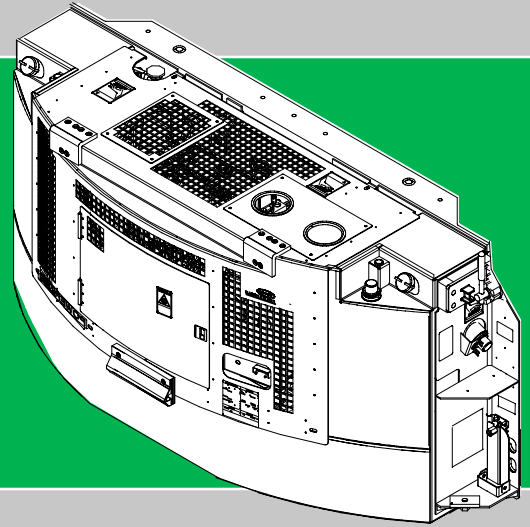
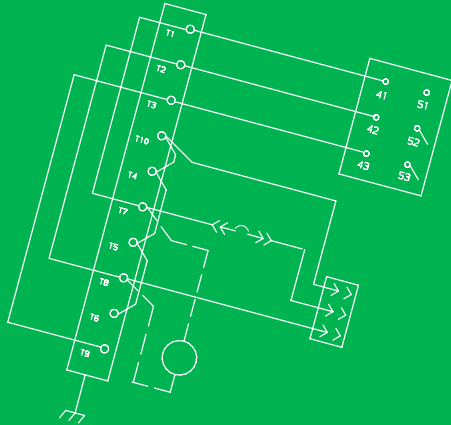




Diesel Generator Set



OPERATION & SERVICE

for

69RG15

Generator Set Units

PID RG1135 and Higher



TRANSICOLD

**OPERATION AND SERVICE MANUAL
DIESEL DRIVEN GENERATOR SET**

MODEL 69RG15
PID RG1135 & Higher

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.

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.

WARNING

Disconnect power plug before removing generator set.

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.

WARNING

Beware of moving 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 glow plugs.

WARNING

Beware of moving V-Belt and belt driven components.

WARNING

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.

SPECIFIC WARNING AND CAUTION STATEMENTS (Continued)

 **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.

 **CAUTION**

Never pour cold water into a hot engine.

 **CAUTION**

Use only ethylene glycol, anti-freeze (with inhibitors) in system as glycol by itself will damage the cooling system. (Refer to paragraph 1.10.i.)

 **CAUTION**

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

 **CAUTION**

Do not under fill or overfill the cup. Overfilling of cup means loss of capacity and under filling means lack of filtering efficiency.

 **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 shock-mounts may result in engine or generator damage.

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SECTION 1

DESCRIPTION

1.1 INTRODUCTION

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

The generator set (see Figure 1-1 and Figure 1-2) consist 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 or 230 VAC, 3 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 starting battery, solid state battery charging system, glow plugs (used as a starting aid), "spin-on" lube oil and fuel filters (for easier filter changes) 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.

1.2 CONFIGURATION IDENTIFICATION

Generator set identification information is provided on a plate located just above the main circuit breaker (see Figure 1-2). 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 1-1. The model number, serial number and PID number must be included when ordering parts and inquiring about your unit.

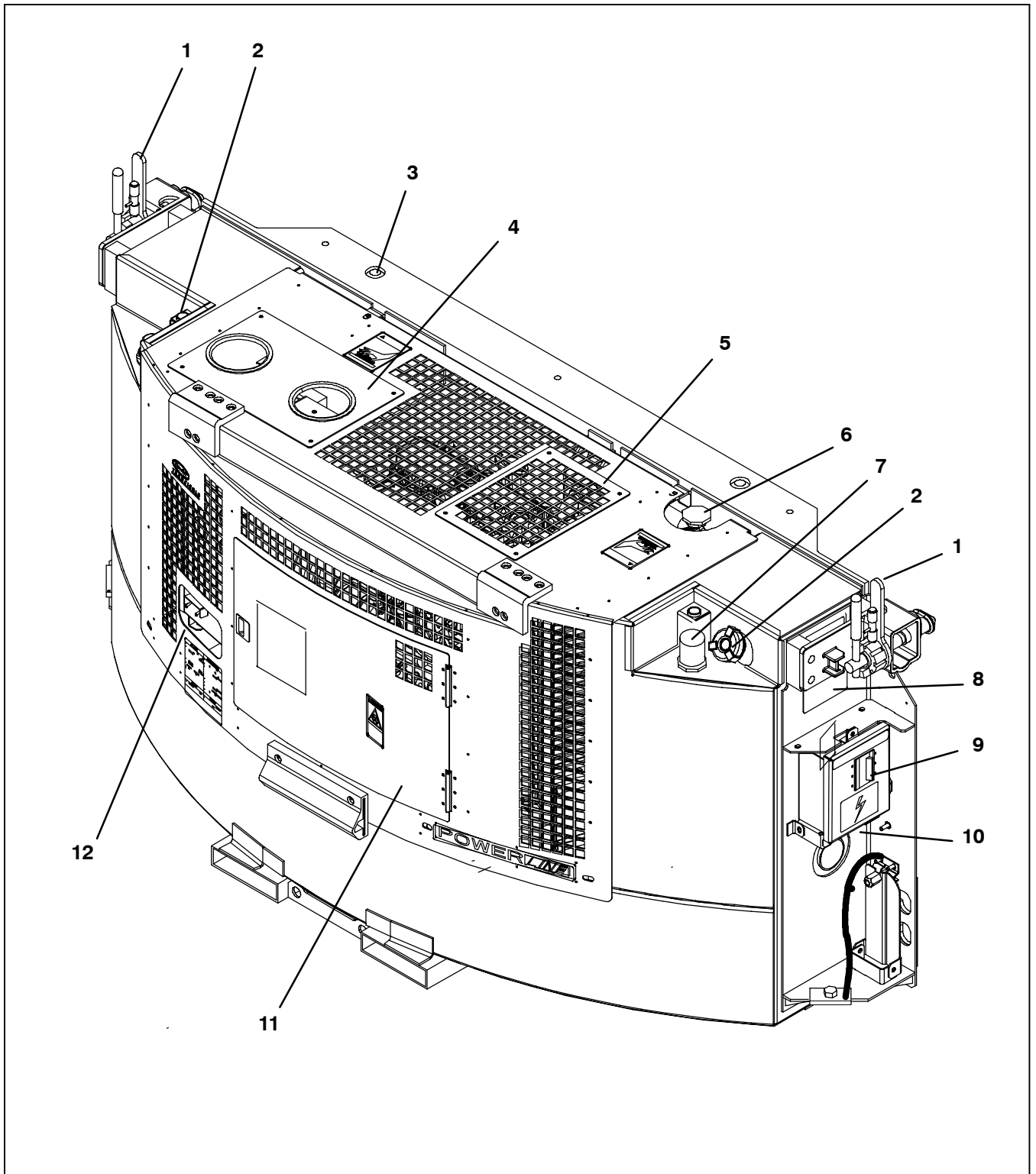
Separately bound manuals covering the diesel engine, Auto Restart option and Alternator option are also available; see the following chart for additional information. Note, all referenced engines have been assembled using the two piece oil pan.

Manual/Form No.	Equipment Covered	Type of Manual
62-10863	CT4-134-DI	Engine Parts List
62-10865	CT4-134-DI	Workshop

**Table 1-1. Model Chart
LEGEND**

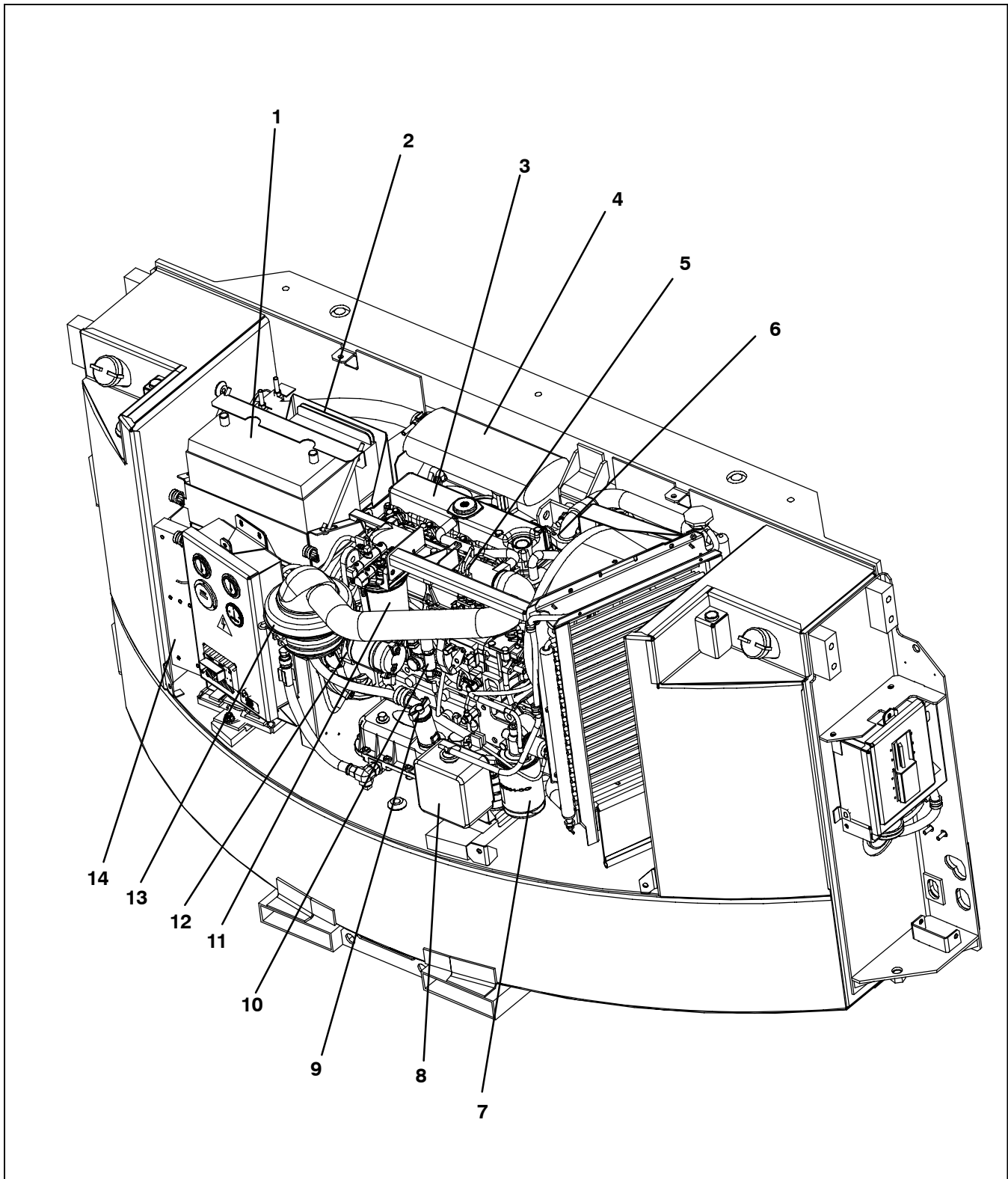
- | | |
|---|--|
| A1 - Pin Mount | C1 - Control Box 91-00375-00 (Standard) |
| A2 - Clamp Mount | C2 - Control Box 91-00375-01 (Auto Restart) |
| A3 - Pin Mount with Clamp Provision | C3 - Control Box 91-00375-02 (Auto Restart and Time Delay) |
| A4 - Pin Mount with with Tether | C4 - Control Box 91-00338-08 (Standard) |
| B1 - Receptacle, 4-Pole, Gasketed Pivot-Cap | C5 - Control Box 91-00338-12 (Auto Restart and Time Delay) |
| B2 - Receptacle, 5-Pole, Pivot-Cap | |
| B3 - Receptacle, 4-Pole, Pivot-Cap | |
| B4 - Receptacle, Time Delay, 4-Pole, Gasketed Pivot-Cap | |

Model	PID	Electrical Wiring Schematic and Diagram Figures	Unit Mounting	Receptacle Box	Control Box
69RG15-102P-03	RG1135	5-1, 5-2, 5-3	A1	B1	C4
69RG15-102P-03	RG1161	5-1, 5-2, 5-3	A1	B1	C1
69RG15-130C-01	RG1139	5-1, 5-2, 5-3	A2	B1	C4
	RG1148	5-1, 5-2, 5-3	A2	B1	C4
	RG1152	5-1, 5-2, 5-3	A2	B1	C4
	RG1169	5-1, 5-2, 5-3	A2	B1	C1
	RG1171	5-1, 5-2, 5-3	A2	B1	C1
	RG1172	5-1, 5-2, 5-3	A2	B1	C1
69RG15-130C-03	RG1175	5-1, 5-2, 5-3	A2	B1	C4
	RG1145	5-4, 5-5, 5-6	A2	B4	C5
69RG15-130C-03	RG1170	5-4, 5-5, 5-6	A2	B4	C3
	RG1173	5-4, 5-5, 5-7	A2	B1	C2
69RG15-130C-04	RG1173	5-4, 5-5, 5-7	A2	B1	C2
69RG15-130P-01	RG1136	5-1, 5-2, 5-3	A4	B3	C4
	RG1137	5-1, 5-2, 5-3	A4	B3	C4
	RG1162	5-1, 5-2, 5-3	A4	B3	C1
	RG1163	5-1, 5-2, 5-3	A4	B3	C1
69RG15-130P-02	RG1138	5-1, 5-2, 5-3	A1	B1	C4
	RG1157	5-1, 5-2, 5-3	A1	B1	C4
	RG1164	5-1, 5-2, 5-3	A1	B1	C1
	RG1165	5-1, 5-2, 5-3	A1	B1	C1
	RG1177	5-1, 5-2, 5-3	A1	B1	C4
69RG15-130P-03	RG1160	5-1, 5-2, 5-3	A1	B1	C2
69RG15-130W-01	RG1142	5-1, 5-2, 5-3	A3	B1	C4
	RG1143	5-1, 5-2, 5-3	A3	B1	C4
	RG1144	5-1, 5-2, 5-3	A3	B1	C4
	RG1149	5-1, 5-2, 5-3	A3	B1	C4
	RG1159	5-1, 5-2, 5-3	A3	B1	C4
	RG1166	5-1, 5-2, 5-3	A3	B1	C1
	RG1167	5-1, 5-2, 5-3	A3	B1	C1
	RG1168	5-1, 5-2, 5-3	A3	B1	C1
RG1176	5-1, 5-2, 5-3	A3	B1	C4	



- | | |
|--------------------------|-----------------------------------|
| 1. Mounting Clamp | 7. Fuel Gauge (Either Side) |
| 2. Fuel Cap | 8. Unit Model, Serial & PID Plate |
| 3. Mounting Pin | 9. Circuit Breaker (CB1) |
| 4. Battery Access Panel | 10. Receptacle |
| 5. Fan Belt Access Panel | 11. Access Door |
| 6. Radiator Cap | 12. Control Box |

Figure 1-1. Generator Set



- | | |
|---|---|
| 1. Battery | 8. Coolant Recovery Bottle |
| 2. Solid State Battery Charger | 9. Lube Oil Dip Stick/Fill Cap |
| 3. Engine | 10. Mechanical Fuel Pump |
| 4. Exhaust Muffler | 11. Fuel Filter (Present Arrangement Shown,
Previous Arrangement Is Lower) |
| 5. Injection Pump | 12. Starter Motor |
| 6. Water Temperature Sender
(Located under Thermostat Cover) | 13. Air Cleaner |
| 7. Engine Oil Filter | 14. Alternating Current Generator |

Figure 1-2. Generator Set - Top Cover Removed

1.3 ENGINE

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

1.3.1 Engine Air System

The air cleaner (Figure 1-2) 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. However, the operator is charged with the responsibility of providing the air cleaner equipment with regular maintenance in accordance with the instructions.

1.3.2 Lube Oil Filter Arrangement

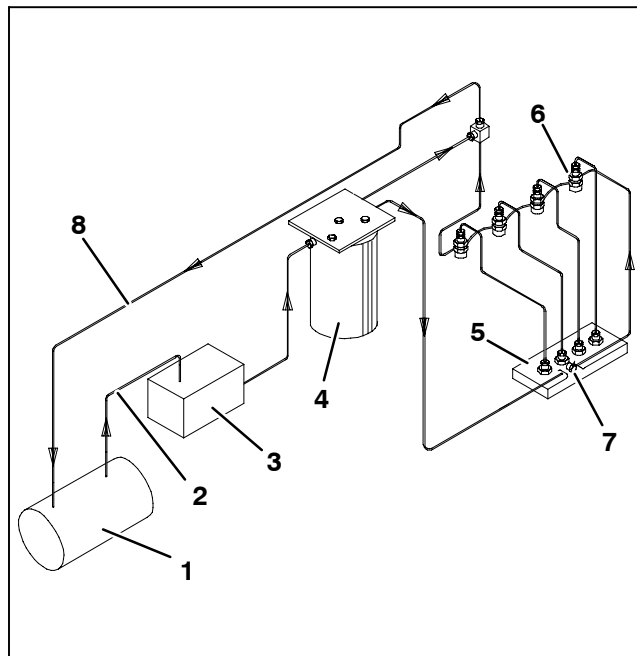
The engine lubricating oil filter may be mounted in a vertical arrangement. Filter arrangements are shown in Figure 1-4.

1.3.3 Fuel System

The fuel system is fitted with a filter which also acts as a water separator. The filter is also fitted with a heater. The fuel system is shown in Figure 1-3.

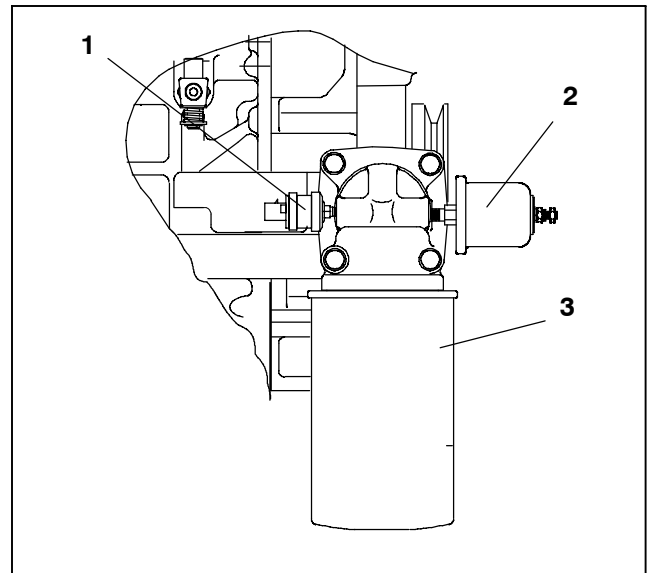
1.4 ENGINE SCREW THREADS

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



- | | |
|----------------------------------|---------------------|
| 1. Fuel Tank | Separator |
| 2. Fuel Supply Line | 5. Injection Pump |
| 3. Mechanical Fuel Pump (Engine) | 6. Injector Nozzles |
| 4. Fuel Filter & Water | 7. Fuel Bleed Valve |
| | 8. Fuel Return Line |

Figure 1-3. Fuel System Diagram



1. Oil Pressure Switch
2. Oil Pressure Sender
3. Oil Filter

Figure 1-4. Lube Oil

1.5 ALTERNATING CURRENT GENERATOR

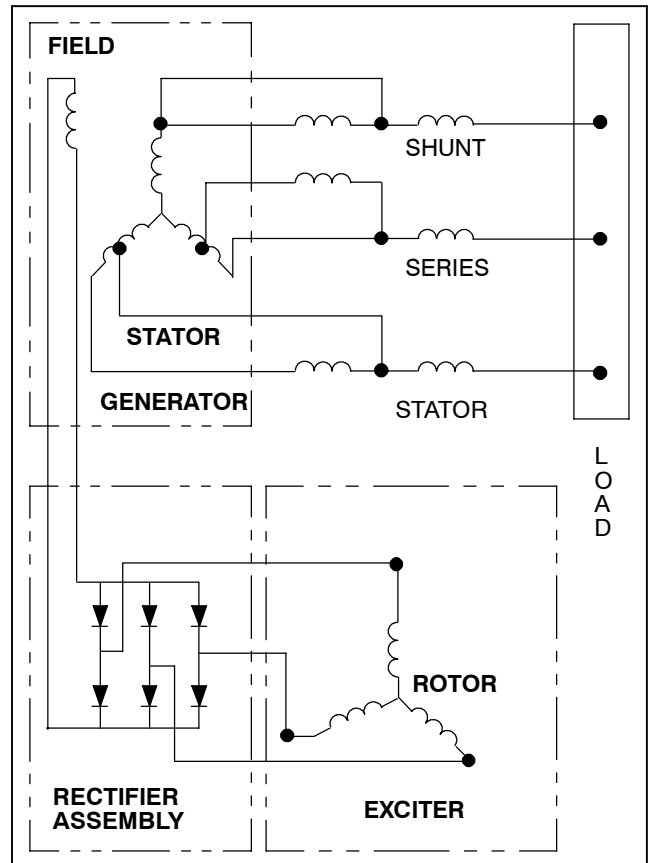


Figure 1-5. A-C Generator Circuit Diagram

1.5.1 Principle of Operation

The Marathon Alternator Company (Lima) brushless alternating current generator (see Figure 1-2) 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 internal within the stator housing. Only the output power leads are connected at the terminal box, located on top of the generator.

1.5.2 Alternating Current Generator Diagram

Figure 1-5 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 the 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 since the exciter stator carries an alternating current corresponding to the load current which 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.



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.

1.6 BATTERY CHARGING SYSTEM

The solid state battery charger (see Figure 1-2) 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.

1.7 OPERATING CONTROLS AND INSTRUMENTS

1.7.1 Introduction

Components required for monitoring and controlling the unit are located in the control box, on the control panel (see Figure 1-1) and on the receptacle box (see Figure 1-1).

1.7.2 Control Panel and Related Components

a. Gauges and Senders

1. Oil Pressure Gauge (see Figure 1-6 or Figure 1-7)

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

This sensing device (see Figure 1-4) senses engine lube oil pressure and transmits a signal to the oil pressure gauge. The oil pressure sender is located on the primary oil filter housing.

3. Water Temperature Gauge (see Figure 1-6 or Figure 1-7)

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

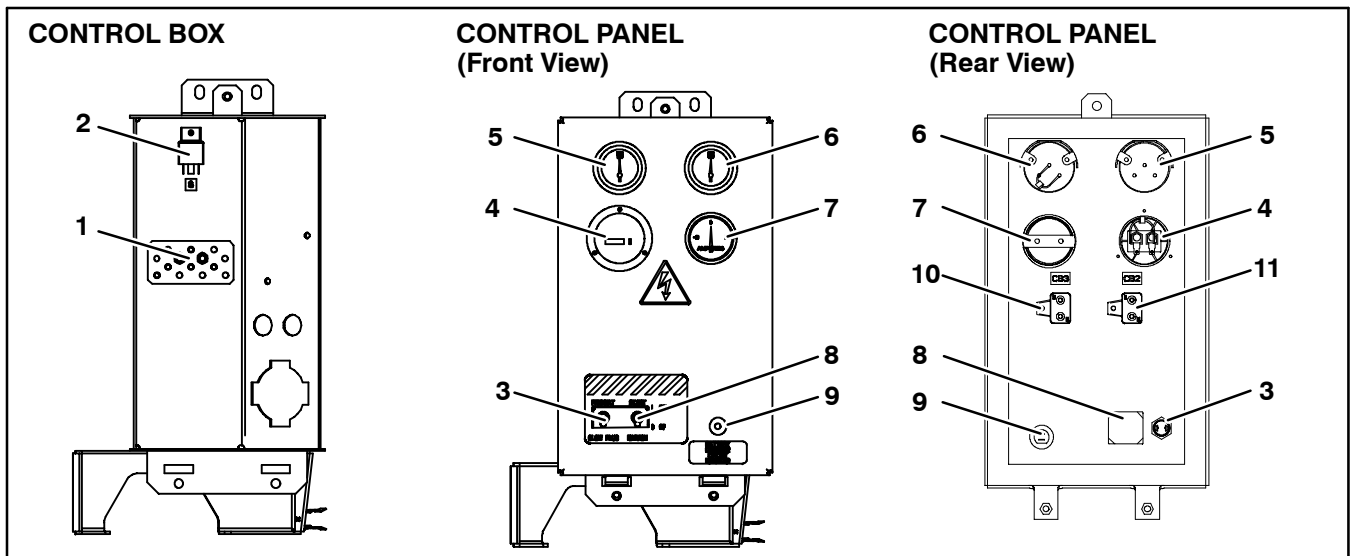
4. Water Temperature Sender

This device (see Figure 1-2) 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.

5. Auto Restart Module (see Figure 1-7)

Auto start/restart is provided to simplify the start-up 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 1-2 for system preset values.

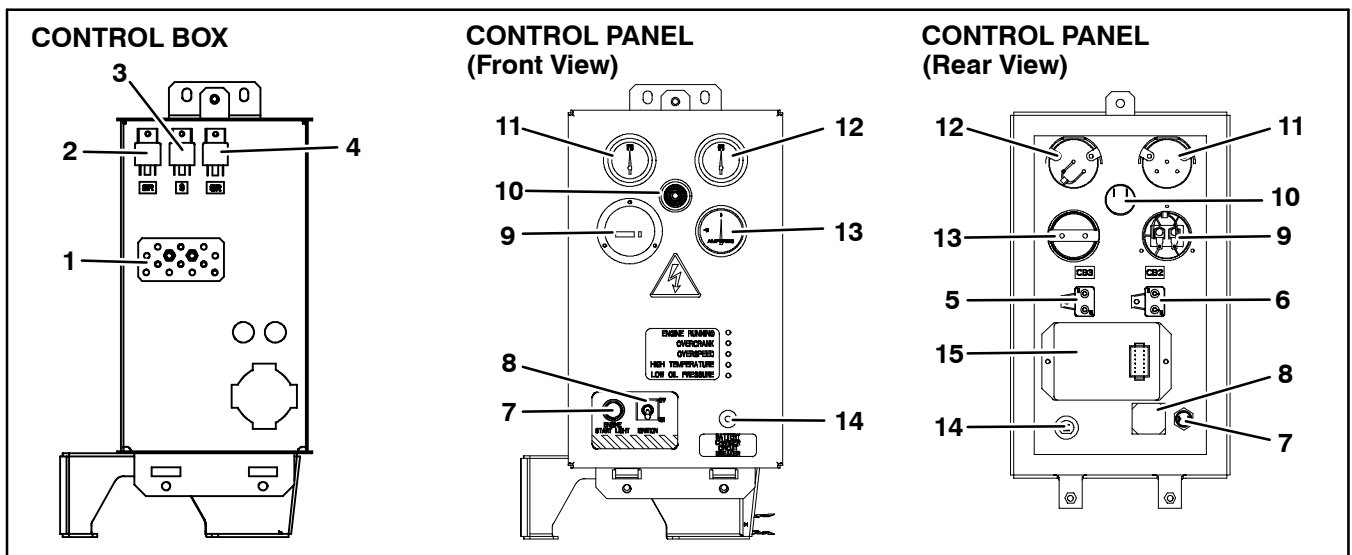
The auto restart function will perform a series of six attempts to restart the unit and make three attempts within each series. Once the function has completed all 18 attempts, the unit will automatically lock out future crank attempts. Refer to Table 1-3 for detailed information on auto restart sequencing.



- 1. Ground Strap Assembly
- 2. Safety Relay
- 3. Glow Plug Switch
- 4. Total Time Meter
- 5. Water Temperature Gauge
- 6. Oil Pressure Gauge

- 7. Ammeter
- 8. Ignition Switch
- 9. Battery Charger Fuse or Circuit Breaker (CB5)
- 10. Circuit Breaker (CB3)
- 11. Circuit Breaker (CB2)

Figure 1-6. Standard Control Box and Panel



- 1. Ground Strap Assembly
- 2. Starter Relay
- 3. Safety Relay
- 4. Glow Plug Relay
- 5. Circuit Breaker (CB3)
- 6. Circuit Breaker (CB2)
- 7. Engine Start Light
- 8. Ignition Switch

- 9. Total Time Meter
- 10. Engine Start Alarm (Buzzer)
- 11. Water Temperature Gauge
- 12. Oil Pressure Gauge
- 13. Ammeter
- 14. Battery Charger Fuse or Circuit Breaker (CB5)
- 15. Auto Restart Module

Figure 1-7. Auto-Restart Control Box and Panel

b. Meters

1. Ammeter (A) (see Figure 1-6 or Figure 1-7)

The ammeter indicates the rate of discharge or charge of the battery. It is an indicator of charging system function. Also, the ammeter provides information on glow plug condition. During operation, each plug draws approximately 7.5 amps.

2. Total Time Meter (TT) (see Figure 1-6 or Figure 1-7)

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 4-1.)

3. Voltmeter (V) (see Figure 1-6 or Figure 1-7)

The A-C voltmeter is a sealed device indicating the line-to-line voltage output from the A-C generator. When the unit has an output of 460 vac (or 230 vac if so optioned), the indicating needle will be in the green band. (Refer to section 4.4.7.)

c. Manual Switches

1. Glow Plug Switch (GPS) (see Figure 1-6)

The glow plug switch is of the momentary type and when held in the PREHEAT position, permits battery current (approximately 30 amps) to flow to the glow plugs and preheat the combustion chambers. The glow plugs are located under the fuel injectors. When starting engine, it is necessary to continue to hold the glow plug switch in the UP position until the engine has developed sufficient oil pressure to close the oil pressure safety switch.

2. Ignition Switch (IGN) (see Figure 1-6)

The ignition switch is of the momentary type, when held in the START 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 1-7)

The ignition switch is of the ON/OFF type. When switched to the RUN position, it energizes the control module, which in turn controls all functions of the gen-set.

1.8 SAFETY DEVICES

System components are protected from damage caused by unsafe operating conditions by safety devices including circuit breakers, fuses and safety switches.

The A-C generator, battery charger and the glow plug circuits are protected by circuit breakers, which will open on excessive current draw to interrupt the component electrical circuit.

The engine, engine control devices and engine monitoring devices are protected by a circuit breaker, a low oil pressure switch and a high water temperature switch. These safety devices monitor system operating conditions and open a set of electrical contacts when an unsafe condition occurs. Opening one or more of these safety switch contacts will de-energize the fuel solenoid.

De-energizing the fuel solenoid shuts off the fuel supply to the engine, thus stopping the engine. Safety device specifications are provided in Table 1-4.

Table 1-2. 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)
Glow Plug Delay	20 seconds	The Glow Plug delay is used to energize the glow plug circuit. The Glow Plug delay begins timing after the auto restart module signal is received. During the entire delay, the glow plug circuit is energized and an audible 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)

Table 1-3. Auto Restart Sequencing

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

Series Attempt Number	Glow Plugs Energized in Seconds	Fuel Solenoid Engaged	Engine Crank Duration (Seconds)	Engine Rest Duration (Seconds)	Engine Status
1	20	X	Up to 15	25	<p>If the engine starts:</p> <p>a. Run sequence begins.</p> <p>If the engine fails to start:</p> <p>a. Glow plugs will de-energize.</p> <p>b. Fuel solenoid will de-energize.</p> <p>c. Crank output will de-energize.</p> <p>d. Overcrank LED will flash once. Wait two seconds and repeat.</p> <p>e. Unit will rest 30 minutes and proceed to the next series.</p>
2	20	X	Up to 15	25	<p>If the engine starts:</p> <p>a. Glow plugs will de-energize.</p> <p>b. Run sequence begins.</p> <p>If the engine fails to start:</p> <p>a. Glow plugs will de-energize.</p> <p>b. Fuel solenoid will de-energize.</p> <p>c. Crank output will de-energize.</p> <p>d. Overcrank LED will flash twice. Wait two seconds and repeat.</p> <p>e. Unit will rest 30 minutes and proceed to the next series.</p>
3	20	X	Up to 15	25	<p>If the engine starts:</p> <p>a. Glow plugs will de-energize.</p> <p>b. Run sequence begins.</p> <p>If the engine fails to start:</p> <p>a. Glow plugs will de-energize.</p> <p>b. Fuel solenoid will de-energize.</p> <p>c. Crank output will de-energize.</p> <p>d. Overcrank LED will flash three times. Wait two seconds and repeat.</p> <p>e. Unit will rest five hours and proceed to the next series.</p>

Table 1-3. Auto Restart Sequencing (Continued)

Series Attempt Number	Glow Plugs Energized in Seconds	Fuel Solenoid Engaged	Engine Crank Duration (Seconds)	Engine Rest Duration (Seconds)	Engine Status
4	20	X	Up to 15	25	<p>If the engine starts:</p> <ul style="list-style-type: none"> a. Glow plugs will de-energize. b. Run sequence begins. <p>If the engine fails to start:</p> <ul style="list-style-type: none"> a. Glow plugs 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.
5	20	X	Up to 15	25	<p>If the engine starts:</p> <ul style="list-style-type: none"> a. Glow plugs will de-energize. b. Run sequence begins. <p>If the engine fails to start:</p> <ul style="list-style-type: none"> a. Glow plugs 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	20	X	Up to 15	25	<p>If the engine starts:</p> <ul style="list-style-type: none"> a. Glow plugs will de-energize. b. Run sequence begins. <p>If the engine fails to start:</p> <ul style="list-style-type: none"> a. Glow plugs 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.

Table 1-4. Safety Devices

Unsafe Condition	Safety Switch	Switch Setting
ENGINE		
Low engine lubricating oil pressure	Low oil pressure switch (LOP) - Automatic reset	Opens below 15 psig (1.05 kg/cm ²)
High engine cooling water temperature	Water temperature switch (HWT) - Automatic reset	Opens at 230F (110C)
Low coolant	Low coolant sensor Automatic reset	Opens with a loss of 32 ounces of coolant
Excessive current draw by the fuel solenoid, fuel heater, water temperature gauge, oil pressure gauge or total time meter.	Circuit breaker (CB2) - Automatic reset	Trips at 30 amps
GLOW PLUGS		
Excessive current draw on glow plug circuit.	Circuit breaker (CB-3) - Automatic reset	Opens at 50 amps
BATTERY CHARGER		
Excessive current draw on 230 volt feed circuit.	Circuit breaker (CB-5) - Automatic reset or fuse	Opens at 3 amps
GENERATOR		
Excessive current draw by load	Circuit breaker (CB1, 460 volt) - Manual reset	Trips at 26 amps (460 vac)
	Circuit breaker (CB4, 230 volt) - Manual reset	Trips at 48 amps (230 vac)

1.9 UNIT SPECIFICATIONS

	Nominal Tank Sizes	Fill Capacity	Draw Capacity
a. Fuel Tanks	130 Gallon	128.5 Gallon	122 Gallon*
	102 Gallon	102 Gallon	97 Gallon*

*Allows for DOT required 5% vapor space

b. Weights	Battery	52 lb (23.6 kg)
	Generator (A-C)	285 lb (129 kg)
	Engine (Dry) - without Accessories	418 lb (189.5 kg) Approximate
	Unit (less fuel 102 or 130 gallon tank)	1675 lb (760 kg)
	Unit (with fuel 102 gallon tank)	2395 lb (94.3 kg)
	Unit (with fuel 130 gallon tank)	2550 lb (1156 kg)

1.10 ENGINE DATA

a. Bore/Stroke	3.43 inches (87 mm) / 3.64 inches (92.4 mm)	
b. Compression Ratio	20.5 : 1	
c. Cylinders (Number)	Four	
d. Displacement	134 cubic inches (2.2 liters)	
e. Firing Order	1-3-4-2	
f. Fuel and Fuel Heater Thermostat (FHT)	Winter	Summer
	Diesel No. 1	Diesel No. 2
	FHT	
	Close on temperature fall @ 45 +/- 6.5F	Open on temperature rise @ 75 +/- 6.5F
g. Glow Plug Amperage	7.5 amps per plug at 12 vdc	
	Power Consumption: 140-165 Watts @ 12-15.5 VDC	

1.10 ENGINE DATA (Continued)

h. Horsepower	28 hp @ 1800 rpm at 3000 feet above sea level.			
	33 hp @ 1800 rpm at sea level.			
i. Cooling System	Capacity	6 U.S. quarts (5.68 liters) - includes 1 quart (0.95 liter) in coolant recovery bottle. (Refer to section 4.4.4)		
	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.		
	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). Replacement, with a 50/50 mix of extended life coolant (ELC) meeting GM specification GM6277M and deionized water is recommended. Extended life coolant is red or orange in color. DO NOT mix with conventional coolant.		
	Water Temperature Safety Switch Setting	Opens	230 +/- 5F (110 +/- 3C)	
		Resets	200F (93C) - minimum	
	Thermostat	Starts to open	177 to 182F (80 to 84C)	
Fully open		203F (95C)		
j. Lubrication System	Oil Pressure	35 to 60 psig (3.3 to 5.2 kg/cm ²)		
	Oil Pressure Safety Switch Setting Opens	15 psig (2.08 kg/cm ²)		
	Capacity	Engine - 17.2 U.S. quarts (16.3 liters) includes standard filter.		
	Oil Level Indicator	Dipstick in oil pan or fill cap NOTE To check oil level on engines with the dipstick mounted in the fill cap, remove the cap and wipe the dipstick clean. Reinsert the cap into the oil fill tube then remove to check level. It is not necessary to screw the cap back on 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 CD (DS), Base Number 8 or above.		
	Lube Oil Viscosity	Outdoor Temperature		
Fahrenheit		Centigrade	SAE	
Below -20F		Below -29C	0W, 5W or 5W20	
-20 to 32F		-29 to 0C	10W or 10W30	
32 to 77F		0 to 25C	20W or 15W40	
Over 77F	Over +25C	30W or 15W40		

SECTION 2 OPERATION

2.1 GENERATOR SET INSTALLATION AND REMOVAL - PIN TYPE with LOCKING PLATE

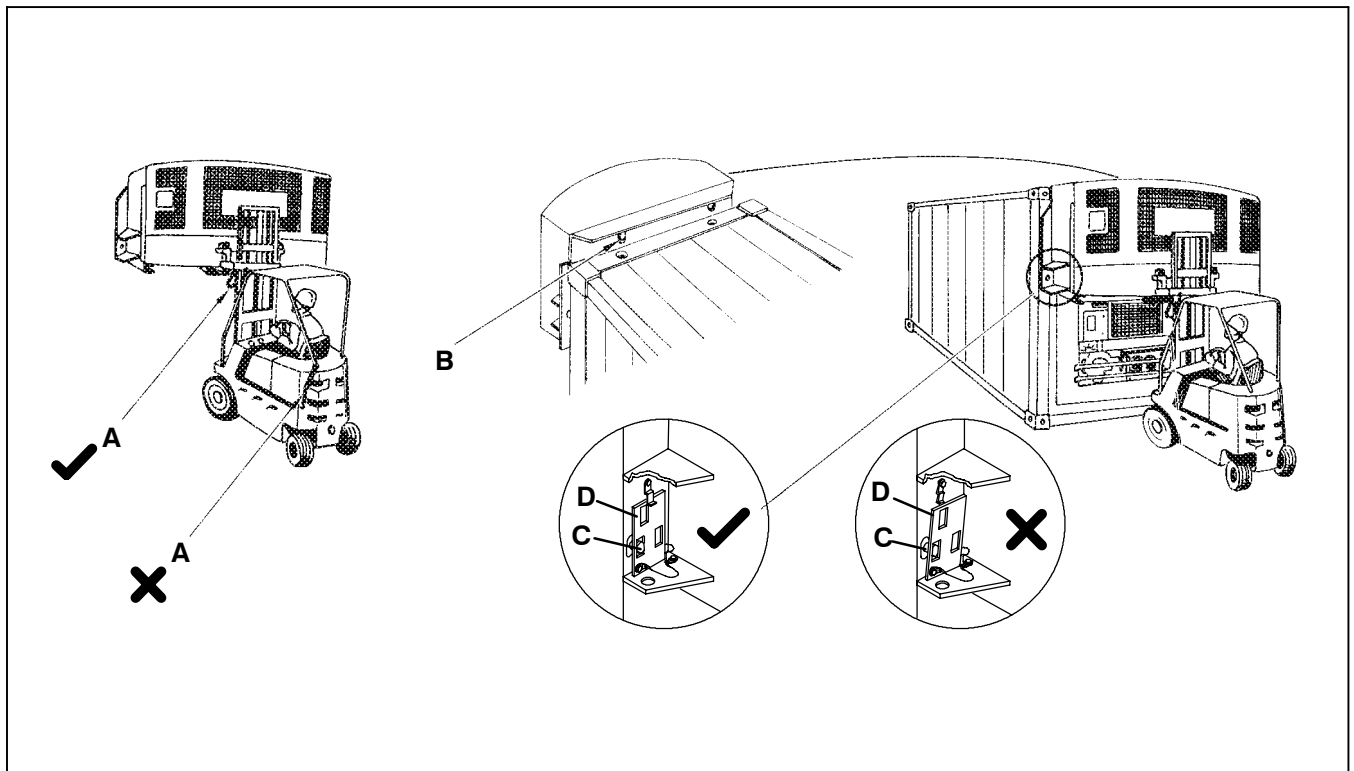


Figure 2-1. Generator Set Mounting - Pin Type with Locking Plate



WARNING

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

NOTE

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

a. Installation

1. 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.
2. 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



WARNING

Disconnect power plug before removing generator set.

1. 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.
4. Raise generator set several inches to disengage pins (B) from mating holes and remove from container.

2.2 GENERATOR SET INSTALLATION AND REMOVAL - CLAMP TYPE with LOCKING PLATE

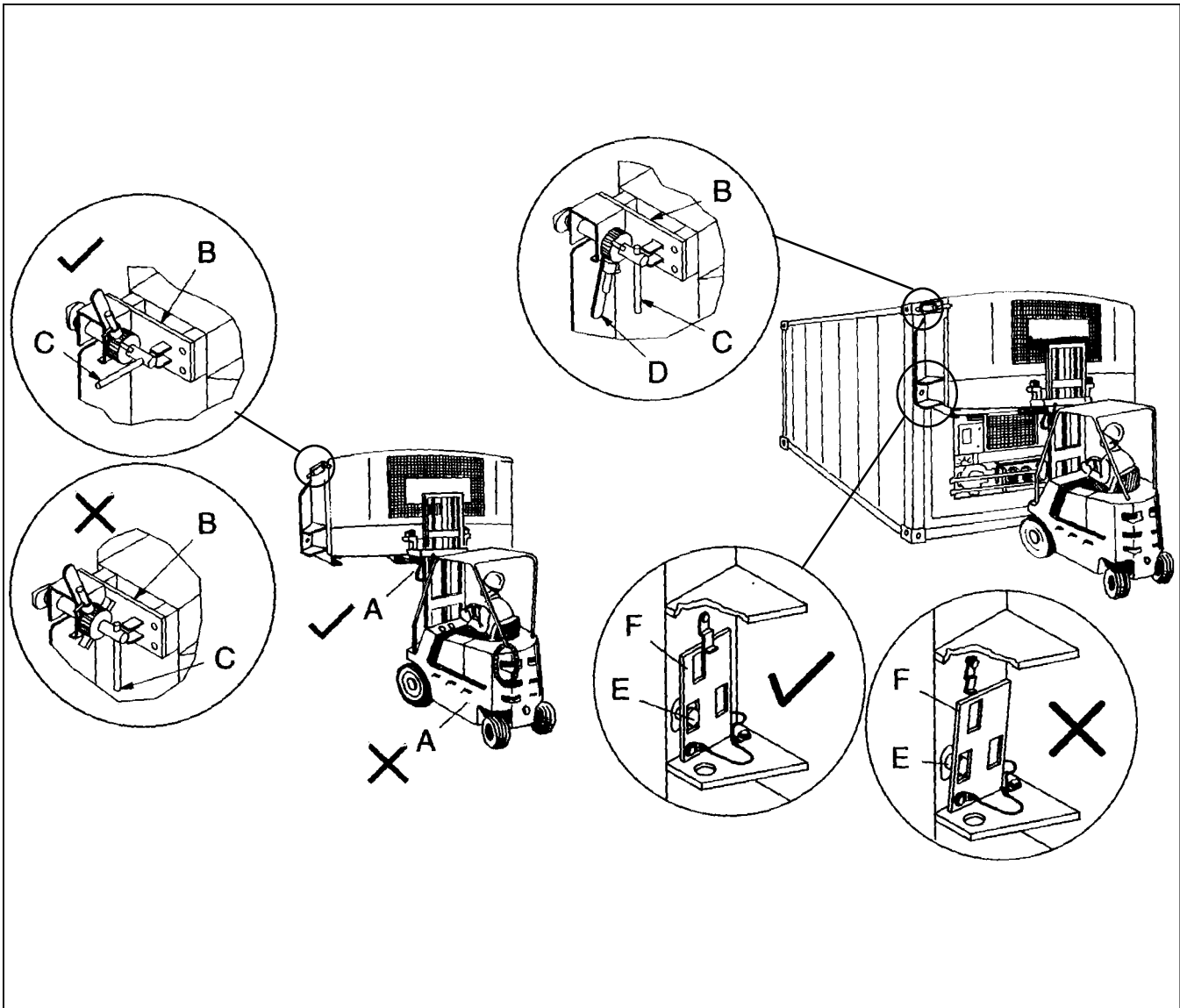


Figure 2-2. Generator Set Mounting - Clamp Type with Locking Plate



WARNING

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

NOTE

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

1. 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.

3. 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.

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.
4. 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.
6. Carefully remove the generator set from the container.

2.3 GENERATOR SET INSTALLATION AND REMOVAL - PIN TYPE with LOCKING BRACKET

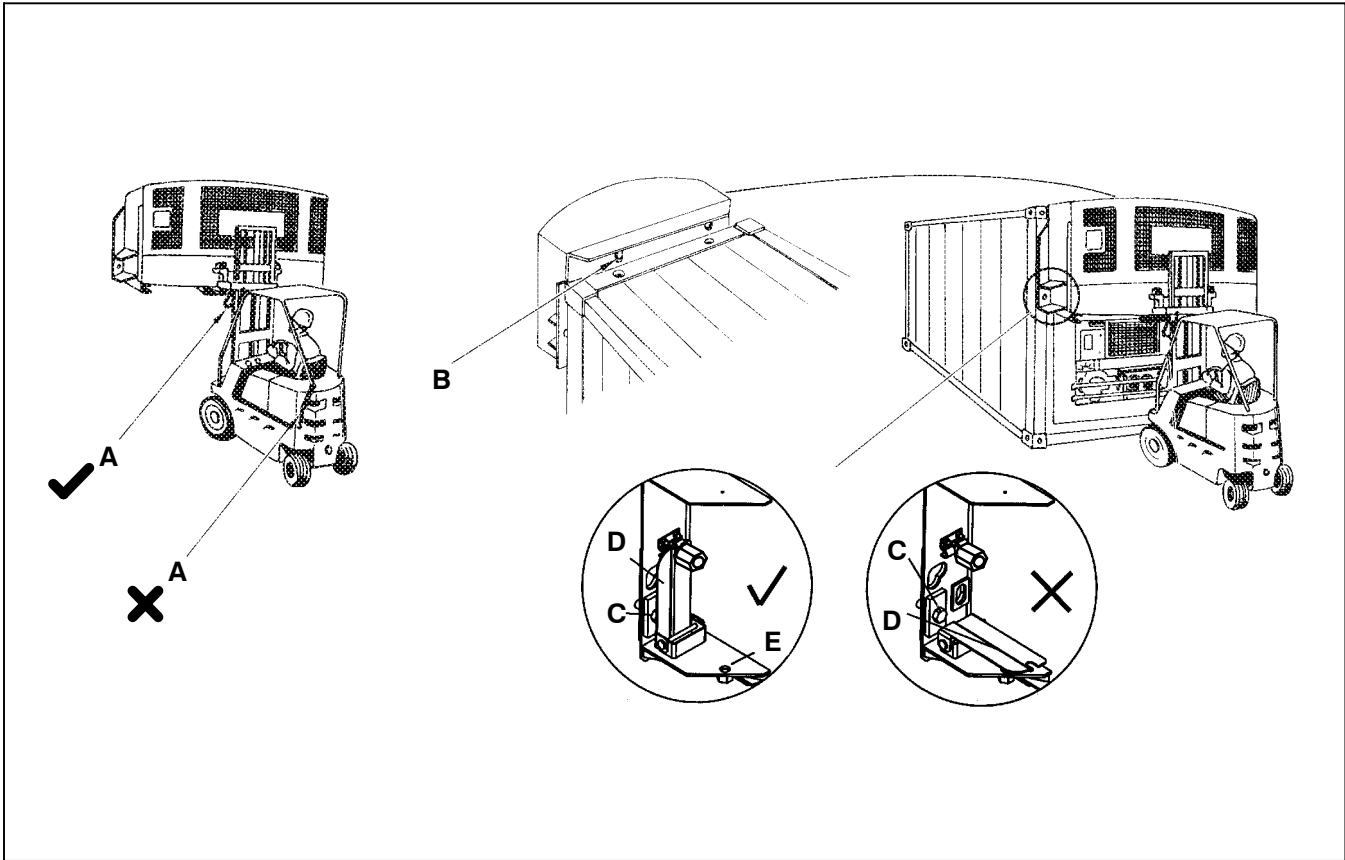


Figure 2-3. Generator Set Mounting - Pin Type with Locking Bracket

WARNING

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

NOTE

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

a. Installation

1. 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.
2. 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 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.

1. 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 into threaded hole (E).
4. Raise generator set several inches to disengage pins (B) from mating holes and remove from container.

2.4 GENERATOR SET INSTALLATION AND REMOVAL - CLAMP TYPE with LOCKING BRACKET

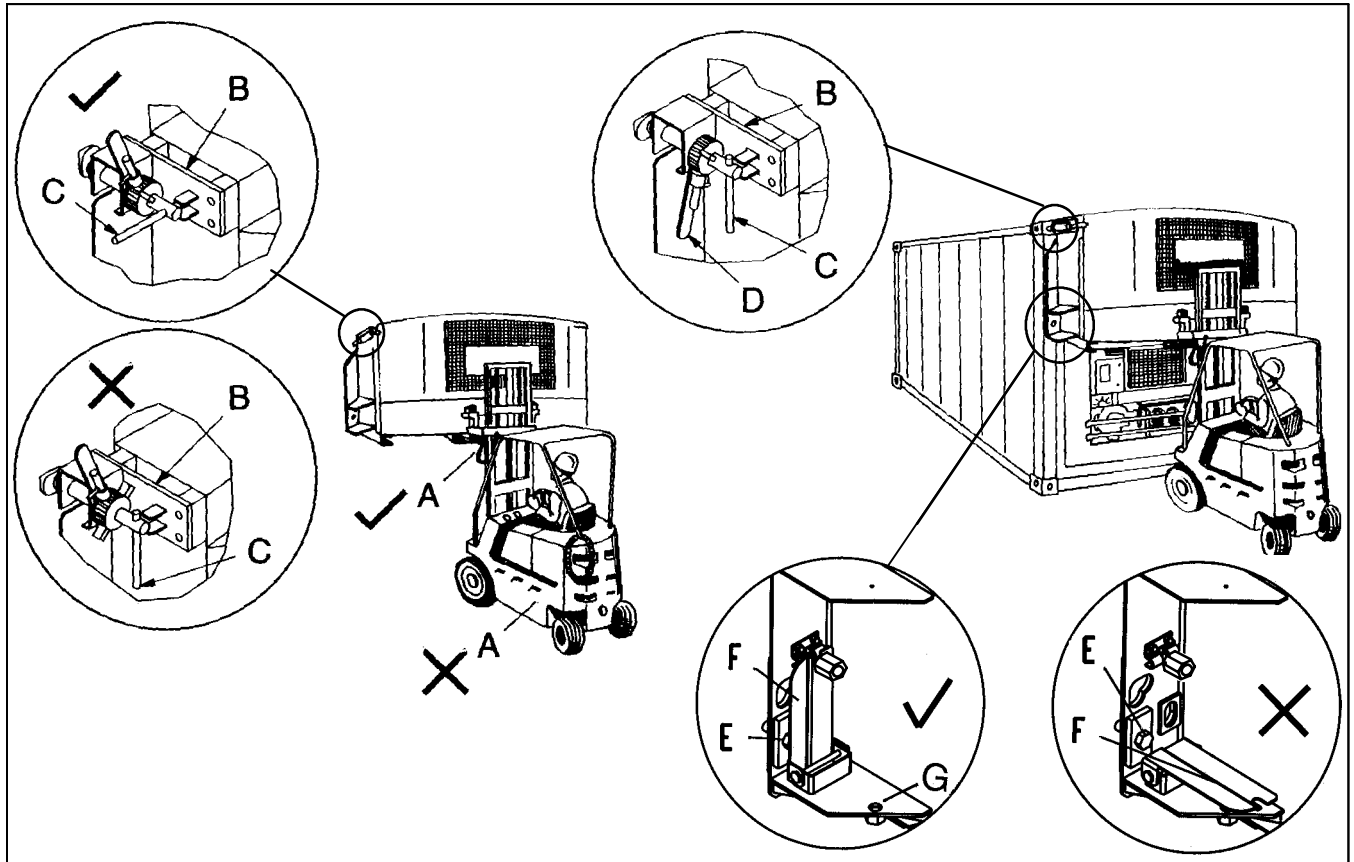


Figure 2-4. Generator Set Mounting - Clamp Type with Locking Bracket

WARNING

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

NOTE

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

1. 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.

3. 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)**.
4. 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.
6. Carefully remove the generator set from the container.

2.5 STARTING AND STOPPING INSTRUCTIONS

2.5.1 Pre-Start Inspection

- a. Check engine lubrication and fuel filters, oil lines, and connections for leaks. If required, tighten connections and/or replace gaskets.
- b. Check engine lubricating oil level. (Refer to paragraph 1.10, table entry j.)
- c. Check V-belt for fraying or cracks and proper tension. (Refer to paragraph 4.4.5.)
- d. Check radiator hoses for leaks and check radiator coolant level. (Refer to paragraph 1.10, table entry i.)
- e. Check radiator coil and generator air intake screen for cleanliness. If required, clean using compressed air, reversing the normal air flow.
- f. Check air cleaner for cleanliness and clean if necessary. (Refer to paragraph 4.4.8).
- g. Drain water from fuel filter bowl.
- h. Fill fuel tank with diesel fuel. (Refer to paragraph 1.10, table entry f.)
- i. Check glow plug amperage. (Refer to paragraph 1.10, table entry g.)
- j. Check battery terminals for cleanliness and secureness. If required, clean, then coat with a battery terminal sealant.
- k. Check and if required, tighten all electrical connections.
- l. Check and if required, tighten all hardware (brackets, etc.).
- m. Ensure the main generator set circuit breaker (CB1) is in the OFF position. Connect power cable to refrigeration unit and proceed to paragraph 2.5.2.

2.5.2 Starting Instructions



WARNING

Beware of moving 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 glow plugs.

NOTE

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 condition persists, check valve clearance when engine is cold. (Refer to engine workshop manual listed in paragraph 1.2.)

a. Standard Units

1. Hold glow plug switch (See Figure 1-6) in the PRE-HEAT position. Suggested hold times for a cold engine are as follows:

COLD ENGINE GLOW TIMES	
Ambient Temperature	Time
68F / 20C	5 seconds
32F / 0C	20 seconds
18F / -8C	40 seconds
Below 18F / -8C	1 minute intervals

2. With glow plug switch held in the PREHEAT position, place the ignition switch in the START position.
3. After engine has started, continue to hold the glow plug switch in the PREHEAT position until the engine develops sufficient oil pressure to close the oil pressure safety switch. When released, the glow plug switch will automatically return to the OFF position.

b. Units with Auto Restart

1. Place the Ignition switch (IGN) (See Figure 1-7) in the Run position.
2. The Auto Restart module will energize the glow plugs for 40 seconds and the safety buzzer will sound. After the 20 second delay, the unit will attempt to start.

2.5.3 Post-Start Inspection

- a. Check generator output with a voltmeter. In the no load condition, output should be at rated output of 460 (+/- 10%) or 230 volts ac (+/- 5%) with 1820 to 1840 engine RPM. Place generator set main circuit breaker in the ON position. Start refrigeration unit and check generator (1710 rpm).
- b. Check total time meter operation (run engine 10 minutes).
- c. Listen for abnormal bearing noise (A-C generator).

- d. Check fuel lines, lube oil lines and filters for leaks.
- e. Check exhaust system for leaks.

2.5.4 Stopping Instructions

Place the ignition switch in the OFF position.

2.6 SEQUENCE OF OPERATION



Beware of moving V-Belt and belt driven components.

a. Standard Units

With the glow plug switch (GPS) held in the pre-heat position (refer to schematic diagrams, Section 5), current flows to the glow plugs (GP). A second set of contacts also energizes the safety relay (S).

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

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) and to the pull in winding of the fuel solenoid (FS). Also, a second set of contacts energizes the oil pressure gauge (OPG), water temperature gauge (WTG), the run winding of the fuel solenoid, and (on units fitted with a 12-volt total time meter) the total time meter (TT). Also, at this time, power is available at the fuel heater thermostat (FHT) or (on systems fitted with a heater relay) the heater relay (HR) is energized. Energizing HR provides a circuit to the fuel heater thermostat. The thermostat, internal to the fuel filter head, energizes the fuel heater (FH) at cold fuel temperatures.

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 contacts close to maintain power to the safety relay.

Once the engine has started, the ignition switch is released to the RUN position. The glow plug switch is then released. Releasing the glow plug switch de-energizes the glow plugs while releasing the ignition switch de-energizes the starter motor.

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 is placed in the run position, 12-volt DC power will be applied to the auto restart module. All the indicator lights on the auto restart module will illuminate. As the module performs its self test, the lights will go out individually.

After the self test is complete, the module will energize the glow plugs and sound the audible warning alarm indicating that the unit has been powered on and will start (the 20 second glow plug delay starts at this time). When the 20 second glow plug delay expires, power will be applied to the fuel solenoid and the engine attempts to crank for 15 seconds.

When the engine starts, the glow plug circuit is de-energized, the shutdown lockout time delay of 15 seconds will begin timing and the starter will be disengaged. During this 15 second delay, at start up, the auto restart module will disregard the signals to the oil pressure and engine temperature inputs, and the Run sequence begins (see Restart Procedure). If engine does not start, refer to Table 1.3 for auto restart sequencing.

SECTION 3

TROUBLESHOOTING

3.1 DIESEL ENGINE

CONDITION	POSSIBLE CAUSE	REMEDY/ REFERENCE SECTION
3.1.1 Engine Will Not Start		
Starter motor will not crank or low cranking speed	Battery insufficiently charged Battery terminal post or battery defective Bad electrical connections at starter Starter motor malfunctions Starter motor solenoid defective Open starting circuit Incorrect grade of lubricating oil	Charge Check Correct 3.1.4 Engine Manual 3.1.4 1.10.j
Starter motor cranks but fails to start	No fuel in tank Air in fuel system Water in fuel system Plugged fuel filters Glow plug(s) defective Plugged fuel lines to injector(s) Mechanical lift fuel pump malfunction	1.9/1.10.g 4.4.1 Drain Sump Replace 4.4.10 Engine Manual Engine Manual
Starter cranks, engages but dies after a few seconds	Engine lube oil too heavy Voltage drop in starter cable(s)	1.10.j Check
3.1.2 Engine Starts Then Stops		
Engine stops after a few rotations	No fuel in tank Fuel filter restricted Air cleaner or hose restricted Safety device open Open wiring circuit to fuel solenoid Fuel solenoid Fuel supply restricted Mechanical lift fuel pump malfunction Oil pressure switch defective Leak in fuel system Injector nozzle(s) defective Injection pump defective Generator internal overloads open	1.9/1.10.g Replace 4.4.8 1.8 Check Replace 1.10.g/4.2 Engine Manual Replace Check Engine Manual Engine Manual Table 1-4
3.1.3 Engine Will Not Shut Off		
Engine will not shut off	Loose ground connection Improperly seated fuel solenoid	Clean & Tighten Correct

CONDITION	POSSIBLE CAUSE	REMEDY/ REFERENCE SECTION
3.1.4 Starter Motor Malfunction		
Starter motor will not crank or turns slowly	Battery insufficiently charged Battery cable connections loose or oxidized Battery cables defective Starter brushes shorted out Starter brushes hung up, defective or have no contact Starter solenoid damaged Ignition switch defective Engine lube oil too heavy	Charge Check Replace Engine Manual Engine Manual Engine Manual Replace 1.10.j
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 defective Starter motor solenoid defective	Replace Engine Manual
Pinion does not disengage after engine is running	Defective starter	Engine Manual
3.1.5 Malfunction In The Engine Starting Circuit		
No power to starter motor solenoid	Battery defective Loose electrical connections	Correct Tighten
Fuel solenoid does not energize or does not remain energized	Battery defective Loose electrical connections Oil pressure switch defective Water temperature safety switch open Fuel solenoid defective Ignition switch defective	Correct Tighten 1.8 1.8 Engine Manual Replace
3.1.6 Miscellaneous Engine Troubleshooting		
Loss of power	Restriction in air cleaner Air in fuel system Air vent restricted Restricted fuel lines Defective fuel injection pump Defective injector(s) or incorrect type Incorrect fuel injection pump timing Incorrect valve timing Poor compression	4.4.8 4.4.1 Clean Engine Manual Engine Manual Engine Manual Engine Manual Engine Manual
Vibration	Engine shockmounts defective Poor compression	Replace Engine Manual
Overheating	Restriction in air cleaner Exhaust pipe restriction Restriction in water jacket Restriction in radiator Coolant level too low Loose water pump/alternator V-belt Defective thermostat Defective water pump	4.4.8 Remove Engine Manual 4.4.4 1.10.i. 4.4.5 Engine Manual Engine Manual
Excessive crankcase pressure	Plugged crankcase breather line	4.4.9

CONDITION	POSSIBLE CAUSE	REMEDY/ REFERENCE SECTION
3.2 BATTERY CHARGER (SOLID STATE)		
Input fuse blows when charger is turned on	Short in 12-volt wiring causing overload of charger	Locate and remove short
Input fuse blows repeatedly, even when not connected	Internal short	Replace
Charger does not taper back after charging for a few minutes	Bad cell in battery Defective charger	Test battery for defect according to battery manufacturer's instructions Replace
Charger does not charge	Open input circuit breaker Charger is not receiving AC input Charger output is not connected to 12 volt battery Defective charger	Reset Using a voltmeter, confirm charger is receiving correct (230v) AC voltage. If not, check input connections. Check output wiring connections to battery. 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 battery has caused charger to stop charging	Internal DC fuse blown and possible damage to current carrying components	Replace

CONDITION	POSSIBLE CAUSE	REMEDY/ REFERENCE SECTION
3.3 ALTERNATING CURRENT GENERATOR		
No voltage	Loss of residual magnetism in exciter field Circuit breaker tripped Open in stator windings Open or short in rotating rectifiers Short circuited Open in alternator field Shorted exciter armature	4.5.1.a. Check 4.5.4 4.5.1.c. 4.5.4 4.5.4 4.5.4
Low voltage	Low engine speed Excessive load High resistance connections - connections warm or hot Shorted field	4.4.7 Check Tighten 4.5.4
Fluctuating voltage (May be indicated by flickering lights)	Fluctuating speed Irregular speed of engine Loose terminal or load connections Defective bearing causing uneven air gap	4.4.7 Engine Manual Tighten 4.5.1.4.5.3
High voltage	Excessive engine speed	4.4.7
Overheating	Generator overloaded Clogged ventilating screens High temperature surrounding generator Insufficient circulation Unbalanced load Dry bearing	Check Clean 4.4.4 4.4.4 Balance 4.5.1./4.5.3
Mechanical noise	Defective bearing Rotor scrubbing on stator Loose laminations Loose or misaligned coupling	4.5.1./4.5.3 4.5.1./4.5.3 4.5.4 4.5.4
Generator frame produces shock when touched	Static charge Grounded armature of field coil	Check ground to frame 4.5.4

CONDITION	POSSIBLE CAUSE	REMEDY/ REFERENCE SECTION
3.5 AUTO RESTART OPTION		
When the Ignition switch is placed in the run position, nothing happens	Wait 60 seconds for glow plug delay Relay defective Ignition switch defective 3 amp fuse bad Loose connector on module Defective module	- Check and re- place Check and replace switch Check and replace fuse Tighten connec- tor Check for 12 volts at pin 4 Replace module
Alarm sounds, but engine does not crank	No voltage at pin 2 of the connector Check Starter Solenoid Defective module	Trace and correct Refer to 3.1.1 Replace
Engine starts, but the starter does not disengage	Speed sensor wiring loose Speed sensor defective Defective module	Check and correct Replace Replace
Engine starts, but shuts down from overspeed	Engine speed out of adjustment	Refer to 4.4.7
Engine cranks, but will not start	Refer to 3.1.1 Defective module	Refer to 3.1.1 Replace
Engine starts, but shuts down on low oil	Refer to 3.1.2	Refer to 3.1.2
Engine starts, but shuts down on high water temperature	Refer to 3.1.6	Refer to 3.1.6

SECTION 4

SERVICE AND PREVENTIVE MAINTENANCE

4.1 INTRODUCTION

This section covers service for the generator set and general engine service. Refer to the Kubota engine workshop manual (refer to section 1.1) for other engine servicing.

WARNING

Beware of moving V-belt and belt driven components.

4.2 PREVENTIVE MAINTENANCE SCHEDULE

A tabular listing of the recommended preventative maintenance activities and schedule is provided in Table 4-1.

4.3 BATTERY SERVICE

When replacing the battery, note if the unit was supplied with a matt in the battery tray. If so equipped, the matt must also be replaced.

4.4 ENGINE SERVICE AND COMPONENTS

4.4.1 Priming 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:

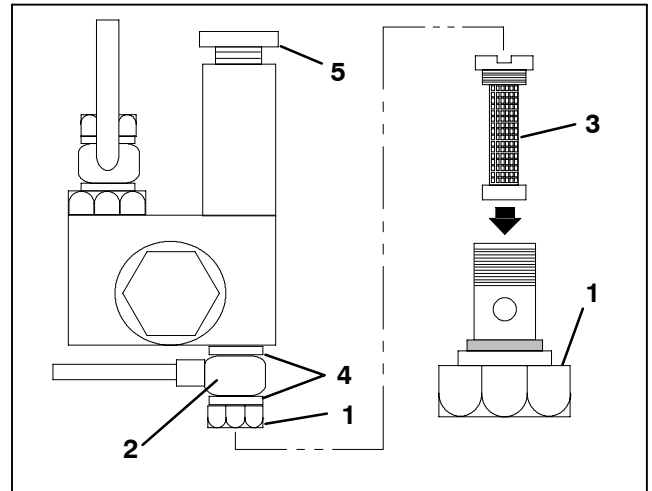
- Turn bleed valve (Red, see Figure 1-3) counter-clockwise until fully opened.
- Turn the top of the hand priming pump (see Figure 4-1) counter-clockwise to unlock it then, rapidly pump the hand priming pump until a positive pressure (resistance) is felt, which will indicate fuel flow.
- Depress and turn the top of the hand priming pump clockwise to lock in place.
- Start engine. (Refer to section 2.5).
- When engine is running properly, turn bleed valve clockwise until fully closed.

4.4.2 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 lose capacity. The filter must be cleaned on a regular schedule. Quality of fuel will effect filter cleaning schedule (refer to section 4.2).

- Turn nut (item 1) counter-clockwise to loosen and remove .
- Remove banjo fitting (item 2) and let it hang loose, making sure to keep copper rings (item 4) for replacement.

- Turn filter (item 3) counter-clockwise and remove. Check and clean.
- To install, reverse steps 1 through 3.



- | | |
|-----------|----------------------|
| 1. Nut | 4. Copper Rings |
| 2. Banjo | 5. Hand Priming Pump |
| 3. Filter | |

Figure 4-1. Mechanical Fuel Pump

4.4.3 Fuel Filter

The full flow filter is located at the front of the engine (see Figure 1-2). To renew, remove the filter with a filter wrench, pre-fill the new filter with fuel, lightly oil gasket with lube oil and replace by hand.

4.4.4 Cooling System

The radiator must be clean, externally and internally, for adequate cooling. The fan belt must be adjusted periodically to provide maximum air flow (refer to paragraph 4.4.5). 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.
- Drain coolant completely by opening drain-cock and removing radiator cap.

CAUTION

Never pour cold water into a hot engine.

- Close drain-cock and fill system with clean, untreated water to which three to five percent of an alkaline base radiator cleaner should be added; six ounces (dry) = 151 grams to one gallon (3.8 liter) of water.

Table 4-1 Preventative Maintenance Actions and Schedule

Description of Procedure	Reference Paragraph	Perform at Pre-Trip Inspection	Every 2000 Hours	Annually or Every 4000 Hours
For Pre-Trip inspection perform items 1 through 13 then perform "After Start-up" checks, items 30 through 34				
1. Check (In Place) Engine/Generator Shockmounts for Cracks, Cuts, Abrasion or Flaring		X		
2. Check Engine Lubrication, Fuel Filter, Oil Lines and Connections for Leaks		X	X	
3. Check Engine Lubrication Oil Level	1.10.j.	X	X	
4. Check V-Belt for Fraying or Cracks and Proper Tension	4.4.5	X	X	
5. Check Radiator Hoses for Leaks, Check Coolant Level and 50/50 Mixture	1.10.i.	X	X	
6. Check Radiator Coil and Generator Air Intake for Cleanliness (Clean Using Compressed Air, Reversing Air Flow Direction)		X	X	
7. Check Air Cleaner for Cleanliness and Clean as Necessary		X	X	
8. Drain Water from Fuel Tank Sump and Fuel Filter Bowl		X	X	
9. Fill Fuel Tank with Diesel Fuel	1.10.a.	X	X	
10. Check Glow Plug Amperage	1.10.g.	X	X	
11. Check Battery Terminals for Tightness and Cleanliness (Clean then coat with battery terminal sealant)		X	X	
12. Check for Loose Electrical Connections		X	X	
13. Tighten all Hardware (Brackets, etc.)		X	X	
14. Change Lubricating Oil and Filter(s) (See Note)	4.4.6		X	
15. Clean Air Filter Body, Check Hose Connections. (See Note)	4.4.8		X	
16. Change Oil Bath Air Filter Oil (See Note)	4.4.8		X	
17. Clean Mechanical Fuel Lift Pump Internal Filter	4.4.2		X	
18. Tighten Engine and Generator Mounting Bolts	4.7		X	
19. Tighten all Electrical Connections in the Control Box			X	
20. Check Water Pump Bearing End Play	See Engine Manual		X	

Note: More frequent intervals may be necessary in extreme operation conditions.

Table 4-1 Preventative Maintenance Actions and Schedule (Continued)

Description of Procedure	Reference Paragraph	Perform at Pre-Trip	Every 2000 Hours	Annually or Every 4000 Hours
21. Verify Operation Of Engine Protective Devices				X
22. Change Fuel Filter	4.4.3			X
23. Check Crankcase Breather	4.4.9			X
24. Remove and Check Engine/Generator Shockmounts for Cracks, Cuts, Splits, Abrasion or Flaring	4.6.2			X
25. Check and If Required Replace V-Belt	4.4.5			X
26. Clean and Flush Coolant System	4.4.4			X
27. Check Starter Condition	See Engine Manual			X
28. Check Engine Compression	See Engine Manual			X
29. Check and Adjust Injector Nozzles	See Engine Manual			X
After Starting Generator Set, perform the following:				
30. Check Total Time Meter Operation (Allow Engine to Run 10 Minutes)		X		
31. Listen for Abnormal Bearing Noise		X		
32. Check Fuel Lines, Lube Oil Lines and Filters for Leaks		X		
33. Check Exhaust System For Leaks		X		
34. Check with voltmeter. Generator output should be 467 volts AC (+/- 10%) no load (engine, 1820-1840 rpm). Turn refrigeration unit on and check generator 1710 rpm minimum under full load (430 volts +/- 10%)		X		

- d. Run engine 6 to 12 hours and drain system while warm. Rinse system three times after it has cooled down. Refill system with water.

CAUTION

Use only ethylene glycol, anti-freeze (with inhibitors) in system as glycol by itself will damage the cooling system. (Refer to paragraph 1.10.i.)

- e. Run engine to operating temperature. Drain system again and fill with treated water/anti-freeze. (See above Caution note and refer to paragraph 1.10.i.)

4.4.5 Servicing and Adjusting V-belt

WARNING

Beware of moving V-belt and belt driven components.

NOTE

Frayed, cracked or worn V-belt must be replaced. After installing a new belt, it is advisable to check the adjustment after running the unit for three or four hours. This is to 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 V-belt is driven by a sheave on the engine crankshaft. Its three functions are: (1) drive the radiator fan, and (2) to drive the water pump. To replace or adjust the belt, do the following:

a. Replacing the V-Belt

- Using the proper size socket on the crank pulley nut, slowly rotate the crank. 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.

4.4.6 Lube Oil Filter

The oil filter is located near the radiator fan (see Figure 1-4).

- 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. Add lube oil. (Refer to paragraph 1.10.j.) Warm up engine and check for leaks.

4.4.7 Adjusting Engine Speed

The engine is to operate at 1820 to 1840 rpm (no load), 1710 rpm (with full load). To check the engine speed, do the following:

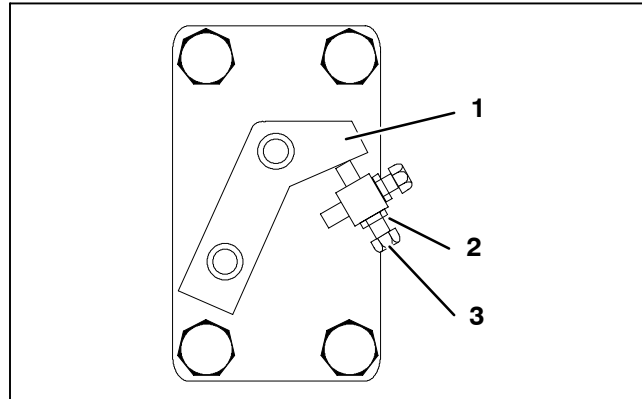
- With the engine stopped, place a mark (white paint for example) on the crankshaft sheave. Start engine and verify engine speed using a strobe tachometer (Carrier Transicold Part No. 07-00206.)

b. To Increase Speed:

Loosen jam nut (see Figure 4-2). Turn capscrew clockwise until correct speed is achieved, then tighten jam nut and recheck engine speed.

c. To Decrease Speed:

Loosen jam nut (see Figure 4-2). Turn capscrew counter-clockwise until correct speed is achieved, then tighten jam nut and recheck engine speed.



1. Speed Lever
2. Jam Nut
3. Capscrew

Figure 4-2. Engine Speed Adjustment

4.4.8 Engine Air Cleaner

a. Inspection

The oil bath air cleaner should be inspected routinely for leaks. A damaged air cleaner or hose can seriously affect the performance and life of the engine. To inspect the air cleaner, do the following

- Check all connections for mechanical tightness. Be sure outlet pipe is not fractured.
- If cleaner has been dented or damaged, check all connections immediately.
- In case of leakage, replace necessary parts or gaskets. *Swelled or distorted gaskets must be replaced.*

b. Service - Oil Cup

Inspect the oil cup (see Figure 4-3) at regular intervals. Initially inspect daily or as often as conditions require. 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 to carry over into the engine causing accelerated engine wear. Heavily contaminated oil will not allow the air cleaner to function properly.

CAUTION

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

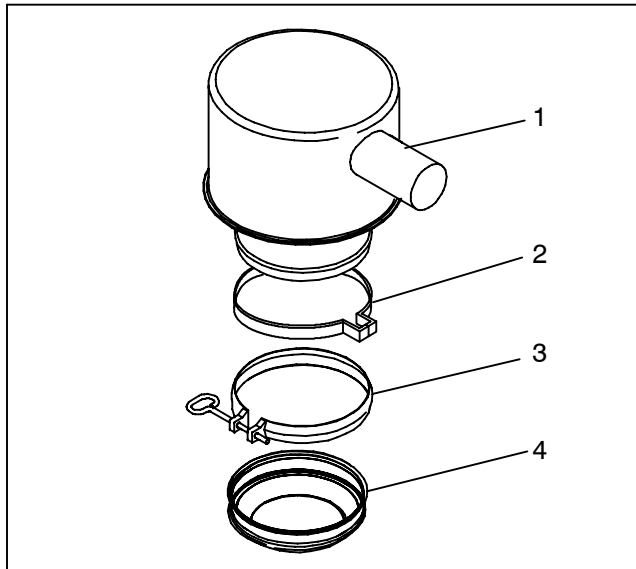
Stop the engine and remove the oil cup from the air cleaner. Dispose of the oil in an environmentally safe manner. Clean the cup.



CAUTION

Do not under fill or overfill the cup. Overfilling of cup means loss of capacity and under filling means lack of filtering efficiency.

Fill the oil cup to the *indicated level* with oil specified in paragraph 1.10. j. Reassemble.



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

Figure 4-3. Air Filter

c. Service - Body Assembly

The upper portion of the air cleaner should be inspected each time the oil cup is inspected or serviced. If there is any sign of contaminant buildup or plugging, the body assembly should be removed and back flushed. At least once a year or at regular engine service periods, remove the entire air cleaner and perform the following:

- 1 Remove oil cup. Check wire mesh filter.



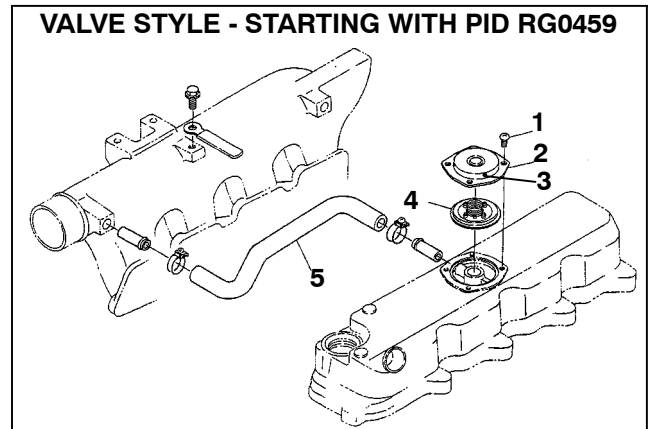
WARNING

Do not use gasoline to clean air cleaner parts.

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

4.4.9 Engine Crankcase Breather

The engine uses a closed type breather with the breather line attached to the cylinder head cover. (See Figure 4-4.) 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 4000 hours maintenance interval (whichever comes first).



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

Figure 4-4. Engine Crankcase Breather

4.4.10 Servicing Glow Plugs

The glow plugs are parallel connected and when energized, each plug draws 7.5 amps at 12 vdc. When servicing, the glow plug is to be hand fitted into the cylinder head to prevent thread damage.

Torque value for the glow plugs is 28.9 to 36.2 ft-lb (4.0 to 5.0 mkg).

Checking for a Defective Glow Plug:

- a. Method 1: Place an ammeter (or clip-on ammeter) in series with each glow plug and energize the plugs. Each plug should show 7 to 10 amps draw.
- b. Method 2: Disconnect the wire connection to the plug and test the resistance from the plug to a ground on the engine block. The reading should be 0.7 to 1.2 ohms if the plug is good.

4.5 SERVICING THE ALTERNATING CURRENT GENERATOR

4.5.1 Preventive Maintenance and Operating Precautions

Costly repairs and down time can usually be prevented by operating electrical equipment under conditions which are compatible with those at 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 80C (176F) 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)



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



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.
- 2 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 guide lines 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.

4.5.2 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.

NOTE

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 ensure fusing does not take place.

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 and then remove. It is suggested that a 30 ampere fuse be inserted in 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 on the following table.

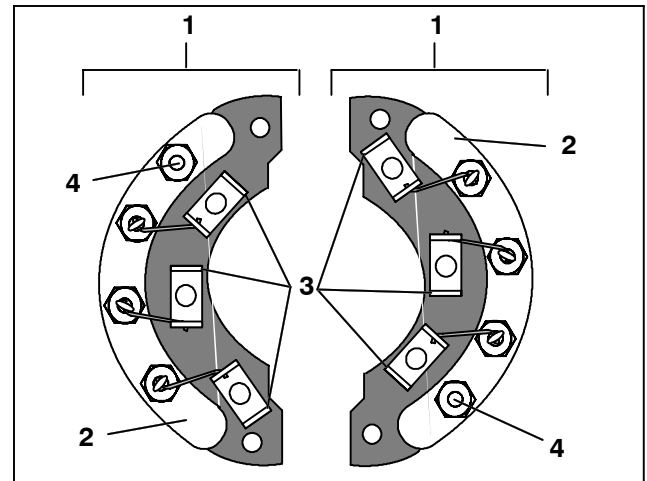
Wire Pair	Ohm*	Wire Pair	Ohm*	Wire Pair	Ohm*
T10-T1	I	T1-T8	I	T4-T5	I
T10-T2	I	T1-T9	I	T4-T6	I
T10-T3	I	T2-T3	I	T4-T7	I
T10-T4	I	T2-T4	I	T4-T8	I
T10-T5	I	T2-T5	0	T4-T9	I
T10-T6	I	T2-T6	I	T5-T6	I
T10-T7	0	T2-T7	I	T5-T7	I
T10-T8	0	T2-T8	I	T5-T8	I
T10-T9	0	T2-T9	I	T5-T9	I
T1-T2	I	T3-T4	I	T6-T7	I
T1-T3	I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

1. Remove the bearing cover by removing the four bolts (see Figure 4-6). Both the bearing and diode assemblies will be visible.
2. 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 4-5.)
3. Remove the two capscrews which secure each diode assembly to the spider. 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.
6. If both resistances are high or both are low, then the diode is defective and the diode assembly should be replaced.



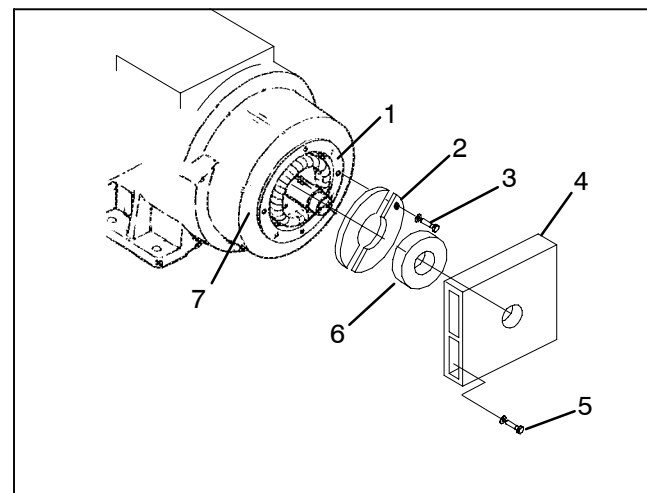
1. Diode Assembly
2. Diode Bridge
3. Exciter Rotor Lead Connection
4. Alternator Rotor Lead Connection

Figure 4-5. A-C Generator Rectifier Assembly

4.5.3 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:

1. Remove bearing cover. (See Figure 4-6.)
2. Remove bearing with the use of a bearing or wheel puller.
3. Install new bearing. Ball bearings are pre-lubricated and require no further 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). Replace bearing cover.



1. Rectifier Flange
2. Rectifier Assembly
3. Rectifier Bolt
4. Bearing Cover
5. Bearing Cover Bolt
6. Bearing
7. Bearing Cover Flange

Figure 4-6. Rectifier Removal

4.5.4 Generator Installation and Removal

a. Removing the Generator

1. Remove covers and ground wire from frame of generator set.
2. Remove connection box cover, 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.
9. 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

NOTE

Refer to paragraph 4.7 for torque values.

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

1. Brush anti-seize lubricant (lube-plate) on the face of flywheel.
2. 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 bolts.
4. Secure two of the housing bolts (3/8), on the top and bottom of the generator housing, to draw the mating flanges together.
5. Secure remaining bolts and washers (3/8) 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.

4.6 GENERAL GENERATOR SET MAINTENANCE

4.6.1 Maintenance of Painted Surfaces

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

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

4.6.2 Checking and Replacing Shockmounts

a. Replacement Criteria

CAUTION

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

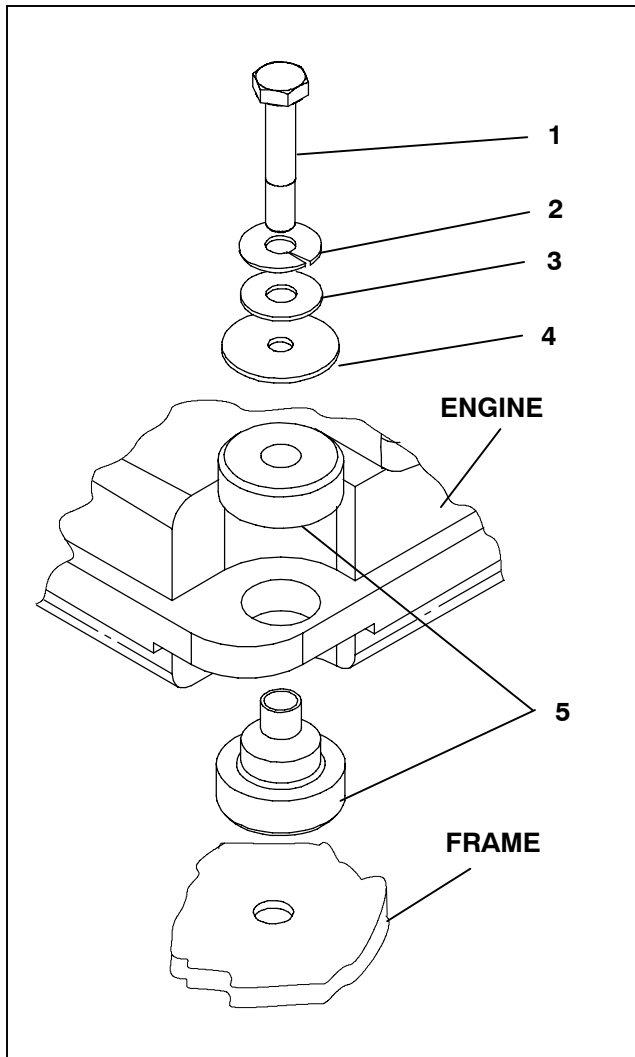
NOTE

Refer to paragraph 4.7 for torque values.

1. Use the two lift eyes to lift and support the engine.
2. Remove all hardware as shown in Figure 4-7.
3. Raise the engine just enough to remove the shockmounts (item 5).
4. Inspect shockmounts and replace if required.
5. Lower the engine enough to assemble hardware as shown and torque per paragraph 4.7.
6. Remove chains from the lift eyes.

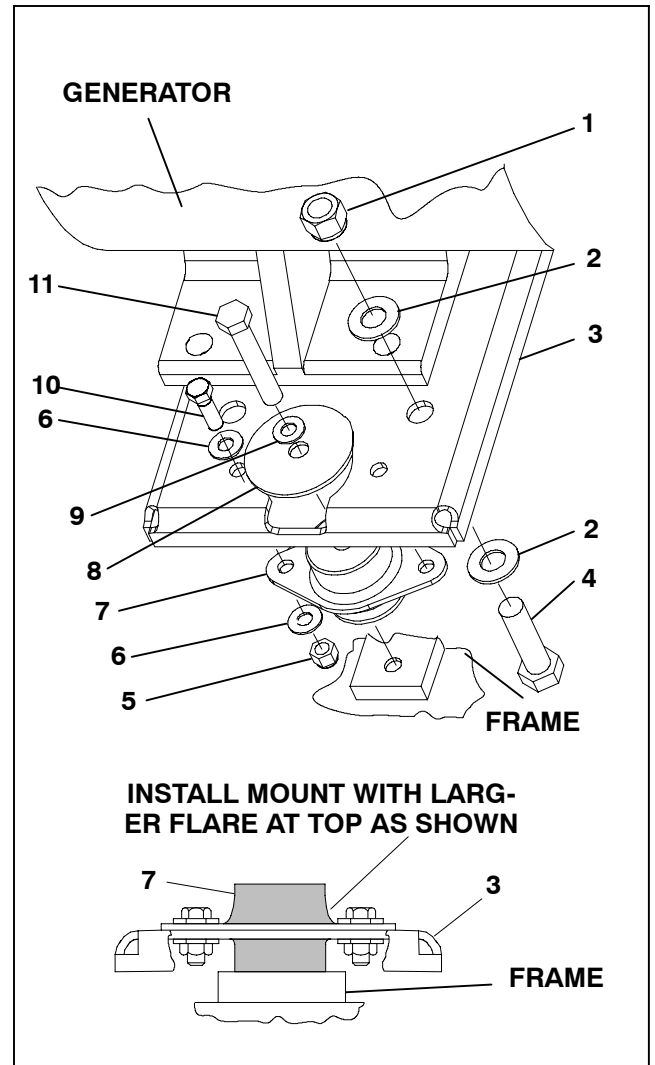
c. Generator Shockmount Replacement (see Figure 4-8)

1. Use the two lift eyes to lift and support the engine.
2. Remove shockmount hardware, items 5 through 11, figure Figure 4-8.
3. Raise the generator just enough to remove the shockmounts (item 8).
4. Inspect and if required, install new shockmounts.
5. Lower the engine enough to assemble hardware as shown and torque. Refer to paragraph 4.7 for torque values.
6. Remove chains from the lift eyes.



- | | |
|----------------|--------------------|
| 1. Screw | 4. Snubbing Washer |
| 2. Lock Washer | 5. Shockmount |
| 3. Flat Washer | |

Figure 4-7. Engine Shockmounts



- | | |
|----------------------|----------------------|
| 1. Locknut (5/8) | 7. Shockmount |
| 2. Flat Washer (5/8) | 8. Snubbing Washer |
| 3. Mounting Base | 9. Flat Washer (1/2) |
| 4. Screw (5/8) | 10. Screw (3/8) |
| 5. Locknut (3/8) | 11. Screw (1/2) |
| 6. Flat Washer (3/8) | |

Figure 4-8. Generator Shockmounts

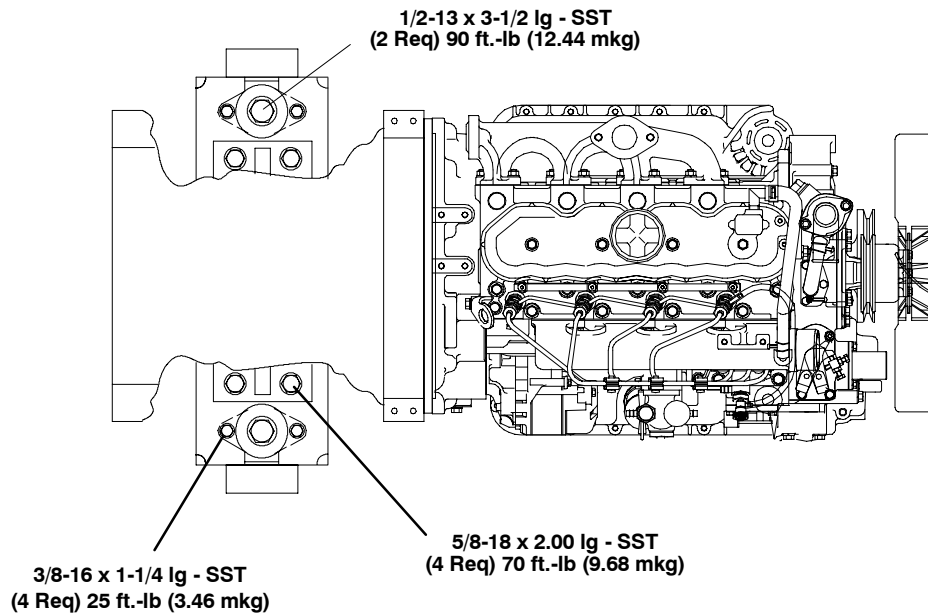
4.7 UNIDRIVE TORQUE REQUIREMENTS

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.

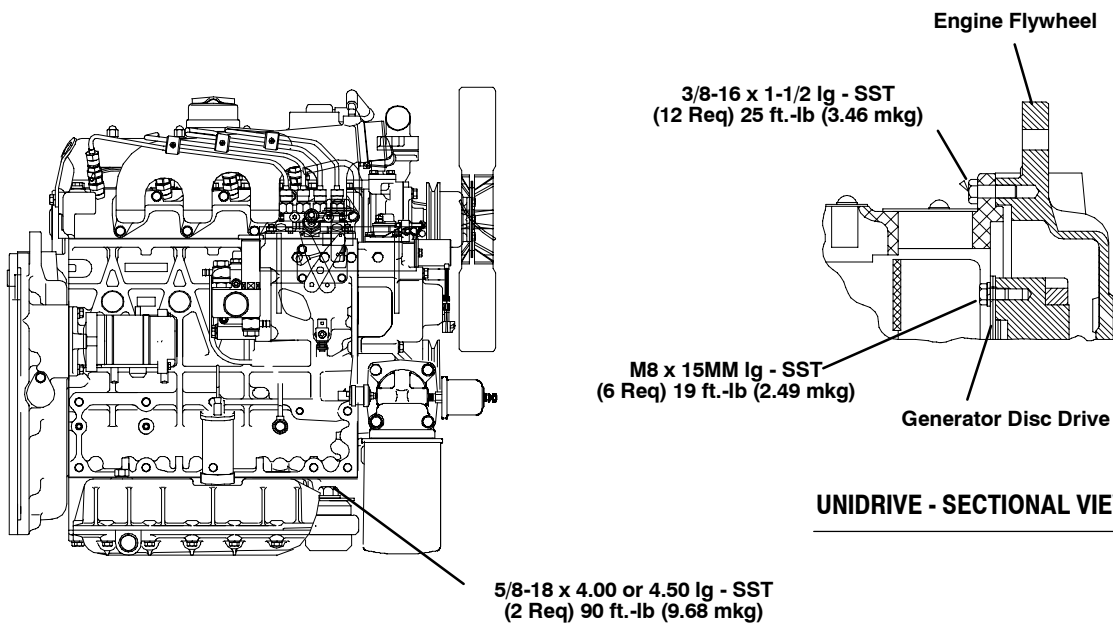
Torque value and hardware requirements for unidrive assembly are provided in Figure 4-9.

NOTES

1. SST is an abbreviation for 300 Series Corrosion Resistant Steel.
2. Loctite #242 or an equivalent product should be used on ALL hardware shown in Figure 4-9.



ENGINE & GENERATOR SHOCKMOUNTS - TOP VIEW



ENGINE MOUNT - RIGHT SIDE VIEW

UNIDRIVE - SECTIONAL VIEW



Figure 4-9. Unidrive Torque Requirements

SECTION 5

SCHEMATICS

5.1 INTRODUCTION

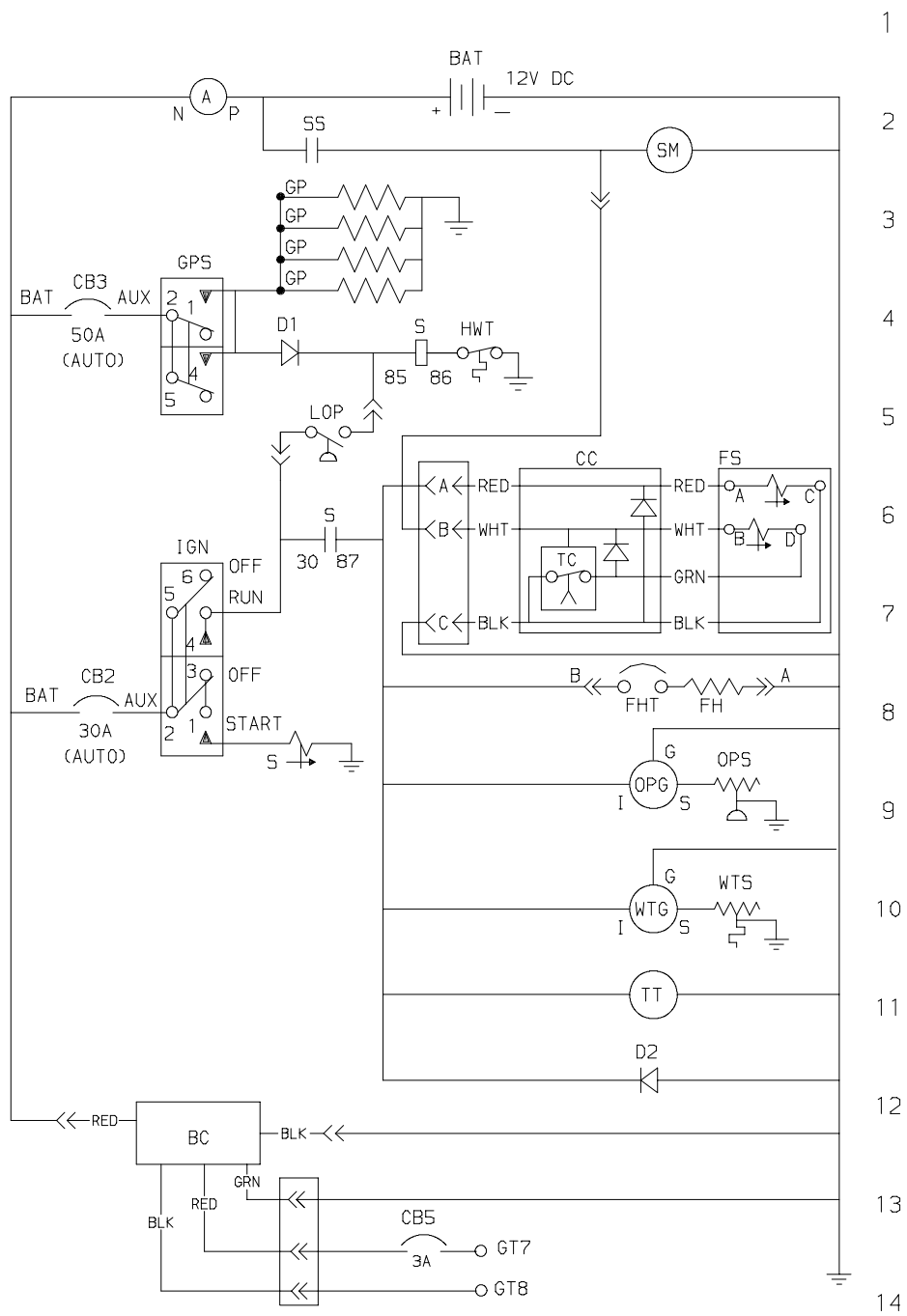
This section contains the 12 volt DC control circuit schematics and the 460 volt alternating current schematics. To identify the schematics applicable to your model and PID number, refer to Table 1-1.

LINE	SYMBOL	LEGEND
3,5,8,9,14		ENGINE GROUND
21		CHASSIS GROUND
2	A -	AMMETER
12,21	BC -	BATTERY CHARGER
2	BAT -	BATTERY
4,8,13,15,18	CB -	CIRCUIT BREAKER
5	CC -	COIL COMMANDER
4,11	D -	DIODE
7	FH -	FUEL HEATER
7	FHT -	FUEL HEATER THERMOSTAT
5	FS -	FUEL SOLENOID
5	FSA -	FUEL SOLENOID HOLD
6	FSB -	FUEL SOLENOID PULL
15	G -	GENERATOR
3	GP -	GLOW PLUG
4	GPS -	GLOW PLUG SWITCH
4	HWT -	HIGH WATER TEMP. SWITCH
7	IGN -	IGNITION SWITCH
5	LOP -	LOW OIL PRESS. SWITCH
8	OPG -	OIL PRESSURE GAUGE
8	OPS -	OIL PRESSURE SENDER
15	R1 -	RECEPTACLE
4,6	S -	SAFETY RELAY
2	SM -	STARTER MOTOR
2	SS -	STARTER SOLENOID
6	TC -	TIMER CIRCUIT
10	TT -	TIME METER
9	WTG -	WATER TEMP. GAUGE
9	WTS -	WATER TEMP. SENDER

Based on Drawings 62-10937-00 Rev A, 62-11258-00 Rev -, 62-11015-00 Rev B, 62-11261-00 -

Figure 5-1. Schematic Diagram
Legend - (Applies to Figures 5-2 and 5-3)

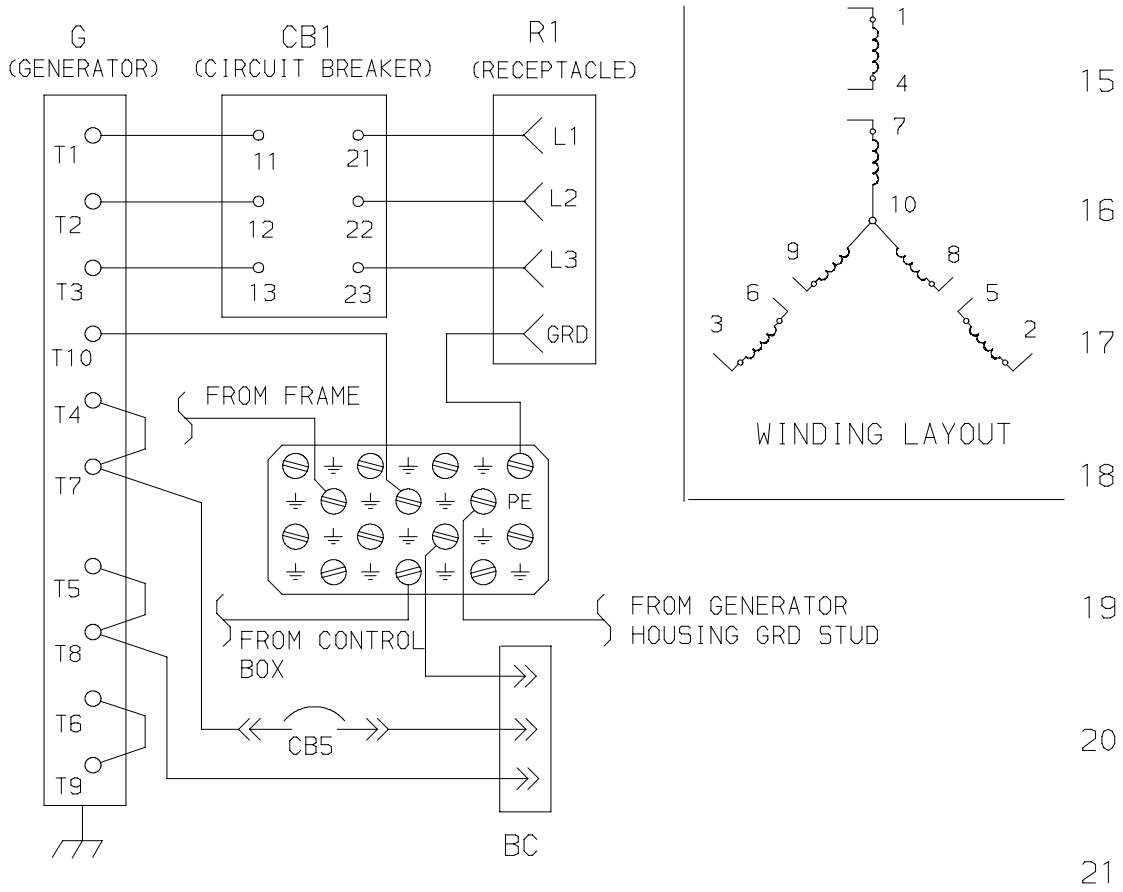
12VDC CONTROL CIRCUIT



Based on Drawings 62-10937-00 Rev A, 62-11258-00 Rev -, 62-11015-00 Rev B, 62-11261-00 -

Figure 5-2. Schematic Diagram
(For Applicability, Refer to Table 1-1)

460V



Based on Drawings 62-10937-00 Rev A, 62-11258-00 Rev -, 62-11015-00 Rev B, 62-11261-00 -

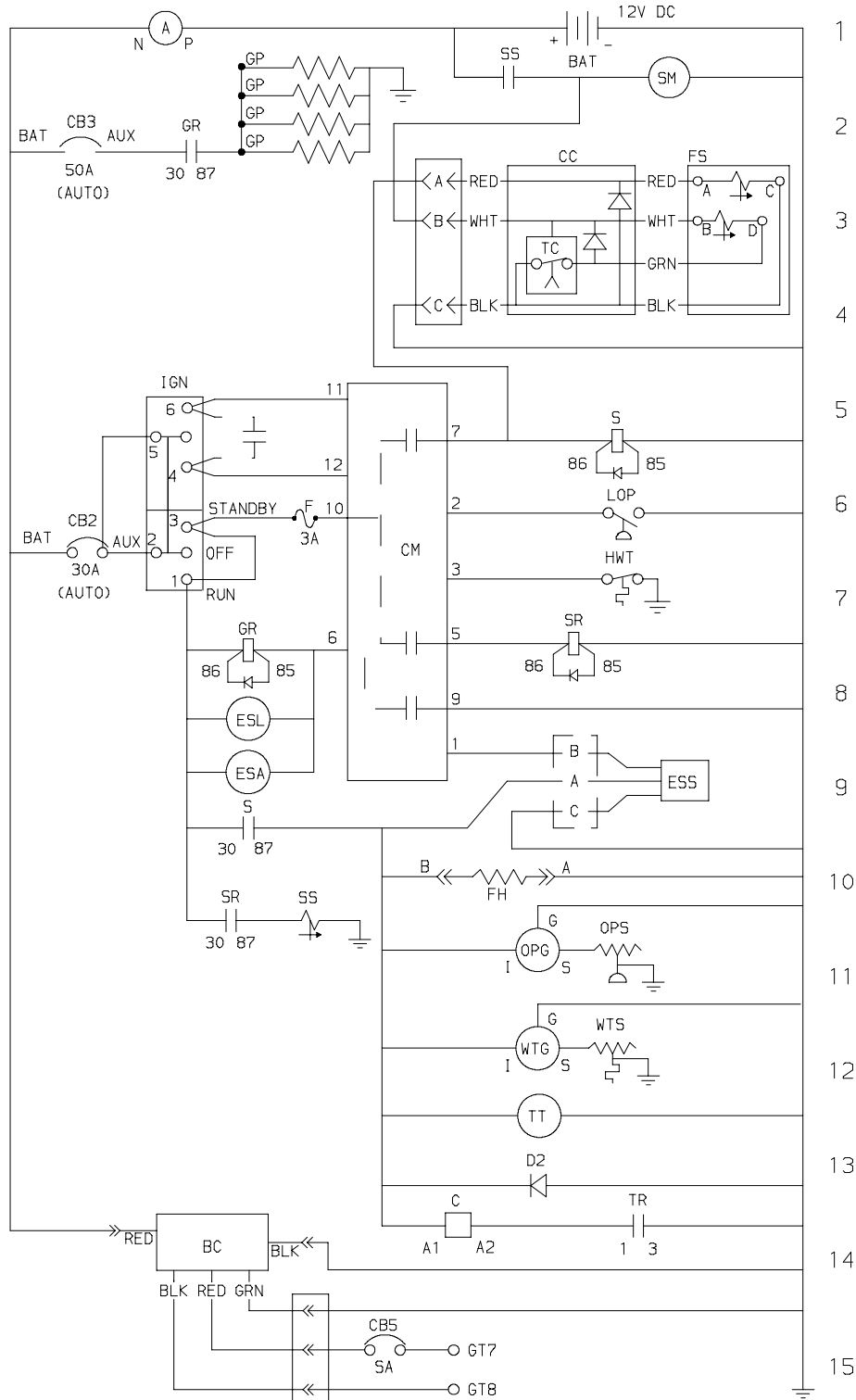
Figure 5-3. Schematic Diagram
460 Volt Alternating Current Generator (For Applicability, Refer to Table 1-1)

LINE	SYMBOL	LEGEND
2, 7, 11, 12, 15		ENGINE GROUND
21		CHASSIS GROUND
1	A -	AMMETER
14, 16	C -	CONTACTOR
2	CC -	COIL COMMANDER
14, 21	BC -	BATTERY CHARGER
1	BAT -	BATTERY
2, 6, 16	CB -	CIRCUIT BREAKER
4, 6, 13	CM -	CONTROL MODULE
13	D -	DIODE
9	ESA -	ENGINE START ALARM
8	ESL -	ENGINE START LIGHT
9	ESS -	ENGINE SPEED SENSOR
6	F -	FUSE
10	FH -	FUEL HEATER
3	FS -	FUEL SOLENOID
3	FSA -	FUEL SOLENOID HOLD
3	FSB -	FUEL SOLENOID PULL
13	TR -	TIME RELAY
12	TT -	TIME METER
12	WTG -	WATER TEMP. GAUGE
12	WTS -	WATER TEMP. SENDER
16	G -	GENERATOR
2	GP -	GLOW PLUG
2	GR -	GLOW PLUG RELAY
7	HWT -	HIGH WATER TEMP. SWITCH
4	IGN -	IGNITION SWITCH
6	LOP -	LOW OIL PRESS. SWITCH
11	OPG -	OIL PRESSURE GAUGE
11	OPS -	OIL PRESSURE SENDER
16	R1 -	RECEPTACLE
5, 9	S -	SAFETY RELAY
2	SM -	STARTER MOTOR
10	SR -	STARTER RELAY
2	SS -	STARTER SOLENOID

Based on Drawings 62-11013-00 Rev B, 62-11259-00 Rev-, 62-11257-00 Rev-

Figure 5-4. Schematic Diagram
- Legend - (Applies to Figures 5-5, 5-6 and 5-7)

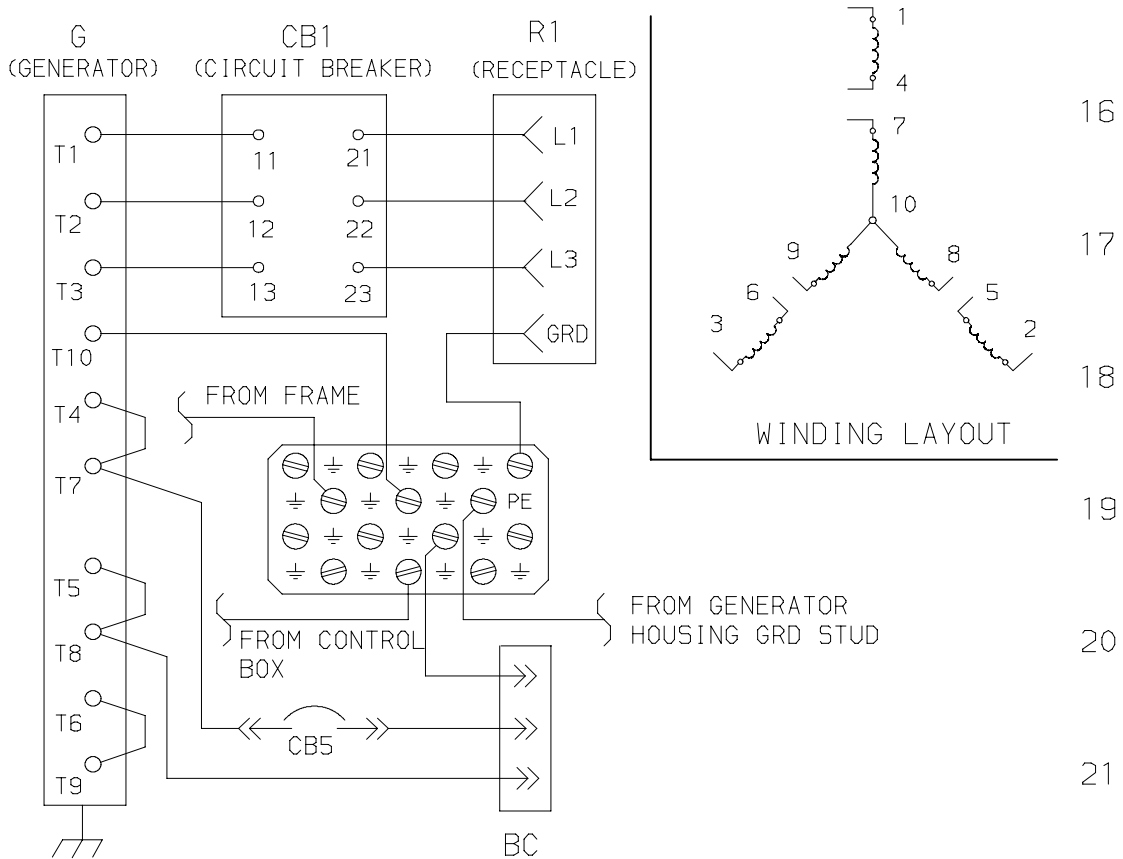
12VDC CONTROL CIRCUIT



Based on Drawings 62-11013-00 Rev B, 62-11259-00 Rev-, 62-11257-00 Rev-

Figure 5-5. Schematic Diagram
(For Applicability, Refer to Table 1-1)

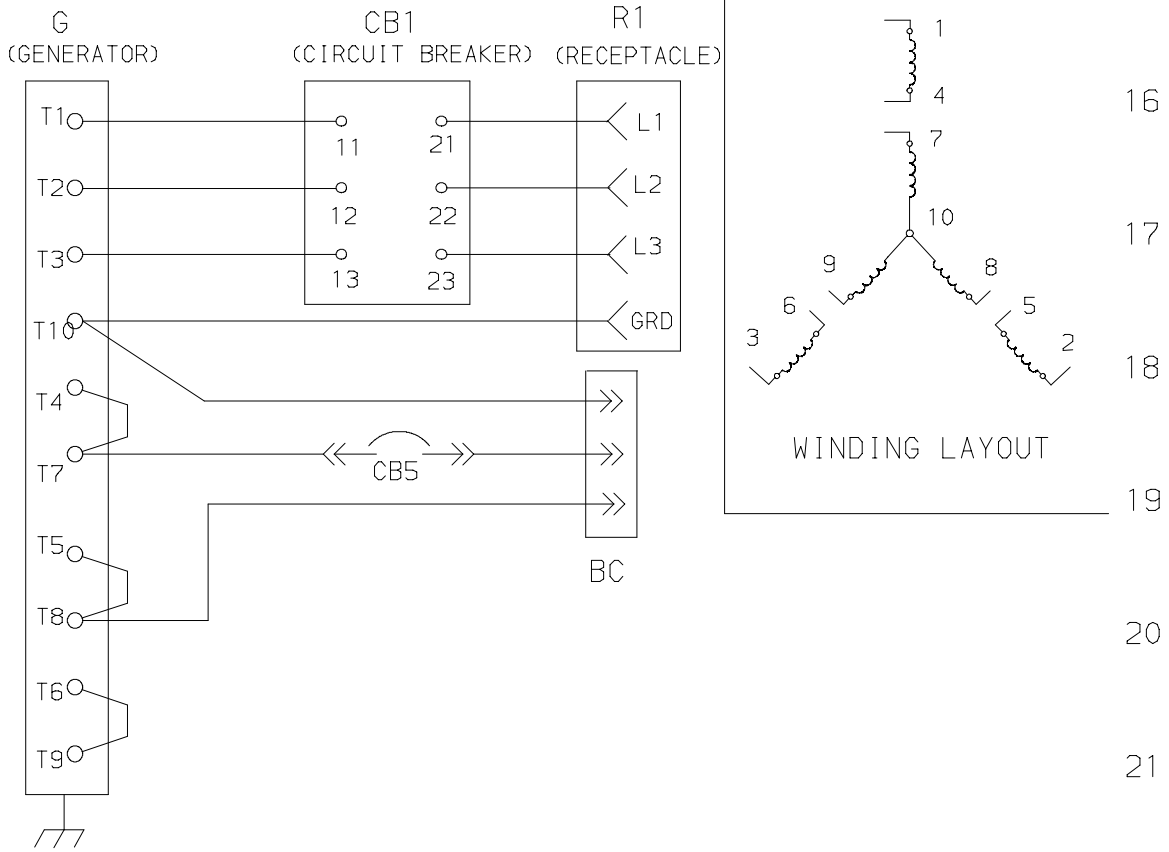
460V



Based on Drawings 62-11013-00 Rev B, 62-11259-00 Rev-

Figure 5-6. Schematic Diagram
460 Volt Alternating Current Generator (For Applicability, Refer to Table 1-1)

460V



Based on Drawing 62-11257-00 Rev-

Figure 5-7. Schematic Diagram
460 Volt Alternating Current Generator (For Applicability, Refer to Table 1-1)

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