OPERATIONS AND MAINTENANCE MANUAL

for the

Trailer Mounted Support System (TMSS)

Prepared by:

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CHAPTER 1 - INTRODUCTION

1.1 SCOPE

1.2 EQUIPMENT DESCRIPTION
The DEG is a 33kW, 120/208-Volts AC, 60Hz, 3-phase, Diesel Engine Generator with and auxiliary equipment.

1.3 MAJOR COMPONENTS

1.3.1 Diesel Engine Generator (DEG): Each 33kW is rated for continuous operation, 120/208-Volts AC, 60-Hz, 3-phase, DEG uses a three-cylinder, turbocharged, John Deere diesel engine close coupled to a single bearing Marathon Electric generator. The DEG is rated for 33kW operation at 10,000 feet and 55 degrees Celsius. The DEG is housed in a weatherproof, aluminum enclosure with removable access doors. The enclosure includes an Instrument Panel and Circuit Breaker Panel protected by a hinged access door with a window. A Power Panel is provided for interfacing.

1.3.1.1 DEG Instrument Panel: The generator instrumentation consists of an AC Ammeter, an AC Voltmeter, an AC Wattmeter and a Frequency Meter. The engine instrumentation consists of a DC Ammeter for the Engine Battery Charging Alternator, Oil Pressure Gauge, a Coolant Temperature Gauge, and an Hour Meter. A control switch is provided for the engine OFF/RUN/START. A seven position AC Voltmeter switch, a Synchronizing Switch Battle Short, idle switch, air compressor and a Panel Illumination Light Switch are incorporated into the Generator Instrument Panel. Automatic shut-off for Low Oil Pressure, Overspeed, Reverse Power and High Coolant Temperature are incorporated into the panel along with alarm indicators. The Instrument Panel will also incorporate a voltage adjust potentiometer, a speed control potentiometer and an “IN SYNCH” indicator LED. The speed control potentiometers and synch indicator are used in the “Load Share” operation. There is a controller for the Air Compressor also.
1.3.1.2 DEG Barrier: The Barrier contains mounted control components, relays, fuses, battery charger, transducers, terminal blocks, voltage regulator, governor controller, and associated wiring. It is located behind the Instrument Panel. It may be accessed by releasing the two latches at the top of the Instrument Panel and allowing the Instrument Panel to hinge forward. A Circuit Breaker Panel directly below the Instrument Panel provides circuit protection for the generator and receptacle outlets.

1.3.1.3 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 provided to switch the source of power from either the Generator Set or from commercial utility power (Shore Power).

1.3.1.4 DEG Power Panel: MIL-C-5015 and MIL-C-22992, or equivalent, connectors are installed at the generator power panel. Neon light indicators indicate when power is available at each connector. All receptacles are energized in either the Shore Power or Generator mode of operation:

a) One (1) MS90558C44412P, J1, 3-phase, 100-Ampere, 5-wire, wall mount inlet, J1, for accepting 3-phase 120/208-Volt power from an external source (Shore Power).

b) Two (2) MS90555C32412S, J3 and J4, 3-phase, 5-wire, 60-Ampere, wall-mount receptacles. Each outlet shall be circuit breaker protected at 60-Ampere, for connecting to system loads.

c) One (1) MS90555C44412S, 3-phase, 5 wire, 100-Ampere, wall-mount receptacle, J5, circuit breaker protected at 100-Ampere, for connecting to the system loads or to perform load share.

d) One (1) Single-phase 120VAC, Ground Fault Circuit Interrupted duplex outlet receptacle, J6, with weather tight cover, circuit breaker protected at 20-Ampere.

e) One (1) MIL-DTL-5015, J9, 2-wire inlet for interconnecting the Generator Sets to control the load share paralleling operation.

f) One (1) MIL-C-5015, or equivalent, J7, single-phase, 3-wire, external power inlet for accepting 120-Volts AC input power to the static Battery Charger.

1.3.1.5 NATO Receptacle: The enclosure is equipped with a 24-Volt “NATO” receptacle, J10, to accept 24-Volts for emergency starting or to provide 24-Volt DC power for an external requirement.
1.3.1.6 Battery System: Two (2) 12-Volt maintenance free batteries, connected in series for 24-Volt engine starting and control are installed within the Generator Set enclosure. The engine-charging alternator charges the batteries. Charging of the batteries is displayed on the Alternator Ammeter at the Instrument Panel. An additional Static Battery Charger is also built into the Generator Set that may be used with an external source of 120-Volt AC power through the Battery Charger Inlet. A Battery Charger Ammeter that displays the charging of the batteries is at the Instrument Panel.

1.3.2 Air Compressor: An Engine Driven Compressed Air System is attached to the 35 kW Diesel Engine Generator (35 kW DEG) that can be used to support the erecting of the transported 32 foot air beam shelter and other tasks requiring compressed air.

1.3.3 Fuel Fired Coolant Heater: A diesel fuel-fired coolant heater is integrated into the DEG 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.

1.3.4 ECU: The EEECU is a packaged system designed to operate in a portable field use application, providing conditioned air to the shelter. It is controlled with a remote or unit mounted control unit. It operates using 208VAC, 3-phase, 50/60Hz power supplied by the on board generator or shore power via an auxiliary power plug located on the EEECU. 80 amp service is required. The refrigeration system uses R-410A refrigerant and has a cooling capacity at 60 Hz of 120,000 BTU/Hr at 130°F ambient outside temperatures 130°F Ambient Dry Bulb / 90°F Entering Dry Bulb / 75°F Entering Wet Bulb. The heating system is furnished with a nominal heat of 47,000 BTU/Hr which consists of a resistive type heater in addition to the fan heat. The ECU is mounted on slides to allow it to be moved forward for normal operation of the system. This allows access for proper airflow and maintenance access.

1.3.5 Hydraulic Boom: The HDT Trailer Mounted Support System (TMSS) incorporates a lifting system capable of lifting, stowing and setting off the HDT 32’ Air Beam Shelter when packed for transport. The lift system is capable of deploying the shelter at a nominal weight of 1,200 lbs.
1.3.6 Ancillary Equipment:

1.3.5.1 Cables: The Generator Set is supplied with one (1) battery charging cable HDT P/N 2000326 to connect the power inlet at the Power Panel to an external source of 120-VAC to power the static battery charger and HDT Part Number 2000587, one (1) 25-foot, multi-conductor Signal Interlock Cable to control the “Load Share” operation.

1.3.5.2 Cable (optional): The DEG may be supplied with: HDT Part Number 2001730, One (1) 15-foot, 100-Amperes, 5-wire Power Cable to connect the DEG to a load or to the Power Distribution Unit (PDU) for a “Load Share” operation.

1.3.5.3 Auxiliary Fuel Hoses: One 16-foot auxiliary fuel supply hose and one 16-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 DEG base to allow the generator set to be connected to an alternative fuel source.

1.3.5.4 Power Distribution Unit (PDU): The Power Distribution Unit, HDT P/N 2001698, consists of two-100amp 120/208-volt circuit breaker protected inlets, and four-100amp 120/208 volt circuit breaker protected outlets, and three 0-250amp meters to monitor each phase of power for balancing loads. Power-On neon indicator lights are located adjacent to the receptacles and illuminate when power is available at the connector.
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 and in the Commercial Manuals furnished in Appendices A, B, C, D, E, F, G, H, and I. 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) Insure there is proper ventilation for the DEG.

b) Keep the engine and generator enclosure clean.

c) Do not restrict airflow.

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

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

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

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

i) 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.

j) Observe battery voltage and polarity markings.

k) Ensure that the fuel, water and lubrication oil levels are correct.

l) Do not use ether based cold start aids.

2.3.2 Engine: The safety precautions to be observed at the engine are also outlined in the John Deere Operation and Maintenance Manual, Appendix A.

2.3.3 Generator: The safety precautions to be observed at the generator are also outlined in the Marathon Electric Operation and Maintenance Manual, Appendix B.
CHAPTER 3 - OPERATION

3.1 OPERATION OF THE 30kW GENERATOR SET

This section describes the operation of the 33kW Generator Set. The 2004859 DEG is designed to power equipment as a stand-alone unit or as a load share unit. If a connection to utility 3-phase power is available, the equipment may be powered via the Shore Power Inlet, J1, at the Power Panel. The Power Select Switch must be set to the Shore Power position for operation in this mode. AC Instrumentation will monitor demand in either Generator Set or Shore Power mode of operation. The Generator System set-up and operation is as follows:

Damage to equipment or personnel may occur if these directions are not followed in specific order.

3.1.1 DEG Set-up:

1) Drive ground rods (minimum two sections) at a 45° angle. Ensure drive bolt is installed into top of rod before driving.
2) Connect ground wire from ground stun at Power Panel to ground rod.
3) Connect cable between connector at DEG power panel and the power distribution unit (PDU). Ensure all circuit breakers (CB) at the PDU and all CBs at DEG power panel are de-energized.
4) Check engine oil level. Fill with proper oil if required.
5) Check engine coolant level. Fill with proper coolant if required.

6) Check fuel level. Fill with D1, D2, JP5, or JP8 if required.
7) Place fuel select switch to GENERATOR or AUX position.

**GENERATOR Position**

1) See step 8.

**AUX Position**

1) Connect supply and return fuel lines to quick disconnects on the DEG enclosure.

**WARNING**

DO NOT REMOVE RADIATOR CAP IF ENGINE IS WARM. ALLOW ENGINE TO COOL. THE COOLANT IS UNDER PRESSURE. SERIOUS INJURY COULD RESULT.

6) Check fuel level. Fill with D1, D2, JP5, or JP8 if required.
7) Place fuel select switch to GENERATOR or AUX position.

**GENERATOR Position**

1) See step 8.

**AUX Position**

1) Connect supply and return fuel lines to quick disconnects on the DEG enclosure.
IMPORTANT

DAMAGE MAY OCCUR TO FUEL SYSTEM IF RETURN LINE IS NOT CONNECTED WHEN USING AN AUXILIARY FUEL SOURCE.

2) Place other end of lines in a fuel container below fuel level.
3) Pump supply line priming bulb until fuel runs out of return line.
4) See step 8.

8) Determine if DEG will be operating in Stand-Alone or Load Share mode.

3.1.2 Stand-Alone Mode Start Procedure:
1) Ensure all CBs are de-energized.
2) Place Voltmeter switch to desired position.
3) If temperature is below 32°F see Cold Start Procedure prior to continuing to step 4.
4) Turn ESS to START position and release ESS once engine starts (spring return to RUN position).
5) Verify oil pressure is 20-psi minimum.
6) Verify frequency is 60 Hz.
7) Verify voltage is 208/120 V.
8) Energize Generator CB.
9) Place the SINGLE-PARALLEL switch to the SINGLE position
10) Place the SYNCHRONIZING switch to the OFF position.
11) Energize CB for Power Connector.
12) Plug in load at Power Panel.
13) Verify DEG is properly loaded. Load should be at least 15Kw.

3.1.3 Load Share Mode Start Procedure:
1) Ensure all CBs are de-energized on each DEG.
2) Connect cables between power connector at each DEG power panel and the PDU inlets. Ensure all circuit breakers (CB) at the PDU and all CBs at each DEG power panel are de-energized. (See load share diagram.)
3) Connect the signal cable between the signal interconnect receptacles on each DEG. (See load share diagram.)
4) Place Voltmeter switch to desired position on each DEG.
5) If temperature is below 32°F see Cold Start Procedure prior to continuing to step 6.
CAUTION

DO NOT START THE ENGINE WITH THE GENERATOR CIRCUIT BREAKER IN THE ON POSITION. CONNECT THE POWER CABLES BETWEEN THE EACH DEG AND PDU BEFORE ENGAGING GENERATOR CIRCUIT BREAKER. DO NOT CONNECT OR DISCONNECT POWER CABLES WITH POWER APPLIED. AN AMBER LIGHT IS ILLUMINATED WHERE POWER IS AVAILABLE.

6) Turn ESS to the START position on each DEG and release ESS once engine starts (spring return to RUN position) on each DEG.
7) Verify oil pressure is 20-psi minimum on each DEG.
8) Verify frequency is 60 Hz on each DEG.
9) Verify voltage is 208/120 V on each DEG.
10) Energize Generator CB on DEG one.
11) Energize CB for the Power Connector on each DEG.
12) Energize PDU CBs (orange LED will illuminate).
13) Place the SINGLE-PARALLEL switch to the SINGLE position on DEG one.
14) Place the SINGLE-PARALLEL switch to the PARALLEL position on DEG two.
15) Place the SYNCHRONIZING switch to the ON position on DEG two.
16) Energize Generator CB on DEG two when light illuminates steady.
17) Place the SYNCHRONIZING switch to the OFF position.
18) Plug in load at PDU.
19) Energize PDU CBs required for load (LED will illuminate).
20) Verify the load is balanced by observing each of the amp meters on the PDU.
21) Verify each DEG is properly loaded. Load should be at least 15Kw.
3.1.4 Cold Start Procedure:
1) Place ESS to RUN position.
2) Place Coolant Heater switch / CB to ON position (amber LED will illuminate).
3) Monitor temperature gauge until temperature is greater than 100°F.
4) Place Coolant Heater switch / CB to OFF position (amber LED will extinguish).
5) Continue with step 4 of Stand-Alone or step 6 of Load Share Mode Start Procedure.

3.1.5 DEG Shut Down:
1) Shutdown load (electrical equipment).
2) De-energize all CBs at PDU.
3) De-energize Power Connector.
4) De-energize Generator CB last.
**CAUTION**

ENSURE THAT ALL CIRCUIT BREAKERS ARE DE-ENERGIZED PRIOR TO STOPPING ENGINE.

**IMPORTANT**

SUDDENLY REMOVING ENTIRE LOAD MAY CAUSE AN OVERSPEED CONDITION. REMOVE LOAD GRADUALLY.

5) Run Engine for **5 minutes** to allow turbo charger to cool.

**IMPORTANT**

NOT ALLOWING TURBO CHARGER TO COOL MAY DAMAGE DEG.

6) Place ESS in OFF Position.

**3.1.6 Shore Power Operation:**

**CAUTION**

DO NOT APPLY SHORE POWER WITH THE GENERATOR SET IN OPERATION.

The equipment connected to the Generator Set may be powered from an external source. With all circuit breakers in the off position, switch the Power Select Switch from the OFF position to the SHORE POWER position. A 100-Amperes, 3-phase 5-wire power cable may be connected to the Shore Power Inlet, J1. The Instrument Panel will monitor power in either SHORE POWER or GENERATOR position.
Prolonging the Life of Your HDT Genset

Avoid running at no or low load.

Perform recommended maintenance on schedule. This includes changing coolant, oil and filters. In desert environments, or high dust levels, halve the time between changes of all filters.

Store your diesel correctly. If it is not to be used for 3 months or more: -
1. Run engine up to running temp, shutdown and drain oil. Change filter, refill with fresh oil, and run for 5 minutes. Shutdown.
2. Top up the coolant levels to remove any air-gaps.
3. Allow the exhaust pipes to dry out. Seal exhaust pipe end to prevent entrance of moisture into the engine through exhaust valves that are open.
4. Cover/seal the air intake.
5. Remove batteries and store them somewhere cool and dry.
6. To prevent corrosion and/or moisture, either completely fill the fuel tank or drain it. If leaving full, add stabilizer. Always seal the top securely. We recommend draining the tank.
7. Consider covering the unit with a ‘tarp’ to provide additional protection.

Avoid short running times. If you’re going to start the engine, run it long enough to get to full operating temp.

Maintain airflow over the engine to prevent overheating. Keep the air flowing by checking/cleaning the intake boxes on the genset and using a low pressure water hose to wash any debris off the inside of the radiator louvers. Wash from the inside towards the outside.

Match your oil viscosity to the environment. Below -4 deg F (-20 deg C), consider using 0W-40-viscosity oil.
For general use, -4 deg F (-20 deg C) to 122 deg F (50 deg C), 15W-40-viscosity oil is perfect.

If you have any questions, contact HDT EP, Inc. for further information or advice on the usage and storage of your generator.
CHAPTER 4 - ENGINE MAINTENANCE

4.1 GENERAL

4.1.1 Engine Serial Number: Prior to 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. The serial number denotes the following information:

Example: PE3029T207985

PE = Location of Manufacture
30 = Number of cylinders (3.0)
2.9 = Displacement in Liters
T = Aspiration Code (Turbocharged)
207985 = Serial Number
F = Application Code OEM

4.1.2 Engine Option Code Table: Located on the rocker cover is the engine option code label. This code identifies engine as initially manufactured by John Deere. The engine has been modified further with build options after receipt from the factory. If parts or service of the engine is required, furnish the servicing agent with these numbers and the numbers shown in the Build Configuration Table (see Paragraph 4.1.3). The engine option code label attached to the 3029T engine used in the DEG is as follows:

<table>
<thead>
<tr>
<th>1105</th>
<th>1299</th>
<th>1330</th>
<th>1418</th>
<th>1501</th>
<th>16EJ</th>
<th>1710</th>
<th>1901</th>
<th>2021</th>
</tr>
</thead>
<tbody>
<tr>
<td>2118</td>
<td>2408</td>
<td>2802</td>
<td>3014</td>
<td>4006</td>
<td>4199</td>
<td>4399</td>
<td>4402</td>
<td>5603</td>
</tr>
<tr>
<td>5904</td>
<td>6218</td>
<td>6547</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
4.1.3 **Build Number:** The engine has been modified to meet certain performance envelopes by the addition of various options or builds. The build configuration as shown in Table I, identifies the options incorporated into the engine used in the Generator Set.

**Table I**

<table>
<thead>
<tr>
<th>John Deere Build Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1105</td>
<td>Rocker Arm Cover, Front Filler</td>
</tr>
<tr>
<td>1299</td>
<td>Oil Filler Cover (No Front Filler)</td>
</tr>
<tr>
<td>1330</td>
<td>Crankshaft Pulley, 168 mm (6.6&quot;) PD, 8- Ribbed Poly-Vee Groove</td>
</tr>
<tr>
<td>1418</td>
<td>Flywheel Housing, SAE#3, LH 3-Bolt Type 1 Starter Mount with Rear Engine Oil Seal Provisions for Magnetic Tach Drive</td>
</tr>
<tr>
<td>1501</td>
<td>Flywheel for SAE 11.5-Inch Over Center Clutch, 129 Tooth 8/10 Pitch Ring Gear.</td>
</tr>
<tr>
<td>16EJ</td>
<td>Injection Pump, Standard Governor, 24-V Electric Shut-Off, Stanadyne DB4, Outboard Throttle Lever, 1800 RPM</td>
</tr>
<tr>
<td>1710</td>
<td>Air Intake, High Position Turbo</td>
</tr>
<tr>
<td>1901</td>
<td>Oil Pan, Aluminum, Center Sump (Bottom and RH Drains), Off level Operating Capability: 30 Degrees Continuous</td>
</tr>
<tr>
<td>2021</td>
<td>Thermostat Cover, Aluminum, Horizontal, single Thermostat, four Sensor Ports for Automatic Tensioner</td>
</tr>
<tr>
<td>2118</td>
<td>Fan Housing, Aluminum Support, Standard Duty Bearing with Hub</td>
</tr>
<tr>
<td>2408</td>
<td>Fan Belt</td>
</tr>
<tr>
<td>2802</td>
<td>Exhaust Manifold, High Mount Turbo with Elbow Pad</td>
</tr>
<tr>
<td>3014</td>
<td>Starting Motor, 24V Denso, 10HP, 3-Bolt Type 1 Mount, Gear Reduction</td>
</tr>
<tr>
<td>4006</td>
<td>Dipstick</td>
</tr>
<tr>
<td>4199</td>
<td>No Auxiliary Front Drive Pulley</td>
</tr>
<tr>
<td>4399</td>
<td>No Starting Aid</td>
</tr>
<tr>
<td>4402</td>
<td>Gear-Driven Auxiliary Drive Cover</td>
</tr>
<tr>
<td>John Deere Build Number</td>
<td>Description</td>
</tr>
<tr>
<td>------------------------</td>
<td>---------------------------------------------------------------</td>
</tr>
<tr>
<td>5603</td>
<td>Finish, Industrial Yellow (Finish Coat)</td>
</tr>
<tr>
<td>5904</td>
<td>Water Pump Inlet</td>
</tr>
<tr>
<td>6218</td>
<td>No Auxiliary Drive Pulley</td>
</tr>
<tr>
<td>6547</td>
<td>Turbocharger, High Mount for Low Front RH Side Oil Filter (GenSet)</td>
</tr>
</tbody>
</table>

4.2 ENGINE CHARACTERISTICS

4.2.1 Electrical System: 24-Volt DC negative ground. Engine is equipped with a mounted 40-Ampere battery-charging alternator.

4.2.2 Fuel: Only those fuels conforming to the following standards should be used:
- ASTM D-975-77 (Grades No. 1-D and 2-D)
- EN-590

4.2.2.1 Alternate Fuels: Although the engine may operate on fuels outside the listed specifications, such operation may result in excessive wear and/or damage. Fuel lubricity must pass the BOCLE scuffing test at 3100-gram minimum load test. If lubricity is unknown, add diesel Fuel Conditioner (John Deere TY22030 or equivalent). JP-5 and JP-8 May be used. The lubricity is good and there is very little wear on the injection equipment.

4.2.3.1 Fuel Consumption: 2.8 GPH @ 100% load. Fill tank every 8 hours to prevent possible fuel starvation.

4.2.4 Lubricating Oil: Capacity 9 quarts. The engines should be run on heavy duty lubricating oils meeting the requirements of MIL-L-2104. The lubricating oil should have an API rating of CF, CF-4, CG-4, CH-4 or CI-4. Straight Mineral Oils are not suitable. Do not overfill.
4.2.4.1 Oil Viscosity: Recommended lubricating oil viscosity is as follows:

<table>
<thead>
<tr>
<th>AMBIENT TEMPERATURE</th>
<th>MONOGRAGE</th>
<th>MULTI- GRADE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Below -20 C Degrees</td>
<td>Not Recommended</td>
<td>5W/30</td>
</tr>
<tr>
<td>Between -20 and 10 C Degrees</td>
<td>Not Recommended</td>
<td>10W/40</td>
</tr>
<tr>
<td>Between 10 and 30 C Degrees</td>
<td>30W</td>
<td>15W/40</td>
</tr>
<tr>
<td>Above 30 C Degrees</td>
<td>30W</td>
<td>15W/40</td>
</tr>
</tbody>
</table>

4.2.5 Engine Cooling and Coolant Capacity: Engine cooling is with coolant circulation assisted by a centrifugal belt driven pump using a "V" belt. The total coolant capacity is 13 quarts (engine and radiator).

4.2.5.1 Coolant: The engine requires a 50% concentration of ethylene glycol concentrate (anti-freeze) under all operating conditions. Supplemental Coolant Additives are recommended in Appendix A. The coolant concentrate should comply with one of the following:

- ASTM D5345 (Pre-diluted Coolant)
- ASTM D4985 (Coolant Concentrate mixed with 50% water)
- MIL-A-11755/D
- MIL-A-46153/B
- BS6580:1992

4.3 PERIODIC ENGINE MAINTENANCE

The following maintenance activities should be performed at the periodic intervals shown below:

4.3.1 Daily:

Check fuel supply, oil and coolant levels.
Check for any leaks.
4.3.2 Every 50 Hours of Operation:

Check tension of belt drives; adjust if loose.
Check fuel filter.

4.3.3 At 100 Hours of Operation:

Change the break-in oil and oil filter. Oil and oil filter changes thereafter are at every 250 hours.

4.3.4 Every 250 Hours of Operation:

Change oil and oil filter.
Drain water from the fuel filter. If contaminated fuel is used there may be a need to drain fuel/water from filter more frequently.
Check battery.
Check belt tension.

If operating in dusty or desert environments, wash the radiator to remove sand or accumulated dust. If operating in extreme conditions (sand storms or dust storms) washing the radiator may be required more often.

<table>
<thead>
<tr>
<th>IMPORTANT</th>
</tr>
</thead>
<tbody>
<tr>
<td>DO NOT EXCEED 20 PSI WHEN WASHING RADIATOR.</td>
</tr>
</tbody>
</table>

4.3.5 At 500 Hours of Operation:

Replace the fuel filter.
Clean crankcase vent tube.
Check the cooling system.
Replace air cleaner.
Change oil and oil filter.

4.3.6 Every 1000 Hours of Operation or every year:

Check all external nuts, bolts and fittings.
Clean crankcase vent tube.
Replace fuel filter.
Perform analysis of coolant solution (if necessary).
Replace air filter.
Change oil and oil filter.

4.3.7 Every 2000 Hours of Operation or every two years:

Adjust valve clearance.
Drain and clean fuel tank.
Check injectors, clean or change as required.
Change drive belts.
Flush coolant system.
Replace Thermostat.
Replace radiator hoses.
Replace radiator cap.

4.4 MAINTENANCE TASKS

4.4.1 Access to Engine: The engine is accessed through two access panels on each side of the DEG enclosure. To check oil level, change the oil filter, fuel filter, air cleaner, to drain the lubricating oil, to check or add coolant, or to adjust the fan belt, the right side access panel must be removed. To replace the injectors, the left panel must be removed. Both panels must be removed to drain the coolant and to replace the thermostat. The panels are removed as follows:

a) Unlock the panel latch.

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

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

d) 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.

4.4.2 Checking Oil Level: A dipstick is used to determine the lubricating oil level in the sump of the engine. The engine has a 9-quart capacity. The dip stick handle is located at the right side of the engine block. 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. A level indicated below the add mark, indicates that oil should be added.
4.4.3 Replacing Lubrication Oil and Oil Filter: The oil filter, HDT Part Number 3000213-001, is a spin on-type cartridge type located on the right side of the engine block directly below the fuel pump. Only the approved John Deere 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. Removal of the old lubrication oil and replacement of the oil filter is performed as follows:

a) Run the engine for five minutes before replacement. Oil should be warm prior to draining.

b) Place an oil collection bucket or pan under the oil drain plug. The oil drain plug is provided at the front of the DEG.

c) Remove the 1/2-inch pipe plug at the drain.

d) Open the access panel.

e) Open the valve at the oil pan to allow 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.

f) Reset the lever at the oil drain valve to a position perpendicular with the hose.

g) Place an oil collection bucket or pan under the oil filter. Use a band-type-gripping tool to remove the oil filter from the engine. Unscrew from engine block.

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

i) Screw the new filter onto the crankcase filter bracket until the rubber joint makes contact.

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

k) Insert the 1/2-inch pipe plug into the drain port.

l) Refill the oil sump.

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

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

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

4.4.4 Replacing the Air Cleaner: The air cleaner, HDT Part Number 3000191-001, should be replaced every 500 hour interval. The air cleaner is accessed through the access door and replaced as follows:

a) Loosen the hose clamp that retains the air filter on the air intake system.

b) Loosen the Velcro strap that holds the filter element on the mounting bracket.

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

d) Remove the filter element and properly discard.

e) Secure new filter element with Velcro strap.

f) Tighten the hose clamp.

4.4.6 Replacing the Fuel Filter: The fuel filter element should be replaced at every 500-hour interval. The fuel filter, HDT Part Number 3000212-001, is accessed through the access door. The filter element is replaced as follows:

a) Place fuel supply switch in “OFF” position.

b) Clean filter assembly and surrounding area.

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

d) Loosen filter drain plug on bottom of filter assembly.

e) Loosen filter bleed valve on top of the filter assembly.

f) Drain fuel into collection pan.

g) Lift retaining ring up and rotate ¼ turn clockwise.

i) Remove the fuel filter element and retaining ring.

j) Insert the replacement fuel filter element aligning the keys on the filter element with the slots in the filter housing. A plug is provided with the new element for plugging the
used filter element.

k) Lift retaining ring up and rotate \( \frac{1}{4} \) turn counter-clockwise. The proper installation is indicated when a click is heard and a release of the retaining ring is felt.

l) Prime the fuel system by manually pumping. Depress priming bulb on top of the pre-filter. Continue manually priming until pumping action is not felt.

n) Start the engine and check for fuel leaks.
4.4.7 Replacing Coolant: The engine coolant and engine thermostat, HDT Part Number 3000302-001 should be replaced every 2000 hours or every two years. Check the condition of the radiator hoses. Soft hoses can collapse and restrict coolant flow. It is a good practice to check the Upper Radiator Hose, HDT Part Number 3001584-001 and the Lower Radiator Hose, HDT Part Number 3001307-001 and replace if necessary at this time as well.

**WARNING**

ENGINE AND COOLANT MAY BE HOT. ALLOW SUFFICIENT TIME FOR THE ENGINE TO COOL BEFORE ATTEMPTING TO DRAIN COOLANT.

a) Place a coolant collection bucket or pan under the coolant drain plug. The coolant drain plug is provided at the front of the frame.

b) Remove the 1/2-inch pipe plug at the drain.

c) Remove both access panels.

d) A valve is located at the base of the radiator, it is provided to prevent coolant flow from the radiator through the hose to the drain port. Move the lever so that it lies in the direction of the hose. Coolant will now flow out of the radiator, through the hose to the coolant drain port.

e) At the engine block is another valve to prevent coolant flow from the engine block through the hose to the drain port. Move the lever so that it lies in the direction of the hose. Coolant will now flow out of the engine block, through the hose to the coolant drain port.

f) Allow the engine and radiator to drain fully. Slowly open the engine coolant fill cap to relieve pressure. Remove the radiator filler cap to allow coolant in radiator to drain faster.

g) With the coolant drained, remove the two 9/16 inch hex cap screws holding the thermostat housing onto the engine block. Remove the thermostat and flush the engine block with clean fresh water until clean water emerges at the coolant drain port.

h) Flush the radiator through the filler neck with clean fresh water until clean water emerges at the coolant drain port.
i) Reset the lever at the radiator drain valve and engine block drain valve to a position perpendicular with the hose.

j) Insert the 1/2-inch pipe plug into the drain port.

k) Replace the thermostat, HDT Part Number 3000302-001, using a new gasket, HDT Part Number 3000303-001.

l) Refill the radiator and engine block with a 50% concentration of ethylene glycol and water.

<table>
<thead>
<tr>
<th>IMPORTANT</th>
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<tbody>
<tr>
<td>AIR MUST BE EXPELLED FROM THE COOLING SYSTEM WHEN REFILLED. LOOSEN THE TEMPERATURE-SENDING UNIT LOCATED JUST BELOW THE BOTTOM RADIATOR HOSE AT THE ENGINE BLOCK. THIS WILL ALLOW AIR TO ESCAPE FROM THE ENGINE BLOCK WHEN FILLING COOLANT SYSTEM. RETIGHTEN FITTING WHEN ALL AIR HAS BEEN EXPELLED.</td>
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</table>

m) Start the engine and allow the engine to run for a few minutes to circulate the coolant and the thermostat to open (180 F Degrees). Check for any leaks.

n) Stop the engine and allow cooling.

o) Re-check the coolant level at the radiator fill neck. Add coolant as required.

p) Dispose of the used coolant in accordance with site regulations.
4.4.8 Tightening or Replacing the Fan Belt: The tension of the radiator fan and alternator belt should be checked every 50 hours of operation. The HDT Part Number for the fan belt is 3001090-001. On a newly installed belt, the belt should be fitted and the tension adjusted such that a 20-lbs/ft force is required to deflect the belt 3/4 inch at the mid point between pulleys. Recheck after the engine has been run for 10 minutes. See Figure 2.

4.4.8.1 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.

4.4.9 Replacing the Starter: If it is necessary to replace the starter, the replacement should be performed as follows:

4.4.9.1 Removal:

a) Disconnect the jumper and the negative cable from the batteries.

b) Move the protective cover away from the starter terminals.

c) Tag and disconnect electrical wires from the starter.

d) Remove the (2) two 14mm bolts that hold the starter to the engine block.
4.4.9.2 Installation:

a) Properly align the starter mounting holes with the mounting holes on the engine block.

b) Install the (2) two 14mm bolts that hold the starter to the engine block.

c) Connect the electrical wires to the starter in the same locations the wires were removed from.

d) Place the protective cover over the starter terminals.

e) Connect the jumper and the negative cable to the batteries.

4.4.10 Winterization: The DEG should be winterized to prevent fuel and oil system malfunctions. The following procedure should be followed:

a) Remove the oil and filter according to the procedure outlined in section 4.4.3. Replace with the appropriate oil as outlined in section 4.2.4.

b) Drain fuel filter located on the bottom of the fuel filter.

c) Drain the fuel tank and refill with the appropriate fuel as outlined in section 4.2.2.

d) Start engine and run for at least 30 minutes to purge the fuel system.
CHAPTER 5 - DIESEL ENGINE TROUBLESHOOTING

5.1 GENERAL

The following section contains information on the fault isolation of the diesel engine. Generator Set fault isolation is contained in Appendix 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.

5.2 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, test for proper voltage at the Engine Selector Switch between terminal 6 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.

c) 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 20 (ground). If voltage is present proceed to paragraph d).

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.

5.3 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. If drawing from an external source, ensure that the fuel is properly primed and that an air bound condition does not exist.
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 terminal F (+) and terminal E (-) wires at the governor controller. If voltage is not present, examine wiring back to the battery. Momentarily connect terminals A and F; the Actuator should move to the full fuel position. If it does not, replace the actuator.

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.

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

a) 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.

b) 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.

c) 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 Battery Charger. The charger will charge a weak battery. Ensure an external source of power is connected into the Battery Charging Inlet, J7.

5.5 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 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 5.6, 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.

f) An overspeed condition may be the result of a defective Governor Controller or Magnetic Pick-Up.

5.6 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 at 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 forced back to the air inlet louvers.

c) Air inlets or exhausts may be obstructed.

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

d) Lubrication oil level may be low. Maintain an adequate level of lubrication oil.

e) 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 radiator filler neck.

f) Coolant system may be obstructed. Drain and flush coolant system if coolant is dirty or persistent problems occur.
g) The radiator may be coated with sand or dust. Wash to remove debris.

5.7 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 pre-filter is fitted with a drain at the bottom of the fuel bowl. Water in the fuel pre-filter may be removed by draining the collected water. If the fuel is contaminated, drain the fuel tank and purge the fuel lines and 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. With an increased load, the smoke should clear within a few minutes. It is not recommended to run for extended 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.

d) Overload, choked air filter or excessive air inlet temperatures may cause Black smoke. Injectors may also cause certain smoking conditions. Replace Injectors.
5.8 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 50% 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 extended periods. Run engine for at least 8 hours under heavy load (80% or more) to burn out excess carbon deposits.
CHAPTER 6 - GENERATOR SET DOCUMENTATION

6.1 FAMILY TREE

The following section contains assembly drawings, schematics and wiring diagrams for the DEG. 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 A

OPERATIONS AND MAINTENANCE MANUAL

FOR THE

JOHN DEERE 3029T

DIESEL ENGINE
APPENDIX B

OPERATION, MAINTENANCE AND SERVICE MANUAL

FOR THE

MARATHON ELECTRIC

GENERATOR
APPENDIX C

INSTRUCTION MANUAL FOR THE
MARATHON ELECTRIC VOLTAGE REGULATOR
APPENDIX D

INSTRUCTION MANUAL FOR THE

GOVERNORS AMERICA

ENGINE GOVERNING SYSTEM

SPEED CONTROL UNIT
&
ELECTRONIC ACTUATOR
APPENDIX E

OPERATION AND MAINTENANCE

MANUAL FOR THE

ECU
APPENDIX I

INSTRUCTION MANUAL

FOR THE HYDRAULIC BOOM