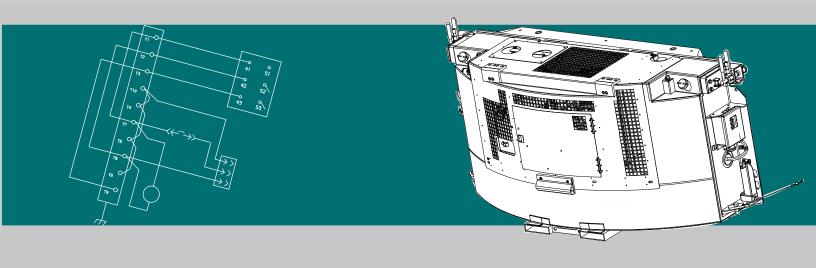


Diesel Generator Set



OPERATION AND SERVICE

For

69RG15

Generator Set Units:

PID RG1400 Series

PID RG1500 Series

PID RG1600 Series

PID RG1700 Series

PID RG1800 Series

PID RG1900 Series



OPERATION AND SERVICE

For **69RG15**

Generator Set Units:

PID RG1400 Series

PID RG1500 Series

PID RG1600 Series

PID RG1700 Series

PID RG1800 Series

PID RG1900 Series

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SECTION 1 SAFETY SUMMARY

GENERAL SAFETY NOTICES

The following general safety notices supplement the specific warnings and cautions appearing elsewhere in this manual. They are recommended precautions that must be understood and applied during operation and maintenance of the equipment covered herein. The general safety notices are presented in the following three sections labeled: First Aid, Operating Precautions and Maintenance Precautions. A listing of the specific warnings and cautions appearing elsewhere in the manual follows the general safety notices.

FIRST AID

An injury, no matter how slight, should never go unattended. Always obtain first aid or medical attention immediately.

OPERATING PRECAUTIONS

Always wear safety glasses and hearing protection.

Keep hands, clothing and tools clear of the radiator fan and rotating belts.

No work should be performed on the unit until all circuit breakers and start-stop switches are turned off and the negative battery terminal has been disconnected.

Always work in pairs. Never work on the equipment alone.

In case of severe vibration or unusual noise, stop the unit and investigate.

MAINTENANCE PRECAUTIONS

Be sure power is turned off and the negative battery cable is disconnected before working on generator set.

Do not bypass any electrical safety devices, e.g. bridging an overload, or using any sort of jumper wires. Problems with the system should be diagnosed, and any necessary repairs performed, by qualified service personnel.

In case of electrical fire, open circuit switch and extinguish with CO₂ (never use water).

Fuel Tanks present explosion, fire and rupture hazards even if liquid fuel has been drained. Do not attempt any repairs, especially repairs using flame, welder or torch, unless you have been properly trained and the tank has been emptied of liquid fuel and fuel vapors and the tank is properly ventilated.

UNIT HAZARD LABEL IDENTIFICATION

To help identify the hazard labels on the Unit and explain the level of awareness each one carries, explanations with appropriate consequences are provided below:



Indicates an immediate hazard which WILL result in severe personal injury or death.



Indicates hazards or unsafe conditions which COULD result in severe personal injury or death.



Indicates potential hazards or unsafe practices which COULD result in minor personal injury, product or property damage.

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SPECIFIC WARNING AND CAUTION STATEMENTS

The statements that follow are applicable to the generator set and appear elsewhere in this manual. These recommended precautions must be understood and applied during operation and maintenance of the equipment covered herein.

⚠ WARNING

To prevent injury, the procedures provided for installation and removal of the generator set must be followed carefully.

WARNING

Disconnect power plug before removing generator set.

WARNING

To prevent injury, the procedures provided for installation and removal of the generator set must be followed carefully.

MARNING

Double-check that the generator set clamp (B) is securely tightened against the face of the corner casting and that the generator set clamp hand nut is tight before transporting the container. A loose fit could cause damage to both the generator set and the generator set clamp, and cause serious injury during transport.

WARNING

Disconnect power plug before removing generator set.

WARNING

Beware of moving poly V-belt, belt driven components and hot exhaust components.

WARNING

Under no circumstances should ether or any other unauthorized starting aids be used in conjunction with the air intake heater.

WARNING

Beware of moving poly V-Belt and belt driven components.

WARNING

Beware of pinch points.

MARNING

Do not use gasoline to clean air cleaner parts.

⚠ WARNING

Do not direct water or steam into the generator openings. Do not allow any soap and water solutions to enter the alternator.

⚠ WARNING

High voltage (dielectric) testing must not be performed to the machine without first observing NEMA rules. The insulation of this generator winding may be safely checked by using a megger. A high megger reading indicates good insulation.

! CAUTION

Observe proper polarity when installing the battery or connecting a battery charger, the negative battery terminal must be grounded. Reverse polarity may damage the charging system. When charging the battery in unit, isolate the battery by disconnecting the negative battery terminal first, then the positive. Once the battery has been charged, connect the positive battery terminal first, then the negative.

A CAUTION

Never pour cold water into a hot engine.

A CAUTION

Use only ethylene glycol, anti-freeze (with inhibitors) in system. Use of glycol by itself will damage the cooling system.

! CAUTION

Always cover the engine inlet tube while the air cleaner is being serviced.

! CAUTION

Do not underfill or overfill the oil bath cups. Overfilling of cups causes loss of capacity; underfilling cups causes lack of filtering efficiency.

! CAUTION

When trying to restore residual magnetism, be sure to wear safety glasses and non-conductive gloves. Use an insulated 12 gauge (or higher) jumper wire. Cut off all but a few strands from both ends of the jumper wire to help prevent fusing.

A CAUTION

The rotor should not be pulled out from the alternator more than 0.75 inches. Damage to the bearing and windings may result.

! CAUTION

Continued operation with failed shockmounts may result in engine or generator damage.

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SECTION 2 DESCRIPTION

2.1 INTRODUCTION

The Carrier Transicold model 69RG15 clip-on diesel driven generator sets provide electrical power for all-electric refrigeration units.

The generator set (see Figure 2.1 and Figure 2.2) consists of a diesel engine direct-connected to an alternating current generator and mounted in a structural steel frame. The engine is a vertical in-line, four cylinder diesel manufactured by Kubota, while the generator is a 15 kW, brushless, single bearing type manufactured by Lima. The generator provides a constant 460 VAC, three-phase, 60 hertz electrical supply.

Electrical controls are mounted in a control box with operating controls and gauges mounted on a control panel (which also serves as the control box cover). The control panel components are protected by a deflector assembly or a windowed control box door.

Auxiliary engine equipment consists of the battery, solid state battery charging system, "spin-on" lube oil filter, fuel filter and other necessary components for proper unit operation. The water pump and the radiator cooling fan are belt-driven from the engine crankshaft. All references to engine are as viewed from the fly wheel end.

The 69RG15 is available as a standard configuration, with an Auto Restart option. The Auto Restart option automatically restarts the unit in the event of a unit shutdown.

Carrier Transicold's Ecodriven dual speed option provides an energy saving alternative to the practice of continuously running the generator at full speed. This speed reduction results in increased fuel economy, reduced carbon footprint, and lowers operating costs.

2.2 CONFIGURATION IDENTIFICATION

Generator set identification information is provided on a plate located below the right mounting clamp (front facing). The plate provides the generator set model number, serial number, and parts identification number (PID). The model number identifies the overall configuration while the PID provides information on specific optional equipment and differences in detailed parts.

Configuration identification for models covered herein are provided in **Table 2–1**. The model number, serial number and PID number must be included when ordering parts and inquiring about your unit.

Separately bound manuals covering the diesel engine are also available (see the following chart).

.

Manual/ Form No.	Equipment Covered	Type of Manual
62-11335	V2203-DI	Engine Part List
62-11362	V2203-DI	Workshop

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Table 2–1 Model Chart LEGEND

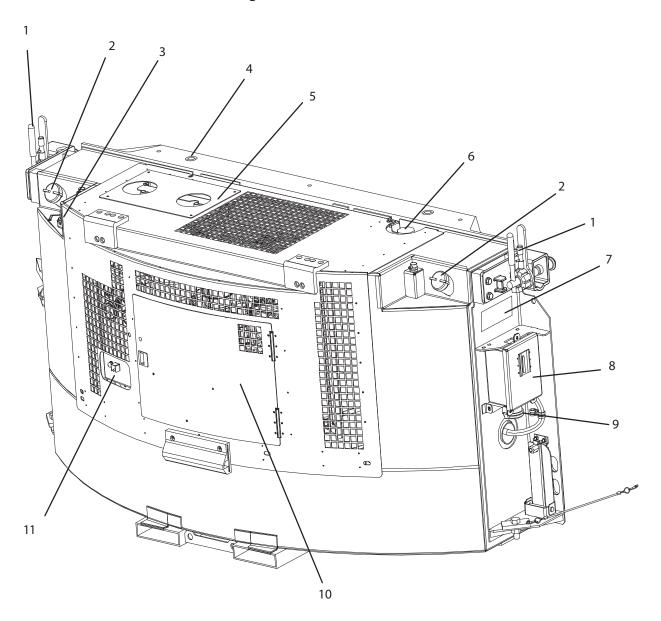
- A1-Pin Mount
- A2-Clamp Mount
- A3-Pin Mount with Clamp Provision
- B1-Receptacle, Standard
- B2-Receptacle, Time Delay
- B3-Receptacle, GPS
- C1-Control Box, Standard

- C2-Control Box, Auto Restart
- C3-Control Box, Auto Restart and Time Delay
- C4-Control Box, Dual Speed, GPS
- C5-Control Box, Auto Restart, Dual Speed
- C6-Control Box, Auto Restart, Dual Speed, Time Delay
- C7-Control Box, Dual Speed
- C8-Control Box, Standard, 2 Speed Provision

Model	PID	Electrical Wiring Schematic and Diagram Figures	Unit Mounting	Receptacle Box	Control Box
		1400 Series, Single S	Speed		
CODC45 420C 05	RG1450	6.6, 6.7, 6.8	A2	B1	C1
69RG15-130C-05	RG1411	6.6, 6.7, 6.8	A2	B1	C1
69RG15-130C-07	RG1403	6.3, 6.5, 6.8	A2	B2	C3
09KG15-130C-07	RG1409	6.3, 6.5, 6.8	A2	B2	С3
	RG1406	6.6, 6.7, 6.8	A1	B1	C1
69RG15-130P-06	RG1407	6.1, 6.2, 6.8	A1	B1	C1
09KG15-130F-00	RG1412	6.6, 6.7, 6.8	A1	B1	C1
	RG1413	6.3, 6.5, 6.8	A1	B1	C1
69RG15-130P-07	RG1402	6.3, 6.4, 6.8	A1	B1	C2
09KG15-130F-07	RG1408	6.3, 6.4, 6.8	A1	B1	C2
69RG15-130W-05	RG1404	6.6, 6.7, 6.8	А3	B1	C1
69KG15-130W-05	RG1410	6.6, 6.7, 6.8	А3	B1	C1
		1500 Series, Dual S	peed		
	RG1514	6.6, 6.7, 6.8	A2	B1	C4
69RG15-130C-08	RG1515	6.6, 6.7, 6.8	A2	B1	C4
	RG1520	6.6, 6.7, 6.8	A2	В3	C4
69RG15-130P-07	RG1502	6.6, 6.7, 6.8	A1	B1	C7
69RG15-130W-05	RG1504	6.6, 6.7, 6.8	A1	B1	C7
69RG15-130W-08	RG1518	6.6, 6.7, 6.8	A1	В3	C4
69RG15-130P-08	RG1519	6.6, 6.7, 6.8	A1	В3	C4
69RG15-130C-05	RG1521	6.6, 6.7, 6.8	A2	B1	C7
	16	600 Series, Dual Speed	Provision		
	RG1604	6.6, 6.7, 6.8	A1	B1	C8
69RG15-130W-05	RG1616	6.6, 6.7, 6.8	A1	B1	C8
	RG1624	6.6, 6.7, 6.8	A1	B1	C8
69RG15-130C-05	RG1621	6.6, 6.7, 6.8	A2	B1	C8
091/010-100/-00	RG1623	6.6, 6.7, 6.8	A2	B1	C8
69RG15-130P-06	RG1613	6.6, 6.7, 6.8	A1	B1	C8

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Figure 2.1 Generator Set



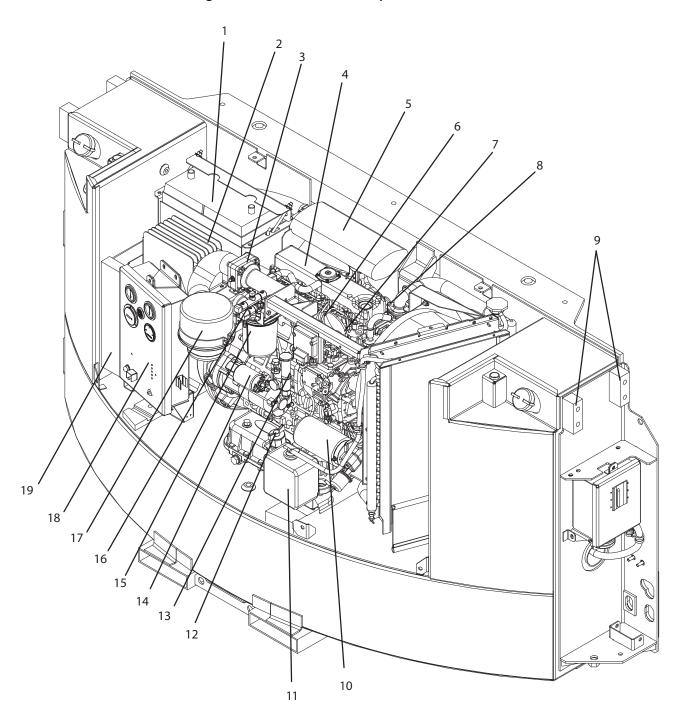
- 1. Mounting Clamp (Optional)
- 2. Fuel Cap
- 3. Fuel Gauge (Either Side)
- 4. Mounting Pin
- 5. Battery Access Panel
- 6. Radiator Cap

- 7. Unit Model, Serial & PID Plate
- 8. Circuit Breaker (CB1)
- 9. Receptacle
- 10. Access Door
- 11. Control Box

_ _ _ _ .

2–3

Figure 2.2 Generator Set - Top Cover Removed



- 1. Battery
- 2. Solid State Battery Charger
- 3. Intake Heater (IH)
- 4. Engine
- 5. Exhaust Muffler
- 6. Injection Pump
- 7. Fuel Warmer (If Equipped)
- 8. Water Temperature Sender
- 9. Mounting Blocks
- 10. Engine Oil Filter

- 11. Coolant Recovery Bottle
- 12. Lube Oil Dip Stick/Fill Cap
- 13. Mechanical Fuel Pump
- 14. Starter Motor
- 15. Fuel Filter
- 16. Fuel Heater (If Equipped)
- 17. Air Cleaner
- 18. Control Box and Panel (see Figure 2.7 or Figure 2.8)
- 19. Alternating Current Generator

- - - -

2.3 ENGINE

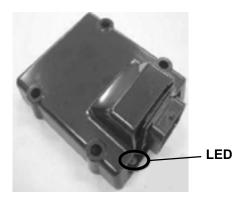
The engine is a vertical, in-line four cylinder diesel engine, which is direct-connected to the alternating current generator. Information on the major engine systems is provided in the following subparagraphs.

2.3.1 Electronic Governor Module

The electronic governor module (EG) is a solid state control module preprogrammed for 1800 RPM high speed and 1500 RPM low speed operation. The electronic governor module, along with the engine speed sensor, replaced the manual governor in order to provide constant and economical engine speed.

The unit has an LED which may be used to diagnose failures within the electronic speed control system, refer to **Section 4.6** for additional troubleshooting information on diagnosing failures.

Figure 2.3 Electronic Governor Module



2.3.2 Engine Air System

The air cleaner (Figure 2.2) is designed to prolong engine life and performance by preventing dirt and grit from entering the engine and causing excessive wear on all operating parts. In order for the air filter to operate properly, the operator must regularly maintain the air cleaner equipment in accordance with the instructions provided within this document.

2.3.3 Fuel System

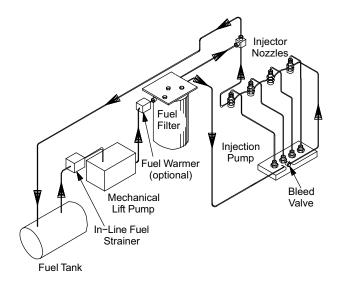
The fuel system is fitted with an in-line fuel strainer and a fuel filter, which also acts as a water separator. The fuel system is shown in **Figure 2.4**.

There are two fuel heating / warming options:

The fuel heater system is located in the fuel filter, and uses a 12 volt heater to heat fuel as it passes through the fuel filter, see **Figure 2.2**.

The fuel warming system is a mechanical system that warms fuel by passing it through a heat exchanger that is warmed with engine coolant, see **Figure 2.2**.

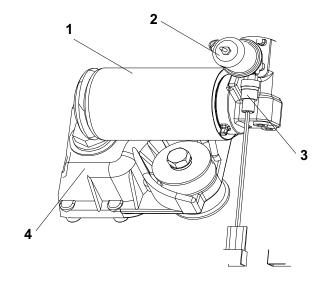
Figure 2.4 Fuel System Diagram



2.3.4 Lube Oil Filter Arrangement

The engine lubricating oil filter is mounted in a horizontal arrangement and shown in **Figure 2.5**.

Figure 2.5 Lube Oil



- 1. Oil Filter (Primary)
- 2. Oil Pressure Sender
- 3. Oil Pressure Switch
- 4. Oil Pan

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2.4 ENGINE SCREW THREADS

All threads used on the engine are metric except for the oil drain plug, which is American Standard Pipe Thread (NPT).

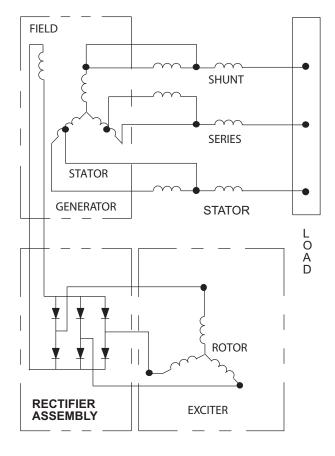
2.5 ALTERNATING CURRENT GENERATOR

2.5.1 Principle of Operation

The Marathon Alternator Company (Lima) brushless alternating current generator (see Figure 2.2) is a self-regulated, rotating field synchronous unit. The generator stator and exciter stator are combined in a common housing. The generator field, exciter rotor, and rotating rectifier assembly are mounted on a common shaft. The output of the exciter rotor is applied to the generator field winding through a rotating, full-wave bridge, silicon rectifier unit.

All connections between the exciter stator windings and the generator stator windings are internal within the stator housing. Only the output power leads are connected at the terminal box, located on top of the generator.

Figure 2.6 A-C Generator Circuit Diagram



2.5.2 Alternating Current Generator Diagram

Figure 2.6 shows the internal schematic diagram of the generator, exciter, and rectifier unit. The generator is a three-phase unit, and the exciter stator and exciter rotor also have three-phase windings. A portion of the exciter stator windings is connected across a tap on the generator stator winding. This exciter shunt winding provides the generator field excitation power required for the generator no-load voltage. Another portion of exciter stator windings is connected in series with the output of the generator and provides a compounding excitation characteristic.

The rotor is, in effect, the secondary of a rotating current transformer induction frequency converter. The exciter rotor output voltage is applied to the generator field windings by a three-phase, full wave rotating silicon rectifier unit. The response time of the excitation system is very fast as the exciter stator carries an alternating current corresponding to the load current that appears immediately on the exciter primary. An increase in load current will cause an immediate increase in the exciter secondary output voltage, which is rectified and applied to the generator field windings. The inherent compounding characteristics of the excitation system provide excellent voltage regulation even under heavy overload conditions.

2.6 BATTERY CHARGING SYSTEM

The solid state battery charger (see Figure 2.2) is located on top of the generator. The charger is powered by the generator, and this input is protected by a circuit breaker located on the control panel. The battery charger produces a tapered charge (25 amps maximum) and is designed not to overcharge the battery.

! CAUTION

Observe proper polarity when installing the battery or connecting a battery charger. The negative battery terminal must be grounded. Reverse polarity may damage the charging system. When charging the battery in unit, isolate the battery by disconnecting the negative battery terminal first, then the positive. Once the battery has been charged, connect the positive battery terminal first, then the negative.

2.7 OPERATING CONTROLS & INSTRUMENTS

2.7.1 Introduction

Components required for monitoring and controlling the unit are located in the control box, on the control panel (see Figure 2.1) and on the receptacle box (see Figure 2.1).

2.7.2 Control Panel and Related Components

a. Gauges and Senders

Oil Pressure Gauge (see Figure 2.7 or Figure 2.8)

The purpose of this gauge is to observe normal operating engine oil pressure. Normal oil pressure is 35 to 60 psig (3.3 to 5.2 kg/cm²).

2. Oil Pressure Sender (see Figure 2.5)

This device senses engine lube oil pressure and transmits a signal to the oil pressure gauge. The oil pressure sender is located on the oil filter housing.

Water Temperature Gauge (see Figure 2.7 or Figure 2.8)

The function of this gauge is to observe water operating temperature. The gauge is connected to the water temperature sender.

4. Water Temperature Sender

This device (see **Figure 2.2**) senses engine water temperature and transmits a signal to the water temperature gauge. The water temperature sender is located on the top, left-hand side of the engine below the high water temperature switch.

Auto Restart Module (If So Equipped) (see Figure 2.8)

Auto start/restart is provided to simplify the startup process and provide an automatic restart feature that will automatically attempt to restart the unit in the event of shutdown. Four LEDs are used to indicate shutdown from overcrank, overspeed, low oil pressure, and high water temperature. A fifth LED is used to indicate the unit is running. Refer to **Table 2–2** for system preset values.

The auto restart function will perform a series of six attempts to restart the unit and make three attempts within each series. Once the function has completed all 18 attempts, the unit will automatically lock out future crank attempts. Refer to Table 2–3 for detailed information on auto restart sequencing.

b. Meters

1. Ammeter (A) (see Figure 2.7 or Figure 2.8)

The ammeter is an indicator of the charging system and unit electrical draw. It indicates the rate of discharge or charge of the battery. During start up, the intake heater draws approximately 42 amps.

Total Time Meter (TT) (see Figure 2.7 or Figure 2.8)

This meter designates the total hours and provides an accurate readout of accumulated engine running time. This data can be used to establish the proper periodic maintenance schedule. (Refer to **Table 5–1**.)

c. Manual Switches

1. Intake Heater Switch (HS)

The intake heater switch is of the momentary type. When held in the PREHEAT position, the switch allows approximately 42 amps of battery current to flow into the intake heater, which preheats the air within the intake manifold and allows the engine to start. After starting the engine, the intake heater switch should continue to be held in the ON position for approximately 5 seconds until the engine has developed enough oil pressure to close the oil pressure safety switch.

2. Ignition Switch (IGN) (see Figure 2.7)

The ignition switch is of the momentary type to be used in the OFF/ON/START positions. When held in the START (ignition) position, it energizes the starter motor solenoid, which in turn allows the starter motor to crank the engine. The switch is released to the RUN position once the engine has started.

3. Ignition Switch (IGN) (Auto Restart) (see **Figure 2.8**)

The ignition switch is of the maintained contact type to be used in the RUN/OFF positions. When switched to the RUN position, it energizes the control module, which in turn controls all functions of the genset.

4. Operating Mode Switch (If So Equipped) (see Figure 2.7 and Figure 2.8)

The Operating Mode (Dual Speed) switch is of the maintained contact type to be used in the ECONOMY/POWER positions. When switched to the ECONOMY position, it energizes the dual speed timer control module, which signals the programmed electronic governor module (EG) to reduce engine speed from 1800 RPM to 1500 RPM after a period of two (2) hours.

d. Timers

2-7

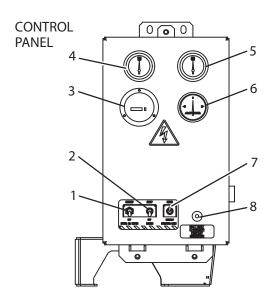
1. Intake Heater Timer (IHT) (If So Equipped)

The Intake Heater Timer continues to supply power to the intake heater for 3 minutes after initial start-up.

2. Dual Speed Timer (DT) (If So Equipped)

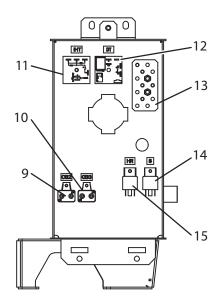
The Dual Speed Timer provides power to the electronic governor module for a 2 hour period to maintain initial high speed operation.

Figure 2.7 Standard Control Panel Box and Panel With Dual Speed Option



- 1. Intake Heater Switch
- 2. Ignition Switch
- 3. Total Time Meter
- 4. Water Temperature Gauge
- 5. Oil Pressure Gauge
- 6. Ammeter
- 7. Operating Mode Switch (If Equipped)
- 8. Battery Charger Fuse or Circuit Breaker (CB5)

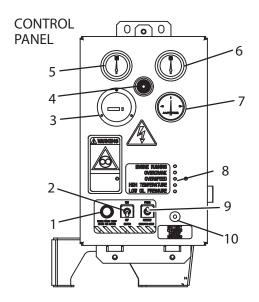
CONTROL BOX (Front View with Cover Removed)



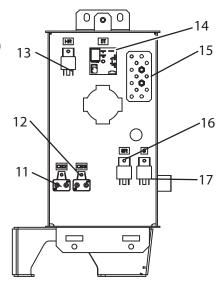
- 9. Circuit Breaker (CB2)
- 10. Circuit Breaker (CB3)
- 11. Intake Heater Timer
- 12. Dual Speed Timer (If Equipped)
- 13. Ground Strap Assembly
- 14. Safety Relay
- 15. Intake Heater Relay

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Figure 2.8 Auto Restart Control Box and Panel With Dual Speed Option



CONTROL BOX (Front View with Cover Removed)



- 1. Engine Start/Intake Heater Energized Light
- 2. Ignition Switch
- 3. Total Time Meter
- 4. Engine Start Alarm (Buzzer)
- 5. Water Temperature Gauge
- 6. Oil Pressure Gauge
- 7. Ammeter
- 8. Auto Restart Module
- 9. Operating Mode Switch (If Equipped)

- 10. Battery Charger Fuse or Circuit Breaker (CB5)
- 11. Circuit Breaker (CB2)
- 12. Circuit Breaker (CB3)
- 13. Intake Heater Relay
- 14. Dual Speed Timer (If Equipped)
- 15. Ground Strap Assembly
- 16. Starter Relay
- 17. Safety Relay

Table 2-2 Auto Restart Preset Values

Indicator	Preset Value	Description
Overspeed	2100 RPM	Overspeed is the point at which the unit will signal for shutdown.
Crank Disconnect	700 RPM	Crank Disconnect is the point at which the Auto Restart module senses the engine has started and will disengage the starter.
Shutdown Lockout Delay	15 seconds	The oil pressure and water temperature inputs are ignored during this 15 second delay (during startup).
Intake Heater Delay	30 seconds preheat 3 minutes post heat	The delay is used during start up. The intake heater delay begins timing after the Auto Restart module signal is received. During the entire delay, the intake heater circuit will be energized, an indicator light will be illuminated, and an alarm will sound. When the delay expires, the unit will crank.
Crank Attempts	18 attempts	A series of six attempts with three attempts in each series (total of 18 attempts), refer to Table 2–3 , Auto Restart Sequencing.

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Table 2-3 Auto Restart Sequencing

*Engine crank and rest is repeated three times each series unless the engine starts.

Series Attempt Number	Intake Heater Energized in Seconds	Fuel Solenoid Engaged	Engine Crank Duration (Seconds)	Engine Rest Duration (Seconds)	Engine Status
1	30	X	Up To 15	25	If the engine starts: a. Run sequence begins b. Intake heater remains energized for 3 minutes If the engine fails to start: a. Intake heater will de-energize. b. Fuel solenoid will de-energize. c. Crank output will de-energize. d. Overcrank LED will flash once. Wait two seconds and repeat. e. Unit will rest 30 minutes and proceed to the next series.
2	30	X	Up To 15	25	If the engine starts: a. Run sequence begins. b. Intake heater remains energized for 3 minutes. If the engine fails to start: a. Intake heater will de-energize. b. Fuel solenoid will de-energize. c. Crank output will de-energize. d. Overcrank LED will flash twice. Wait two seconds and repeat. e. Unit will rest 30 minutes and proceed to the next series.
3	30	X	Up To 15	25	If the engine starts: a. Run sequence begins. If the engine fails to start: a. Intake heater will de-energize. b. Fuel solenoid will de-energize. c. Crank output will de-energize. d. Overcrank LED will flash three times. Wait two seconds and repeat. e. Unit will rest five hours and proceed to the next series.
4	30	Х	Up To 15	25	If the engine starts: a. Run sequence begins. If the engine fails to start: a. Intake heater will de-energize. b. Fuel solenoid will de-energize. c. Crank output will de-energize. d. Overcrank LED will flash four times. Wait two seconds and repeat. e. Unit will rest five hours and proceed to the next series.

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Table 2–3 Auto Restart Sequencing

*Engine crank and rest is repeated three times each series unless the engine starts.

Series Attempt Number	Intake Heater Energized in Seconds	Fuel Solenoid Engaged	Engine Crank Duration (Seconds)	Engine Rest Duration (Seconds)	Engine Status
5	30	X	Up To 15	25	If the engine starts: a. Run sequence begins. If the engine fails to start: a. Intake heater will de-energize. b. Fuel solenoid will de-energize. c. Crank output will de-energize. d. Overcrank LED will flash five times. Wait two seconds and repeat. e. Unit will rest five hours and proceed to the next series.
6	30	X	Up To 15	25	If the engine starts: a. Run sequence begins. If the engine fails to start: a. Intake heater will de-energize. b. Fuel solenoid will de-energize. c. Crank output will de-energize. d. Overcrank LED will illuminate solid and lock out future crank attempts. e. To reset, turn unit power switch OFF and back ON.

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2.8 SAFETY DEVICES

Safety devices, such as circuit breakers, fuses, and safety switches, protect system components from damage.

The AC generator, solid state battery charger, fuel heater, high water temperature, safety relay, total time meter and intake heater are protected by circuit breakers. If a safety device opens and there is an interruption of electrical current, the electronic governor module will be de-energized, which will also de-energize the fuel solenoid, interrupt the fuel flow to the engine and stop the engine.

In units with auto restart, the engine, engine control devices, and engine monitoring devices are protected by the auto restart module, circuit breaker, low oil pressure switch, and high water temperature switch. These safety devices monitor system operating conditions and open a set of electrical contacts when an unsafe condition occurs. If a safety device opens and there is an interruption of electrical current, the electronic governor module will be de-energized, which will also denergize the fuel solenoid, interrupt the fuel flow to the engine and stop the engine.

De-energizing the fuel solenoid shuts off the fuel supply to the engine; thus stopping the engine. Safety device specifications are provided in **Table 2–4**.

Table 2-4 Safety Devices

Unsafe Condition	Safety Switch	Switch Setting		
ENGINE				
Low engine lubricating oil pressure	Low oil pressure switch (LOP) - Automatic reset	Opens below 18 psig (1.27 kg/cm ²)		
High engine cooling water temperature	Water temperature switch (HWT) - Automatic reset	Opens at 230°F (110°C)		
Excessive current draw by the safety relay, fuel heater, water temperature gauge, oil pressure gauge or total time meter	· · · · · ·	Trips at 30 amps		
Excessive current draw by the electronic governor module	Fuse 1, 2, 3	Trips at 10 amps		
	INTAKE HEATER			
Excessive current draw on intake heater circuit	Circuit breaker (CB3) - Automatic reset	Opens at 50 amps		
BATTERY CHARGER				
Excessive current draw on 230 volt feed circuit	Circuit breaker (CB5) - Manual reset	Opens at 3 amps		
GENERATOR				
Excessive current draw by load	Circuit breaker (CB1, 460 volt) - Manual reset	Trips at 26 amps (460 VAC)		

2.9 UNIT SPECIFICATIONS

a. Fuel Tanks	Nominal Tank Sizes	Fill Capacity	Draw Capacity
a. i dei ranks	130 Gallon	130 Gallon	124 Gallon*

^{*}Allows for DOT required 5% vapor space

	Battery	63 lb (28.6 kg)
b. Weights	Generator (A-C)	280 lb (127 kg)
b. Weights	Engine (Dry) - without Accessories	439 lb (199 kg) Approximate
	Unit (dry, with 130 gallon tank)	1830 lb (830.1 kg)

2.10 ENGINE DATA

a. Bore/Stroke	3.26	in. (83 mm) / 4.03 in. (102.4 mm)	
b. Compression Ratio		21.5 : 1	
c. Cylinders (Number)		Four	
d. Displacement	1:	35.2 cubic inches (2.22 liters)	
e. Firing Order		1-3-4-2	
	Oil Pressure Safety Switch Setting Opens	18 psig (1.27 kg/cm ²)	
	Capacity	Engine - 16.0 US quarts (15.1 liters), includes standard filter.	
		Dipstick in oil pan or fill cap	
	Oil Level Indicator	NOTICE	
f. Lubrication System		To check oil level on engines with the dipstick mounted in the fill cap, remove the cap and wipe the dipstick clean. Insert the cap back onto the oil fill tube, then remove to check level. It is not necessary to screw the cap back into the fill tube when checking level. DO NOT add oil if level is within the "safe" range. If needed, add oil to bring level within the "safe" range. Screw cap fully into fill tube after checking level.	
	Lube Oil Specification	Use a heavy duty lubricating oil conforming to American Petroleum Institute (API) Service Classification CG, CH or CI, Base Number 10 or above.	
	Lube Oil Viscosity (Outdoor Temperature)	Fahrenheit: 0°F to 45°F Centigrade: -18°C to 7°C SAE: 10W30	
		Fahrenheit: 45°F and above Centigrade: 7°C and above SAE: 10W30 or 15W40	

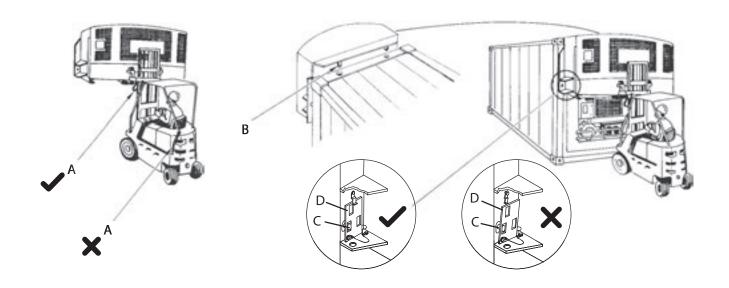
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	Winter	Summer		
	Diesel No. 1	Diesel No. 2		
g. Fuel and Fuel Heater		FHT		
Thermostat (FHT)	Close on temperature fall @ 45+/- 6.5°F	Open on temperature rise @ 75+/- 6.5°F		
	Power Consu	mption: 150 Watts @ +/- 10% at 14 VDC		
h. Fuel Warmer		Coolant Temperature		
i. Intake Heater	Ar	nperage - 42 amps at 12 VDC		
	Resi	stance (cold) - Approx. 0.3 ohms		
j. Horsepower	27 HP @ 1	800 RPM at 3000 feet above sea level		
	32	HP @ 1800 RPM at sea level		
	Capacity	6 U.S. quarts (5.68 liters) - includes 1 quart (0.95 liter) in coolant recovery bottle. (Refer to Section 5.4.5)		
	Anti-Freeze: Conventional	The cooling system may be factory charged with a 50/50 mix of ethylene glycol and water. This mixture provides protection to -34F (-37C). For replacement, use a low silicate anti-freeze meeting GM specifications GM 6038M or equal. Again, a 50/50 mix is recommended.		
k. Cooling System	Anti-Freeze: Extended Life	The cooling system may be factory charged with a 50/50 mix of extended life coolant (ELC) and deionized water. This mixture provides protection to -34F (-37C). For replacement, with extended life coolant (ELC) meeting GM specification GM6277M and deionized water. Again, a 50/50 mix is recommended. Extended life coolant is red or orange in color. DO NOT mix with conventional coolant.		
	Water -	Temperature Safety Switch Setting		
	Opens	230 +/- 5°F (110 +/- 3°C)		
	Resets	200°F (93°C) - minimum		
	Thermostat:			
	Starts to open	177 to 182°F (80 to 84°C)		
	Fully open	203°F (95°C)		
I. Lubrication System	Oil Pressure	35 to 60 psig (3.3 to 5.2 kg/cm ²)		
m. Electrical	Generator	460 VAC (+/- 10%) @ 60 hz		

SECTION 3 OPERATION

3.1 GENERATOR SET INSTALLATION AND REMOVAL - PIN TYPE WITH LOCKING PLATE

Figure 3.1 Generator Set Mounting - Pin Type with Locking Plate



MARNING

To prevent injury, the procedures provided for installation and removal of the generator set must be followed carefully.

NOTICE

This generator set is equipped with special pins and mounting bolts and can be installed only on containers with matching installation points.

a. Installation

- Place forks into fork pockets of generator set. Attach safety chain (A) between fork pockets on generator set and fork truck. Be sure chain (A) is short enough to retain the generator set on the forks.
- Line up generator set with refrigeration unit and container. Raise generator set until the top is several inches above the top edge of the container. Move generator set against container and lower into position. Ensure the two pins (B) are fully engaged in mating holes in container.

- 3. Keep forks in pockets on generator set and tighten mounting bolt (C) on each side of generator set into container frame. Torque mounting bolts to 125 +/- 25 ft.-lbs (17.3 +/- 3.5 mkg). Ensure retaining plates (D) are locked into position so as to capture bolt heads and prevent turning.
- 4. Remove safety chain (A) before removing forks.

b. Removal

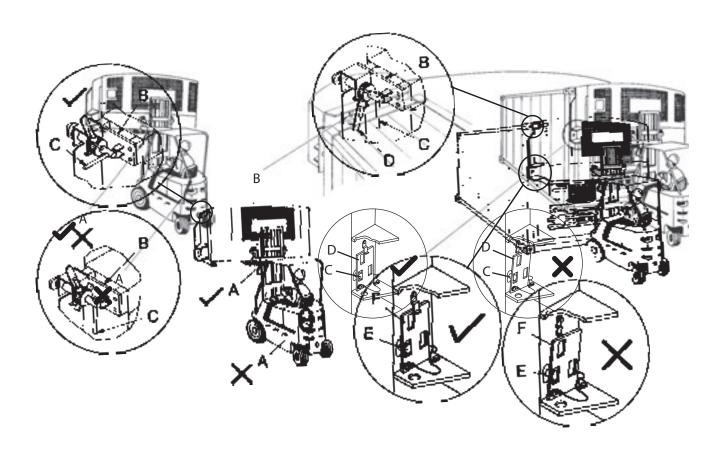
<u> NARNING</u>

Disconnect power plug before removing generator set.

- Move forks into fork pockets on generator set. Attach safety chain (A) between fork pockets on generator set and fork truck.
- 2. Release retaining plate (D) from locking bracket on each side of generator set.
- 3. Remove mounting bolt (C) on each side of generator set.
- Raise generator set several inches to disengage pins (B) from mating holes and remove from container.

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Figure 3.2 Generator Set Mounting - Clamp Type with Locking Plate



⚠ WARNING

To prevent injury, the procedures provided for installation and removal of the generator set must be followed carefully.

NOTICE

This generator set is equipped with clamps and mounting bolts and can be installed only on containers with matching installation points for the mounting bolts.

a. Installation

 Place forks into fork pockets of generator set. Attach safety chain (A) between fork pockets on generator set and fork truck. Be sure chain (A) is short enough to retain generator set on forks. Ensure that generator set clamps (B) are in the unlocked position and actuating handle (C) in the horizontal position. 2. Move generator set against container and fully engage clamps into mating holes in container castings. On both clamps, turn the actuating hand lever (C) into the vertical down position (locked). Using the ratchet handle (D), tighten the hand nut. Tightening should continue until the face of the clamp is hard against the corner casting and the actuating hand lever is moved over the locking tabs. Leave the ratchet handle (D) engaged in the tightening direction with the ratchet handle in the vertical down position.

! WARNING

Double-check that the generator set clamp (B) is securely tightened against the face of the corner casting and that the generator set clamp hand nut is tight before transporting the container. A loose fit could cause damage to both the generator set and the generator set clamp, and cause serious injury during transport.

Keeping forks in pockets on the generator set, tighten bolt (E) into container frame on each side of the generator set. Torque mounting bolts to 125 +/- 25 ft.-lbs (17.3 +/- 3.5 mkg). Ensure retaining plates (F) are locked into position so as to capture bolt heads (E) and prevent turning.

4. Remove safety chain (A) before removing forks.

b. Removal

WARNING

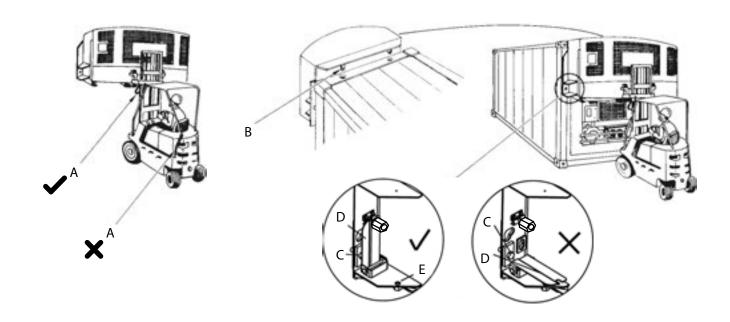
Disconnect power plug before removing generator set.

 Place forks into fork pockets on generator set. Attach safety chain (A) between fork pockets on generator set and fork truck.

- 2. Release retaining plate from locking bracket on each side of generator set.
- 3. Remove mounting bolt (E) on each side of generator set.
- Disengage clamps (B) by setting ratchet handle (D) in the loosening position. Loosen the hand nut until the actuating hand lever is clear of the locking tabs.
- 5. Turn actuating hand lever (C) upward into the horizontal position.
- Carefully remove the generator set from the container.

3.3 GENERATOR SET INSTALLATION AND REMOVAL - PIN TYPE WITH LOCKING BRACKET

Figure 3.3 Generator Set Mounting - Pin Type with Locking Bracket



WARNING

To prevent injury, the procedures provided for installation and removal of the generator set must be followed carefully.

NOTICE

This generator set is equipped with special pins and mounting bolts and can be installed only on containers with matching installation points.

a. Installation

- Place forks into fork pockets of generator set. Attach safety chain (A) between fork pockets on generator set and fork truck. Be sure chain (A) is short enough to retain the generator set on the forks.
- Line up generator set with refrigeration unit and container. Raise generator set until the top is several inches above the top edge of the container. Move generator set against container and lower into position. Ensure the two pins (B) are fully engaged in mating holes in container.
- Keep forks in pockets on generator set and tighten mounting bolt (C) on each side of generator set into container frame. Torque mounting bolts to 125 +/- 25 ft.-lbs (17.3 +/- 3.5 mkg).

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Ensure locking brackets (D) are locked into position so as to capture bolt heads (C) and prevent turning.

4. Remove safety chain (A) before removing forks.

b. Removal

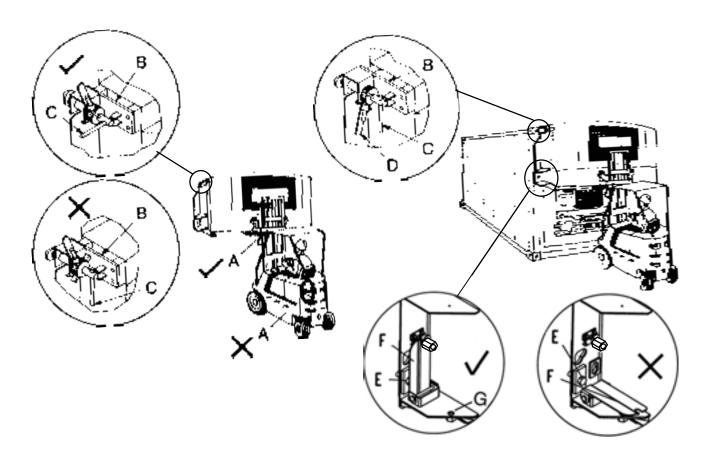
⚠ WARNING

Disconnect power plug before removing generator set.

- Move forks into fork pockets on generator set. Attach safety chain (A) between fork pockets on generator set and fork truck.
- 2. Release locking brackets (D) on each side of generator set.
- 3. Remove mounting bolt (C) on each side of generator set and tighten threaded hole (E).
- Raise generator set several inches to disengage pins (B) from mating holes and remove from container.

3.4 GENERATOR SET INSTALLATION AND REMOVAL - CLAMP TYPE W/ LOCKING BRACKET

Figure 3.4 Generator Set Mounting - Clamp Type with Locking Bracket



MARNING

To prevent injury, the procedures provided for installation and removal of the generator set must be followed carefully.

NOTICE

This generator set is equipped with clamps and mounting bolts and can be installed only on containers with matching installation points for the mounting bolts.

a. Installation

 Place forks into fork pockets of generator set. Attach safety chain (A) between fork pockets on generator set and fork truck. Be sure chain (A) is short enough to retain generator set on forks. Ensure that generator set clamps (B) are in the unlocked position and actuating handle (C) in the horizontal position.

2. Move generator set against container and fully engage clamps into mating holes in container castings. On both clamps, turn the actuating hand lever (C) into the vertical down position (locked). Using the ratchet handle (D), tighten the hand nut. Tightening should continue until the face of the clamp is hard against the corner casting and the actuating hand lever is moved over the locking tabs. Leave the ratchet handle (D) engaged in the tightening direction with the ratchet handle in the vertical down position.

♠ WARNING

Double-check that the generator set clamp (B) is securely tightened against the face of the corner casting and that the generator set clamp hand nut is tight before transporting the container. A loose fit could cause damage to both the generator set and the generator set clamp, and cause serious injury during transport.

- Keeping forks in pockets on the generator set, tighten bolt (E) into container frame on each side of the generator set. Torque mounting bolts to 125 +/- 25 ft.-lbs (17.3 +/- 3.5 mkg). Ensure locking brackets (F) are locked into position so as to capture bolt heads (E) and prevent turning.
- 4. Remove safety chain (A) before removing forks.

b. Removal

WARNING

Disconnect power plug before removing generator set.

- 1. Place forks into fork pockets on generator set. Attach safety chain (A) between fork pockets on generator set and fork truck.
- 2. Release retaining plate from locking bracket on each side of generator set.
- 3. Remove mounting bolt (E) on each side of generator set and tighten into threaded hole (G).
- Disengage clamps (B) by setting ratchet handle (D) in the loosening position. Loosen the hand nut until the actuating hand lever is clear of the locking tabs.
- 5. Turn actuating hand lever (C) upward into the horizontal position.

Carefully remove the generator set from the container.

3.5 STARTING AND STOPPING INSTRUCTIONS

3.5.1 Pre-Start Inspection

- 1. Check engine lubrication and fuel filters, oil lines, and connections for leaks. If required, tighten connections and/or replace gaskets.
- Check engine lubricating oil level. (Refer to Section 2.10, table entry f.)
- 3. Check poly V-belt for fraying or cracks and proper tension. (Refer to **Section 5.4.10**.)
- Check radiator hoses for leaks and check radiator coolant level. (Refer to Section 2.10, table entry k.)
- 5. Check radiator coil and generator air intake screen for cleanliness. If required, clean using compressed air, reversing the normal air flow.
- Check air cleaner for cleanliness and clean if necessary. (Refer to Section 5.4.11.)
- 7. Check in-line fuel strainer and clean if necessary. (Refer to **Section 5.4.4**.)
- 8. Drain water from fuel filter bowl.
- 9. Fill fuel tank with diesel fuel. (Refer to **Section 2.10**, table entry g.)
- 10. Check air intake heater amperage. (Refer to **Section 2.10**, table entry i.)
- 11. Check battery terminals for cleanliness and secureness. If required, clean, then coat with a battery terminal sealant.
- 12. Check, and if required, tighten all electrical connections.
- 13. Check, and if required, tighten all hardware (brackets, etc.).
- Ensure the main generator set circuit breaker (CB1) is in the OFF position. Connect power cable to refrigeration unit and proceed to Section 3.5.2.

3.5.2 Starting Instructions

3-5

Before start up, both the Genset circuit breaker (CB1) and the refrigerated unit should be OFF. After start up, the Genset unit should be run for at least two minutes to allow the power source to stabilize before supplying power to the refrigerated unit. This will eliminate the potential of any cold start transient spikes from reaching the refrigerated unit. Cold start transient spikes can potentially cause nuisance over voltage alarms on refrigerated units that are sensitive to electrical spikes or transients.

↑ WARNING

Beware of moving poly V-belt, belt driven components and hot exhaust components.

MARNING

Under no circumstances should ether or any other unauthorized starting aids be used in conjunction with the air intake heater.

NOTICE

Piston rings in engines that have operated less than 100 hours may not be fully seated. This may lead to the possibility of oil seepage from the exhaust pipe. To properly seat the rings, operate the engine under full load for a period of 24 hours. If the condition persists, check valve clearance when the engine is cold. (Refer to engine workshop manual listed in Section 2.2.)

a. Standard Units

- 1. Make sure that CB-1 is in the OFF position.
- 2. Hook up the 460 volt cable from the refrigerated unit to the Genset receptacle.
- Hold intake heater switch (see Figure 2.7) in the PREHEAT position. Suggested hold times for a cold engine are as follows:

COLD ENGINE PREHEAT TIMES			
Ambient Temperature Time			
78° F / 26° C	5 seconds		
32° F to 78° F (0° to 26°C)	10 seconds		
18° F to 32° F (-8° to 26° C)	20 seconds		
Below 18° F / -8° C	30 seconds		

- 4. With the intake heater switch held in the PRE-HEAT position, place the ignition switch in the START position.
- 5. After the engine has started, continue to hold the intake heater switch in the PREHEAT position until the engine develops sufficient oil pressure to close the oil pressure safety switch (approximately 5 seconds). When released, the intake heater switch will automatically return to the OFF position and the heater will remain energized for 3 minutes.

b. Units with Auto Restart

- 1. Make sure that CB-1 is in the OFF position.
- 2. Hook up the 460 volt cable from the refrigerated unit to the Genset receptacle.
- 3. Place the Ignition switch (IGN) (see **Figure 2.7**) in the RUN position.

 The auto restart module will energize the heater for 30 seconds and the safety buzzer will sound. After the 30 second delay, the unit will attempt to start.

3.5.3 Post-Start Inspection

- 1. Allow the Genset unit to run for at least 2 minutes.
- 2. Turn on CB-1 for 460 volt units.
- Check generator output with a voltmeter. In the no load condition, output should be at 490 (+/-15 volts) with 1800 engine RPM.
- 4. Start refrigeration unit.
- 5. Run engine 10 minutes (check total time meter operation).
- 6. Listen for abnormal bearing noise (AC generator).
- 7. Check fuel lines, lube oil lines, and filters for leaks.
- 8. Check exhaust system for leaks.

3.5.4 Stopping Instructions

- 1. Place CB-1 in the OFF position.
- 2. Place the ignition switch in the OFF position.

3.6 SEQUENCE OF OPERATION

⚠ WARNING

Beware of moving poly V-Belt and belt driven components.

a. Standard Units

With the intake heater switch (HS) held in the ON position, current flows through the ammeter to the intake heater. While the heater is on, the ammeter will show a 42-amp draw.

A second set of contacts also energizes the safety relay (S).

If the high water temperature switch (HWT) opens to break the safety relay ground connection, the safety relay will not energize, and the engine will not start.

To start the engine, the ignition switch (IGN) is held in the START position. With the switch in the START position, current flows to the start solenoid (SS), through the SS contacts to the starter motor (SM). Current then flows to the intake heater timer, intake heater relay (HR) and to the heater, while simultaneously powering the electronic governor module (EG), fuel solenoid (FS), and engine speed sensor (ESS).

The starter motor turns over the engine resulting in pumping of fuel to the engine cylinders by the injection pump. This fuel is ignited by heat of compression; thus starting the engine. When the engine has developed sufficient oil pressure, the low oil pressure switch (LOP) contacts close to maintain power to the safety relay (S).

Once the engine has started and the start switch has been released, the starter motor will stop cranking and the intake heater will remain energized for 3 minutes.

With the engine running, the battery charger provides DC power to operate the control system and charge the battery.

b. Units with Auto Restart

When the ignition switch (IGN) is placed in the RUN position, 12-volt DC power is applied to the auto restart module. The auto restart module will maintain power and all lights on the module will illuminate. As the auto restart module performs its self test, the lights will go out individually.

After the self test is complete, the auto restart module will energize the intake heater and sound the audible alarm warning, indicating that the unit has been powered on and will start. The 30-second delay starts at this time. When the 30-second delay expires, power will be applied to the electronic governor and the engine attempts to crank for 15 seconds.

When the engine starts, the intake heater will remain energized for 3 minutes; during this time, the engine/intake heater light and alarm will be energized, the shutdown/lockout time delay of 15 seconds will begin counting, and the starter will be disengaged. During the shutdown/lockout time delay at start up, the auto restart module will disregard the signals to the oil pressure and engine temperature inputs, and the Run sequence will begin. If engine does not start, refer to Table 2–3 for auto restart sequencing.

c. Units with Dual Speed Option

When the Operating Mode switch is placed in the POWER position, the engine will run continuously at 1800 RPM, 60 Hz (normal operating mode).

When the Operating Mode switch is placed in the ECONOMY position, 12-volts DC will be supplied to the Dual Speed Timer (DT). The timer will pass 12-volts DC to Electronic Governor Module (EG) via pin #15 after a period of two (2) hours. The power to pin #15 will signal the control logic within the EG to throttle the engine to 1500 RPM, 50 Hz operation.

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SECTION 4 TROUBLESHOOTING

4.1 DIESEL ENGINE

4.1.1 Engine Will Not Start

CONDITION	POSSIBLE CAUSE	REMEDY/REFERENCE SECTION
	Battery insufficiently charged	Charge
	Battery terminal post or battery defective	Check
	Electrical connections at starter are bad	Correct
Starter motor will not crank or low cranking speed	Starter motor malfunctions	Section 4.1.4
oraniming opeou	Starter motor solenoid defective	Engine Manual
	Open starting circuit	Section 4.1.5
	Incorrect grade of lubricating oil	Section 2.10, f.
	No fuel in tank	Section 2.9/Section 2.10, g.
	Air inside the fuel system	Section 5.4.1
	Water inside the fuel system	Drain Sump
	Plugged fuel filters	Replace
	Air intake heater is bad	Section 5.4.14
	Low oil / Oil pressure switch defective	Section 5.4.7
start	Faulty heater switch	Section 5.4.15
	Plugged fuel lines to injector(s)	Engine Manual
	Mechanical lift fuel pump malfunction	Engine Manual
	Fuses F1, F2, F3, F4 are bad	Check/Replace
	Loose or no connection between wire harness and Electronic Governor Module (EG)	Check/Correct
Starter cranks and engages, but	Engine lube oil too heavy	Section 2.10, f.
dies after a few seconds	Voltage drop in starter cable(s)	Check

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4.1.2 Engine Starts Then Stops

CONDITION	POSSIBLE CAUSE	REMEDY/REFERENCE SECTION
	No fuel in tank	Section 2.9/Section 2.10, g.
	Intake heater switch not held long enough	Hold switch
	Fuel filter restricted	Replace
	Air cleaner or hose restricted	Section 5.4.11
	Engine crankcase breather or hose restricted	Section 5.4.12
	Safety device open	Section 2.8
	Open wiring circuit to fuel solenoid	Check
Engine stops after a few rotations	Fuel solenoid defective	Replace
and a low relation	Fuel supply restricted	Section 2.10.g, Section 5.4.2, and Section 5.4.3
	Mechanical lift fuel pump malfunction	Engine Manual
	Low oil / Oil pressure switch defective	Section 5.4.7
	Leak in fuel system	Check
	Injector nozzle(s) defective	Engine Manual
	Injection pump defective	Engine Manual
	Generator internal overloads open	Table 2–4

4.1.3 Engine Will Not Shut Off

CONDITION	POSSIBLE CAUSE	REMEDY/REFERENCE SECTION
Engine will not shut off	Loose ground connection	Clean/Tighten
Lingine will flot strut on	Improperly seated fuel solenoid	Correct

4.1.4 Starter Motor Malfunction

CONDITION	POSSIBLE CAUSE	REMEDY/REFERENCE SECTION
	Battery insufficiently charged	Charge
	Battery cable connections loose or oxidized	Check/Replace
	Battery cables defective	Check/Replace
Starter motor will not crank or turns	Starter brushes shorted out	Engine Manual
slowly	Starter brushes hang up, defective or have no contact	Engine Manual
	Starter solenoid damaged	Engine Manual
	Ignition switch defective	Replace
	Engine lube oil too heavy	Table 2.10, f.
Starter motor turns, but pinion does not engage	Pinion or ring gear obstructed or worn	Engine Manual
Starter motor does not disengage after switch has been released	Ignition switch is bad	Check/Replace
	Starter motor solenoid is bad	Engine Manual
Pinion does not disengage after engine is running	Starter is bad	Engine Manual

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4.1.5 Malfunction In The Engine Starting Circuit

CONDITION	POSSIBLE CAUSE	REMEDY/REFERENCE SECTION
No power to starter motor solenoid	Battery defective	Correct
No power to starter motor sciencia	Loose electrical connections	Tighten
	Battery defective	Correct
	Loose electrical connections	Tighten
	Oil pressure switch defective	Section 2.8
Fuel solenoid does not energize or	Water temperature safety switch open	Section 2.8
does not remain energized	Fuel solenoid defective	Engine Manual
	Intake heater switch is bad	Check (Engine Manual)
	Electronic Governor Module (EG) is bad	Replace (Section 5.4.14) Check/Replace
	Intake heater switch is bad	Section 5.4.14
loteka baatan daan met amannisa	Timer is bad	Section 5.4.14
Intake heater does not energize	Heater element is bad	Section 5.4.14
	Heater relay is bad	Section 5.4.14

4.1.6 Miscellaneous Engine Troubleshooting

Table 4-1 Miscellaneous Engine Troubleshooting

CONDITION	POSSIBLE CAUSE	REMEDY/REFERENCE SECTION
	Restriction in air cleaner	Section 5.4.11
	Air in fuel system	Section 5.4.1
	Air vent restricted	Clean
	Restricted fuel lines	Engine Manual
Loss of power	Fuel injection pump is bad	Engine Manual
	Injector(s) bad or incorrect type used	Engine Manual
	Incorrect fuel injection pump timing	Engine Manual
	Incorrect valve timing	Engine Manual
	Poor compression	Engine Manual
A file motions	Engine shockmounts are bad	Replace
Vibration	Poor compression	Engine Manual
	Restriction in air cleaner	Section 5.4.11
	Exhaust pipe restriction	Remove
	Restriction in water jacket	Engine Manual
Over the anation of	Restriction in radiator	Section 5.4.5
Overheating	Coolant level too low	Section 2.10, k.
	Loose water pump/alternator poly V-belt	Section 5.4.10
	Thermostat is bad	Engine Manual
	Water pump is bad	Engine Manual
Excessive crankcase pressure	Plugged crankcase breather line	Section 5.4.12

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4.2 BATTERY CHARGER (SOLID STATE)

CONDITION	POSSIBLE CAUSE	REMEDY/REFERENCE SECTION
Circuit breaker trips when charger is turned on	Short in 12-volt wiring causing overload of charger	Locate and remove short or replace charger
Circuit breaker trips repeatedly, even when not connected	Internal short	Replace charger
Charger does not taper back after charging for a few minutes	Bad cell in battery	Test battery for defect according to battery manufacturer's instructions
	Charger is bad	Replace
	Open input circuit breaker	Reset
Charger does not charge	Charger is not receiving AC input	Using a voltmeter, confirm charger is receiving correct (230v) AC voltage. If not, check input connections.
	Charger output is not connected to 12 volt battery	Check output wiring connections to battery.
	Charger is bad	Replace
Low output voltage measured across charger output	Battery not connected to charger. It is normal to measure 12 volts or less across charger output with no battery connected	Check charging leads from charger to battery
Reverse polarity connection to bat- tery has caused charger to stop charging	Internal DC fuse blown and possible damage to current carrying components	Replace

4.3 ALTERNATING CURRENT GENERATOR

CONDITION	POSSIBLE CAUSE	REMEDY/REFERENCE SECTION
	Loss of residual magnetism in exciter field	Section 5.5.2.a
	Circuit breaker tripped	Check
	Open in stator windings	Section 5.5.4/Replace
No voltage	Open or short in rotating rectifiers	Section 5.5.1.c
	Short circuited	Section 5.5.4/Replace
	Open in alternator field	Section 5.5.4/Replace
	Shorted exciter armature	Section 5.5.4/Replace
Low voltage	Low engine speed	Section 5.4.8
	Excessive load	Check
	High resistance connections - connections are warm or hot	Tighten
	Shorted field	Section 5.5.4/Replace
	Fluctuating speed	Section 5.4.8
Fluctuating voltage (May be indi-	Irregular speed of engine	Engine Manual
cated by flickering lights)	Loose terminal or load connections	Tighten
	Bad bearing causing uneven air gap	Section 5.5.1/Section 5.5.3
High voltage	Excessive engine speed	Section 5.4.8

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CONDITION	POSSIBLE CAUSE	REMEDY/REFERENCE SECTION
	Generator overloaded	Check
	Clogged ventilating screens	Clean
Overheating	High temperature surrounding generator	Section 5.4.5
Overheating	Insufficient air circulation	Section 5.5.1
	Unbalanced load	Balance
	Dry bearing	Section 5.5.1/Section 5.5.3
	Bad bearing	Section 5.5.1/Section 5.5.3
Mechanical Noise	Rotor scrubbing on stator	Section 5.5.1/Section 5.5.3
Mechanical Noise	Loose laminations	Section 5.5.4/Replace
	Loose or misaligned coupling	Section 5.5.4
Generator frame produces shock	Static charge	Check ground to frame
when touched	Grounded armature of field coil	Section 5.5.4/Replace

4.4 AUTO RE-START OPTION

CONDITION	POSSIBLE CAUSE	REMEDY/REFERENCE SECTION
	Wait 30 seconds for intake heater to be activated	Wait
	Coolant level below the low coolant sensor	Section 2.10, k.
	Relay defective	Check/Replace
When the Ignition switch is placed	Ignition switch defective	Check/Replace Switch
in the RUN position, nothing happens - no lights illuminate	3 amp Fuse is bad	Check and Replace Fuse
pens - no lights illuminate	Loose connector on module	Tighten connector
	Auto restart module is bad	Check for 12 volts at Pin 4/Replace module
	Mis-wired connectors	Check/Correct wiring
	No voltage at Pin 2 of the connector	Trace/Correct
Alarm sounds, but engine does not crank	Check Starter Solenoid	Section 4.1.1
	Auto restart module is bad	Replace module
	Speed Sensor wiring loose	Check/Correct
Engine starts, but the starter does not disengage	Speed Sensor is bad	Replace
3.01	Auto restart module is bad	Replace module
Engine starts, but shuts down from over speed	Electronic Governor Module (EG) is bad	Replace
Engine cranks, but will not start	Electronic Governor Module (EG) is bad. See Section 4.1.1	Replace/Section 4.1.1
Engine starts, but shuts down on low oil	See Section 4.1.2	Section 4.1.2
Engine starts, but shuts down on high water temperature	See Section 4.1.6	Section 4.1.6

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4.5 DUAL SPEED OPTION

CONDITION	POSSIBLE CAUSE	REMEDY/REFERENCE SECTION
	Wait 2 hours for the Dual Speed Timer (DT) to activate the Electronic Governor Module (EG).	Wait
When the Operating Mode switch is placed in the Economy position, nothing happens.	The Dual Speed Timer (DT) is bad.	Check for 12 volts at Pin 15/Replace module
Trouring nappens.	12v is not available to the Dual Speed Timer (DT).	Check/Replace Switch
	12v is not available to the Operating Mode switch.	Check/Correct wiring

4.6 ELECTRONIC GOVERNOR MODULE

FAULT	LED FLASH CODE	POSSIBLE CAUSE
Engine Over Speed: more than 2,530 RPM	One Long-One Short	ESS or mechanical engine problem
Actuator Wiring Disconnection. No signal from ESS for 2 seconds after RPM is greater than 1,000 RPM for 10 seconds, OR for 5 seconds while engine cranking (no voltage at EG pin 18).	Two Long-One Short	Short ESS or wiring problem
Speed Sensor Disconnection. Fuel/speed actuator (FS) wiring disconnected or open circuit. Coil Resistance Spec: 2.8 ohm +/- 10%.		FS or wiring problem
EG supply voltage is greater than 26V.	Two Long-Seven Short	EG or alternator problem

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SECTION 5

SERVICE AND PREVENTATIVE MAINTENANCE

5.1 INTRODUCTION

This section covers service for the generator set and general engine service. Refer to the Kubota engine workshop manual, **Section 2.1**, for additional engine servicing.



Beware of moving V-belt and belt driven components.

5.2 PREVENTATIVE MAINTENANCE SCHEDULE

A tabular listing of the recommended preventative maintenance activities and schedule is provided in **Table 5–1**.

5.3 BATTERY SERVICE

When replacing the battery, determine whether the unit was supplied with a mat in the battery tray. If so equipped, the mat must also be replaced.

5.4 ENGINE SERVICE AND COMPONENTS

5.4.1 Bleeding the Fuel System

The unit is equipped with a mechanical fuel lift pump mounted on the engine next to the injection pump. The fuel system is a closed circuit which will require bleeding if loss of fuel has occurred. To fill and bleed the system, do the following:

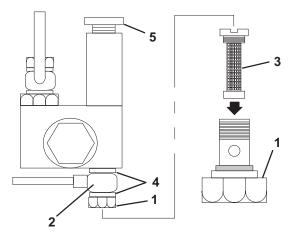
- 1. Turn fuel bleed valve (Red, see Figure 2.4) counterclockwise until fully opened.
- 2. Turn the top of the hand priming pump (see Figure 5.1) counter-clockwise to unlock it, and then hand pump the manual plunger until a positive pressure (resistance) is felt. This will indicate fuel flow.
- 3. Depress and turn the top of the hand priming pump clockwise to lock in place.
- 4. Start engine. (Refer to Section 3.5.)
- 5. When engine is running properly, turn fuel bleed valve clockwise until fully closed.

5.4.2 Servicing Fuel Pump Internal Filter

Foreign particles in the fuel and wax (which results from using the wrong grade or untreated fuel in cold weather) may plug or restrict the internal fuel filter and the engine will loose capacity. The filter must be cleaned on a regular schedule.Quality of the fuel will affect the filter cleaning schedule (refer to Section 5.2).

- Turn nut (item 1) counter-clockwise to loosen and remove.
- 2. Remove banjo fitting (item 2) and let it hang loose, making sure to keep copper rings (item 4) for replacement.
- 3. Turn filter (item 3) counter-clockwise and remove. Check and clean.
- 4. To install, reverse steps 1 through 3.

Figure 5.1 Mechanical Fuel Pump



- 1. Nut
- Copper Rings
- Banjo
 Filter
- 5. Manual Priming Pump

5.4.3 Fuel Filter

5-1

The fuel flow filter is located on the generator set unidrive assembly (see Figure 2.2).

To replace the fuel filter, loosen and remove the filter housing. Lightly oil new gasket with lube oil and replace the filter.

NOTICE

If the generator set is equipped with the fuel filter bowl assembly, when replacing the fuel filter, a new fuel filter O-ring should be oiled and replaced, and then the clear bowl should also be tightened to 18 ft-lbs.

5.4.4 In-Line Fuel Strainer (Option)

Loosen bowl by turning counter-clockwise. To renew, remove in-line fuel strainer, check and clean, and replace.

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5.4.5 Cooling System

To ensure adequate cooling, the radiator must be clean, externally and internally. To service the cooling system, do the following:

- Remove all foreign material from the radiator coil by reversing the normal air flow. Compressed air or water may be used as a cleaning agent. It may be necessary to use warm water mixed with any good commercial dishwasher detergent. Rinse coil(s) with fresh water if a detergent is used.
- 2. Drain coolant completely by opening drain cock and removing radiator cap.

A CAUTION

Never pour cold water into a hot engine.

- Close drain cock and fill system with clean, untreated water to which between 3% and 5% of an alkaline base radiator cleaner should be added; six ounces (dry) = 151 grams to one gallon (3.8 liter) of water.
- 4. Run engine 6 to 12 hours and drain system while warm. Rinse system three times after it has cooled down. Refill system with water.

A CAUTION

Use only ethylene glycol, anti-freeze (with inhibitors) in system. Use of glycol by itself will damage the cooling system (Refer to Section 2.10.k).

5. Run engine to operating temperature. Drain system again and fill with treated water/anti-freeze (see above Caution note).

5.4.6 Lube Oil Filter

The oil filter is located near the radiator fan (see **Figure 2.5**).

- 1. After warming up the engine, stop engine, remove drain plug from oil reservoir and drain engine lube oil.
- Replace filters. Lightly oil gasket on filter before installing.
- 3. Add lube oil (Refer to Section 2.10.f).
- 4. Warm up engine and check for leaks.

5.4.7 Servicing Low Oil Pressure Switch

- 1. Remove harness connection from low oil pressure switch (LOP).
- 2. Remove pressure switch from engine.
- Apply Teflon thread sealer to threads of new low oil pressure switch.

- 4. Install new low oil pressure switch.
- Reconnect harness connection to low oil pressure switch.

5.4.8 Engine Speed

The engine speed is electronically controlled. **DO NOT ATTEMPT TO ADJUST ENGINE SPEED**.

5.4.9 Replacing the Engine Speed Sensor

- 1. Disconnect the plug to the sensor.
- 2. Remove the bolt securing the sensor to the housing.
- 3. Remove the sensor from the housing.
- 4. Clean the recess in the housing to ensure that the sensor seats properly when re-installed.
- 5. Re-install the sensor, replace the securing bolt and connect the plug to the sensor.

5.4.10 Servicing Poly V-belt

MARNING

Beware of moving poly V-belt and belt driven components.



Beware of pinch points.

NOTICE

A frayed, cracked or worn poly V-belt must be replaced. After installing a new belt, check the adjustment after running the unit for three or four hours. This will allow for the initial stretch, which is common on new belts. Once this initial stretch has taken place, the belt should be checked at regular intervals.

The poly V-belt is driven by a sheave on the engine crankshaft. Its two functions are: (1) to drive the radiator fan and (2) to drive the water pump.

To replace the poly V-belt, perform the following steps:

- Using the proper size socket, slowly rotate the crank on the crank pulley nut. At the same time, use a flat, blunt object to guide the belt off the crank pulley towards radiator. Be careful not to damage grooves on the pulley.
- Replace the poly V-Belt by positioning the belt on the water pump pulley, and while rotating the engine (as in step 1.), use a flat, blunt object to guide the belt onto the crank pulley. Be careful not to damage grooves on the pulley or belt.

5.4.11 Engine Air Cleaner

The dry element engine air cleaner uses a dry element filter (see **Figure 5.2**) to filter the engine intake air. The oil bath air cleaner option uses an oil cup instead of the dry element filter (see **Figure 5.3**).

The engine air cleaner should be inspected regularly for leaks, (see **Figure 2.1**). A damaged air cleaner or hose can seriously affect the performance and life of the engine. The air cleaner is designed to effectively remove contaminants from the air stream entering the engine. An excessive accumulation of contaminants in the air cleaner will impair its operation. Therefore, a service schedule must be set up and followed.

- 1. Check all connections for mechanical tightness. Be sure the air cleaner outlet pipe is not fractured.
- 2. In case of leakage, if adjustment does not correct the problem, replace necessary parts or gaskets. Swollen or distorted gaskets must always be replaced.

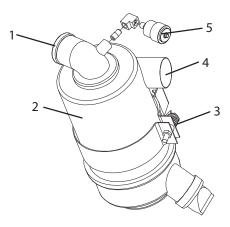
a. Air Filter Indicator

The air filter indicator, used with the dry element filter, is mounted on the unit frame and connected to the engine air intake. Its function is to indicate when the air cleaner dry element needs to be replaced. In operation: When a plugged air cleaner decreases intake manifold pressure to 500 mm (20") WG, the indicator moves to the red line. The air cleaner element should be replaced and the indicator reset by pressing the reset button.

b. Air Cleaner, Dry Element Service

- 1. Stop the engine and open the cap clamps (see Figure 5.2) to remove air cleaner bottom cap.
- 2. Remove the air filter element from the air cleaner body.
- 3. Install the new element, secure the bottom cap with the cap clamps.

Figure 5.2 Air Cleaner, Dry Element



- 1. Air Outlet
- 4. Air Inlet
- 2. Air Cleaner Body
- 5. Air Filter Indicator
- 3. Clamp

⚠ CAUTION

When reassembling the Air Cleaner, make sure the Clamp Bolt faces out, away from the fuel filter. If the Clamp Bolt is assembled facing in, it can contact the fuel filter and cause excessive wear.

c. Air Cleaner, Oil Bath Service

The oil cup should be inspected during pretrip, before each trip. Never allow more than 1/2 inch (12.7 mm) of dirt deposit in the cup. More than 1/2 inch accumulation could result in oil and dirt carrying over into the engine, causing accelerated engine wear. Heavily contaminated oil will not allow the air cleaner to function properly.

A CAUTION

Always cover the engine inlet tube while the air cleaner is being serviced.

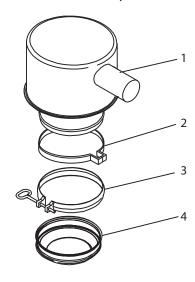
- 1. Stop the engine and remove the oil cup from the air cleaner. Dispose of the oil in an environmentally safe manner.
- 2. Remove the inner oil cup from the oil cup and clean both cups.
- Reassemble and fill both oil cups to the *indi-cated level* with oil specified in Section 2.10.



Do not underfill or overfill the oil bath cups. Overfilling cups causes loss of capacity; underfilling cups causes lack of filtering efficiency.

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Figure 5.3 Air Cleaner, Oil Bath



- 1. Body
- 3. Oil Cup Clamp
- 2. Mounting Clamp
- 4. Oil Cup

d. Air Cleaner Body Service

The air cleaner body should be inspected each time the oil cup is serviced. If there is any sign of contaminant buildup or plugging, the air cleaner body should be removed and back flushed.

At least once a year, or at regular engine service intervals, remove the entire air cleaner and perform the following cleaning procedure:

1. Remove oil cup. Check and clean center tube.

MARNING

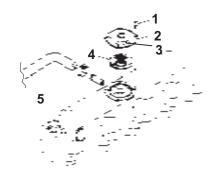
Do not use gasoline to clean air cleaner parts.

 Pump solvent through the air outlet with sufficient force and volume to produce a hard, even stream out of the bottom of the body assembly. Reverse flush until all foreign material is removed.

5.4.12 Engine Crankcase Breather

The engine uses a closed type breather with the breather line attached to the cylinder head cover (see **Figure 5.4**). It is not necessary to disassemble valve style elements for cleaning. However, the bleed hole should be checked to ensure it is free of obstruction. Check once a year or at every 4,000 hours maintenance interval, whichever comes first.

Figure 5.4 Engine Crankcase Breather

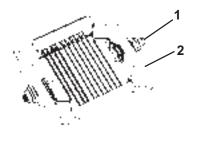


- 1. Screw
- 4. Breather Valve
- 2. Breather Cover
- 5. Breather Tube
- 3. Bleed Hole

5.4.13 Intake Heater Test

- 1. Disconnect the lead from the heater terminal (1).
- 2. Measure the resistance between the heater positive terminal (1) and the heater body (2).
- 3. If the resistance is infinity or significantly different than the specification, *resistance* (cold) 0.3 ohms, replace the heater.

Figure 5.5 Intake Heater



1. Positive Terminal 2. Heater Body

5.4.14 Intake Heater Service

- 1. Remove harness connection from heater.
- 2. Remove intake transition mounting hardware.
- Remove intake transition, heater and both gaskets.
- Clean old gasket material off the transition and manifold mounting services.
- 5. Install new heater with a new gasket on either side.
- Assemble transition to heater and torque mounting hardware (refer to engine manual for torque values).
- 7. Reconnect harness to heater connection point.
- 8. Coat stud on heater with protective coating.

5.4.15 Intake Heater Switch

- 1. Remove control box cover.
- 2. Remove all connections going to heater switch (HS).
- 3. Remove heater switch from control box.
- 4. Install new heater switch.
- 5. Reconnect wire harness connections to switch.
- 6. Confirm wires are connected to correct terminals.
- 7. Reinstall control box cover.

5.5 SERVICING THE ALTERNATING CURRENT GENERATOR

5.5.1 Preventative Maintenance and Operating Precautions

Costly repairs and down time can usually be prevented by operating electrical equipment under conditions that are compatible with those under which the equipment was designed. Follow the instructions outlined below to insure maximum efficiency of the electrical equipment.

a. Cooling

Keep all cooling parts clean. DO NOT EXCEED TEMPERATURE RISE OF 80°C (176°F) ABOVE A 40C (104F) AMBIENT. This ensures that the NEMA Class "F" insulation will not be damaged. DO NOT EXCEED RATED LOAD except as specified for the equipment. OPERATE GENERATOR AT RATED SPEED. Failure to operate generators at rated load or speed will cause overheating and possible damage to windings due to over voltage or current.

b. Generator Windings (Drying)

WARNING

Do not direct water or steam into the generator openings. Do not allow any soap and water solutions to enter the alternator.

WARNING

High voltage (dielectric) testing must not be performed to the machine without first observing NEMA rules. The insulation of this generator winding may be safely checked by using a megger. A high megger reading indicates good insulation.

Generators that have been in transit, recently steam cleaned or in storage for long periods may be subjected to extreme temperature and moisture changes. This can cause excessive condensation, and the generator windings should be thoroughly dried out before bringing the generator up to full nameplate voltage. If

this precaution is not taken, serious damage to the generator can result. The following steps should be taken to effectively dry the generator windings:

- 1. Dry windings by placing generator in drying oven or hot room, or dry with warm air blower directed through windings.
- If the generator has been operated and is being placed into storage for any period of time, a P.D. George #11127 type air-dry fungus resistant varnish should be applied.

The finest insulation job can be very quickly broken down by carelessly applying high voltage to windings in a moisture saturated condition. Failure to follow these guidelines could easily cause a breakdown, making it necessary to return the generator to the factory for repair.

c. Rotor Damage

If a rotor becomes defective, it should be returned to the factory with full nameplate data. To repair a rotor, the special tooling and technique of the factory are necessary and essential. Should a failure occur, Carrier Transicold should be notified immediately and steps will be taken to return the generator for service.

5.5.2 Generator Repair/Test Procedures

a. Restoring Residual Magnetism

The direct current (DC) necessary to magnetize the alternator field is obtained from the exciter. Initially, upon starting the generator, current flow and voltage are induced into the exciter armature by the magnetic lines of force set up by the residual magnetism of the exciter field poles.

Residual magnetism of the exciter field poles may be lost or weakened by a strong neutralizing magnetic field from any source, or if the generator is not operated for a long period of time.

Should the generator fail to build up voltage after being disassembled for any reason, a momentary short-circuit of any two generator leads (L1, L2 and L3) while generator is running should be sufficient to correct this condition.

A CAUTION

When trying to restore residual magnetism, be sure to wear safety glasses and non-conductive gloves. Use an insulated 12 gauge (or higher) jumper wire. Cut off all but a few strands from both ends of the jumper wire to help prevent fusing.

As an alternate method, apply either an alternating current or a direct current voltage of approximately 20 volts to any two generator leads (L1, L2 and L3) while generator is running. Do not make a positive connection, but rather touch the leads together until the generator voltage begins to rise, then remove. Insert a 30

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ampere fuse into the circuit to prevent any damage in case the build-up voltage is not removed quickly enough. Reflash field if generator output voltage does not build up.

b. Winding Insulation Testing

Continuity test results for the stator winding tests are provided in the following table:

Wire Pair	Ohm*	Wire Pair	Ohm*	Wire Pair	Ohm*
T10-T1	I	T1-T8	I	T4-T5	I
T10-T2	I	T1-T9	I	T4-T6	I
T10-T3	I	T2-T3	I	T4-T7	I
T10-T4	I	T2-T4	I	T4-T8	I
T10-T5	I	T2-T5	0	T4-T9	I
T10-T6	I	T2-T6	I	T5-T6	I
T10-T7	0	T2-T7	I	T5-T7	I
T10-T8	0	T2-T8	I	T5-T8	I
T10-T9	0	T2-T9	I	T5-T9	I
T1-T2	I	T3-T4	I	T6-T7	I
T1-T3	I	T3-T5	I	T6-T8	I
T1-T4	0	T3-T6	0	T6-T9	I
T1-T5	I	T3-T7	I	T7-T8	0
T1-T6	I	T3-T8	I	T7-T9	0
T1-T7	I	T3-T9	I	T8-T9	0

^{* 0 =} no resistance (closed circuit) & I = infinite resistance (open circuit)

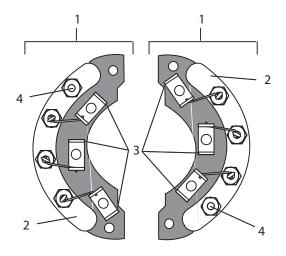
c. Diode Testing

The rectifier diode assemblies can be tested, and if damaged, replaced. Over current, over voltage, over speed, or reverse currents can damage the assembly or diodes. To remove the diode assemblies and perform diode testing, do the following:

- Remove the bearing cover by removing the four bolts (see Figure 5.7). Both the bearing and diode assemblies will be visible.
- Mark and disconnect the alternator rotor wires at the rectifier screw terminals. Note that the terminals are marked with red paint for the forward diode assembly and black for the reverse diode assembly. Mark and disconnect the exciter leads from the double spade terminals (see Figure 5.6).
- Remove the two cap screws that secure each diode assembly to the exciter. Once this procedure is complete, the diode assemblies are free for removal.

- 4. A forward diode should have a low resistance when the + of an ohm meter is connected to the exciter rotor lead connection (anode) and the - to the diode bridge (cathode), and a high resistance when the polarity of the ohmmeter is reversed.
- 5. A reverse diode should have a high resistance when the + of an ohm meter is connected to the exciter rotor lead connection (anode) and the to the diode bridge (cathode), and a low resistance when the polarity of the ohmmeter is reversed.
- If both resistances are high or both are low, the diode is defective and the diode assembly should be replaced.

Figure 5.6 A-C Generator Rectifier Assembly



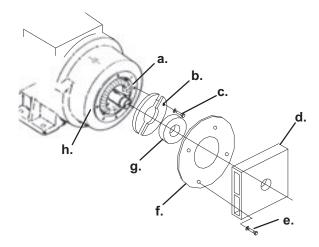
- 1. Diode Assembly
- 2. Diode Bridge
- 3 Exciter Rotor Lead Connection
- 4. Alternator Rotor Lead Connection

5.5.3 Bearing Replacement

Factory lubricated shielded bearings will normally provide years of trouble-free service when operated under normal conditions. Excessive bearing load and adverse environment conditions will greatly shorten bearing life. To remove the bearings, do the following:

- Remove bearing cover and mylar gasket. (See Figure 5.7).
- 2. Remove bearing with a bearing or wheel puller.
- Install new bearing. Ball bearings are pre-lubricated and require no additional lubrication for the life of the bearing.
- 4. Coat mating surface of bearing cover flange with anti-corrosion compound (Tef-Gel, Carrier Part Number 02-00083-00).
- 5. Replace bearing cover and mylar gasket.

Figure 5.7 Rectifier Removal



- a. Rectifier Flange
- b. Rectifier Assembly
- c. Rectifier Bolt
- d. Bearing Cover
- e. Bearing Cover Bolt
- f. Mylar Gasket
- g. Bearing
- h. Bearing Cover Flange

5.5.4 Generator Removal and Installation

a. Removing the Generator

- Remove covers and ground wire from frame of generator set.
- 2. Remove connection box cover and disconnect power leads.
- 3. Remove control box mounting screws from the generator mount and the battery mounting bracket.
- 4. Disconnect air filter from battery mounting bracket.
- 5. Remove battery and battery box.
- 6. Remove battery charger shield.
- 7. Remove battery mounting bracket from the top of the generator.
- 8. Remove screen cover and generator exhaust baffle from coupling end of generator.
- Remove the 8mm hex head bolts and washers securing the generator drive disc to the engine flywheel. Turn bolts counter-clockwise with offset wrench to start, then use flexible shaft and socket assembly for removal of bolts.
- 10. Remove the 3/8 inch hex head capscrews and washers that secure generator frame to engine flywheel housing.
- 11. Remove four 5/8 inch bolts that secure the generator mounting feet to the shock mount bracket, then remove generator.

b. Installing the Generator

NOTICE

For torque values refer to Section 5.7.

The generator is a single bearing type, which means the shaft end of the rotor floats. Before installing the generator, rotate shaft and check if bearing rotates.

- Brush anti-seize lubricant (lube-plate) on the face of flywheel.
- Move generator into position and line up with the holes on housing and flywheel. If required, turn crankshaft to align threaded holes in flywheel with generator drive disc mounting holes.

! CAUTION

The rotor should not be pulled out from the alternator more than 0.75 inches. Damage to the bearing and windings may result.

- 3. Start the 8mm bolts (by hand) through the disc plate and into the flywheel. Once alignment is made torque the six bolts.
- 4. Secure two of the housing bolts (3/8 inch) on the top and bottom of the generator housing to draw the mating flanges together.
- 5. Secure the remaining bolts and washers (3/8 inch) and torque bolts in a staggered pattern.
- 6. Install and torque generator mounting bracket bolts (5/8 inch). Install screen cover, battery mounting bracket, battery charger shield, battery box, battery, power leads, ground wiring and generator cover. Install new gasket when installing generator connection box cover. Reconnect air filter to battery mounting bracket.

5.6 GENERAL GENERATOR SET MAINTENANCE

5.6.1 Maintenance Of Painted Surfaces

The unit is protected against the corrosive atmosphere in which it normally operates by a special paint system. However, if the paint system is damaged, the base metal can corrode. If the paint system is scratched or damaged, do the following:

- 1. Clean area to bare metal using a wire brush, emery paper or equivalent cleaning method.
- 2. Immediately following cleaning, spray or brush on a zinc rich primer.
- 3. After the primer has dried, spray or brush on finish coat of paint to match original unit color.

5-7

5.6.2 Checking and Replacing Shockmounts

a. Replacement Criteria



Continued operation with failed shockmounts may result in engine or generator damage.

When a shockmount has been cut, split, abraded or has flared due to normal deterioration, it must be replaced. Damage to the mounts may not be visible when installed and under load from the component. To correctly inspect shockmounts, they must be removed.

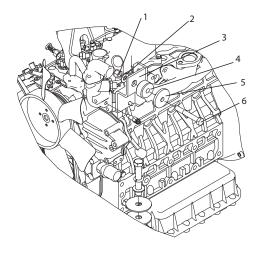
b. Engine Shockmount Replacement

NOTICE

For torque values refer to Section 5.7.

- 1. Use the two lift eyes to lift and support the engine.
- Remove snubber hardware as shown in Figure 5.8.

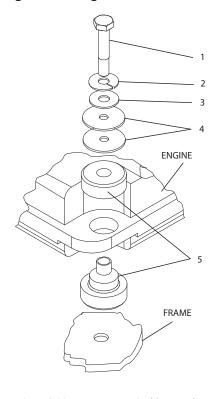
Figure 5.8 Snubber Hardware



- 1. Lock -nut (1/2-13)
- 2. Washer (1/2)
- 3. Bracket Assembly
- 4. Snubber
- 5. Washer
- 6. Hexhead Screw (1/2-13 X 3.25)
- 3. Remove all hardware as shown in Figure 5.9.
- 4. Raise the engine just enough to remove the shockmounts (item 5).
- 5. Inspect shockmounts and replace if required.
- 6. Lower the engine enough to assemble hardware as shown and torque per **Section 5.7**.

- 7. Replace snubber hardware (Figure 5.8).
- 8. Remove chains from the lift eyes.

Figure 5.9 Engine Shockmounts

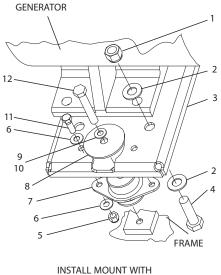


- 1. Screw (5/8)
- 2. Lock Washer (5/8)
- 3. Flat Washer (5/8)
- 4. Snubbing Washer
- 5. Shockmount

c. Generator Shockmount Replacement

- Use the two lift eyes to lift and support the engine.
- 2. Remove snubber hardware as shown in **Figure 5.8**.
- 3. Remove shockmount hardware, items 5 through 12, Figure 5.10.
- 4. Raise the generator just enough to remove the shockmounts (item 7).
- 5. Inspect and if required, install new shockmounts.
- Lower the engine enough to assemble hardware as shown and torque. Refer to Section 5.7 for torque values.
- 7. Replace snubber hardware (Figure 5.8).
- 8. Remove chains from the lift eyes.

Figure 5.10 Generator Shockmounts



- LARGER FLARE AT TOP AS SHOWN

 7

 FRAME
- 1. Lock -nut (5/8)
- 2. Plain Washer (5/8)
- 3. Mounting Base
- 4 Screw (5/8)
- 5. Lock –nut (3/8)
- 6. Plain Washer (3/8)
- 7. Shockmount
- 8. Flat Washer
- 9. Flat Washer (1/2)
- 10. Lock Washer (1/2)
- 11. Screw (3/8)
- 12. Screw (1/2)

5.7 UNIDRIVE TORQUE REQUIREMENTS

Extensive damage may occur if the proper hardware is not used and/or proper procedures are not followed when working with the unidrive assembly. Periodic inspection of hardware and bolt torque is recommended to ensure the integrity of the unidrive.

Torque value and hardware requirements for unidrive assembly are provided in **Figure 5.11**.

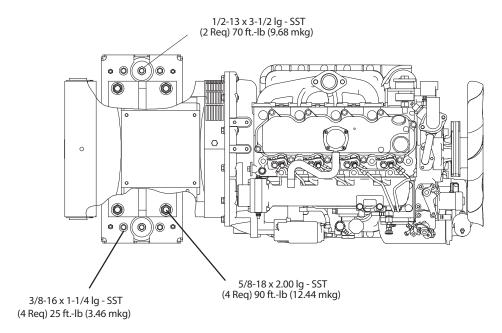
NOTICE

SST is an abbreviation for 300 Series Corrosion Resistant Steel.

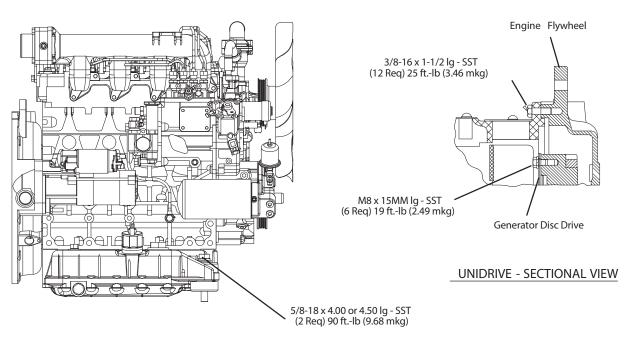
Loctite #242 or an equivalent product should be used on ALL hardware shown in Figure 5.11.

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Figure 5.11 Unidrive Torque Requirements



ENGINE & GENERATOR SHOCKMOUNTS - TOP VIEW



ENGINE MOUNT - RIGHT SIDE VIEW

Table 5-1 Preventative Maintenance Actions and Schedule

	Description of Procedure	Reference Para- graph	Perform at Pre-Trip Inspection	Every 2000 Hours	Annually or Every 3000 Hours
For Pre-Trip inspection, perform items 1 through 13; for "After Start-up" checks, perform items 30 through 34.					ıgh 34.
1.	Check (in place) engine/generator shock mounts for cracks, cuts, abrasion or flaring		X		
2.	Check engine lubrication, fuel filter, oil lines and connections for leaks		Х	Х	
3.	Check engine lubrication oil level	Section 2.10.f	Х	Х	
4.	Ensure poly V-Belt has proper tension; check belt for fraying or cracks	Section 5.4.10	Х	Х	
5.	Check radiator hoses for leaks; check coolant level and 50/ $\!$ 50 mixture	Section 2.10.k	X	Х	
6.	Check radiator coil and generator air intake for cleanliness (Clean using compressed air, reversing air flow direction)		X	Х	
7.	Check air cleaner; clean as necessary		Х	Х	
8.	Drain water from fuel tank sump and fuel filter bowl		Х	Х	
9.	Fill tank with diesel fuel	Section 2.10.g	X	X	
10	Check intake heater amperage	Section 2.10.i	Х	Х	
11.	Check battery terminals for tightness and cleanliness. Clean and coat terminals with battery terminal sealant		Х	Х	
12	Check loose electrical connections		Х	Х	
13.	Tighten all hardware (brackets, etc.)		Х	Х	
14.	Change lubricating oil and filter(s) ¹	Section 5.4.6			Х
15.	Clean air filter body; check hose connections ¹	Section 5.4.11		Х	
16	Change oil bath air filter oil ¹	Section 5.4.11		Х	
17.	Clean mechanical fuel lift pump internal filter	Section 5.4.2		X	
18	Tighten engine and generator mounting bolts	Section 5.7		Х	
19	Tighten all electrical connections in the control box			X	
20	Check water pump bearing end play	See Engine Manual		Х	
21.	Verify operation of engine protective devices				Х
22	Change fuel filter	Section 5.4.3			Х
23.	Check crankcase breather	Section 5.4.12			Х
24.	Remove and check engine/generator shockmounts for cracks, cuts, splits, abrasion or flaring	Section 5.6.2			Х
25.	Check and, if required, replace poly V-Belt	Section 5.4.10		Х	Х
26	Clean and flush coolant system	Section 5.4.5			Х
27	Check starter condition	See Engine Manual			Х
28	Check engine compression	See Engine Manual			Х
29	Check and adjust injector nozzles	See Engine Manual			Х

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Table 5-1 Preventative Maintenance Actions and Schedule

Description of Procedure	Reference Para- graph	Perform at Pre-Trip Inspection	Every 2000 Hours	Annually or Every 3000 Hours	
After Starting Generator Set, perform the following:					
30. Check total time meter operation (Allow engine to run 10 minutes)		Х			
31. Listen for abnormal bearing noise		Х			
32. Check fuel lines, lube oil lines and filters for leaks		Х			
33. Check exhaust system for leaks		Х			
34. Check with voltmeter. Generator output should be 490 volts AC +/- 15 volts (engine, 1800 RPM) with a nominal frequency of 60 Hz +/- 0.1% Turn refrigeration unit on and check generator 1800 RPM minimum under full load (15 kW)		Х			

NOTICE

More frequent intervals may be necessary in extreme operation conditions.

SECTION 6 SCHEMATICS

6.1 INTRODUCTION

This section contains the 12-volt DC control circuit schematics and the 460 volt alternating current generator schematics. To identify the schematics applicable to your model and PID number, refer to **Table 2–1**.

Figure 6.1 Legend - Standard Unit

LINE	SYMBOL	LEGEND
3,5,8,9,14	<u> </u>	ENGINE GROUND
21		CHASSIS GROUND
2	Α –	AMMETER
12,21	BC -	
1	BAT -	
4,8,13,15,20	CB -	
3/11	D –	
5	EG -	
4	ESS -	
6,7	F -	FUSE
8	FH -	FUEL HEATER
8	FHT -	
5	FS -	
15	G –	
2,11		INTAKE HEATER RELAY
2	HS -	HEATER SWITCH
3	HWT -	HIGH WATER TEMP. SWITCH
6	IGN -	IGNITION SWITCH
2	IH –	INTAKE HEATER
10	IHT -	INTAKE HEATER TIMER
4	LOP -	LOW OIL PRESS. SWITCH
9	OPG -	OIL PRESSURE GAUGE
9	OPS -	OIL PRESSURE SENDER
15	R1 -	RECEPTACLE
3,6	S -	SAFETY RELAY
2	SM -	STARTER MOTOR
2	SS -	STARTER SOLENOID
11	TT -	TIME METER
10	WTG -	WATER TEMP. GAUGE
10	WTS -	WATER TEMP. SENDER
7	• -	BUTT SPLICE

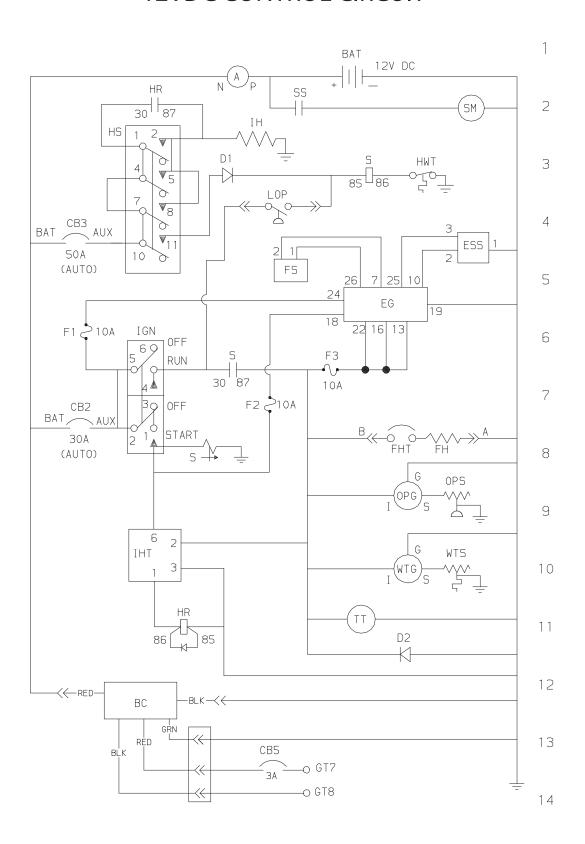
Based on Drawing 62-11292-00 Rev -

(Applies to Figure 6.2 and Figure 6.8)

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Figure 6.2 Schematic Diagram - Standard Unit

12VDC CONTROL CIRCUIT



Based on Drawing 62-11292-00 Rev -

(For Applicability, Refer to Table 2-1)

Figure 6.3 Legend - Units with Auto Restart and Power Time Delay

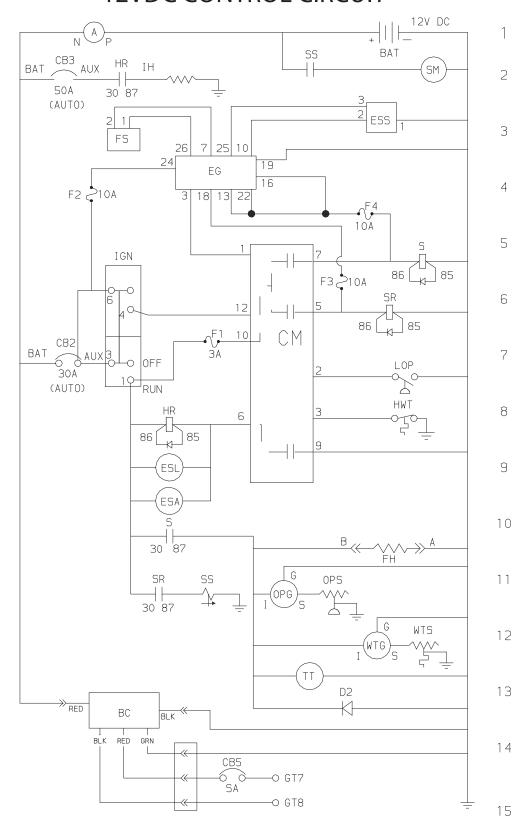
```
SYMBOL LEGEND
    LINE
2, 8, 12, 15
                       ENGINE GROUND
       21
                      CHASSIS GROUND
        1
              А
                      AMMETER
    14,21
              BC -
                      BATTERY CHARGER
              BAT -
                      BATTERY
        1
       13
              C –
                      CONTACTOR (Figure 5-5 only)
   2,7,16
              CB
                       CIRCUIT BREAKER
        7
              CM -
                      CONTROL MODULE
                      DIODE
              D -
       13
                      ELECT. GOVERNOR MODULE
        4
              EG -
             ESA -
                      ENGINE START ALARM
       10
              ESL -
                      ENGINE START LIGHT
        9
        3
              ESS -
                      ENGINE SPEED SENSOR
    4,6,7
              F -
                      FUSE
                      FUEL HEATER
       11
             FH -
        3
             FS -
                      FUEL SOLENOID
              G
                      GENERATOR
       16
             HR -
                      INTAKE HEATER RELAY
        8
        8
             HWT -
                      HIGH WATER TEMP. SWITCH
        5
                      IGNITION SWITCH
             IGN -
        2
                      INTAKE HEATER
              ĬΗ –
        7
              LOP -
                      LOW OIL PRESS. SWITCH
              OPG -
                       OIL PRESSURE GAUGE
       11
       11
              OPS -
                       OIL PRESSURE SENDER
              R1 -
                       RECEPTACLE
       16
              S
                       SAFETY RELAY
     5,10
              SM
         2
                       STARTER MOTOR
        6
              SR
                       STARTER RELAY
         2
              SS
                       STARTER SOLENOID
        13
                       TIMER RELAY
              TR
        13
              TT -
                       TIME METER
       12
                       WATER TEMP. GAUGE
              WTG -
       12
              WTS -
                      WATER TEMP. SENDER
                      BUTT SPLICE
        4
```

Based on Drawings: 62-11287-00 Rev B 62-11419-00 Rev -

(Applies to Figure 6.4, Figure 6.5, and Figure 6.8)

Figure 6.4 Schematic Diagram - Legend

12VDC CONTROL CIRCUIT

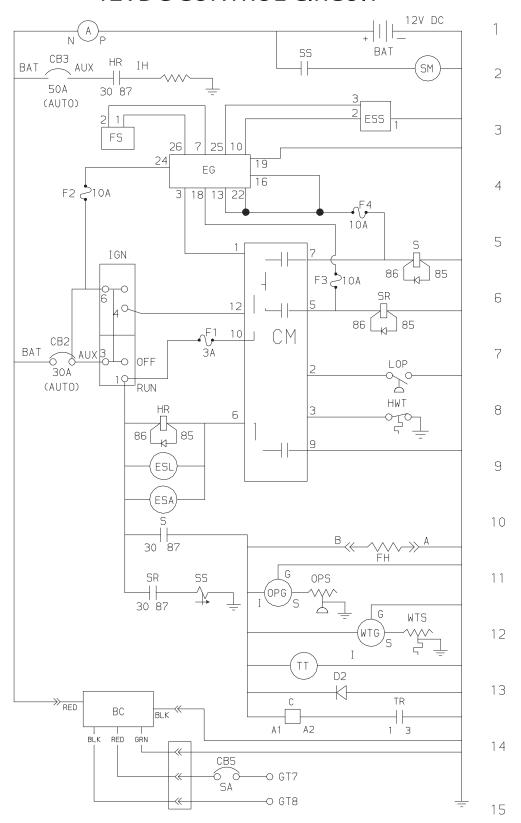


Based on Drawing 62-11287-00 Rev B

(For Applicability, Refer to Table 2-1)

Figure 6.5 Schematic Diagram - Units with Auto Restart and Power Time Delay

12VDC CONTROL CIRCUIT



Based on Drawing 62-11419-00 Rev – B

(For Applicability, Refer to Table 2–1)

Figure 6.6 Legend - Units with Dual Speed Option

LINE	SYMBOL	LEGEND
7 3,5,8,9,14 21 2 12,21 1 4,8,13,15,20 3/11 11 5 4 6,7,8 5 7 - 15 2,11 2	CB — DS — DT — EG — ESS — F — FS — FHT — FW — G — HR —	BATTERY CIRCUIT BREAKER DIODE DUAL SPEED SWITCH (OPTION) DUAL SPEED TIMER (OPTION) ELECTRONIC GOVERNOR MODULE ENGINE SPEED SENSOR FUSE
3 6 2 10 4 8 8 15 3,6 2 2 10 9	HWT — IGN — IH — IHT — LOP —	HIGH WATER TEMP. SWITCH IGNITION SWITCH INTAKE HEATER INTAKE HEATER TIMER LOW OIL PRESS. SWITCH OIL PRESSURE GAUGE OIL PRESSURE SENDER RECEPTACLE SAFETY RELAY STARTER MOTOR STARTER SOLENOID TIME METER WATER TEMP. GAUGE

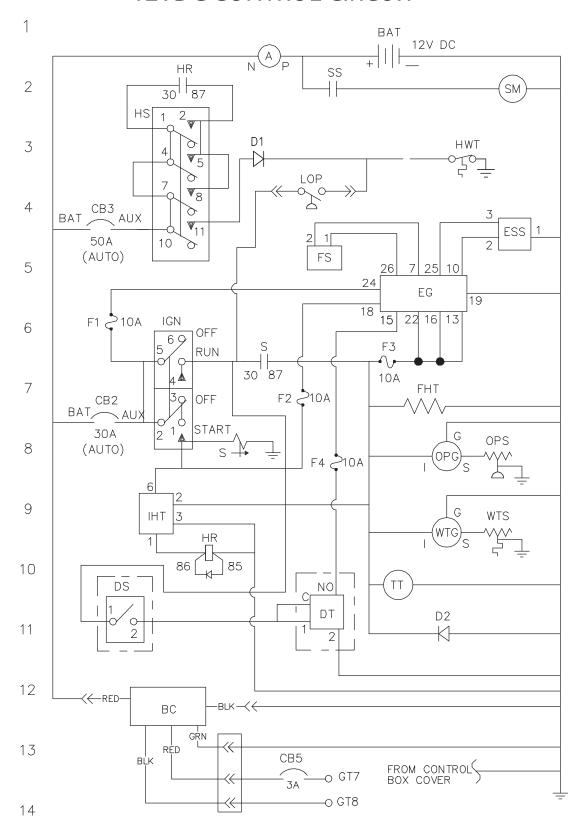
FUEL HEATER IS STANDARD WITH SINGLE SPEED OPTION FUEL WARMER IS STANDARD WITH DUAL SPEED OPTION

Based on Drawing 62-11442-00 Rev E

(Applies to Figure 6.7 and Figure 6.8)

Figure 6.7 Schematic Diagram - Units with Dual Speed Option

12VDC CONTROL CIRCUIT

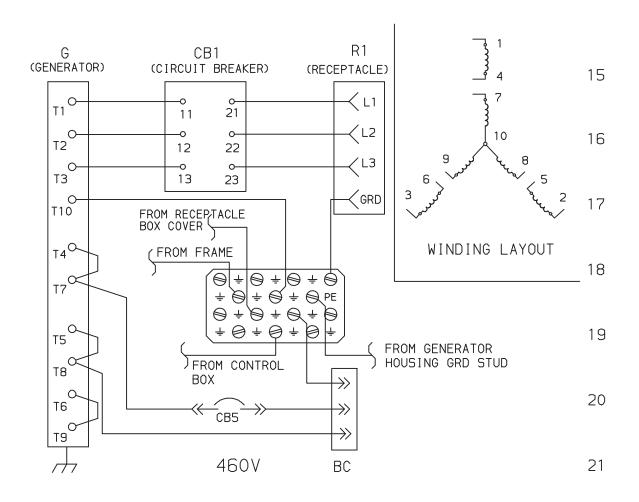


Based on Drawing 62-11442-00 Rev E

(For Applicability, Refer to Table 2-1)

Figure 6.8 Schematic Diagram - 460 Volt Alternating Current Generator

460V



Based on Drawings 62-11292-00 Rev -

62-11287-00 Rev B

62-11419-00 Rev -

62-11442-00 Rev E

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