Winco®

Mobile Power Systems

OWNERS MANUAL

MD25

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).

ENERGY CORPORATION

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A GUIDE TO PRODUCT SAFETY

This engine generator set has been designed and manufactured to insure your personal safety. Improper use can result in potential deadly hazards; from 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 electric 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 - Diesel fuel and other 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

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.

SPECIFICATIONS

GENERATOR SPECIFICATIONS	MD25
KILOWATT	20 KW
KILOVOLT-AMPS (.8 PF)	25 KVA
AMPERAGE	
277/480 VOLT 3 PHASE	30 AMPS*
120/240 VOLT 3 PHASE	60 AMPS*
120/208 VOLT 3 PHASE	69 AMPS*
120/240 VOLT 1 PHASE	80 AMPS

*Based on .8 power factor at 130 degrees C.

Derate 3% per 1000 feet (305 meters) between 300 feet (90 meters) and 7,500 feet (2,286 meters) above sea level. Contact the factory for rating data for operation in altitudes above 7,500 feet (2,286 meters).

GENERATOR RESISTANCES	MD25
Main Stator	.20 ohms
Main Rotor	3.5 ohms
Excitor Stator	25 ohms
Excitor Rotor	.350 ohms
	Excitor Voltage (F1-F2)
No Load	15 VDC
Full Load	34 VDC
Excitor Amperage (F1-F2)	
No Load	.58 Amps
Full Load	1.3 Amps

ENGINE SPECIFICATIONS

See Cummins Operation and Maintenance Manual for complete engine specifications. Cummins Publication for "A" Series Engines.

TRAILER/HOUSING	MD25
Capacity	3500 lbs
Fuel Capacity	20 gals
Axles	Single
Hitch Height	Fixed
Tires	P235/75B15 4 Ply Tread
Tire Pressure	35 psi
Sound Attenuated Housing	Standard

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.

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

The use of a multi-grade lubricating oil has been found to improve oil consumption control and improve engine cranking in cold temperatures while maintaining lubrication at high operating temperatures. A multi-graded oil 15W-40 is recommended, meeting API Classification CD. The use of single grade lubrication oil is not recommended except in Arctic conditions

See your engine operators manual for recommended oil grades when operating in extreme cold conditions (ambients under -10 deg. C.) and Arctic conditions.

OIL QUANTITY	US Qts.
MD25	5.7

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 degrees C. it is acceptable to use a seasonal blend of No. 2 and No. 1 fuel. The use of lighter fuel will reduce fuel economy.

Filling the Fuel Tank

Standard Trailer - The standard trailer is equipped with single 20 gallon fuel tank. Use caution when filling the tank to overflow into the trailer.

COOLANT REQUIREMENTS

Antifreeze should be used during all seasons to protect the engine cooling system from corrosion as well as freezing damage. It is also recommended that a corrosion inhibitor be used in the coolant system.

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 degrees F.

Never exceed a 60/40 antifreeze/water mix ratio and never use 100% antifreeze for makeup coolant.

COOLANT QUANTITY	US Gal
MD25	4.0

BATTERY CONNECTION INSTRUCTIONS

The standard Mobile Power System is equipped with a 12 (group 27F) volt battery starting system. The battery has been disconnected from the battery cables prior to shipment of this engine generator set. 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 BATTERY CONNECTIONS AND FOLLOW THE CORRECT SEQUENCE CAREFULLY.

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).

WARNING! EQUIPMENT DAMAGE!

FAILURE TO PUT THE ENGINE CONTROL SWITCH IN THE 'OFF' POSITION PRIOR TO CONNECTING THE BATTERY CABLE(S) MAY RESULT IN DAMAGE TO THE ECM. (SOLID STATE ENGINE CONTROL MODULE).

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 position turns on the solenoid that controls the glow plugs on the engine. When turned on the yellow preheat light will come on. Hold in the preheat postion until the preheat light goes out.

b. "Off" - This switch 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 fuel solenoid, the engine control module and the gauges on the front panel.

c. "Start" - This swtich position engages the engine starter. 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 230 f (407 k)

c. Battery Voltage Meter (VM-2) - This DC voltmeter monitors the VOLTAGE of the battery under static (at rest) conditions, under 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.

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 center tank. DO NOT USE THIS GAUGE FOR FILLING.

4. A.C. Generator Controls

a. Voltage adjust rheostat - Controls the output voltage of the generator by varying voltage regulators reference voltage.

b. Field circuit breaker (FCB) - Protects voltage regulator and exciter field in the event of a load short circuit or equipment malfunction.

c. Voltage selector power switch - This heavy duty three position switch allows the operator to quickly and safely reconnect the 12 wire generator to any one of three output voltages. Once the output voltage is selected, the switch may be locked to prevent it from accidentally being changed during operation.

Three output voltage combinations are available with this selector switch:

1. 120/240 Three Phase* (series Delta configuration)
2. 120/208 Three Phase (Low or Parallel "WYE" configuration)
3. 277/480 Three Phase (High or series "WYE" configuration)

*This selector position is also used for single phase 120/240 output by using only the L1 and L2 leads. The three phase L3 output lead is the "wild" leg in the delta configuration.

5. AC Generator Instruments

a. AC voltmeter (VM) - Monitors generator output voltage, for 208/240/480v operations.

6. Warning Lights - 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 light 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 light 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 light will go out. The switch can then be moved to the "preheat" and "start" position and the unit will be able to restart.

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

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

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

a. 120 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. 120 Volt 20 Amp 3 wire twist lock, Nema Spec L5-20. This twistlock receptacle is also protected by

a 20 Amp circuit breaker.

c. 240 Volt 20 Amp 3 wire twist lock, Nema Spec L6-20. This twistlock receptacle is protected by a two pole 240 volt circuit breaker.

d. 120/240 Volt 50 Amp 4 wire twistlock. This receptacle is rated for dual voltage, 120 or 240 volt use. It is a four wire receptacle, with a center grounding pin. Four wire drop cords plugged into this receptacle may be split into 120 volt receptacles at a distribution box. This receptacle is protected by a two pole 50 amp circuit breaker mounted just above it. THIS RECEPTACLE UTILIZES A SPECIAL HUBBELL PLUG.(HUBBELL PART NUMBER "CS 6365".)

B. Full Power Load Connections and Breakers - This Mobile Diesel Power System is equipped with both high voltage (480) and low voltage (208/240) main line breakers. The breakers are interlocked with a lockable bar to insure that only one breaker can be turned on at a time.

A full power output terminal block is provided. This terminal block is located below the main power breakers and is accessible through the rear door.

C. 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 and instruments 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, as both drive solenoids directly.

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

3). "Run" - position powers up the ECM. This allows the ECM to power the fuel solenoid and the panel gauges via a CR1 relay on the back panel. This CR1 relay is powered by the ECM via lead #24.

4). "Start" - This position powers up the ECM as well as engaging the start solenoid.

b. Lamp test -Push button energizes all four lights

simultaneously. This feature is disabled with the control switch in the "off" position, and has no other effect on unit operation.

2. Safety inputs:

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 tip 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.

b. "Overspeed" indicator light 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.

D. VOLT/HERTZ VOLTAGE REGULATOR - The purpose of the voltage regulator is to maintain the voltage output of the Generator Set within a specified percentage of its rated output from no load to full load. The voltage regulator controls the voltage output of the main generator by regulating the amount of current delivered to the exciter field.

1. Location -Access to the voltage regulator assembly is gained by removing the control panel access door located through the left rear housing door.

2. Description - The Basler model APR125-5X voltage regulator is an encapsulated unit contained in a metal case. The regulator controls the DC exciter fields power of medium sized 50 or 60 Hz brushless generators to regulate the output voltage.

Regulation is provided by sensing the generator output voltage, converting it to a DC signal and comparing the signal to a reference voltage signal. An error signal is developed and used to control the DC field power in order to maintain a constant generator output.

3. Operation of voltage regulator - The voltage regulator has been installed in the Mobile Diesel Generator set and tested at the factory prior to shipment. No additional set-up is required when changing from one voltage to another. The only adjustment required is to fine tune the exact voltage you want using the voltage adjustment rheostat located

on the front panel. The adjustment range is 10% of the nominal voltage.

Some minor changes must be made for 50 cycle operation. Refer to 50 Hz operation later in this section for set up procedures.

a. During periods of operation at reduced speed use the field circuit breaker to remove the power from the regulator.

b. If the exciter field voltage exceeds 95 VDC, the regulator senses overexcitation and automatically removes the field current after a time delay. This time delay is inversely proportional to the magnitude of the detected overvoltage condition. At approximately 140 VDC, the field voltage is removed instantaneously.

Upon detection of overexcitation and the resulting field voltage shutdown, the regulator will not reset or return to an operational condition until the generator output voltage drops to less than 6 VAC for ten seconds (minimum). TO ACCOMPLISH THIS ON A MOBILE DIESEL GENERATOR SET THE FIELD CIRCUIT BREAKER MUST BE TURNED OFF FOR TEN SECONDS.

For additional information on the Basler Voltage regulator model APR125-5X see Basler Electric publication number: 9 1688 00 992.

OPERATING THE UNIT

A. SELECTING THE CORRECT VOLTAGE - A variety of voltages are available from the three position selector switch. The three basic connection patterns are, Delta (120/240), Low or Parallel WYE (120/208), and High WYE (277/480). Single phase 120/240 is available with the switch in the 120/240 (Delta) position.

Before connecting this unit to a distribution panel or any other loads be sure you have the selector switch set for the right voltage and locked. If you have any doubts as to the voltage in your area compare your incoming power or load name plates to the voltage table below.

1. 120/240 Three Phase* (Delta/Series configuration) - This configuration will produce the following line-to-line and line-to-neutral voltage. In this selector switch position, all of the receptacles on the front panel are powered.

L1 - L2 - L3 240 Volts three phase
L1 - L2 240 volts single phase

L2 - L3	240 volts single phase
L1 - L3	240 volts single phase
L1 - N	120 Volts
L2 - N	120 Volts
L3 - N	208 volts

*This selector position is also used for single phase 120/240 output, using only the L1 and L2 leads. The L3 three phase output lead is the "wild" leg in the delta configuration and is used only for three phase loads.

2. 120/208 Three Phase (Low/Parallel WYE configuration) This configuration will produce the following line-to-line and line-to-neutral voltage. Use of this selector switch position allows utilization of the 120 volt receptacle only. The 240 volt receptacles cannot be used as the voltage at them will be 208 volts, the line to line voltage.

L1 - L2 - L3	208 Volts three phase
L1 - L2	208 volts single phase
L2 - L3	208 volts single phase
L1 - L3	208 volts single phase
L1 - N	120 Volts
L2 - N	120 Volts
L3 - N	120 volts

3. 277/480 Three Phase (High/Series WYE configuration) This configuration will produce the following line-to-line and line-to-neutral outputs. None of the front panel receptacles are powered in this voltage configuration.

L1 - L2 - L3	480 Volts three phase
L1 - L2	480 volts single phase
L2 - L3	480 volts single phase
L1 - L3	480 volts single phase
L1 - N	277 Volts
L2 - N	277 Volts
L3 - N	277 volts

After you have selected the correct voltage for your application and locked the selector switch, do the same with the main line circuit breakers. Be sure to secure the lock bar in place, this will prevent the incorrect breaker from being turned on.

B. 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 to within 15 degrees
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.
11. Clean out dust cup on the air cleaner.

C. ELECTRIC STARTING (Normal portable use)

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. Select the desired voltage on the voltage selector switch and lock in place.

2. Turn off both main line circuit breakers.

3. Turn the field circuit breaker "off".

4. Depress the DC breaker to the "on" position to power the control switch.

5. Turn the control switch to the "preheat" position. The yellow preheat indicator light will come on, hold in the "preheat" position until the indicator light goes out.

6. 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 accidently left in the "start" position. Releasing the switch in the "start" position will automaticaly return it to the "run" position.

7. Turn on the field circuit breaker.

8. Adjust the voltage to the desired level using the external voltage rheostat.

9. Turn on the proper main line breaker (either high or low voltage) and padlock the lock bar to prevent the incorrect breaker from being turned on.

D. CONNECTING THE LOADS - There are two ways the loads may be connected to a Mobile Diesel Generator.

1. FRONT PANEL - A variety of receptacles have been provided for your convenience on the front panel. The 120 volt receptacles are powered when the voltage selector switch is in the 120/240 or 120/208 volt position. The 240 volt receptacles although powered in both positions are only usable in the 120/240 volt position. In the 120/208 volt position the 240 volt receptacles have only 208 volts at them.

2. FULL POWER LOAD CONNECTION TERMINAL BLOCK - For remote connections and connecting load distribution boxes heavy duty terminal blocks have been provided. These terminal blocks are located on the rear of the unit just below the main line circuit breakers.

The neutral and ground are connected together at this panel. For use with an isolated neutral, remove the jumper strap between the neutral connection block and the ground lug. This will isolate the neutral from the ground and allow you single point grounding at a distribution panel.

When using these terminal blocks be sure to use wire rated to carry your full load or the full rated load of the generator.

3. GROUNDING THE UNIT - To comply with current safety standards this generator set must be properly grounded. Ground the Mobile Diesel generator set by driving an 8 ft copper ground rod into the earth. Then connect a #1/0 AWG ground cable from the grounding lug on the generator to the ground rod.

E. UNIT STORAGE - Certain precautions must be taken if a mobile Diesel Generator set 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 Cummins engine dealer. They have certain procedures that must be followed in order to prevent engine damage, i.e. cylinder rust and injector deterioration.

50 CYCLE (HZ) OPERATION

With a couple of minor changes these Mobile Diesel Generators are capable of producing 50 hz power. Two changes must be made.

A. The engine must be reduced to 1500 RPM governed speed.

Consult your local Cummins Service center for the proper procedure for reducing the engine speed and setting up the governor to operate at 1500 RPM.

B. The automatic volt/hertz regulator must also be reset to operate at 50 hz instead of the standard 60 hz. This is done by changing one jumper lead on the regulator.

1. Locate the voltage regulator and identify the top three terminals marked "60 Hz", "Comm", and "50 Hz".

2. Remove the metal jumper between the "60 Hz" and the "Comm" terminal.

3. Reinstall the metal jumper between the "50 Hz" and the "Comm" terminal.

4. Start the engine and readjust the voltage to the desired level. All other functions including the voltage selector switch are still functional, except that all the receptacles are now powered 50 Hz instead of 60 HZ.

MAINTENANCE

The ultimate aim of a 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 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.
** Check air cleaner service indicator. Change the filter element when the red indicator flag is at the raised position
** Inspect for any fluid leaks
** Look for any loose or damaged parts
** Check belts for cracks or frays
** Check trailer hitch and safety chains for fitness
** Check tires for proper pressure
** Battery for proper fluid level.
** Generator control panel for loose or damaged parts.
** Unit for general appearance and cleanliness.

B. Routine Engine 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 Cummins authorized repair location for recommended intervals.

ENGINE DAILY 8 HOURS	INTIAL BREAK-IN MAJOR OVERHAUL 50 HOURS	EVERY 6 MONTHS OR 200 HOURS	EVERY 12 MONTHS OR 400 HOURS
CHECK	----------CHANGE OR REPLACE ----------		
Oil Level	Lube Oil	Lube Oil	Lube Oil
Coolant Level	Lube Filter	Lube Filter	Lube Filter
Fuel Water Trap			Fuel Filter
	----------ADJUST----------		
Voltage Level	Valve Lash Clearance		Valve Lash Clearance
Battery Water Level	----------CHECK AND INSPECT----------		
		Air Cleaner	Air Cleaner
Air Cleaner Service Indicator		Intake System	Intake System
		Antifreeze	Antifreeze
		Battery Electrolyte Level	Battery Electrolyte Level
		Exhaust System	Exhaust System
			Fan Belt Tension

C. Generator Routine Maintenance

There is very little routine maintenance that is required on the generator itself as it contains no consummable parts. The generator and control panel should be kept clean of oil and dirt and 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, or overhauling is 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. 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, etc.

2. Load - two basic checks regarding apparent overload.

a. Verify load is within nameplate capacity.
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.

3. External control malfunction - does the unit perform properly when operated from the front panel but not from the remote location. (automatic units only).

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 the system or component and refer to section of this manual covering the suspected system.

DIAGNOSTIC TABLE

SYMPTOM	POSSIBLE CAUSE	CORRECTION
Low Voltage (under 208 volts) Test with selector switch in 120/208 position	**Engine Speed too Slow**	Check the noload engine speed with a frequency meter and adjust the governor to 61.5 Hertz at noload.
	Defective Voltage Regulator	Follow test procedure replace if defective.
	Voltage Adjust Rheostat defective	Rotate knob back and forth look for change in output voltage. If no change check Voltage Regulator and replace as required.
	Generator Overloaded	Measure load being run and compare with name plate rating With 3-phase generator, 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 (3 to 5 ohms). Check for grounds. Replace if defective.
	Defective Voltage Selector Switch	Troubleshoot and repair.
(40 to 60 Volts)	Load Circuit Breaker open	Reset/Replace
	Field Circuit Breaker open	Reset/Replace
	Voltage Adjust Rheostat dirty	Rotate knob back and forth then rest. Test/Replace
	Loose or shorted wires in control cabinet	Check all wiring and repair as needed.
	Defective Voltage Regulator	Follow test procedure replace if defective.
	Defective Rectifier	Follow test procedure replace if defective .
	Defective Excitor Stator (Field Coils)	Measure excitor stator resistance (25 ohms minimum). Test for opens and shorts. Replace if defective.
	Defective Main Rotor (Rotating Fields)	Measure rotor resistance (3 to 5 ohms). Check for grounds. Replace if defective
(3 to 5 volts)	Defective Rectifier	Follow test procedure replace if defective.
	Defective Surge Suppressor	Follow test procedure Replace if defective.
	Rotating Rectifier Assembly Wired incorrectly	Check wiring and correct as necessary.
	Defective Excitor Rotor	Measure rotor resistance

	(Armature)	line to line (.3 ohms). Check for grounds and growl for internal shorts. Replace if defective.
	Defective Main Rotor (Rotating Fields)	Measure rotor resistance (3 to 5 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.
Fluctuating Voltage	Erratic Engine Speed	Refer to the Engine manufacturer's maintenance manual.
	Loose terminal or Load Connections	Check all AC wiring connections at circuit breakers and voltage selector switch.
	Voltage Regulator unstable	Follow voltage regulator test procedures. Replace if defective.
	Defective Voltage Selector Switch	Troubleshoot and repair.
High Voltage	Defective Voltage Regulator	Readjust voltage level at voltage regulator, if it will not adjust replace regulator.
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 it.
	Engine exhaust leaking into trailer	Repair exhaust system.
	Generator Overloaded or Unbalanced	Measure load being run and compare with name plate rating With 3-phase generator, 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 around inside the generator. If these have broken loose consult your dealer.
	Engine Unbalanced	Consult local engine dealer.
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.
	Start 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. Center tank must have fuel in it.
	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	Troublesoot and Replace.
	Water/Fuel Separator full of water	Drain water from separator.
	Fuel Filter Plugged	Replace Filters.
	Defective ECM	Troubleshoot and repair.
	Defective Preheat	Toubleshoot glow plug solenoid and glow plugs.
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.

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 left hand access cover . The control panel may also be accessed by removing the top cover on the control cabinet.

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 DC and check the voltage between the following points:

   Reference Wiring Diagram C97422-2

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 an ignition relay (CR1). Voltage present here indicates the ECM has power going to the CR1 relay which in turn will power up the meters, fuel solenoid and the excitation lead to the engine alternator regulator. No voltage here indicates the EMC is defective.

Test #3; Voltage present here indicates the lamp test switch is powered. Depressing the test switch should light the four failure lamps. No voltage present and voltage normal test #3 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. With your VOM set to ohms Rx1 wire #5 to #91 should have continuity.

4. Move the mode switch to "run".

5. Now check for continuity between wire #5 and #6.

6. Move the switch to "start".

7. Now check for continuity between wire #5 and #9.

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

9. 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. With your VOM set to ohms Rx1 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.

4. Replace if defective.

c. Panel Light Switch

1. Move the DC circuit breaker to the open

position.

2. With your VOM set to ohms Rxl 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.

3. Replace if defective.

3. METERS

a. AC Voltmeter - Testing of the AC voltmeter must be done with the Mobile Diesel set running.

Caution: Personal Danger. These engine generator sets, when operating, develop sufficient voltage to delivery a fatal shock. Use extreme caution when testing this unit with the engine running and the generator energized.

1. Start the Mobile Diesel Power system.

2. Turn off the field circuit breaker.

3. Set your VOM to at least 600 volt AC and test the voltage between the two leads on the back of the voltmeter,(wires #G1 and #G2.) This voltage reading should match the reading on the voltmeter.

4. If the meter is functional but the voltage readings are off, confirm that your VOM is reading properly by testing on a standard wall receptacle. If your VOM is correct adjust the AC voltmeter on the control panel by adjusting the small screw located on the face of the meter.

5. If the meter is not functional, replace.

6. It is not necessary to access the back of the meter if you only wish to confirm that the voltage reading on the meter is correct. That can be done by closing the proper main breaker and reading the line-to-line voltage at the full load terminal block.

b. 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 Diesel system must be running to properly test both the meter and the sender unit.

2. Set your VOM for DC voltage and 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.

3. 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.

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

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

c. 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 Diesel system must be running to properly test both the meter and the sender unit

2. Set your VOM for DC voltage and 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.

3. 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.

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

5. 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 Diesel system must be running to properly test both the meter and the sender unit.

2. Set your VOM for DC voltage and 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.

3. 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.

4. 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.

5. 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 Diesel system must be running to properly test this meter.

2. Set your VOM for DC voltage and 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 Diesel system must be running to properly test this meter.

2. Set your VOM for DC voltage and 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.

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

4. VOLTAGE SELECTOR SWITCH - This switch must be completely disconnected for proper testing. Access to switch connection is gained by removing the top cover on the control box and the access cover on the right hand side. Each lead should be tagged for its proper location on the selector switch.

Once the switch has been disconnected each of the switch contacts can be checked for proper operation using a VOM set on the ohms Rx1 scale.

SWITCH POSITION	120/240	120/208	277/480
CONTACTS			
1 TO 2	OPEN	CLOSED	CLOSED
3 TO 4	CLOSED	OPEN	OPEN
5 TO 6	CLOSED	OPEN	CLOSED
7 TO 8	OPEN	CLOSED	OPEN
9 TO 10	CLOSED	CLOSED	OPEN
11 TO 12	OPEN	CLOSED	CLOSED
13 TO 14	OPEN	CLOSED	OPEN
15 TO 16	CLOSED	OPEN	OPEN
17 TO 18	CLOSED	OPEN	CLOSED
19 TO 20	OPEN	CLOSED	OPEN
21 TO 22	OPEN	CLOSED	CLOSED
23 TO 24	CLOSED	OPEN	OPEN
25 TO 26	CLOSED	OPEN	CLOSED
27 TO 28	OPEN	CLOSED	OPEN
29 TO 30	OPEN	CLOSED	OPEN
31 TO 32	OPEN	OPEN	CLOSED
33 TO 34	NOT USED IN ANY POSITION		
35 TO 36	CLOSED	CLOSED	OPEN
37 TO 38	CLOSED	CLOSED	OPEN
39 TO 40	CLOSED	CLOSED	OPEN

Any deviation from this pattern or contacts that do not fully close indicate the switch is defective.

The switches can be disassembled in the field although it is not recommended as placement of the cams and springs is critical. In some cases the only problem with the switch may be that it has been operated in a very dirty environment and dirt has gotten into the switch. If you suspect that may be the case the switch can be blown out with clean dry air. If the switch proves to be defective it should be replaced

5. 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. With your VOM set for DC voltage test wire #5 to wire #1. You should have battery level voltage at this point (13.5 volts).

4. 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.

5. 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 way.

CAUTION: EQUIPMENT DANGER

Do Not assume 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. Using a VOM set on the ohms scale Rxl, test the resistance from the upper to the lower connection on each circuit breaker. The breakers must be in the closed position.

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

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

c. Main Line Circuit Breakers - Both of these circuit breakers are tested the same as the circuit breakers on the front panel.

B. GENERATOR

1. Generator static tests:.

a. Rectifier Assembly - Remove rotating rectifier cover. Disconnect leads from the rectifier to be tested. Mark, if necessary, 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 voltage regulator. The resistance between f1 and f2 should be about 25 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.

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 too small to read on most test equipment. 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 2.5 To 5 ohms (see specifications for exact readings). 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 12 leads from the selector switch. The six coil groups are lead numbers 1 & 4, 2 & 5, 3 & 6, 7 & 10, 8 & 11, 9 & 12.

Using a volt/ohmmeter, test the coil groups for continuity, and shorts to ground. If the stator proves defective it should be returned for repair or replacement.

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 field terminals connected at voltage regulator. Remove field leads F1 and F2 from the voltage regulator and terminal F+ and F-. Connect a 12 volt battery and switch to the F1 and F2 leads.

F1 and F2 polarity is not critical for flashing. However, whichever field lead was connected to the positive battery terminal must be reconnected to voltage regulator F+ terminal and the negative to the F- terminal. Close the switch; 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 leads

F1 and F2 together, to neutralize any stored charge that might damage the solid state components in the voltage regulator before reconnecting to the regulator.

Reconnect F1 and F2 to voltage regulator, 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 leads F1 and F2 removed from the voltage regulator. Stop the engine and reconnect leads F1 and F2. Start set and note voltage buildup. If voltage did not build up while set was running, check other troubleshooting symptoms listed in this Section.

ENGINE

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