OPERATIONS AND MAINTENANCE MANUAL

for the

2000906 TRAILER SYSTEM

Prepared by:

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CHAPTER 1 - INTRODUCTION

1.1 SCOPE:

This Operations and Maintenance Manual provides for the safe installation, operation and maintenance of the 2000906 Trailer System. This manual is supplemented by the Illustrated Parts Breakdown of the engine by Lister-Petter provided as Appendix A; the Operation, Service and Maintenance Manual for the generator by Marathon Electric provided as Appendix B; the Instruction Manual for the SE350 Voltage Regulator by Marathon Electric provided as Appendix C; the Instruction Manual for the DYN1-704 provided by Barber Colman as Appendix D; the Electronic Speed Switch provided by Synchro-Start as Appendix E; and the Operation and Maintenance Manual for the Environmental Control Unit (ECU) provided as Appendix F.

1.2 EQUIPMENT DESCRIPTION:

The Trailer System consists of one 20kW 120/208-Volts AC, 3-phase, 60-Hz, diesel Engine Generator Set (Generator Set), one 96,000 BTU/Hour Environmental Control Unit (ECU), Insulated air ducts and one two-stage Load Bank and is designed to transport rapidly deployable shelters. The trailer is used in conjunction with the heavy High Mobility Multi-purpose Wheeled Vehicle (HMMWV) M-1097, M-1113 or M1123. The equipped trailer meets a GVWR of 4200 pounds, has a tongue weight of less than 420 pounds, and meets the Military Transportation Management (MTMC) standard for internal/external airlift. The Trailer System accommodates load ramp departure angles to prevent damage to the vehicle, aircraft or tarmac and meet the requirements of DH-1-11, Design Note DN 5A2. The Trailer System and HMMWV is capable of being loaded into C-5, C-17, C-130 or C-141 Aircraft.

1.3 MAJOR COMPONENTS

1.3.1 Trailer: The trailer consists of a five-inch structural steel channel frame with aluminum fenders and bed. It is equipped with air and sea-lift tie-down rings positioned suitably for a two point helicopter lift without spreader bar, a 3-inch pintel hook lunette eye, a hydraulic surge break rated at 7,500 pounds and safety chains. The trailer is equipped with two hand operated parking brakes, 37 x 12.5R16.5 Load Rating D radial tires and a 5,000 pound rated axle with an axle width to track with the HMMWV (71.6 inches). The trailer is fitted with two MS52125-2 (24VDC) tail light assemblies and connected via a neoprene jacketed cable to a terminal block in a watertight junction box located at the trailer tongue and then via a neoprene jacketed cable to the MS75020, 12-pin plug for connecting to the HMMWV receptacle. The trailer incorporates an in-chassis 50-gallon aluminum fuel tank, fitted with a four-inch diameter filler and a mechanical type fuel gauge with a dial readout. A two-inch filler is also provided forward of the curbside fender to allow fueling without removal of cargo. Tarpaulin tie-down
hooks are attached around the periphery of the trailer. Two adjustable leveling jacks are provided at the rear of the trailer. A front adjustable support jack is provided to raise and lower the lunette to pintel height. The trailer is 164 inches long and has an overall width of 86 inches.

1.3.2 Generator Set: The 20kW, 120/208VAC, 60Hz, three phase, Generator Set uses a Lister-Petter, four cylinder, turbocharged, liquid cooled, rated 31.9 horsepower at 1800 RPM diesel engine coupled to a single bearing, four-pole Marathon Electric generator. The generator Set is rated at 21kW. When operating at an elevated temperature of 50C-degrees (122F), the rating is reduced to 19kW. For applications at higher elevations, the temperature rating is reduced by 5F-degrees per 1,000 feet of elevation over 3,000 feet. This reduces the ambient temperature to 30C-degrees. The rating of the engine at 10,000 feet and 30C-degrees is 19kW. The Marathon Electric model 282PSL1505 has a 125C-degree temperature rise Class H insulation for a 40C-degree ambient temperature operation and is derated to 17kW for operation at the combination of 10,000 feet and 50C-degree ambient temperature environment. The Generator Set is housed in a weatherproof, acoustical aluminum enclosure with removable access doors. The enclosure includes the Instrumentation Panel protected by an observation door with window, a Barrier, a Circuit Breaker Panel and a connector Power Panel. The Generator Set powers the ECU, the Communication Equipment (CE), shelter lighting and utility outlets.

1.3.2.1 Instrument Panel: AC instrumentation includes an Ammeter, Voltmeter, Frequency Meter and Wattmeter. Engine gauges include the Alternator Charging Ammeter, Lubrication Oil Pressure Gauge, Coolant Temperature Gauge, Battery Charging Ammeter and an Hour Meter. Fault indicators and shutdowns are provided for Low Oil Pressure, High Coolant Temperature and Overspeed. The Instrument Panel contains the Combination Ammeter/Voltmeter Switch, Panel Light Switch, Engine Selector Switch, and a Voltage Adjust Potentiometer. AC Instrumentation continues to monitor the operation in either the Generator or Shore Power mode of operation.

1.3.2.2 Barrier: The Barrier contains mounted control components, relays, fuses, current transformers, battery charger, terminal blocks, transducers and associated wiring. It is located behind the Instrument Panel and is accessed by releasing the two latches at the top of the Instrument Panel and allowing the Instrument Panel to hinge forward.

1.3.2.3 Circuit Breaker Panel: A Circuit Breaker Panel directly below the Instrument Panel provides circuit protection for the generator and receptacle outlets. A Power Select Switch, SHORE POWER-OFF-GENERATOR, mounted on the Circuit Breaker Panel, is provide to switch the source of power from either the Generator Set or from commercial utility power (Shore Power).
1.3.2.4 Power Panel: The Power Panel contains a 60-Ampere, 5-wire, wall mount inlet, J1, for accepting 3-phase 120/208-Volt power from an external source (Shore Power). Power is provided to one 3-phase, 60-Ampere, 5-wire, wall mount receptacles, J2, and to three single-phase 120-Volt AC Ground Fault Interrupting duplex receptacles, J3, J4 and J5 at the Power Panel. The Power Panel also contains a single phase 120-Volt Static Battery Charger Inlet, J6, for operation of the 24-Volt Battery Charger. Neon indicators illuminate wherever power is available at a connector. Mating connector and cable for the Battery Charger is provided with the Trailer System.

1.3.3 ECU: An 8 Ton (96,000 BTU/Hour), 120/208VAC, 60Hz, three phase, ECU is mounted to the trailer to provide required heating and cooling of the enclosed space created by the deployed shelter. The ECU is designed to provide proper heating or cooling over the ambient temperature range of 17 degrees to 120 degrees Fahrenheit. A thermostatic control that monitors return airflow is used to set and regulate temperatures. Airflow is directed to the shelter by way of one 12-inch diameter insulated supply air duct. Air is returned to the ECU via an 18-inch diameter insulated return air duct. A plenum within the interior of the shelter provides for air distribution and circulation.

1.3.4 Battery System: Two 12-Volts maintenance-free batteries, suitable for the 24-volt engine starting, are installed within the Generator Set enclosure. The Batteries are sealed, operate in any orientation, and incorporates a pressure-relief valve for venting excessive gas. The Batteries are approved by Department of Transportation (DOT) and by Military Transport Management Command for transport as non-hazardous material. The enclosure incorporates a “NATO” receptacle, J7, to accept 24-Volts DC for emergency starting from an external source and to provide 24-Volts DC power for an external requirement. The batteries are charged by the engine-charging alternator. An additional static battery charger is built into the Generator Set to allow for charging of the battery from an external source of single phase 120-Volts AC via an inlet at the Power Panel. The DC Charging Ammeter provided at the Instrument Panel displays the charging of the batteries.

1.3.5 Fuel Fired Coolant Heater: A diesel fuel-fired coolant heater is integrated into the GenSet to facilitate cold temperature starting. The 24-Volt DC powered heater is fitted with the necessary connections for diesel fuel, coolant, intake, exhaust and battery power for proper operation. Closing the switch at the Circuit Breaker Panel will start the coolant heater. The yellow LED will illuminate whenever the heater is in operation The heater warms and circulates the engine coolant and allows the engine to be started at temperatures down to minus 40 degrees within 15 minutes of energizing without an external source of power.

1.3.6 Load Bank: The Generator Set is equipped with a 10kW load bank consisting of a 4kW and 6kW resistive loads that may be added to the system load as 4kW, 6kW or 10kW loads. The load is added by closing the appropriate circuit breakers at the circuit
breaker panel. This load should be added to keep the Generator Set operating at loads of at least 12kW. Running the Generator Set at light loads for a protracted period will result in improper combustion and a condition called wet stacking. The Load Bank is automatically disengaged whenever the Generator Set is not providing power.

1.3.7 Ancillary Equipment:

1.3.7.1 Grounding Equipment: The trailer is equipped with a three-section 5/8-inch diameter grounding rod with drive stud and three bronze couplings with mounting provisions. One 10-foot #6 AWG ground wire is provided suitably terminated for grounding the trailer. One four-pound sledgehammer with mount on the trailer bed is provided to drive the ground rod into the earth.

1.3.7.2 Fire Extinguisher: One five-pound ABC dry chemical type fire extinguisher and mount is attached to the trailer.

1.3.7.3 Cables: The Generator Set is supplied with two cables. One 50-foot, 60-Ampere, 5-wire cable terminated at one end with a MS90556C32412P connector plug and a MS90557C32412S receptacle connector at the other end is used to connect the Generator Set to the Utility Distribution Box 2000289. A battery charging cable 2000326 is provided to connect the MIL-C-5105 power inlet mounted on the Power Panel to an external source of 120-VAC to power the static battery charger.

1.3.7.4 Utility Distribution Boxes: One NEMA-4 Utility Distribution Box, 12-inches by 12-inches by 6-inches high containing three 120-Volt, single phase, duplex GFI outlets and one MS90558C32412P inlet for connection to a 3-phase power source are provided. The Utility Distribution Box has a feed thru connector to allow daisy chaining of Utility Distribution Boxes. Each duplex GFI outlet is protected by a 15-Ampere circuit breaker. Power-On neon indicator lights are located adjacent to the receptacles and illuminate when power is available at the connector.

1.3.7.5 Auxiliary Fuel Hoses: One 8-foot auxiliary fuel supply hose and one 8-foot auxiliary fuel return hose are provided. The hoses are fitted with quick disconnects to mate with the appropriate quick disconnect fittings provided at the trailer frame to allow the generator set to be connected to an alternative fuel source. The supply hose is outfitted with a strainer to preclude debris from being drawn up into the engine.

1.3.7.6 Air Ducts: One 18-inch diameter and one 12-inch diameter insulated air ducts are supplied with the trailer. The ducts are 25-foot long and connect the to the duct adapter ports on the ECU to the ports on the shelter. When transported, the 12-inch diameter duct fits within the 18-inch duct.
1.3.8 Shelter: Base-X shelters and shelter accessories may be transported on the rear cargo area of the trailer in transport bags. These shelters are articulated self-supporting frames covered with nylon coated opaque fabric. When being transported or stored, the shelter can be folded to a minimum size and maintained in a transport bag. When deployed, the tent frames open into a self-supporting structure. Nylon coated fabric on each side of the frame provides a double wall with an air gap of approximately twelve inches. When fully deployed, the shelter workspace of 18 feet wide by 25 feet long providing a total floor space of 450 square feet is available. The shelter is equipped with a door boot, plenum, flooring, and spares kit and may be connected to other Base-X shelters or vehicles.
CHAPTER 2 - SAFETY PRECAUTIONS

2.1 QUALIFIED PERSONNEL

For the purposes of this Manual, a qualified person is one who is familiar with the installation and operation of the specific equipment, and the hazards involved.

2.2 SIGNAL WORDS AND LABELS

Signal Words and Labels are used within this manual, in the Commercial Manuals and in the data sheets furnished in Appendices A, B, C and D. The words and symbols convey the following advice:

2.2.1 Danger: Danger refers to immediate hazards that will result in severe personal injury or possible death. The word Danger is displayed within a box and highlighted in bold text and precedes the instruction in a procedure.

2.2.2 Warning: Warning refers to a hazard or unsafe method or practice that may result in a severe personal injury or possible death. The word Warning is displayed within a box and highlighted in bold text and precedes the instruction in a procedure.

2.2.3 Caution: Caution refers to a hazard or unsafe method or practice that may result in equipment damage or personal injury. The word Caution is displayed within a box and highlighted in bold text and precedes the instruction in a procedure.

2.2.4 Important: Important refers to a hazard or unsafe method or practice that can result in equipment damage or related equipment damage. The word Important is displayed and highlighted in bold text and precedes the instruction in a procedure.

2.3 GENERAL PRECAUTIONS

2.3.1 Generator Set: The following safety precautions should be observed at the Engine-Generator Set:

a) Keep the Engine and Generator clean.

b) Do not restrict airflow.

c) Do not run equipment without all safety guards in position.

d) Keep the body and clothing clear of all moving parts.
e) Do not allow the body to come into contact with high-pressure fuel oil (for example when testing fuel injection equipment).

f) Immediately rectify any fuel, water or oil leaks.

g) Do not remove any electrical cables or wires while the battery is connected to the circuit.

h) Disconnect the battery only with the Generator Set stopped and all switches and circuit breakers in the OFF or OPEN position. Disconnect the Negative or Ground cable first; re-connect last.

i) Observe battery voltage and polarity markings.

j) Ensure that the fuel, coolant and lubrication oil levels are correct.

k) Do not use ether based cold start aids.

2.3.2 Engine: The safety precautions to be observed at the engine are also delineated in the Lister-Petter Illustrated Parts Breakdown supplied as Appendix A.

2.3.3 Generator: The safety precautions to be observed at the generator are also delineated in the Marathon Electric Operation and Maintenance Manual, Appendix B and Voltage Regulator Manual Appendix C.

2.3.4 ECU: The safety precautions to be observed at the ECU are delineated in the Operation and Maintenance Manual for the ECU in Attachment F.
CHAPTER 3 - PREPARATION FOR TRANSPORT OR STORAGE

3.1 GENERAL

The Trailer System is designed for outdoor use. No special packaging is required for transport. The trailers may be towed by the HMMWV, transported on the deck of another transporting vehicle or moved using the air/sea lift and tie-downs rings.

3.1.1 Transport: When the trailer is being transported, the trailer wheels should be chocked. The jack stands should be raised to the topmost position. The tongue of the Trailer should be supported using PSI Part Number 1000100 or equivalent. The trailer should be secured to the transport deck using the four tie-down rings. The trailer parking brakes should be engaged. The axle allows for the trailer to move in an up and down motion, therefore do not tie down the enclosure, ECU or other items on the trailer to the deck of the transporting vehicle. If tarpaulins are used to cover the Trailer System, they should be tied only to the trailer and not the transport deck.

3.1.2 Towing: The trailer is towed by engaging the lunette with the pintel on the HMMWV. When towing the trailer, the trailer parking brakes should be disengaged (parking brake handle nearly perpendicular to the frame of the trailer). The stabilizing jacks should be brought to the up-most position. The two safety chains and the brake-away chain should be secured to the towing vehicle. The trailer running gear connector 12-pin plug, MS75020, for the trailer lights should be connected to the receptacle provided at the HMMWV.

3.1.2.1 Surge Brake: The forward momentum force of the pintel pressing against the lunette of the towing vehicle when the towing vehicle slows or brakes activates the surge brake. Hydraulic fluid (Motor Vehicle DOT 8 Brake Fluid) is compressed and sent from the surge brake master cylinder to each wheel cylinder. Each wheel cylinder then actuates the brake shoes against the wheel drum. When the trailer speed matches or is less than the towing vehicle, the actuator returns to the rest position. The trailer brakes are free backing and will not engage in the rearward direction. This enables backing up of the trailer or offloading on aircraft ramps.

3.1.2.2 Breakaway Cable and Lever: The trailer is equipped with a breakaway cable and lever. Should the trailer become separated from the towing vehicle, the cable will pull the lever, actuate and lock the surge brake.

3.1.3 Tarpaulin Covers: A tarpaulin cover is provided for the trailer to protect the equipment from the elements. The tarpaulin is designed to conform to the equipment installed on the trailer. The tarpaulin should not be used when transporting the trailer using external air transport.
3.1.4 Parking Brake: The trailers are equipped with parking brakes. The handles are located on each side of the trailer directly forward of the ECU at the trailer tongue. To engage the parking brake, set the handle so that it is in-line or parallel to the trailer frame. To release the brake place the handle perpendicular to the trailer frame.

3.1.5 Stabilizing Jacks: Three stabilizing jacks are provided on the trailer: one at the trailer tongue and two at the rear of the trailer. Once the trailer has been positioned for use, the stabilizing jacks should be brought into contact with the surface. The trailer tires should remain in contact with the surface and support the trailer weight.
4.1 OPERATION OF THE 20kW GENERATOR SET:

The 20kW Generator Set is designed to power the trailer mounted ECU and to provide power to the shelter. Power connections are made via the wall-mounted receptacles on the generator power panel through the 60-Ampere, 3-phase, 5-wire cables to the Shelter or Utility Distribution Box. Three Ground Fault Interrupt single-phase duplex outlets are also provided at the generator set. A power inlet is provided to allow the Power Panel to be connected to an external power source (Shore Power). The Instrument Panel, Barrier and Power Panel are shown in Drawings 2000712, 2000910 and 2000714 respectively.

4.1.1 Pre-Start Procedure

The Generator Set is shipped with a removable link connecting Neutral to Ground. Determine if this removable link is required. It may be desirable to remove this jumper and connect Neutral to Ground at another point in the system to prevent ground loops.

a) The three-section ground rod provided in a tray on the trailer should be driven into the ground using the sledgehammer. Driving the ground rod into the earth at a 45-degree angle will make removal easier by pulling the ground rod with the HMMWV. Connect the ground cable (AWG #6 green cable) between the Ground Stud at the Generator and the Ground Rod. See Drawing 2000919 for the location of Ground Rod Tray and Sledgehammer.

b) Ensure that the fuel supply is adequate. A fuel switch is located on the right side of the trailer frame forward of the axle below the 4-inch filler. The switch should be set to the TRAILER position if the engine is to run from the trailer fuel tank or to the AUXILIARY position if fuel is to be supplied from an alternative source. Eight-foot long return and supply fuel hoses are supplied with the trailer that may be used to connect to an alternate fuel supply. Quick disconnects are located on the trailer frame on right side of the trailer, forward of the axle adjacent to the fuel switch. The fuel in the trailer fuel tank may be viewed using the mechanical fuel gauge located next to the 4-inch filler.

c) Ensure that the lubrication oil is at the proper level. An engine dipstick (engine oil level gauge) is located at the engine block. See drawing 2000783. The engine may be accessed by removing the forward access door. The door is removed by depressing the top of the two latches on the panel door. This will release the latch from the panel. Twist each latch 90 degrees in an outward direction. This will release the upper portion of the panel door. Allow the panel door to come out from the top of the enclosure and lift. This will release the bottom of the panel that has a locator flange that fits into the enclosure. The dipstick should be removed, wiped clean and inserted and removed.
The oil on the dipstick should be between the two marks on the dipstick. Oil should be added if the level is at or below the lower mark.

d) Ensure that coolant is at the proper level. A coolant recovery bottle is incorporated to collect overflow as the coolant warms and expands. The coolant bottle may be viewed with the aft access panel removed. If there is coolant in the lower half of the bottle, it indicates that coolant is adequate. If there is no coolant is in the bottle, and the engine is cool, remove the radiator cap. Coolant should be within one inch of the filler neck. Fill with coolant if required.

e) Check for any coolant, oil or fuel leaks. Perform repairs as required before running the Generator Set.

f) At the generator, set the Power Select Switch to the OFF position.

g) Connect the power cables from the wall mount receptacle, J2, to the Utility Distribution Box. The cables are rated for 60-Amperes and circuit breaker protected at the generator by 60-Amperes circuit breaker, CB2.

h) Turn the Ammeter/Voltmeter Switch from OFF to the L1-L2 position.

**4.1.2 Generator Set Start Procedure**

a) Ensure all circuit breakers are in the OFF or OPEN position.

b) Turn the Power Selector Switch to the GENERATOR position.

c) Start the Generator Set engine unit by placing the Engine Selector Switch in the PREHEAT position for approximately 10 seconds. Then hold the switch in the START position (spring-return to RUN). After the engine has started, release the Selector Switch. The Selector Switch will return to the RUN position.
d) Verify lubrication oil pressure at the Oil Pressure Gauge on the Instrument Panel (20-PSI minimum). If pressure does not rise promptly, stop the engine by turning the engine selector switch to OFF and investigate the problem.

e) Set the generator output voltage to 208-Volts AC using the Voltage Adjust potentiometer on the Instrument Panel (Voltmeter Switch set to the L1 - L2 position). With the voltage set, verify that the frequency meter is reading properly, approximately 60-Hz at no-load.

f) Close the Generator Circuit Breaker, CB9.

g) Power is made available at the J2 receptacles by closing CB2. Power is available at the duplex receptacles J3, J4 and J5 by closing CB3, CB4 and CB5 respectively. When power is available at a receptacle, a power indicator light adjacent to the receptacle will illuminate.

4.2 ECU Startup Procedure

a) Connect the insulated ducts between the shelter port and the ECU. Keeping the ducts as straight as possible and fully extended maximizes airflow.

b) Ensure that the airflow to the condenser fan is unobstructed.

c) Close the ECU Circuit Breaker (CB1) to power the ECU. The MODE Select switch, located on the control box inside the ECU, is normally set to COOL or HEAT. The thermostat is set to cool or to heat, as required, to maintain a comfortable shelter temperature.

4.3 Generator Set Stop Procedure

[CAUTION!]

ENSURE THAT ALL CIRCUIT BREAKERS ARE OPEN PRIOR TO STOPING ENGINE.

a) Turn all circuit breakers to the OFF position. There should be no load on the Generator.

b) Allow the engine to run without load for 5 minutes to cool the turbocharger.
c) Turn Engine Select Switch to OFF position.

4.4 SHORE POWER OPERATION

The equipment connected to the Generator Set may be powered from an external source. A 60-Amperes, 3-phase 5-wire power cable may be connected to the Shore Power Inlet, J1. With all circuit breakers in the off position, switching the Power Select Switch from the OFF position to the SHORE POWER position controls the external power. The Instrument Panel will monitor power.

4.5 COLD TEMPERATURE STARTING: A diesel fuel-fired coolant heater may be used to assist in starting the Generator Set engine at low temperatures. The fuel-fired heater uses the 24V-DC battery to power a glow plug that ignites diesel fuel in a heat chamber. Once ignited, power is used only to pump fuel and to circulate heated coolant to warm the engine. The heater will allow the engine to be started at temperatures down to minus 40 degrees in approximately 15 minutes after energizing. To operate the fuel-fired heater:

a) Place the Engine Select Switch to the RUN Position

b) Place the coolant heater switch on the Circuit Breaker Panel to the ON position. The yellow LED will illuminate indicating that the heater has been placed in operation. The heater will warm and circulate the coolant and allow the engine to start within minutes.

c) Turn off the coolant heater. The LED should extinguish indicating that the coolant heater is shut down.

d) Start the generator set in accordance with the Generator Set Start Procedure.
CHAPTER 5 - ENGINE MAINTENANCE

5.1 GENERAL

5.1.1 Engine Serial Number: Before performing any maintenance, it is necessary to correctly identify the engine by Serial Number. The Serial Number is stamped on a plate attached to the engine block. The serial number for Generator Set engine is coded 010955331LPWT458 where:

- 01 = Code for Year of Manufacture
- 0955331 = Serial Number
- LPWT4 = 4 Cylinder, direct injection, turbocharged, water-cooled diesel engine.
- A = Rotation anti-clockwise when looking on the flywheel.
- 58 = Build (See Build Sheet Configuration Table)

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Table II
Engine Build Configuration
5.1.2 Build Number: Engines may be specified to meet certain performance envelopes by selecting various options or builds. The build configuration shown in Table II identifies the options selected for the LPWT4 Engines used in the 2000919 Trailer System. These should be referenced when using the Illustrated Parts Breakdown in Appendix A for identifying replacement parts or maintenance items.

5.2 ENGINE CHARACTERISTICS:

5.2.1 Electrical System: 24-Volt DC negative ground. Engine is equipped with a mounted 40-Amperes alternator.

5.2.2 Valve Clearance: The engine is fitted with hydraulic tappets; no adjustment is required.

5.2.3 Firing Order: Engine firing order is 1-3-4-2 (Number 1 Cylinder is at the radiator end)

5.2.4 Rotation: Rotation is counter-clockwise when looking at the flywheel.

5.2.5 Ambient Temperature: 25C Degrees (77F) without derating. Maximum ambient temperature 52C Degrees (125F). From the aspect of engine performance, the temperature of the air entering the engine is the only criterion of ambient temperature. The power developed by the engine depends upon the temperature of the combustion air measured at the air manifold inlet or the air cleaner, and the temperature of the cooling air as measured at the radiator fan inlet. The higher of these two temperatures is the Ambient Temperature for engine ratings. Minimum temperature for the engine is -26F; maximum temperature is +140F.

5.2.6 Fuel: Only those fuels conforming to the following standards should be used:

ASTM D-975-77 (Grades No. 1-D and 2-D)
BSS2869: 1970 Class A1 or A2

5.2.6.1 Alternate Fuels: Although the engine may operate on fuels outside the listed specifications, such operation may result in excessive wear and/or damage. Fuel oil must be a distillate and not a residual oil or blend. Vaporizing Oils are not suitable fuels for diesel engines.

JP-4 - May be used, however the lubricity is not as good as #1 or #2 diesel. The engine should be derated of 10 to 15%. Continued use of this fuel will shorten life of injection equipment. Minimum fuel supply is 6 PSI and requires higher pressure (up to 20 psi) at higher ambient temperatures.
JP-5 and JP-8 - May be used. The lubricity is good and there is very little wear on the injection equipment. Use the same fuel pressure requirements as JP-4.

5.2.6.2 Fuel Consumption: 1.7 GPH @ 100% load and 1.4 GPH @ 75% load. Fill the tank every 36 hours to prevent possible fuel starvation.

5.2.6.3 Fuel Agglomerator: The fuel filter is equipped with a tap at the base of the filter to remove water trapped by the fuel filter.

5.2.7 Lubricating Oil: Capacity 12 Quarts. The engines should be run on heavy duty lubricating oils meeting the requirements of MIL-L-2104 C/D, AAPICD, Series 3. AAPICC, AAPICE and AAPICF lubrication oils are not recommended for turbocharged diesel operation. Straight Mineral Oils are not suitable. Do not overfill.

5.2.7.1 Oil Viscosity: Recommended lubricating oil viscosity is as follows:

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<th>MULTI-GRADE</th>
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</tbody>
</table>

5.2.8 Engine Cooling and Coolant Capacity: Engine cooling is with coolant circulation assisted by a centrifugal belt driven pump using a "V" ribbed belt. The total coolant capacity is the sum of the engine and radiator capacities. The engine coolant capacity is 0.79 gallons. The radiator capacity is 2.21 gallons. Total capacity is 3.0 gallons.

5.2.8.1 Coolant: The engine requires a 40% concentration of concentrate (anti-freeze) under all operating conditions. The coolant concentrate should comply with one of the following:

- MIL-A-11755
- MIL-A-46153/B
- BS6580

5.3 PERIODIC ENGINE MAINTENANCE
The following maintenance activities should be performed at the periodic intervals shown below:

5.3.1 Daily:
Check fuel supply, oil and coolant levels.
Check for any leaks.

5.3.2 Every 50 Hours of Operation:
Check tension of the belt, adjust if loose.

Drain the agglomerator. Unscrew the drain tap at the bottom of the fuel filter and allowing the filter to drain. Use a collector to prevent the water or fuel from draining onto the enclosure floor. Tighten the tap when there is no evidence of water in the fuel.

5.3.3 At 100 Hours of Operation:
The engine is shipped with break-in oil that should be replaced at approximately 100 hours of operation. A tag is attached to the dipstick indicating the need to replace the break-in oil with heavy-duty lubrication oil. (See 5.2.7 for proper viscosity). The tag should be removed after the break-in oil is replaced.

5.3.4 Every 125 Hours of Operation:
Inspect air filter and change if necessary.

5.3.5 Every 250 Hours of Operation:
If the Generator Set was not operating in ambient temperatures of 35C-degree (95F) or higher for protracted periods, the interval for oil and oil filter changes may be extended to every 500 hours. Use only heavy-duty lubrication oils (see 5.2.7).

5.3.6 Every 500 Hours of Operation or every Six Months:
Change lubrication oil, oil filter, fuel filter and air filter. Use only heavy-duty lubrication oils (see 5.2.7).

5.3.7 Every 1000 Hours of Operation:
Check all external nuts, bolts and fittings. Blow out sand or dust from radiator.

5.3.8 Every 2,000 Hours of Operation:
Decarbonize the engine if performing poorly.
Drain and clean the fuel tank.
Check injectors, clean or change as required.
Change the drive belts.
5.4 MAINTENANCE TASKS

5.4.1 Access to Engine: The engine is accessed through two panel access doors on each side of the Generator Set enclosure. To check oil level, change the oil filter, change the fuel filter, to drain the lubrication oil, to drain coolant from the radiator, or to replace the injectors, the forward access door must be removed. To replace the fan belt, to check or add coolant, to drain coolant from the engine block, or to change the air cleaner element, the aft panel access door must be removed. The panels are removed as follows:

a) Depress the top of the two latches on the panel door. The latch will release from the panel.

b) Twist each latch 90 degrees in an outward direction. This will release the upper portion of the panel door.

c) Allow the panel door to come out from the top of the enclosure and lift. This will release the bottom of the panel that has a reverse flange that fits into the enclosure.

5.4.2 Checking Oil Level: A dipstick is used to determine the lubricating oil level in the deep sump build of the engine. The deep sump engine allows for a 12-quart capacity. The dipstick handle is located immediately above the oil filler cap at the engine block. See drawing 2000783. Proper oil level can be checked only with the engine shut off. Remove the dipstick and wipe clean. Reinsert dipstick fully and remove. Proper oil level is indicated by the upper mark on the dipstick.

5.4.3 Adding Lubrication Oil: Two oil fill locations are available, one at the rocker valve cover that can be accessed through the aft panel door, and at the engine block that can only be accessed through the forward access panel. The oil fill at the engine block is the preferred location for adding oil.

CAUTION!

DO NOT OVERFILL WITH OIL. IF ADDING OIL AT THE ROCKER VALVE COVER, THE OIL MUST BE POUR ED INTO THE FILLER AT A RATE THAT ENABLES IT TO DRAIN INTO THE CRANKCASE. IF OIL IS POUR ED TOO QUICKLY IT CAN FLOOD THE CRANKCASE BREATH ER HOLES AND ESCAPE INTO THE INLET MANIFOLD AND CYLINDERS.
a) Fill the sump to the upper mark on the dipstick.

b) Start the engine and allow the engine to run for a few minutes to circulate the oil.

c) Stop the engine and allow the a few minutes for the oil to drain down and re-check the level on the dipstick.

e) Add more oil if necessary.

5.4.4 Replacing Lubrication Oil and Oil Filter: The oil filter, PSI Part Number 3000139-001, is a spin on-type cartridge type located on the engine block. The filter should be used as these have high temperature joints, adequate filter paper characteristics and a rigid case. The lubricating oil and oil filter should be replaced at every 250-hour interval. A lubrication oil drain system is provided with each trailer. Removal of the old lubrication oil and replacement of the oil filter is performed with the engine shut off as follows:

a) Place an oil collection bucket or pan under the oil drain plug. Oil drain plugs are provided at the trailer frame on the left side (control panel side) aft of the axle.

b) Remove the 3/8-inch pipe plug at the drain.

c) Open the forward access panel.

d) A brass valve is provided to prevent oil flow through the hose to the drain port. Move the lever so that it lies in the direction of the hose. Oil will now run out of the engine, through the hose to the oil drain port. Allow the engine to drain fully. Reset the lever at the oil drain valve to a position perpendicular with the hose.

e) Place a container under the oil filter to prevent the oil dripping on the enclosure compartment floor.

f) Use a gripping band type tool to remove the oil filter from the engine. Unscrew from engine block.

g) Lightly grease or oil the face of the rubber joint on the new filter.

h) Screw the new filter onto the crankcase filter adapter until the rubber joint makes contact with the crankcase facing.

i) Screw the filter an additional quarter to one-half turn.

j) Insert the 3/8-inch pipe plug into the drain port.
k) Refill the oil sump.

l) Dispose of the oil and oil filter in accordance with site regulations.

m) Start the engine and allow the engine to run for a few minutes to circulate the oil. Check for any leaks.

n) Stop the engine and allow the a few minutes for the oil to drain down and re-check the level on the dipstick.

5.4.5 Replacing the Air Cleaner Element: The engine is fitted with a 5.5-inch cyclonic air cleaner. The air cleaner element should be replaced every 500 hour interval. The PSI part number for the air cleaner element is 3000013-002. The air cleaner element is access through the forward access panel and replaced with the engine shut off as follows:

a) Turn the knob on the air cleaner element in a counterclockwise direction until the front cover comes free. This will expose the filter element that is held in place with a wing nut.

b) Remove the wing nut and the filter element.

c) Wipe the inside of the air cleaner of any foreign matter.

d) Replace the element and secure the element with the wing nut.

e) Replace the air cleaner front cover and hand-tighten the knob.

5.4.6 Replacing the Fuel Filter: The fuel filter should be replaced at every 500-hour interval. The PSI part number for the fuel filter element is 3000011-002. The fuel filter is accessed through the forward access panel. The filter cartridge screws into the top or head of the fuel filter mount. Replaced the filter with the engine shut off as follows:

a) Place a fuel collection bucket or pan under the fuel filter in the event of fuel spillage.

b) Using a suitable strap wrench, unscrew the cartridge from the head.

c) Screw in a new cartridge onto the head and hand-tighten.

d) Prime the fuel system by manually pumping using the lever at the base of the fuel pump. Loosen the bolt (bleed screw) identified as Item 8 at the top of the fuel filter head as shown in the Lister-Petter Illustrated Parts Breakdown (Attachment A) on page 42. Tighten the bolt after air is purged from the fuel.
e) Start the engine and check for fuel leaks.

5.4.7 Replacing Coolant: The engine coolant should be replaced every year.

a) Place a coolant collection bucket or pan under the coolant drain plug. The coolant drain plug is located at the trailer frame on the left side (control panel side), aft of the axle.

b) Remove the 3/8-inch pipe plug at the drain.

e) Coolant drain valves are located at the base of the radiator and at the engine block to prevent coolant flow through the hose to the drain port. Move the valve levers so that it lies in the direction of the hose. Coolant will now run out of the engine and radiator, through the hose to the drain port.

f) Remove the radiator filler cap. Allow the engine and radiator to drain fully.

g) Flush the radiator through the filler with clean fresh water until clean water emerges.

h) Insert the 3/8-inch pipe plug into the drain port and tighten.

i) Reset the lever at the coolant drain valves to a position perpendicular with the hose.

j) Refill with the 40% concentration of coolant and water.

k) Replace filler cap and run engine.

l) Start the engine and allow the engine to run for a few minutes to circulate the coolant.

Check for any leaks.

m) Stop the engine and recheck the coolant level. Add coolant if required.

---

**WARNING!**

ENGINE AND COOLANT MAY BE HOT. ALLOW SUFFICIENT TIME FOR THE ENGINE TO COOL BEFORE ATTEMPTING TO DRAIN COOLANT.
5.4.8 Tightening or Replacing the Fan Belt: The tension of the radiator fan belt should be checked every 50 hours of operation. The PSI part number for the fan belt is 3000023-002. On a newly installed belt, the belt shall be fitted and the tension adjusted such that a 7 to 7.5 lbs/ft force is required to deflect the belt .14 inch. On subsequent checks, the belt shall be adjusted such that a 5 to 5.4 lbs/ft force is required to deflect the belt .14 inch. See Figure.

5.4.8.1 Fan Belt Adjustment Procedure: If it is necessary to replace the fan belt or to adjust the fan belt tension, the adjustment should be performed as follows:

a) Slightly loosen the bolt at the base of the alternator.

b) Slightly loosen the nut at the alternator support arm. This will allow the alternator to rotate towards or away from the engine block.

c) Position the alternator so that tension is either increased (away from engine) or decreased (towards engine) as required. A lever between the block and the alternator may facilitate positioning. Do not over tension, as this will cause excessive wear.

d) Tighten the nut at the alternator support arm and check for proper tension. If the tension is proper, tighten the bolt at the base of the alternator.

5.4.9 Cleaning or Replacing the Fuel Injectors: Replacement of the injector is recommended at every 2000 hours of operation. The PSI part number for the injector is 3000014-002.
CHAPTER 6 - DIESEL ENGINE TROUBLESHOOTING

6.1 GENERAL

The following section contains information on the fault isolation of the diesel engine. Generator Set fault isolation is contained in Attachment B, Service and Maintenance Manual for the Generator. Proceed to the section that defines the conditions or problems experienced for determining the possible cause and corrective action.

6.2 ENGINE DOES NOT CRANK: Turning the Engine Start Switch to the START position does not cause the starter motor to turn over the engine.

a) Check the Battery. The Battery should be properly connected; terminals should be clean of corrosion. Using a Voltmeter, check the battery voltage for proper potential.

b) With the Engine Start Switch in the START position, check for proper potential at the Cranking Relay, K2. Proper voltage should be present between wire number 8 (+V) and 22 (ground). If voltage is present proceed to paragraph d).

c) With the Engine Start Switch in the START position, test for proper voltage at the Engine Selector Switch between terminal 4 of the switch and ground. If voltage is not present, replace the Engine Selector Switch. If voltage is present, the wire from the switch to the cranking relay is not connected.

d) With the Engine Start Switch in the START position, test for proper voltage at the Starter Solenoid between the red wire (+V) and ground. If voltage is present, replace the starter motor; if voltage is not present, replace the Cranking Relay K2.

6.3 ENGINE CRANKS BUT DOES NOT START: The starter motor turns the engine over but the engine does not run.

a) If an over temperature, a low lubrication oil pressure or an overspeed condition is present or had occurred, the Engine Selector Switch must be turned to the OFF position and then restarted. These three conditions will cause the fuel actuator to de-energize and shut-off fuel to the engine.

b) Check for adequate fuel. The trailer is equipped with a fuel selector switch at the right side of the trailer, forward of the axle. The switch should be in the TRAILER position if drawing fuel from the fuel tank of the trailer or in the AUXILIARY position is drawing fuel from an external source using the fuel supply and return hoses. If drawing from an external source, ensure that the fuel is properly primed and that an air bound condition does not exist. See paragraph 5.4.6 d) for purging air from the fuel lines.
c) Check the fuel filter. The fuel filter should be changed at regular intervals. If regular maintenance was not performed or if operating with dirty fuel, the filter may be clogged and should be replaced.

d) If the Fuel Actuator fails to move to full fuel position, check for battery voltage (24-VDC) between the red terminal (+) and black terminal (-) wires at the controller. If voltage is not present, examine wiring back to the battery.

e) If the Fuel Actuator fails to move to full fuel position, the Actuator may be stuck in the de-energized position. Refer to Appendix D for troubleshooting the Governor System.

6.4 ENGINE CRANKS BUT DOES NOT START (BELOW 32 DEGREES F):

The diesel engine is equipped with glow plugs to assist in cold temperature starting. The glow plugs are energized by holding the Engine Selector Switch in the PREHEAT position. Non-Arctic grades of diesel fuel contain paraffin that may solidify in cold temperatures (clogging the fuel filter). Use D1 rated fuel for cold temperatures.

a) Engine starting at low temperatures may be assisted with the use of the diesel fuel fired coolant heater. (See Cold Temperature Starting Paragraph 4.5)

a) Insure that the proper viscosity lubrication oil is used for the ambient temperature. Improper lubrication oils may be too viscous and present an excessive load preventing the engine from starting.

b) With the Engine Selector Switch in the PREHEAT position, check voltage at the glow plug. Exercise caution, the glow plug may be hot. If voltage is not present at the glow plug, the wire between the glow plug and the glow plug relay may be disconnected.

c) If voltage is not present at the glow plug, check for proper voltage at the Glow Plug Relay, K3. If voltage is not present at relay output terminal, check for voltage between wire 9 at the glow plug relay and ground. If voltage is present at this terminal, replace the Glow Plug Relay. If voltage is not present, check for voltage at the Engine Selector Switch, terminal 12.

d) If voltage is not present at terminal 12 of the Engine Selector Switch, replace the Engine Select Switch.

e) Battery potential decreases with decreasing temperatures. The additional load of heavy or dirty lubrication oil may compound the starting problem. The battery may be charged from an external source using the built-in 3-Amperes Battery Charger. The charger will charge a weak battery by plugging an external source of power into the Battery Charging Inlet, J7.
6.5 ENGINE STOPS:

The Generator Set incorporates sensors to automatically stop the engine should a high coolant temperature, overspeed or low oil pressure condition occurs. If any of these conditions exist, the governor actuator is de-energized and shuts off the engine fuel, stopping the engine to prevent damage. An indicator light on the Instrument Panel should illuminate and remain illuminated until the Engine Selector Switch is turned to the OFF position. Check the engine instrumentation for a high coolant temperature, low oil pressure condition. It is possible that either the indicator light may have burned out and it is not warning of the condition.

a) If Coolant Temperature exceeds 230 degrees F on the Instrument Panel refer to paragraph 6.6 OVERHEATING.

b) If a Low Oil Pressure condition occurs, ensure that lubrication oil is at proper level and that the proper lubrication oil is being used.

c) Check the wattmeter for an excessive load on the engine.

d) Insure fuel supply is adequate and clean. Air or water in the fuel system will cause the engine to run erratically or stop.

e) Check the air filter and the fuel filter. The air and fuel filters should be changed at regular intervals. If regular maintenance was not performed, the filters may be clogged and should be replaced.

6.6 OVERHEATING:

Overheating may occur due to problems with the engine or excessive load or improper operation.

a) An overloaded Generator Set, producing power in excess of the rated capacity, may cause the engine to appear defective. Ensure that the Generator Set is not overloaded by monitoring the wattmeter on the instrument panel.

b) Observe if the exhaust gas or cooling air is being re-circulated. Under unique wind conditions, the engine exhaust or the radiator cooling air may be force back to the air inlet louvers. If this occurs, re-position the Trailer System.

c) Air inlets or exhausts may be obstructed.

d) Inspect fan belt. Check for proper tension. Verify that the fan belt is not worn.

e) Lubrication oil level may be low. Maintain an adequate level of lubrication oil.
f) Coolant level may be low. Coolant recovery bottle should contain coolant as a result of thermal expansion of coolant. If no coolant is in the recovery bottle, allow the engine to cool and add coolant to top of filler neck.

g) Coolant system may be obstructed. Drain and flush coolant system if coolant is dirty or persistent problems occur.

h) Using high pressure air, blow out dust or sand that may have accumulated in the radiator preventing heat transfer.

6.7 EXCESSIVE EXHAUST SMOKE:

The color of the smoke gives an indication of the problem. Generally white smoke is usually a result of water entering the combustion chamber. Faint blue smoke is an indication of a light load on the Generator Set. Heavy blue smoke is usually the result of lubrication oils entering the combustion chamber. Black smoke is the result of incomplete combustion.

a) Water in the combustion chamber indicates that either water is present in the diesel fuel or a gasket is blown and coolant is entering the combustion chamber. The fuel filter is fitted with a drain at the bottom of the fuel bowl. Water in the fuel filter may be removed by draining the fuel filter of collected water. If the fuel is contaminated, drain the fuel tank and purge the fuel lines. Replace the fuel filter. If this does not correct the problem, either a gasket has failed or engine components may have warped due to an overheat condition that was not properly addressed.

b) Faint blue smoke is an indication that the Generator Set is running under a light load. Turn on the ECU or apply additional load to the generator. With the increased load, the smoke should clear within a few minutes. It is not recommended to run for protracted periods of time at a light load. Injectors may also cause certain smoking conditions. Replace Injectors.

c) Blue smoke indicates that oil is being burned in the combustion chamber. This can occur when oil passes by the piston rings due to stuck, worn or broken rings, worn cylinder bore. Overfill of lubrication oil will also cause oil to enter the combustion chamber. See paragraph 5.4.3.

d) Overload, choked air filter or excessive air inlet temperatures may cause Black smoke. Injectors may also cause certain smoking conditions. Replace Injectors.

6.8 EXCESSIVE CARBON DEPOSITS:

Excessive carbon deposits are an indication that the mixture of air and fuel through the engine may be improper, or that the engine is not running under an adequate load.
a) Check the Air Filter. The air filter should be changed at regular intervals. If regular maintenance was not performed or if operating in dusty conditions, the filter may be clogged and should be replaced.

b) Check the exhaust system and ensure the exhaust is not blocked or obstructed.

c) Check for adequate and proper diesel fuel and lubrication oil.

d) Diesel engines running with a light load, under 30% of full load, may exhibit a condition called wet stacking. Under this condition, fuel may not be totally consumed by the combustion of the engine. Do not run the engine under light loads for protracted periods. Add load by engaging the Load Bank for a minimum of 12kW load. Closing the 6kW circuit breaker CB7 or the 9kW circuit breaker CB8 may be used to add load.
CHAPTER 7 - ENCLOSURE REMOVAL

7.1 GENERAL

It may become necessary to perform maintenance activities that require the removal of the Engine or Generator. The Engine Generator is mounted between the fenders of the trailer and must be raised as a unit to be removed from the Trailer. Then the Enclosure may be disassembled to the extent necessary to provide maintenance.

WARNING!

Prior to removal of enclosure, disconnect the battery. Disconnect the negative terminal first and then the positive terminal. When reconnecting, connect the negative terminal last.

7.1.1 Removal of Engine /Generator and Enclosure from Trailer: Proceed as follows to remove the engine/generator and enclosure from the trailer.

a) Unbolt the 24 10-32 Hex Cap Screws securing the roof to the enclosure.

b) Remove the forward and aft service doors.

c) At the forward service door, unstrap the insulating blanket sleeve located on the exhaust pipe 4-inches above the deck to expose the 3-1/4-inch exhaust flange.

d) Remove the four 1/4-20 bolts at the exhaust flange.

e) Verify that the radiator drain valve, engine block drain valve, engine oil drain valve and the fuel system select switch are in the OFF position.

f) Release the hose clamps to disconnect the radiator drain, engine block drain, engine oil drain, fuel supply and fuel return hoses. Plug the ends of all hoses to prevent spillage of fluids that may be in the lines.

g) Unbolt the six 1/2-13 hardware that secures engine base to the trailer.

h) Disconnect 5 wires for the ECU at the Barrier. The wire numbers are 135, 136 and 137 from the bottom terminals of Circuit Breaker, CB1; wire number 134 from the
neutral lug of the Power Terminal Block and wire number 138 from the Ground Stud on the Barrier.

i) Disconnect wire 60, ground wire.

j) Disconnect the locknut securing the 1-inch diameter Sealtite flexible conduit from the enclosure. The locknut is located on the rear wall of the engine compartment.

k) Pull the conduit and ECU wires through the floor plate.

WARNING!

Lift the assembly with the engine block and generator lifting rings only. Do not lift using the enclosure. The enclosure will not support the load. Injury to personnel or equipment could result.

l) Lift the engine/generator mounted on the base and enclosure using the lifting rings.

7.1.2 Removal of the Enclosure from the Freestanding Generator Set: Proceed as follows to remove the enclosure from the engine/generator.

a) Disconnect 19 control wires to the engine at TB1 on the Barrier.

b) Disconnect the ground wire designated ‘G’ and wire number 60 from the ground stud at the Barrier.

c) Disconnect T1, T2 and T3 from the bottom of Circuit Breaker CB-5.

d) Disconnect the locknut securing the 1-1/2-inch diameter Sealtite flexible conduit from the enclosure. The locknut is located on the rear wall of the engine compartment.

e) Refer to drawing 2000367. Unbolt the Enclosure Header, Item 5, from the Radiator End, Item 1 and the Generator End, Item 2 at four places on the right side and four places on the left side of the enclosure.

f) Support the Radiator End so that it does not fall away from the base before performing step g).
g) Unbolt the Radiator End, Item 1, secured at five places with 1/4-20 hardware from the base of the engine/generator.

h) Lift Radiator End (two-man lift) off of the base towards the front end of engine.

i) Support the Generator End so that it does not fall away from the base before performing step j).

j) Unbolt the Radiator End, Item 1, secured at five places with 1/4-20 hardware from the base of the engine/generator.

k) Lift Radiator End (two-man lift) off the base towards the rear end of engine. The control wiring will be pulled through the rear wall of engine compartment.

7.1.3 Generator Removal: To remove the generator, proceed as follows:

a) Support the generator using the generator-lifting ring.

b) Unbolt the two 1/2-13 hardware securing the generator to the base.

c) Unbolt the generator flywheel-housing adapter from the engine flywheel.

d) Lift the generator off the base.

7.1.4 Bearing or Rectifier Replacement: To replace the Bearing or Rectifier Assembly refer to the Generator Service Manual, Attachment C.

7.1.5 Engine Removal: To remove the engine, proceed as follows:

a) Support the engine using the engine block lifting rings.

b) Unbolt the 1/2-13 hardware securing the zee mounts to the engine block.

c) Lift the engine off of the base.
CHAPTER 8 - TRAILER MAINTENANCE

8.1 MAINTENANCE TASKS

The trailer does not require any special attention with the exception of periodic inspections and routine maintenance such as brake shoe replacement.

8.1.1 Torflex Suspension: The independent suspension system is a torsion arm type suspension that is completely self-contained within the axle tube. It attaches directly to the trailer frame with brackets that are an integral part of the axle assembly. The wheel spindle hub is attached to a torsion arm that is fastened to the rubber-encased bar. As load is applied, the bar rotates causing a roller compressive resistance in the rubber cords. The components of the suspension system should be visually inspected for signs of excessive wear, elongation of bolt holes or loosening of fasteners. Except for periodic inspection of the fasteners attaching the axle to the frame, no other maintenance is required for the axle.

8.1.2 Parking Brake: The parking brake lever mechanically actuates the brake shoe by providing a spreading force between the primary and secondary brake shoes until contact is made against the brake drum. Lubricating oil should be applied to the brake handle pivot pin every six months.

8.1.3 Hydraulic Brakes: The brake should be adjusted after the first 200-miles and at 3000-mile intervals. Adjustment is performed by removing the adjustment hole plug and rotating the star wheel adjuster until the shoe nearly contacts with the drum. Freely rotating the wheel will produce an audible scraping noise. Periodically inspect the hydraulic lines and wheel drum for hydraulic leaks and repair as required. Re-install the adjustment hole plug after completing brake adjustment.

8.1.4 Bleeding of Brakes: It may become necessary to purge the air out of the brake lines. Two qualified personnel are required to bleed the brakes.

a) Position the trailer to a level surface.

b) Block the tires to keep the trailer stationary. Do not engage the parking brakes.

c) Lower the trailer tongue until it touches the ground or floor. This will rotate the wheel cylinders to a horizontal position.
d) Remove the cap from the actuator and fill the actuator with brake fluid. Replace cap.

e) Bleed the roadside wheel first. Remove any dirt or paint from the bleed nipple located on the wheel cylinder on the rear top of the backer plate.

f) Place a small hose tightly over the nipple. Place the other end of the hose into a clear container 1/3 full of brake fluid. The end of the hose should be submersed into the fluid and the container held lower than the wheel cylinder.

g) Loose the bleed nipple with a box end wrench.

h) Operate the actuator by moving the breakaway lever upward and toward the front of the trailer. The lever will ratchet and latch against a retainer plate. This will force fluid into the brake lines and force air out of the wheel cylinder. The breakaway lever is located on top of the actuator. A small chain connected to it. A small pipe may be placed over the lever to use as a handle to facilitate operation.

i) As the lever is moved, bubbles will be seen coming from the hose in the container.

j) At the end of each forward stroke of the lever, tighten the nipple.

k) Release the lever and repeat g) through j) until all air is removed. The lever must be released by inserting a screwdriver under the metal retainer. When the fluid from the hose exhibits no bubbles the brake bleeding is completed for the roadside wheel.
1) Check the fluid level in the actuator after each stroke. If the actuator becomes empty, the entire procedure must be repeated.

m) Repeat the procedure for the curbside wheel.

n) Return the trailer to a level position and recheck the brake fluid level. Refill if necessary.

8.1.5 Wheel and Hub Removal: To perform inspection of the brakes or lubricate wheel bearings, it is necessary to remove the wheel and hub. Refer to drawing 4000115.

a) Elevate and support the trailer so that the wheel is not in contact with the ground.

b) Remove grease cap, cotter pin, spindle nut and spindle washer.

c) Remove outer bearing cone and outer bearing cup.

d) Inspect bearings by removing all grease using a suitable solvent.

e) Dry the bearing with a lint free cloth and inspect each roller. If pitted or spalled or if corrosion is present, replace the bearing set (cone and cup)

f) Remove wheel and hub. This will expose the brake system.

g) Inspect excessive wear to the brake shoe linings.

h) Replace shoes if the lining is worn to 1/16-inch or less.

i) Inspect for leaks and replace wheel cylinder if required.

j) Inspect the drum for scouring, cracking or uneven wear. Resurface or replace drum as required.

k) Inspect all moving parts such as springs, cups, pins, links and plugs for visible defects, corrosion or pitting that may cause a possible malfunction of the brake system. Replace the Brake and Back Plate Assembly PSI P/N 4000038-001 or –002 if required.

l) To inspect or change the inner bearing cone and inner bearing cup, remove the brake backing plate.

m) Clean and inspect bearings. Repeat steps d) and e) for inner bearing. Replace if required.

n) Reverse procedure to reinstall wheel and hub.
8.1.6 Tightening Wheel Nuts: When wheels or rims have been removed and are to be installed, wheel nuts should be tightened in stages in the sequence as shown in the figure to the torque value as shown in the Table. Tighten nuts 1-8 in the sequence shown to 20 to 25 foot-pounds (first stage), repeat for second stage and third stage torque values.

```
+--------+--------+--------+
| First  | Second | Third  |
| Stage  | Stage  | Stage  |
| 20-25  | 50-60  | 90-120 |
+--------+--------+--------+
```

8.1.7 Trailer Wiring: Periodically inspects the trailer wiring for chafing or damage. The MS75020 connector to the HMMWV should be periodically lubricated with silicone grease to prevent corrosion of the inner shell. Wiring diagram is 6000043.

8.2 MAINTENANCE SCHEDULE:
Maintenance intervals may vary dependent on use. Recommended intervals for periodic maintenance is as follows:
<table>
<thead>
<tr>
<th>Task</th>
<th>Function</th>
<th>3-Month Intervals</th>
<th>6-Month Intervals</th>
<th>12-Month Intervals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brake Adjustment</td>
<td>Adjust to proper clearance</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brake Linings</td>
<td>Inspect for wear</td>
<td></td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Wheel Cylinders</td>
<td>Check for leaks or sticking</td>
<td></td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Brake Lines</td>
<td>Inspect for leaks, cracks, kinks</td>
<td></td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>Hub/Drum</td>
<td>Inspect for wear, scouring</td>
<td></td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>Wheel Bearings</td>
<td>Inspect and lubricate</td>
<td></td>
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<tr>
<td>Seals</td>
<td>Inspect for leaks</td>
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<td>Springs</td>
<td>Inspect for wear, loss of arch</td>
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<td>Suspension</td>
<td>Inspect for wear</td>
<td></td>
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<td>Wheel Nuts</td>
<td>Tighten to torque values</td>
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<td>Tire Inflation</td>
<td>Inflate to 32 PSI</td>
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<tr>
<td>Tire Condition</td>
<td>Inspect for wear, condition</td>
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<tr>
<td>Brake Handle Pivot</td>
<td>Lubricate</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Trailer Wiring</td>
<td>Inspect for damage or wear</td>
<td></td>
<td></td>
<td>x</td>
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<tr>
<td>Trailer Lights</td>
<td>Proper operation before each use</td>
<td></td>
<td></td>
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<tr>
<td>Trailer Connector</td>
<td>Lubricate to prevent corrosion</td>
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CHAPTER 9 - GENERATOR SET DOCUMENTATION

9.1 FAMILY TREE

The following section contains assembly drawings, schematics and wiring diagrams for the Trailer System. The initial drawing is a family tree drawing that shows the hierarchical relationship of the assembly drawings. The drawings are presented in numerical order.
APPENDIX B

OPERATION, SERVICE AND MAINTENANCE MANUAL

FOR THE

MARATHON ELECTRIC GENERATOR
APPENDIX C

INSTRUCTION MANUAL

FOR THE

SE350 VOLTAGE REGULATOR
APPENDIX D

INSTRUCTION MANUAL

FOR

DYN1-10704 GOVERNOR CONTROLLER
APPENDIX E

INSTRUCTION MANUAL

FOR THE

ESSE-2 SYNCHRO-START SPEED SWITCH
APPENDIX F

OPERATION AND MAINTENANCE MANUAL

FOR

ENVIRONMENTAL CONTROL UNITS
APPENDIX G

SPARE PARTS LISTING

FOR THE

TRAILER SYSTEM