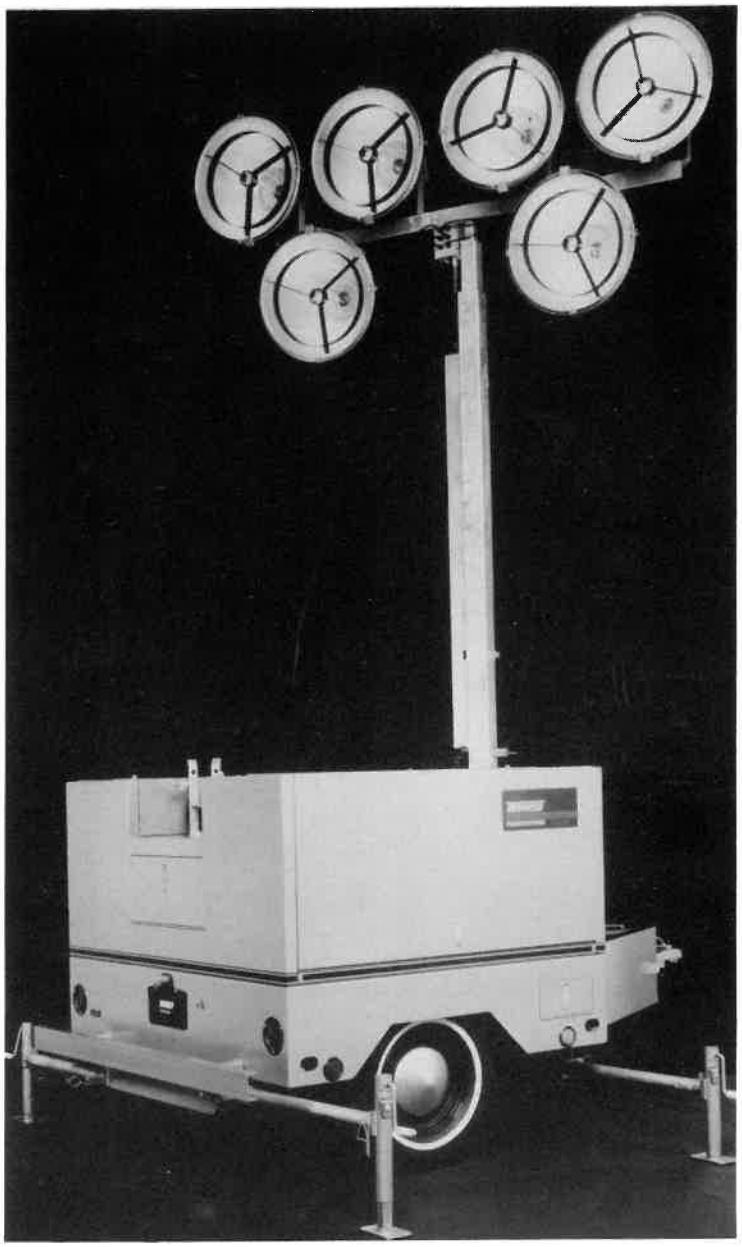
# winco®

Mobile Lighting Systems

# OWNERS MANUAL

# LS4/6—MH



## CAUTION: EQUIPMENT DAMAGE

Never attempt to "jump start" this engine. If the battery should accidentally become discharged disconnect the battery cables and recharge the battery before attempting to start the unit. Boost/jump starting this unit improperly will result in permanent damage to the Engine Control Module (ECM).

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| GENERATOR SCHEMATIC | 97392-001 |
| CONTROL PANEL AC WIRING | 97362-001 |
| CONTROL PANEL DC WIRING | 97383-000 |
| DC SCHEMATIC | 97422-000 |

# 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 burns from 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.

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 housing 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.

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 | LS4/6-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 | | Metal Halide |
| #/Wattage | LS4-MH | 4/1000 |
| | LS6-MH | 6/1000 |

# 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 manufacturer's 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. |
|---|---|
| LS4/6-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

CAUTION: EQUIPMENT DAMAGE

> *Failure to keep the engine full of coolant will result in the the high water temperature being inoperative. This sensor must be in coolant to properly measure the water temperature. Allowing the engine to operate low on coolant may allow the water level to drop below the sensor, when this happens the engine may overheat causing engine damage.*

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 |
|---|---|
| LS4/6-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.

# PREPARATION

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 battery connections and follow the correct sequence carefully.*

INSTALLATION OF LIGHTS

The flood lamps for the Mobile Lighting System have been shipped mounted inside the housing, to prevent damage. Carefully inspect the lamps at the time of receipt to insure they are not damaged.

The individual lamps have been prewired and hardware provided for their installation. Four lamps are installed on the top of the crossbar just prior to tower erection. On the six light tower the other two are attached to the bottom of the crossbar. The lights should be removed from the tower and stored inside the housing when not in use. Never tow the unit without storing the lights first.

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.*

# OPERATION

## DESCRIPTION AND IDENTIFICATION

### A. FRONT PANEL

1. Starting Controls - This unit is equipped for manual start only. A four position MODE switch controls the engine starting.

a. "Preheat" - This switch position controls the glow plug solenoid. When rotated to this position the switch energizes the glow plug solenoid which provides power to the glow plugs and glow plug indicator.

b. "Off" - This switch position stops the engine and disconnects the power from the engine control module. It is intended to safely allow service and maintenance checks on the engine.

c. "Run" - This switch position turns on the engine control module. When activated the engine control module provides power to the front panel gauges and the holding coil of the fuel solenoid through a control relay (CR1).

c. "Start" - This switch position engages the engine starter and the pullin coil of the fuel solenoid. The switch must be held in this position until the engine starts.

2. DC control Circuit Breaker (DCCB) - The 15 amp DC Circuit Breaker protects the engine controller and wiring harness against faults in wiring or control equipment. The DCCB also prevents a discharge of the battery due to a circuit fault. Turn the DCCB to the "off" position to allow personnel to safely work on the panel, especially the ECM, completely powered down.

3. Engine instruments

a. Oil pressure monitor gauge (OPG) - The oil pressure gauge is mounted on the front control panel and indicates the engine oil pressure. A dual function pressure sensor mounted on the engine provides the pressure signal and also provides the safety shutdown signal to the engine control monitor. The shutdown signal is factory preset at 15 psi (103 kPa/m sq).

b. Coolant temperature monitor gauge (CTG) - The

coolant temperature gauge indicates engine coolant temperature. A dual function temperature sensor mounted on the engine provides the temperature signal and also provides the safety shutdown signal to the engine control monitor. The shutdown signal is preset to operate at 220 f (398k)

c. Battery Voltage Meter (VM-2) - This DC voltmeter monitors the VOLTAGE of the battery under static (at rest) conditions, cranking, and charging conditions. The voltmeter indicates not only the condition of the charging system, but also indicates the battery reserve under cranking load in cold weather. Replace or recharge any battery that drops below 10 volts dc when cranking.

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

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

4. Warning Lamps - These units all come equipped with the four basic indicator lamps; three failure lamps and a system normal lamp. When one of the failure lamps is lighted and the unit is stopped, the lamp indicates the reason for the stoppage.

a. Low Oil Pressure Lamp (LOP) - Indicates that the unit did not maintain a minimum oil pressure of 15 psi.

b. High Water Temperature Lamp (HWT) - Indicates the coolant temperature in the engine exceeded upper coolant temperature limits.

c. Overspeed Lamp (OS) - Indicates the engine speed exceeded the allowable speed limit while operating. An OS lamp may also indicate that the ECM has lost its frequency sensing signal (from the engine alternator) during the last run period.

d. System Normal Lamp (SN) - Indicates that everything is operating normal. Any fault detected in the engine operating system will cause this lamp to go out.

If any one of the failure lamps is lighted always find and correct the problem BEFORE restarting the unit. To reset the shutdown circuit, move the mode switch to the "off" position. The lamp will go out. The switch can then be moved to the "preheat" position if still cold or the "start/run" position for restarting.

5. Warning Lamp Test Switch - The lamps can be tested by pressing the lamp test switch. When depressed all four lamps will come on, as soon as the switch is released the lamps will go out. To replace a burned out bulb snap off the front cover and pull the tab out.

6. Panel Light Switch and Light - A panel light is provided for your convenience. It is activated by the panel light switch.

7. Flood Light Switches/Breakers - Each of the lights are individually controlled from the front panel. Each of the light switches serve 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 light ballast. The circuit breaker protects the wiring if the ballast or light wiring develops a short circuit.

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

a. 125 Volt 20 Amp duplex, Nema Spec. 5-20. This duplex receptacle is protected by two 20 Amp circuit breakers mounted just above the duplex. With the "T" slot design both 15 and 20 amp 120 volt cords can be plugged in.

b. 125 Volt 20 Amp 3 wire twist lock, Nema Spec L5-20. This twistlock receptacle is also protected by a 20 Amp circuit breaker.

c. 250 Volt 30 Amp 3 wire twist lock, Nema Spec L6-30. This twistlock receptacle is protected by a two pole 240 volt circuit breaker.

B. ENGINE CONTROL MODULE (ECM) - The ECM is a microprocessor based module that controls the complete unit. It monitors all the engine safety sensors such as oil pressures, water temperature, overspeed and shuts the unit down should any one of the sensor circuits show a fault.

1. Control switch inputs - The following front panel controls are wired into the microprocessor through the ECM terminal blocks.

a. Preheat-Off-Run-Start switch:

1). "Preheat" - position has no effect on the ECM. The mode switch drives the glow plug solenoid directly.

2). "Off" - position prevents unit operation by disconnecting all power to the ECM.

3). "Run" - position energizes the ECM. This allows the ECM to power up the panel gauges and the holding coil of the fuel solenoid, through a CR1 relay on the back panel. This CR1 relay is powered from the ECM by lead #24.

4). "Start" - This position powers up the ECM, energizes the start solenoid coil, and the pull-in coil of the fuel solenoid.

b. Lamp test -Push button energizes all four lamps simultaneously. This feature is disabled when the control switch is in the "off" position, and has no other effect on unit operation.

2. Safety inputs - The following safety controls are wired into the microprocessor through the ECM terminal blocks.

a. Low oil pressure shutdown -(LOP)- Monitoring of oil pressure begins 12 seconds after the unit starts, and remains in effect until unit is shutdown by normal control circuits (except as noted in "loss of frequency input" below). The 'LOP' signal is derived from an oil pressure switch mounted on the engine.

b. High water temperature shutdown -(HWT)- The engine coolant sensor temperature monitoring begins immediately with the start signal. If water temperature is excessive at time of start, (i.e. heat soak after shutdown), the unit is still permitted to start. The 'HWT' condition is permitted to exist for up to 60 seconds after the unit initially starts before a shutdown WITH ALARM occurs. If the excessive water temperature condition is corrected within the initial 60 second period, the 'HWT' circuit begins normal monitoring of the engine temperature and the 'safety shutdown' circuit is reactivated. The 'HWT' signal is derived from a temperature sensor switch mounted on the engine.

c. Overspeed adjustment -(OS)- Overspeed protection is provided by a frequency sensing network within the controller. The trip point of the frequency network is adjustable via a rheostat located on the top of the controller, at the right hand side. (See fig. above). Clockwise (CW) rotation increases the trip frequency, and thereby raises the shutdown speed. The frequency input is obtained from the engine battery charging alternator.

3. E.C.M. - Program notes

a. Loss of frequency input - In the event the input frequency goes to zero (engine runs out of fuel, battery charging alternator fails, etc), the L.O.P. shutdown circuit is by-passed, and a 12 second wait period is initiated. If frequency returns within this time period, L.O.P. monitoring resumes and operation continues normally. If frequency has not returned at the end of this time period, the engine oil pressure status is observed to determine whether the engine is actually running or stopped. If the engine has stopped (i.e.- air in fuel, (etc), the unit is shut down with an "overspeed" indication and alarm. If the engine is running the "System Normal" lamp is shut off and the unit is allowed to continue to run.

b. "Overspeed" indicator lamp can mean a loss of control signal during the previous run period (i.e.- bat. charging alternator belt broken).

NOTE; TROUBLE SHOOTING HINT

This is of particular note since the tendency is to pursue only overspeed faults. The overspeed signal source (battery charging alternator) is a key component in this system and must be checked out thoroughly whenever an "OS" shutdown occurs.

Please note: The controller does not provide protection against loss of signal during start-up. A shutdown with alarm due to any of the above conditions will prevent any subsequent operation of the generator set. The control switch on the control panel must be momentarily placed in the "off" position to reset.

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.*

2. Remove the lights from the trailer housing and attach to the "T" bar. (Four lights on top, two on the bottom is supplied.) Plug each light into the distribution box on the tower.

CAUTION: EQUIPMENT DAMAGE

*Failure to properly tighten the plugs in the distribution box on the tower may cause the plug to vibrate out and in doing so cause the plug to be damaged.*

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. Open the crank door on side of the trailer. Extend winch handle and pin in place.

6. 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.

7. Stop cranking and reverse winch slightly to slacken cable.

8. Pull the telescoping locking pin and hold while operating the winch to extend the tower for at least six inches of tower extension.

9. Release the pin and continue to extend the tower to the desired height or until it is fully extended to the stop.

10. 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.

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. If the lights are to be left on the tower, rotate the trunions to aim the lights down and tighten securely for travel.

7. For long distance shipping or long term storage, lights should be stowed in the trailer housing. Unplug, remove and tighten securely on the mounting studs provided in the housing.

8. 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 start up 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.

6. Battery securely fastened, connection 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 indicator. Service only when indicated. DO NOT OVER-SERVICE.

B. ELECTRIC STARTING

CAUTION: EQUIPMENT DAMAGE

*DO NOT ATTEMPT TO JUMP/BOOST START THIS UNIT. TO DO SO MAY DAMAGE THE ELECTRONIC MICROPROCESSOR IN THE ENGINE CONTROL. TURN THE DC BREAKER "OFF" AND RECHARGE THE BATTERY WITH A BATTERY CHARGER.*

1. Turn the control switch to the "preheat" position. Hold in this position until the glow plug indicator glows red.

CAUTION: EQUIPMENT DAMAGE

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

2. Turn 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. With the mode switch in the run position and the engine running the "System Normal" lamp should be on.

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. CONNECTING THE LOADS

1. After the engine has warmed up, the flood lights may be turned on by turning on the appropriate breaker-switch on the front panel.

2. Front Panel Receptacles - A variety of convenience receptacles have been provided on the front panel. The 120/240 volt receptacles are powered when ever the engine is running. Each of the receptacles is protected

by a circuit breaker. Keep in mind that the total 240 volt generator load must not exceed 7000 watts or 3500 watts per power 120 volt lead from the generator.

D. GROUNDING THE UNIT - To comply with current safety standards, this generator set must be grounded. Ground the Mobile Diesel generator set by driving an 8 ft copper ground rod into the earth. Connect a #8 AWG or larger ground cable from the grounding lug on the generator to the ground rod using approved connectors.

E. 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 long term engine storage procedures, consult your local Kubota engine dealer. They have special procedures that must be followed in order to prevent engine damage, such as 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.

CAUTION: EQUIPMENT DAMAGE

*Failure to keep the engine full of coolant will result in the the high water temperature being inoperative. This sensor must be in coolant to properly measure the water temperature. Allowing the engine to operate low*

*on coolant may allow the water level to drop below the sensor, when this happens the engine may overheat causing engine damage.*

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 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<br>Check air cleaner element<br>Check fuel filter<br>Check injector nozzles<br>Check fuel pipes<br>Check fan belts<br>Check battery electrolyte |
| Every 150 hours | Check radiator hoses |
| Every 500 hours | Clean radiator core<br>Remove sediment in the fuel tank |
| Every one year | Change radiator cleaner and coolant<br>Replace air cleaner element |
| Every two years | Replace radiator hoses and clamps<br>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 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.

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 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.

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.

## DIAGNOSTIC TABLE

### GENERATOR

| SYMPTOM | POSSIBLE CAUSE | CORRECTION |
|---|---|---|
| Low Voltage (under 230 volts no-load) | 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. |
| | Defective Main Rotor (Rotating Fields) | Measure rotor resistance (2.9 ohms). Check for grounds. Replace if defective. |
| | 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. |
| | 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. |
| 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. |
| (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 Stator (Field Coils) | Measure excitor stator resistance (2.9 ohms minimum). Test for opens and shorts. Replace if defective. |
| | Defective Excitor Winding in Main Stator | Follow test procedure repair or replace as required. |
| | Defective Main Rotor (Rotating Fields) | Measure rotor resistance (2.9 ohms). Check for grounds. Replace if defective. |
| (3 to 5 volts) | Defective Rectifier (Excitation) | Follow test procedure replace if defective. |
| | Defective Surge Suppressor (Rotating) | 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) | Corrosion of Excitor Rotor Terminals at Rectifier (High Resistance) | Clean, tighten and/or replace. |
| | 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. |
| | Defective Main Stator | Measure stator resistance (.3 ohms). Check for ground shorts. Replace if defective. |
| | Loss of Initial Exciter Magnetism | Flash the exciter stator (F1 and F2 leads) with a 12 volt battery. |
| 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 too 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 and should not exceed the rated current on any leg. |

| | | |
|---|---|---|
| | Shorted Turns in either the Rotor or Stator | 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 | Replace Bearing. |
| | Rotor unbalanced | 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 Mode Switch | Troubleshoot and 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. |
| | Battery Dead | Check battery with a hydrometer. Recharge or replace as required. |
| Mobile Diesel Set will not crank. | DC Circuit Breaker Off | Turn on. |
| | DC Circuit Breaker Defective | Check DC breaker for continuity. Replace. |
| | Corroded Battery Cable Connections | Remove cables from battery and clean. |
| | Battery Dead | Check battery with a hydrometer Recharge or replace as required. |
| | Mode Switch Defective | Check start switch for proper continuity. Replace |
| | Defective Starter or Solenoid | Test start solenoid and starter. Refer to engine manufactures manual. |
| | Defective ECM (Engine Control Module) | Troubleshoot and replace |
| Cranks but will not start. | Out of Fuel | Fill fuel tanks. |
| | Air in the Fuel Lines | Bleed air out of fuel system See engine manual. |
| | Defective Fuel Solenoid | Troubleshoot and Replace. |

| | | |
|---|---|---|
| | | See engine manual for details. |
| | Defective CR1 Relay | Troubleshoot and Replace. |
| | Water/Fuel Separator full of water | Drain water from separator. |
| | Fuel Filter Plugged | Replace Filters. |
| | Defective ECM | Troubleshoot and repair. |
| | Defective Preheat | Troubleshoot glow plug solenoid and glow plugs. |
| Starts but stops when the start switch is released | Low Battery | Recharge or replace |
| | Defective Holding Coil on Fuel Solenoid | Toubleshoot and repair or replace as required. |
| FAILURE LAMPS | | |
| Low Oil Pressure | Engine Low on Oil | Fill to required level. |
| | Oil Pump Failure | Troubleshoot and repair. |
| | Defective Pressure Sensor | Check actual oil pressure, replace sensor if defective. |
| | Oil is thinning out when the engine gets hot | Check oil for contamination and change the oil. |
| | Defective EMC | Troubleshoot and replace. |
| High Water Temperature | Engine Low on Water | Fill to required level. |
| | Engine Thermostat Defective | Check for water circulation. Repair as required. |
| | Coolant Mixture Incorrect | Check for required 50/50 mix. |
| | Plugged Radiator | Clean or repair as required. |
| | Broke/Loose Fan Belt | Repair. |
| | Defective Sensor | Troubleshoot and replace. |
| | Defective Water Pump | Repair or replace. |
| | Defective ECM | Troubleshoot and replace. |
| Overspeed (Actual overspeed) | Engine Speed High | Reset engine speed to 1800 RPM |
| | Broken/Loose Fan Belts | Repair or replace as required. |
| | Defective Governor | Repair or replace as required. |
| (Engine runs normal but shuts down on overspeed) | Defective Alternator | Test and repair. |
| | Defective Sensor Lead | Troubleshoot and repair. |
| | Defective ECM | Troubleshoot adjust and/or repair. |
| System Normal (Not Lighted Unit Stopped) | Defective ECM | Repair or replace. |
| | Defective Bulb | Replace |
| | DC Circuit Breaker Off | Turn on. |
| | DC Circuit Breaker Defective | Check DC breaker for continuity. Replace. |
| | Corroded Battery Cable Connections | Remove cables from battery and clean. |
| | Battery Dead | Check battery with a hydrometer Recharge or replace as required. |
| | Mode Switch Defective | Check start switch for proper continuity. Replace. |

| | | |
|---|---|---|
| (Engine Running) | Defective Sensor lead from Engine Alternator | Troubleshoot and repair. |
| | Defective Engine Alternator | Repair or replace. |
| Engine Speed Drops too low Under Load | Air Cleaner Plugged | Replace. |
| | Generator overloaded | Remove External load and Troubleshoot generator. |
| | Water/Fuel Separator full of water | Drain water from separator. |
| | Fuel Filter Plugged | Replace Filters. |
| | Injector Pump Defective | Repair or Replace. |
| LIGHT TOWER | | |
| Lamp Switches/ Circuit Breakers do not light up | No Generator output | Troubleshoot Generator. |
| | Defective Breaker | Troubleshoot and replace if defective. |
| Circuit Breaker keeps tripping | Defective Transformer or Capacitor (Ballast) | Troubleshoot and replace if defective. |
| | Short circuit in Tower Wiring | Trace and repair as required. |
| | Defective Breaker | Troubleshoot and replace if defective. |
| | Short Circuit in the Lamp Fixture | Troubleshoot and repair or replace as required |
| | Shorted Green Neon* Lamp | Troubleshoot and replace. |
| Circuit Breaker lights up but Green neon* doesn't | Defective transformer or Capacitor | Troubleshoot and repair or replace as required. |
| | Defect in Ballast Wiring | Trace and repair as required. |
| Circuit Breaker and Green Neon* light up but Lamp doesn't. | Defective Bulb | Replace. |
| | Lamp Not Properly Plugged In | Correct. |
| | Defect in Tower Wiring | Trace and repair as required. |
| Lamps Start to Light and then go out. | Incorrect Generator Output | Troubleshoot Generator. |
| | Incorrect Engine Speed | Check engine speed reset to 1845 RPM (61.5 HZ) no-load. |
| | Defective transformer or Capacitor (Ballast) | Troubleshoot and repair or replace as required. |
| | Defect in Ballast Wiring | Trace and repair as required. |
| | Defect in Tower Wiring | Trace and repair as required. |

* Green Neon light on Ballast Assembly.

## COMPONENT TESTING

### A. CONTROL PANEL

The control systems are simplified to minimize control components. Normal control relays have been replaced by a

single engine control module. This engine control module is controlled by a single three position switch. To access the inside of the control cabinet remove the front panel.

1. ECM (Engine Control Module) - Static test of the ECM is done using a VOM (Volt-Ohm Meter).

   a. Turn on the DC circuit breaker.

   b. Turn the mode switch to the run position.

   c. Set your VOM for 15 to 30 volts DC.

   d. Check the voltage between the following points:

   Reference Wiring Diagram C97422-000

| Test | Wire # | Wire # | Voltage |
|---|---|---|---|
| #1 | 1 | 6 | 12 VDC |
| #2 | 1 | 24 | 12 VDC |
| #3 | 1 | 18 | 12 VDC |

   Results:
   Test #1; Voltage present indicates the ECM is being properly powered through the DC circuit breaker and the Control switch. If voltage is not present, check the control switch and the DC circuit breaker.

   Test #2; Lead # 24 is ignition relay (CR1) control. Voltage present here indicates the ECM has energized the CR1 relay that will power up the meters, fuel solenoid and the excitation lead to the engine alternator regulator. No voltage here indicates the ECM is defective.

   Test #3; Voltage present here indicates the lamp test switch is powered. Depressing the test switch should light all four lamps. No voltage present indicates the ECM is defective.

2. FRONT PANEL SWITCHES

   a. Mode Switch

      1. Move the DC circuit breaker to the open position.

      2. Move the control switch to "preheat".

      3. Set your VOM set to Ohms Rx1

      4. You should have continuity between wire #5 and #91.

5. Move the mode switch to "run".

6. Check for continuity between wire #5 and #6.

7. Move the switch to "start".

8. Check for continuity between wire #5 and #9.

9. With the switch in the "stop" position you should have no continuity between any combination of #5, #91, #6, or #9

10. If you get incorrect readings in any of these tests the switch should be considered defective and replaced.

b. Lamp Test Switch

1. Move the DC circuit breaker to the open position.

2. Move the mode switch to "stop".

3. Set your VOM set to Ohms Rx1.

4. Check for continuity between wire #1 to Wire # 18 when the lamp test switch is depressed. Your VOM should indicate no circuit when the switch is released.

5. Replace if defective.

c. Panel Light Switch

1. Move the DC circuit breaker to the open position.

2. Set your VOM set to Ohms Rx1.

3. Check for continuity between wire #5 to Wire # 26 when the panel light switch is depressed. Your VOM should indicate no circuit when the switch is released.

4. Replace if defective.

3. METERS

a. Oil Pressure Gauge - This meter consists of two parts; one is the electric meter in the panel, and the other is the sender mounted on the engine.

WARNING: EQUIPMENT DAMAGE.

*If the system has shut down with a LOP warning light DO NOT ASSUME that the fault is in the meter or shut down system just because the engine is full of oil. Insure you do have oil PRESSURE before proceeding to test the monitoring system and meters.*

1. The Mobile Lighting system must be running to properly test both the meter and the sender unit.

2. Set your VOM for 15 to 30 volts DC.

3. 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 CR1 and retest the relay.

4. Locate the sender on the engine and test between lead #35 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.

5. Using a short jumper lead, ground wire #35 momentarily. This should cause the meter to go full scale. If it doesn't, the meter is defective.

6. If the meter does go full scale but will not work normally connected to the sender, the sender is defective.

b. Coolant Temperature Gauge - This meter consists of two parts; one is the electric meter in the panel and the other is the sender mounted on the engine.

WARNING: PERSONAL DAMAGE.

*If the system has shut-down with a Coolant System warning light DO NOT REMOVE THE RADIATOR CAP ON A HOT ENGINE. The coolant can be hot enough to severely burn a person. Always assume the radiator is hot until confirmed otherwise.*

1. The Mobile Lighting system must be running to properly test both the meter and the sender unit.

2. Set your VOM for 15 to 30 volts DC.

3. 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 CR1 and retest the relay.

4. Locate the sender on the engine and test between lead #30 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.

5. Using a short jumper lead, ground wire #30 momentarily. This should cause the meter to go full scale. If it doesn't the meter is defective.

6. If the meter does go full scale but will not work normally connected to the sender, the sender is defective.

c. 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.

1. The Mobile Lighting system must be running to properly test both the meter and the sender unit.

2. Set your VOM for 15 to 30 volts DC.

3. 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 CR1 and retest the relay.

4. 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.

5. Using a short jumper lead, ground wire #90 momentarily. This should cause the meter to go full scale. If it doesn't, the meter is defective.

6. If the meter does go full scale but will not work normally connected to the sender, the sender is defective.

d. DC Voltmeter - This meter indicates the condition of your battery and charging system.

1. The Mobile Lighting system must be running to properly test this meter.

2. Set your VOM for 15 to 30 volts DC.

3. Test the voltage level between wire #21 and #1. This reading should match the meter reading. If not, replace the defective meter

e. Running Time Meter - This meter accumulates the total number of hours the engine has operated.

1. The Mobile Lighting system must be running to properly test this meter.

2. Set your VOM for 15 to 30 volts DC.

3. 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 CR1 and retest the relay.

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

4. CIRCUIT BREAKERS

a. DC Circuit Breaker - This circuit breaker controls all the DC voltage to the control panel, for monitoring and starting the engine.

1. Depress the mode switch to the "off" position.

2. Depress the field circuit breaker "on".

3. Set your VOM for 15 to 30 volts DC.

4. Test voltage between wire #5 and #1. You should have battery level voltage (13.5 volts).

5. If you do not get any voltage on wire #5, check the voltage on the opposite side of the breaker (wire #2). If you have good voltage on wire #2, the breaker is defective.

6. If you do not have 13.5 volts on wire #2, recheck the battery for a low charge condition and the battery cables for poor connections.

b. 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 manner.

CAUTION: EQUIPMENT DANGER

*Do Not assume that because a breaker keeps tripping off that the breaker 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.*

1. Move the mode switch to the "off" position.

2. Move the DC circuit breaker to the "off" position.

3. Set your VOM on the Ohms Rxl scale.

4. Test the resistance from the upper to the lower connection on each circuit breaker. The breakers must be in the closed position.

5. You should read a very low resistance between the two terminals on each circuit breaker (less than .5 ohms).

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

5. Light Switch/Breaker - Each of the 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 Rxl scale.

d. Test the resistance between Gl and wire #51, #53, #55, respectfully on each breaker. The breakers must be in the closed position.

e. Test the resistance between G3 and wire #52, #54, #56, respectfully on each breaker. The breakers must be in the closed position.

f. Your should read a very low resistance between the two terminals on each circuit breaker (less than .5 ohms).

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

h. To test the light in each breaker check for

voltage through the breaker. If you have good voltage but the light dosen't come on it is defective.

i. Any breaker that has a defective 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 stator assembly, and excitation rectifier. The excitor rotor, rotating rectifier assembly and the main 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. 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 (0.35 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 | 0.29 Ohms |
| G2 to N2 | 0.29 Ohms |
| 13 to N3 | 0.13 Ohms |

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 excitor field leads. Remove field lead F1 from the excitation rectifier (+) terminal. Connect a SPST toggle switch between the positive battery lead and the F1 lead of the excitor stator. Attach the battery negative lead to the F2 lead from the excitor stator.

Close the switch for approximately 10 seconds. Carefully 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. This 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
(Reference Wiring Diagram C97392-001)

1. Ballasts - It is not necessary to remove the ballasts from the unit to determine if they are working. Located on the back of the control cabinet is a receptacle that connects the output of the ballast to the tower wiring. Switching cables between connnectors isolates defective ballasts, breakers and tower wiring.

If the Circuit breaker for the flood lamps is lighted and the green neon light on the ballasts 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.

a. Check the neon bulb to insure that is not the problem.

b. Locate the tower connection on the back of the

generator control box and disconnect the cable to the tower.

c. Start the unit. The following tests require full generator voltage.

WARNING: PERSONAL DANGER

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

d. Set your VOM set for 600 Volts AC.

e. Check the voltage between the following wires. In all cases the voltage should be approximately 400 volts open circuit.

| Wire # | Pin# | to | Wire # | Pin # | Ballast# |
|---|---|---|---|---|---|
| FOR LS4-MH AND LS6-MH | | | | | |
| 41 | 3 | | N | 4 | 1 |
| 42 | 6 | | N | 4 | 2 |
| 43 | 7 | | N | 8 | 3 |
| 44 | 10 | | N | 8 | 4 |
| FOR LS6-MH ONLY | | | | | |
| 45 | 11 | | N | 12 | 5 |
| 46 | 14 | | N | 12 | 6 |

f. If any one of the ballasts does not have the proper output, it will be necessary to remove that ballast, and check the individual transformer and capacitor inside the case.

g. Stop the engine before removing the ballast.

h. The ballast can be removed from the unit by disconnecting the power cord from the back of the generator control cabinet and removing to bolt.

i. Disconnect all the wiring to the transformer and capacitor. Mark leads carefully.

j. Set your VOM to Ohms RX1 scale.

k. 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 |

1. When checked for resistance capacitors should show a low resistance reading when the meter is first attached and then should rise toward infinity.

m. Check the capacitors to be sure that none of them are leaking, swollen or bulging on the sides. Swollen capacitors should be replaced.

2. Tower Wiring - This wiring can be tested by checking the open circuit voltage at the top of the tower.

a. Locate the light cord connection box at the top of the tower.

b. Disconnect each of the light cords.

c. Start the unit up.

WARNING: PERSONAL DANGER

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

d. Set your VOM set for 600 Volts AC.

e. Check the voltage between pin #2 and Pin #4 on each of the light cord receptacles. In all cases the voltage should be approximately 400 volts open circuit.

f. If you do not get the proper voltage at this point, remove the cover on the connector box and check the receptacles and the plugs for any broken parts or loose wires.

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

WARNING: PERSONAL DANGER

*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. Note orientation of latches. 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 hot.

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 Kubota. 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.

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