

winco[®]

**Mobile
Lighting
Systems**

OWNERS MANUAL

LSC4—MH



ENERGY
CORPORATION

Manufacturing-Engineering & Customer Service
225 South Cordova Avenue
Le Center, MN 56057 • (612) 357-6821

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GENERATOR SCHEMATIC	97392-002
CONTROL PANEL	98429-000
TOWER WIRING	98426-000
DC SCHEMATIC	98446-000

A GUIDE TO PRODUCT SAFETY

This Mobile Lighting System has been designed and manufactured to allow safe reliable performance. Improper or careless use can result in potentially deadly hazards; from electrocution or serious electrical shock, exhaust gas asphyxiation, or fire. Please read all safety instructions carefully before installation or use. Keep these instructions handy for future reference. Take special note and follow all warnings on the unit and in the manuals.

CAUTION: Possible Damage to Equipment.
CAUTION notes indicate any condition or practice, which if not strictly observed or remedied, could result in damage or destruction of the equipment.

WARNING: Personal Danger.
WARNING notes indicate any condition or practice, which if not strictly observed, could result in personal injury or possible loss of life.

1. **ELECTRIC SHOCK** - The output voltage present in this equipment can cause a fatal electric shock. This equipment must be operated by a responsible person.
 - A. Do not allow anyone to operate the generator without proper instruction.
 - B. Guard against electrical shock.
 - C. Avoid contact with live terminals or receptacles.
 - D. Use extreme care if operating this unit in rain or snow.
 - E. Use only three-prong grounded receptacles and extension cords.
 - F. Be sure the unit is properly grounded to an external ground rod driven into the earth.

2. **FIRE HAZARD** - Engine fuels always present a hazard of possible explosion and/or fire.
 - A. Do not refuel when the engine is running or hot. Allow the engine to cool at least two minutes before refueling.
 - B. Keep fuel containers out of reach of children.
 - C. Do not smoke or use open flame near the generator set or fuel tank.
 - D. Keep a fire extinguisher nearby and know its proper use. Fire extinguishers rated ABC by NFPA are appropriate.
 - E. Store fuel only in an approved container, and only in a well-ventilated area.

A GUIDE TO PRODUCT SAFETY

3. **DEADLY EXHAUST GAS** - Exhaust fumes from any internal combustion engine contains carbon monoxide, an odorless and deadly gas that must be mixed with fresh air.
 - A. Operate only in well ventilated areas.
 - B. Never operate indoors.
 - C. Never operate the unit in such a way as to allow exhaust gases to seep back into closed rooms (i.e. through windows, walls or floors).

4. **NOISE HAZARD** - Excessive noise is not only tiring, but continual exposure can lead to loss of hearing.
 - A. Use hearing protection equipment when working around this equipment for long periods of time.
 - B. Always operate with the doors closed to reduce the operational noise level.

5. **CLEANLINESS** - Keep the generator and surrounding area clean.
 - A. Remove all grease, ice, snow or materials that create slippery conditions around the unit.
 - B. Remove any rags or other material that could create potential fire hazards.
 - C. Carefully wipe up any gas or oil spills before starting the unit.
 - D. Never allow leaves or other flammable material to build up around the engine exhaust area.

6. **SERVICING EQUIPMENT** - All service, including the installation or replacement of service parts, should be performed only by a qualified technician.
 - A. Use only factory approved repair parts.
 - B. Do not work on this equipment when fatigued.
 - C. Never remove the protective guards, cover or receptacle panels while the engine is running.
 - D. Never wear neckties or other loose clothing that can be caught in moving parts while you are servicing or operating this equipment.
 - E. Use extreme caution when working on electrical components. High output voltages from this equipment can cause serious injury or death.
 - F. When servicing this unit always avoid hot mufflers, exhaust manifolds, and engine parts. They all can cause severe burns instantly.
 - G. Installing and wiring a standby generator is not a "do it yourself" project. Consult a qualified, licensed electrician or contractor. The installation must comply with all national, state, and local codes.

A GUIDE TO PRODUCT SAFETY

7. **LIFTING THE EQUIPMENT** - When lifting, always make sure that the area under the equipment is kept clear.
 - A. Be certain that rigging is designed to lift unit safely.
 - B. Never attempt to lift the equipment unless you are certain the lifting device has sufficient capacity.
 - C. Never allow the equipment to swing while suspended.
 - D. Be certain the supporting structure is adequate to handle the load.

8. **TOWING THE EQUIPMENT** - When towing this equipment, always use a vehicle large enough for safe operation.
 - A. Never tow without the safety chains secured.
 - B. Always use the proper size hitch ball on the vehicle.
 - C. Never attempt to tow with a vehicle that does not have side mirrors installed.
 - D. Always retract the tower and lock it into the horizontal retracted position before moving the unit.
 - E. Always put all jacks into ("foot up") horizontal position before moving the tower.

9. **TOWER ERECTION** - This equipment will become top heavy very quickly as the tower is raised. Always follow the proper sequence raising or lowering the tower.
 - A. Always extend the leveling jacks and level the unit before lifting the tower from its horizontal position.
 - B. Always lift the tower to the full vertical position (or tilt position) and lock in place before removing the pin to extend the tower.
 - C. Never attempt to lower the tower to the horizontal position without the tower FULLY RETRACTED and locked.
 - D. Always check for proper overhead clearance before attempting to erect the tower. Never raise in the vicinity of overhead power lines.
 - E. Never allow anyone to walk under the tower during the raising or lowering operation.

SPECIFICATIONS

MODEL	LSC4-MH
GENERATOR SPECIFICATIONS	
Kilowatt	7 KW
Generator Resistances	
Main Stator	.29 ohms
Main Rotor	2.9 ohms
Excitor Stator	2.5 ohms
Excitor Rotor	.350 ohms

ENGINE SPECIFICATIONS

See Kubota Operator's Manual for complete engine specifications.

Model	D950-BG
Type	4 cycle, liquid cooled
Starting System	12V electric
Governor	Mechanical

TRAILER/HOUSING

Capacity	3500 lbs
Fuel Capacity	18 gals
Axles	Single
Hitch Height	Fixed
Tires	P235/75B15 4 Ply Tread
Tire Pressure	35 psi
Sound Attenuated	
Housing	Standard
Single Point Lifting	Standard

TOWER

Height	30 Feet
Rotation	360°
Tilt	30°

LIGHTS

Type	Medal Halide
#/Wattage	4/1000

PREPARATION

NOTE: This booklet covers the entire unit, EXCEPT THE ENGINE. See the engine manufacturer's operator manual for specific maintenance and care information regarding the engine. The engine information provided in this manual is for your convenience, only, and in no way supercedes the engine manufactures instruction. If a conflict should arise regarding engine instruction, the engine manual should be considered the authority, unless specifically instructed in this manual to ignore an engine manual instruction.

Read ALL instructions in the manuals provided before attempting to operate the generator set.

UNPACKING

When unpacking the unit, be sure to inspect it carefully for freight loss or damage. Check the nameplate to be sure it is what you ordered (proper KW, voltage, fuel, etc.). If you have questions, contact your local authorized dealer. If you see evidence of loss or damage at the time of delivery, have the driver sign and describe the loss or damage in the "memo of loss or damage" section on the freight bill. Then contact the carrier to get instructions on filing a claim.

When loss or damage is discovered after the equipment is delivered, but not seen at the time of delivery, it is referred to as "concealed damage." Separate any damaged material and contact the carrier for proper procedures to file a "concealed damage" claim.

OIL REQUIREMENTS

Engine oil should be MIL-L-2104B/MIL-L-2140C or have properties of API classification CC/CD grades. Change the type of engine oil according to the ambient temperature.

above 77° F	SAE30
32 to 77° F	SAE20
below 32° F	SAE10 or SAE10W-30

OIL QUANTITY	US Qts.
LSC4-MH	5

FUEL REQUIREMENTS

ASTM No. 2 diesel fuel is recommended for these engines. The use of No. 2 diesel fuel will result in optimum engine performance. When normal operating temperatures are below 0°C, it is acceptable to use a seasonal blend of No. 2 fuel. The use of lighter fuel will reduce fuel economy. (SEE THE ENGINE OPERATORS MANUAL FOR ADDITIONAL FUEL INFORMATION.)

PREPARATION

Filling the Fuel Tank

Standard Trailer - The standard trailer is equipped with a single 18 gallon fuel tank. Use caution when filling the tank to prevent it from overflowing.

COOLANT REQUIREMENTS

Premium antifreeze with corrosion inhibitor should be used during all seasons to protect the engine cooling system from corrosion as well as freezing damage.

The cooling system of the engine has been filled at the factory with a 50% water and 50% ethylene-glycol antifreeze mixture. This mixture provides protection to -34°F.

CAUTION: ENGINE DAMAGE

Always maintain a 50/50 ratio water and antifreeze for refilling the cooling system.

COOLANT QUANTITY	US Gal
LSC4-MH	2.0

BATTERY CONNECTION INSTRUCTIONS

CAUTION: EQUIPMENT DAMAGE

Insure the control switch is in the 'off' position before connecting or disconnecting either of the battery cables. Failure to turn the control switch 'off' can cause equipment damage when the battery cables are connected or disconnected.

The standard Mobile Lighting System is equipped with a single 12 volt (group 27F) battery for starting. The battery has been disconnected from the battery cables prior to shipment of this unit. When re-connecting the battery, ALWAYS CONNECT THE POSITIVE CABLE FIRST and THE NEGATIVE CABLE LAST! Disconnecting the battery is done in reverse, disconnecting the negative cable first and then the positive cable.

WARNING ! - POTENTIAL BATTERY EXPLOSION !

This unit uses a negative ground. Connecting the negative cable first makes the battery positive terminal 'HOT'. Connecting the positive cable last may result in accidental short circuit of the positive battery terminal to any of the surrounding metal surfaces. (i.e. dropping a tool, wrench swing etc.) Use extreme caution whenever making or breaking the

PREPARATION

battery connections and follow the correct sequence carefully.

INSTALLATION OF LIGHTS

The four flood lamps for the Mobile Lighting System have been shipped on a separate pallet to prevent damage during shipment. Carefully unpack and inspect the lamps prior to installing them on the tower crossbar.

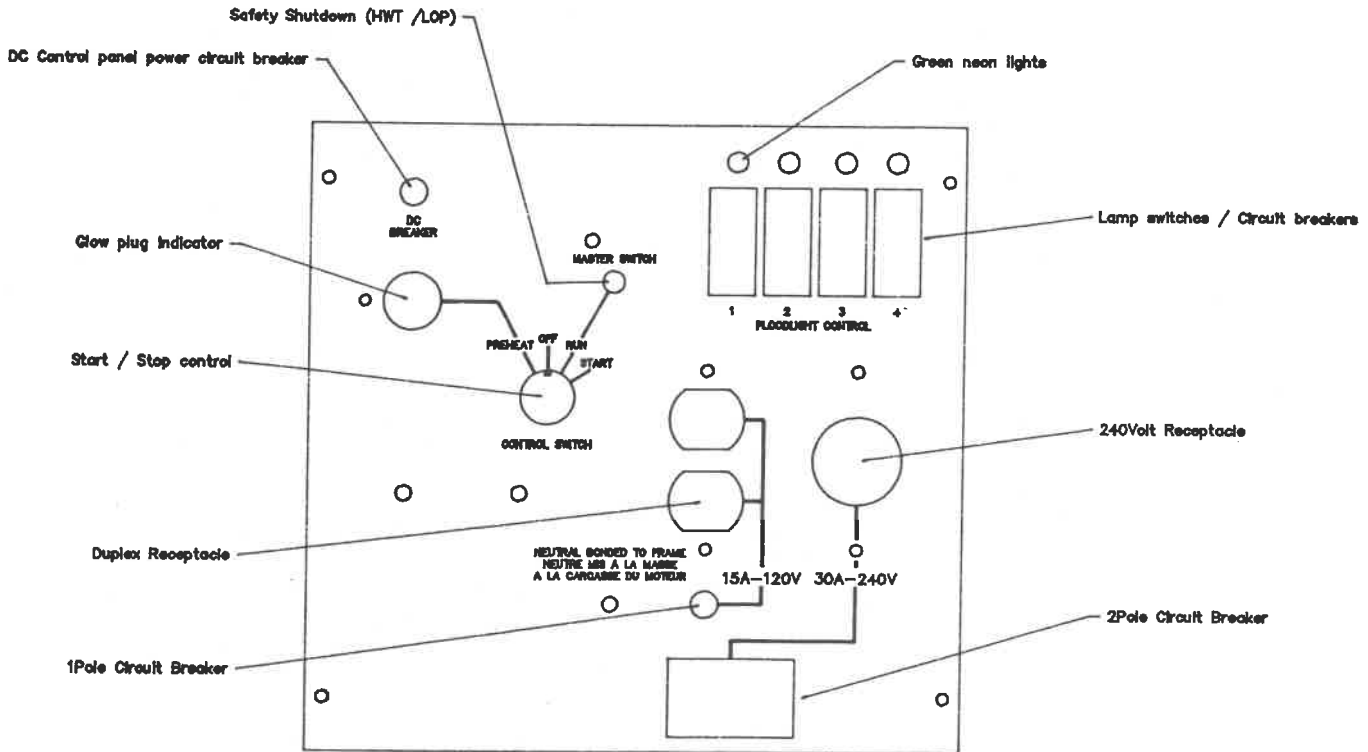
The individual lamps have been prewired and hardware provided for their installation. Two lamps are installed on the top of the crossbar and two are attached to the bottom of the crossbar. The lights should be tipped straight down and the swivel joints locked before towing.

CAUTION: LIGHT BULB DAMAGE

Never handle the metal halide bulbs with your bare hands! Doing so will leave body oil deposits on the bulbs which will shorten the bulb life. In addition, a hot bulb will cause severe burns instantly. See the Maintenance section of this manual for the proper procedures.

OPERATIONS

DESCRIPTION AND IDENTIFICATION



FRONT PANEL LAYOUT

A. FRONT PANEL

1. Control Switch - This unit is equipped for manual start only. A four position Control Switch controls the engine.

a. "Preheat" - This position turns on the glow plug solenoid which provides power to the glow plug indicator and the glow plugs on the engine.

b. "Off" - This switch position stops the engine. With the Control Switch in this position, the unit can be safely serviced.

c. "Run" - This switch position activates the fuel gauge, running time meter, electric fuel pump and the holding coil in the fuel solenoid when the Master Switch is depressed.

d. "Start" - This switch position engages the engine starter when the Master Switch is depressed. Both switches must be held in position until the engine starts. It also engages the pull-in coil on the fuel solenoid.

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2. DC control Circuit Breaker (DCCB) - The 15 amp DC Circuit Breaker protects the Master Switch and wiring harness against faults in wiring or control equipment. The DCCB also prevents a discharge of the battery due to a circuit fault.

3. Master Switch - This is a mechanically held SLR (safety latching relay). It controls the battery (+) power for the Control Switch. This SLR will shut down the unit if a fault should occur in either the cooling system or the engine lubricating system.

Two monitoring switches have been installed on the engine. One to monitor coolant temperature (HCT) and the other to monitor oil pressure (LOP). In the event either device senses a system failure, the monitoring switch will ground the coil of the Master Switch, releasing the mechanical latch. This will disconnect the battery (+) power to the Control Switch shutting the unit down.

Depressing the switch while starting the unit bypasses the low oil shut down until the engine has time to build minimum oil pressure. In addition, it 'arms' the SLR by engaging an internal mechanical latch.

WARNING: EQUIPMENT DAMAGE

Under no circumstances should the switch be depressed more than 10 seconds after the unit has been started! If the relay will not remain latched after 10 seconds, determine the cause before restarting the unit. It is possible the engine is not building sufficient oil pressure, and continued starting may cause major engine damage.

4. Engine Meters

a. Fuel Level Gauge - This gauge monitors the level of fuel in the tank. DO NOT USE THIS GAUGE FOR FILLING.

b. Running Time Meter - This DC meter records the total hours the engine has run.

5. AC Controls

a. Light Switches/Breakers - Each of the four lamps are individually controlled from the front panel. Each of the lamp switches serves two functions. In addition to functioning as a switch to turn on the lights, they are also a 15 Amp circuit breaker. When the individual switches are turned on, they will glow red indicating voltage is being provided to the

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light ballast.

b. Neon Ballast Indicator Lights - Each of the individual light circuits is equipped with a green neon light mounted in the front panel. When lighted, these neon's indicate that the individual light ballasts have output to the tower.

c. Receptacles and Circuit Breakers - All of the receptacles on the panel are protected by circuit breakers.

1. 120 Volt 15 Amp duplex, Nema Spec. 5-15. This duplex receptacle is protected by a 15 amp circuit breaker mounted just below the duplex.

2. 240 Volt 30 Amp Twistlock, Nema Spec. L6-30. This twistlock receptacle is protected by a two pole 30 amp breaker mounted just below the receptacle.

6. GROUNDING THE UNIT - To comply with current safety standards, this generator set must be properly grounded. Ground the Mobile Lighting System by driving an 8 ft. copper ground rod into the earth. Connect a #8 AWG copper ground cable from the grounding lug on the control panel to the ground rod.

TOWER PROCEDURES

A. RAISING THE TOWER

WARNING: PERSONAL DANGER

Always check your overhead clearance before raising the tower and never raise in the vicinity of overhead power lines.

1. Extend all four outriggers by removing the locking pins to release the arms. Pull out the arm until the outrigger holes line up in the extended position and insert the locking pins. Rotate the jacks into the "foot-down" vertical position and lock. Level the trailer using the outriggers and the tongue jack, all five jacks must be in contact with the ground.

CAUTION: EQUIPMENT DAMAGE

Never attempt to raise the tower without all the outriggers fully extended and the trailer properly leveled. Failure to properly support the trailer may cause it to tip over in a high wind with the tower raised.

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2. Insure each light is plugged into a receptacle in the distribution box on the tower.
3. Loosen the light on the trunion pivots. Aim (forward) 5° to 30° as desired, re-tighten.
4. Remove the mast travel locking pin.
5. Crank the winch to raise the tower to the desired tower angle insuring that the vertical tower locking pin completely engages the vertical tower locking arm. Insert the safety pin in the vertical tower locking pin.
6. Stop cranking and reverse winch slightly to slacken cable.
7. Pull the telescoping locking pin and hold while operating the winch to extend the tower for at least six inches of tower extension.
8. Release the pin and continue to extend the tower to the desired height or until it is fully extended to the stop.
9. Loosen the "L" bolt and rotate the tower to aim the light and re-tighten the "L" bolt, only if the tower is in the true vertical position.

B. LOWERING THE TOWER

1. Loosen the "L" bolt, rotate the tower until the winch cable is aligned on the tongue end of the trailer and the recess is under the "L" bolt. Re-tighten.
2. Crank the winch to lower the tower until the telescoping lock pin engages with an audible click.

WARNING: PERSONAL DANGER

Do not attempt to tilt the tower down until the telescoping lock pin is fully engaged. Tilting the tower without the pin properly engaged will allow the tower to re-extend out causing it to tilt very rapidly. The impact of the tower hitting the transport carrier will cause damage to the tower. The tower extending out may also cause severe personal injury or damage to adjacent property.

3. Remove the safety pin from the vertical tower lock and pull the vertical-tower lock pin. Crank the winch to tilt the tower into the travel position.

OPERATIONS

4. Install the mast travel locking pin.
5. Raise all the outrigger jacks to their fully retracted position. Rotate all the jacks to the "foot-up" vertical position. Pull the locking pins and slide the outriggers into the fully retracted position, making sure the locking pins are re-installed.
6. Rotate the trunions to aim the lights down and tighten securely for travel.
7. Before moving the trailer, fully retract the tongue jack after hooking up to the towing vehicle. **DO NOT MOVE WITHOUT THE SAFETY CHAINS HOOKED UP.**

OPERATING THE UNIT

A. **STARTUP CHECKLIST** - Before initial startup and each subsequent start, complete the following checklist:

1. Check oil level, refill with proper grade oil.
2. Check coolant level, refill with 50/50 mix of demineralized water and a permanent ethylene-glycol antifreeze.
3. Check for loose bolts or hardware.
4. Check tire pressure. (35 psi)
5. Trailer level to within 15°.
6. Battery securely fastened, connections clean and tight, and proper fluid level.
7. Fuel tank filled with the proper grade of diesel fuel.
8. Check the fan belt for tightness and excessive wear.
9. Check hoses and clamps for leakage.
10. Check the air cleaner. Service only when indicated. Do not over-service.

B. STARTING INSTRUCTIONS

CAUTION: EQUIPMENT DAMAGE

DO NOT USE STARTING FLUIDS! Immediate engine damage may result!

Note: This unit is equipped with both low oil pressure and highwater temperature shutdowns. To Over-ride the shutdown lockout during starting, the Master Switch must be depressed. Depress and hold down the Master Switch during preheating, starting and for an additional 10 seconds after the engine starts to allow it to build oil pressure.

1. Depress the Master Switch and turn the selector switch to the "preheat" position and hold until the glow plug indicator glows.

OPERATIONS

2. Depress the Master Switch and turn the Selector Switch to the "start" position. The starter will engage and the engine will start. The Control Switch is spring loaded so it can't be accidentally left in the "start" position. Releasing the switch in the "start" position will automatically return it to the "run" position.

3. Continue to hold the Master Switch in for 10 seconds after the engine has started.

4. Allow the engine to stabilize in speed and warm up, then turn on the lights or other external loads.

5. When stopping the unit, first turn off the lights or disconnect the external loads, and allow the engine to cool down at no-load for 5 minutes. Then turn the selector switch to the 'off' position.

C. UNIT STORAGE - Certain precautions must be taken if a Mobile Light System is to be stored for a long period of time. The unit must be stored in a dry location to prevent the generator winding from drawing moisture. The unit should also be thoroughly cleaned prior to storage.

For engine storage procedures, consult your local Kabota engine dealer. They have certain procedures that must be followed in order to prevent engine damage, i.e. cylinder rust and injector deterioration.

MAINTENANCE

The ultimate aim of any preventive maintenance program is to maintain the equipment in optimum condition, either in service or ready for service, for the maximum amount of time during the useful life of the equipment. The detection of faults before they develop into major sources of difficulty will decrease the incidence of repair. To this end, a regular schedule of cleaning and inspection will go far toward assuring trouble-free operation. Personnel *responsible for maintenance should set up a schedule for inspection, and cleaning at intervals calculated to keep the equipment in good condition.* In making up a schedule, keep the following in mind:

- A. New equipment must be carefully monitored until extended operation has demonstrated that it is performing satisfactorily.
- B. Old equipment requires more frequent inspection, and possibly servicing, than similar equipment that has seen less service.
- C. Time spent in cleaning, inspecting and correcting minor defects before they become major troubles means time saved in overhaul and repair.

PREVENTIVE MAINTENANCE

A. Daily Maintenance Checklist

- ** Oil level is maintained between the "L" Low mark and the "H" high mark on the dipstick.
- ** Fuel tank full of proper grade of diesel fuel.
- ** Water and sediment drained from water separator.
- ** Radiator filled with the proper coolant mixture.
- ** Air cleaner checked regularly. Change the filter element as required.
- ** Inspect for any fluid leaks.
- ** Look for any loose or damage parts.
- ** Belts checked for tightness, cracks or frays.
- ** Trailer hitch and safety chains checked for fitness.
- ** Tires checked for proper pressure.
- ** Battery checked for proper fluid level.
- ** Generator control panel checked for loose or damaged parts.
- ** Unit checked for general appearance and cleanliness.
- ** Tower cable checked for broken strands or frays.
- ** Insure flood lights are securely fastened.

B. Engine Routine Maintenance - A good preventive maintenance program begins with a good day-to-day maintenance check and continues with a rigid routine maintenance program at the proper service intervals. The chart below is to be used as a guide for your maintenance

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program. Shorter maintenance intervals are required if the engine is operated in a dusty environment or if frequent stops are made. If the engine is operated in consistent ambient temperatures below 0 or above 100 degrees F maintenance should be performed at shorter intervals. Consult your Kubota authorized repair location for recommended intervals.

Interval	Item
Every 100 hours	Change engine oil and oil filter Check air cleaner element Check fuel filter Check injector nozzles Check fuel pipes Check fan belts Check battery electrolyte
Every 150 hours	Check radiator hoses
Every 500 hours	Clean radiator core
Every one year	Change radiator cleaner and coolant Replace air cleaner element
Every two years	Replace radiator hoses and clamps Replace fuel pipes and clamps

- C. Generator Routine Maintenance - Very little routine maintenance is required on the generator itself as it contains no consumable parts. The generator and control panel should be kept free of oil and dirt. The generator air intake and exhaust must be kept clear of all debris.

The Generator frequency should be checked periodically to insure that the engine is operating at the right speed. The voltage should be checked with an external voltmeter to be certain the voltmeter on the control panel is correct.

1. Inspecting generator insulation - Routine non-destructive testing of the stator windings may be required where the unit is subjected to excessive humidity, and/or dirty environment. This is especially important when the Generator Set is used for prime power.

CAUTION: EQUIPMENT DAMAGE

When making an insulation test on the exciter armature or main field, disconnect all diodes (including the rotating rectifiers). This is

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(including the rotating rectifiers). This is done to protect diode elements and rectifiers from high-voltage breakdown during megger test.

Measure insulation resistance with a megger. If reading of less than 200 megohm is obtained at 75 degrees f (297k) ambient temperature and moisture is suspected, dry the insulation as described later in this section.

Note: Measurement of insulation resistance is an important part of an adequate program for the maintenance of electric equipment. The measured values of insulation resistance serve as a useful guide in determining whether or not insulation is defective. Drying, revarnishing, or overhauling may be necessary to prevent failure.

- a) Check windings, connections, load cables, and other components for excessive dirt and grime. Clean if applicable.
- b) Make sure all mounting bolts have been installed and are tight. Refer to applicable portions of the text for torque specifications.
- c) Make certain no foreign objects are lodged in the generator. Remove all tools and shop clothes from the vicinity of the Generator Set.
- d) Be sure that all covers and guards are re-installed.

2. Cleaning - Cleanliness is of primary importance in preventive maintenance. Do not allow dust, moisture, oil, or other substances to remain in or on the equipment. The importance of keeping all insulation clean cannot be over-emphasized. Dust, dirt and other foreign materials tend to block ventilating ducts and retard dissipation of heat, which in turn, leads to local overheating. If the particles are allowed to build up, the windings may eventually be short circuited or grounded. Abrasive particles may puncture insulation. Iron dust is especially harmful because the particles are continually agitated by magnetic pulsations. For these reasons, equipment must be kept clean, both externally and internally, and particularly, all air ducts must be kept clean and unobstructed.

There are four (4) acceptable methods of cleaning insulation associated with electrical equipment:

- a) clean with a vacuum cleaner with suitable plastic attachments.

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- b) Wipe clean with a cloth.
- c) Blow off with direct stream of filtered, oil-less low pressure compressed air.
- d) Clean with solvent and soft bristle brush.

Of the methods listed above, the vacuum cleaner method is the most practical for removing loose, dry particles because it does not redeposit them on other parts of the equipment as is done when compressed air is used. Also, a vacuum cleaner is capable of removing dust from coils and from grooves between wires that is otherwise inaccessible to a wipe cloth.

Substances such as grease and oil can best be removed by wiping whenever possible with a cloth or a brush, and flushing inaccessible windings and other areas with a minimum volume of trichloroethane* solvent. Flush windings with trichloroethane beginning at the top or 12 o'clock position and proceeding to the bottom or 6 o'clock position, on either side. After cleaning and drying (which is rapid with trichloroethane), take megger readings to determine whether resistance has increased to above the acceptable 200 megohm level. If resistance is still low, clean the affected areas again.

*WARNING: PERSONAL DANGER

The explosive and fire hazards of trichloroethane are negligible and it has the least toxic effect of all the chlorinated hydrocarbons; however, avoid prolonged skin contact with the solvent and perform cleaning operations in a well ventilated area. If the solvent is splashed on the skin, wash off with soap and water. If splashed into the eyes, flush with water and get medical help. Avoid prolonged breathing of fumes.

3. Drying insulation - It is sometimes necessary to dry insulation in order to recondition electrical equipment that has been submerged or splashed with water. It may also be necessary to dry equipment that has absorbed moisture from the air after standing idle for an extended period of time.

Heat and circulation of dry air, or the application of a vacuum, is required in order to effectively remove moisture from insulation. Heat may be provided by either of 2 methods or a combination of both.

- a) By external application of heat.
- b) By circulation of electrical current at low

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voltage through the conductors.

The best method to use on a specific case depends upon local conditions and the facilities/equipment available. Do not use the second method until after insulation has been partially dried by the first method. Regardless of heating method used, keep a close check on temperature of the insulation. This can be done by means of temperature detectors, either permanently or temporarily installed, or by thermometers so placed that they can be easily read at the hottest areas on the equipment. Heat applications should be continuous. Interruption of the heating operation to the extent that the equipment cools and approaches ambient temperature, may allow moisture to condense in the insulation and retard the drying process. Drying cannot be hurried. Many hours, or even days, may be required to achieve satisfactory results.

4. Revarnishing insulation - In some cases, after long periods of operation, or if repeated cleaning and drying has been necessary, the results of insulation resistance tests may indicate that revarnishing of insulation is necessary. However, the application of varnish will not permanently increase the insulation resistance or dielectric strength of the insulating material and should not be done in lieu of repairing defective insulation.

TROUBLESHOOTING

A. General - Check for loose wires, connections, and hardware whenever the engine or generator control panels are opened. If the troubleshooting chart indicates a particular component discrepancy, proceed to that portion of the test procedure.

To properly check out electronic components and generator wiring, they must be isolated from associated circuitry. Always mark leads disconnected to insure correct reconnection after testing.

Test equipment required to accomplish the static and operational tests:

1. Volt-ohmmeter - 20,000 ohms per volt (or higher).
2. Frequency meter - 58 to 62 hertz (cycles per second).
3. Clamp-on ammeter 0-600 ampere range.

B. Problem isolation - Malfunctions are generally classified and described by symptoms, with the symptoms pointing to causes.

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Start failure, poor speed regulation, high voltage, low voltage, etc., are only SYMPTOMS. To find and correct CAUSES of these malfunctions, it is necessary to isolate the problem to one of the basic system components.

1. Engine - including fuel and cranking systems.
2. Generator - including voltage regulator
3. Control panel - manual start or meters
4. Light tower - lamps, ballasts, or wiring
5. Other external influences - such as load, fuel, battery, accessory equipment (remote control panels, exhaust system, etc).

C. Eliminate external causes of malfunction

1. Installation - restrictions in exhaust, ventilation, fuel, low battery etc.
2. Load - two basic checks regarding apparent overload.
 - a. Verify load is within nameplate capacity using a clamp-on ammeter.
 - b. If within nameplate capacity on all legs, determine if speed drops below specifications.
 1. If speed drops, engine/fuel etc., problem.
 - a. Fuel filters plugged.
 - b. Tank empty.
 - c. Water in system.
 - d. Lines broken or disconnected.
 - e. Air filter plugged
 2. If speeds OK, generator/electrical problem.

Efficient troubleshooting will rapidly narrow the number of possible causes of malfunction with the minimum of checks, To do this, a general understanding of the total system operation is necessary. Each system component has unique input and output characteristics that provide clear messages that properly interpreted will point directly to the cause of malfunction. Verify defect and repair or replace as required.

For resolution of specific failure symptoms, isolate to system or component and refer to section of this manual covering the suspected system.

MAINTENANCE

DIAGNOSTIC TABLE

GENERATOR

SYMPTOM	POSSIBLE CAUSE	CORRECTION
Low Voltage (under 220 volts loaded)	Engine Speed too Slow	Check the no-load engine speed with a frequency meter and adjust the governor to 61.5 Hertz at no-load. Troubleshoot engine and determine why it will not hold the proper speed.
	Generator Overloaded	Measure load being run and compare with name plate rating. The load on each leg should be as evenly balanced as possible and should not exceed the rated current on any leg.
	Defective Rectifier (Rotating one phase)	Follow test procedure and replace if defective.
	Defective Main Rotor (Rotating Fields)	Measure rotor resistance (2.9 ohms). Check for grounds. Replace if defective.
Low Voltage (under 230 volts no-load)	Defective Excitor Rotor (one phase open)	Measure rotor resistance line to line (.3 ohms). Check for grounds and growl for internal shorts. Replace if defective.
	Engine Speed too Slow	Check the no-load engine speed with a frequency meter and adjust the governor to 61.5 Hertz at no-load.
	Generator Overloaded	Measure load being run and compare with name plate rating. The load on each leg should be as evenly balanced as possible and should not exceed the rated current on any leg.
	Defective Main Rotor (Rotating Fields)	Measure rotor resistance (2.9 ohms). Check for grounds. Replace if defective.
(20 to 40 Volts)	Loose or shorted wires in control cabinet	Check all wiring and repair as needed.
	Defective Rectifier (Excitation)	Follow test procedure and replace if defective .
	Defective Excitor Winding in Main Stator	Follow test procedure repair or replace as required.
	Defective Excitor Stator (Field Coils)	Measure excitor stator resistance (2.9 ohms minimum). Test for opens and shorts. Replace if defective.
	Defective Main Rotor (Rotating Fields)	Measure rotor resistance (2.9 ohms). Check for grounds. Replace if defective.

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(3 to 5 volts)	Defective Rectifier (Excitation)	Follow test procedure replace if defective.
	Defective Surge Suppressor	Follow test procedure Replace if defective.
	Defective Rectifier (Rotating)	Follow test procedure replace if defective .
	Rotating Rectifier Assembly Wired incorrectly	Check wiring and correct as necessary.
	Defective Excitor Rotor (Armature)	Measure rotor resistance line to line (.3 ohms). Check for grounds and growl for internal shorts. Replace if defective.
	Defective Main Rotor (Rotating Fields)	Measure rotor resistance (2.9 ohms). Check for grounds. Replace if defective.
(0 volts)	Loss of Initial Exciter Magnetism	Flash the exciter stator (F1 and F2 leads) with a 12 volt battery.
	Defective Main Stator	Measure stator resistance (.3 ohms). Check for ground shorts. Replace if defective.
	Short Circuit on the AC Output	Turn off all circuit breakers for the lights and disconnect all external loads. Check all the AC wiring in the control cabinet for shorts. Repair or replace as required.
Fluctuating Voltage	Erratic Engine Speed	Refer to the Engine manufacturer's maintenance manual.
	Loose terminal or Load Connections	Check all AC wiring connections.
High Voltage	Engine Speed to High	Check engine speed reset to 1845 RPM (61.5 HZ) no-load.
	Excitation Rectifier Wired wrong	Check wiring and correct as required.
Generator Overheating	Air Vents Obstructed	Clear Obstruction.
	High Intake Air Temperature	Improve ventilation. Allow at least two feet clearance around generator.
	Engine Radiator Blocked or plugged	Clear the blockage from the radiator and clean the core inside and outside.
	Engine exhaust leaking into trailer	Repair exhaust system.
	Generator Overloaded or Unbalanced	Measure load being run and compare with name plate rating. The load on each leg should be as evenly balanced as possible

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	Shorted Turns in either the Rotor or Stator	and should not exceed the rated current on any leg. Measure rotor and stator resistance for shorted turns. Replace if defective.
Generator noisy and or vibrates	Loose Sheetmetal	Check nuts, bolts and doors for tightness.
	Rotor Rubbing	Repair or replace defective part.
	Bearing Defective Rotor unbalanced	Replace Bearing. These rotors are 'spin balanced' before assembly. Small washers or bars are used as balancing weights. Check inside the generator for loose or missing parts. If any balance weights have broken loose, do not run the unit. Consult your Energx dealer.
	Engine Unbalanced	Consult local engine dealer.
ENGINE		
Glow Plug Indicator Inop	DC Circuit Breaker Tripped	Reset.
	DC Circuit Breaker Defective	Check DC breaker for continuity. Replace.
	Defective Master Switch	Troubleshoot and replace.
	Control Switch Defective	Check start switch for proper continuity. Replace.
	Defective Glow Plug Solenoid	Troubleshoot and replace.
	Defective Glow Plug Indicator	Troubleshoot and replace.
	Corroded Battery Cable Connections	Remove cables from battery and clean.
Diesel engine will not crank.	Battery Dead	Check battery with a hydrometer. Recharge or replace as required.
	Corroded Battery Cable Connections	Remove cables from battery and clean.
	Battery Dead	Check battery with a hydrometer. Recharge or replace as required.
	Defective Starter or Solenoid	Test start solenoid and starter. Refer to engine manufactures manual.
	DC Circuit Breaker Tripped	Reset.
DC Circuit Breaker Defective	Check DC breaker for continuity. Replace.	
Defective Master Switch	Troubleshoot and replace.	
Control Switch Defective	Check start switch for proper continuity. Replace.	

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Crankes but will not start.	Out of Fuel Air in the Fuel Lines Misadjusted or Defective Fuel Solenoid Water/Fuel Separator full of water Fuel Filter Plugged	Fill fuel tank. Bleed air out of fuel system. See engine manual. Troubleshoot and Replace. See engine manual for details. Drain water from separator. Replace Filters.
Starts but will not run.	Defective holding coil in Fuel Solenoid Low Battery	Troubleshoot and replace. Test and Recharge or replace.
Master Switch keeps Tripping	Either low Oil Pressure or High Water Temperature	Determine which sensor is shutting the system down. Troubleshoot that system.
Low Oil Pressure	Engine Low on Oil. Oil Pump Failure. Defective Pressure Sensor.	Fill to required level. Troubleshoot and repair. Check actual oil pressure, replace sensor if defective. Check oil for contamination and change the oil.
High Water Temperature	Oil is thinning out when the engine gets hot. Engine Low on Water Engine Thermostat Defective Coolant Mixture Incorrect Plugged Radiator Broke/Loose Fan Belt Defective Sensor Defective Water Pump	Fill to required level. Check for water circulation. Repair as required. Check for required 50/50 mix. Clean or repair as required. Repair. Troubleshoot and replace. Repair or replace.
Engine Speed Drops too low Under Load	Air Cleaner Plugged Generator overloaded Water/Fuel Separator full of water Fuel Filter Plugged Injector Pump Defective	Replace. Remove External load and Troubleshoot generator. Drain water from separator. Replace Filters. Repair or Replace.
LIGHT TOWER		
Lamp Switches/ Circuit Breakers do not light up	No Generator output Defective Breaker	Troubleshoot Generator. Troubleshoot and replace if defective.
Circuit Breaker keeps tripping	Defective Transformer or Capacitor (Ballast) Short circuit in Tower Wiring Defective Breaker Short Circuit in the Lamp Fixture	Troubleshoot and replace if defective. Trace and repair as required. Troubleshoot and replace if defective. Troubleshoot and repair or replace as required

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	Shorted Green Neon Lamp	Troubleshoot and replace.
Circuit Breaker lights up but Green neons don't	Defective transformer or Capacitor Defect in Ballast Wiring	Troubleshoot and repair or replace as required. Trace and repair as required.
Circuit Breaker and Green Neon light up but Lamp doesn't.	Defective Bulb Lamp Not Properly Plugged In Defect in Tower Wiring	Replace. Correct. Trace and repair as required.
Lamps Start to Light and then go out.	Incorrect Generator Output Incorrect Engine Speed Defective transformer or Capacitor (Ballast) Defect in Ballast Wiring Defect in Tower Wiring	Troubleshoot Generator. Check engine speed reset to 1845 RPM (61.5 HZ) no-load. Troubleshoot and repair or replace as required. Trace and repair as required. Trace and repair as required.

COMPONENT TESTING

CONTROL PANEL

A. FRONT PANEL SWITCHES - Access to the all front panel controls is gained by removing the four screws holding the front panel in place and pulling the front panel forward.

1. Control Switch

- a. Disconnect the negative battery cable.
- b. Set your VOM to Ohms Rx1 scale.
- c. Move the control switch to "preheat".
- d. Check for continuity between wire #5 and #91. You should have continuity.
- e. Move the mode switch to "run".
- f. Now check for continuity between wire #5 and #21.
- g. Move the switch to "start".
- h. Now check for continuity between wire #5 and #9.
- i. With the switch in the "stop" position you should have no continuity between any combination of #5, #91, #21 or #9
- j. If you get incorrect readings in any of these tests the switch should be considered defective and replaced.

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2. Master Switch

- a. Disconnect the negative battery cable.
- b. Set your VOM to Ohms Rx1 scale.
- c. Check for continuity between the "B" and "C" terminal when the Master Switch button is depressed.
- d. Leave the Master Switch button depressed (armed). Turn the DC breaker back on. The Master Switch button should pop back out as soon as the DC breaker is closed.
- e. Replace if defective.

B. METERS

1. FUEL LEVEL GAUGE - This meter consists of two parts; one is the electric meter in the panel, and the other is the sender mounted in the fuel tank.

- a. Turn the control switch to the "run" position.
- b. Set your VOM for 15 to 30 volts DC.
- c. Test between lead #21 on the back of the meter and lead #1 for 12 VDC. If you do not have the proper voltage trace the #21 lead back to the control switch and retest the switch.
- d. Locate the sender on the fuel tank and test between lead #90 and ground for 12 VDC. The absence of voltage at this point indicates a problem in the wiring harness. Trace back to the meter and repair as required.
- e. Using a short jumper lead ground-out wire #90 momentarily, should cause the meter to go full scale. If it doesn't the meter is defective.
- f. If the meter does go full scale but will not work normally connected to the sender, the sender is defective.

2. RUNNING TIME METER - This meter accumulates the total number of hours the engine has operated.

- a. Turn the control switch to the "run" position.
- b. Set your VOM for 15 to 30 volts DC.
- c. Test between lead #21 on the back of the meter and lead #1 for 12 VDC. If you do not have the

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proper voltage trace the #21 lead back to the Selector Switch and retest the switch.

d. If the proper voltage is present and the running time meter is not operating it is defective and should be replaced.

C. CIRCUIT BREAKERS

1. AC Circuit Breakers - Each receptacle on the front panel is protected by a circuit breaker. All of the circuit breakers can be tested the same way.

CAUTION: EQUIPMENT DANGER

Do Not assume that because a breaker keeps tripping it is defective. Most breaker trips are caused by an overload. If continual breaker interruptions are being experienced, use a clamp-on ammeter to determine the actual load before replacing the circuit breaker.

- a. Move the control switch to the "off" position.
- b. Disconnect the negative battery cable.
- c. Set your VOM to Ohms Rx1 scale.
- d. Test the resistance from the upper to the lower connection on each circuit breaker. The breakers must be in the closed position.
- e. Your should read a very low resistance between the two terminals on each circuit breaker (less than .5 ohms).
- f. Any circuit breaker that has a high resistance or is open and can't be reset must be replaced.

2. Light Breakers - Each of the four lamp circuits is protected by an individual breaker. In addition each breaker has a small red light in it to indicate that power is available at the breaker.

- a. Turn the control switch to the "stop" position.
- b. Disconnect the negative battery cable.
- c. Set your VOM to Ohms Rx1 scale.
- d. Test the resistance from the G1 or G3 lead to wire #51, #52, #53, #54 respectfully on each breaker. The breakers must be in the closed position.
- e. Your should read a very low resistance between

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the two terminals on each circuit breaker (less than .5 ohms).

f. Any circuit breaker that has a high resistance or is open and can't be closed must be replaced.

g. To test the light in each breaker check for a circuit between the G1 or G3 and wire #N on each breaker.

h. Any breaker that does not have a circuit through the light need not be replaced. The light is provided only as a 'status light' and does not affect the operation the Mobile Lighting System.

B. GENERATOR

1. Generator static tests - To access the generator for testing, first remove the lower access panel on the back end of the housing. Next remove the generator rear cover by removing the four Torx T-25 screws, one located in each corner of the panel. This will expose the excitor assembly, and excitation rectifier. The rotating rectifiers and rotor leads are located under the round fiber cover.

a. Rectifier Assembly - Remove rotating rectifier cover. Disconnect leads from the rectifier to be tested. Mark the leads for identification. Place one ohmmeter lead on the positive terminal and the other lead on each AC terminal in turn. These readings should be the same whether high or low. Reverse the ohmmeter leads and repeat the test. These readings should be opposite. Repeat these tests between the negative terminal and each AC terminal in turn. If resistance readings are incorrect, replace the rectifier.

b. Surge Suppressor - Set volt-ohmmeter to Rx10,000. Disconnect the two field leads, marking if necessary to identify which is positive and which is negative. Disconnect the negative (-) leads from the two rotating rectifiers. Place an ohmmeter lead on each end of the surge suppressor and then reverse the leads. Readings should be infinite one direction, and a high resistance the other direction. If resistance readings are incorrect, replace the surge suppressor.

c. Exciter Field - The exciter field is checked for shorts and opens. Disconnect exciter field leads f1 and f2 from the exciter rectifier. The resistance between f1 and f2 should be about 2.9 ohms.

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Resistance between either f1 or f2 and ground should be infinite. Replace the exciter field coil and ring assembly if resistance readings are incorrect. Watch your polarity, f1 goes to the positive terminal on the rectifier.

Note: In very isolated cases it is possible for the VOM to flash the field in reverse polarity. If you had a residual output voltage before testing (3 to 5 Volts) and after testing you have zero volts re-flash the fields. The field flashing procedure is outlined later in the section.

d. Exciter Armature - The exciter armature is checked for shorts and opens. Disconnect the three exciter armature leads from the rotating rectifiers. Connect an ohmmeter lead to one lead of the armature leads, and the other ohmmeter lead to each of the remaining armature leads in turn. The resistance measured should be very low (.35 ohms). Resistance between each exciter armature lead and the rotor shaft should be infinite.

e. Main Rotor - Disconnect both rotor leads. These are connected to the surge suppressor on the rotating rectifier assembly. Measure the resistance between leads. The resistance should measure approximately 2.9 ohms. If the reading is correct, connect one ohmmeter lead to the rotor shaft and the other ohmmeter lead to one of the rotor leads. The reading should show infinite resistance. If the rotor has a resistance reading to ground, it is defective and may need to be replaced. Consult factory before replacing.

f. Main Stator - To test the stator for opens and shorts, the windings must be isolated.

Caution: Mark all leads for correct reconnection and disconnect all 6 leads from the terminal block. The three independent coil groups are labeled with lead numbers G1 & N1, G3 & N3, 13 & N. There should be no internal circuit between the three groups.

Using a volt/ohmmeter, test the coil groups for continuity, and shorts to ground. If the stator tests defective, it should be returned for repair or replacement. Normal resistances are very low:

G1 to N1	.29 Ohms
G2 to N2	.29 Ohms
13 to N3	.13 Ohms

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2. Flashing the Exciter Field - A newly repaired generator or one returned to service after extended shutdown, may not build up voltage initially due to lost residual magnetism. Correct this temporary condition by flashing the exciter field as follows:

a) Remove the control box cover to gain access to the location of excitor field leads. Remove field lead F1 from the excitation rectifier (+) terminal. Connect a SPST toggle switch between the positive battery lead and to F1 lead of the excitor stator. Attach the battery negative lead to the ground lug in the same location as the F2 lead from the excitor stator.

Close the switch and allow it to remain closed approximately 5 seconds, then open it. Remove the battery leads from terminals. Residual magnetism has been restored to the exciter field.

Caution: It is good practice to momentarily touch the F1 to the ground lug, to neutralize any stored charge that might damage the solid state elements in the excitation rectifier before reconnecting the field to the rectifier.

Reconnect F1 to excitation rectifier, start the engine and note the voltage buildup. If voltage does not build up normally, repeat flashing procedure while set is running with the exciter field lead F1 removed from the excitation rectifier. Stop the engine and reconnect lead F1. Start set and note voltage buildup. If voltage did not build up while set was running, check other troubleshooting symptoms listed in this Section.

C. Ballasts, Lights and Tower Wiring

1. Ballasts - It is not necessary to remove the ballasts from the unit to determine if they are working. Located behind the front panel is a six place terminal strip that connects the output of the ballast to the tower wiring and the neon indicator lights.

If the Circuit breaker for the flood lamps is lighted and the indicator lights are lighted, the ballasts are working properly. If the green neon lights are not lighted and the lamp circuit breakers are lighted, one of two problems exist. Either a ballast is not functioning or the neon light is burned out. The only other time the neon light will be out is during the time in which the lamp is igniting, in which case the neon lamps should start to glow and gradually get brighter.

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- a. Check the neon bulb to insure that is not the problem.
- b. Remove the six leads on the left hand side of the terminal strip which go to the tower.
- c. Start the unit up.

WARNING: PERSONAL DANGER

HIGH VOLTAGE! Use extreme caution when testing. This panel contains voltage capable of killing you.

- d. With your VOM set for 600 Volts AC check the voltage between the following wires. In all cases the voltage should be approximately 400 volts open circuit.

Color Code-#	To	Color Code-#
Black-41		White-45
Red-42		White/Black-46
Orange-43		White-45
Blue-44		White/Black-46

- e. If any one of the ballasts does not have the proper output it will be necessary to pull the ballast drawer out, and check that individual transformer and capacitor.
- f. Turn the unit off before removing the ballast drawer.
- g. To remove the ballast drawer, open the rear housing door on the side opposite the control panel.
- h. Locate and remove the two sheet metal screws, on the lower left, holding the ballast drawer in place.
- g. Grasp the bottom of the drawer assembly and pull toward you.

WARNING: PERSONAL DANGER

Use extreme caution when pulling out the ballast drawer. This drawer is very heavy and will tilt down once it is pulled out. To avoid back strain two people should remove the drawer together.

The ballast can be removed from the unit by disconnecting the two incoming power cords and lifting out using the center lift handle.

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Optional: The transformers and capacitors can be checked out with the drawer in place by supporting the out-side end of the drawer on the fender.

h. Disconnect the wiring to the transformer and capacitor that is suspected to be defective.

i. The following resistance should be obtained on the transformer.

From Wire #	to Wire #	Resistance
480	Comm	1.50 ohms
120	Comm	.27 ohms
120	480	1.26 ohms
120	Ground	Infinite
480	Ground	Infinite
Comm	Ground	Infinite

j. The capacitors when checked for resistance should show a resistance reading when the meter is first attached and then should taper to infinity.

k. Check the capacitors to be sure that none of them are swelled or bulging on the sides. Swollen capacitors should be replaced.

2. Tower Wiring - This wiring can be checked by checking the open circuit voltage at the top of the tower. You should read about 400 volts between the following wire combinations. Be sure to unplug the lamps before turning on the switches on the front panel.

WARNING: PERSONAL DANGER

HIGH VOLTAGE! Use extreme caution when testing. This panel contains voltage capable of killing you.

Color Code-#	To	Color Code-#
Black-41		White-45
Red-42		White/Black-46
Orange-43		White-45
Blue-44		White/Black-46

While you have the connector box open, be sure to check the receptacle and the plugs for any broken parts or loose wires.

3. Lamps/Bulbs - Use the following sequence to replace defective bulbs.

WARNING: PERSONAL DANGER

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Always wear clean cotton gloves when removing or replacing a metal halide bulb. Use extreme caution, allow the bulb to cool for at least 30 minutes before opening the fixture to attempt a lamp change. These lamps operate at temperatures over 500 °f., and will burn your hand instantly.

CAUTION: EQUIPMENT DAMAGE

In addition to protecting your hand from hot bulbs the clean cotton gloves will protect the bulb surface from body oil or dirt which will shorten the bulb life.

- a. Unsnap the lens cover and lower gently. Let it hang on the fixture hinge.
- b. Using clean cotton gloves remove the black bulb support bracket by pulling straight out while supporting the bulb.
- c. Remove the defective bulb by unscrewing it. Be careful, it may still be warm.
- d. Install the new metal halide bulb. Handle only with clean white gloves to make sure that no oil, grease or other foreign material is left on the bulb surface. Clean with alcohol and a lint free cloth if necessary and allow to completely dry before lighting.
- e. Hold the end of the bulb while replacing the support bracket. Gently snap the bracket into place.
- f. Close the lens cover and re-snap all latches. Be very sure that the lens cover has sealed properly to prevent water or foreign material from entering the fixture.

ENGINE

A basic engine Operation and Maintenance Manual has been provided with each Mobile Light Tower set. Additional copies of basic and overhaul manuals can be ordered from Cummins. Order forms are in the back of the engine Operation and Maintenance Manual.

LIMITED WARRANTY

ENERGX Corporation warrants for **one year** from date of shipment that it will repair or replace at its option, for the **original user**, the whole or any part of the product found upon examination, by **ENERGX** at its **factory** at 225 South Cordova Avenue, Le Center, Minnesota, or by any **factory-authorized service station**, to be defective in material or workmanship under normal use and service.

For warranty service, return the product within **one year** from date of shipment, transportation charges **prepaid**, to the **ENERGX** factory or to your nearest factory-authorized service station.

There is no other express warranty. To the extent permitted by law, any and all warranties, including those of merchantability and fitness for a particular purpose, are limited to one year from date of shipment, and liability for incidental or consequential damages or expenses is excluded. Some states do not allow limitations on the duration of an implied warranty, and some states do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you. This warranty gives you specific legal rights; you may have other rights which vary from state to state.

ENERGX does not warrant engines or certain other component parts of the product since such items are warranted by their manufacturers.

ENERGX does not warrant alterations or repairs which were not made by the **ENERGX** factory or a factory-authorized service station and which affect the stability or reliability of the product.

ENERGX does not warrant products which have been exposed to misuse and/or negligence or have been involved in an accident.

ENERGX reserves the right to change or improve its products without incurring any obligations to make such changes or improvements on products purchased previously.

ENERGX
CORPORATION

225 South Cordova Avenue
Le Center, MN 56057 • (612) 357-6821