit.
 - C. 12 volts is applied to pin 85 of control relay from run contacts of transfer switch, energizing it. This allows power to flow to pin 30 of fault relay from pin 87 of control relay.
 - D. Oil pressure sensor switch is normally closed. This puts ground at pin 87A of bypass relay until pressure builds enough to open oil pressure sensor circuit.
 - E. If engine coolant switch is not closed (engine temp ok) it will have no effect. If engine coolant switch is closed (engine overheated) ground will be applied at pin 86 of fault relay. This will energize fault relay shutting engine down and activating fault light.
 - F. If oil and temperature are both ok the fault relay will remain closed. 12 volts DC will be applied to fuel solenoid, governor, ignition processor, alternator, and cylinder coils. Engine will run and voltage will be produced.
3. Oil shut down circuit:
 - A. Oil sensor is normally closed. This means ground is present when engine starts. During start sequence the coil in the bypass relay is activated opening contact 87A. This eliminates the ground that would normally feed through to pin 86 of fault relay. When the oil pressure builds the oil sensor switch opens removing ground. When the crank sequence ends terminal 87A and 30 make again. However, since ground is not present nothing happens. If oil pressure drops the oil sensor switch makes reapplying ground to terminal 87A of bypass relay on to terminal 86 of fault relay. This activates relay breaking contact 87A killing power to operating circuits and lighting the fault light though terminal 87.

KATOLIGHT SERVICE MANUAL

A. Auto Crank Circuit Normal Run - No Faults

1. Conditions:

- Circuit breaker on.
- Mode switch in auto.
- ASCO test button pushed or power outage.



2. Operation:

- A power failure or pressing the ASCO test button applies 12VDC to crank relay energizing it.
- 12VDC is applied to start solenoid through crank relay.
- The starter engages engine initiating cranking.
- At same time 12VDC is applied through transfer switch diode through circuit breaker to bypass relay. Opening low oil sensor circuit.
- Low oil sensor pressurizes opening switch and removing ground from 87A of bypass relay in preparation of run sequence.

KATOLIGHT SERVICE MANUAL

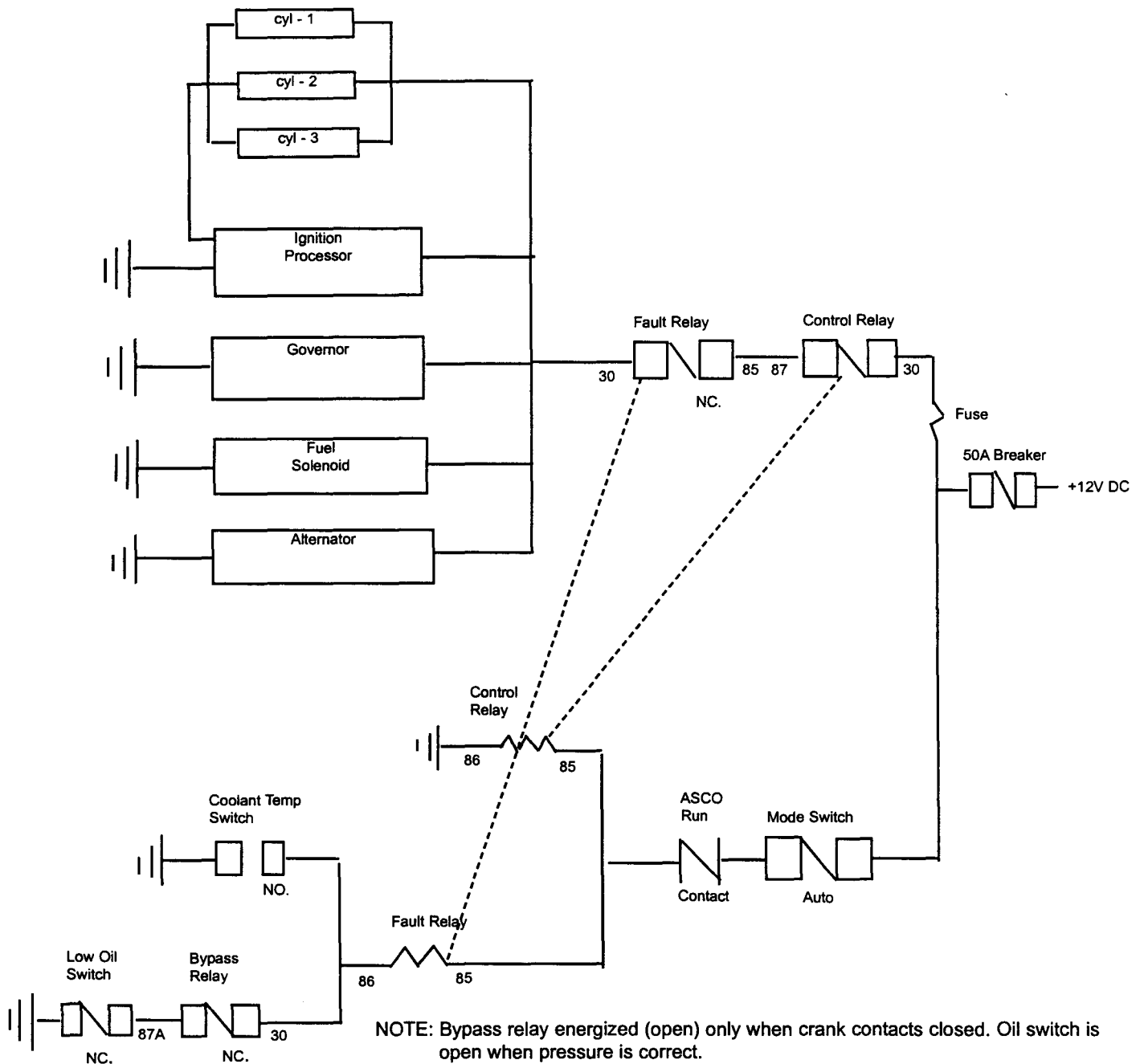
B. Auto run circuit normal run - No faults

1. Conditions:

- a. Circuit breaker on mode switch in Auto.

2. Operation:

- a. The engine cranks (see crank circuit).



- b. 12VDC is applied to control relay coil closing control relay.
- c. Voltage is applied to fuel solenoid, governor, ignition processor, alternator, and the three cylinder coils as long as the ASCO run contact is closed and there are no faults. The ASCO run contact is controlled by power outages or test sequences initiated by the test button.
- d. Engine runs and generator set produces voltage to load.

KATOLIGHT SERVICE MANUAL

TROUBLESHOOTING INDIVIDUAL CIRCUITS 15kW

Manual Mode Start Operation / Sequence -- Breakers Closed Fuse Good:

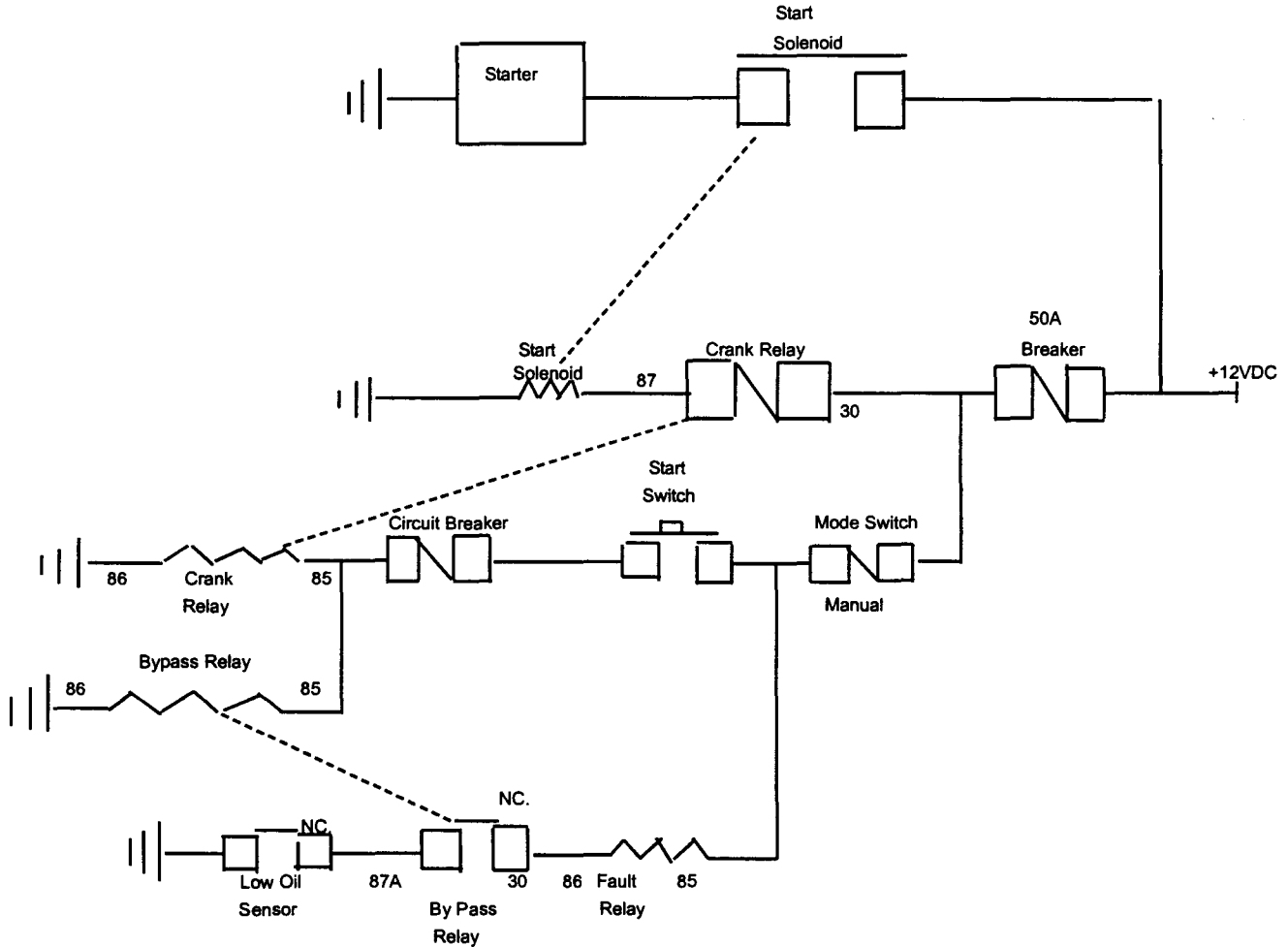
1. With the battery hooked up there will be 12VDC at the following locations; starter motor terminal, "B" of alternator, pin 85 of control relay, pin 85 of fault relay, pin 30 of control relay and start switch.
2. When the start switch is pushed the following things happen;
 - A. 12VDC is applied to pin 85 of crank relay closing relay and allowing 12VDC from pin 30 to pass through to start solenoid. This activates solenoid engaging starter.
 - B. Oil pressure sensor switch is normally closed. This puts ground at pin 87A of bypass relay until pressure builds enough to open oil pressure sensor switch.
 - C. 12VDC is applied to pin 85 of bypass relay energizing it. This opens normally closed contacts 87A - 30 of bypass relay removing ground from fault relay circuit.
 - D. If engine coolant switch is not closed (engine temp ok) it will have no effect. If engine coolant switch is closed (engine overheated) ground will be applied at pin 86 of fault relay. This will energize fault relay shutting engine down and activating fault light.
 - E. If oil and temperature are both ok the fault relay will remain closed, 12VDC will be applied to fuel solenoid, governor ECU, ignition processor, alternator and cylinder coils. Engine will run and voltage will be produced.
3. Oil shut down circuit;
 - A. Oil sensor is normally closed. This means ground is present when engine starts. During start sequence the coil in the bypass relay is activated opening contact 87A. This eliminates the ground that would normally feed through to pin 86 of fault relay. When the oil pressure builds the oil sensor switch opens removing ground. When the crank sequence ends terminal 87A and 30 make again. However, since ground is not present nothing happens. If oil pressure drops the oil sensor switch makes reapplying ground to terminal 87A of bypass relay on to terminal 86 of fault relay. This activates relay breaking contact 87A, killing power to operating circuits and lighting the fault light through terminal 87.

KATOLIGHT SERVICE MANUAL

C. Manual crank circuit normal run - No faults.

1. Conditions:

- Circuit breaker on.
- Mode switch in manual.
- Start switch pressed.



2. Operation:

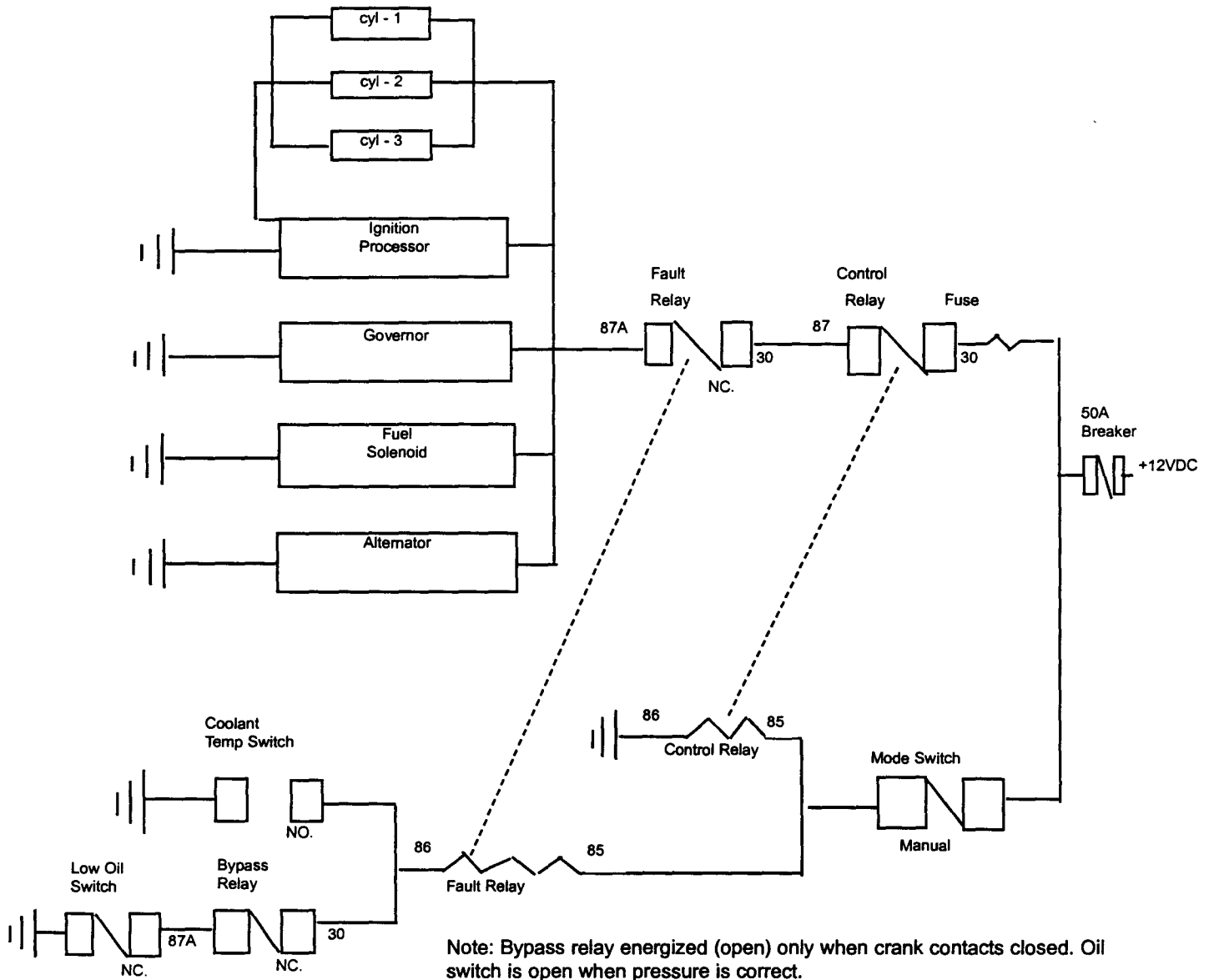
- Pressing the start switch applies 12VDC to crank relay coil.
- Crank relay closes applying 12VDC to start solenoid.
- Start solenoid closes applying 12VDC to starter.
- Starter engages engine initiating cranking.
- At the same time 12VDC is applied to the bypass relay opening the low oil sensor circuit.
- Low oil sensor pressurizes, opening switch and removing ground from 87A of bypass relay in preparation of run sequence.

KATOLIGHT SERVICE MANUAL

D. Manual run circuit normal run - No faults.

1. Conditions:

- Circuit breaker on.
- Mode switch in manual.



2. Operation:

- The engine cranks (see crank circuit).
- 12VDC is applied to control relay coil closing control relay.
- 12VDC is applied to fuel solenoid, governor, ignition processor, alternator, and the three cylinder coils as long as there are no faults.
- Engine runs and generator set produces voltage to load.

KATOLIGHT SERVICE MANUAL

TROUBLE SHOOTING GENERATOR SECTION 9kW

A. Generator has no Output. Volts or Frequency:

1. Re-excite generator section with 12 volt battery. Control cover will have to be removed so excitation can be done by touching positive and negative wires to black (pos.) and white (neg.) main power posts.
2. Test capacitors, insuring they discharge and charge at the same rate, or that they have the proper MF readings.
3. Check Ohm's resistance reading for Stator and Rotor.
 - Rotor - 5.9-6.0 Ohm's each winding.
 - Stator - Black to White .30-.50 Ohm's
 - Red to Red 1.4 to 1.6 Ohm's
 - Green to Green 1.4 to 1.6 Ohm's

B. Generator will not pull load:

1. Check engine speed by measuring no load Volts or Hz readings.
 - Volts - 240-245
 - Hz - 60-61
2. Inspect engine for dirty or oil soaked air filter. Spark plug gap .030, plug wires connected correctly.
3. Fuel flow should be checked at utility side of regulator with manometer. Pressure should be 7 to 14" water column, or 4 to 8 oz. flow.
4. Diode on rotor has opened. Should only read continuity through diode in one direction.
5. Rotor has partial broken or open winding. Check resistance (Ohm's) of windings on rotor.
6. Dead short or open winding in stator. Check resistance (Ohm's) of windings in stator.

C. Engine will not start:

1. Check oil level, and low oil sender unit.
2. Check battery for full charge.
3. Check to make sure fuel is turned on. Fuel pressure should be 7 to 14" water column, or 4 to 8oz. flow.
4. Check starter solenoid. Should have reading between big posts. Should get a reading between the positive and little post when starter is engaged.
5. Check starter motor.

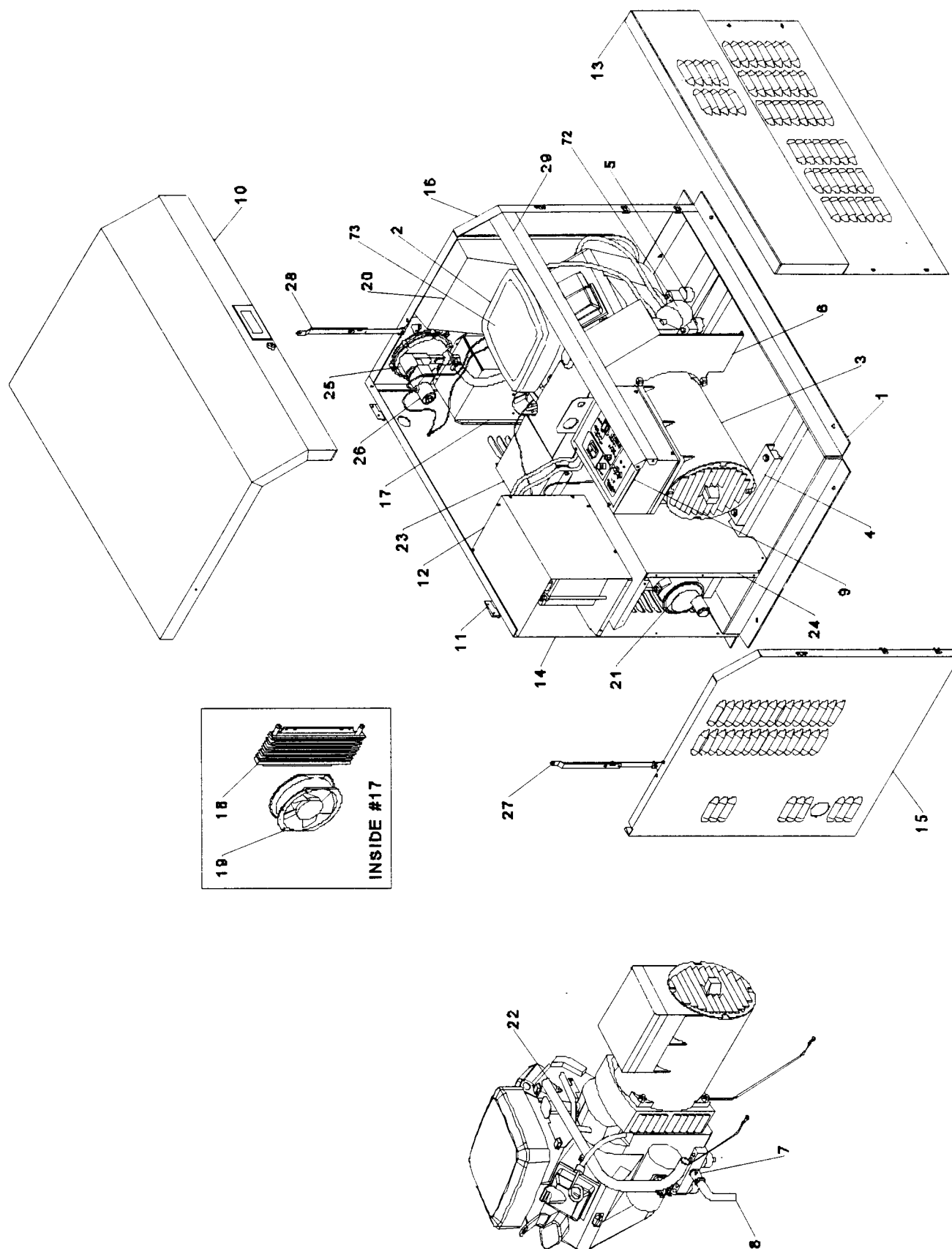
DISASSEMBLY AND ASSEMBLY INSTRUCTIONS 9kW UNIT

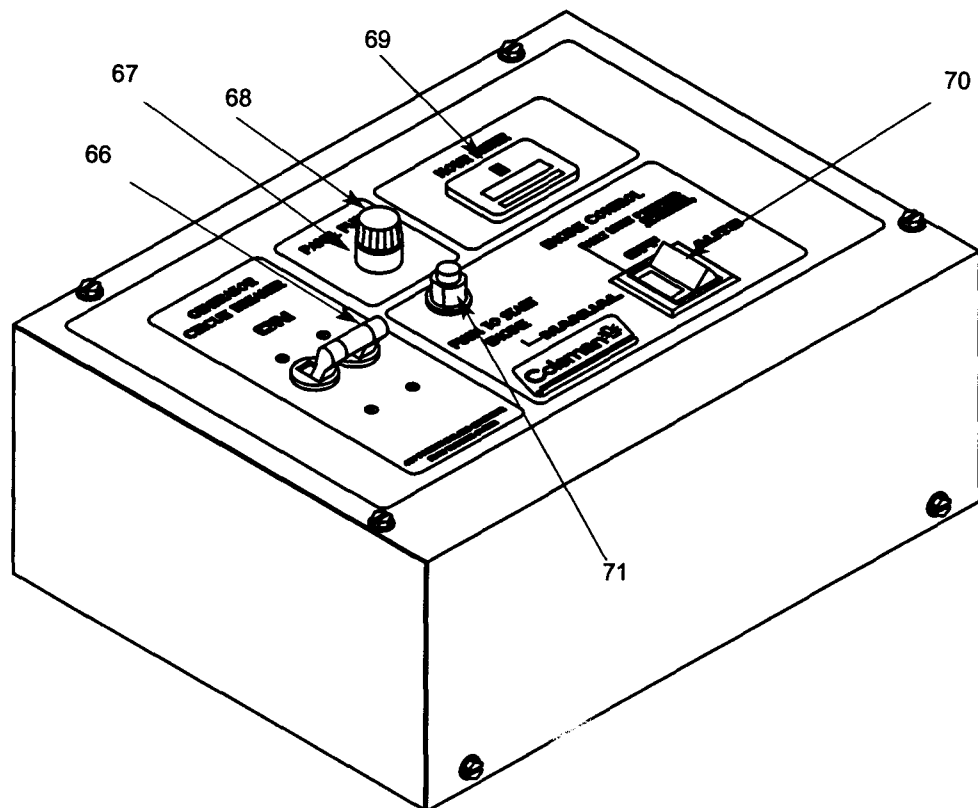
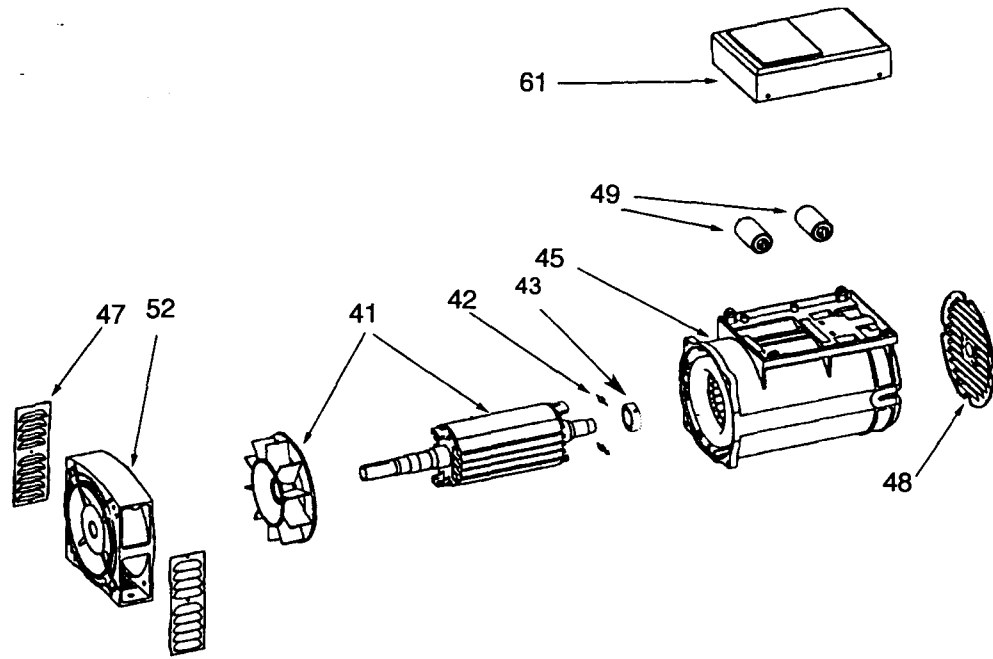
1. Remove lid by taking nyloc nuts and bolts off lid support arms. Close lid and remove mounting screws on back for hinges. Lift lid off unit and set a side. Disconnect battery cables and remove battery.
2. To remove front cover, turn middle two and bottom two screws one half turn counter clockwise to unlock. The top two are just pins, pull out on front cover and remove.
3. To remove engine end panel first make sure fuel is shut off at fuel supply. Remove fuel line from regulator. Remove all screws on end panel. Pull end panel out two inches to access mounting bolts for oil cooler, remove bolts and panel.
4. To remove generator end panel remove screws and panel.
5. To remove back panel disconnect AC and DC power cables. Remove screws and take off panel.
6. Remove the muffler heat shield.
7. Remove stator assembly. Unbolt stator isolators from stator bracket. Place block of wood under engine adapter. Use a three hook puller or rubber mallet to work stator assembly off unit.
8. Remove rotor assembly. Remove rotor bolt. With rubber mallet strike rotor shaft bearing at a 90' angle to break wedge loose. Hold on to rotor with free hand, when wedge breaks loose remove rotor.
9. Engine may be removed from frame at this time.

KATOLIGHT SERVICE MANUAL

ASSEMBLY INSTRUCTIONS 9kW UNIT

1. Install four isolators to engine torque to 10-17 ft./lbs. (13.56 to 23.05Nm).
2. Install ground wire (star washer with lock) (starter side) two holes same side closest to shaft.
3. Attach engine to frame, four 5/16 nyloc nuts and flat washer. Torque to 10-17 ft./lbs.(13.56 to 23.05Nm). Attach ground wire to frame with star washer under wire head.
4. Bolt engine adapter to engine with solid side of adapter to the top, put blue loctite on adapter whiz bolts and torque to 10-17 ft./lbs.(13.56 to 23.05Nm).
5. Install rotor on engine shaft. Install 13mm nut and flat washer on rotor bolt, loctite engine end of bolt. Install rotor bolt and torque to 10 to 17 ft./lbs.(13.56 to 23.05Nm).
6. Install stator to adapter start lower bolt on exhaust side first with J clamp and nut with flat washer. J hook out, horizontal to frame, twist to 90 degree. With rubber mallet tap stator housing onto rotor bearing.
7. Loosen screw on governor spring retainer. Install manifold shield tightening screw governor spring retainer and installing shield screw on exhaust side.
8. Install three remaining adapter to gen head bolts nuts and flat washers torque to 10 to 17 ft./lbs.(13.56 to 23.05Nm).
9. Attach control box to top of stator housing.
10. Stator hook up; black to black. Remove nut and washer from right hand stud. Both small black ring terminals then second black, make sure terminals do not touch each other. Remove nut and washer two small white wires to one of the white posts. Attach ground (starwasher).
11. Engine wire hook up. Put harness into J hook. Attach blue wire to oil pressure sensor. Connect voltage regulator lead. Connect black insulated wire to solenoid. Connect red ring terminal to empty stud of starter and large red battery cable, pointing to the left.
12. Install muffler and muffler shield. Note; when tightening muffler hanger bolt do not put hole in muffler.
NOTE: WHEN PUTTING IN THE #10-16 x .50 SCREWS WITH RUBBER WASHER DON'T OVER TORQUE. ONLY TIGHTEN UNTIL RUBBER WASHER FLATTENS OR 10 inch lbs. (1.13Nm)
13. Attach (genset) end panel, back side muffler shield first. Line muffler up closer to top. Tighten muffler clamp torque 3 to 12 ft./lbs.(10.84 to 16.27Nm).
Attach back panel; screw back panel to end panel first. Attach manifold to muffler shield. Attach muffler shield to back panel.
15. Set engine end panel to unit; hook up fan. Hook up red wire (solenoid) to regulator. Attach panel to back panel.
16. Oil cooler top hose goes to top fitting. Bottom hose goes to bottom fitting.
17. Hook up fuel line to regulator (clamp).
18. Attach ground wire (starwasher) attach propane ground wire.
19. Attach battery box. Feed cables into battery box.
20. Attach front panel.
21. Attach lid. Attach lid supports.
22. Test unit. Refer to page 9 and 10.





KATOLIGHT SERVICE MANUAL

SERVICE PARTS LIST			9kW LIGHTHOUSE	MODEL #	PM0639011
Ref.#	Part Number		Description		Qty.
1.	74121		Frame 9kW		1
2.			Engine 570cc B&S Vanguard LPG		1
3.	74122		Generator Head 9kW		1
4.	74123		Assy. Stator Bracket		1
5.	74124		Isol. Vib 1.50 OD x 1.00 .69 Stud		6
6.	74125		Assy. Shield Air 9kW		1
7.	73190		Drain. Oil FSTEX 7400-02-9909		1
8.	74126		Hose Oil Drain		1
9.	74127		Panel Wired 9kW		1
10.	74128		Assy. Lid 9kW		1
11.	74129		Hinge Slip Joint		2
12.	73131		Assy. Panel Battery Box 9kW		1
13.	74132		Panel. Front 9kW		1
14.	74133		Panel. Back 9kW		1
15.	74134		Panel. Stator End. 9kW		1
16.	74135		Panel. Engine End. 9kW		1
17.	74136		Box. Oil Cooler		1
18.	74137		Oil Cooler Hayden 001243		1
19.	74138		Fan 178 CRMAC 178x150 x50mm		1
20.	74139		Intake Duct		2
21.	74155		Muffler 9kW		1
22.	74156		Manifold 9kW		1
23.	74157		Shield. Manifold 9kW		1
24.	74158		Shield. Muffler 9kW		1
25.	74159		Regulator KN039-0004		1
26.	74160		Solenoid LPG/NG AFC 171		1
27.	74162		Support Lid LH		1
28.	74161		Support Lid RH		1
29.	74163		Front Brace 9kW		1
30.	73194	NOT SHOWN	Battery Charger Guest 2608		1
31.	74164		Lock with Key		1
32.	74165		Lid Hook for Lock		1
33.	73204	NOT SHOWN	Starter Solenoid		1
34.	74166	NOT SHOWN	Assy. Varistor 140V		2
41.	74167		Rotor 8.5kW -10kW		1
42.	73224		Diodes Rotor		2
43.	74168		Bearing		1
45.	74169		Stator		1
47.	74130		Louvered Side Panel		2
48.	Not Used		Louvered End Panel		
49.	73188		Capacitor. 35 mfd 450 V		2
52.	74188		Engine Adapter		1
61.	Not used		Generator Head Cover		
62.	73195	NOT SHOWN	Control Panel / Transfer Switch		1
63.	74189	NOT SHOWN	100 Amp TS Unit		1
64.	74190	NOT SHOWN	200 Amp TS Unit		1
65.	74191	NOT SHOWN	NEMA 1 Enclosure		1
66.	73196		Circuit Breaker 40A 2 Pole		1
67.	73197		Fuse Holder		1
68.	73198		20 Amp Fuse 250V		1
69.	74187		Hour Meter		1
70.	73199		Switch SPDT Light		1
71.	73200		Switch Momentary		1

KATOLIGHT SERVICE MANUAL

SERVICE PARTS LIST			9kW LIGHTHOUSE	MODEL #	PM0639011
Ref.#	Part Number		Description	Qty.	
72.	73201		Oil Filter	1	
73.	73202		Air Filter	1	
74.	74164	NOT SHOWN	Handle W / Keys	1	
75.	92216000	NOT SHOWN	Paint (Spray Can)	1	
76.	74533	NOT SHOWN	Oil Heater 75 Watt / 120 Volt	1	

KATOLIGHT SERVICE MANUAL

TROUBLESHOOTING GENERATOR SECTION 15kW UNIT

A. Generator has no output: Volts or Frequency

1. Re-excite the generator with a 12 volt battery, by touching just for an instant, pins 3 & 1 on the voltage regulator with a 30 Ohm resistor in series. Positive to pin 3, negative to pin 1 on regulator board.
2. Generator has no output after being excited. Check connections per attached drawings.
3. Check Ohm readings for stator and rotor.
Stator windings:
Exciter - Disconnect wire from terminal 1 on regulator board. Check across that wire to pin 3 on regulator board. Reading should be 15 - 17 Ohm.
Auxiliary winding - Unfasten wires from pin 4 on regulator board. Use Ohm meter to determine which wire goes directly to V1. on the connector board. Measure from the other wire that was on pin 4 to pin 3 on regulator board. Reading should be 1.4 - 1.6 Ohm.
Main winding - Measure between U2 & W1 and between V1 & V2 on connector board. Each should be .08 to .10 Ohm's.
Rotor
Excitor - There are 3 small red wires soldered in with the diodes. Should read 1.3 to 1.5 Ohm between any of the 3. Should read .7 to .8 Ohm between any of the small red wires and either of the large white wires.
Main Winding - There are two large white wires on end of rotor soldered in with diodes. Should read 9 -10 Ohm across these.

CAUTION: Reading may vary depending on accuracy and calibration of your meter. Use these readings as a general guideline.

B. Low Voltage / Frequency at no load:

1. Units are preset and adjusted at factory for proper voltage and frequency (240 - 245 volts & 59.5 - 60.5 Hz).
2. Both the generator and the governor on this unit will attempt to increase output to proper level. Check the engine RPM's, should be approximately 3700 RPM. If the RPM's are low, try to physically open up the governor. If the RPM's increase the problem is in the governor, replace governor. If the RPM's are correct, calibrate the voltage using the volts potentiometer on the regulator board. **CAUTION !** Move potentiometer very slowly. Small movement clockwise produces large increase in voltage.
3. Check windings for possible short.

C. High Voltage / Frequency at no load:

1. Check engine RPM's, should be approximately 3700. If RPM's are high try to physically close the governor. If the RPM's decrease and voltage comes down the problem is in the governor, replace governor.
2. If the RPM's are correct calibrate the voltage using the volts potentiometer on regulator board. **CAUTION !** Move potentiometer very slowly. Small movement counterclockwise produces large decrease in voltage.

D. Generator will not pull load:

1. Check engine speed by measuring no load voltage and hertz readings.
Volts - 240 - 245
Hertz - 59.5 - 60.5
2. Inspect engine for dirty or oil soaked air filter. Check spark plug for correct gap (.030). Plug wires connected correctly.
3. Fuel flow should be checked at utility side with manometer 7 - 14" water column.
4. Check fuel pressure at utility side 4 - 8 oz. psi.
5. Check diodes on rotor. Should only have continuity in one direction.
6. Rotor has partial short or open winding. Check Ohm reading on rotor.
7. Short or open winding in stator. Check Ohm reading on stator.

KATOLIGHT SERVICE MANUAL

E. Engine will not start:

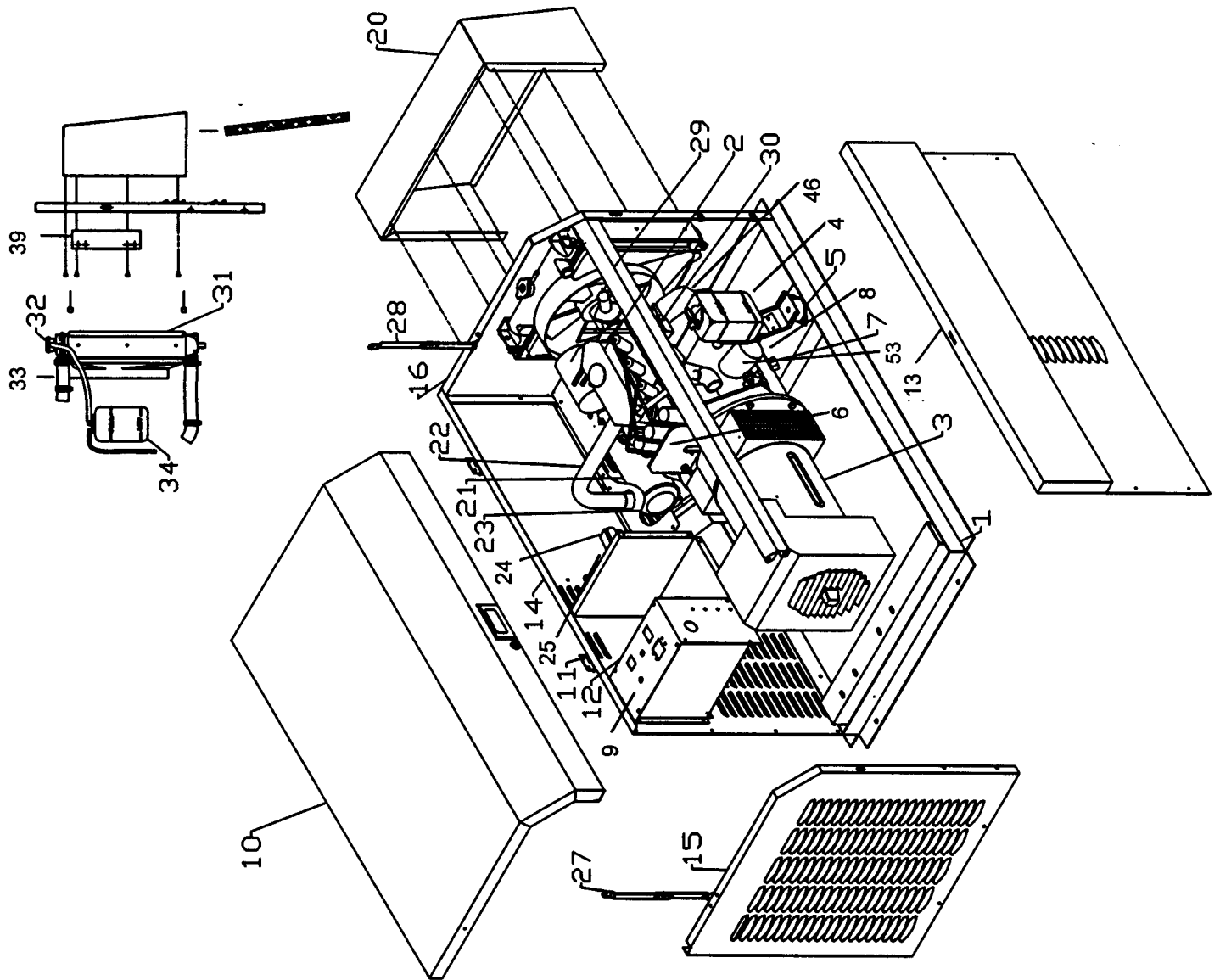
1. Check oil level and low oil sender unit.
2. Check battery for full charge.
3. Check to make sure fuel is turned on. Fuel pressure should be 7 to 14" water column or 4 to 8 oz psi.
4. Check starter solenoid. Should have reading between big posts. Should get reading between the positive and little post when starter is engaged.
5. Check starter motor.

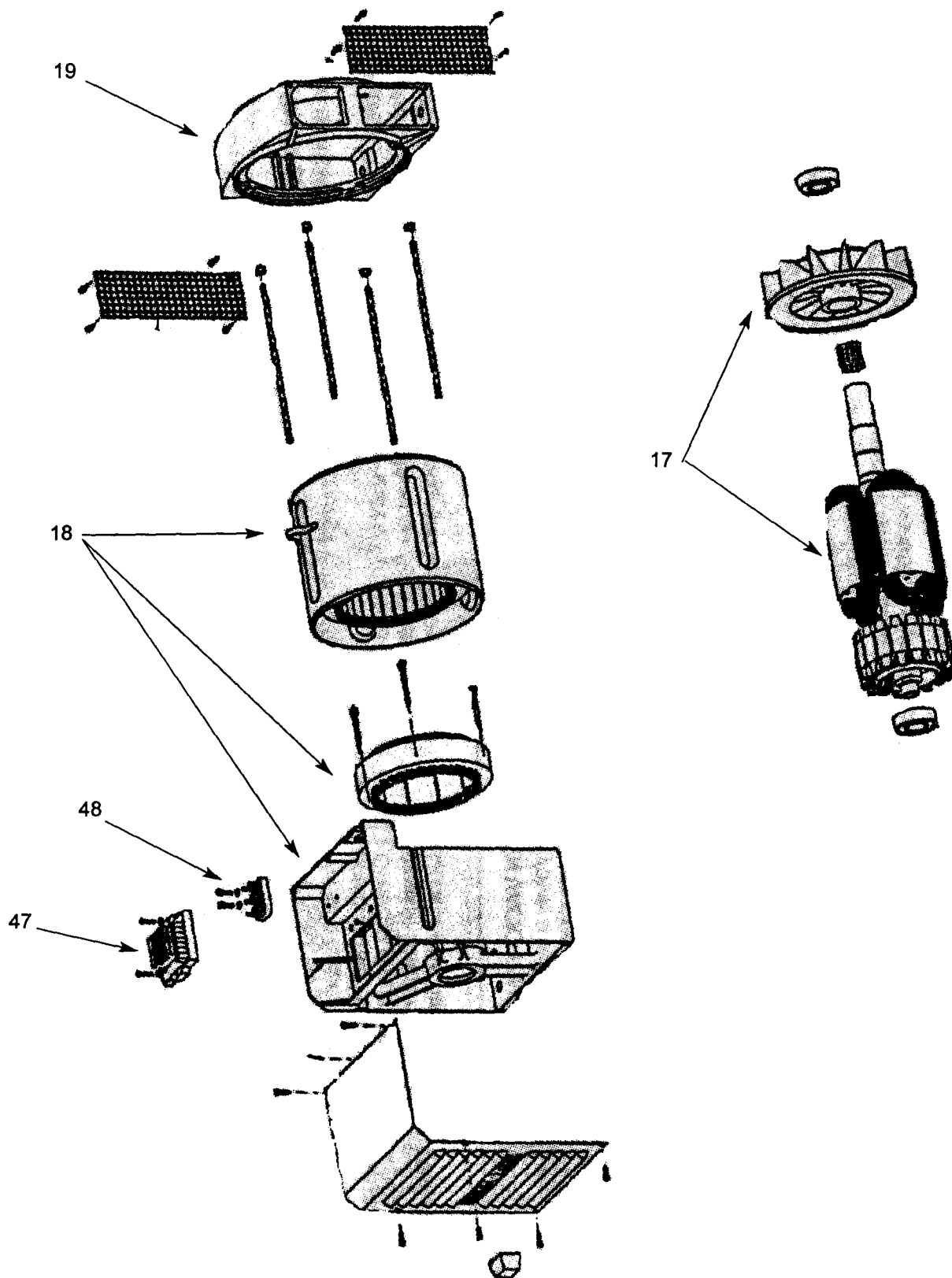
DISASSEMBLY INSTRUCTIONS - 15kW UNIT

1. Remove lid by taking nyloc nuts and bolts off lid support arms. Remove locking screw from panel beside hinge. Slide lid of hinge pins.
2. Remove front cover by removing screws from panel at top on each side. Turn middle and bottom screws one half turn counterclockwise to unlock. Set front aside.
3. Remove front top brace by removing the two screws on each end of brace.
4. Remove generator end panel by removing the 4 screws from the back panel.
5. Make sure gas is turned off. Disconnect gas line from valve. Disconnect gas valve wires. Disconnect gas line from carburetor.
6. Remove battery compartment lid. Disconnect cables and remove battery.
7. Remove the generator head cover. Disconnect the three wires coming from the control panel.
8. Remove cover from control box, disconnect AC & DC power cords. Disconnect wire block connector.
9. Remove 8 screws from back panel that hold the control and battery box and set aside.
10. Remove the 4 nuts holding the exhaust to the manifold.
11. Remove the screws from the back panel that hold it to the engine end panel.
12. Remove the back panel with muffler assembly and set aside.
13. Remove the 4 screws that hold the protecting screen over the generator air vent. Remove the 6 hex drive bolts inside that fasten generator rotor plate to engine plate. Remove the 8 bolts that fasten generator housing to engine housing. Remove the 2 bolts fastening generator to frame. The generator may now be removed.
CAUTION: Unit is very heavy.
14. Drain radiator, remove hoses from engine. Remove radiator and panel and set aside.
15. Remove 2 bolts fastening engine to frame. Engine may now be removed.

ASSEMBLY INSTRUCTIONS - 15kW UNIT

1. Attach the 2 mounting brackets to the engine with 4 bolts. Torque 7 - 10ft./lb.
2. Attach antifreeze overflow bracket to mounting bracket on front side of engine.
3. Attach black ground wire to engine block on back side.
4. Remove governor from old engine and attach to new engine.
5. Attaching generator head. Remove the 4 screws holding the protective screen on the front of the generator.
6. Align the generator and the engine. Start 2 bolts through the generator into the engine housing on each side. Do not tighten. Attach lift bracket through the generator into the engine housing with 2 bolts. Finger tighten only.
7. Align the rotor plate on the generator with the engine plate. The generator flange must fit inside the engine plate. Start the 6 hex drive bolts through the generator flange into the engine plate. Finger tighten bolts only.
8. Raise unit and install 2 bottom bolts through the generator head into engine housing. Tighten all 8 bolts, torque to 30 - 50 ft./lb.
9. Make sure the generator flange fits snug into engine plate. Tap bearing on end of generator if necessary to move rotor forward. Generator flange should be approximately 1/32" inside engine plate. Tighten the 6 hex drive bolts inside generator, torque to 10 - 17 ft./lb.
10. Replace protective screen on generator. Place unit on metal frame and attach with 4 bolts.
11. Follow disassembly instructions in reverse to complete assembling metal cabinet.





KATOLIGHT SERVICE MANUAL

SERVICE PARTS LIST			15kW LIGHTHOUSE	MODEL #	PM0621512
Ref#	Part Number		Description		Qty.
1.	74140		Frame 15KW HSB		1
2.	74233		Engine BS&D 950 Daihatsu		1
3.	74141		Head Gen Mecc Alte 15KW		1
4.	74180		Mount Eng. Daihatsu 950		2
5.	74172		Isolator, 30 Duro ebco 4690		4
6.	74171		Lift Hook 15KW HSB		1
7.	73190		Drain, Oil FSTEX 7400-02-9909		1
8.	74182		Hose Oil Drain		1
9.	74152		Panel, Wired PM0621512		1
10.	74145		Assy. Lid 15 KW HSB		1
11.	74129		Hinge Slip Joint		2
12.	74148		Box, Wired PM0621512		1
13.	74154		Panel, Front 15KW HSB		1
14.	74150		Panel, Back 15 KW HSB		1
15.	74151		Panel, Stator End 15KW HSB		1
16.	74178		Assy, Engine End Panel 15KW HSB		1
17.			Rotor 15KW		1
18.			Stator 15KW		1
19.			Adapter 15KW		1
20.	74175		Panel Radiator Deflector 15KW		1
21.	74143		Muffler 15KW HSB		1
22.	74142		Assy, Manifold 15KW HSB		1
23.	74144		Assy, Muffler Shield		1
24.	74234		Solenoid		1
25.	74159		Regulator KN039-0004		1
26.	73203	NOT SHOWN	Circuit Breaker 60 Amp 2 pole w/Aux. Switch		1
27.	74162		Support Lid LH		1
28.	74161		Support Lid RH		1
29.	74235		Front Brace 15KW		1
30.	74236		Governor, Woodward LCS		1
31.	74147		Radiator Daihatsu 950G		1
32.			Radiator Cap		1
33.	57459		Radiator Hose, Upper		1
34.			Over Flow Bottle		1
35.	74149	NOT SHOWN	Panel Battery Box Cover 15KW HSB		1
36.	73217	NOT SHOWN	Circuit Breaker 50 Amp Auto-Reset		1
37.	74153	NOT SHOWN	Relay 12 VDC Siemens VF4-45F11		1
38.	74173	NOT SHOWN	Lock Hooked Pawl		1
39.	74174		Bracket Radiator Mount 15KW		1
40.	74176	NOT SHOWN	Spark Arrest Clamp		1
41.	74177	NOT SHOWN	Bracket Coolant Tank		1
42.	73194	NOT SHOWN	Battery Charger Guest 2608		1
43.	74185	NOT SHOWN	Switch Momentary		1
44.	74186	NOT SHOWN	Switch SPDT Light		1
45.	74187	NOT SHOWN	Hour Meter		1
46.	73189		Air Cleaner		1
47.			Electronic Regulator SR7		1
48.			Terminal Board		1
49.	57462	NOT SHOWN	Mixer LPG/NG Daihatsu 950G		1
50.	57458	NOT SHOWN	Bracket Overflow Bottle 950G		1
51.	74153	NOT SHOWN	Fault Relay 12VDC Siemens VF4-45F11		4
52.	53625	NOT SHOWN	Diode, Transfer Switch, IN4004 400V 1.0A		1
53.	74051		Oil Filter		1

KATOLIGHT SERVICE MANUAL

SERVICE PARTS LIST

15kW LIGHTHOUSE

MODEL #

PM0621512

Ref#	Part Number		Description	Qty.
54.	92216000	NOT SHOWN	Paint Aerosol Almond (Touch Up Paint)	1
55.	74164	NOT SHOWN	Handle W / Keys	1
56.	825133BS	NOT SHOWN	Lower Radiator Hose	1
57	3200001	NOT SHOWN	Lower Hose Heater 1" 375 Watt (TEMRO)	1