Carrier
TRANSICOLD

Diesel Driven Generator Set

Model 69GC15-164

OPERATION AND SERVICE

T-247-05

Carrier
TRANSICOLD

OPERATION AND SERVICE MANUAL

DIESEL DRIVEN GENERATOR SET

MODEL 69GC15-164

UNITED TECHNOLOGIES CARRIER TRANSICOLD

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SECTION 1

DESCRIPTION

1.1 INTRODUCTION

WARNING

Beware of moving V-Belts and belt driven components.

This manual contains Operating Data, Electrical Information, and Service Instructions for the diesel generator set shown in Table 1-1. (See left side of unit for serial/model number plate.) Separately bound manuals covering the CT4-134-DI diesel engine for the diesel-driven generator sets are also supplied, see chart below.

MANUAL/ FORM NO.	EQUIPMENT COVERED	TYPE OF MANUAL/FORM
62-03459	CT4-134-DI	Engine Parts List
62-03741	CT4-134-DI	Workshop Manual

The diesel-driven generator sets are intended for front mounting upon a refrigeration unit. They provide a constant electrical power supply for the operation of an all-electric refrigeration unit.

Located inside the frame are the diesel engine, A-C generator (main alternator), control and monitoring cabinet, starting battery, 12 vdc solid state battery charger, and other necessary accessory components for proper unit operation.

For power, the Carrier Transicold Model CT4-134-DI, vertical in-line, four cylinder diesel engine is used. The engine is equipped with glow plugs (used as a starting aid), “spin-on” lube oil and fuel filters for easier filter changes. All references to the engine are viewed from the fly wheel end.

Electrical power is generated by a Lima 15 KW, brushless, single bearing A-C generator. The generator is coupled directly to the engine flywheel. The generator provides a constant 460 vac, 3 phase, 60 hertz electrical supply.

The water pump and the radiator cooling fan are belt-driven from the engine crankshaft sheave.

1.2 SAFETY DEVICES (Refer to Table 1-2)

System components are protected from damage caused by unsafe operating conditions by automatically shutting down the diesel engine when such conditions occur. This is accomplished by the safety devices *CB-2*, *HWT* or *LOP*. 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 run control relay. This, in turn, opens a set of *RCR* contacts to de-energize the fuel solenoid.

De-energizing fuel solenoid releases the stop-run lever to the *STOP* position, shutting off the fuel supply to the engine; thus stopping the engine.

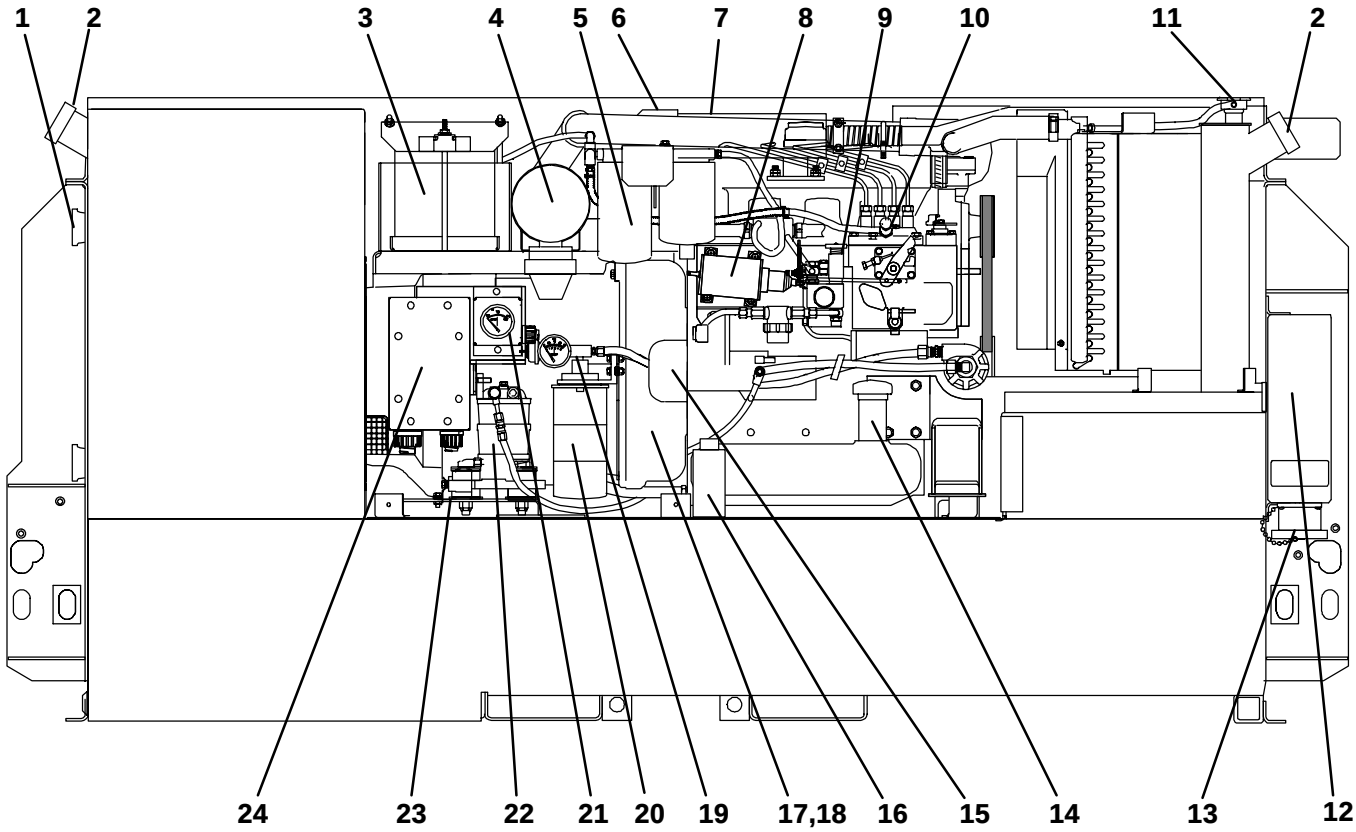
The *A-C* generator and the glow plug circuit are protected by circuit breakers (listed below) but will not shut down the engine if an overload occurs.

Table 1-1. Model Chart

Model No.	Engine CT4-134DI	Solid State Battery Charger	Dual Fuel Gauges	Fuel Tank 120 U.S. Gallons
69GC15-164	X	X	–	X
69GC15-164-1	X	X	X	X
69GC15-164-2	X	X	X	X
69GC15-164-3	X	X	X	X
69GC15-164-4	X	X	X	X

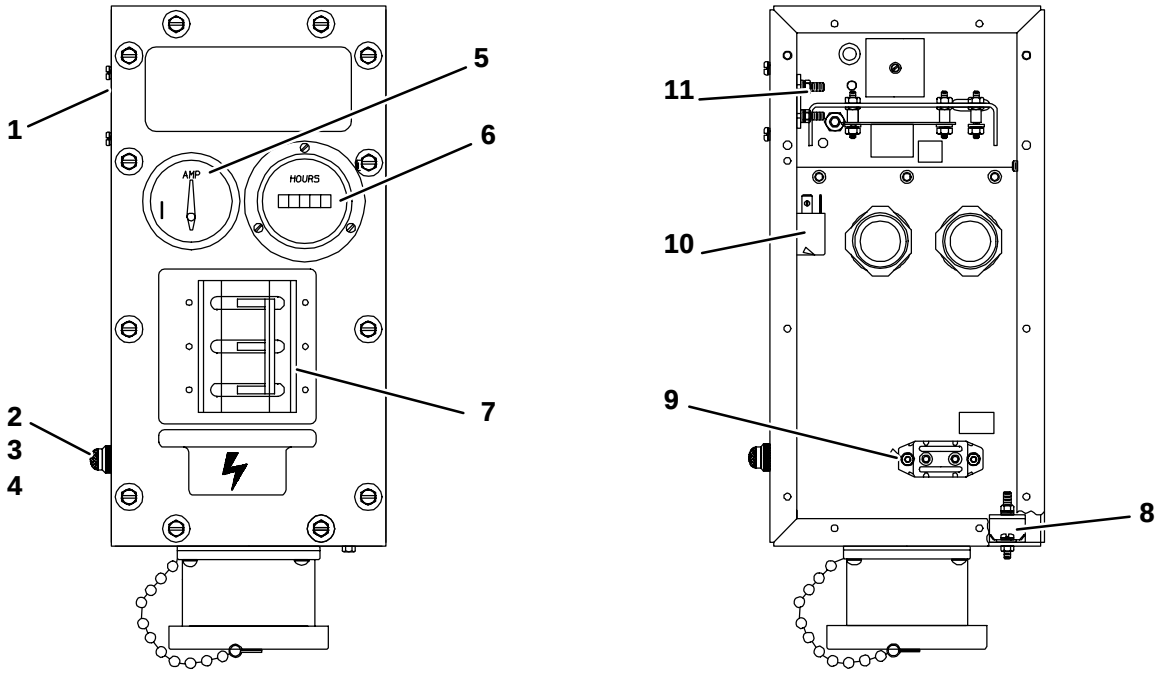
Table 1-2. Safety Devices

Unsafe Condition	Safety Switch	Switch Setting
a. Engine		
1. Low engine lubricating oil pressure	1. Oil pressure switch (LOP) – Automatic reset	1. Opens below 15 psig (1.05 kg/cm@)
2. High engine cooling water temperature	2. Water temperature switch (HWT) – Automatic reset	2. Opens above 230 ¦ 5_F (110 ¦ 3_C)
3. Excessive current draw by FS, HWT, L1, OPG, WTG, RCR or TT	3. Circuit breaker (CB-2) – Automatic reset	3. Trips at 20 amps
4. Excessive current draw by battery charger	4. Circuit breaker (CB-4) – Automatic reset	4. Trips at 30 amps
b. Glow-Plugs		
1. Excessive current draw on glow plug circuit	1. Circuit breaker (CB-3) – Automatic reset	1. Opens at 45 amps
c. Generator		
1. Excessive current draw by generator	1. Circuit breaker (CB-1) – Manual reset	1. Trips at 25 amps (460 vac)



1. Fuel Gauge
2. Fuel Fill
3. Battery (BAT)
4. Air Cleaner
5. Fuel Filters
6 Battery Charger (Located on top of generator – 69GC15-164-3, -4)
7. Muffler
8. Fuel Solenoid (FS)
9. Mechanical Lift Pump
10. Fuel Bleed Valve
11. Radiator Cap
12. Control Box and Panel
13. Power Receptacle
14. Lube Oil Dipstick
15. Starter Motor (SM)
16. Radiator Overflow Tank
17. A-C Generator
18. Oil Pressure Switch (LOP)
19. Oil Pressure Gauge
20. Lube Oil Filter
21. Water Temperature Gauge(WTG)
22. Water Separator
23. Fuel Shut-Off Valve
24. Generator Terminal Box

Figure 1-1. Generator Set – Front View with Cover Removed



1. Battery Charger (B) (Located behind box for models 69GC15-164, -1, -2)
2. Glow Plug Switch (GPS)
3. Ignition Switch (IGN)
4. Circuit Breaker Trip Indicator (L1)
5. Ammeter (A)
6. Total Time Meter (TT)
7. Circuit Breaker (CB-1)
8. Circuit Breaker (CB-2)
9. Circuit Breaker (CB-3)
10. Run Control Relay (RCR)
11. Circuit Breaker (CB-4)

Figure 1-2. Control Box and Gauge Panel

1.3 UNIT SPECIFICATIONS

a. Unit Weight Approx.

2690 lb (1223 kg) with fuel and battery

b. Engine (Dry) – with Accessories

421 lb (191 kg)

c. A-C Generator

225 lb (102 kg)

d. Fuel Tank Capacity

Liquid: 126 U.S. Gallons (477 liter)

Draw: 119.5 U.S. Gallons (452.4 liter)

1.4 ENGINE DATA

a. Bore/Stroke

CT4-134-DI (V2203):

3.43 in. (87 mm) /3.64 in. (92.4 mm)

b. Compression Ratio

CT4-134-DI (V2203):

20.5:1

c. Cooling System

Capacity:

8 U.S. quarts (7.57 liters) – includes 1 quart (0.946 liter) in coolant recovery bottle. (Refer to section 4.3.1)

Type of Anti-Freeze:

Ethylene Glycol 4 quarts (3.78 liters)
Water 4 quarts (3.78 liters)

Use a low silicate anti-freeze meeting GM specifications GM 6038M or equal.

Water Temperature 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)

d. Cylinders (Number)

Four

e. Displacement

CT4-134-DI (V2203):

134 cu. in. (2.2 liters)

f. Firing Order

1-3-4-2

g. Fuel

Winter: Diesel No. 1
Summer: Diesel No. 2

h. Glow Plug Amperage

7.5 amps per plug at 12 vdc

i. Horsepower

CT4-134-DI (V2203):

33.0 hp @ 1800 rpm

j. Lubrication System

Oil Pressure:

40 to 60 psig (3.8 to 5.2 kg/cm@)

Oil Pressure Switch Setting Closes:

15 psig (2.08 kg/cm@)

Capacity:

20 U.S. quarts (18.9 liters)

Time between Oil Changes:

First 400 Hours, thereafter every 1000 Hours (maximum)

Oil Level Indicator:

Dipstick in oil pan

Lube Oil Specification:

Use a heavy duty lubricating oil conforming to American Petroleum Institute (API) Service Classification CD (DS).

Lube Oil Viscosity:

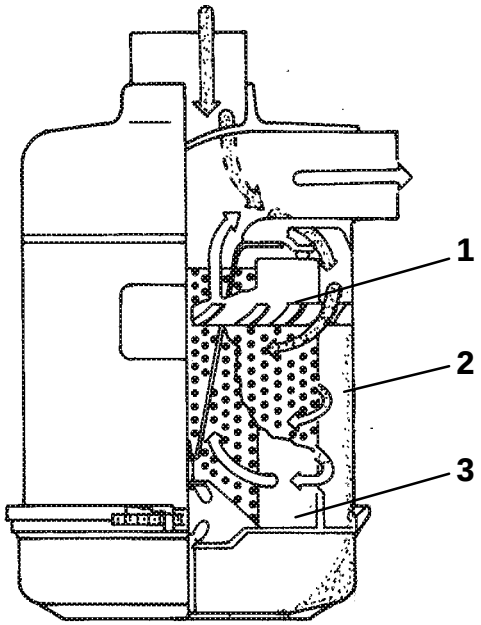
Outdoor Temperature

Fahrenheit	Centigrade	SAE
Below 32_	0_C	10W or 10W30
32_ to 77_F	0_ to 25_C	20
Over 77_F	Over +25_C	30 or 15W40

1.5 ENGINE SCREW THREADS

All threads used on the Model CT4-134-DI engine are metric except the oil drain plug which is American Standard Pipe Thread (NPT).

1.6 ENGINE AIR SYSTEM



1. Pre-Cleaner
2. Ejected Dust
3. Duralife Filter

Figure 1-3. Engine Air Cleaner

Clean air is supplied to the engine through the air cleaner. (See Figure 1-3) The air is necessary for complete combustion and scavenging of the exhaust gases. As the engine piston goes through the intake stroke, the piston draws clean fresh air down into the cylinder for the compression and power strokes. As the engine goes through its exhaust stroke, the upward movement of the piston forces the hot exhaust gases out of the cylinders through the exhaust valves and the exhaust manifold. If the air filter is allowed to become dirty, the operation of the engine would be impaired. Blow-by gases from the diesel engine crankcase are introduced in the air intake manifold through the crankcase breather. Therefore, the filter must be kept clean and air restriction reduced to a minimum. A dry type air cleaner is used with this unit. Air passes through the screen where dirt or dust in the air is removed before it enters the engine. As the dust and dirt accumulate, the filter should be changed periodically. If the filter is not changed, it will be blocked so that it cannot effectively remove the dirt and dust from the air passing over the screens. The air cleaner is equipped with Vacuator ™ Valve which continuously expel dust and moisture. On cleaners equipped with dust cup, the cup is emptied as dust accumulates.

a. Pre-cleaner

The illustration shows a fin which gives high-speed rotation to the intake air, and separates a large portion of the dust from the air by centrifugal action. The plastic fin, the element, and the gasket are vital parts of the cleaner and are designed into a single replaceable assembly. This design feature assures continued high performance of the cleaner.

b. Ejected dust

The dust is swept through a slot in the baffle and collected in the dust cup or Vacuator ™ Valve body.

c. Duralife filter

The small portion of the dust remaining in the pre-cleaned air is removed by the Duralife element. The element is chemically-treated and oven-cured for resistance to oil and water. Perforated steel supports the element inside and out and, together with rigid metal end caps, provides structural rigidity to this vital part of the cleaner. The element can be cleaned for re-use by one of several recommended processes. (Refer to section 4.3.5)

1.7 OPERATING CONTROLS AND INSTRUMENTS

1.7.1 Introduction

Most components required for monitoring and controlling the unit are located in the control box and control panel, the remaining components and their locations are also described below.

1.7.2 Control Panel and Related Components

a. Gauges and Senders

1. Ammeter (A)

The ammeter indicates the rate of discharge or charge of the battery charging system composed of the battery and the solid state battery charger. (See Figure 1-2)

2. Oil Pressure Gauge

The purpose of this gauge is to observe normal operating engine oil pressure. Normal oil pressure is 40 to 60 psig (2.8 to 4.2 kg/cm@). (See Figure 1-1)

3. Water Temperature Gauge (WTG)

The function of this gauge is to observe water operating temperature (180 to 205_F = 82 to 94_C). The gauge is connected to a water temperature sensing device. If the gauge or sender fails, both must be replaced (kit available). (See Figure 1-1)

4. Water Temperature Sender

This sensing device senses engine water temperature and transmits a signal to the water temperature gauge. The water temperature sender is located on the top, front, right side of the engine below the HWT switch. The water temperature gauge and sender both must be replaced if either component fails (kit available).

b. Indicator Light

1. Circuit Breaker Trip Light (L1)

This light (red) may be checked (unit not running) by placing the circuit breaker (CB-1) in the off position and at the same time moving the ignition switch to the run position. When the circuit breaker is in the off position, a set of contacts close to complete a circuit to the light.

If the unit is running and the circuit breaker trips, the light will illuminate to signal the operator of a malfunction with the generator. (See Figure 1-2)

c. Meter

1. Total Time Meter (TT)

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 section 4.1) (See Figure 1-2)

d. Switches

1. Glow Plug Switch (GPS)

The glow plug switch (momentary contact type), when held in the UP position (pre-heat), permits battery current (approximately 7.5 amps per plug at 12 vdc) to flow to the glow plugs in the engine to pre-heat 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. (See Figure 1-2)

2. Ignition Switch (IGN)

The ignition switch (momentary contact type in the start position), when held in the START (ignition) position energizes the starter motor solenoid which in turn allows the starter motor to crank. (See Figure 1-2)

1.7.3 Protective Devices

a. Circuit Breakers

1. A-C Generator Circuit Breaker (CB-1)

This device trips at 25 amps to protect the A-C generator (main alternator) from excessive current (amperage) draw. When the circuit breaker trips, the generator power output to the refrigeration unit ceases. The diesel engine will continue to run (with normal engine operation), but the voltmeter will indicate no output and the circuit breaker indicator light will be illuminated. (See Figure 1-2)

2. Circuit Breaker (CB-2)

The circuit breaker is located in the right-hand bottom corner of the control box. This device prevents excessive current draw by the components FS, HWT, L1, OPG, RCR, WTG, and TT. The circuit breaker opens at 20 amps and will automatically reset.

3. Circuit Breaker (CB-3)

The circuit breaker is located above CB-2 in the control box. This device prevents excessive current draw by the glow plug circuitry. The circuit breaker opens at 45 amps and will reset automatically.

4. Circuit Breaker (CB-4) (69GC15-164, -1, -2)

The circuit breaker is located above the run control relay in the control box. This device prevents excessive current draw by the battery charging transformer line voltage. The circuit breaker opens at 30 amps and will reset automatically.

b. Switches

1. Oil Pressure Switch (LOP)

This switch, set to open below 15 psig (1.05 kg/cm@) will automatically stop the engine upon loss of oil pressure. This switch is located above the oil filter. (See Figure 1-1) When the switch opens, the run control relay (RCR) coil is de-energized and the RCR contacts open to de-energize the fuel solenoid (FS); thus stopping the engine.

2. Water Temperature Switch (HWT)

This switch, set to open at 230 ¦ 5_F (110 ¦ 3_C), will automatically stop the engine upon high water temperature. The switch is located near the thermostat housing. When the switch opens, the run control relay (RCR) coil is de-energized and the RCR contacts open to de-energize the fuel solenoid (FS); thus stopping the engine.

1.8 MAIN ALTERNATOR (A-C GENERATOR)

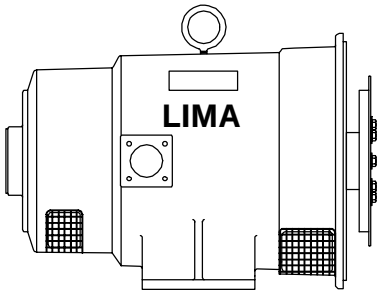


Figure 1-4. Main Alternator (A-C Generator)

1.8.1 Principle of Operation

The MAC (Lima) brushless A-C generator is a self-regulated, rotating field synchronous unit with the rotor having a salient pole construction with amortisseur windings. 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, silicone rectifier unit.

The exciter pole pieces contain residual magnetism, setting up lines of force across the air gap to the exciter armature. When the exciter armature begins to rotate a voltage is induced and current flow is initiated in the exciter armature AC windings. This voltage is fed to the rotating rectifier assembly, rectified and fed to the alternator field coils. This DC voltage is sufficient to magnetize the laminated alternator field which will set up lines of force across the air gap to the alternator stator. As the generator rotor rotates a voltage will be induced and current will flow in the alternator stator windings and to the output circuit.

All connections between the exciter stator windings and the generator stator windings are internally connected within the stator housing. Only the output power leads of the generator unit are brought out to the generator terminal box.

1.8.2 A-C Generator (Main Alternator) Circuit Diagram

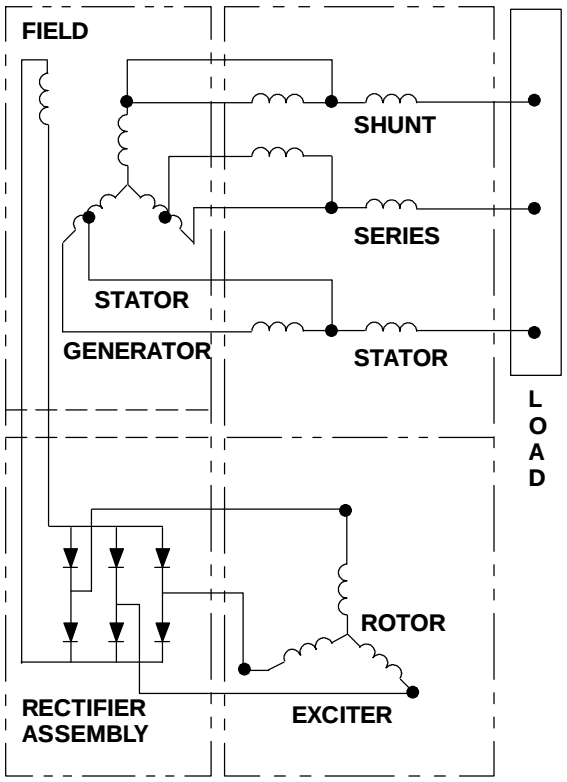


Figure 1-5. A-C Generator Circuit Diagram

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 silicone 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.

1.9 Battery Charging System – 69GC15-164, -1, -2

The solid state battery charging system is located on the control box, see Figure 1-2. This battery charging system consists of two sections; first, a 17–18 volt transformer, that is powered by the LIMA generator. Second, is a solid state voltage regulator that rectifies the input voltage and controls the output voltage for optimum charging. The battery charger has a maximum charge rate of 20 amps and is designed not to over charge the battery.

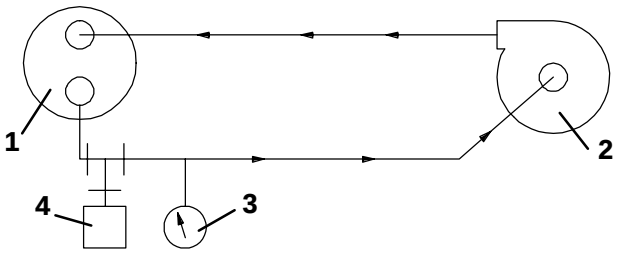
1.10 Battery Charging System – 69GC15-164-3, -4

On models 69GC15-164-3 and 69GC15-164-4, the solid state battery charger is located on top of the generator, next to the air cleaner (see Figure 1-1). The charger is powered by the Lima generator and this input is protected by a 3 amp fuse located on the generator junction box. The battery charger has a maximum charge rate of 25 amps and is designed not to overcharge the battery.

CAUTION

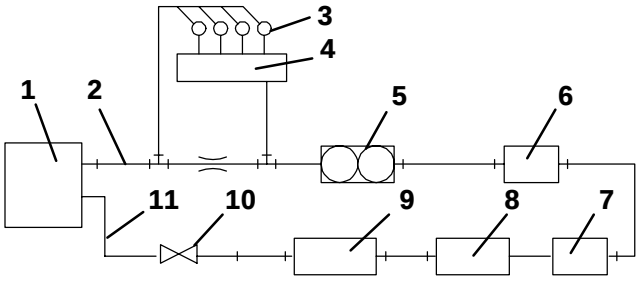
Observe proper polarity when installing the battery, the negative battery terminal must be grounded. Reverse polarity will destroy the rectifier diodes in the generator sets solid state battery charging system if a battery charger is connected in reverse. As a precautionary measure isolate the battery from the unit as follows: disconnect negative battery terminal first, then the positive battery terminal when charging battery in unit. Once the battery has been fully charged, connect the positive battery terminal first, then the negative battery terminal. NEVER jump start the battery when its mounted in the unit, this will destroy the components of the generator sets battery charger.

1.11 LUBE OIL AND FUEL FLOW DIAGRAMS



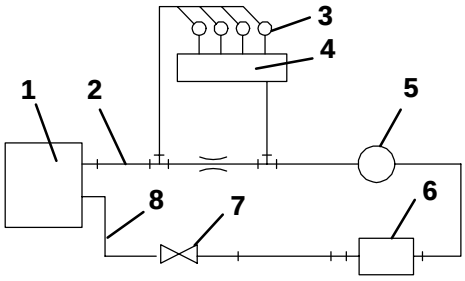
1. Full flow oil filter
2. Engine block oil pump connections
3. Oil pressure gauge
4. Oil pressure switch

Figure 1-6. Lube Oil Flow Diagram



1. Fuel Tank
2. Fuel Return Line
3. Injector Nozzles
4. Injection Pump
5. Fuel Filters
6. Fuel Warmer
7. Mechanical Pump
8. Strainer
9. Water Separator
10. Shut-Off Valve
11. Fuel Supply Line

Figure 1-7. Fuel System Diagram



1. Fuel Tank
2. Fuel Return Line
3. Injector Nozzles
4. Injection Pump
5. Fuel Filters
6. Mechanical Pump
7. Shut-Off Valve
8. Fuel Supply Line

Figure 1-8. Fuel System Diagram – 69GC15-164-3, -4

SECTION 2
OPERATION

2.1 GENERATOR SET INSTALLATION AND REMOVAL

2.1.1 Pin mounting

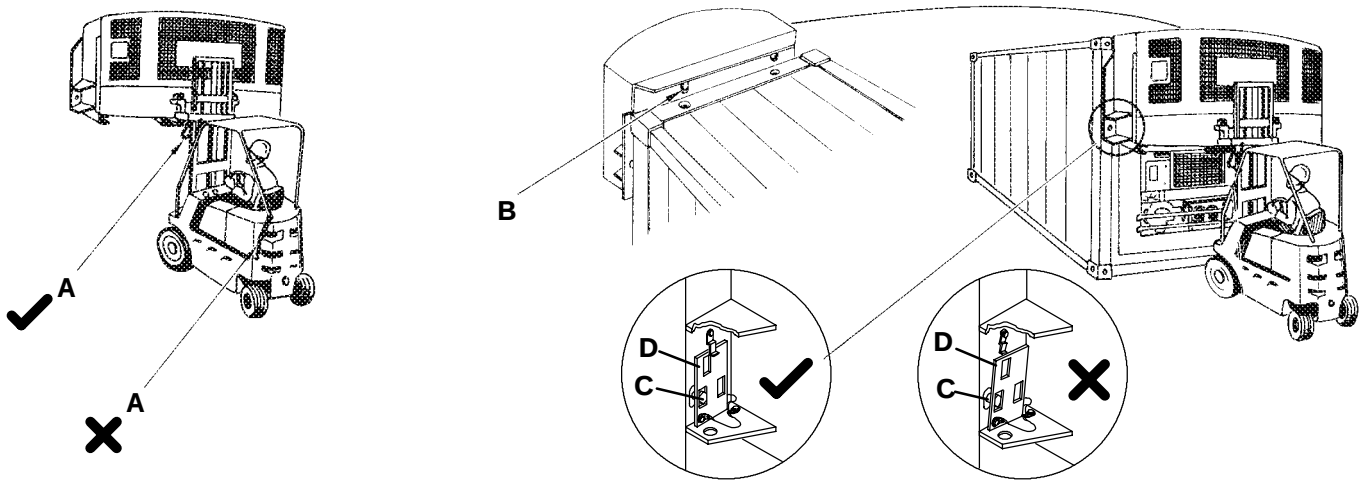


Figure 2-1. Pin Mounting

WARNING

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

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 generator set on forks.

2. Line up generator set with refrigeration unit and container. Raise generator set until top of set is several inches above top edge of container. Move generator set against container and lower into position.

Important – Two pins **(B)** *must be 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.

Important – Bolts must be tight and retaining plate **(D)** *must be locked into position.*

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 PRE-TRIP INSPECTION

a. Before Starting Generator Set

1. Check engine lubrication and fuel oil filter cases, oil lines, and connections for leaks.
(Tighten connections and/or replace gaskets)

2. Check engine lubrication oil level.
(Refer to section 1.4.j.)

3. Check engine V-Belt for proper tension, fraying or cracks. Adjust belt or replace.
(Refer to section 4.4)

4. Check radiator hoses for leaks and check radiator coolant level. (Add pre-mixed 50/50 antifreeze-water as required.) Refer to section 1.4.c.

5. Check radiator coil and generator air intake screen for cleanliness. (Clean using compressed air, reversing the normal air flow.)

6. Check air cleaner for cleanliness and clean if necessary. (Refer to section 4.3.5)

7. Drain water from fuel tank sump.

8. Fill fuel tank with diesel fuel.
(Refer to section 1.4.g.)

9. Check glow plug amperage.
(Refer to section 1.4.h.)

10. Check battery terminals for cleanliness and secureness. (Clean and coat with a mineral type grease.)

11. Check for loose electrical connections.

12. Connect power cable to refrigeration unit. Start genset as detailed in section 2.3 and then turn refrigeration unit on to check operation.
(Refer to section 2.2.b.)

13. Grease Fuel Solenoid plunger.
(Use P/N 07-00245-00.)

b. After Starting Generator Set

1. Refer to section 2.3 for starting and stopping instructions.

2. Check total time meter operation.
(Run engine 10 minutes)

3. Listen for abnormal bearing noise.
(Main alternator)

4. Check fuel lines, lube oil lines and filters for leaks.

5. Check radiator and hoses for leaks.

6. Check exhaust system for leaks.

7. Check operation of indicator light.
(Refer to section 1.7.2.c.)

2.3 STARTING AND STOPPING INSTRUCTIONS

a. Starting Instructions

WARNING

Under no circumstances should ether or any other unauthorized starting aids be used in conjunction with the glow plugs.

NOTE

When starting the engine, it is necessary to continue to hold the glow plug switch in the UP position until the engine develops sufficient oil pressure to close the oil pressure safety switch, energizing and completing all circuits for unit operation.

1. Hold glow plug switch in the UP position for 30 seconds. (See Figure 1-2)

NOTE

Below 0_F, hold glow plug switch for two minutes, release switch for 30 seconds and again hold glow plug switch for two minutes. If engine does not start after 10 seconds cranking, wait for 30 seconds before repeating starting procedure.

2. With glow plug switch held in the *UP* position, push the ignition switch to the *START* position.

3. After engine has started, continue to hold the glow plug switch in the *UP* position until the oil pressure safety switch closes (when engine develops sufficient oil pressure). The glow plug switch will automatically be in the *OFF* position when released.

NOTE

At this point, observe the ammeter reading which should be positive. If the reading is negative or neutral, this is an indication of improper charging (refer to section 3.2).

4. Complete pre-trip inspection.
(Refer to section 2.2.b.)

b. Stopping Instructions

1. Push ignition switch to the *OFF* position.

2.4 CONTROL CIRCUIT OPERATION

WARNING

Beware of moving V-Belts and belt driven components.

CAUTION

The generator set circuit breaker must be in the ON position in order to supply power to the refrigeration unit.

When the glow plug switch is held in the pre-heat position, current flows to the glow plugs. The glow plugs (starting aids) provide a source of heat to pre-heat the combustion chamber during start-up. Power also flows to the run control relay which energizes, and closes the *RCR* contacts. From the relay *RCR*, power flows through the high water temperature switch to ground.

In order to start engine, hold the glow plug switch in the UP position for the recommended time as detailed in section 2.3.a. and then hold the ignition (Start-Run-Off) switch in the *START* position. With ignition switch in the *START* position, starter solenoid is energized closing starter motor contactor contacts (SS), which energizes starter motor. The starter motor turns over the engine resulting in pumping fuel to the engine cylinders by the injection pump. This fuel is ignited by heat of compression; thus starting the engine. Also, run control relay is energized at the same time to close a set of contacts and completes a circuit to the fuel solenoid.

When the engine has developed sufficient oil pressure, oil pressure safety switch contacts close to maintain a circuit to the run control relay. Energizing this relay closes (RCR) contacts providing a circuit to keep the fuel run solenoid energized as long as the safety switch contacts remain closed. The glow plug switch is then released and the ignition switch is released to the *RUN* position. Releasing glow plug switch de-energizes the glow plugs.

Total time meter is energized simultaneously with the fuel solenoid.

With the engine running, the solid state battery charger provides 12-volt d-c power to operate the control system and charge the battery.

SECTION 3

TROUBLESHOOTING

3.1 DIESEL ENGINE

INDICATION/ TROUBLE	POSSIBLE CAUSES	REFERENCE SECTION
3.1.1 Engine Will Not Start		
a. Starter motor will not crank or low cranking speed.	Battery insufficiently charged	Charge
	Battery terminal post or Battery defective	Check
	Battery charger assembly defective	Replace
	Bad electrical connections at starter	Correct
	Starter motor malfunctions	3.1.3
	Starter motor solenoid defective	Engine Manual
	Open starting circuit	3.1.4
	Incorrect grade of lubricating oil	
	Closed fuel shut-off valve	Open
b. Starter motor cranks but engine fails to start	No fuel in tank	1.4.g.
	Air in fuel system	4.2
	Water in fuel system	Drain Sump
	Plugged fuel filters	Replace
	Faulty fuel control operation	4.3.3
	Run control relay	4.3.3
	Glow plug(s) defective	4.3.7
	Plugged fuel lines to injector(s)	Engine Manual
c. Starter cranks, engages but dies after a few seconds	Engine lube oil too heavy	1.4.j.
	Voltage drop in starter cable(s)	Check
3.1.2 Engine Starts Then Stops		
a. Engine stops after several rotations	No fuel in tank	1.4.g.
	Faulty fuel control operation	4.3.3
	Fuel filter(s) restricted	Replace
	Air cleaner or hose restricted	4.3.5
	Safety device open	1.2
	Open wiring circuit to run solenoid	Check
	Fuel solenoid linkage disconnected	4.3.3
	Oil pressure switch defective	Replace
	Closed fuel shut-off valve	Open
	Fuel supply restricted	Engine Manual
	Leak in fuel system	Engine Manual
	Injector nozzle(s) defective	Engine Manual
	Injection pump defective	Engine Manual

INDICATION/ TROUBLE	POSSIBLE CAUSES	REFERENCE SECTION
3.1.3 Starter Motor Malfunction		
a. Starter motor will not crank or turns slowly	Battery insufficiently charged	Charge
	Battery cable connections loose or oxidized	Check
	Battery charger assembly defective	Replace
	Battery cables defective	Replace
	Starter brushes shorted out	Engine Manual
	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	1.4.j.
b. Starter motor turns but pinion does not engage	Pinion or ring gear obstructed or worn	Engine Manual
c. Starter motor does not disengage after switch has been released	Ignition switch defective	Replace
	Starter motor solenoid defective	Engine Manual
d. Pinion does not disengage after engine is running	Defective starter	Engine Manual
3.1.4 Malfunction In the Engine Starting Circuit		
a. No power to starter motor solenoid	Battery defective	Correct
	Loose electrical connections	Tighten
b. Fuel solenoid does not energize or does not remain energized	Battery defective	Correct
	Loose electrical connections	Tighten
	Water temperature safety switch open	1.2
	Oil pressure switch defective	Replace
	Run control relay defective	4.3.3
	Fuel solenoid defective	4.3.3
	Ignition switch defective	Replace
3.1.5 Miscellaneous Engine Troubleshooting		
a. Loss of power	Restriction in air cleaner	4.3.5
	Air in fuel system	4.2
	Air vent in fuel cap restricted	Clean
	Restricted fuel lines	Engine Manual
	Defective fuel injection pump	Engine Manual
	Defective injector(s) or incorrect type	Engine Manual
	Incorrect fuel injection pump timing	Engine Manual
	Incorrect valve timing	Engine Manual
	Poor compression	Engine Manual

INDICATION/ TROUBLE	POSSIBLE CAUSES	REFERENCE SECTION
3.1.5 Miscellaneous Engine Troubleshooting (continued)		
b. Vibration	Engine shockmounts defective	Replace
	Poor compression	Engine Manual
	Fuel solenoid or linkage	4.3.3
c. Overheating	Restriction in air cleaner	4.3.5
	Exhaust pipe restriction	Remove
	Restriction in water jacket	Check
	Loose water pump V-Belt	4.4
	Restriction in radiator	4.3.1
	Coolant level too low	1.4.c.
	Defective thermostat	Engine Manual
	Defective water pump	Engine Manual
d. Excessive crankcase pressure	Plugged crankcase breather line	4.3.6
3.2 BATTERY CHARGER (SOLID STATE) – 69GC15-164, -1, -2		
Battery Undercharged	Defective cables, dirty battery posts or corroded terminals	Replace/Clean
	Defective transformer or battery charger (Ammeter indicates negative)	Replace
Battery Overcharged – excessive use of water. Voltmeter indicates greater than 14.5 volts (connected across battery with no load) with engine idling.	Defective battery charger system	Check
3.3 BATTERY CHARGER (SOLID STATE) – 69GC15-164-3, -4		
a. Input fuse/breaker blows when charger is turned on	Short in 12 volt wiring causing overload of charger	Locate and remove short
b. Input fuse/breaker blows repeatedly, even with no battery connected	Internal short	Replace
c. Charger does not taper back in charge	Bad cell in battery	Test battery for defect according to battery manufacturer's instructions
	Defective charger	Replace
d. Charger does not charge	Blown input fuse/breaker	Replace fuse
	Charger is not receiving AC input	Using a voltmeter, confirm charger is receiving correct AC voltage. If not check input connections.

INDICATION/ TROUBLE	POSSIBLE CAUSES	REFERENCE SECTION
3.3 BATTERY CHARGER (SOLID STATE) – 69GC15-164-3, -4 (continued)		
	Charger's output is not connected to 12 volt battery	Check output wiring connections to battery.
	Defective charger	Replace
e. 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
f. Reverse polarity connection to battery has caused charger to stop charging	Internal DC fuse blown and possible damage to current carrying components	Replace
3.4 A-C BRUSHLESS GENERATOR (MAIN ALTERNATOR)		
No voltage	Loss of residual magnetism in exciter field	4.5.1.g.
	Circuit breaker tripped	Check
	Open in stator windings	4.5.2
	Open or short in rotating rectifiers	4.5.1.c
	Short circuited	4.5.2
	Open in alternator field	4.5.2
	Shorted exciter armature	4.5.2
Low voltage	Low engine speed	4.3.4
	Excessive load	Check
	High resistance connections – connections warm or hot	Tighten
	Shorted field	4.5.2
Fluctuating voltage (May be indicated by flickering lights)	Fluctuating speed	4.3.4
	Irregular speed of engine	Engine Manual
	Loose terminal or load connections	Tighten
	Defective bearing causing uneven air gap	4.5.1.b.
High voltage	Excessive engine speed	4.3.4
Overheating	Generator overloaded	Check
	Clogged ventilating screens	Clean
	High temperature surrounding generator	4.3.1
	Insufficient circulation	4.3.1
	Unbalanced load	Balance
	Dry bearing	4.5.1
Mechanical Noise	Defective bearing	4.5.1
	Rotor scrubbing on stator	4.5.1
	Loose laminations	4.5.2
	Loose or misaligned coupling	4.5.2
Generator frame produces shock when touched	Static charge	Check ground to frame
	Grounded armature of field coil	4.5.2

SECTION 4

SERVICE

This section covers service for the generator set and some engine servicing only. Refer to the Kubota engine workshop manual for other engine servicing. (Refer to chart in section 1.1)

WARNING

Beware of moving V-Belts and belt driven components.

4.1 MAINTENANCE SCHEDULE

Unit ON	Unit OFF	Operation	Reference Section
4.1.1 Daily Maintenance			
	X	1. Pre-Trip Inspection – before starting	2.2.a.
X		2. Pre-Trip Inspection – after starting	2.2.b.
X		3. Check total time meter	Run 10 minutes
4.1.2 First 400 Hour Maintenance			
	X	1. Pre-Trip Inspection – before starting	2.2.a.
X	X	2. Change lube oil and filter	4.3.2
X		3. Pre-Trip Inspection – after starting	2.2.b.
X		4. Check total time meter	Run 10 minutes
4.1.3 Every 1000 Hour Maintenance (Normal Operating Conditions)			
X	X	1. Complete 400 Hour Maintenance	4.1.2
	X	2. Tighten engine and generator mounting bolts	4.6
	X	3. Tighten all electrical connections in terminal/control box	Tighten
	X	4. Clean air cleaner, check hose and connections	4.3.5
	X	5. Check water pump bearing end play	None
	X	6. Check battery charger assembly amperage output	None
	X	7. Check mechanical fuel lift pump filter	4.3.8
	X	8. Clean screen in fuel strainer	None
4.1.4 Every 3000 to 6000 Hour Maintenance			
X	X	1. Complete a 400 and 1000 Hour Maintenance	4.1.2 & 4.1.3
	X	2. Clean crankcase breather	4.3.6
X	X	3. Clean and flush cooling system	4.3.1
	X	4. Check starter condition	Engine Manual
X	X	5. Check engine compression	Engine Manual
	X	6. Check and adjust injector nozzles	Engine Manual
	X	7. Replace V-Belt	4.4

4.2 PRIMING THE FUEL SYSTEM

The unit is equipped with a mechanical fuel lift pump, it is mounted on the engine next to the injection pump. (Also, refer to section 4.3.8) This pump has a manual plunger for bleeding fuel when the fuel tank has been run dry.

Since the unit employs a closed fuel circuit, it is recommended to use the following steps:

1. Turn bleed valve (Red) counter-clockwise until fully opened (see Figure 1-1).

2. Turn the top of the manual plunger counter-clockwise to unlock it. (See Figure 1-1) Then, rapidly hand pump the manual plunger until a positive pressure (resistance) is felt, which will indicate fuel flow.

3. Depress and turn the top of the manual plunger clockwise to lock in place.

4. Start engine. (Refer to section 2.3)

5. When engine is running properly, turn bleed valve clockwise until fully closed.

4.3 ENGINE SERVICE AND COMPONENTS

4.3.1 Cooling System

The radiator, externally and internally, must be clean for adequate cooling. The fan belt must be adjusted periodically to provide maximum air flow. (Refer to section 4.4)

Do the following to service the cooling system:

a. Remove all foreign material from the radiator coil by reversing the normal air flow (Force air in thru the front of the radiator and discharge thru the radiator toward the engine.) 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.

b. Drain coolant completely by opening drain-cock and removing radiator cap.

CAUTION

Use only ethylene glycol, anti-freeze (with inhibitors) in system as glycol by itself will damage the cooling system.
Always add pre-mixed 50/50 anti-freeze and water to radiator/engine. Never exceed more than a 50% concentration of anti-freeze. Use a low silicate anti-freeze meeting GM specifications GM 6038M or equal.

c. 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.

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.

e. Run engine to operating temperature. Drain system again and fill with treated water/anti-freeze. (See Caution note and refer to section 1.4.c.) *NEVER POUR COLD WATER INTO A HOT ENGINE,* however hot water can always be added to a cold engine.

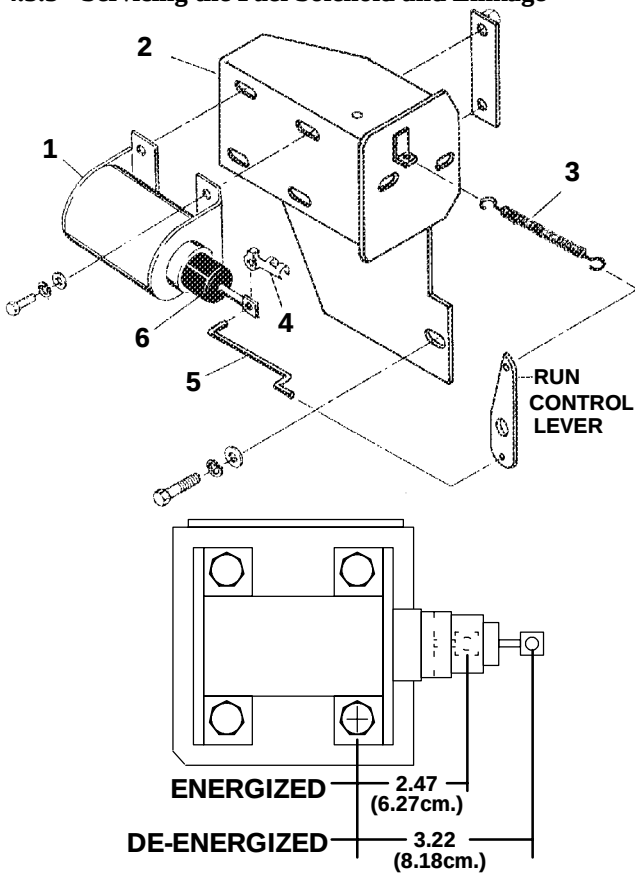
4.3.2 Lube Oil Filters

The full flow filter is located near the run solenoid as shown in Figure 1-1.

After warming up the engine, stop engine, remove drain plug from oil reservoir and drain engine lube oil. Lightly oil gasket on filter before installing.

Replace filters and add lube oil. (Refer to section 1.4.j.) Warm up engine and check for leaks.

4.3.3 Servicing the Fuel Solenoid and Linkage



1. Solenoid
2. Solenoid Bracket
3. Spring
4. Clip
5. Linkage Rod
6. Boot

Figure 4-1. Fuel Solenoid Assembly

NOTE

Periodically grease (P/N 07-00245-00) Fuel Solenoid plunger.

a. Remove spring linkage from injection pump run lever (item 3, Figure 4-1).

b. Disconnect wiring to solenoid. Remove clip (item 4) from linkage rod (item 5). Remove mounting hardware from solenoid and then remove solenoid.

c. Install new solenoid and mounting hardware, connect wiring. Place ignition (Start-Run-Off) switch in the START position to energize solenoid. Check energized dimension as shown in Figure 4-1. Turn switch OFF. Check de-energized dimension. If energized dimension needs adjusting, loosen solenoid mounting bolts and move solenoid.

d. Energize solenoid and check clearance.

e. If the engine does not shut off when the fuel solenoid is de-energized, loosen the four (4) mounting bolts and move the solenoid toward the lever until it shuts off. Tighten the mounting bolts.

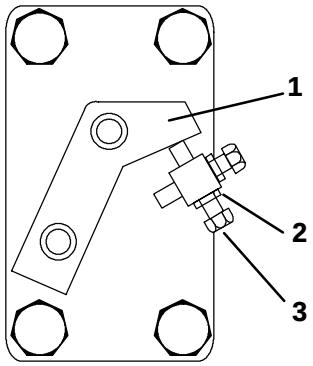
4.3.4 Adjusting Engine Speed

The engine speed operates at 1820 to 1840 rpm (no load), 1710 rpm (with load).

Two methods to check engine speeds are:

a. With the engine stopped, place a mark (white paint for example) on the crankshaft sheave. Start engine and verify engine speed by using a Strobette-model 964 (Strobetachometer), Carrier Transicold Part No. 07-00206.

b. With the engine stopped, the second method of checking engine speed is by using a frequency (hertz) meter. Attach one lead to CB-1 terminal 1, Figures 5-1/5-2, electrical schematics, and the other to chassis ground. Start engine and 60.5 hertz will be 1820 rpm and 61.3 hertz will be 1840 rpm (no load).



1. Speed Lever
2. Jam Nut "B"
3. Capscrew "B"

Figure 4-2. Speed Adjustment

To Increase Speed:

Loosen jam nut "B." Turn capscrew "B" clockwise until correct speed is achieved, then tighten jam nut "B" and check engine speed.

To Decrease Speed:

Loosen jam nut "B." Turn capscrew "B" counter-clockwise until correct speed is achieved, then tighten jam nut "B" and check engine speed.

4.3.5 Engine Air Cleaner

a. Inspection

The air cleaner should be inspected constantly for leaks. A damaged air cleaner or hose can seriously affect the performance and life of the engine. The following simple service steps are easily made while the engine is being serviced in the field.

The simple service steps are as follows:

1. Watch all connections for mechanical tightness. Be sure cleaner outlet pipe is not fractured.

2. If cleaner has been dented or damaged, check all connections immediately.

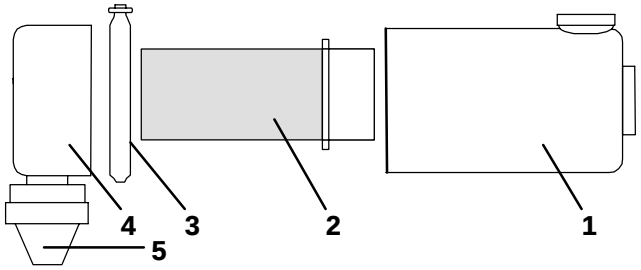
3. In case of leakage and if adjustment does not correct the trouble, replace necessary parts or gaskets. *Swelled or distorted gaskets must always be renewed.*

b. Service Procedure

1. Empty dust cover as required. Check to see that the Vacuator is not inverted, damaged or plugged.

2. Stop the engine, remove and clean the dust cap. Remove the dirty element from the air cleaner. Install new filter and tighten wing nut securely.

3. Install dust cover, making sure it seals 360_ around the air cleaner body. Check all connections between the air cleaner and the engine to be certain that they are tight and leak-free.

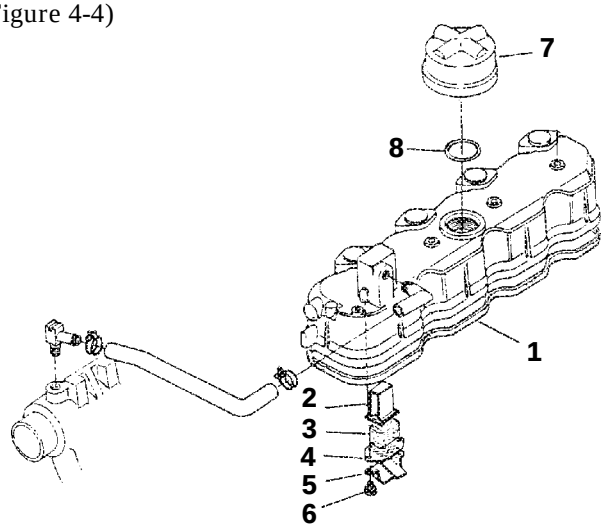


1. Body Assembly
2. Primary Element
3. Clamp
4. Dust Cap
5. Vacuator

Figure 4-3. Air Cleaner

4.3.6 Engine Crankcase Breather

Both engines use a closed type breather with the breather line attached to the cylinder head cover. (See Figure 4-4)



1. Cylinder Head Cover
2. Breather Cover
3. Breather Element
4. Plate
5. Breather Oil Shield
6. Capscrew
7. Breather Assembly
8. O-Ring

Figure 4-4. Engine Crankcase Breather

The breather assembly should be cleaned once a year or at every 3000 hours maintenance interval (whichever comes first).

4.3.7 Servicing Glow Plugs

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

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. One method is to remove the injector and then energize the glow plug. The glowing tip may then be observed.

b. Another method is to place an ammeter (or clip-on ammeter) in series with each glow plug and energize the plugs. Each plug (if good) should show amperage draw.

4.3.8 Servicing Fuel Pump

a. Mechanical Pump (See Figure 4-5)

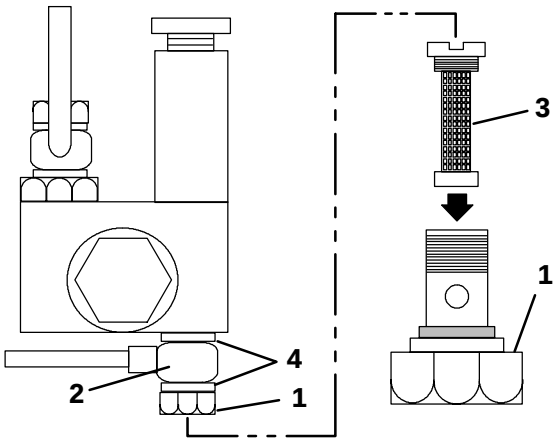
Due to foreign particles in the fuel and wax as a result of using the wrong grade of fuel or untreated fuel in cold weather. The fuel filter may become plugged or restricted, and the engine will loose capacity. The filter must be cleaned on a regular schedule such as unit pretrip or when the oil and fuel filters are changed (refer to section 4.1).

1. Turn nut counter-clockwise to loosen and remove (item 1).

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.



1. Nut
2. Banjo
3. Filter
4. Copper Rings

Figure 4-5. Mechanical Fuel Pump

4.4 SERVICING AND ADJUSTING V-BELT

WARNING

Beware of moving V-Belts and belt driven components.

NOTE

Frayed, cracked or worn V-Belts 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 may be checked at regular intervals.

4.4.1 Water Pump V-Belt

The water pump V-Belt is driven by a sheave on the engine crankshaft. Adjustment is achieved by altering position of the idler pulley.

a. Replacing the V-Belt

1. Loosen the idler bracket pivot bolt.

2. Replace belt. Use hand force only on idler pulley to tighten belt. *Do not use pry bar or excessive force as it may cause water pump bearings to fail.* When belt is tight, tighten idler bracket pivot bolt.

3. Check belt tension, correct specifications are 40-45 lbs. on the Burroughs gauge Carrier Transicold P/N 07-00203.

4.5 SERVICING THE GENERATOR (MAIN ALTERNATOR)

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 to operate. Follow the instructions outlined below to insure maximum efficiency of the electrical equipment.

a. Cooling

Keep all cooling parts clean and make certain sufficient room is left on all sides for a plentiful supply of fresh coolant air flow. *DO NOT EXCEED TEMPERATURE RISE AS SHOWN FOR 80_C (176_F) ABOVE A 40_C (104_F) AMBIENT.* This ensures that the insulation NEMA Class "F" 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. Bearing Replacement

Factory lubricated shielded bearings will normally provide several years of trouble free service when operated under normal conditions. Excessive bearing load and adverse environment conditions will greatly shorten bearing life. Should bearing failure occur, bearings can be replaced. *ALWAYS REPLACE WITH THE SAME TYPE BEARING AS INSTALLED AT THE FACTORY. CHECK PARTS LIST FOR PART NUMBER*. Include generator serial number when ordering bearings.

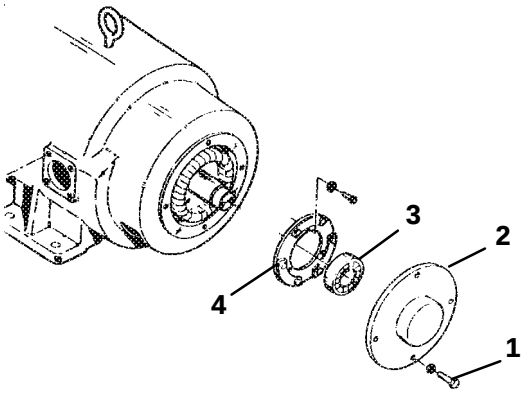
Do the following to remove bearing:

1. Remove bearing cap. (See Figure 4-6)

2. Remove bearing with the use of a bearing or wheel puller.

3. Install new bearing. Ball bearings on Lima generators are pre-lubricated and require no further lubrication for the life of the bearing.

4. Replace end cap.



1. Bolt
2. Bearing Cap
3. Bearing
4. Rotating Diode Bridge

Figure 4-6. Rectifier Removal

c. Rotating Diode Bridge (Rectifier Assembly) Replacement

The rotating diode bridge can be removed and replaced. Overcurrent, overvoltage, overspeed, or reverse currents can cause damage to the assembly or any of the component parts. The rotating diode bridge may be removed through the bearing cap on the rear of the generator. (See Figure 4-6 and Figure 4-7)

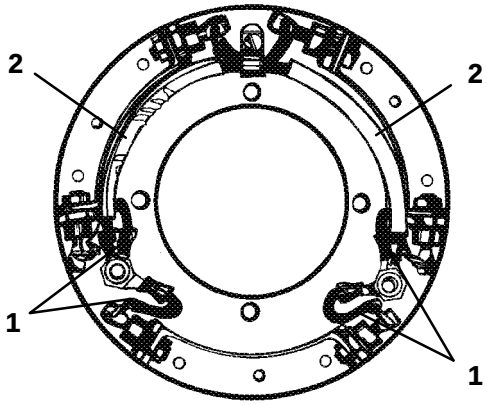
1. Remove the bearing cap by removing the four bolts shown in Figure 4-6 and both the bearing and rectifier assembly will be visible.

2. Use a bearing puller to remove the bearing from main shaft being careful to locate the puller on the inner race of the bearing to avoid bearing damage. Once the bearing is free, it is then necessary to disconnect the alternator and exciter rotor leads as shown in Figure 4-6.

3. Remove the three hold-down cap screws which secure the rectifier assembly to its adapter. Once this procedure is complete the rectifier assembly is free for removal.

Follow the testing procedures outlined in section 4.5.1.d.

After the rectifier assembly has been repaired or replaced, reverse the procedure as stated above, being careful that all lead connections are tight and that set screws are locked with Loctite. (Loctite Corporation)



1. Exciter Rotor Lead
2. Alternator Rotor Lead

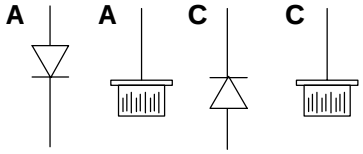
Figure 4-7. A-C Generator (Rectifier Assembly)

d. Testing Diodes With An Ohmmeter

1. Remove the diode from the circuit. Do not press body out of heat sink. Disconnect the lead. Do not use excessive heat in unsoldering the lead.

2. A good diode should have a low resistance when the + of an ohm meter is connected to the anode and the – to the cathode, and a high resistance when the polarity of the ohmmeter is reversed. (See Figure 4-8)

If both resistances are high or both are low, then the diode is defective and should be replaced.



RED LETTERING	BLACK LETTERING "R" After Number
Forward Polarity Diode	Reverse Polarity Diode
A (+) = Anode	C (–) = Cathode

Figure 4-8. Diode Testing

e. Rotor Damage

The damper bars of the generator prevent excessive hunting when AC generators are operated in parallel. Damper bars, because they must have a low electrical resistance and are subjected to extreme centrifugal forces, must be mechanically secure and permanent. Consequently, they are welded to end plates completely covering the field.

All rotors are static and dynamically balanced to a high degree on precision machines to assure minimum vibration. They will, therefore, remain dynamically stable at speed well beyond the synchronous speed of the generator. The rotors on generators are, however, subjected to extreme centrifugal forces which can increase beyond safe operating limits at overspeed. Therefore, the prime mover should be adequately governed to prevent overspeed.

Damage to the rotor can also occur due to overheating which can be caused by the air flow being restricted from dust or other foreign objects collecting in the air passage.

If a rotor becomes defective, it should be returned to the factory with full nameplate data, because the rotor coils are enclosed in welded squirrel case winding. To repair a rotor the special tooling and technique of the factory is necessary and essential. Should a failure occur, Carrier Transicold should be notified immediately and steps will be taken to get the generator back into service with the least expense; and more important, to determine the cause of the failure and take steps to prevent a recurrence.

f. Generator Windings (Drying)

Generators that have been in transit or 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. (a)Place generator in drying oven or hot room.

(b)Dry with warm air blower directed through windings.

2. (a)If the generator has been operated and then put into storage for any period of time, a P.D. George #11127 type air-dry fungus resistant varnish should be applied.

Experience has shown that it is necessary to take these precautions in locations such as seaboard installations and other highly humid areas. Some installations will be in atmospheres that are much more corrosive than others. A little precautions along the lines outlined here could eliminate an unnecessary repair job.

Each generator was subjected to a standard NEMA insulation test, which means 1000 volts plus twice the highest voltage for which the generator is rated was impressed between the winding and frame. All machines are insulated with a high safety factor for the class of insulation used. The latest and newest in insulation and baking techniques are used.

The finest insulation job can be very quickly broken down by carelessly applying high voltage to windings in a moisture saturated condition. Mishandling in this respect can easily cause a breakdown, making it necessary to return the generator to the factory for repair, and consequent expense and loss of time.

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 low insulation leakage.

g. Restoring Residual Magnetism

NOTE

When trying to restore residual magnetism, be sure to wear leather gloves and use an insulated 12 gauge (or higher) jumper wire. Cut-off a few strands from both ends of the jumper wire to ensure fusing does not take place.

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. If not, an alternate method may be used. 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.

4.5.2 Installation and Removal

a. Removing the Generator

1. Remove generator set cover assembly and generator ground wire.

2. Remove generator leads from terminal box, and all electrical wires from generator and engine. Then remove four 1/4-20 x 1.00 lg screws securing terminal box to generator.

3. Drain radiator, then disconnect all air/coolant hoses from generator and engine. Remove fan.

4. Separate flex exhaust pipe from muffler.

5. Remove mounting foot hardware from generator, and engine mounting brackets from frame.

6. Place slings around generator and engine. Raise both up enough to clear approximately two inches, then swing engine out first and bring entire assembly straight out.

7. Remove necessary mounting brackets (battery, fuel, ect.). Remove generator screen from coupling end of generator.

8. Remove four 5/16-18 x 1-1/2 screws and two 5/16-18 x 1-1/4 screws securing the engine fly wheel housing to the generator flange.

9. Remove five 3/8-24 x 3/4 screws securing generator disc to engine flywheel. (A socket brazed to a flexible

shaft and an offset wrench are required to remove the bolts.) Turn bolts counter-clockwise with offset wrench to start, then use flexible shaft and socket assembly for removal of bolts.

b. Installing the Generator

NOTE

For torque values refer to section 4.8.

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.

The use of stud guides, two in bell housing (5/16-18 x 2 lg) and two in the flywheel (3/8-24 x 2-1/2 lg) will make installation easier. These studs should have a square or hex design on the end opposite the threads. This is necessary to remove studs after generator is installed.

1. Remove screen covering from shaft end of generator and brush anti-seize lubricant (lube-plate) on the face of flywheel.

2. Move generator (with hoist) into position with engine and line up with the studs on housing and flywheel. Turn crankshaft (with large wrench) to align flywheel with generator, if necessary.

NOTE

It may be necessary to apply pressure under the cooling fan shaft to align the generator with the flywheel counterbore.

3. Start the 3/8-24 bolts (by hand) through the disc plate and into the flywheel. Once alignment is made remove studs and torque bolts (five).

4. Secure two of the housing bolts (5/16-18) to draw the mating flanges together.

5. Remove studs and secure remaining bolts and washers 5/16-18 (four) and torque bolts (six).

6. To install reverse steps 1 through 7 in section 4.5.2.a..

NOTE

Install new gaskets (one between generator and terminal box and the other between box and cover) when installing terminal box.

7. Torque generator/engine mounting bolts (six).

4.6 REPLACING SHOCKMOUNTS

NOTE

For torque values refer to section 4.8.

The engine and generator use different style shockmounts and hold down hardware.

4.6.1 Replacement Criteria

When the neoprene shockmount has been cut, split, abraded or has flared due to wear from bolts and normal deterioration.

4.6.2 Shockmount Replacement

a. Engine

1. Remove the two 1/2-13 x 3-1/2 inch long capscrews. (Loctite has been applied to these bolts.) Place sling or other device around engine (near oil reservoir) and slowly raise the engine enough to remove the engine mounting shockmounts. (The fan may have to be rotated to prevent striking the fan shroud.)

2. Install shockmounts and flat washers as shown in Figure 4-9.

3. Apply Loctite EV (purple in color) to threads of bolts.

4. Lower engine, and torque shockmount bolts.

b. Generator

1. Remove the four 1/2-13 x 3-1/4 inch long capscrews. (Loctite has been applied to these bolts.) Place sling or other device around generator, slowly raise enough to replace shockmounts.

2. Install shockmounts and flat washers as shown in Figure 4-9.

3. Apply Loctite EV (purple in color) to threads of bolts.

4. Lower generator and torque shockmount bolts.

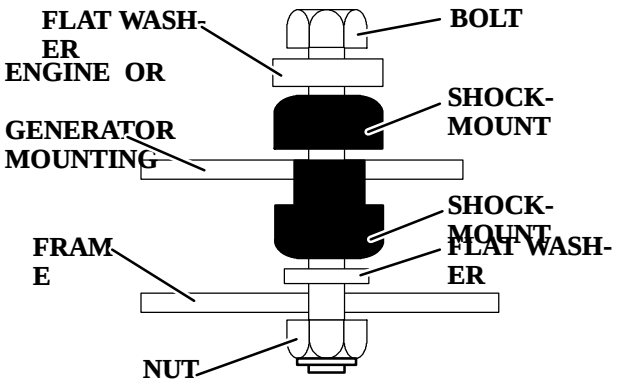


Figure 4-9. Shockmount Installation

4.7 MAINTENANCE OF PAINTED SURFACES

The unit is protected by a special paint system against the corrosive atmosphere in which it normally operates. However, should the paint system be damaged, the base metal can corrode. In order to protect the unit from the highly corrosive sea atmosphere or if the protective paint system is scratched or damaged:

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.

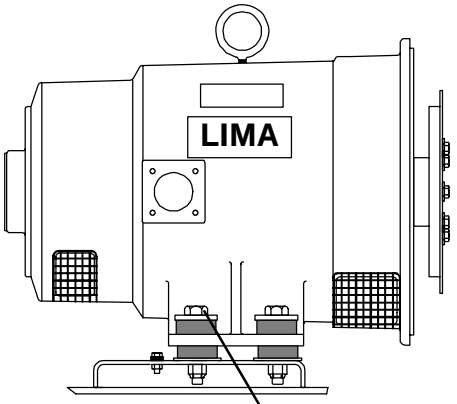
4.8 UNIDRIVE TORQUE REQUIREMENTS

Extensive damage may occur if the proper hardware and procedures are not followed. Periodic inspection of hardware and bolt torque is recommended to ensure the integrity of the unidrive.

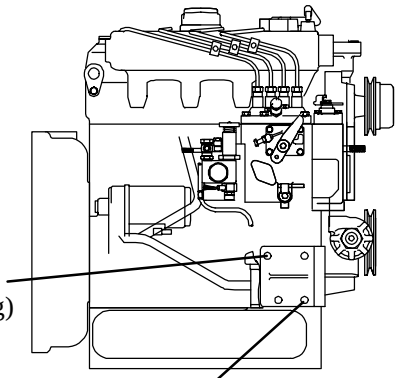
The figures below show the torque value, size and grade of the hardware to be used when assembling the unidrive assembly.

NOTE

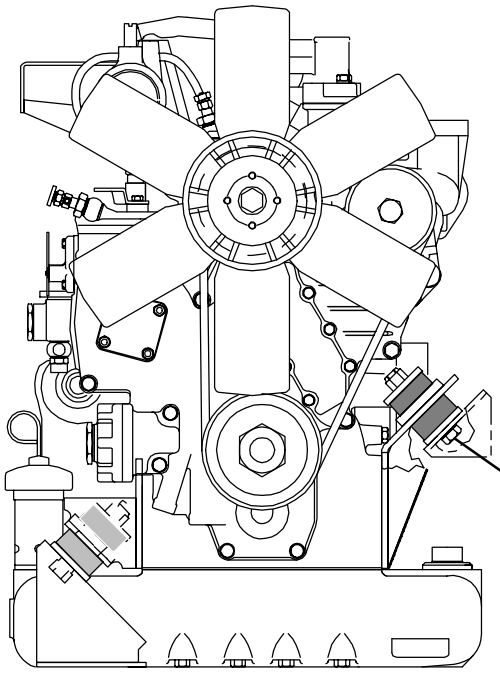
SST is an abbreviation for; 300 Series Corrosion Resistant Steel.



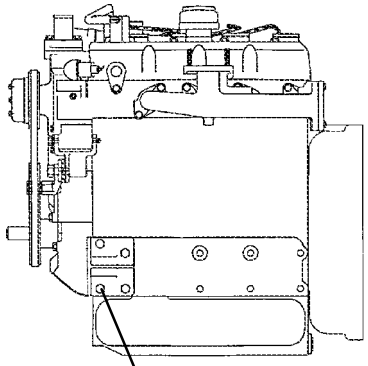
GENERATOR SHOCKMOUNTS – SIDE VIEW



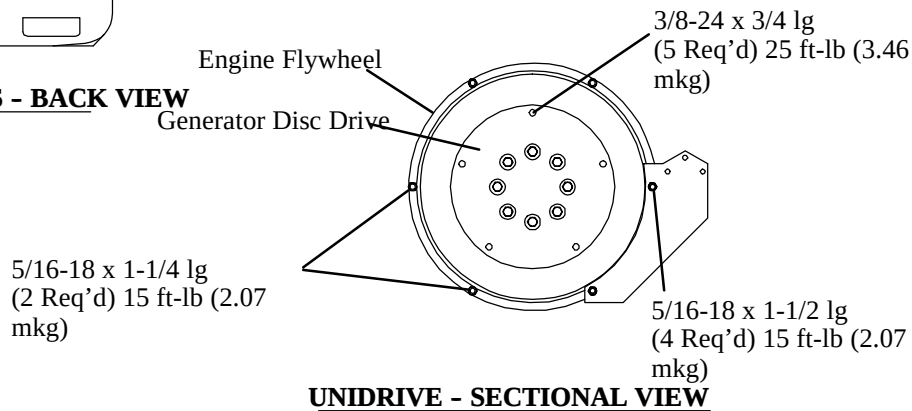
ENGINE MOUNT – RIGHT SIDE VIEW



ENGINE SHOCKMOUNTS – BACK VIEW



ENGINE MOUNT – LEFT SIDE VIEW



UNIDRIVE – SECTIONAL VIEW

Figure 4-10. Unidrive Torque Requirements

SECTION 5

SCHEMATICS

5.1 INTRODUCTION

This section contains Electrical Wiring Schematics and Diagrams covering the Models listed in Table 1-1. 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.

WARNING

Electrical power is generated by a Lima 15 KW, A-C generator. The generator provides a constant 460 or 230 vac, 3 phase, 60 hertz electrical supply.

WARNING

Beware of moving V-Belts and belt driven components.

WARNING

Before servicing unit, make sure the unit circuit breaker (CB1) and the start-stop switch are in the OFF position. Also disconnect power plug and cable.

Make sure the power plug(s) are clean and dry before connecting to any power receptacle.

WARNING

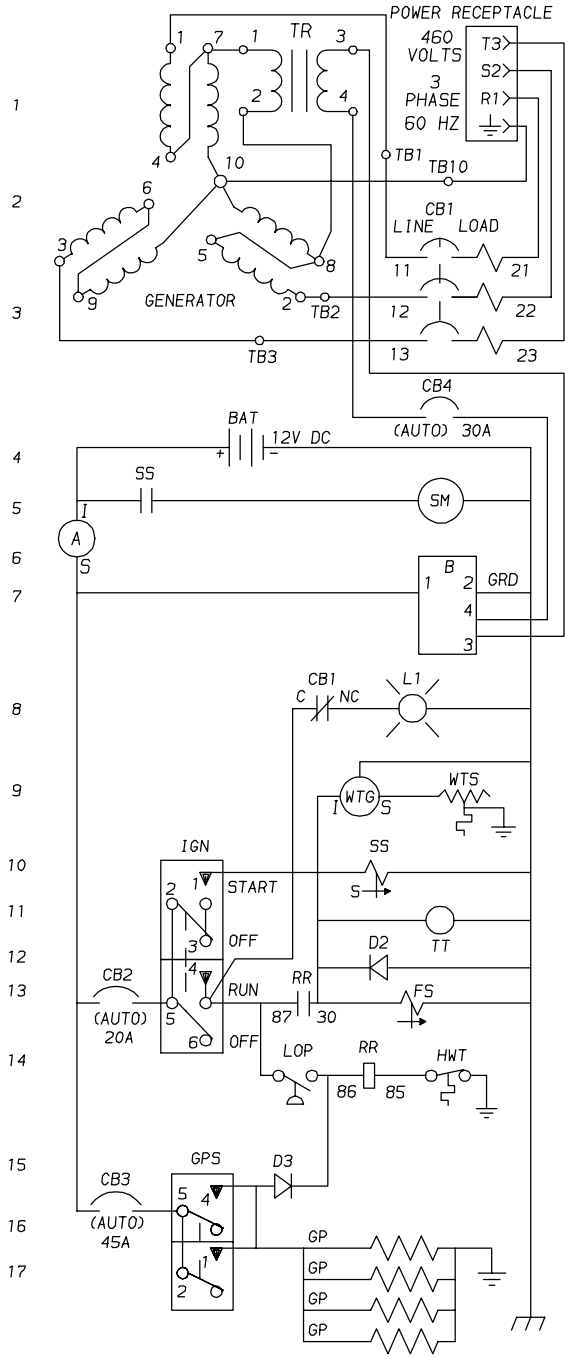
High voltage (dielectric) testing must not be performed to the machine without first observing NEMA rules. The insulation of this generator winding may be safely checked by using a megger. A high megger reading indicates low insulation leakage.

CAUTION

The generator set circuit breaker must be in the ON position in order to supply power to the refrigeration unit.

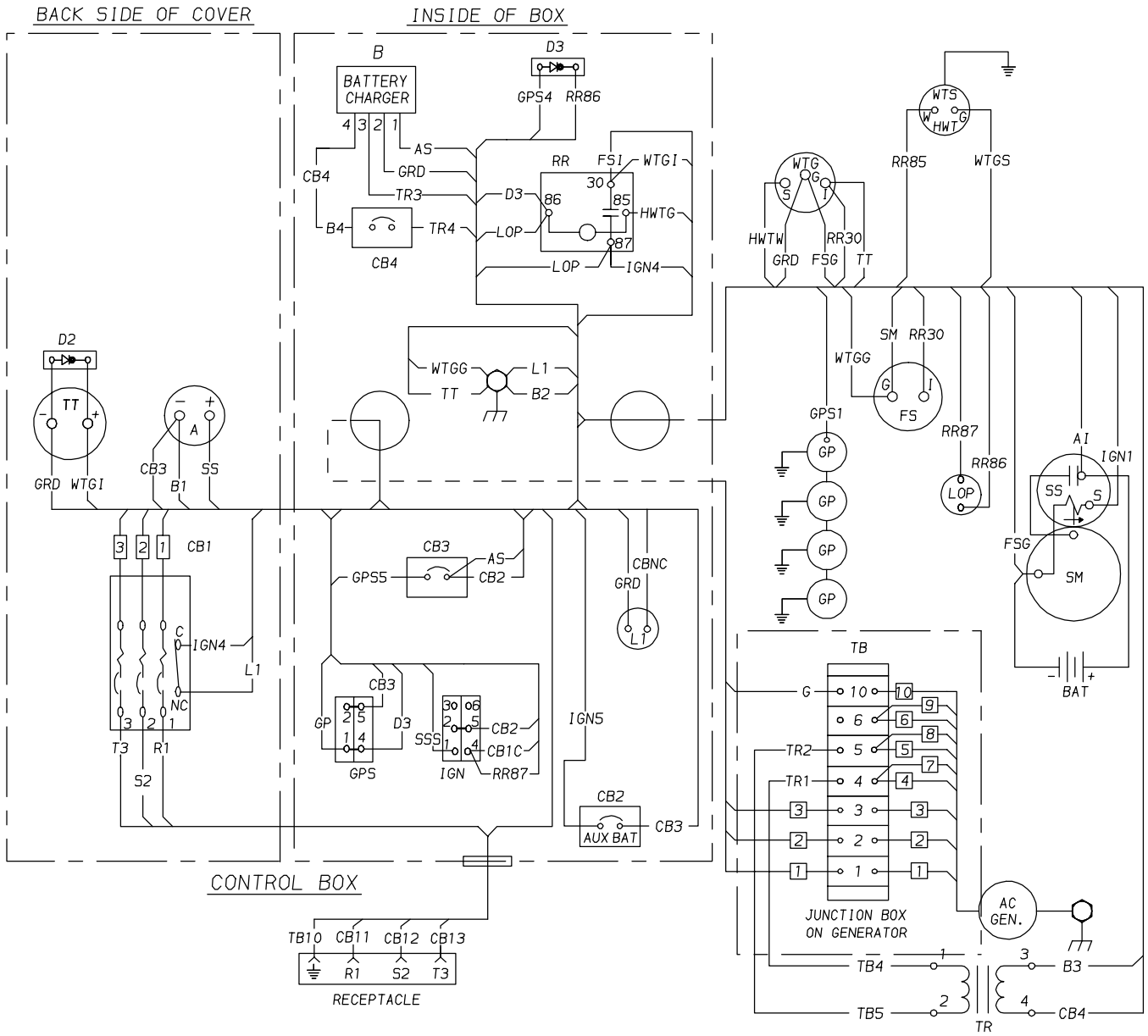
CAUTION

Observe proper polarity when installing the battery, the negative battery terminal must be grounded. Reverse polarity will destroy the rectifier diodes in the generator sets solid state battery charging system if a battery charger is connected in reverse. As a precautionary measure isolate the battery from the unit as follows: disconnect negative battery terminal first, then the positive battery terminal when charging battery in unit. Once the battery has been fully charged, connect the positive battery terminal first, then the negative battery terminal. NEVER jump start the battery when its mounted in the unit, this will destroy the components of the generator sets battery charger.



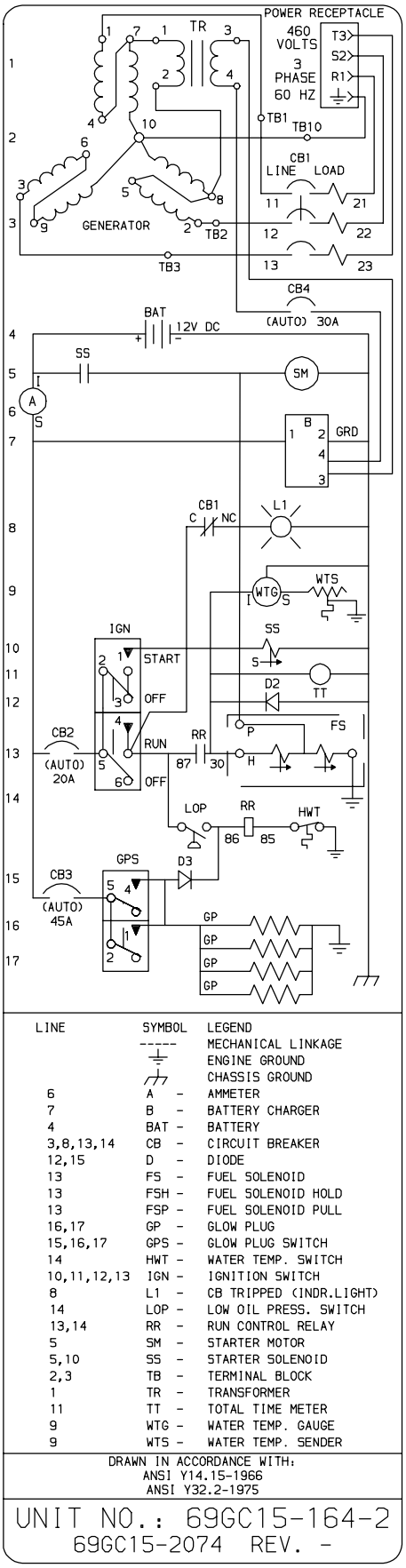
LINE	SYMBOL	DESCRIPTION	LINE	SYMBOL	DESCRIPTION
		MECHANICAL LINKAGE	10,11,12,13	IGN	IGNITION SWITCH
		ENGINE GROUND	8	L1	CB TRIPPED (INDR. LIGHT)
		CHASSIS GROUND	14	LOP	LOW OIL PRESSURE
6	A	AMMETER	13,14	RR	RUN CONTROL RELAY
7	B	BATTERY CHARGER	5	SM	STARTER MOTOR
4	BAT	BATTERY	5,10	SS	STARTER SOLENOID
3,8,13,14	CB	CIRCUIT BREAKER	2,3	TB	TERMINAL BLOCK
12,15	D	DIODE	1	TR	TRANSFORMER
13	FS	FUEL SOLENOID	11	TT	TOTAL TIME METER
16,17	GP	GLOW PLUG	9	WTG	WATER TEMP. GAUGE
15,16,17	GPS	GLOW PLUG SWITCH	9	WTS	WATER TEMP. SENDER
14	HWT	WATER TEMP. SWITCH			

Figure 5-1. Electrical Wiring Schematic & Diagram – Models 69GC15-164 & 69GC15-164-1
Drawing Numbers 69GC15-1824-RA & 69GC15-1954-R-
(Sheet 1 of 2)



1 thru 10 are wires from A-C generator

Figure 5-1. Electrical Wiring Schematic & Diagram – Models 69GC15-164 & 69GC15-164-1
Drawing Number 69GC15-1814-RB
(Sheet 2 of 2)



LINE	SYMBOL	LEGEND
	-----	MECHANICAL LINKAGE
	⏚	ENGINE GROUND
	⏚	CHASSIS GROUND
6	A -	AMMETER
7	B -	BATTERY CHARGER
4	BAT -	BATTERY
3,8,13,14	CB -	CIRCUIT BREAKER
12,15	D -	DIODE
13	FS -	FUEL SOLENOID
13	FSH -	FUEL SOLENOID HOLD
13	FSP -	FUEL SOLENOID PULL
16,17	GP -	GLOW PLUG
15,16,17	GPS -	GLOW PLUG SWITCH
14	HWT -	WATER TEMP. SWITCH
10,11,12,13	IGN -	IGNITION SWITCH
8	L1 -	CB TRIPPED (INDR.LIGHT)
14	LOP -	LOW OIL PRESS. SWITCH
13,14	RR -	RUN CONTROL RELAY
5	SM -	STARTER MOTOR
5,10	SS -	STARTER SOLENOID
2,3	TB -	TERMINAL BLOCK
1	TR -	TRANSFORMER
11	TT -	TOTAL TIME METER
9	WTG -	WATER TEMP. GAUGE
9	WTS -	WATER TEMP. SENDER

DRAWN IN ACCORDANCE WITH:
ANSI Y14.15-1966
ANSI Y32.2-1975

UNIT NO.: 69GC15-164-2
69GC15-2074 REV. -

Figure 5-2. Electrical Wiring Schematic & Diagram – Model 69GC15-164-2 (Sheet 1 of 2)

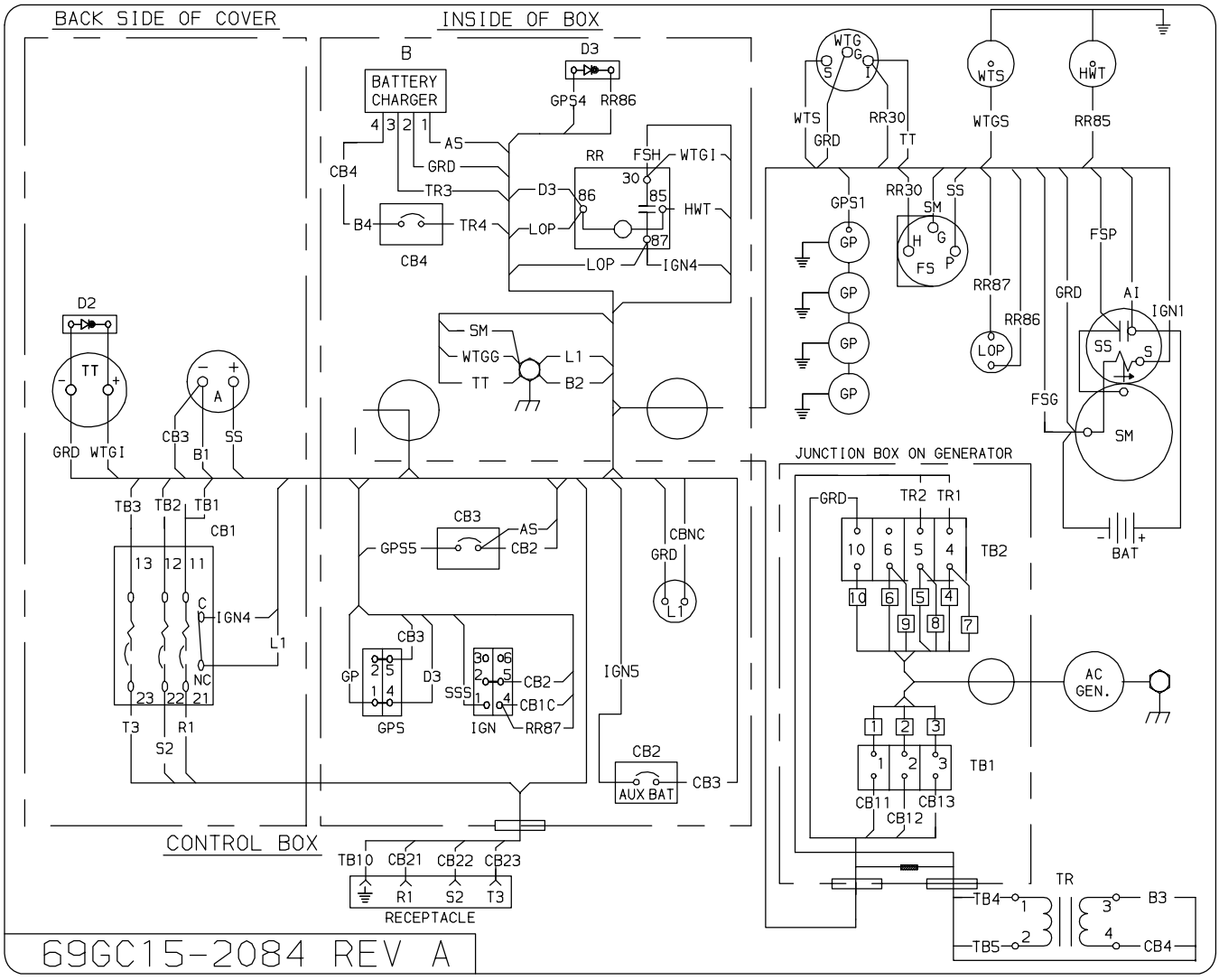
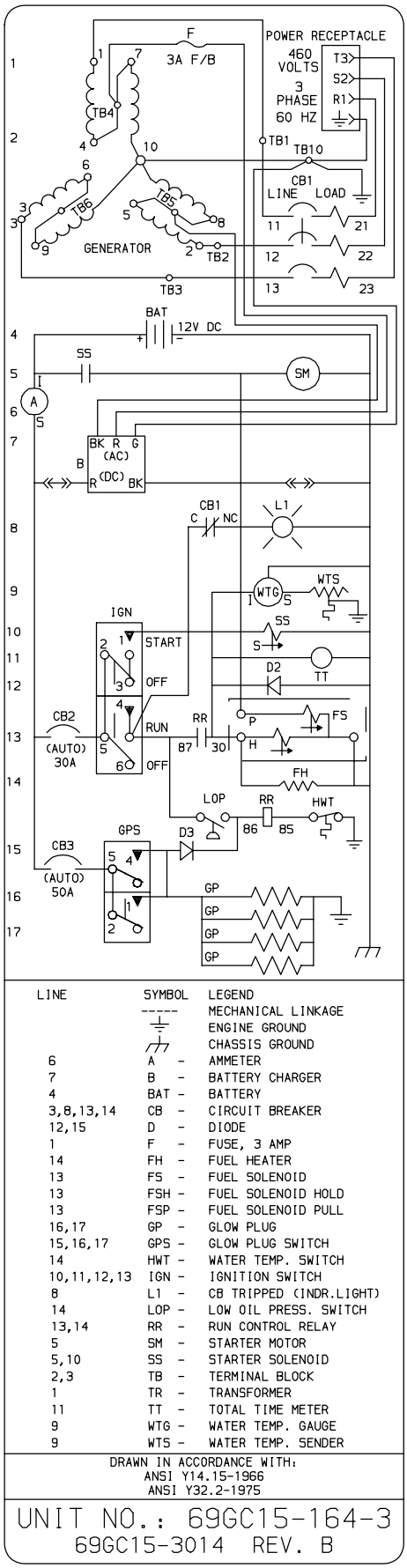


Figure 5-2. Electrical Wiring Schematic & Diagram – Model 69GC15-164-2 (Sheet 2 of 2)



LINE	SYMBOL	LEGEND
	-----	MECHANICAL LINKAGE
	⏚	ENGINE GROUND
	⏚	CHASSIS GROUND
6	A -	AMMETER
7	B -	BATTERY CHARGER
4	BAT -	BATTERY
3,8,13,14	CB -	CIRCUIT BREAKER
12,15	D -	DIODE
1	F -	FUSE, 3 AMP
14	FH -	FUEL HEATER
13	FS -	FUEL SOLENOID
13	FSH -	FUEL SOLENOID HOLD
13	FSP -	FUEL SOLENOID PULL
16,17	GP -	GLOW PLUG
15,16,17	GPS -	GLOW PLUG SWITCH
14	HWT -	WATER TEMP. SWITCH
10,11,12,13	IGN -	IGNITION SWITCH
8	L1 -	CB TRIPPED (INDR.LIGHT)
14	LOP -	LOW OIL PRESS. SWITCH
13,14	RR -	RUN CONTROL RELAY
5	SM -	STARTER MOTOR
5,10	SS -	STARTER SOLENOID
2,3	TB -	TERMINAL BLOCK
1	TR -	TRANSFORMER
11	TT -	TOTAL TIME METER
9	WTG -	WATER TEMP. GAUGE
9	WTS -	WATER TEMP. SENDER

DRAWN IN ACCORDANCE WITH:
ANSI Y14.15-1966
ANSI Y32.2-1975

UNIT NO.: 69GC15-164-3
69GC15-3014 REV. B

Figure 5-3. Electrical Wiring Schematic & Diagram – Model 69GC15-164-3 (Sheet 1 of 2)

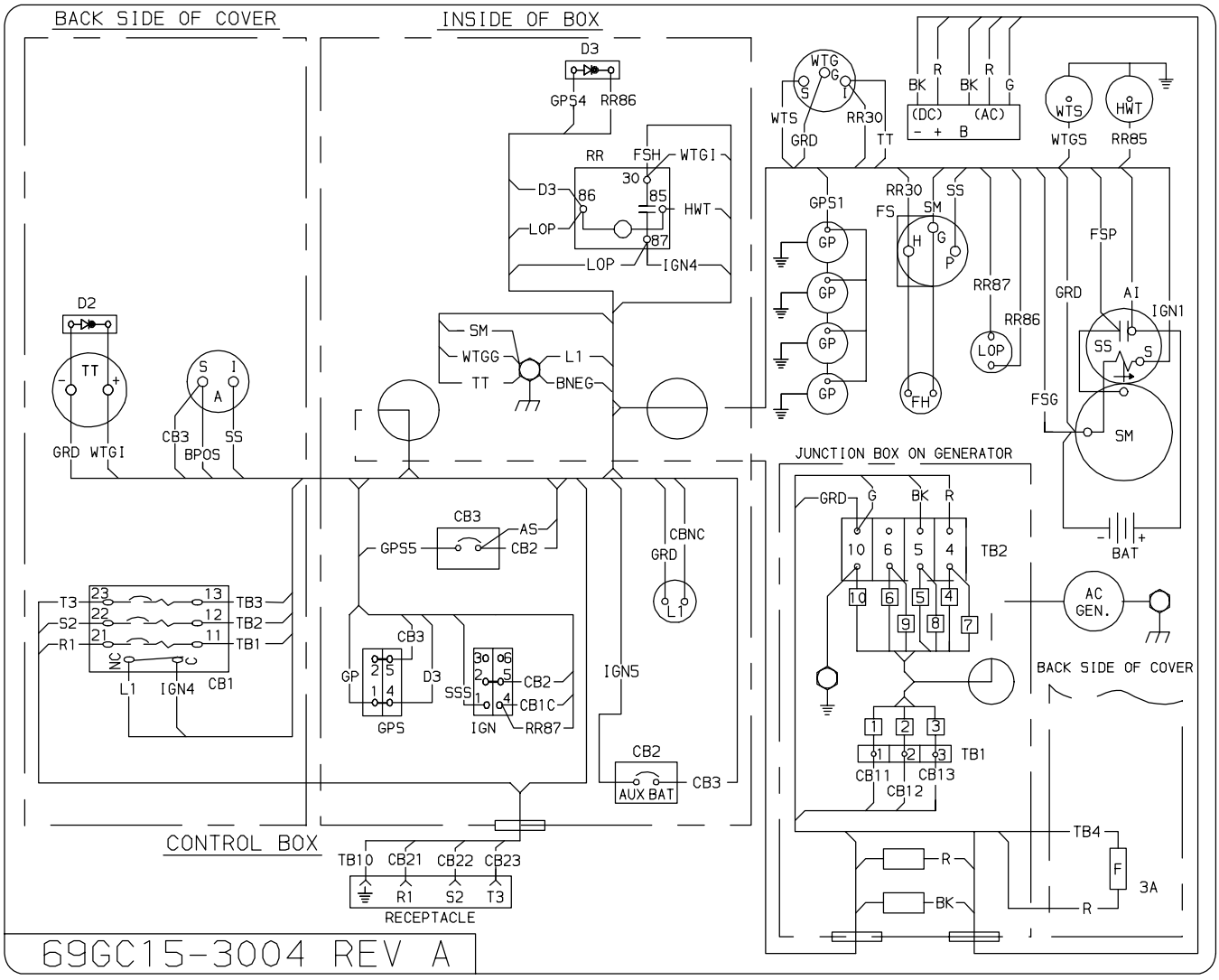
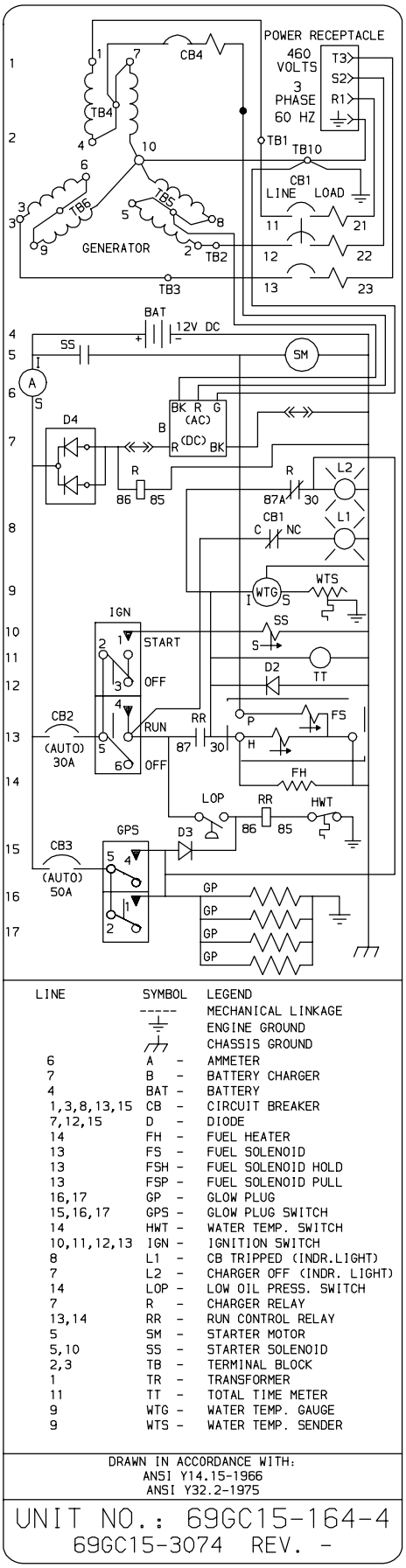


Figure 5-3. Electrical Wiring Schematic & Diagram – Model 69GC15-164-3 (Sheet 2 of 2)



LINE	SYMBOL	LEGEND
	-----	MECHANICAL LINKAGE
	⏚	ENGINE GROUND
	⏚	CHASSIS GROUND
6	A -	AMMETER
7	B -	BATTERY CHARGER
4	BAT -	BATTERY
1,3,8,13,15	CB -	CIRCUIT BREAKER
7,12,15	D -	DIODE
14	FH -	FUEL HEATER
13	FS -	FUEL SOLENOID
13	FSH -	FUEL SOLENOID HOLD
13	FSP -	FUEL SOLENOID PULL
16,17	GP -	GLOW PLUG
15,16,17	GPS -	GLOW PLUG SWITCH
14	HWT -	WATER TEMP. SWITCH
10,11,12,13	IGN -	IGNITION SWITCH
8	L1 -	CB TRIPPED (INDR.LIGHT)
7	L2 -	CHARGER OFF (INDR. LIGHT)
14	LOP -	LOW OIL PRESS. SWITCH
7	R -	CHARGER RELAY
13,14	RR -	RUN CONTROL RELAY
5	SM -	STARTER MOTOR
5,10	SS -	STARTER SOLENOID
2,3	TB -	TERMINAL BLOCK
1	TR -	TRANSFORMER
11	TT -	TOTAL TIME METER
9	WTG -	WATER TEMP. GAUGE
9	WTS -	WATER TEMP. SENDER

DRAWN IN ACCORDANCE WITH:
ANSI Y14.15-1966
ANSI Y32.2-1975

UNIT NO.: 69GC15-164-4
69GC15-3074 REV. -

Figure 5-4. Electrical Wiring Schematic & Diagram – Model 69GC15-164-4 (Sheet 1 of 2)

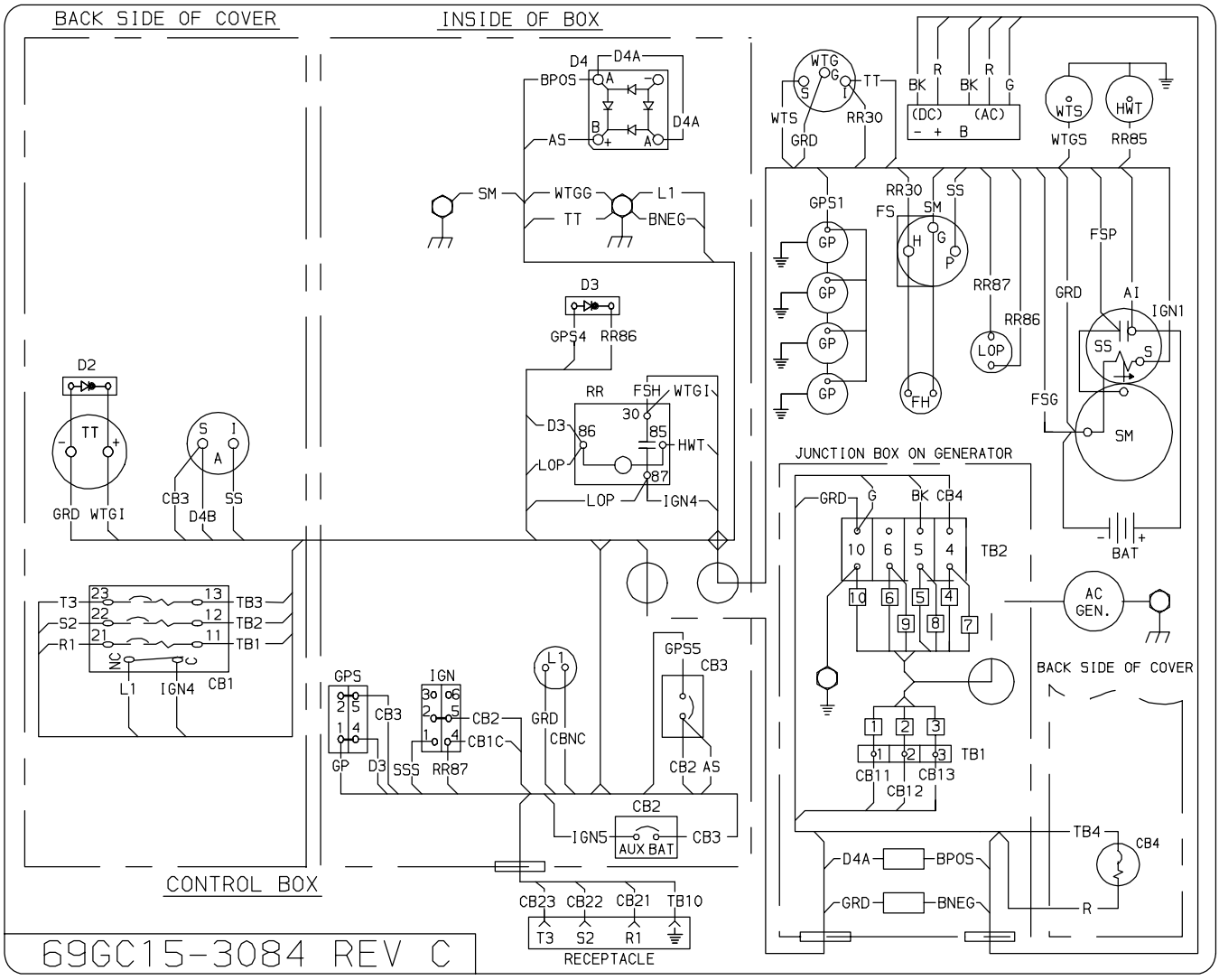


Figure 5-4. Electrical Wiring Schematic & Diagram – Model 69GC15-164-4 (Sheet 2 of 2)