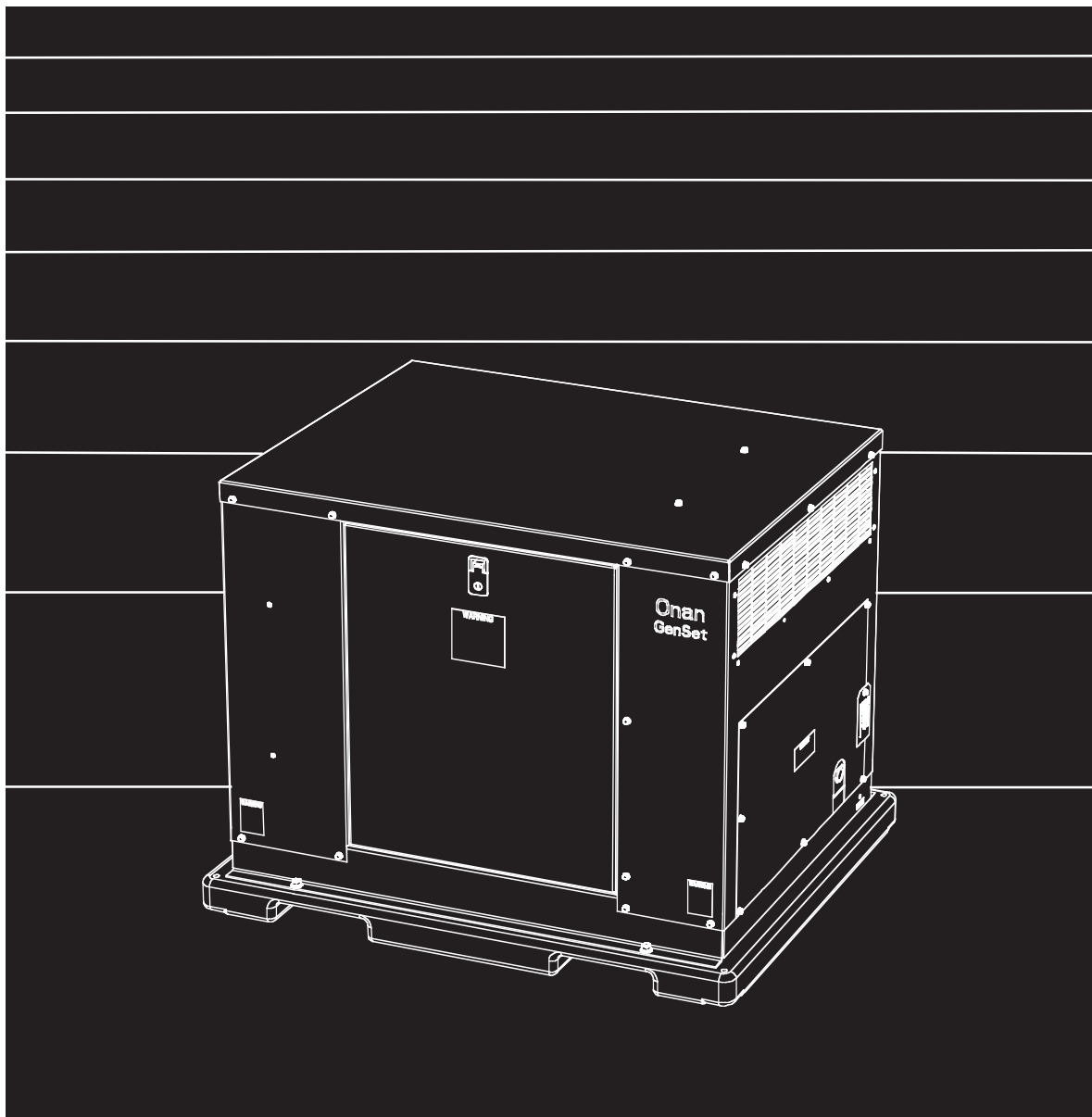


Caution: This document contains mixed page sizes (8.5 x 11 or 11 x 17), which may affect printing. Please adjust your printer settings according to the size of each page you wish to print.

Onan Service Manual

GRCA



Printed in U. S. A.

184-0177
July, 2004



WARNING:



The engine exhaust from this product contains chemicals known to the State of California to cause cancer, birth defects or other reproductive harm.

Supplement 965–1081

Date: 12-2004

Insert with-

Titles: GRCA Installation Manual
GRCA Service Manual

Numbers: 184–0169, dated May, 2004
184–0177, dated July, 2004

This supplement updates the GRCA Installation Manual and GRCA Service Manual to include information on the RSZ transfer switch time delay relay.

TIME DELAY RELAY

Beginning in April of 2004, GRCA generator sets include a transfer switch time delay relay.

This relay eliminated a loss of start signal that sometimes occurred on earlier models during transfer from normal to emergency power. Without this relay, the genset may not start as commanded during a loss of power or when testing the transfer switch.

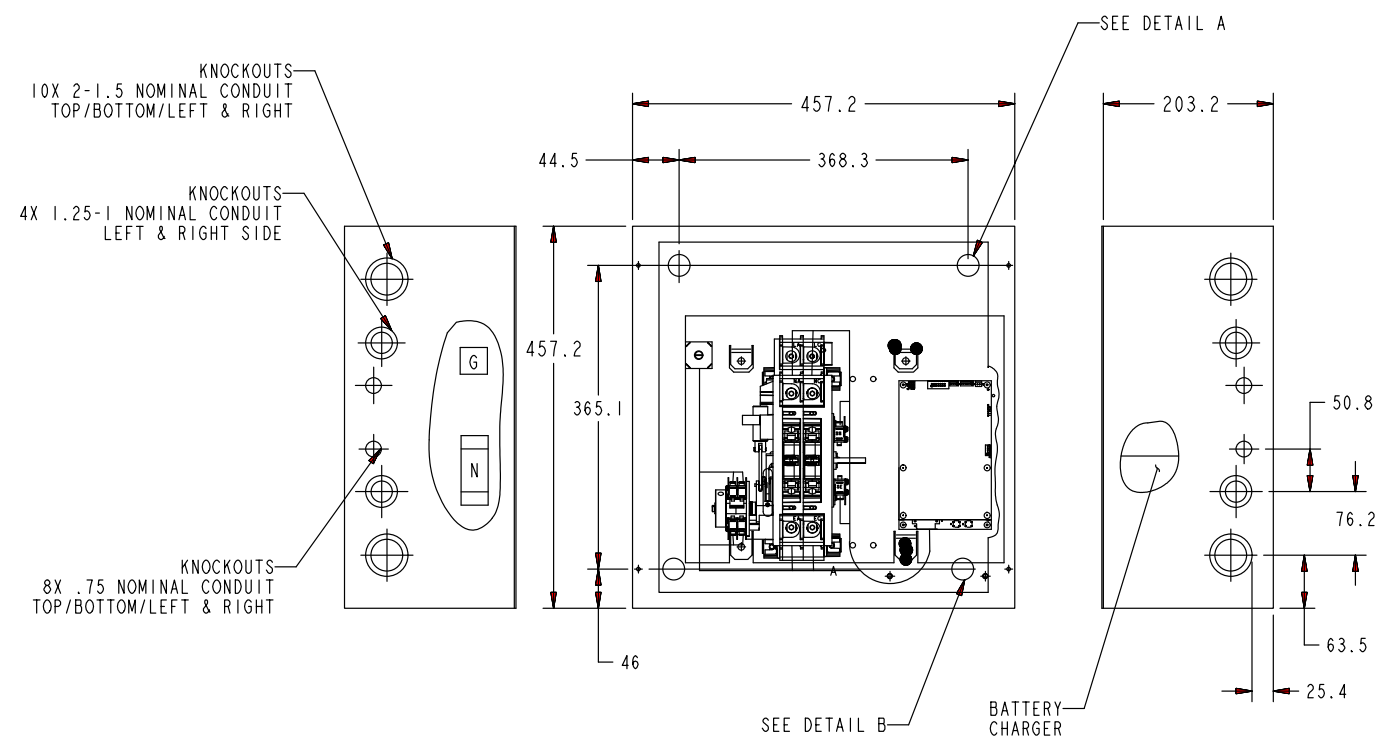
If your genset does not include this relay, kit 307–3040 can be purchased separately.

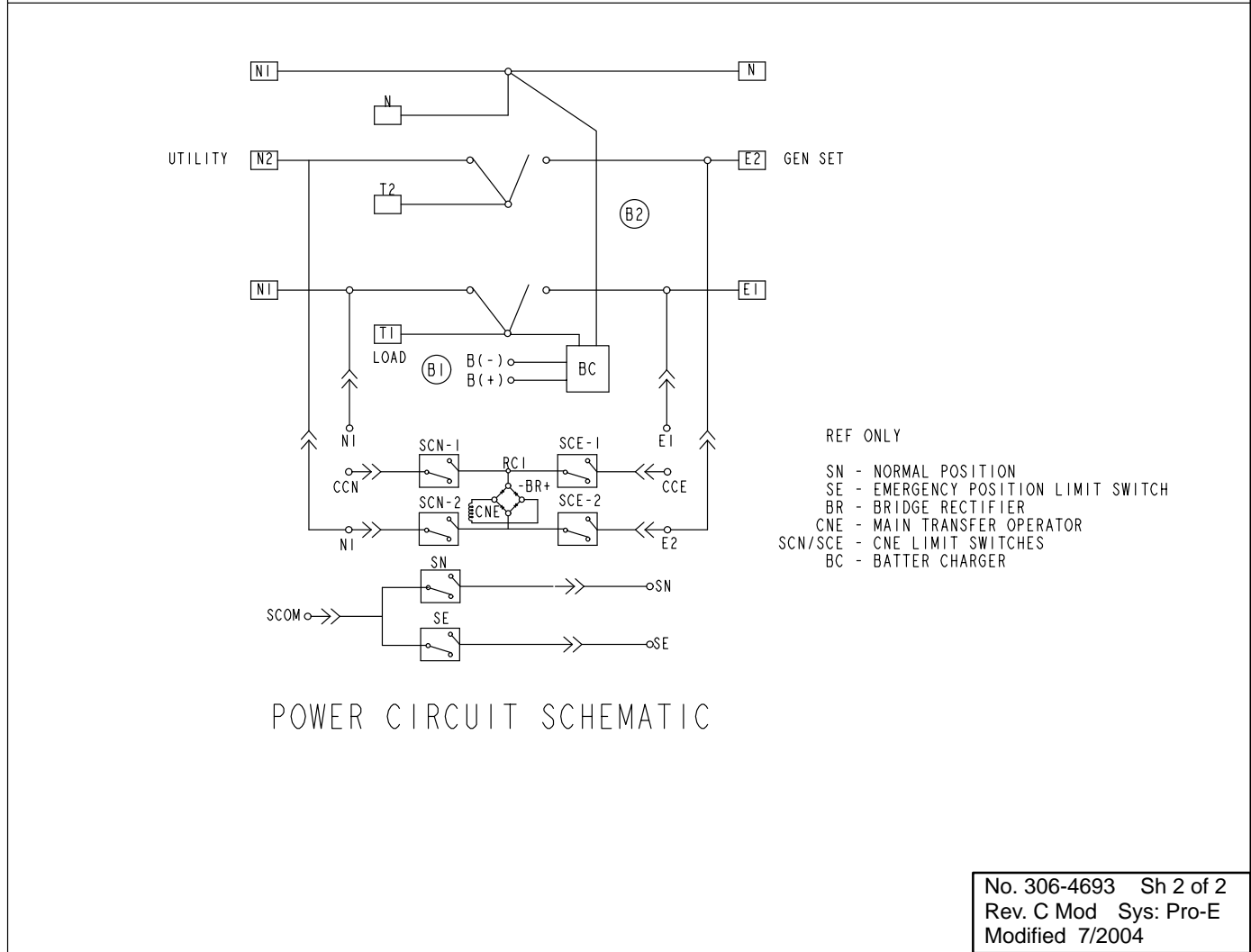
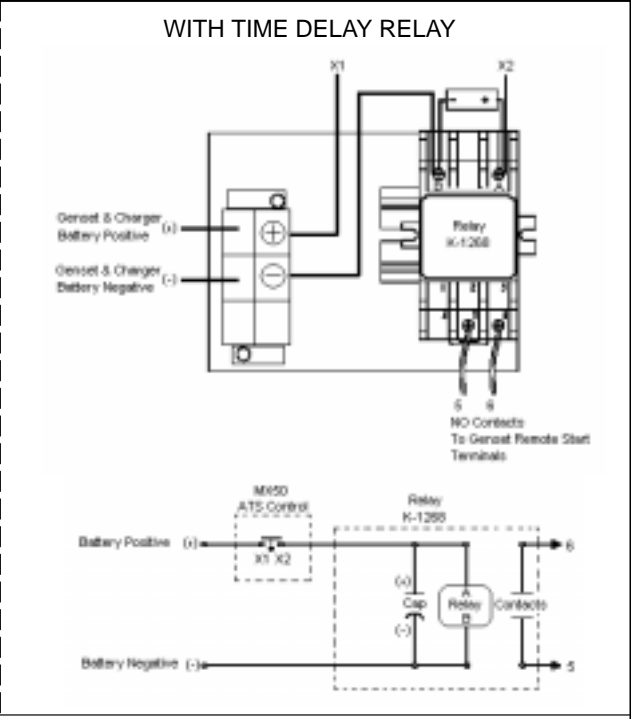
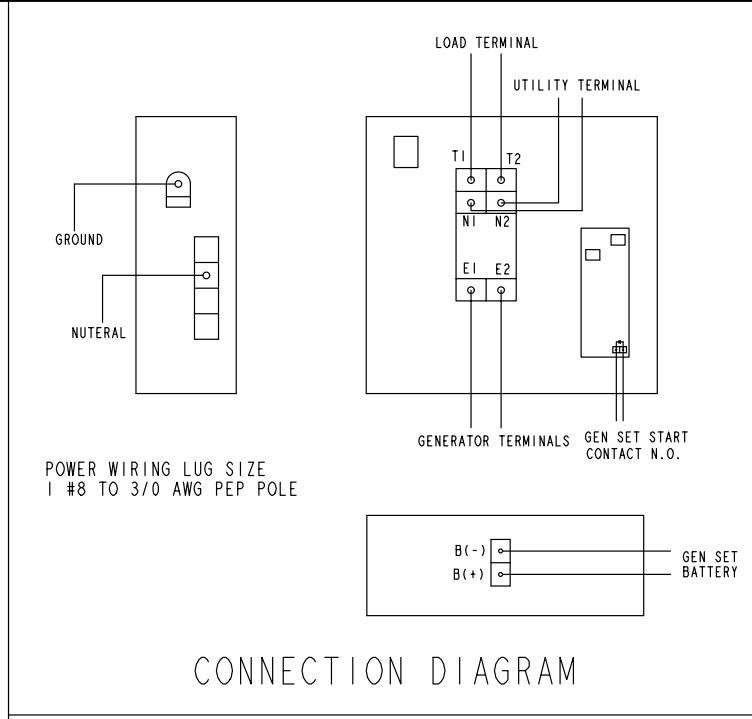
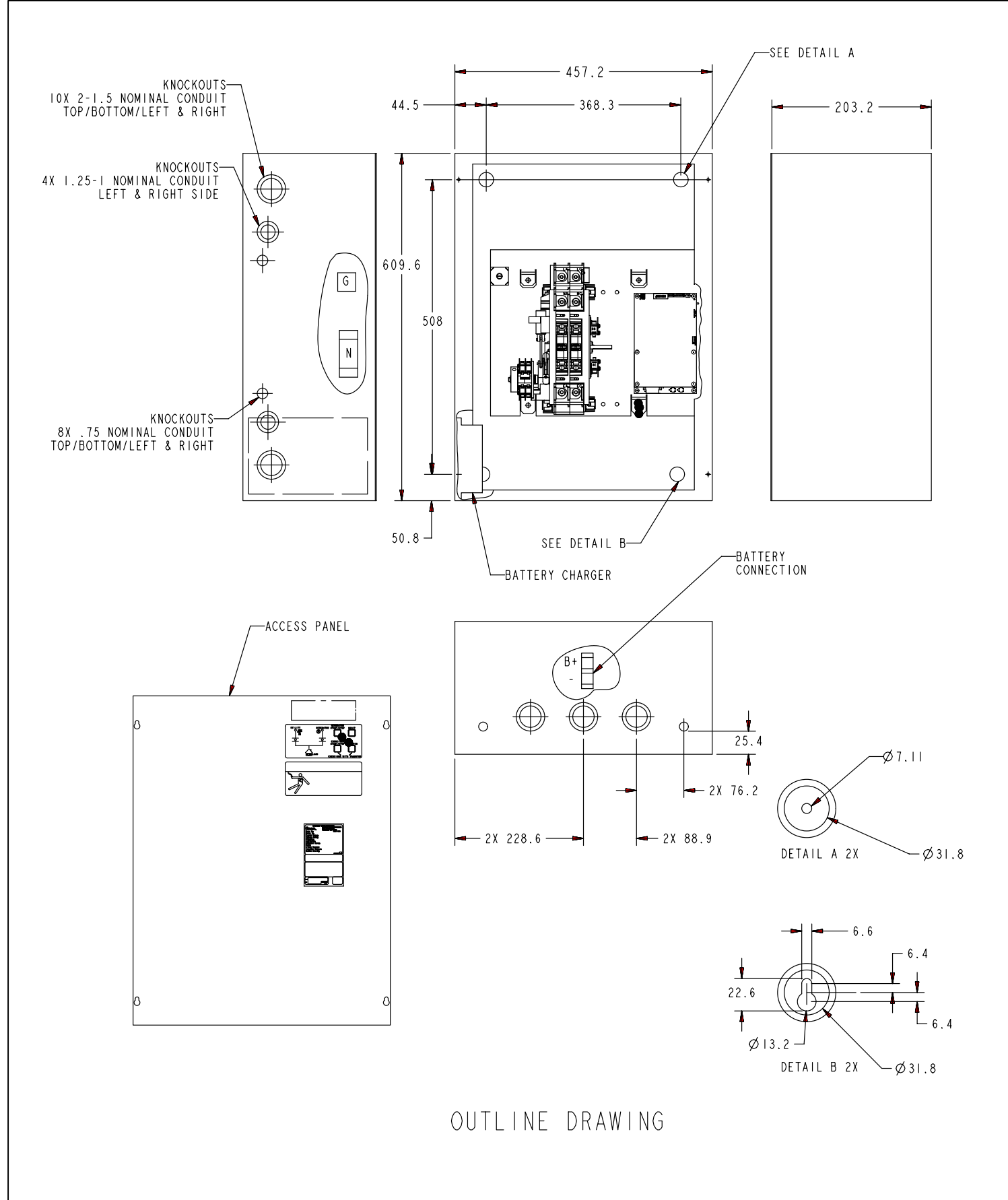
NOTE: The wiring diagram provided with the transfer switch shows connections of this relay to a genset, incorrectly indicating that terminals 1 and 5 are normally open contacts. As shown in the illustrations, the normally open contacts are terminals 5 and 6.

CHANGES TO MANUALS

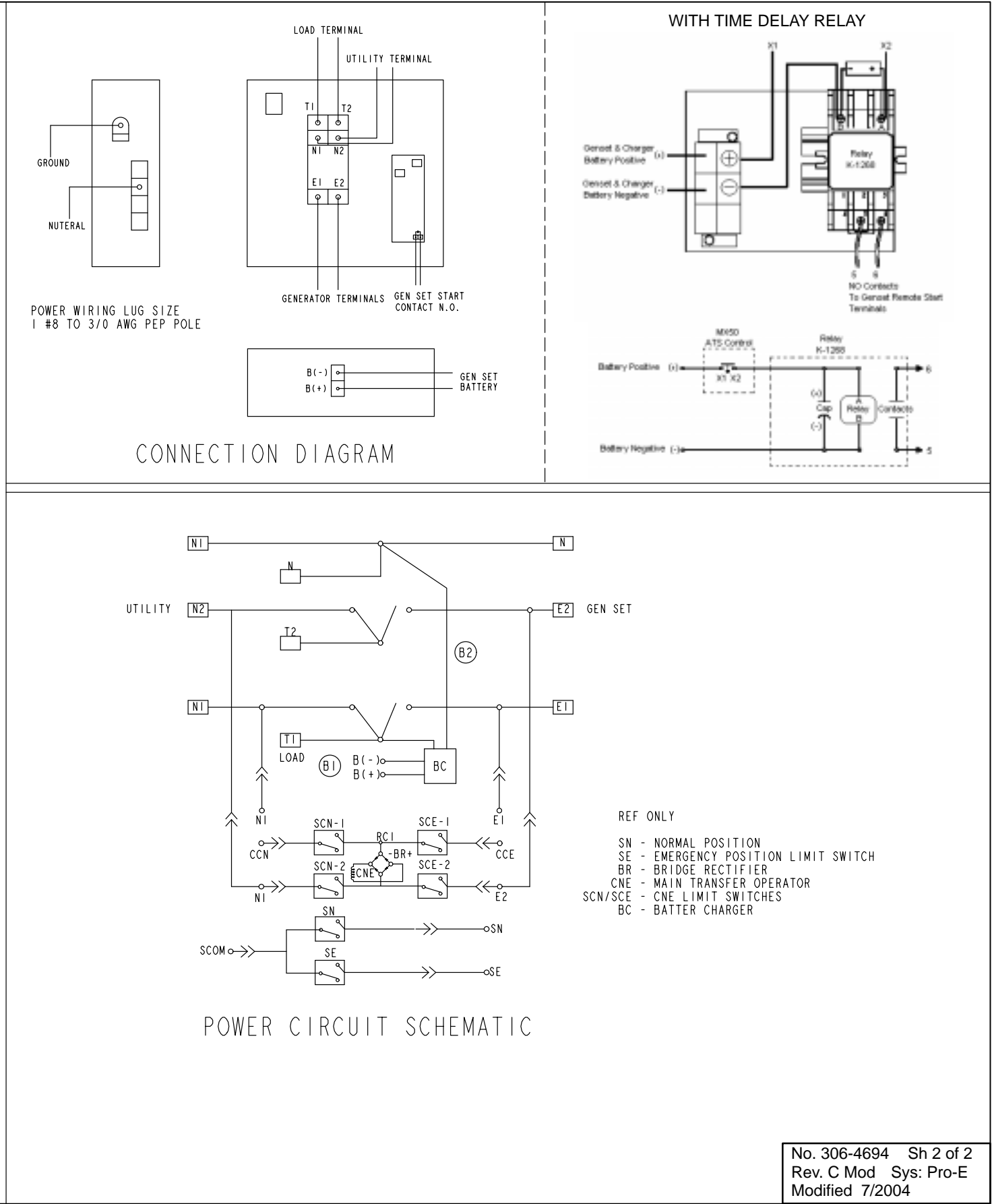
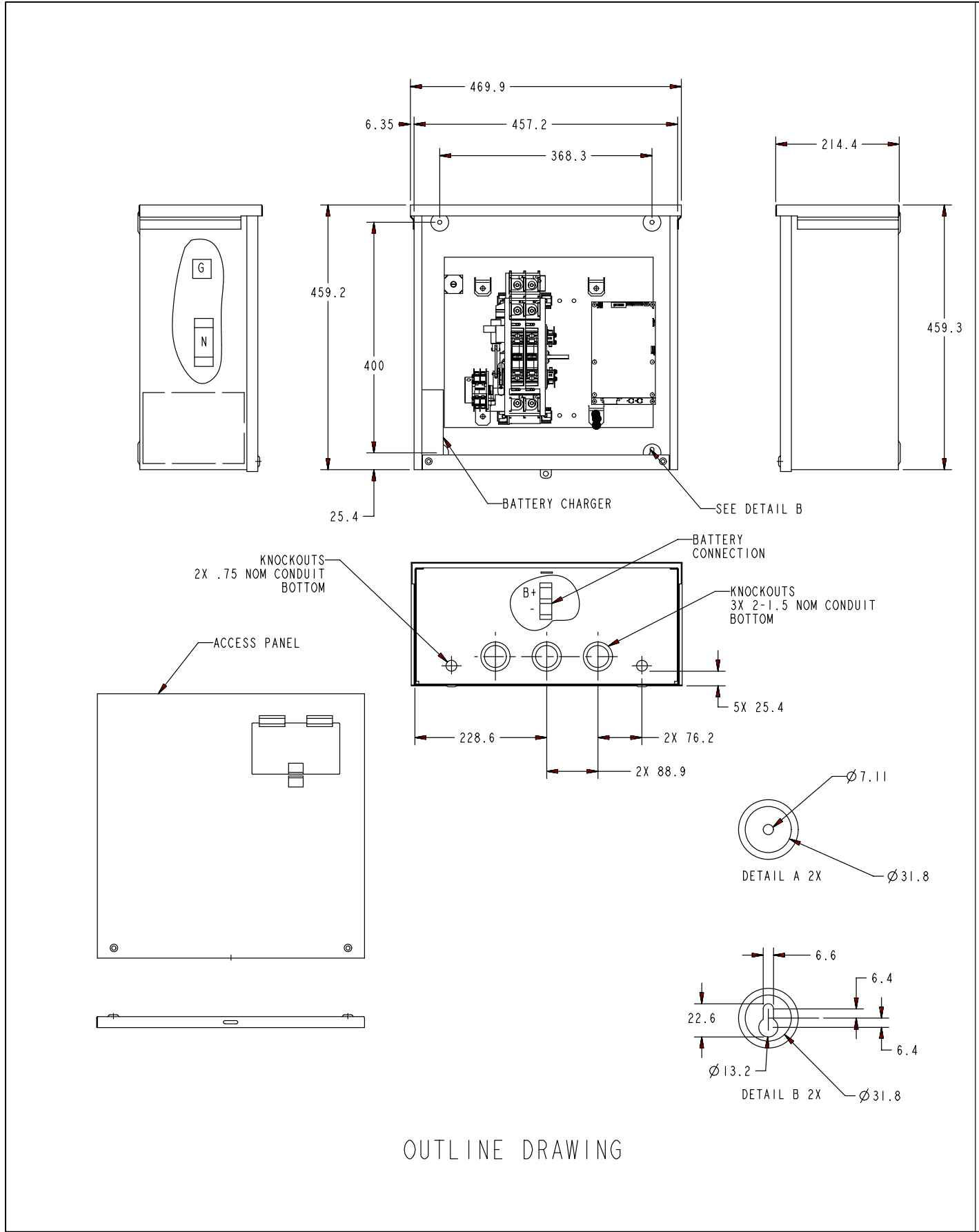
GRCA Installation Manual (184–0169) – Replace Figures 7-3, 7-4, 7-5, and 7-6 with the attached pages.

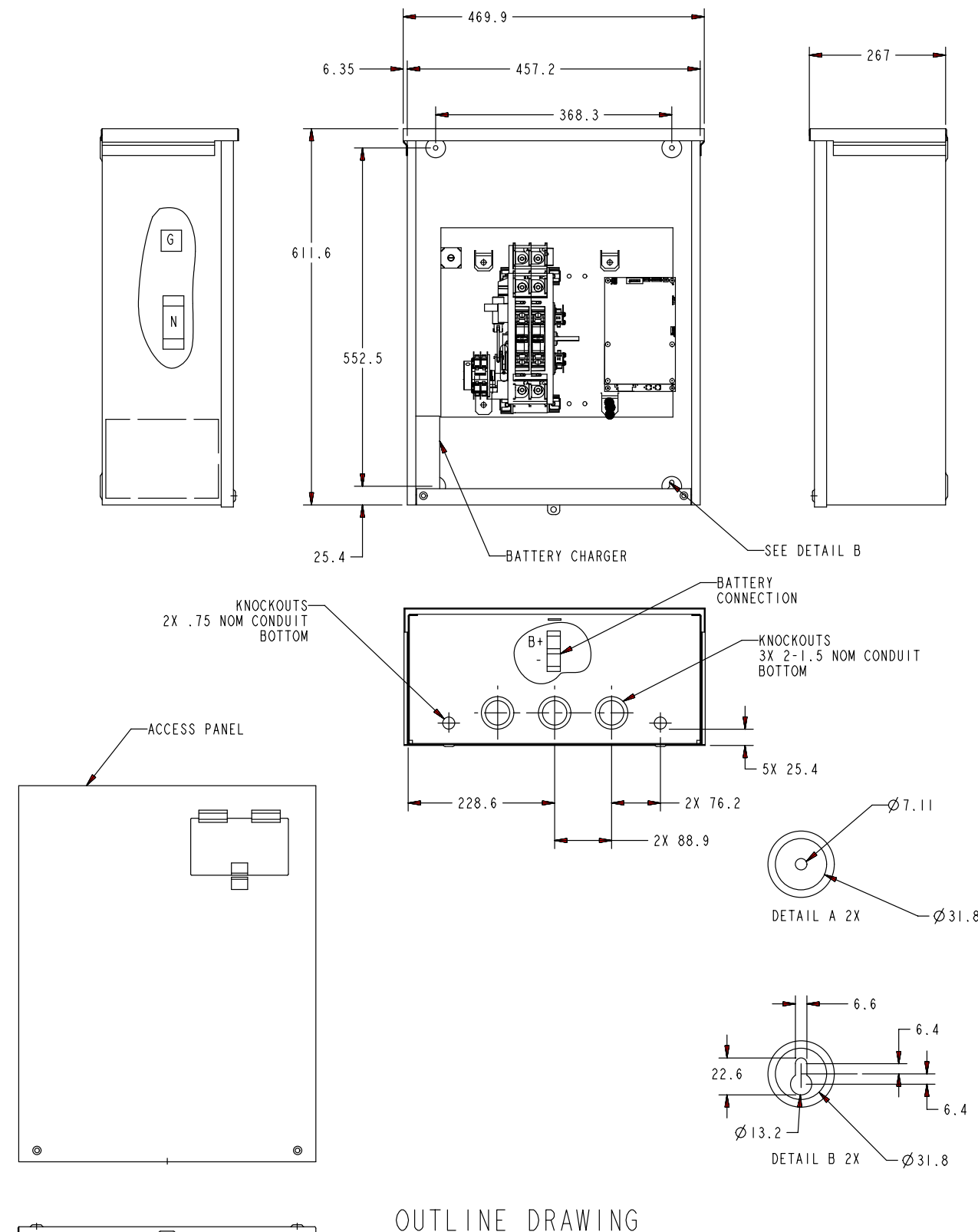
GRCA Service Manual (184–0177) – Replace page 11-2 with the attached page.



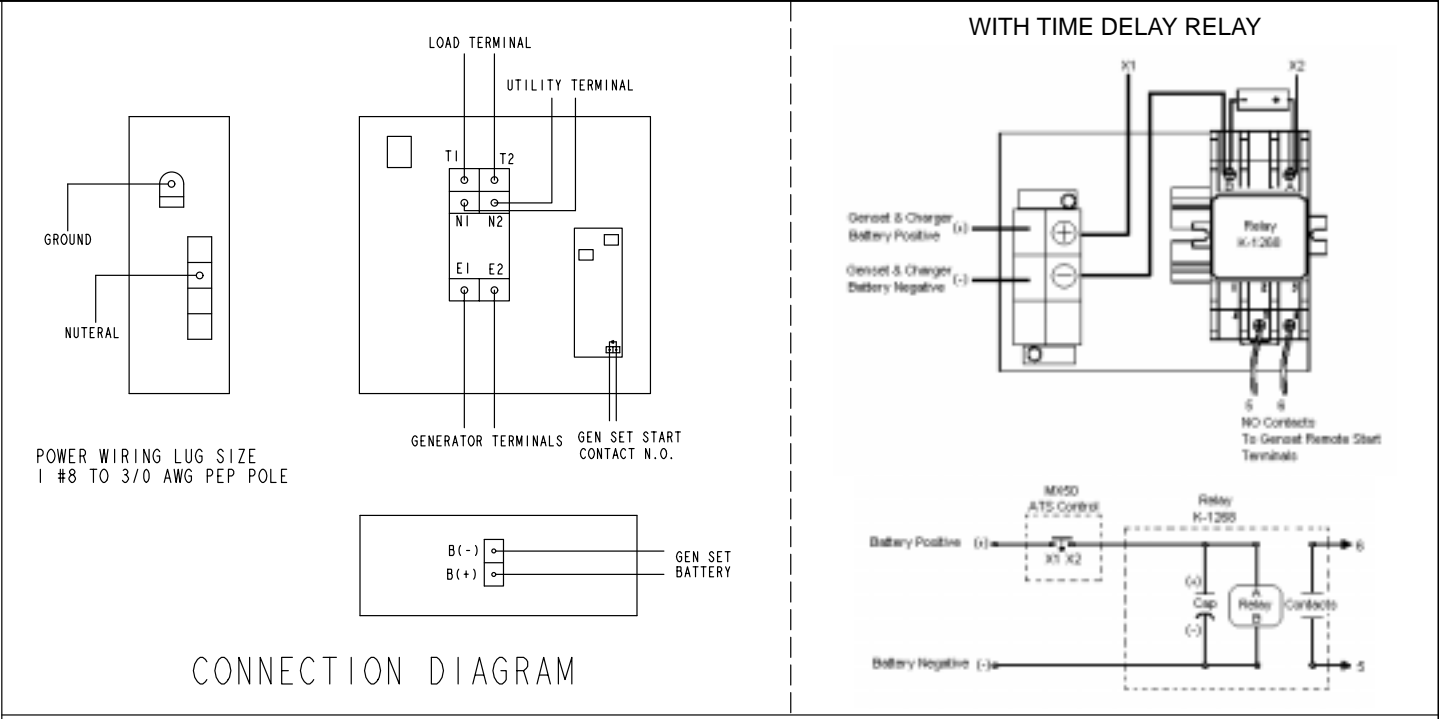


No. 306-4693 Sh 2 of 2
Rev. C Mod Sys: Pro-E
Modified 7/2004

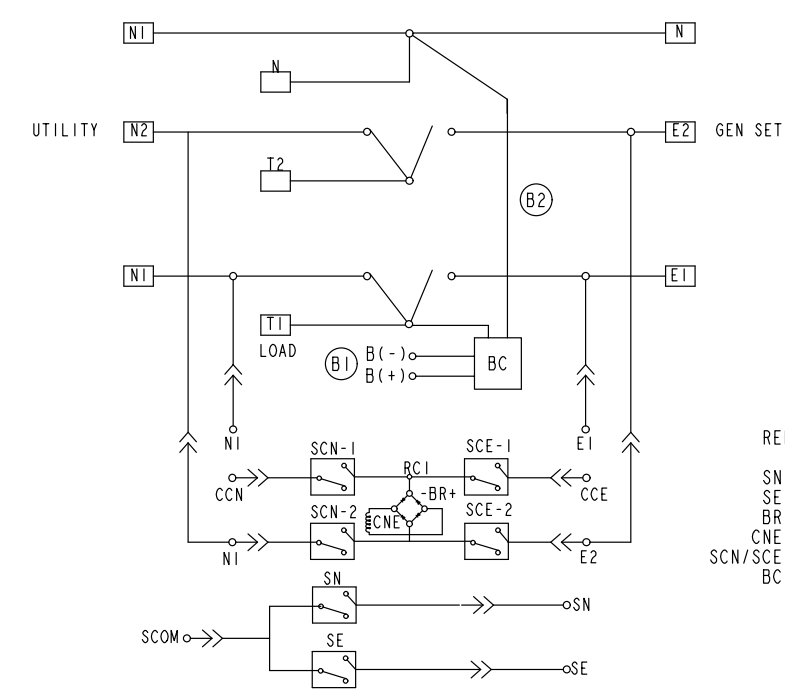




OUTLINE DRAWING



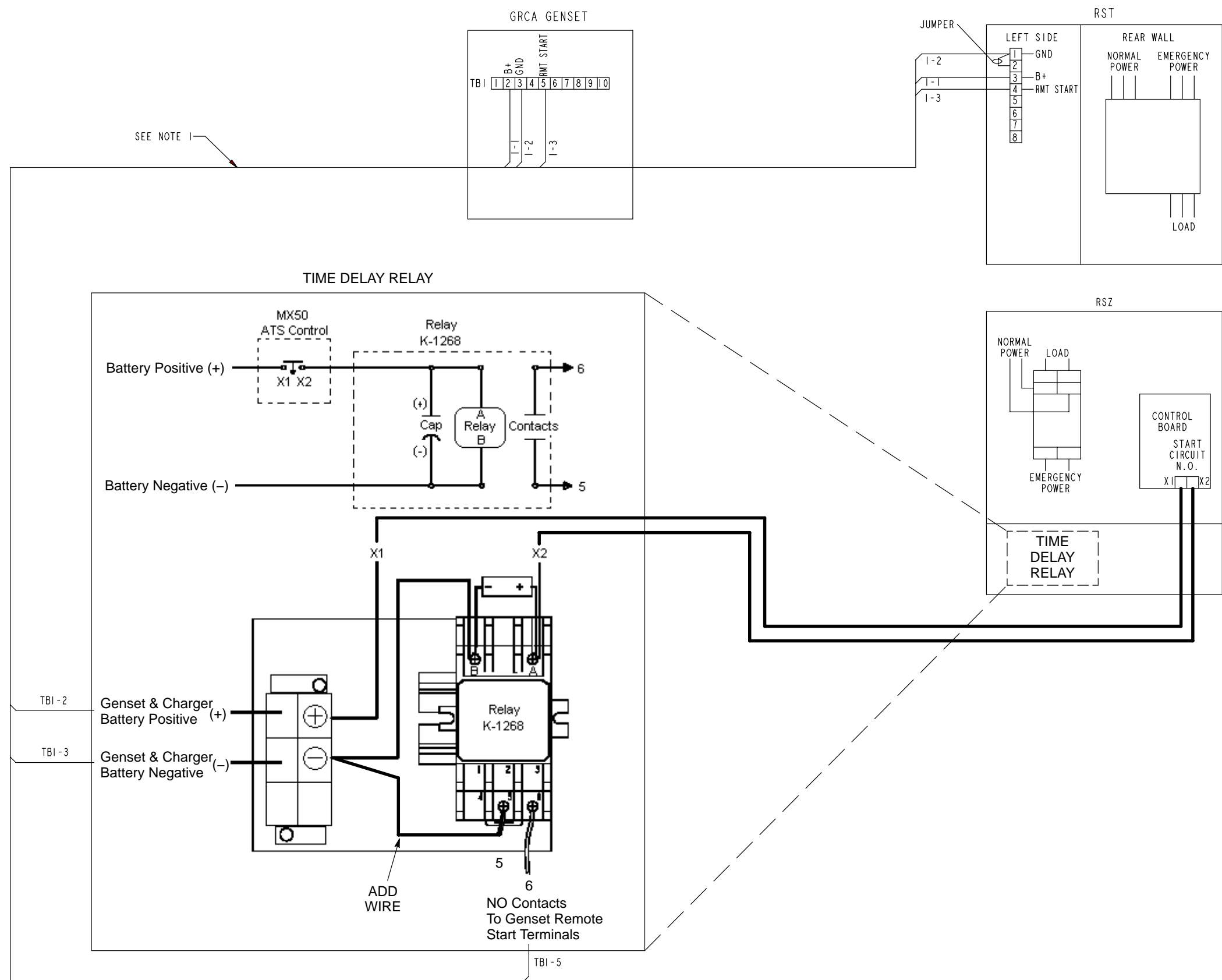
CONNECTION DIAGRAM



- REF ONLY
- SN - NORMAL POSITION
 - SE - EMERGENCY POSITION LIMIT SWITCH
 - BR - BRIDGE RECTIFIER
 - CNE - MAIN TRANSFER OPERATOR
 - SCN/SCE - CNE LIMIT SWITCHES
 - BC - BATTER CHARGER

POWER CIRCUIT SCHEMATIC

No. 306-4695 Sh 2 of 2
Rev. C Mod Sys: Pro-E
Modified 7/2004



NOTE:
1. SIZE WIRES AS FOLLOWS:

WIRE SIZE (AWG)	DISTANCE IN FEET (ONE WAY)
16	125
14	200
12	300
10	500

2. NORMAL/EMERGENCY LEADS ARE SIZED FOR LOAD AND LENGTH.

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Safety Precautions

Thoroughly read the OPERATOR'S MANUAL before operating the genset. Safe operation and top performance can be obtained only when equipment is operated and maintained properly.

The following symbols in this manual alert you to potential hazards to the operator, service person and equipment.

▲ DANGER alerts you to an immediate hazard which will result in severe personal injury or death.

▲ WARNING alerts you to a hazard or unsafe practice which can result in severe personal injury or death.

▲ CAUTION alerts you to a hazard or unsafe practice which can result in personal injury or equipment damage.

Electricity, fuel, exhaust, batteries and moving parts present hazards which can result in severe personal injury or death.

GENERAL PRECAUTIONS

- Keep ABC fire extinguishers handy.
- Make sure all fasteners are secure and torqued properly.
- Keep the genset and its compartment clean. Excess oil and oily rags can catch fire. Dirt and gear stowed in the compartment can restrict cooling air.
- Before working on the genset, disconnect the negative (–) battery cable at the battery to prevent starting.
- Use caution when making adjustments while the genset is running—hot, moving or electrically live parts can cause severe personal injury or death.
- Used engine oil has been identified by some state and federal agencies as causing cancer

or reproductive toxicity. Do not ingest, inhale, or contact used oil or its vapors.

- Do not work on the genset when mentally or physically fatigued or after consuming alcohol or drugs.
- Carefully follow all applicable local, state and federal codes.

GENERATOR VOLTAGE IS DEADLY!

- Generator output connections must be made by a qualified electrician in accordance with applicable codes.
- The genset must not be connected to the public utility or any other source of electrical power. Connection could lead to electrocution of utility workers and damage to equipment. An approved switching device must be used to prevent interconnections.
- Use caution when working on live electrical equipment. Remove jewelry, make sure clothing and shoes are dry and stand on a dry wooden platform.

FUEL IS FLAMMABLE AND EXPLOSIVE

- Keep flames, cigarettes, sparks, pilot lights, electrical arc-producing equipment and switches and all other sources of ignition well away from areas where fuel fumes are present and areas sharing ventilation.
- Fuel lines must be secured, free of leaks and separated or shielded from electrical wiring.
- Leaks can lead to explosive accumulations of gas. Natural gas rises when released and can accumulate under hoods and inside housings and buildings. LPG sinks when released and can accumulate inside housings and basements and other below-grade spaces. Prevent leaks and the accumulation of gas.

ENGINE EXHAUST IS DEADLY!

- Learn the symptoms of carbon monoxide poisoning in this manual.
- The exhaust system must be installed in accordance with the genset Installation Manual.
- Do not use engine cooling air to heat a room or compartment.
- Make sure there is ample fresh air when operating the genset in a confined area.

BATTERY GAS IS EXPLOSIVE

- Wear safety glasses and do not smoke while servicing batteries.

- When disconnecting the battery cables, always check for a battery charger and disconnect it first then disconnect the negative (–) battery cable.
- When reconnecting battery cables, always reconnect the negative (–) battery cable after the positive (+) cable, then reconnect the battery charger to reduce arcing.

MOVING PARTS CAN CAUSE SEVERE PERSONAL INJURY OR DEATH

- Do not wear loose clothing or jewelry near moving parts such as fans.
- Keep hands away from moving parts.
- Keep guards in place over fans.

1. Introduction

ABOUT THIS MANUAL

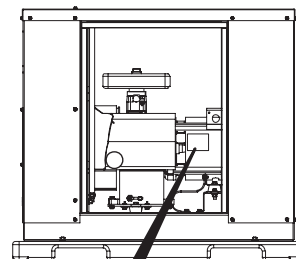
This is the Service Manual for the Series GRCA generator set (genset). Read and carefully observe all of the instructions and precautions in this manual. For quick reference, this manual includes Operation and Periodic Maintenance, which are also covered in the Operator's Manual.

See the Parts Catalog for part identification numbers. Genuine Onan® replacement parts are recommended for best results. When contacting Onan for parts, service or product information, be ready to provide the model number and the serial number, both of which appear on the genset nameplate (Figure 1-1). (The serial number is in the row marked "S/N", just below the model number. The last character of the model number is the specification letter, which is important for obtaining the right parts.)

⚠ WARNING Improper service or parts replacement can lead to severe personal injury or death and to damage to equipment and property. Service personnel must be qualified to perform electrical and mechanical service.

⚠ WARNING Unauthorized modifications or replacement of fuel, exhaust, air intake or speed control system components that affect engine emissions are prohibited by law in the State of California.

See the Installation Manual for important recommendations concerning the installation and for a list of the installation codes and standards for safety which may be applicable.



IMPORTANT ENGINE INFORMATION

Onan® CUMMINS POWER GENERATION
1400 73rd Ave. NE
Minneapolis, MN 55432
Made in U.S.A.

Model No: 12GRCA-4229
S/N: 0000 000000

AC Volts: 120/ 240 kVA: 11.0 PH: 1
Amps: 45.8 Pf: 1.0 RPM: 3600
Fuel: Hz: 60 Bat: 12V

Options: B241 B274 C053 Wire Diagram: 0611-1266
F172 L888 R104

Insulation: NEMA Class H Ambient 40 C

THIS ENGINE MEETS U. S. EPA PH1 AND 1995-1999
CALIFORNIA EMISSION REGULATIONS FOR ULGE ENGINES
XN5XS. 9802EL 980 CC

REFER TO OPERATOR'S MANUAL FOR MAINTENANCE
SPECIFICATIONS AND ADJUSTMENTS 10-2486 URC

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2. Specifications

GENERATOR SET GRCA:				
Fuel Type	Natural Gas		LP Vapor	
Rated Power	9 kW		11 kW	
Frequency	60 Hertz			
Voltage	120/240 volts			
Circuit Breaker Rating	2-Pole, 50 amperes			
Speed	3600 RPM			
FUEL CONSUMPTION:	ft. ³ /hr	BTU/hr	ft. ³ /hr	BTU/hr
Quarter load	72	74,736	38	97,166
Half-load	101	104,838	47	120,179
Three Quarter Load	133	138,054	60	153,420
Full-load	184	190,992	73	186,661
Natural Gas Supply Pressure	7-11" WC (water column) (178–279 mm)			
LP Supply Pressure (vapor)	9-13" WC (water column) (228-330 mm)			
Gas Supply Connection	3/4 inch NPT		3/4 inch NPT	
ENGINE: Honda GX670 90 Degree V-Twin, 4 Stroke, OH Valve 2 Cylinder, Specifications available in your Honda Owners Manual				
Bore	3.03 inch (77 mm)			
Stroke	2.83 inch (72 mm)			
Displacement	40.9 inch ³ (670 cc)			
Oil Capacity (with filter)*	1.48 Qt (1.4 Liter)			
Intake Valve Clearance (Cold)	.006 + .001 inch (.15 + .02 mm)			
Exhaust Valve Clearance (Cold)	.008 + .001 inch (.20 + .02 mm)			
Spark Gap	.012 - .016 inch (.030 - .040 mm)			
Cylinder compression pressure	85 - 114 lbf/in ² (6.0 - 8.0 kg/cm ²) at 500 rpm			
CRANKING SYSTEM:				
Nominal Battery Voltage (BCI, GP 26)	12 volts			
Battery Cranking Capacity	530 CCA @ 0° F (-17° C)			
Nominal Battery Charging Output	6 amperes			
Fuse F1 (control B+ input circuit)	10 amperes			
ENCLOSURE:				
Control Features	Lighted Run-Off-Auto Switch, Running Time Meter, 50 Amp UL Listed Circuit Breaker, DC Control Fuse. Large User Connection Area			
Enclosure Features	Sound Attenuated Drip-Proof Design, less than 70 dBA at 23 ft. (7M), Easy Service Access, Internal Starting Battery Tray and Tie-Down, Heavy Duty Exterior High Performance Fluoropolymer Finish Coat System			
Exhaust Silencer	Exhaust Silencer, Insulated for Low Noise and heat			
Installation Features	Pre-Mounted UV Resistant Plastic Installation Base, Convenient Electrical and Gas Supply Connections, Ground Anchor System for Base Included			
Unit Dimensions	45 in (1143 mm) Length, 34 inch (864 mm) Width, 39 inch (986 mm) Height (Including installation base)			
Weight	575 Pounds (261 kg)			
Sound Level at Full Load	Less than 70 dBA at 23 ft. (7 m)			
ENGINE PART TOLERANCES AND CLEARANCES				
Refer to your Honda Owners Manual - Part # 0031-ZN1-6011				
* See Periodic Maintenance for oil filling instructions.				

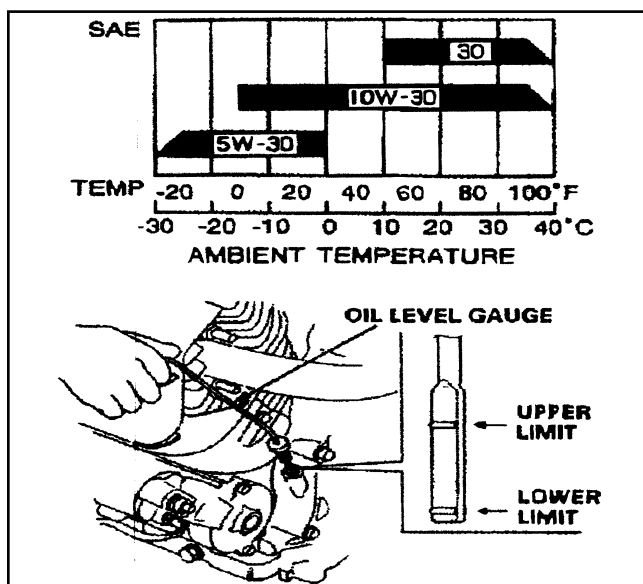
THREAD TORQUES	
Bolt torques are in lb-ft (N-m)*	
Rotor Through-Bolt	32.5 ± 2.5 (45 ± 3)
Stator Feet to Base	16-20 (22-27)
Adapter-Engine Mounting Screws	12 (16)
Adapter-Generator Mounting Screws	25-35 (34-47)
Rear Vibration Isolators	
Center Screw	30-35 (41-47)
Flange to Drip Tray Screws	16-20 (22-27)
Stator Studs to Engine Adaptor	Finger tight
Stator Nuts	30 (41)
Front Vibration Isolators	
Center Screw	30-35 (41-47)
Flange to Drip Tray Screws	16-20 (22-27)
Engine to Mounting Plate	30-35 (41-47)
Skidbase to Pallet	16-22 (22-27)
Spark Plug	13 (18)
* - Use engine oil as a lubricant for all threads EXCEPT for spark plug and rotor through-bolt threads.	

3. Operation

Engine Oil Recommendations

Oil is a major factor affecting performance and service life. Use 4-stroke automotive detergent oil that is designed for engines operating on LPG or NATURAL GAS.

(The table below are examples of oils that meet Honda's requirements for LPG/NATURAL GAS-fueled engines.) SAE 30 (API service classification SJ) is recommended for general use. For operation in temperatures below 32°F (0°C), 5W-30 sythetic oil may be used for easier starting. Do not use 5W-30 sythetic oil when the air temperature is above 32°F (0°C). Units are shipped with 10W-30 Oil.



STARTING BATTERY

This genset has a 12 VDC starting battery and control system. See Specifications in Section 2 for minimum battery requirements for genset cranking.

FUEL RECOMMENDATIONS

⚠ WARNING Fuels are flammable and explosive and can cause severe personal injury or death. Do not smoke if you smell gas or are near fuel tanks or fuel-burning equipment or are in an area sharing ventilation with such equipment. Keep flames, sparks, pilot lights,

arc-producing equipment, switches, and all other sources of ignition well away. Keep a type ABC fire extinguisher handy.

NFPA Standard No. 58 requires all persons handling and operating LP to be trained in proper handling and operating procedures.

When natural gas is the required fuel, use commercially available natural gas fuel having a methane content of at least 90 percent (by volume).

When LP (liquified petroleum) is the required fuel, use grade HD-5 or equivalent consisting of at least 90 percent propane. Commercial LP may contain more than 2.5 percent butane, which can result in poor fuel vaporization and poor engine starting in ambient temperatures below 32° F (0° C).

Satisfactory performance requires that fuel be supplied at a pressure within the range indicated in Specifications.

⚠ WARNING High gas supply pressure can cause gas leaks which can lead to fire and severe personal injury or death. Gas supply pressure must be adjusted to Specifications in Section 2 by qualified personnel.

FUEL SELECTION

The natural gas/LP vapor genset leaves the factory set up for natural gas. If the genset is to be run on LP vapor it must be converted for use with LP vapor. See NG/LP Vapor Fuel System in Installation Manual.

A genset purchased to use natural gas or LP vapor cannot be converted to use LP liquid.

⚠ CAUTION Wrong fuel selection can result in hard starting, poor genset performance, and fault shutdown.

GENSET CONTROL

Figure 3-1 shows the genset control panel. The control features are as follows:

Control Switch – This is a three-position **Run-Off-Auto** switch with a status/diagnostics light. The **Run** and **Off** positions are for manual starting and stopping of the genset. The **Off** position is also used for resetting the controller following a

fault shutdown. The **Auto** position is for remote start or transfer switch control.

Status/Diagnostics Light – This is an LED (light emitting diode) in the control switch. It blinks rapidly during cranking. It blinks in a coded fashion to indicate the nature of a genset shut down. See Troubleshooting in Section 11.

Hour Meter – The hour meter records the total running time of the genset. It cannot be reset.

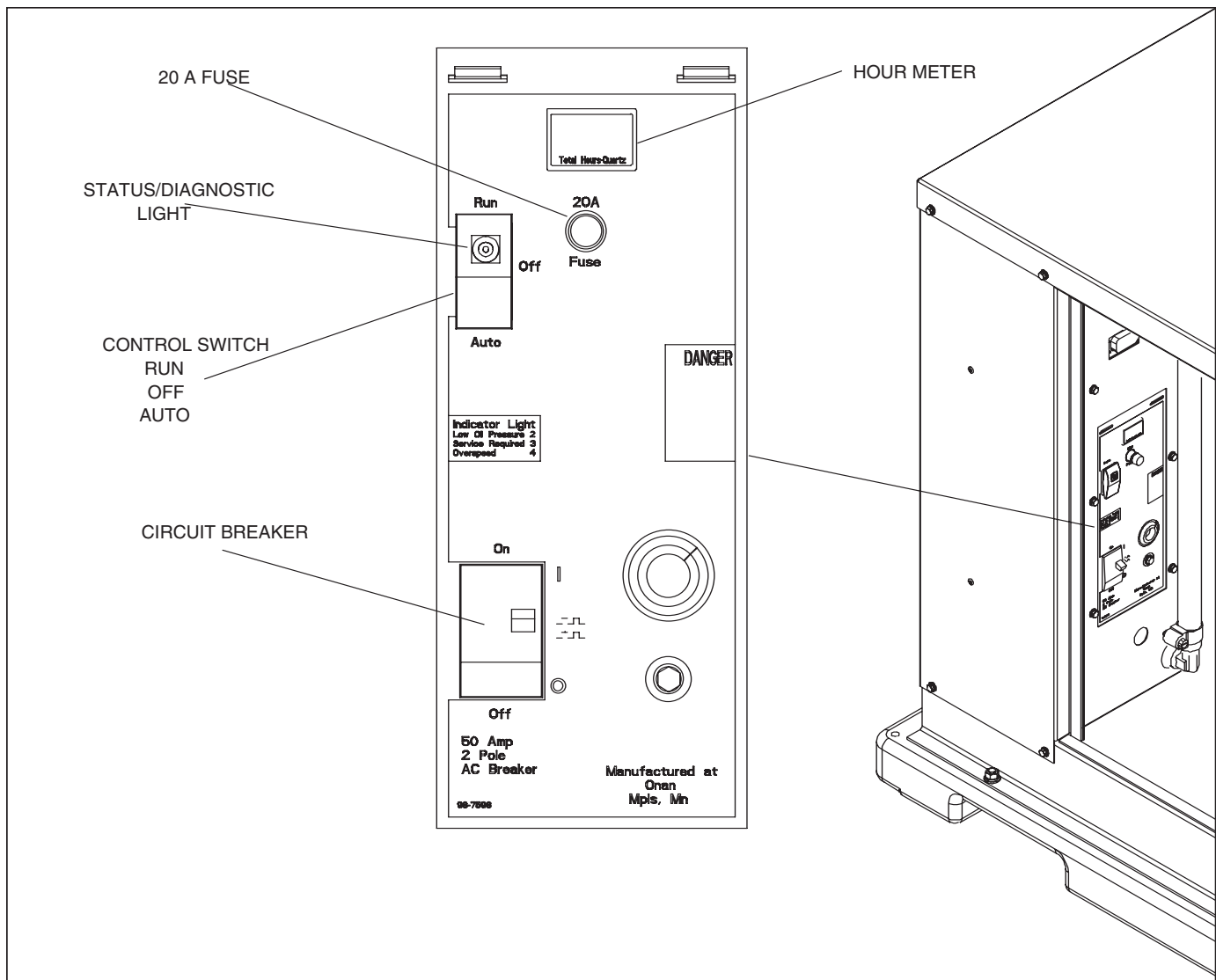


FIGURE 3-1. GENSET CONTROL

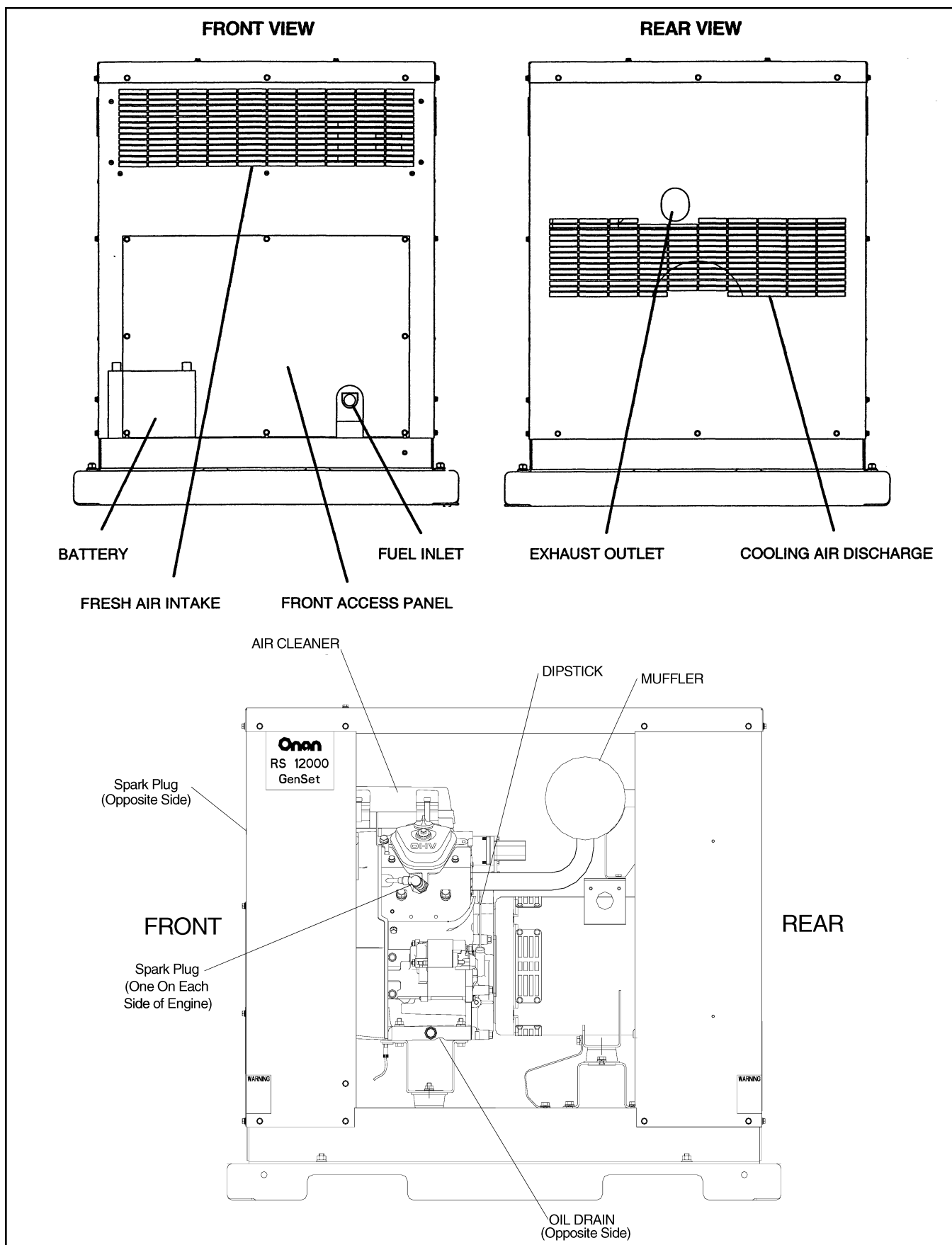


FIGURE 3-2. GRCA GENSET

⚠ WARNING EXHAUST GAS IS DEADLY!

All engine exhaust contains carbon monoxide, an odorless, colorless, poisonous gas that can cause unconsciousness and death. Symptoms of carbon monoxide poisoning include

- Dizziness
- Headache
- Weakness and Sleepiness
- Nausea
- Vomiting
- Inability to Think Coherently

IF YOU EXPERIENCE ANY OF THESE SYMPTOMS, GET INTO FRESH AIR IMMEDIATELY. If symptoms persist, seek medical attention. Shut down the genset and do not operate it until it has been inspected and repaired.

The exhaust system is an integral part of the genset. Do not modify the exhaust system. Make sure there is ample fresh air when operating the genset in a confined area.

STARTING AND STOPPING THE GENSET

Pre-start Checks

Perform the maintenance checks instructed in General Inspection (See page 4-2). Service the genset and make repairs as required if a fault shutdown code displays (see Troubleshooting in Section 11). Also, see Genset Break-In and Genset Storage in this section before placing in service a new or rebuilt genset or one that has been in storage.

Manual Starting

Push the control switch to **Run**. The engine should crank, start, and run up to governed speed in approximately 15 seconds. The starter disconnects automatically as the status light stops blinking.

If the engine does not start (after 20 seconds of cranking), the starter disengages. See Troubleshooting in Section 11 if the engine does not start.

Check for fuel and exhaust leaks. Stop the genset immediately if there is a fuel or exhaust leak and have it repaired before continuing operation.

Whenever possible, allow the engine to warm up for a few minutes before connecting the electrical loads.

Manual Stopping

Push the control switch to **Off**. Whenever possible, allow the engine to cool down with the electrical loads disconnected for a few minutes before stopping the genset.

⚠ CAUTION Failure to push the control switch to **AUTO** before leaving the genset renders the genset unavailable for automatic standby service.

Automatic Starting and Stopping

Push the control switch to **Auto** for remote, automatic starting and stopping (transfer switch).

⚠ WARNING Automatic startup of the genset while performing maintenance or service can cause severe personal injury or death. Push the control switch to **Off** and disconnect the negative (–) battery cable from the battery to keep the genset from cranking and starting while working on it.

POWERING EQUIPMENT

Genset Loading

How much electrical equipment (system load) can be connected at one time depends upon how much power is available from the genset (See Specifications, Section 2) and the type of load being supplied. If the genset is “overloaded,” its circuit breaker trips or its controller shuts it down or both.

Determine how much equipment can be operated at one time by adding the power consumption ratings of the individual system loads that are likely to be used at the same time. Compare the sum of the loads to the kW (kilowatt) rating of the genset. Note that 1 kW = 1000 watts. See Table 3-2 for power consumption of typical residential appliances.

Note that when a genset is loaded nearly to full power and one of the large motor loads (such as

an air conditioner) “cycles on,” an undervoltage or under frequency fault shutdown (Code Numbers 13 and 15) could occur. The reason is that for a brief moment, at startup, motors can draw up to three or more times their rated power consumption. You may, therefore, have to consider shutting off some loads at times when large motor loads are “On.” When powering large motor loads (such as an air conditioner) it is recommended that the total load should not exceed 80% of the genset kW rating.

Operating at High Altitude or High Temperature

Air density is less at higher altitudes, resulting in less available engine power. Power decreases approximately 3.5 percent of rated power each 1000 feet (305 meters) of increase in elevation above sea level. Power also decreases approximately 1.5 percent each 10°F (5.5°C) increase in ambient temperature above 77°F (25°C).

TABLE 3–2. TYPICAL APPLIANCE POWER CONSUMPTION

Appliance	Typical Watts	Basic Loads	Loads Chosen
Basic Needs			
Electric Lighting - N=Number of 100 W Bulbs	N 100 W Bulbs	$N \times 100 =$	
Furnace - Gas	750		
Electric Heat (See Heater Nameplate)	2000-5000		
Well Pump - 1/2 HP	1000		
Well Pump - 1 HP	2000		
Refrigerator - 20 Cu. Ft.	800		
Heat Pump	5000		
Electric Water Heater	5000		
Security System	20		
Freezer - 20 Cu. Ft.	550		
Sump Pump 1/3 HP	500		
Garage Door Opener - 1/3 HP	500		
Garage Door Opener - 1/2 HP	720		
Typical Discretionary Loads			
Microwave Oven - 800 Watt	1200		
Microwave Oven - 1000 Watt	1500		
Coffee Maker	900		
Dishwasher	1400		
Toaster	900		
Computer	250		
Electric Range - Two Burners	2900		
Electric Range - Oven	7500		
TV - 13" Color	70		
TV - 32" Color	170		
VCR	60		
Stereo System	140		
Electric Iron	1100		
Electric Clothes Dryer	6000		
Gas Clothes Dryer	720		
Washing Machine	1000		
Electric Hair Dryer	1600		
Air Conditioner - 1 Ton	2000		
Air Conditioner - 2 Ton	3000		
Window A/C - 17,800 BTU	2000		
Ceiling Fan	100		
Vacuum Cleaner	780		
Central Vacuum	1750		
Total Basic Loads:			
Total Chosen Loads:			
Total Power Requirement:			

How To Use the Table

Table 3-2 lists the typical power consumption of some common household appliances. The value in the table is a typical value, check the value on the nameplate of your appliance for the most accurate value. Also, you may want to use appliances that are not listed in the table. In that case, use the value on the nameplate of the appliance for its power consumption. For the most accurate genset loading, substitute the values from the nameplates on the appliances for all calculations.

Select the appliances that satisfy your basic needs and write the power consumption in the Basic Loads column. Add the power consumption of all Basic Loads and place it in the Total Basic Loads box at the bottom of the table.

Compare the Basic Loads Total with the rated output of the genset. If the genset still has additional capacity (that is the Basic Loads Total is less than 80% of the genset capacity), you can select additional loads from the list. Write the power consumption of these additional loads in the Loads Chosen column. Add the power consumption of all Chosen Loads and place it in the Total Chosen Loads box at the bottom of the table. You can add loads to the Basic Loads until you reach 80% of the genset capacity.

Example

Using the chart on the previous page for a genset rated at 10 kW. Select a total load less than 8kW (8000 watts) in order to operate within the 80% limit.

Well Pump (1/2 HP)	1000
Refrigerator	800
Air Conditioner (2 ton)	2000
10 100 watt Bulbs	1000
Sump Pump (1/3 HP)	500
Microwave Oven (1000 W)	1500
Coffee Maker	900
Total	7700

This example uses 7700 watts. You could still safely use a TV, a small appliance, or even your computer before you exceed the 80% limit.

Remember that some loads are intermittent. For example your refrigerator does not run constantly. However, as it starts it requires considerably more current than when it is running. For the sake of the calculation from the table assume that all loads are constant. If total power consumption exceeds genset power output, the genset may shut down. In this case, you may have to operate some loads in sequence, one after another, rather than all at the same time.

If the load on the genset exceeds the rated capacity of the genset, the genset shuts down. If the genset shuts down under load, remove loads by turning off appliances, press the switch on the control to OFF and back to AUTO to allow automatic remote restarting.

Restarting The Genset

If the genset shuts down because it is overloaded, disconnect or turn off as many loads (appliances) as possible and try to restart the genset as instructed in Starting and Stopping in this section. Reconnect the loads one by one up to 80% of the genset rating.

Resetting Circuit Breakers

If a circuit breaker in the main power distribution panel or on the genset (see Figure 3-1) trips, there is either a short circuit or too many loads operating at the same time. Note that the genset continues to run after a circuit breaker trips.

If a circuit breaker trips, disconnect or turn off as many loads (appliances) as possible and reset the circuit breaker. If the circuit breaker trips right away, either the main distribution system has a short or the circuit breaker is faulty.

If the circuit breaker does not trip, reconnect the loads, one by one, up to 80% of the genset rating. If a circuit breaker trips right away when a load is connected, the load probably has a short.

Connecting The System To Utility Power

An approved device such as an automatic transfer switch must be provided to keep the genset and utility from being interconnected. The automatic transfer switch automatically reconnects the utility when service is restored.

⚠ WARNING Interconnecting the genset and the public utility (or any other power source) can lead to the electrocution of utility workers and damage to equipment and fire. An approved switching device must be used to prevent interconnections.

VARYING OPERATING CONDITIONS

Cold Weather

Perform maintenance due according to Periodic Maintenance in Section 4. See Engine Oil Recommendations in this section.

An optional thermostatically controlled heater for the battery is recommended for more reliable starting in ambient temperatures down to -0° F (-17.6°C). Genset may crank longer before starting compared to warmer conditions. This is normal.

Hot Weather

Perform maintenance according to Table 4-1 of Periodic Maintenance. Make sure nothing blocks airflow to and from the genset. Keep the cooling fins clean.

High Altitude

See Powering Equipment in this section for information on how altitude affects the maximum power output of the genset.

Dusty Conditions

Keep the cooling fins clean. Perform air cleaner maintenance and change engine oil and oil filter more often than usual. See Periodic Maintenance in Section 4.

GENSET BREAK-IN

Proper engine break-in on a new genset or on one with a rebuilt engine is essential for top engine performance and acceptable oil consumption. For proper break-in, run the genset at 1/2 rated power for the first 2 hours and then at 3/4 rated power for 2 more hours. Avoid light load or no load operation during break in. See Powering Equipment in this section.

Proper engine oil and oil level are especially critical during break-in because of the higher engine temperatures that can be expected. See Engine Oil Recommendations in this section. Check the oil level twice a day or every 4 hours during the first 24 hours of operation and change the oil after the first 25 hours of operation.

GENSET EXERCISE

If genset use is infrequent, it is recommended that the genset be exercised at least 1/2 hour, once a month, without load. Exercising the genset drives off moisture, re-lubricates the engine, and removes oxide from electrical contacts and generator slip rings, thereby promoting better starting, more reliable operation, and longer engine life.

An operator can exercise the genset by placing the control switch in the ON position. The genset would start and run at no load for a time determined by the operator. When the exercise period is finished, return the control switch to the AUTO position.

▲ CAUTION Failure to push the control switch to AUTO before leaving the genset renders the genset unavailable for automatic standby service.

When a transfer switch with an exerciser clock is available, set the clock to exercise the genset once a month for 1/2 hour at no load.

See the transfer switch operator's manual for instructions on how to adjust and activate the genset exerciser clock.

GENSET STORAGE

If the genset is to be stored for 120 days or longer, proper storage is essential for preserving top genset performance and reliability.

Storing the Genset

1. Push the genset line circuit breaker **OFF** (Figure 3-1).
2. Remove the air filter and start the genset. While the genset is running, spray an engine fogger (OnaGard™)¹ into the carburetor, following the instructions on the container label, and then stop the genset. (A fogger coats the intake, cylinder and exhaust systems with a protective coat of oil.)
3. Change the engine oil and oil filter. Also, change the air filter if it is dirty.
4. Disconnect the battery cables (negative [-] cable first) from the starting battery and store the battery according to the battery manufacturer's recommendations.
5. Close the fuel supply valve. If the genset is being removed from the premises, cap or plug any unused fuel line to prevent gas leakage if a fuel shutoff valve is opened inadvertently.

▲ WARNING Leaks can lead to explosive accumulations of gas. Natural gas rises when released and can accumulate under hoods and inside housings and buildings. LP vapor sinks when released and can accumulate inside housings and basements and other below-grade spaces. Prevent leaks and the accumulation of gas.

Returning The Genset To Service

1. Reconnect the starting battery (negative [–] cable last). See Battery Care in Section 4.
2. Open the fuel supply valve.
3. Inspect the genset. See General Inspection.
4. Start the genset at the genset control panel. The initial startup may be slow and there may be smoke and rough operation for a few minutes until the oil in the cylinders from the fogger

burns off. If the engine does not start, clean or replace the spark plugs as they may have been fouled by the fogger.

5. Push the genset line circuit breaker to **Run** (Figure 3–1) and the control switch to **Auto** for remote, automatic starting and stopping (transfer switch).

⚠CAUTION Failure to push the control switch to **AUTO** before leaving the genset renders the genset unavailable for automatic standby service.

4. Periodic Maintenance

Refer to Your Honda Owners Manual for Maintenance Schedule

⚠ WARNING Automatic startup of the genset while performing maintenance or service can cause severe personal injury or death. Push the control switch to Off and disconnect the negative (–) battery cable from the battery to keep the genset from starting while working on it.

Periodic maintenance is essential for top performance and long genset life. Use Table 4-1 as a guide for normal periodic maintenance. Under hot or dusty operating conditions some maintenance

operations should be performed more frequently, as indicated by the footnotes in the table. Keep a log of maintenance performed and the hours run. Recording maintenance helps you keep it regular and provide a basis for supporting warranty claims.

Maintenance, replacement, or repair of emission control devices and systems may be performed by any engine repair establishment or individual. However, warranty work must be completed by an authorized Cummins/Onan dealer or distributor.

SERVICING YOUR ENGINE

MAINTENANCE SCHEDULE

REGULAR SERVICE PERIOD (3)		Each use	First month or 20 Hrs.	Every 3 months or 50 Hrs.	Every 6 months or 100 Hrs.	Every year or 300 Hrs.	Refer to page
ITEM Perform at every indicated month or operating hour interval, whichever comes first.							
•	General Inspection		○				
•	Engine oil Check level	○					4-3
	Change		○	○			4-4
•	Oil filter Replace					Every 200 hrs.	4-4
•	Air cleaner Check	○					4-5
	Clean			○ (1)			4-5
	Replace					○ (*)	
•	Spark plug Check-adjust				○		2-1
	Replace					○	4-6
•	Valve clearance Check-adjust					○ (2)	
•	Combustion chamber Clean	After every 300 hrs. (2)					
•	Fuel Lines Check	Every 2 years (Replace if necessary) (2)					
•	Starting battery Check		○				

* Emission-related items.

(*) Replace the paper element type only.

(1) Service more frequently when used in dusty areas.

(2) These items should be serviced by your service dealer, unless you have the proper tools and are mechanically proficient. Refer to Honda shop manual for service procedures.

GENERAL INSPECTION

Inspect the genset according to the genset Periodic Maintenance Schedule.

Oil Level

Check the engine oil level as explained under Checking Engine Oil Level in this section.

Exhaust System

Look and listen for exhaust system leaks while the genset is running. Shut down the genset if a leak is found and have it repaired before operating the genset.

Fuel System

Check the fuel supply line and fittings for leaks while the genset is running. Check flexible fuel hose sections for cuts, cracks, and abrasions. Make sure the fuel line is not rubbing against other parts. Replace worn or damaged fuel line parts before leaks occur.

⚠️ WARNING Gaseous fuels are highly flammable and explosive and can cause severe personal injury or death. Shut down and repair leaks immediately.

Battery Connections

Check the battery terminals for clean, tight connections. Loose or corroded connections have high electrical resistance which makes starting

harder. Shut the genset off and disconnect corroded or loose battery cables (negative [–] cable first) and clean and reconnect them as instructed under Battery Care in this section.

⚠️ WARNING Batteries give off explosive gases that can cause severe personal injury. Do not smoke near batteries. Keep flames, sparks, pilot lights, electrical arcs and arc-producing equipment and all other ignition sources well away.

Do not disconnect the battery charger or battery cables while the genset is cranking or running: the arcing can ignite the explosive battery gases.

Mechanical

Look for mechanical damage. Start the genset and look, listen, and feel for any unusual noises and vibrations.

Check to see that the genset air inlet and outlet openings are not blocked or clogged with debris.

Clean accumulated dust and dirt from the genset. Do not clean the genset while it is running or still hot. Always wear safety glasses when using compressed air.

⚠️ WARNING Always wear safety glasses when using compressed air to avoid severe eye injury.

CHECKING ENGINE OIL LEVEL

Set the genset control to the Off position before checking the engine oil level.

1. Remove the dipstick (see Figure 4-1), wipe it clean, screw the cap back on and then remove it again to check the oil level on the dipstick.

⚠ WARNING Crankcase pressure can blow hot engine oil out the fill opening causing severe burns. Always stop the genset before removing the oil fill cap or dipstick.

2. Add oil as necessary until the full mark is reached. See Engine Oil Recommendations in Section 3. **Do Not Fill to a Level Above the Full Mark on the Dipstick.** Drain the excess oil if too much has been added. It is not necessary to add oil between oil changes, if oil level is between upper and lower limits.

⚠ CAUTION Too much oil can cause high oil consumption, high operating temperatures and oil foaming. Too little oil can cause severe engine damage. Keep the oil level between the Full and Add marks on the dipstick.

3. Secure the oil fill cap by turning clockwise until secure.

Return the genset control to Auto when finished performing maintenance.

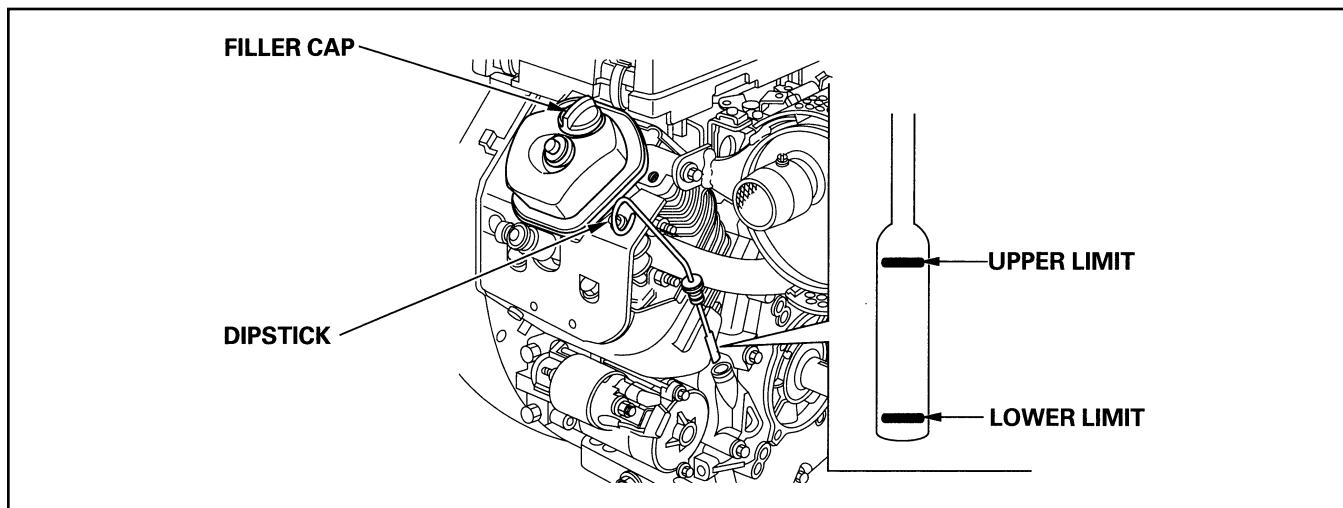


FIGURE 4-1. OIL LEVEL CHECK

CHANGING ENGINE OIL AND OIL FILTER

Refer to Table 4-1 for scheduled engine oil change. In hot weather and dusty conditions the oil should be changed more often.

Set the genset control to the Off position before changing engine oil.

⚠ WARNING State and federal agencies have determined that contact with used engine oil can cause cancer or reproductive toxicity. Take care to limit skin contact and breathing of vapors as much as possible. Use rubber gloves and wash exposed skin.

1. Place a pan under the oil drain hose. Run the engine until it is warm and then shut it off.
2. Remove the oil fill cap (see Figure 4-2), remove the hose plug, open the oil drain valve (see Figure 3-2), and allow all of the oil to drain from the engine.
3. Close the oil drain valve and replace the hose plug.
4. Spin off the oil filter canister (see Figure 3-2) and catch the oil in the canister. Discard the oil filter according to local regulations.
5. Thoroughly wipe off the filter mounting surface. Make sure that the mounting surface is clean and free of filter particles (gasket from old filter is not stuck to surface).
6. Make sure the gasket is in place on the new filter canister and apply a thin film of oil to the gasket.
7. Spin on the new filter canister by hand until the gasket just touches the mounting pad and then turn it an additional 1/2 to 3/4 turn. Do not over-tighten.
8. Refill with oil (see Engine Oil Recommendations in Section 3 and Specifications in Section 2) for oil capacity. Check oil level.
9. Secure the oil fill cap by turning clockwise until secure.
10. Used oil is harmful to the environment if it is not disposed of properly. Pour used oil into a sealed container and deliver it to the nearest recycling center or automotive service station.

Return the genset control to Auto when finished performing maintenance.

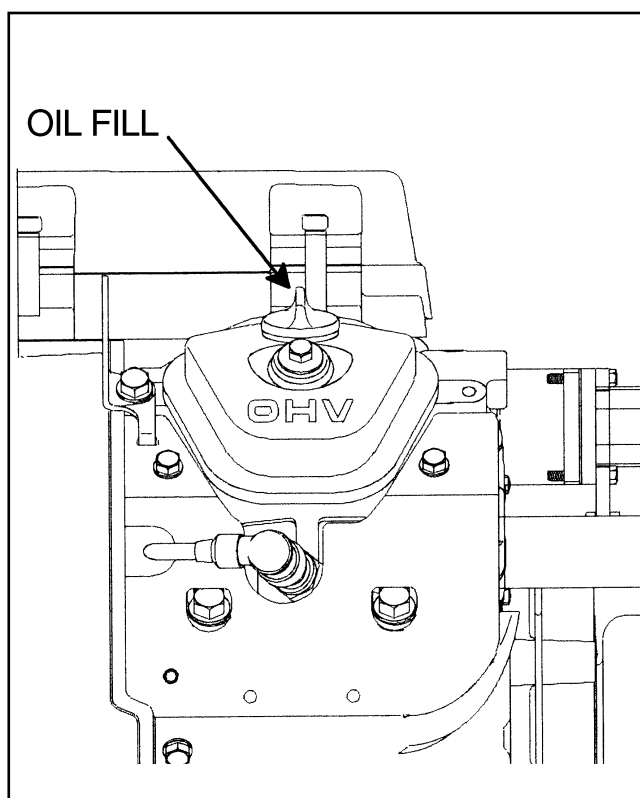


FIGURE 4-2. OIL FILL LOCATION

AIR FILTER

Refer to Table 4-1 for scheduled air filter replacement. In dusty conditions the air filter element and wrapper should be inspected and changed more frequently for best operation.

Set the genset control to the Off position before checking the air filter.

To change the air filter element and wrapper, loosen the 4 clips and remove the cover (Figure 4-3). Reassemble the air filter with a new air filter element foam filter element. **Do not oil either the paper or the foam filter elements.**

Return the genset control to Auto when finished performing maintenance.

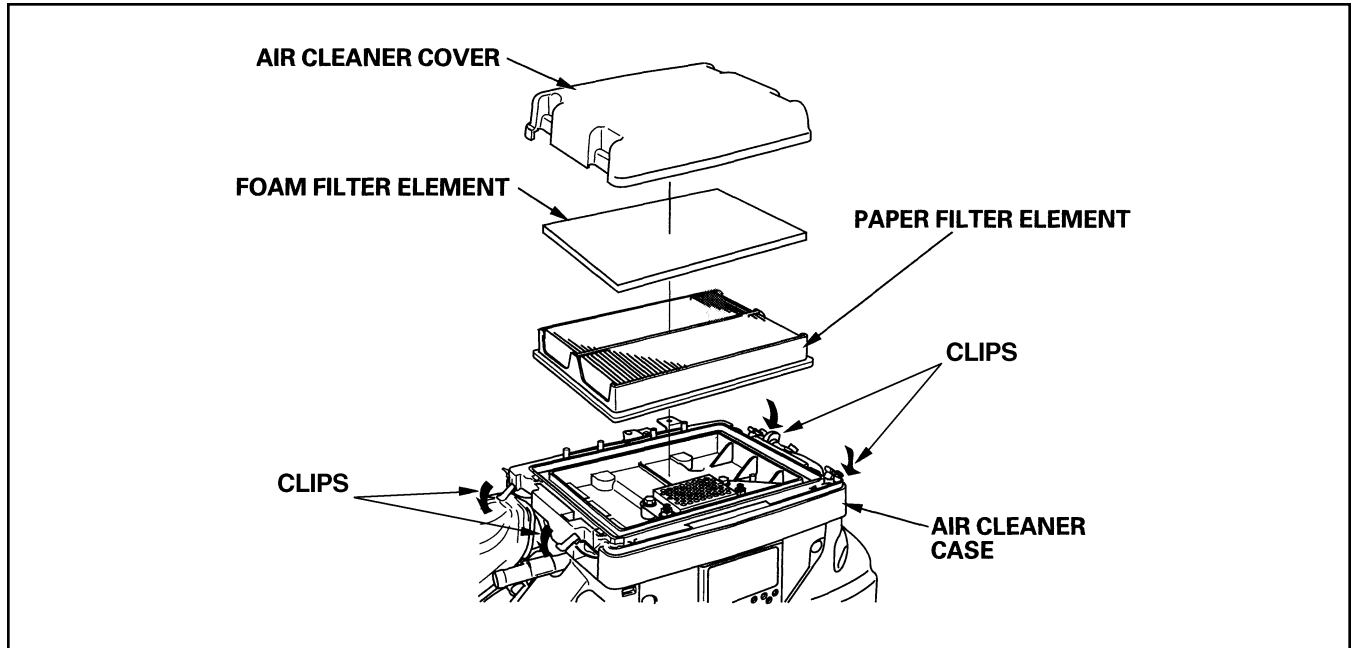


FIGURE 4-3. AIR FILTER ELEMENTS

SPARK PLUGS

Set the genset control to the Off position before checking the spark plugs.

See Table 4-1 for scheduled spark plug replacement. (The genset has two spark plugs: one on each side of the engine, see Figure 4-3.) The spark plugs must be in good condition for proper engine starting and performance. A spark plug that fouls frequently or has heavy soot deposits indicates the need for engine service. See Troubleshooting in Section 11.

To prevent crossthreading a spark plug, always thread it in by hand until it seats. If the spark plug is being reused, turn it with a wrench an additional 1/4 turn. If the spark plug is new, turn it an additional 3/8 to 1/2 turn. If you have a torque wrench, tighten the spark plug to 8 lb-ft (10 N-m).

Return the genset control to Auto when finished performing maintenance.

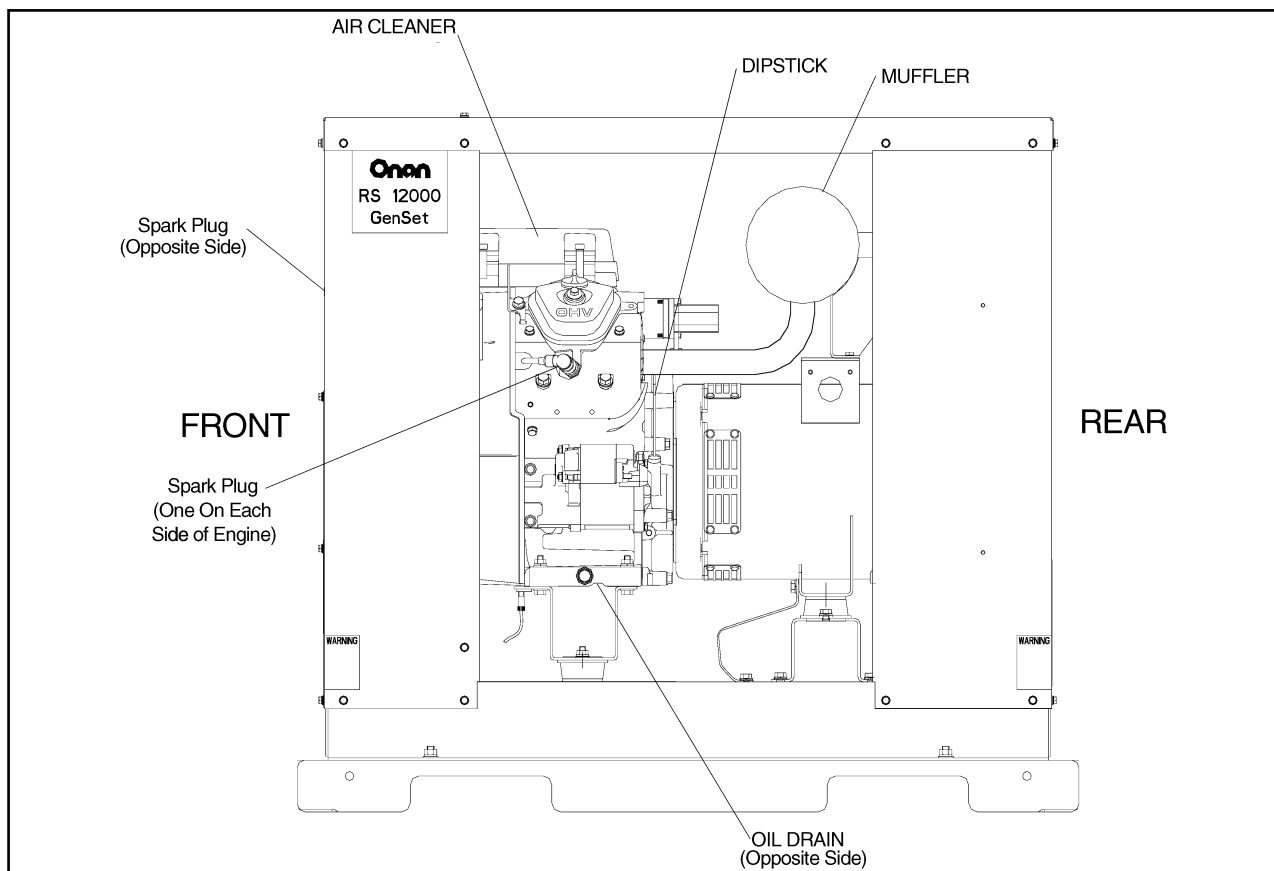


FIGURE 4-3. SPARK PLUGS

BATTERY CARE

See Table 4–1 for scheduled battery maintenance and to the battery manufacturer's recommendations and instructions for battery care.

Set the genset control to the Off position before checking the battery.

⚠ WARNING Batteries give off explosive gases that can cause severe personal injury. Do not smoke near batteries. Keep flames, sparks, pilot lights, electrical arcs and arc-producing equipment and all other ignition sources well away.

Do not disconnect the battery charger or battery cables while the genset is cranking or running: the arcing can ignite the explosive battery gases.

⚠ WARNING Battery electrolyte can cause severe eye damage and skin burns. Wear goggles, rubber gloves and a protective apron when working with batteries.

Maintain the battery as follows unless the battery manufacturer has other instructions and recommendations:

1. Keep the battery case clean and dry.
2. Make certain that the battery cable connections are clean and tight. Use a terminal puller tool to remove the battery cables.
3. Identify the cable as positive (+) or negative (–) before making the battery connections. Always remove the negative (–) cable first and connect it last, to reduce the risk of arcing.
4. To remove corrosion from the battery terminals, wash the terminals with an ammonia solution or a solution consisting of 1/4 pound (about 100 grams) of baking soda in 1 quart (about 1 liter) of water. Be sure the vent plugs

are tight to prevent cleaning solution from entering the cells. After cleaning, flush the outside of the battery and the surrounding areas with clean water.

5. If the battery is not of the “maintenance-free” type, maintain the electrolyte level by adding distilled water. Fill each cell to the split-level marker in the battery. The water component of the electrolyte evaporates, but the sulfuric acid component remains. For this reason, add water, not electrolyte to the battery.
6. Use a battery hydrometer to check the specific gravity of the electrolyte in each battery cell (see Figure 4–4). Charge the battery if the specific gravity measures less than 1.215. Do not overcharge the battery. Stop charging the battery when the electrolyte specific gravity reaches 1.260, at approximately 80° F (27° C).

Return the genset control to Auto when finished performing maintenance.

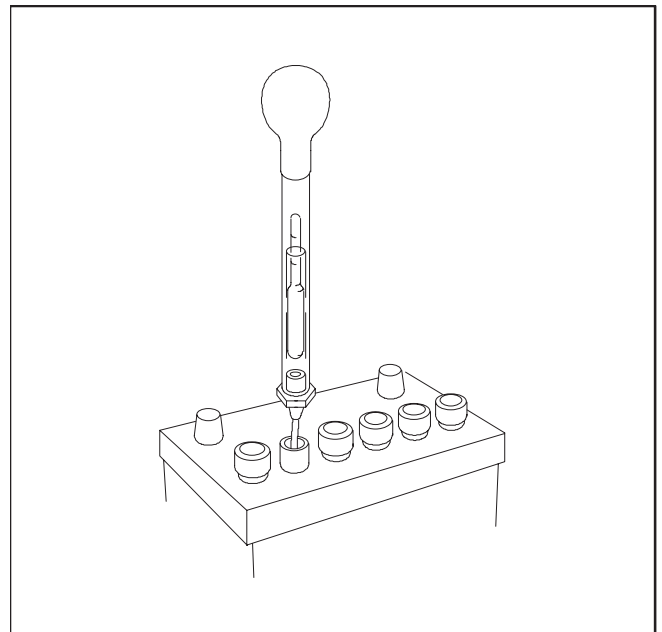


FIGURE 4-4. BATTERY CHECK WITH HYDROMETER

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5. Preparations for Service

SAFETY

There are hazards in servicing gensets. Study Safety Precautions and become familiar with the hazards listed in Table 5–1. Note the following safeguards and ways of avoiding hazards:

- **Reduce the hazard:** A safe, orderly workshop area and well-maintained equipment reduce the hazard potential. Keep guards and shields in place on machinery and maintain equipment in good working condition. Store flammable liquids in approved containers; away from fire, flame, spark, pilot light, switches, arc-producing equipment and other ignition sources. Keep the workshop clean and well lighted and provide adequate ventilation.
- **Develop safe work habits:** Unsafe procedures lead to accidents when using tools and machines. Be familiar with the equipment and its safe use. Use the correct tool for the job and check its condition before using it. Observe the warnings in this manual. Take special precautions when working around electrical equipment. Do not work alone, if possible. Do not take risks.
- **Use personal protection:** Wear appropriate protective safety equipment, such as safety shoes and safety glasses. Do not wear rings or jewelry and do not wear loose or damp clothing that might get caught in equipment or conduct electricity.
- **Be prepared for an accident:** Keep fire extinguishers and safety equipment nearby. Agencies such as the Red Cross and public safety departments offer courses in first aid, CPR and fire control. Take advantage of this information and be ready to respond to an accident. Learn to be safety-conscious and make safety procedures part of the work routine.

TABLE 5–1. HAZARDS AND THEIR SOURCES

Fire and Explosion	<ul style="list-style-type: none">• Leaking fuel• Hydrogen gas from battery• Oily rags improperly stored• Flammable liquids improperly stored
Burns	<ul style="list-style-type: none">• Hot exhaust pipes• Hot engine and generator surfaces• Electrical shorts• Jewelry touching electrical components
Poisonous Gas	<ul style="list-style-type: none">• Operating genset where exhaust gases can accumulate
Electrical Shock	<ul style="list-style-type: none">• Improper generator connections• Faulty wiring• Working in damp conditions• Jewelry touching electrical components
Rotating Machinery	<ul style="list-style-type: none">• Fan and pulley guards not in place
Slippery Surfaces	<ul style="list-style-type: none">• Leaking or spilled oil
Heavy Objects	<ul style="list-style-type: none">• Mounting or removing genset

SPECIAL TOOLS

The following tools are necessary for servicing the genset:

Engine Tools

Torque wrench: 0-75 lb-ft (0-100 N-m)
Hole gauge: 0.300-0.400 inch (5-10 mm)
Outside micrometer set: 0-4 inch (0-100 mm)
Telescoping gauge set: up to 4 inch (100 mm)
Feeler gauge
Plasti-Gage bearing clearance guide
Spark plug gap gauge
Oil pressure gauge: 0–30 psi (0–200 kPa)
Manometer: 14 inch (350 mm) WC
Inclined Manometer: 1 inch (25 mm) WC range with 0.01 inch (0.1 mm) WC divisions
Cylinder compression tester
Flywheel puller
Crankshaft gear puller ring, bolts and puller (or special shoulder bolts and flywheel puller)
Snap ring pliers
Combination main and cam bearing remover

Oil seal loader and driver
Cylinder ridge reamer
Piston ring spreader
Piston groove cleaner
Piston ring compressor
Cylinder hone
Valve spring compressor
Valve lock replacer
Valve seat cutter kit
Valve guide driver
Slide hammer
Lead or dead-blow hammer

Generator and Control Tools

Rotor removal tool (headless bolt)
(approximately 13 3/8 inches long)
Commutator stone
Battery hydrometer
Digital multi-meter
Load test panel and leads

REMOVING AND INSTALLING THE HOUSING PANELS

Before removing housing panels (Figure 5–1) to access the genset for maintenance or service, perform the following steps.

⚠ WARNING Gaseous fuels are flammable and explosive and can cause severe personal injury or death. Do not smoke if you smell gas or are near fuel tanks or fuel–burning equipment or are in an area sharing ventilation with such equipment. Keep flames, sparks, pilot lights, electrical switches and arc–producing equipment and all other sources of ignition well away. Keep a type ABC fire extinguisher handy.

NFPA Standard No. 58 requires all persons handling and operating gaseous fuel to be trained in proper handling and operating procedures.

1. Close the fuel supply shut off valve. If the genset can be started, purge the fuel supply line and genset as much as possible by running the genset until it runs out of fuel with the shut off valve closed.
2. Press the control switch to **Stop**.
3. Remove the front access panel (Figure 5–1).
⚠ WARNING This unit can start automatically. Accidental starting of the generator set while working on it can cause severe personal injury or death. Prevent accidental starting by disconnecting the negative (–) cable from the battery terminal.
4. Disconnect the negative (–) battery cable from the battery to prevent accidental starting.

⚠ WARNING Do not operate the genset without the housing panels secured in place. The panels guard against rotating parts and bare live electrical parts that can cause severe personal injury or death. The housing is also required for proper genset cooling.

The housing consists of removable side doors and panels. The two side doors are secured by latches and the remaining panels are secured by screws.

To open the side doors, lift handle up and out, then turn counter-clockwise, swing the side door down, and lift out.

Disassemble the housing in the following order

5. Remove the side doors.
6. Remove the roof panel by removing the following screws.
 - a. Two screws securing the top face of the roof to the engine divider panel.
 - b. Seven screws securing the roof to the front panel. Note that one of these screws has a toothed washer to provide a ground path between the roof and the front panel.
 - c. Seven screws securing the roof to the rear panel.
7. Remove the front panel, by removing the seven screws securing it to the base. Note that one of these screws has a toothed washer to provide a ground path between the front panel and the base.
8. Remove the rear panel as follows.
 - a. Working inside the unit, remove the two screws and the panel hole cover (see Figure 5-1), that is attached to the divider panel (located directly below the exhaust pipe) This must be removed to allow the exhaust pipe to clear the panel during removal.
 - b. Inside the unit, remove the two screws located at the base of the divider panel (see Figure 5-1).
 - c. Remove the seven external screws securing the rear panel to the base. Note that one of these external screws has a toothed washer to provide a ground path between the front panel and the base.

Reassembly is the reverse of disassembly. To make sure that all of the panel screw holes will line up, wait to tighten the screws until all of the panels and screws are in place. Before fitting the roof panel, it is helpful to screw two M6 studs into the tapped holes on the top edge of the engine divider panel. These studs should then be guided through the holes in the roof panel as it is being fitted. This will ensure that, once the studs are removed, the tapped holes in the engine divider panel are aligned with the holes in the roof panel, so that the screws can be easily fitted. Pay particular attention to the refitting of the toothed washers in steps 8,7 and 6, as these are necessary to meet the grounding requirements of UL 2200.

Lock the unit to prevent unauthorized access.

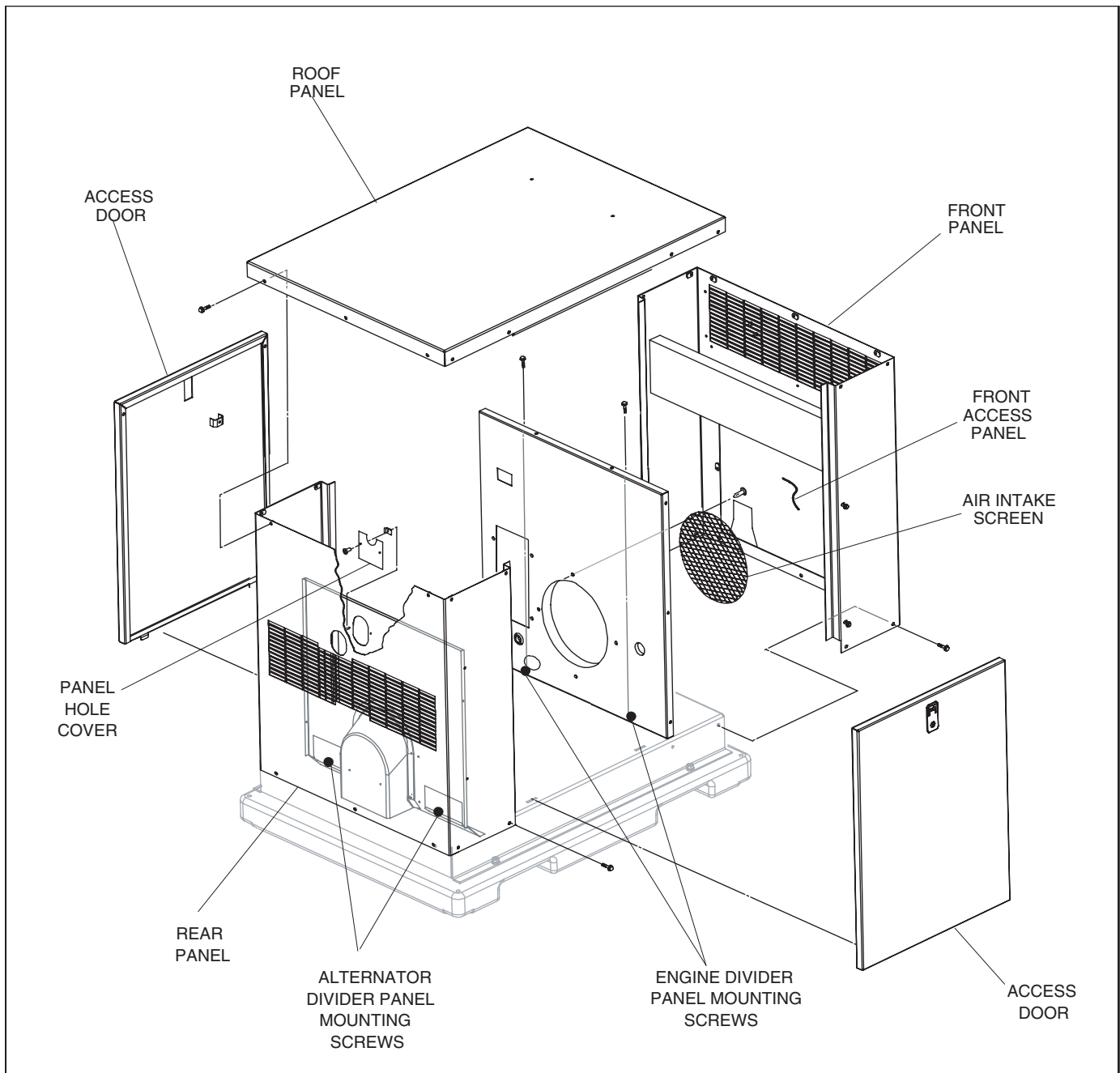


FIGURE 5-1. GENSET HOUSING

ACCESSING THE ENGINE FOR SERVICE

In order to gain access to the engine to carry out adjustments and/or component replacements, proceed as follows.

⚠ WARNING Accidental starting of the generator set while working on it can cause severe personal injury or death. Prevent accidental starting by disconnecting the starting battery cables (negative [-] first).

Ventilate battery area before disconnecting or connecting batteries. Arcing can ignite the explosive hydrogen gas given off by batteries, causing severe personal injury. Arcing can occur if the negative (-) battery is connected and a tool is being used to connect or disconnect the positive (+) battery cable accidentally touches the frame or other grounded metal part of the set. To prevent arcing, always remove the negative (-) cable first, and reconnect it last.

1. Run the unit out of fuel as described in steps 1 & 2 of Section 5-3
2. Disconnect both battery cables (Battery negative (B-) first) and remove the battery.
3. Remove the side doors, if not already removed.
4. Remove the roof panel, as described in step 6

of Section 5-3.

5. Remove the front panel, as described in step 7 of Section 5-3.
6. Remove the battery tray.
7. Remove the bolts securing the gas inlet connection to the base.
8. Remove the two bolts that secure the engine divider panel to the base. Note that one of these bolts has a toothed washer to provide a ground path between the engine divider panel and the base.
9. Carefully swing the engine divider panel, complete with the fuel inlet connection and piping, round to the right and lean it against the engine.
10. This will provide access to the flywheel end of the engine and the magnetic pick up, for adjustment and replacement as detailed elsewhere in this manual.

On completion of the engine work refit the panels and other components in the reverse order. Do not tighten the bolts securing the gas inlet connection to the base, until the screws securing the roof panel and the engine divider panel are tightened.

Pay particular attention to the refitting of the toothed washers in step 8 in this section, and in steps 7 & 6 in Section 5-3, as this is necessary to meet the grounding requirements of UL 2200.

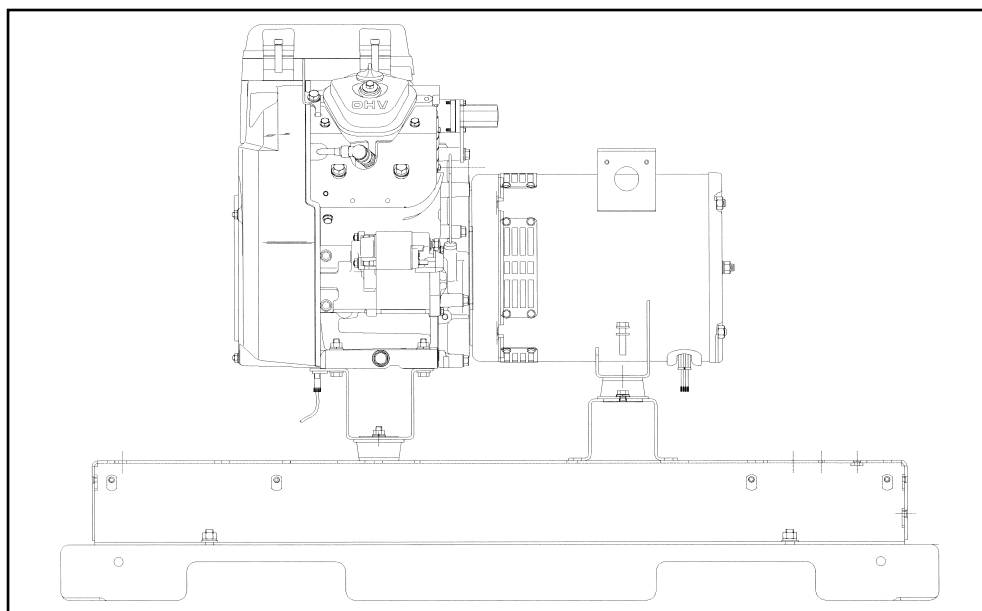


FIGURE 5-2. ENGINE/GENERATOR ASSEMBLY

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6. Engine Subsystems

These engine subsystems or service procedures do not require removal of the cylinder heads, gearcase or main bearings for access and may be serviceable without removing the engine from the cabinet.

CYLINDER COMPRESSION TEST

Examining the spark plugs and testing cylinder compression can tell much about the condition of the valves, piston rings and cylinders. Test cylinder compression as follows:

1. Start the genset and let it warm up.
2. Stop the genset and remove and inspect the spark plugs. See Ignition System in this section.

3. Insert the compression gauge nozzle into one of the spark plug holes, hold the throttle open and crank the engine. Note the pressure indicated by the gauge.
4. Repeat the test on the other cylinder.
5. Compare the readings obtained with the Cylinder Compression Pressure Specifications given on Page 2-1.

Note: Do not operate the starter for more than 5 seconds at one try. If stable compression is not obtained within 5 seconds, stop the starter motor and wait 10 - 20 seconds to allow the starter motor to cool, and repeat the operation again.

VALVE CLEARANCE (LASH) ADJUSTMENT

For Specifications, refer to Page 2-1

Valve clearance and inspection must be performed with the engine cold.

⚠ WARNING Accidental starting of the generator set while working on it can cause severe personal injury or death. Prevent accidental starting by disconnecting the starting battery cables (negative [-] first).

⚠ WARNING The generator will be inoperable during this inspection and adjustment. Be sure to notify all potentially affected persons before beginning work

To access the flywheel and the timing marks on the fan cover, it is necessary to remove the 2 access doors, the roof panel, the rear panel and move the engine divider panel as described on page 5-5.

Inspection & Adjustment

1. Remove the Head Cover Bolt and the Cylinder Head Cover from both Cylinder Heads.
2. Rotate the flywheel until the "T" mark on the cooling fan aligns with the "T" mark on the right side of the fan cover. (This alignment point is Top Dead Center of No. 1 cylinder, See Figure 6-1.)

Be sure that No.1 cylinder is at TDC on the

compression stroke. This can be checked by "rocking" the flywheel an inch or so either side of the "T" mark and observing that both the valves remain closed. If either valve moves, the engine is at TDC on the exhaust stroke and must be rotated one complete revolution to reach TDC on the compression stroke.

3. Check the intake and exhaust valve clearances for No.1 cylinder by inserting a feeler gauge between the valve stem and the valve rocker arm.
4. If the clearance of either valve does not fall within the specification given in Table 2-1, loosen the pivot adjusting nut and turn the rocker arm pivot to obtain the correct clearance.
5. Hold the rocker arm pivot using a wrench, and tighten the pivot adjusting nut to a torque of 6.5 lbf.ft (9Nm) (Figure 6-2)
6. Recheck the valve clearance after tightening the adjusting nut.
7. Rotate the flywheel 270° in a clockwise direction until the "T" mark on the cooling fan aligns with the "T" mark on the left hand side of the fan cover.
8. This will put No.2 cylinder at TDC of its compression stroke.
9. Repeat steps 3,4,5 and 6 for No. 2 cylinder.
10. Replace the cylinder head covers and tighten the head cover bolts.
11. Refit the engine divider panel, the rear panel and the roof panel as described in 5-5.

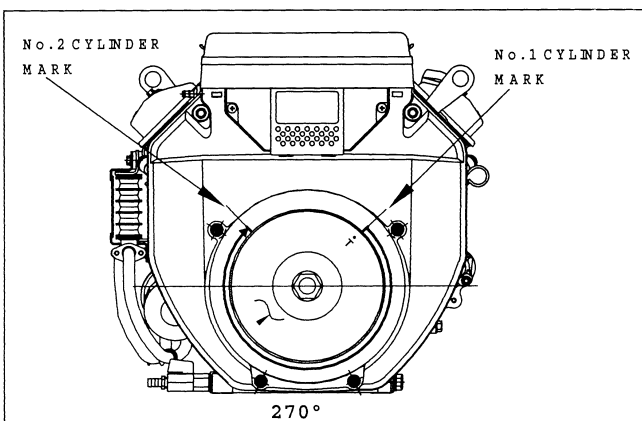


FIGURE 6-1

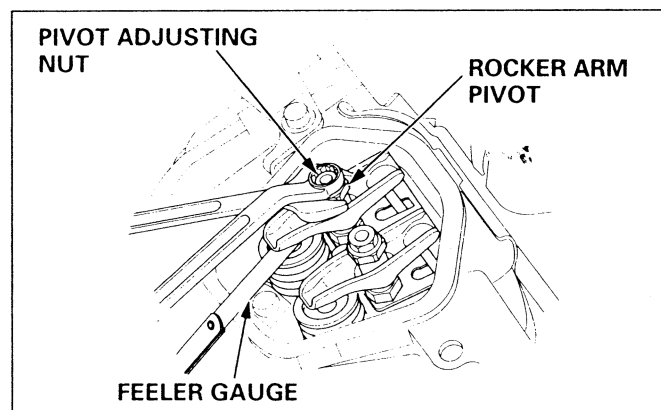


FIGURE 6-2

EXHAUST SYSTEM

See Figure 6-3. The exhaust system is a welded assembly that consists of two exhaust manifolds, muffler, and exhaust pipe. This welded assembly is mounted inside the heat shield assembly.

Always service a leaking exhaust system before running a genset. Never try welding a broken or leaky tailpipe, muffler or manifold.

⚠ WARNING Exhaust gas is deadly. The exhaust system must not leak and must discharge all engine exhaust away from people, buildings and areas where exhaust can accumulate.

Liability for injury, death, damage and warranty expense due to the use of an unapproved muffler or due to modifications becomes the responsibility of the person installing the unapproved muffler or performing the modifications. Use Onan approved exhaust system parts.

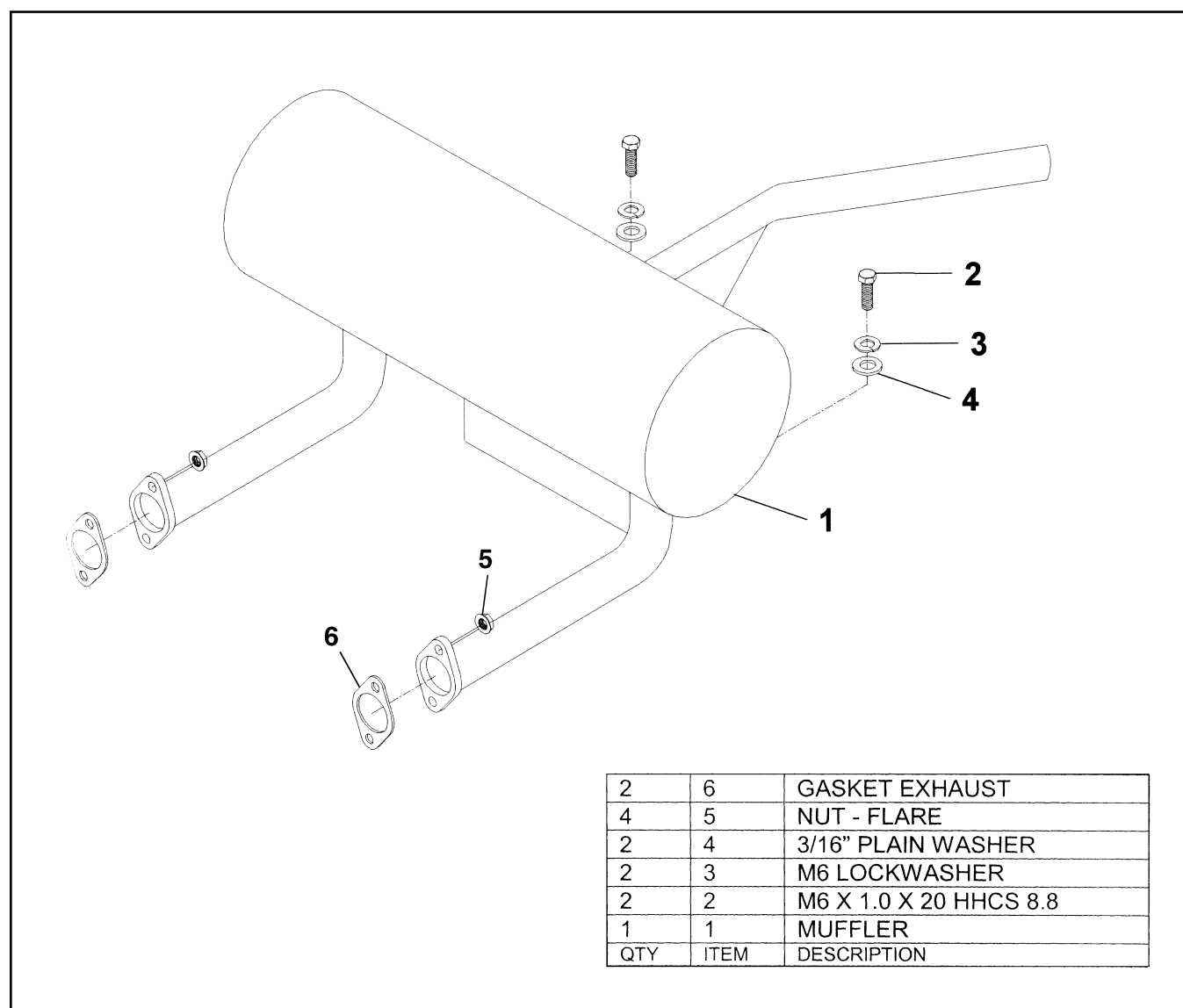


FIGURE 6-3. EXHAUST SYSTEM

Spark Plugs

The genset has two spark plugs. The spark plugs must be in good condition and have the proper gap for top engine performance. See Specifications.

To prevent crossthreading a spark plug, always thread it in by hand until it seats. Then tighten the spark plug according to Thread Torques (Page 2-2). Alternatively, if the spark plug is being reused, turn it with a wrench an additional 1/4 turn. If the spark plug is new, turn it an additional 3/8 to 1/2 turn.

If the engine misses or performance otherwise deteriorates, remove and examine the spark plugs for signs of the following problems:

Light tan, gray or reddish deposits - Normal

One spark plug fouled - Broken spark plug cable, low cylinder compression

Soot fouled - Wrong spark plug heat range (too cold), duty cycle too short for engine to reach normal operating temperature

Fuel fouled - Wrong spark plug heat range (too cold), faulty choke operation, overly rich fuel mixture, dirty air filter

Oil fouled - Malfunctioning crankcase breather, worn rings, worn valve guides or seals

Burned or overheated - Leaking intake manifold gaskets, lean fuel mixture

Worn - Spark plug service life used up.

Quick Ignition Test

If the engine misfires, test the ignition system as follows to quickly determine if the problem is in the ignition system. First recheck the spark plug cable connection to each spark plug.

⚠ WARNING Gaseous fuels are flammable and explosive and can cause severe personal injury or death. Conduct this test only in a well ventilated area and make sure you cannot smell gas. Keep a Type ABC fire extinguisher handy.

1. Open both access doors and wait several minutes and make sure you cannot smell gas before conducting this test.
2. Remove one of the spark plugs.
3. Reconnect the spark plug cable and lay the spark plug on bare engine metal to ground it.

⚠ WARNING HIGH VOLTAGE. To prevent electric shock do not touch the spark plug or wire during this test.

4. Crank the engine and observe the spark. A strong, consistent spark indicates that the ignition system probably is functioning properly and the problem is elsewhere. If no spark occurs or is weak or inconsistent, go to step 5.
5. Repeat step 4 using a new, or known good spark plug. If still no spark occurs, refer to the Honda Workshop Manual or your service dealer.

MAGNETIC PICK UP

The magnetic pick-up is situated directly below the engine flywheel and is mounted on a bracket that is secured with the engine mounting bolts at the flywheel end.

There is an aperture in the plastic fan cover which allows the tip of the magnetic pick up to be positioned in close proximity to the starter ring gear on the engine flywheel.

The red and black leads from the magnetic pick-up are terminated with “faston” connectors which are connected, respectively, to the blue (MAG PU+) and green (MAG PU -) leads on the Governor Controller Board situated at the top right corner of the engine divider panel.

The operation of the magnetic pick-up can be checked by disconnecting the leads and checking for AC voltage while cranking the engine. The voltage at cranking speed should be approximately 5 VAC. Reconnect the leads after checking.

The voltage at running speed (with the leads connected) should be approx. 22 VAC.

To access the magnetic pick-up, it is necessary to remove the roof panel, the rear panel and move the engine divider panel as described in Section 5-5.

⚠ WARNING The generator will be inoperable during this adjustment.. Be sure to notify all potentially affected persons before beginning work.

⚠ WARNING Incorrect installation, service, or replacement of parts can result in severe personal injury or death, and/or equipment damage. Service personnel must be trained and qualified to perform electrical and mechanical work.

Magnetic Pick-up Adjustment

1. Remove the Air Filter Assembly and the Fan Cover.
2. Turn the flywheel until the crown of one of the teeth on the flywheel ring gear is exactly opposite the tip of the magnetic pick up.

3. Slide a 0.012 inch feeler gauge between the crown of the tooth and tip of the magnetic pick up.
4. If necessary, adjust by loosening the locknut and rotating the magnetic pick-up until the correct clearance is obtained.
5. Retighten the lock nut and re-check the clearance.
6. Rotate engine one revolution by hand to make sure ring gear does not hit magnetic pick-up.
7. Refit the Fan Cover and the Air Filter Assembly.
8. Refit the engine divider panel, the rear panel and the roof panel as described in 5-5

Removal and replacement of the magnetic pickup

9. Disconnect the magnetic pick-up leads from the governor controller board leads..
10. Cut the cable ties and remove the leads from the split conduit.
11. Loosen and remove the bolts which secure the flywheel end of the engine and the magnetic pick up bracket to the engine bracket.
12. Remove the magnetic pick-up bracket with the magnetic pick-up threaded into it.
13. The magnetic pick-up bracket is not reversible, so note that the top side is the side through which the tip of the pick up is protruding. Mark it as such if necessary.
14. Loosen the lock nut, and unscrew the pick up from the bracket.
15. Screw a new magnetic pick-up into the bracket, so that the tip of the pick up protrudes about 1/2 inch to 5/8 inch (about 13 to 15 mm) on the side marked top.
16. Fit the magnetic pick-up and bracket to the engine bracket, and refit the engine mounting bolts.
17. Make sure that the tip of the pick-up is positioned directly below the center line of the crankshaft, before tightening the engine mounting bolts.
18. Adjust the pick-up as described in steps 2) through 5) under “Magnetic Pick-up Adjustment” in this section.
19. Refit the Fan Cover and the Air Filter Assembly.
20. Refit the engine divider panel, the rear panel and the roof panel as described in Section 5-5.

GOVERNOR ROD AND ACTUATOR

See Figure 6–10. The genset controller operates the throttle by means of the governor rod and actuator to maintain a nearly constant engine speed (frequency) as the electrical load on the genset varies.

To determine if the governor actuator is defective or needs to be replaced, check the coil resistance

with the two leads disconnected. Coil resistance should be 1.5 to 3.0 ohms and open to ground. Also, with the leads disconnected, apply 12 VDC to the actuator. The actuator should open the carburetor to full throttle.

If necessary, replace the governor actuator per governor actuator setting procedure located at section 6-5.

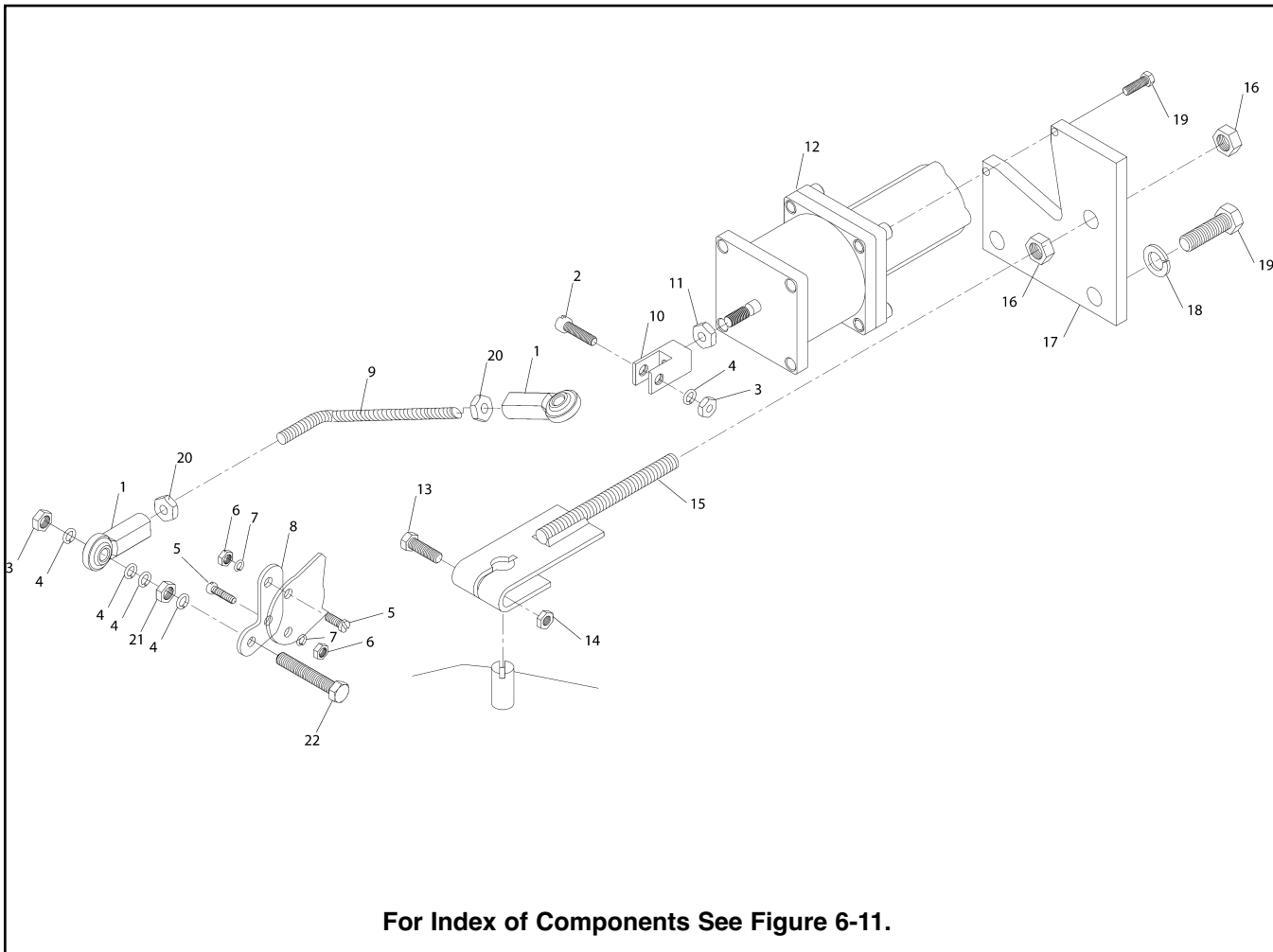


FIGURE 6–10. GOVERNOR ROD AND ACTUATOR

GOVERNOR ADJUSTMENT

The relationship between the Governor Actuator and the Carburetor has been carefully set during assembly, to give the required performance and should not require adjustment.

If either the Actuator or the Carburetor is replaced, then the settings should be checked and adjusted as follows.

1. To access the Carburetor and Governor Rod
 - a. Remove the roof panel (Section 5-3).
 - b. Remove the Air Cleaner assembly (Section 4-5).
2. To adjust the Carburetor
 - a. Holding the butterfly closed by hand, adjust the Idle Stop Screw (Figure 6-11 Item 23) until a 0.006" (0.15mm) feeler gauge is a snug fit between the Idle Stop Screw and the Carburetor Throttle Lever (Figure 6-11 Item 8).
 - b. Remove the feeler and turn the Idle Stop

Screw a further one and one quarter turns (1 1/4) clockwise.

3. To adjust the Actuator
 - a. Check that the carburetor is correctly adjusted as above.
 - b. Check that the distance from the actuator housing to the shoulder at the end of the ground portion of the actuator shaft (Section 6-11 Item 24) is 0.500" (1/2 inch or 12.7mm).
 - c. If adjustment is required, loosen the clevis lock nut (Figure 6-11 Item 11).
 - d. Holding the clevis (Figure 6-11 Item 10) from turning, rotate the actuator shaft until the correct dimension is obtained.
 - e. Tighten the clevis locknut and recheck the dimension.
 - f. Move the actuator through its range of motion by hand, verifying that the linkage is free at both the idle and full throttle positions.
4. Refit the Air Cleaner (Section 6-8) and the roof panel (Section 5-3)

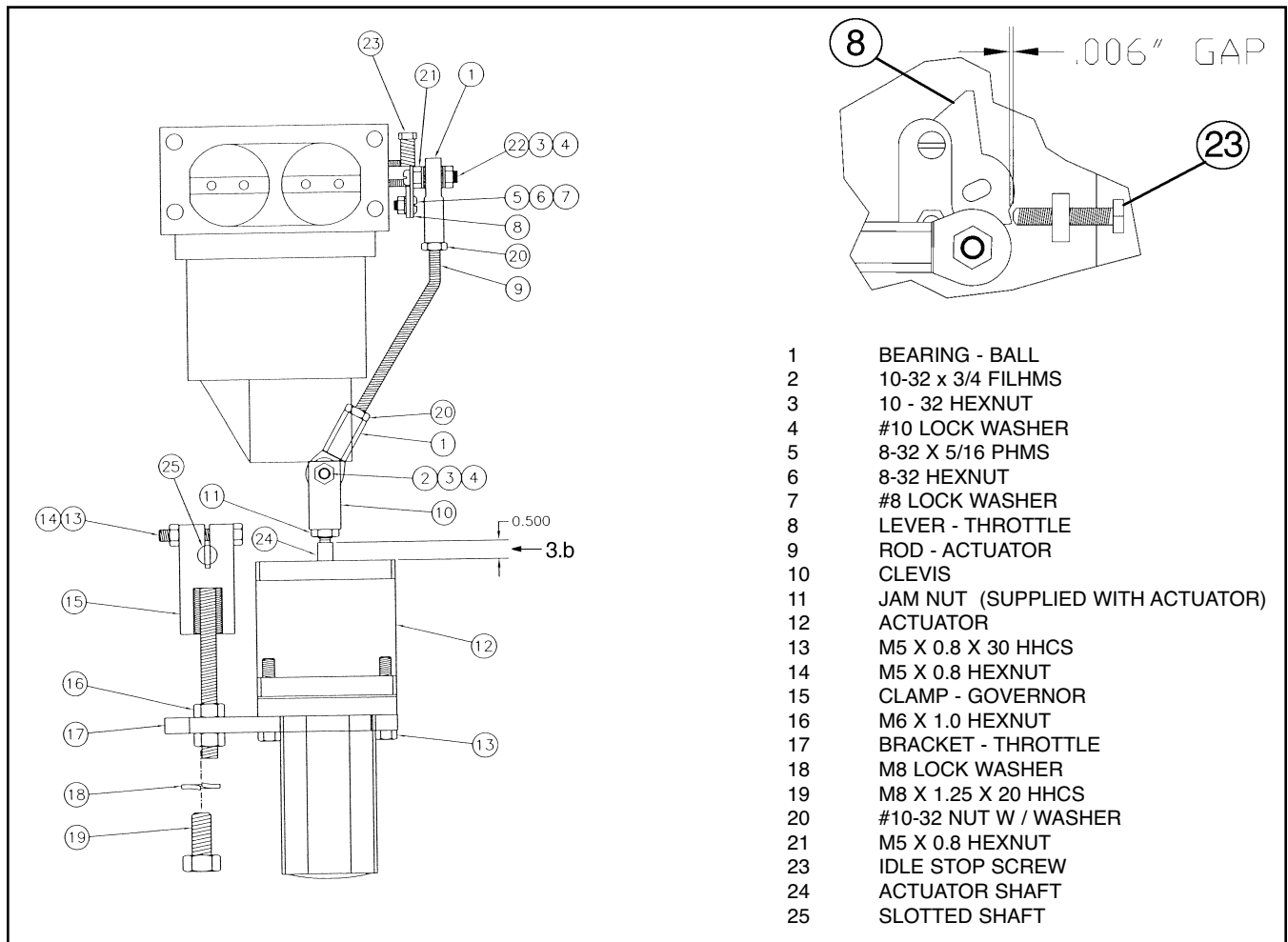


FIGURE 6-11

FUEL SYSTEM

The engine is equipped with a fuel system that is designed to run on either natural gas or LP vapor.

A genset purchased to use natural gas or LP vapor can not be converted to use LP liquid.

The genset leaves the factory set up for natural gas. If the genset uses LP vapor, follow conversion instructions in the Installation Manual.

⚠ WARNING Gaseous fuels are flammable and explosive and can cause severe personal injury or death. Do not smoke if you smell gas or are near fuel tanks or fuel-burning equipment or are in an area sharing ventilation with such equipment. Keep flames, sparks, pilot lights, electrical switches and arc-producing equipment and all other sources of ignition well away. Keep a type ABC fire extinguisher handy.

NFPA Standard No. 58 requires all persons handling and operating gaseous fuel to be trained in proper handling and operating procedures.

⚠ WARNING Gaseous fuel leaks into an inadequately ventilated space can lead to explosive

accumulations of gas. Natural gas rises when released into the air and can accumulate under overhanging hoods and inside housings and buildings. LPG sinks when released into the air and can accumulate inside housings, basements and other below-grade spaces. Precautions must be taken to prevent gas leaks and the accumulation of gaseous fuel in the event of a leak.

Air Cleaner Assembly

Disassembly:

1. Open the side access doors. (See Removing and Installing the Housing Panels in Section 5.
2. Loosen the four spring clips (Figure 6–12).
3. Lift off the air cleaner element assembly.
4. Remove the five screws that secure air cleaner housing (two screws to the support bracket and the three screws to the carburetor) and remove housing.

Reassembly: Reassembly is the reverse of disassembly. Use a new gasket between the adapter and the carburetor.

Note: When replacing the air cleaner housing, take care to reattach the crankcase breather hose to the stub on the bottom face of this housing. A pair of long needle nose pliers will be helpful for this.

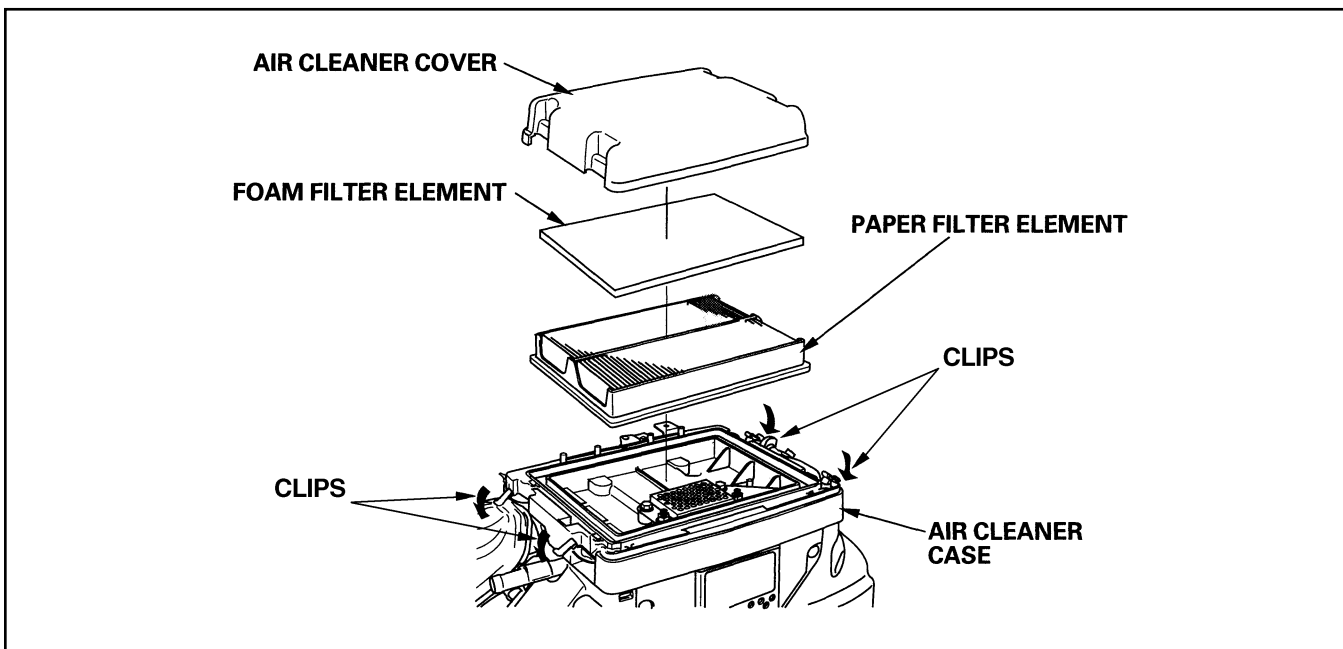


FIGURE 6–12. AIR CLEANER

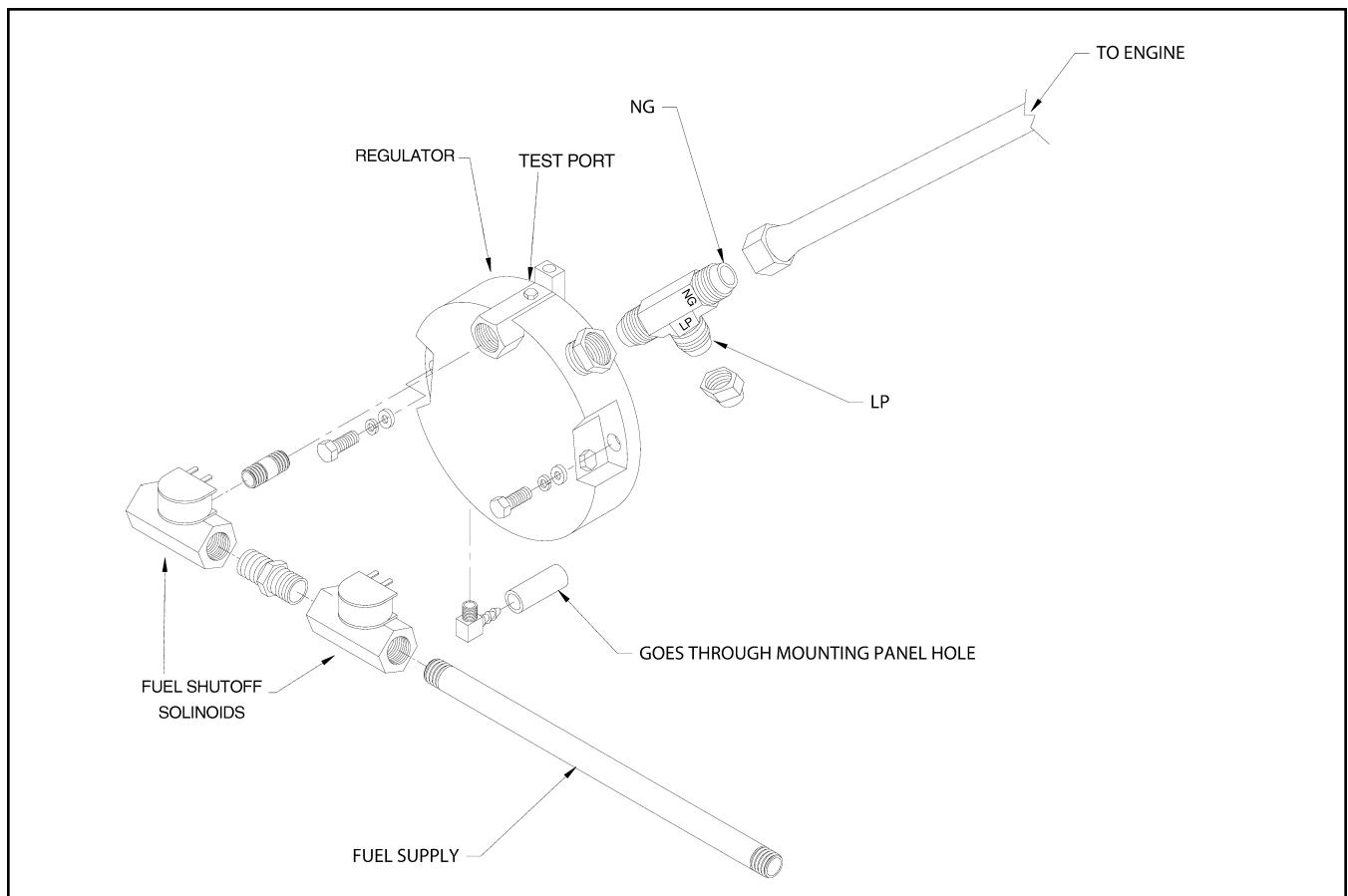


FIGURE 6-13. LP VAPOR/NATURAL GAS FUEL SYSTEM

NG / LP Vapor Fuel System

The fuel system for NG or LP vapor consists of a 3/4" NPT female gas supply connection (located toward the bottom right hand side of the front access panel), supplying fuel through a pair of fuel shut off solenoids (plumbed in series, wired in parallel) to a gas pressure regulator (located at the top left hand corner of the engine divider panel). A vent tube from the regulator protrudes through the engine divider panel to ensure that the atmospheric pressure at the regulator and at the carburetor is balanced.

The gas pressure regulator fitted to the unit provides constant gas pressure to the carburetor under varying load conditions. It is pre-set and sealed to comply with EPA and CARB regulations.

The change of gas supply between NG and LP vapor is accommodated simply by fitting the engine hose to the appropriate outlet on the tee-piece at the regulator (refer to Figure 6-13). No

adjustment to the regulator is necessary or possible.

Adjusting Inlet Gas Supply Pressure:

There is a pressure test port on the inlet side of the regulator. To access this test port it is necessary to remove the roof panel (Section 5-3). The pressures given in the Specifications (Section 2-1) are taken at this point, which is after the fuel shut off solenoids.

A more practical and convenient method of checking and adjusting the inlet pressure is to connect a manometer, by means of a suitable tee piece, between the gas supply and the Fuel Inlet fitting on the unit (Figure 3-2). The manometer should have a scale range of at least 14 inches (350 mm)

The pressure at this point, on either NG or LP vapor, should be 2 inches (25mm) WC greater than the pressure given in the Specifications (Section 2-1) to allow for the pressure drop through the fuel solenoid valves.

Adjust the supply pressure as follows:

1. Close the gas supply shut off valve.
2. Disconnect the gas supply pipe, and fit a tee-piece and the manometer.
3. Reconnect the gas supply pipe.
4. Test for leakage by performing a soap bubble test.
5. Open the gas shut off valve.
6. With the genset at rest, adjust the gas supply pressure regulator to obtain between 7 and 13 inches (178-330mm) WC.
7. Start the unit, and while running at no load, note the gas supply pressure. Adjust if necessary.
8. If the genset is operable, check the gas supply pressure under full load. If gas pressure drops below the required minimum of 7 inches (178mm) WC, the gas supply piping may be too small. On an LP vapor supply system, the tank may be too small to provide the required rate of vaporization, or it may not contain enough fuel.
NOTE: Be sure to have all other gas appliances running during this test, to place full demand on the gas supply.
9. Close the gas supply shut off valve
10. Disconnect the manometer, and remove or plug off the tee piece.
11. Open the gas shut off valve
12. Before returning the unit to service, test for leakage, by performing a soap bubble test at any connection point that has been disturbed.

Fuel Solenoid Valve Tests

To access the fuel solenoid valves, remove the

roof panel (Section 5-3)

Replace a leaky fuel solenoid valve or one that fails to open.

To test for leakage, use a test pressure of at least 11 inches (279mm) WC and perform a soap bubble test.

To test for opening, jumper both solenoids across the battery cable connections at the genset. A manometer connected to the test port on the regulator can be used to indicate whether both valves are opening.

⚠ WARNING Gaseous fuels are flammable and explosive and can cause severe personal injury or death. Do not smoke if you smell gas or are near fuel tanks or fuel-burning equipment or are in an area sharing ventilation with such equipment. Keep flames, sparks, pilot lights, electrical switches and arc-producing equipment and all other sources of ignition well away. Keep a type ABC fire extinguisher handy.

NFPA Standard No. 58 requires all persons handling and operating gaseous fuel to be trained in proper handling and operating procedures.

⚠ WARNING Gaseous fuel leaks into an inadequately ventilated space can lead to explosive accumulations of gas. Natural gas rises when released into the air and can accumulate under overhanging hoods and inside housings and buildings. LPG sinks when released into the air and can accumulate inside housings, basements and other below-grade spaces. Precautions must be taken to prevent gas leaks and the accumulation of gaseous fuel in the event of a leak.

7. Generator

GENERAL DESCRIPTION

The YVB generator (Figure 7-1) is a two-pole, revolving field, brush-type design with drip-proof construction. It is regulated by the microprocessor-based genset controller.

The generator rotor and engine crankshaft have a tapered coupling secured by the rotor through-bolt. The other end of the rotor is supported in a sealed, pre-lubricated ball bearing assembly. The cooling blower wheel is bolted to the rotor assembly

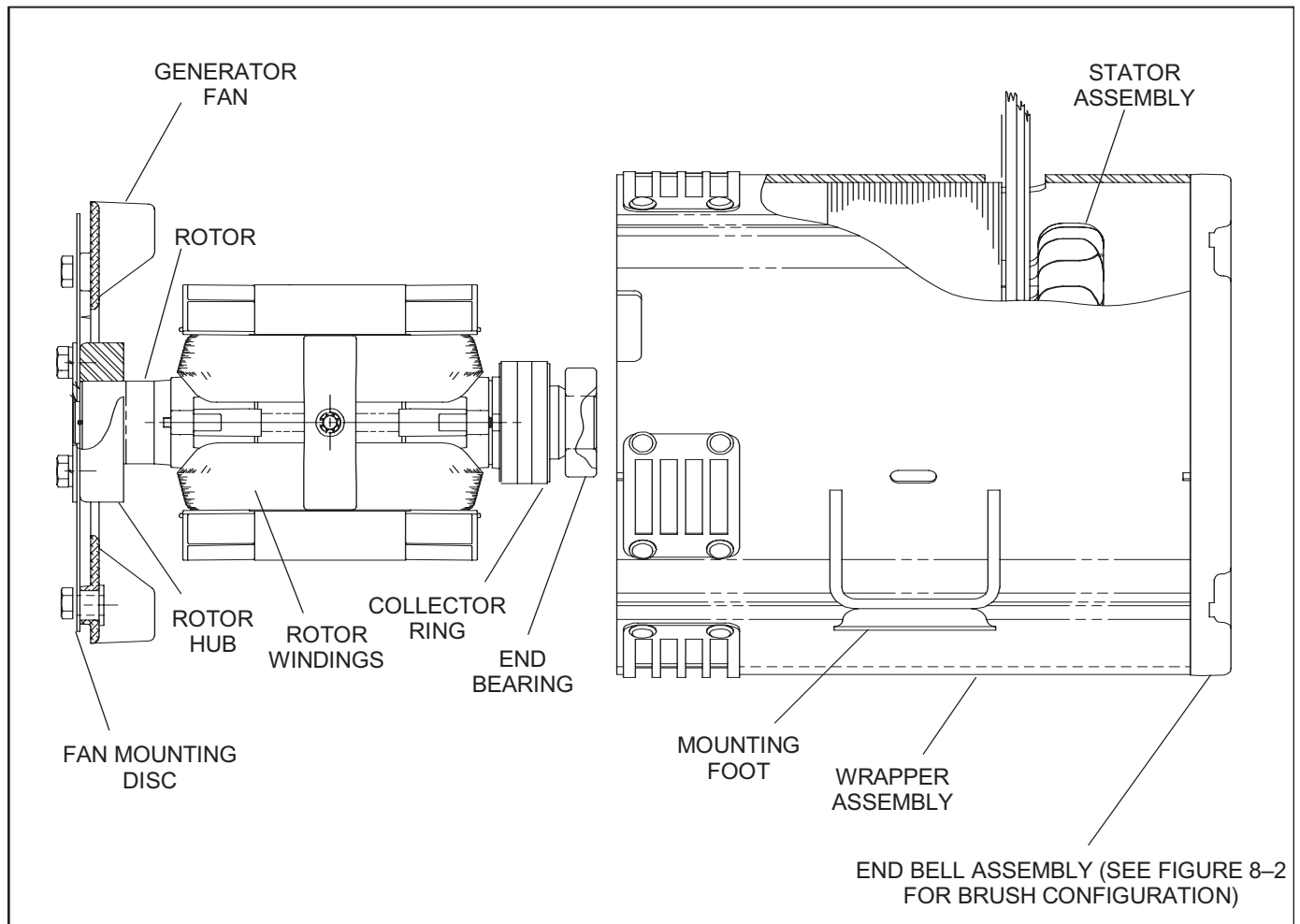


FIGURE 7-1 YVB GENERATOR

SERVICING BRUSHES AND SLIP RINGS

Remove the rear panel to access the generator brushes. See Removing and Installing the Housing Panels in Section 5.

Remove the brush block and inspect for burned brushes and grooved or pitted slip rings and other damage. (Turn the rotor to inspect all the way around the slip rings.)

If everything looks good, check brush wear with a piece of wire marked off as shown in Figure 8-2. Replace the brushes and brush springs if the wire can be inserted more than 1 inch (25 mm) into the hole in the brush holder. (Make sure the wire rests on top of the brush and not on part of the brush spring.)

If the slip rings are grooved or pitted try cleaning them up with a commutator stone. If the slip rings need to be replaced, see Removing and Replacing the Slip Ring Assembly under Generator Assembly/Disassembly in this section.

To replace the brushes or to clean up the slip rings:

1. Disconnect the leads marked **F1** and **F2** from the brush block terminals.
2. Remove the brush block mounting screws (2) and lift out the brush block assembly.

⚠ WARNING Incorrect installation, service, or replacement of parts can result in severe personal injury or death, and/or equipment damage. Service personnel must be trained and qualified to perform electrical and mechanical work. When carrying out the following procedure, be aware of the dangers of working with rotating parts. Take care to keep body parts, hair and loose clothing from coming into contact with rotating parts.

3. If the slip rings need to be cleaned up, insulate the ends of leads **F1** and **F2**, disconnect all leads from the positive (+) terminal of the ignition coil to keep the engine from starting, hold the commutator stone lightly against the slip rings and crank the engine for 3 to 6 seconds. Check the slip rings and repeat the procedure as necessary until the pits and groves have been removed. Clean any resulting debris from the inside of the generator, using compressed air, if available, or a small brush.
4. Replace the brushes and brush springs with

new parts. Connect each brush pigtail to the terminal on its side of the insulating divide (Figure 7-3).

5. Remount the brush block. Center the brushes on the slip rings before tightening the mounting screws.
6. Reconnect the lead marked **F1** to the out-board brush terminal and the lead marked **F2** to the in-board brush terminal and secure.
7. Reassemble Housing as detailed in Section 5.

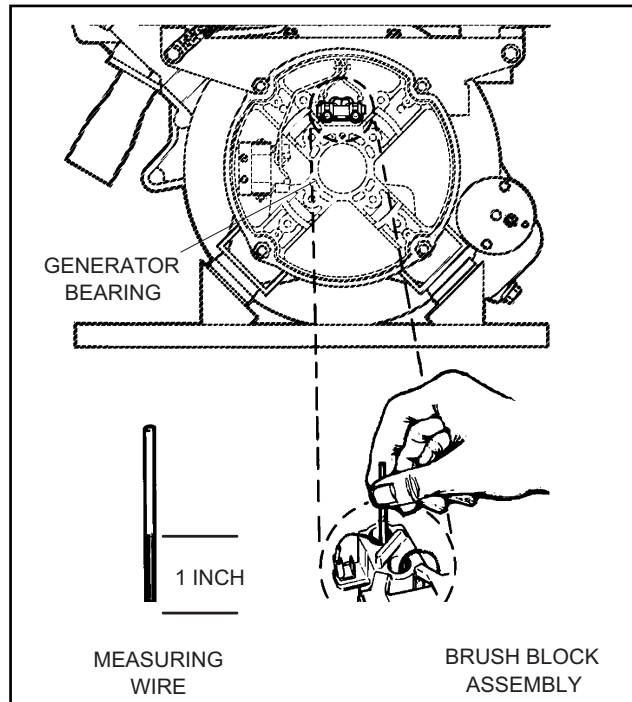


FIGURE 7-2 CHECKING BRUSH WEAR

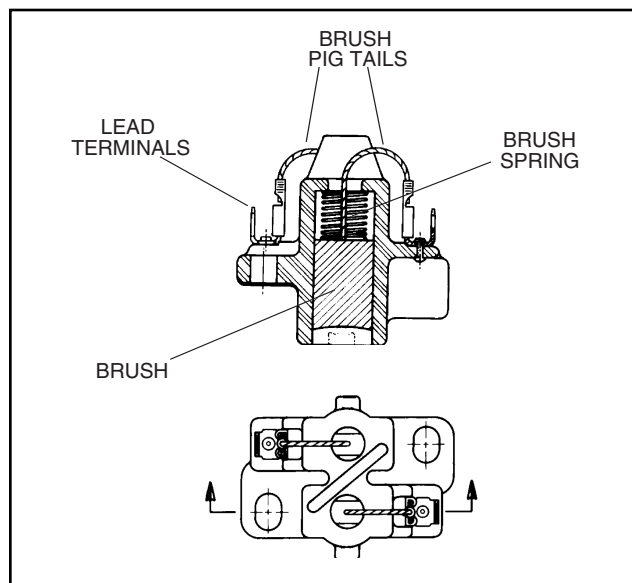


FIGURE 7-3 BRUSH BLOCK ASSEMBLY

GENERATOR DISASSEMBLY/ASSEMBLY

The following sections describe the disassembly and reassembly procedures for the generator. Figure 7-4 illustrates generator assembly.

⚠ WARNING Generator components are heavy and can cause severe personal injury if dropped or lifted during service. Be careful, use appropriate lifting techniques, keep hands and feet clear during service, and use the recommended service procedures.

Disassembly

1. Remove the rear panel. See Removing and Installing the Housing Panels in Section 5.

Check lead markings before disconnecting a lead. If the lead markings do not clearly identify reconnection, mark the leads with tape.

2. Remove the two harness clamps that secure the harness to the outside of the generator (Figure 7-4).
3. Remove the cover from the control box and disconnect stator leads T1 and T4 from the circuit breaker and T2 and T3 from the neutral terminal. Cut necessary cable ties to remove these leads from the harness sleeving up to the rear of the generator.
4. Disconnect leads Q1 and Q2. Connectors are located in the harness sleeving at the rear of the generator (Figure 7-4).
5. Disconnect leads F1 and F2 from the brush block terminals (Figure 7-3).
6. Remove the bonding strap from the generator mounting foot.
7. Remove the exhaust assembly (see Exhaust System in Section 6).

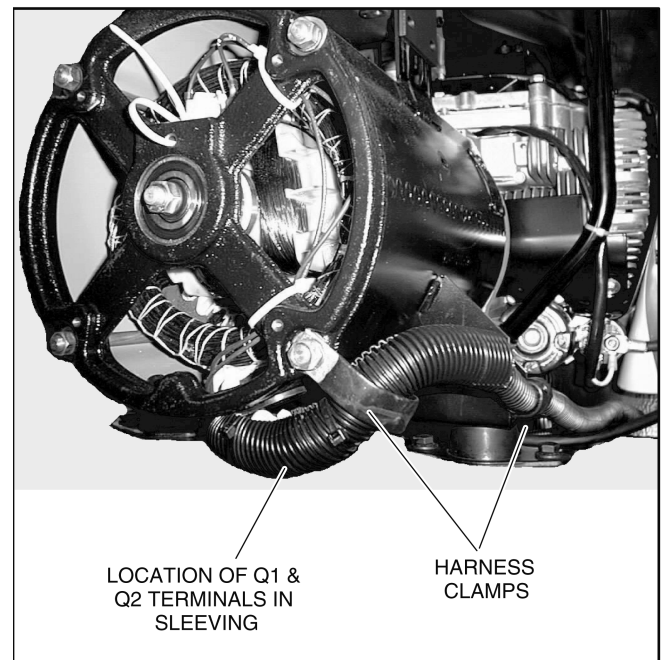


FIGURE 7-4 ALTERNATOR HARNESS

8. To keep from damaging the brushes and to keep them from interfering when remounting the stator, either:
 - A. Remove the brush block assembly by disconnecting the leads marked **F1** and **F2** from the brush block terminals (Figure 7-3) and then removing the two mounting screws, **or**
 - B. Insert a stiff wire through the small hole in the end of the stator housing and into the brush block, to hold the brushes up and out of the way (Figure 7-5). To do this, first pull both brush pigtails to lift the brushes off the slip rings.
9. Remove the two generator vibration isolator center-bolts.
10. Place a piece of "two-by-four" lumber under the rear of the engine mounting plate to support the engine.
11. Remove the four nuts (Figure 7-6 item 20) and lock washers (Item 21) from the generator studs (Item 22). Pry the end bell free of the rotor bearing. Be careful not to damage the brush holder. (Figure 7-6).
12. Pull the stator/wrapper assembly off the rotor and away from the engine, taking care not to scrape stator windings. Set it aside.

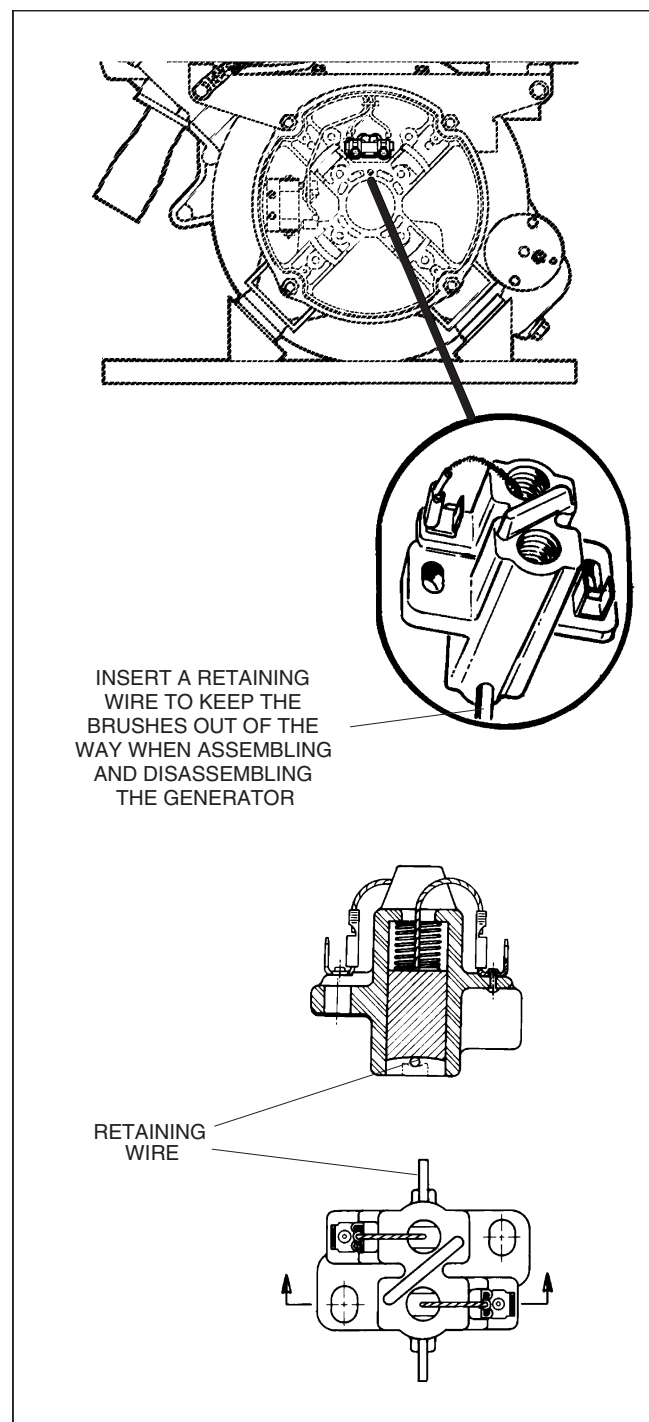


FIGURE 7-5 BRUSH BLOCK ASSEMBLY

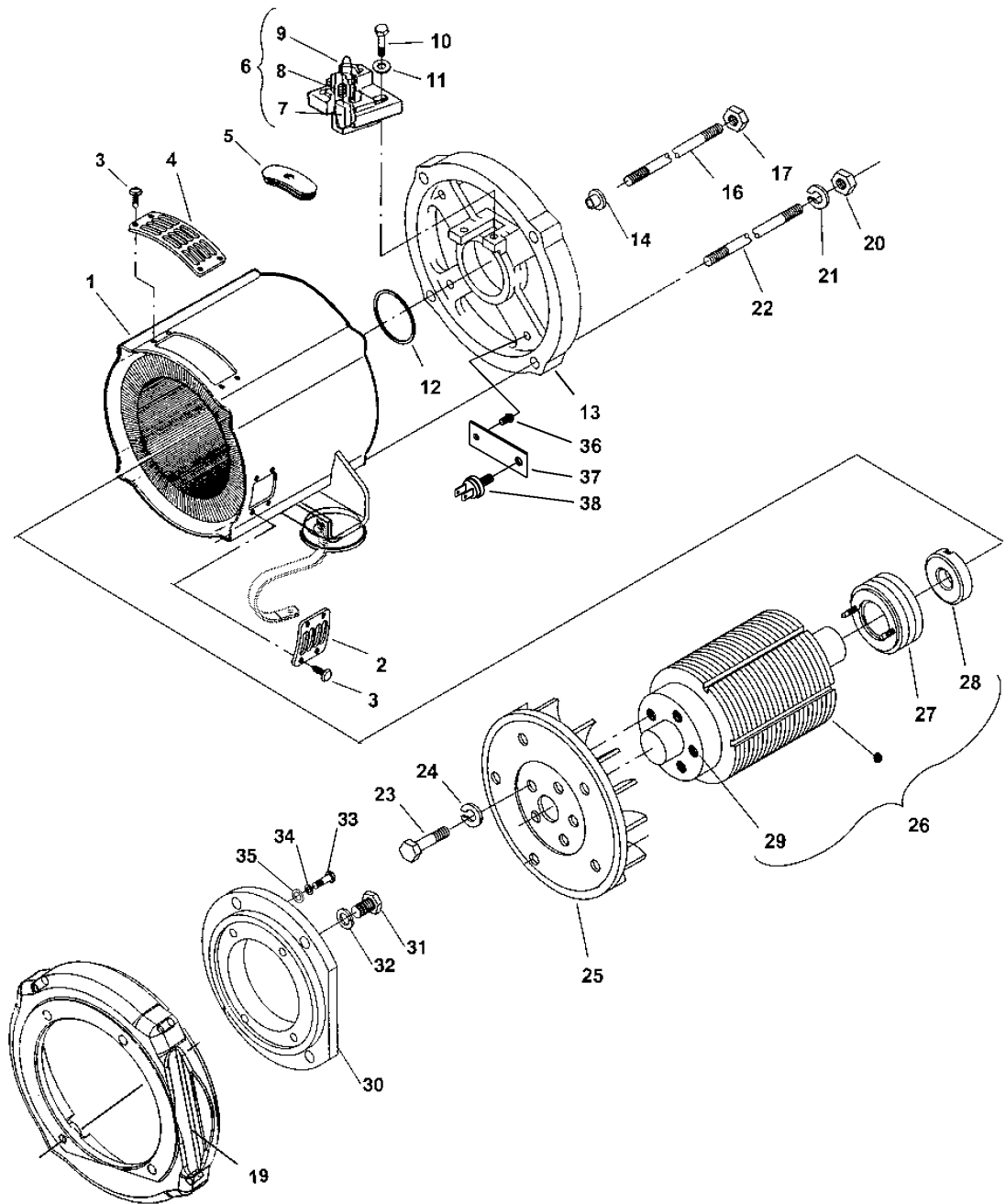


FIGURE 7-6 GENERATOR DISASSEMBLY/REASSEMBLY

Removing the Rotor

1. Remove the rotor through stud. (Use two nuts locked together at the end of the rotor through stud to loosen and remove stud from crankshaft.)
2. Thread in a rotor removal rod (Figure 7-7) and turn it with a screwdriver until it bottoms in crankshaft. Thread in and tighten a 9/16-12 x 1-3/4 inch bolt against the rod until the rotor breaks loose from the crankshaft. A tap with a lead hammer on the rotor assy. May be required. Be careful not to hit the windings.
3. If necessary, replace the bearing and the slip ring assembly as instructed in this subsection.

Remounting the Rotor

Replace the bearing and the slip ring assembly, if necessary, as instructed in this section. Use the rotor removal tool to guide the rotor on. Torque the through bolt to torque indicated in Section 2-2 Thread Torques.

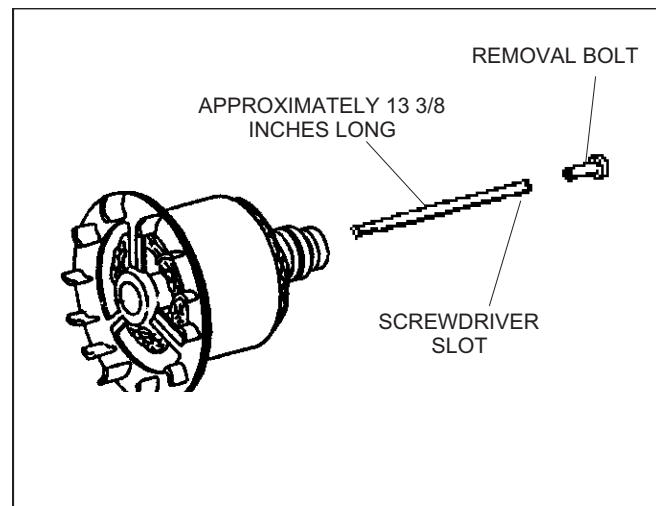


FIGURE 7-7 ROTOR REMOVAL TOOL

Remounting the Stator Housing

Remounting is the reverse of removal. Note the following:

1. Mount the rotor.
2. Make sure the brush block assembly has been removed or that the wire is holding both brushes up and out of the way.
3. Make sure the bearing O-ring is in place in the housing bearing bore.
4. Torque the stator housing nuts, the rotor through stud nut and vibration isolator center bolts to Thread Torques in Section 2.
5. Make sure to secure the bonding strap to the generator mounting foot using one EIT (external and internal toothed) lock washer on each side of the strap terminal for a good electrical connection.
6. Reconnect or reassemble all other parts that were disconnected or removed.
7. Install the brush block assembly if it was removed. If it was left in place, pull the brush pig tails and remove the retaining wire. If necessary, loosen the brush block mounting screws, align the brush block so that the brushes are centered on the slip rings and retighten the mounting screws.
8. Connect the lead marked **F1** to the outboard brush terminal and the lead marked **F2** to the inboard brush terminal.

9. Replace all cable ties that were removed during this procedure.

Removing and Replacing the Rotor Bearing with the Rotor already removed.

Use a gear puller to remove the bearing from the rotor shaft if it or the slip ring assembly is to be replaced, otherwise leave it in place. If the bearing is to be reused, make sure the fingers of the gear puller bear on the inner race of the bearing only.

⚠CAUTION The bearing will be damaged and become unusable if force is applied to the outer race either when pulling it off or pressing it on.

Replace the bearing as follows:

1. Replace the slip ring assembly first, if necessary.
2. Bearing is glued on. Follow the instructions in the Bearing Replacement Kit.

Removing and Replacing the Slip Ring Assembly

Unsolder the two rotor leads from the slip ring assembly and pull the slip ring assembly off with a gear puller. Tape the key to the shaft to keep from losing it if a new assembly is not going to be installed right away.

Press on a new slip ring assembly with a press, making sure the key is in place and the assembly is aligned with the key. Solder the two rotor leads to the solder terminals on the slip ring assembly.

TESTING THE GENERATOR

The following tests and adjustments can be performed without disassembly of the generator.

⚠ WARNING Many troubleshooting procedures present hazards that can result in severe personal injury or death. Only qualified service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Review safety precautions on inside cover page.

Testing Field Flash Voltage

⚠ WARNING Incorrect installation, service, or replacement of parts can result in severe personal injury or death, and/or equipment damage. Service personnel must be trained and qualified to perform electrical and mechanical work. When carrying out the following procedure, be aware of the dangers of working with rotating parts. Take care to keep body parts, hair and loose clothing from coming into contact with rotating parts.

Field flash voltage can be tested at the brush holder terminals with a DC voltmeter (Figure 7-8). With the engine cranking, check for 12 VDC. If present, check for open windings in the rotor. If not present, alternator harness or genset control (A11) PCB is defective.

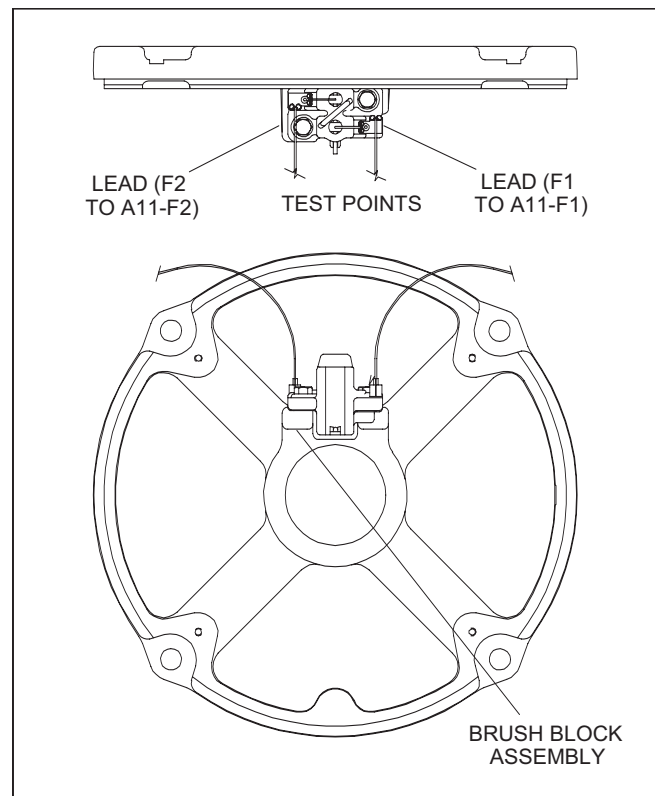


FIGURE 7-8 FIELD VOLTAGE TEST POINTS

Testing the Rotor

The generator circuits can be tested without having to disassemble the generator. It is recommended that an ohmmeter be used to check for open circuits and an insulation resistance meter for grounded circuits. An ohmmeter can be used to check for grounded circuits, but it may not be able to detect marginal insulation breakdown.

Testing for Grounds: Check for grounds between each slip ring and the rotor shaft, Figure 7-9. Use a Megger or insulation resistance meter which applies 500 VDC at the test leads. Perform test as follows:

1. Isolate the rotor windings by disconnecting the two leads to the brush holder.
2. Connect test leads between each ring and the rotor shaft in turn. Meter should register 100,000 ohms or greater.
3. If less than 100,000 ohms, rotor is questionable. Thoroughly dry the rotor and retest.
4. Replace a grounded rotor with a new identical part.

Testing for Open or Shorted Windings: Perform this test with an accurate meter such as a digital ohmmeter.

1. Isolate the rotor windings by disconnecting the two leads to the brush holder.
2. Using ohmmeter, check resistance between F1 and F2 collector rings ($25.47 \text{ ohms} \pm 10\%$), Figure 8-10.

If there is a large difference, replace the defective rotor with new, identical part.

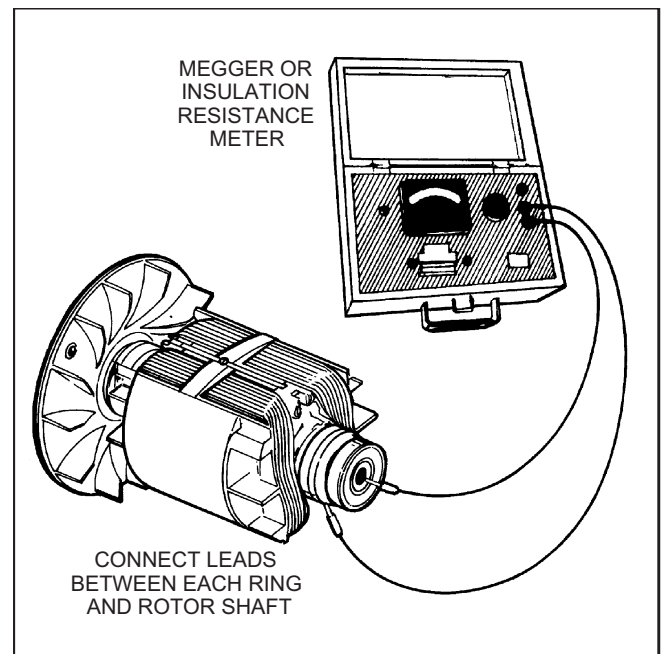


FIGURE 7-9 TESTING ROTOR FOR GROUNDS

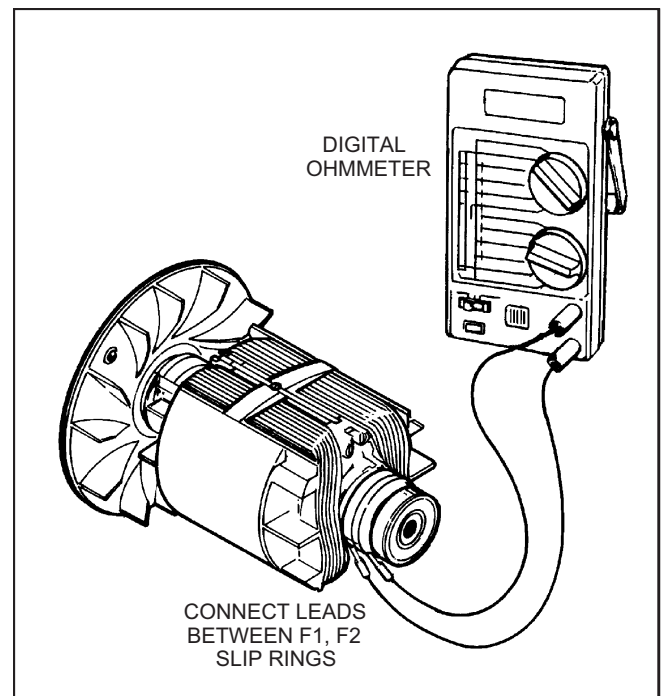


FIGURE 7-10 TESTING ROTOR FOR AN OPEN

Testing Generator Stator

Using proper test equipment, check the stator for grounds, opens, and shorts in the windings. Isolate the stator windings by disconnecting all six stator leads. Test each winding T1-T2, T3-T4, Q1-Q2.

Testing for Grounds: Some generators have ground connections to the frame. Check wiring diagram. All stator leads must be isolated for testing.

Use a megger or insulation resistance meter which applies not more than 500VDC to the test leads (Figure 7-11). Test each stator winding for short to laminations. A reading of less than 100,000 ohms indicates a questionable stator. Thoroughly dry the stator and retest. T1,T2,T3,T4,Q1,Q2 : be open to ground.

Testing for Open or Shorted Windings: Test for continuity between coil leads as shown in Figure 7-12. Use an accurate instrument for this test such as a Wheatstone Bridge. Resistance should correspond to the values shown below.

- Resistance values ($\pm 5\%$):
 - T1-T2: 0.095 ohms
 - T3-T4: 0.095 ohms
 - Q1-Q2: 1.185 ohms
 - T1-T3: open
 - T1-T4: open
 - T2-T3: open
 - T2-T4: open
 - T1,T2,T3,T4-Q1: open
 - T1,T2,T3,T4-Q2: open

If a winding is shorted, open or grounded, replace the stator assembly. Before replacing the assembly, check the leads for broken wires or insulation.

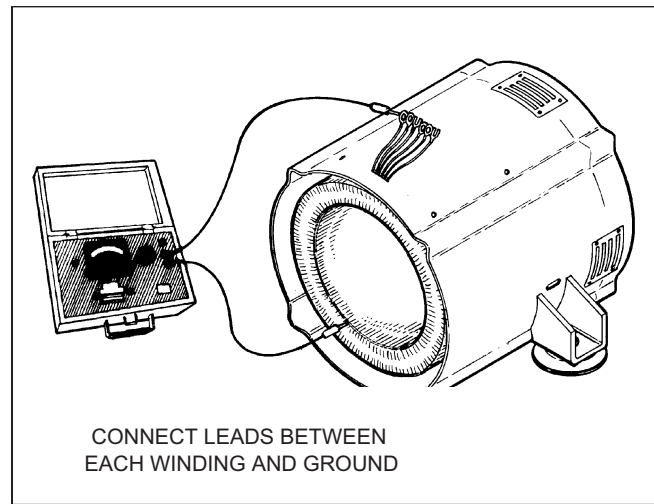


FIGURE 7-11 TESTING STATOR WINDING FOR GROUNDS

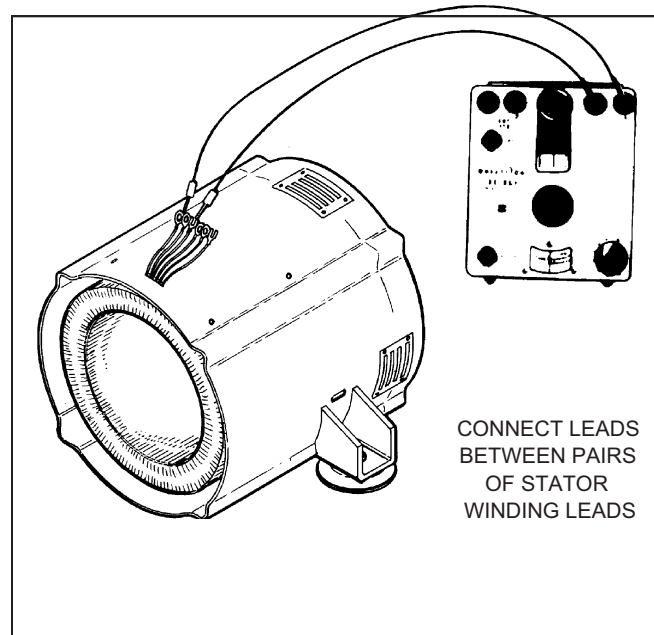


FIGURE 7-12 TESTING STATOR WINDING RESISTANCE

8. Genset Control PCB (A11)

The genset control PCB (A11) is a fully potted assembly with one connector (P1) and is mounted by one screw to the generator control assembly. A bracket is also used at the top of the control PCB for additional bracing for removing and installing the P1 connector. To remove the control PCB, perform the following steps.

3. Remove the side access doors, top and front access panel. (See Removing and Installing the Housing Panels in Section 5 for instructions and important safety precautions.)
4. Remove connector P1 from the control PCB (Figure 8-1). To remove connector, insert small blade screwdriver into slot of connector
5. retainer tab. Move tab downward to release and remove connector.
6. Remove retainer screw from the base of the control PCB.
7. Loosen the lower two screws and remove the upper four screws that secure the control assembly panel to the engine divider panel.
8. Lightly pull back on the top of the control assembly until the connector on the back of the control PCB clears the cutout in the back of the engine divider panel.
9. With the control assembly tilted back, lift up on the control PCB to release the bracket from the control assembly and remove the control PCB.

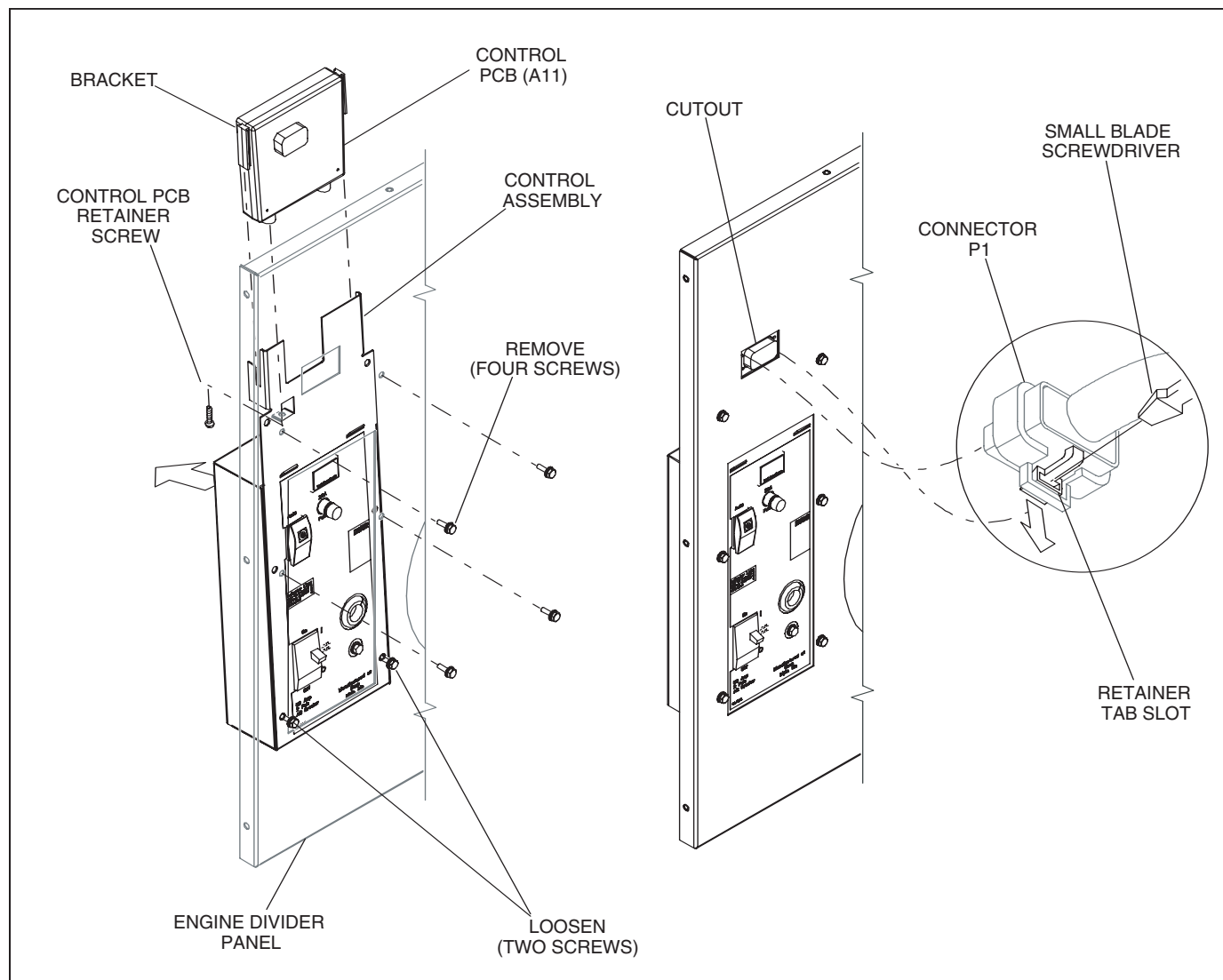


FIGURE 8-1 REMOVING CONTROL PCB

The control PCB uses a microprocessor with embedded software. The micro-controller supports the traditional functions of genset control along with

voltage regulation and extensive diagnostics (see Troubleshooting, Section 11). Figure 8–2 is a block diagram of control PCB inputs and outputs.

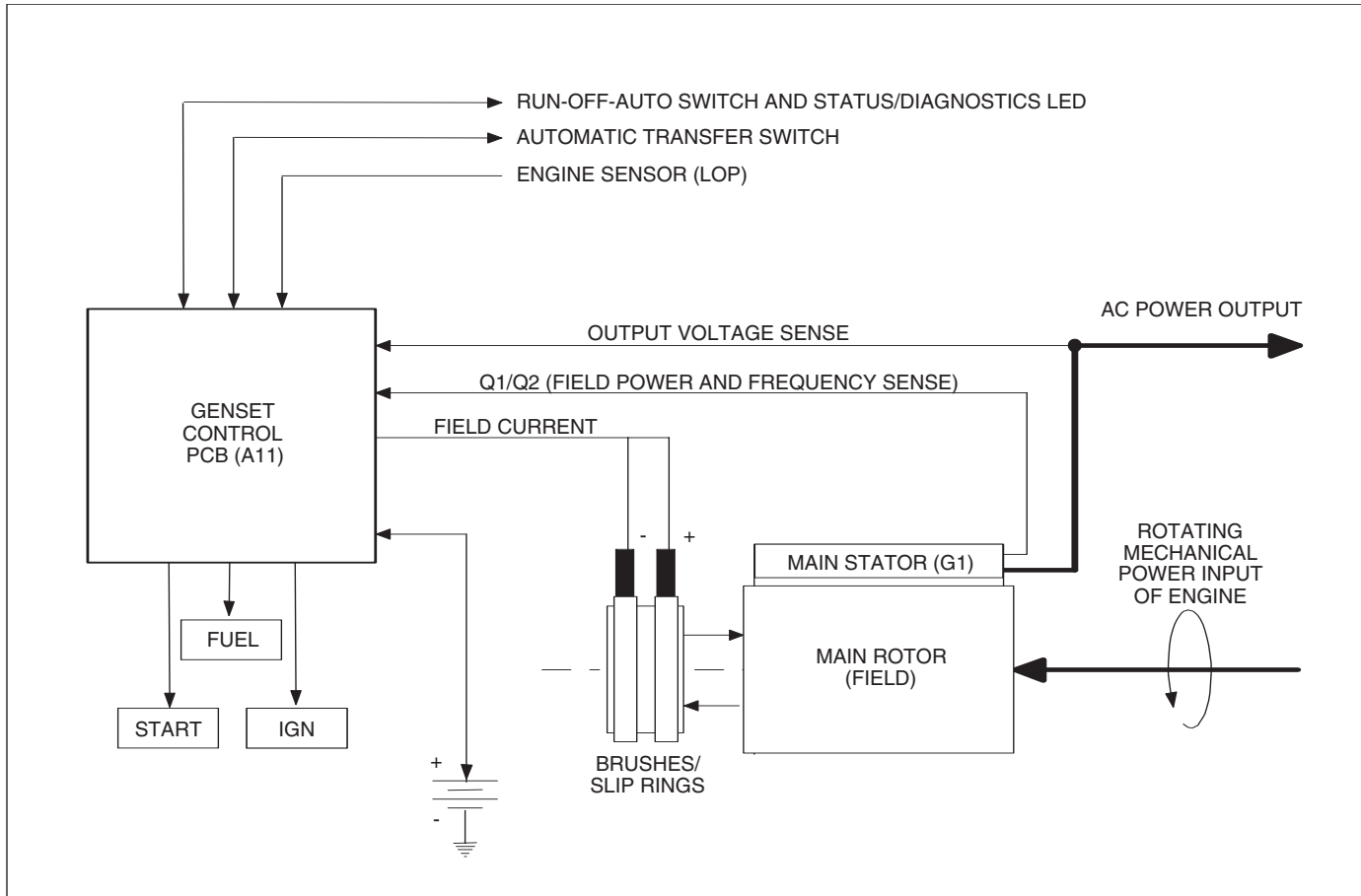


FIGURE 8-2 GENSET CONTROLLER INPUTS AND OUTPUTS

9. Governor Controller Board (A12)

The genset governor controller board (A12) is mounted on the engine divider panel, directly above the control PCB. It receives the governing control (tachometer) signal from the magnetic pick-up and B+ from the control PCB. **THIS CONTROLLER IS PROGRAMMED SPECIFICALLY FOR THE 12GRCA. IN ORDER TO ENSURE CORRECT OPERATION OF THE 12GRCA UNIT, THIS CONTROL MUST BE ORDERED FROM AN AUTHORIZED DEALER.**

The governor controller board outputs a DC voltage that drives the governor actuator, which in turn moves the carburetor throttle to maintain an engine speed of 3600 RPM (60 Hz). The input from the magnetic pick-up and B+ from the control PCB can signal the governor controller board to shut the engine off under the following adverse conditions:

- If power (B+) is lost to the control PCB
- Any control PCB shutdown fault
- If signal from the magnetic pick-up stops

Under all these circumstances, governor controller board shuts down the genset. The governor controller board is a non-serviceable component.

Note: This controller possesses a warm up feature to assist with low ambient start up. As part of

the warm up sequence, the genset will climb to 2600 rpm and maintain this speed for up to 8 seconds. After 8 seconds, the unit will then ramp up until it reaches its running speed of 3600 rpm. The total time for the start up sequence to occur can be as long as 18 seconds.

GOVERNOR CONTROLLER BOARD TROUBLESHOOTING

When starting the genset, the actuator should open the carburetor to approximately 1/2 throttle. If not, first check the operation of the actuator and linkage (see Governor Rod and Actuator in Section 6) and also the ignition system (see Ignition System in Section 6) and then check the following to determine if the governor controller board is defective.

The status indicator on the governor controller board should light for 1 second, then off for 1 second and then remain on during cranking and genset operation. If the indicator flashes more than once, the governor controller board is defective.

If the indicator does not light, check all connections before replacing the governor controller board. Also check for +12 VDC at the ignition coil. If not present the controller PCB may be defective.

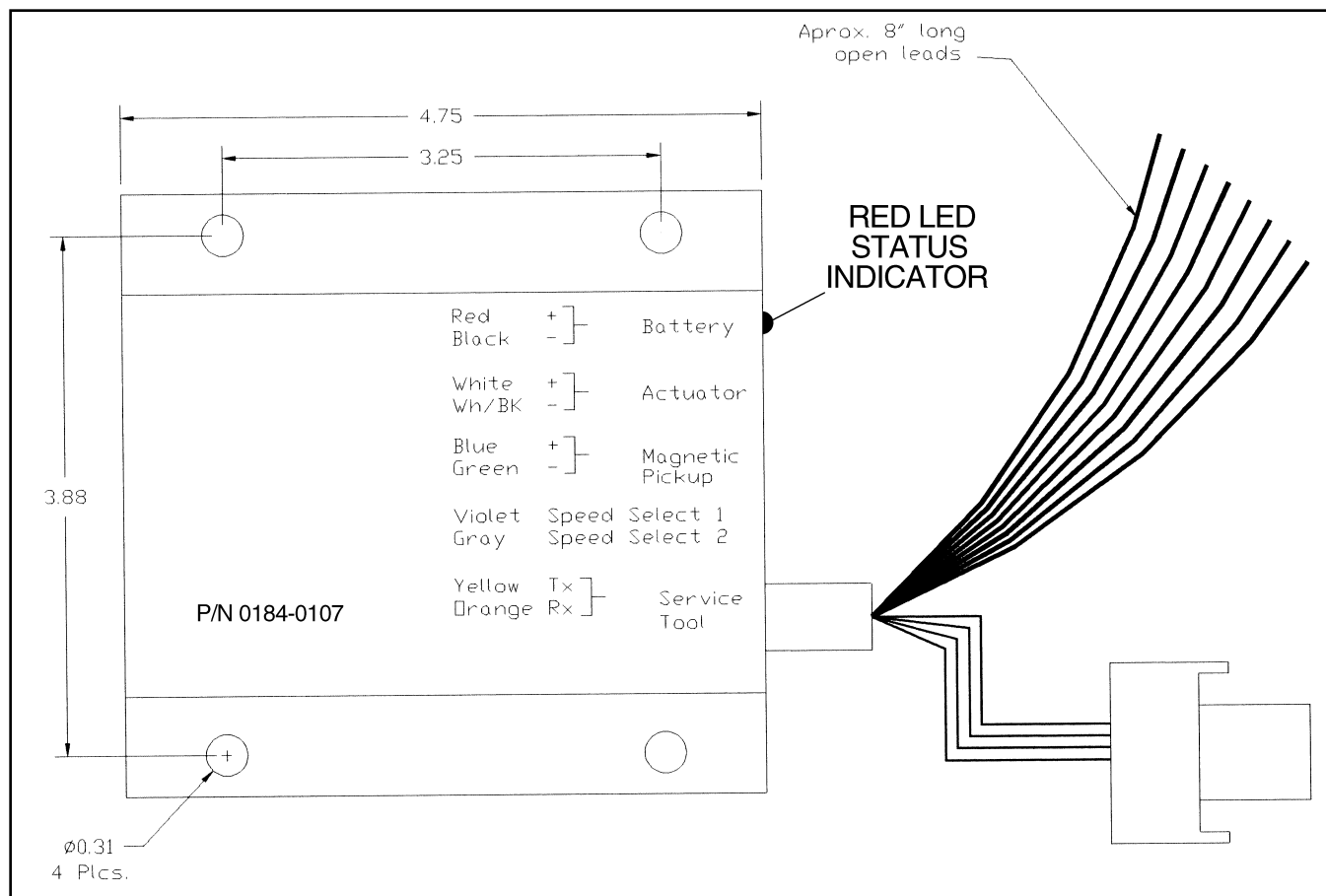


FIGURE 9-1. GOVERNOR CONTROLLER BOARD A12

10. Troubleshooting

Table 10–1 provides troubleshooting guidance for a genset that fails to start or that shuts down. The genset controller has an extensive diagnostic capability and its fault codes are covered in numerical sequence in Table 110–1. Gaps in the code numbers are for codes that do not apply to this genset.

Most shutdowns can be prevented by proper maintenance and use of the genset—maintaining oil levels, keeping battery connections clean and tight, and not overloading the genset.

STATUS/DIAGNOSTICS LIGHT ON THE GENSET CONTROL SWITCH

The genset controller causes the status/diagnostics LED to indicate a fault code if there is a fault shutdown that requires maintenance or service. There are distinct (longer) pauses between repetitions of the code blink transmissions.

Single-Digit Fault Code – A single-digit fault code is indicated by a corresponding number of blinks. For example:

Code No. 4: blink-blink-blink-blink-long pause repeat code

Two-Digit Fault Code – A two-digit fault code is indicated by two sets of blinks separated by a short pause. The first set corresponds to the tens digit and second to the ones digit. For example:

Code No. 32: blink-blink-blink-pause-blink-blink-long pause-repeat code

FAULT CODE LEVEL

There are two levels of fault codes. Level One is a “single digit” fault code that indicates engine faults (possibly correctable by customer) or that there is a level two fault.

Level Two fault is a “two digit” fault code that requires repair by an authorized service representative.

DISPLAYING LEVEL ONE/TWO FAULT CODES

Immediately following a fault shutdown, the indicator light will blink a Level One fault code and will stop after five minutes. To restore and read this fault, perform the following:

9. Disconnect the remote start wire from the terminal block of the control assembly (TB1-5). This will prevent accidental starting of the genset by the transfer switch while performing this procedure.
10. Grasp the side of the Run/Off/Auto switch and toggle the switch three times between Off and Auto within five seconds.
11. The Level One fault code will be displayed. If a Level One fault code “3” is displayed, a Level Two fault has occurred. To display the Level Two code, toggle the switch one more time between Off and Auto.
12. See Table 10–1 for troubleshooting guidance of indicated fault code.

Note: The fault displayed is the last fault logged and will remain in memory even though the condition has been corrected and the genset is running normally.

⚠ WARNING Automatic startup of the genset while performing maintenance or service can cause severe personal injury or death. Push the control switch to Off and disconnect the negative (–) battery cable from the battery to keep the genset from starting up while working on it.

⚠ WARNING Hot engine parts can cause severe burns. Always allow the engine time to cool before performing any maintenance or service.

TABLE 10–1. TROUBLESHOOTING

⚠ WARNING Some genset service procedures present hazards that can result in severe personal injury or death. Only qualified service personnel with knowledge of fuels, electricity, and machinery hazards should perform genset service. See Safety Precautions.

NO RESPONSE WHEN THE CONTROL SWITCH IN THE RUN POSITION

(Marginal batteries, connections, or charging system)

Corrective Action:

1. Replace **Fuse F1** (B+) if blown.
2. Clean and tighten the positive (+) and negative (–) battery cable connections at the battery and genset.
3. Recharge or replace the battery. Refer to the battery manufacturer’s recommendations.
4. Test the battery charging system and service as necessary. See Flywheel Alternator - Section 6.
5. Push the control switch to **Auto** and try starting the genset through the transfer switch control. Replace control switch **S2** if the genset can be operated remotely but not locally.
6. Resettable fuse on genset control PCB is open. Check for short to ground in the starter, fuel solenoid, ignition, field flash circuits.
7. Replace the genset control PCB (see Section 8).

NO POWER—GENSET RUNNING, RUN LIGHT ON

(Line circuit breaker OFF or tripped or faulty wiring)

Corrective Action:

1. Turn on or reset the line circuit breaker on the genset.
2. Turn on or reset the line circuit breakers on the main distribution panel.
3. Check for proper transfer switch function.
4. Check genset AC output connections at the equipment (transfer switch) and reconnect as necessary.
5. Attempt to reset the circuit breakers and measure electrical continuity across terminals. Replace a circuit breaker that does not close or that has measurable resistance across the contacts.
6. Check all AC wiring connections in genset.

LOW OIL FAULT—CODE NO. 2

(The controller sensed that the low oil pressure cutoff did not open within 10 seconds of starting or closed during operation)

Corrective Action:

1. Check engine oil level and add oil as necessary. Repair oil leaks.
2. Drain excess oil. (Excess oil leads to foaming and a consequent loss of oil pressure.)
3. Repair the low oil pressure cutoff switch (**S1**) wiring or replace defective switch.
4. Service a worn lubricating system and/or engine according to Engine Subsystems (Section 5) and/or Honda recommendations).

TABLE 10–1. TROUBLESHOOTING (CONT.)

⚠ WARNING Some genset service procedures present hazards that can result in severe personal injury or death. Only qualified service personnel with knowledge of fuels, electricity, and machinery hazards should perform genset service. See Safety Precautions.

SERVICE CHECK FAULT—CODE NO. 3

(A Level Two fault occurred)

Corrective Action: Check the second–level fault code. See Displaying Level One/Two Fault Codes in this section.

OVERCRANK FAULT—CODE NO. 4

(Cranking exceeded 20 seconds without engine starting)

Corrective Action:

1. Open any closed fuel shutoff valves.
2. Check the governor linkage for binding and service as necessary (see Governor Linkage and Actuator in Section 6).
3. Check magnetic pick-up for proper operation (See Section 6-5).
4. Fill the LPG fuel tank if less than half full. On cold days the LPG container may have to be kept at least half full to provide the rate of vaporization required to keep up with genset fuel demand. LPG with more than 2.5 percent butane will not vaporize below 32° F (0° C). Use HD-5 grade LPG.
5. Inspect/secure the spark plug cable on the spark plugs.
6. Service the air cleaner.
7. Check for a blocked exhaust system and service as necessary.
8. Check fuel solenoid valve operation (see Fuel System in Section 6).
9. Check the gas supply pressure and adjust as necessary (see Fuel System in Section 6).
10. Conduct the ignition system tests and service as necessary (see Ignition System in Section 6).
11. Check the governor controller board (see Section 9).
12. Conduct a cylinder compression test and service the engine if it is worn or malfunctioning.

OVERVOLTAGE FAULT—CODE NO. 12

(Controller not able to regulate to rated voltage)

Corrective Action:

1. Service the brushes and slip rings as necessary (see Servicing Brushes and Slip Rings in Section 8).
2. Replace the genset control PCB (see Section 8).

UNDERVOLTAGE FAULT—CODE NO. 13

(Controller not able to regulate to rated voltage)

Corrective Action:

1. Turn the genset line circuit breaker **OFF**. If the genset runs without shutting down, run the genset with fewer connected loads.
2. Check power factor. Disconnect loads that cause a power factor of 0.5 or less.
3. Service the brushes and slip rings as necessary (see Servicing Brushes and Slip Rings in Section 7).
4. Test the generator field, stator and quadrature windings for opens or shorts. Replace the generator rotor or stator assembly if winding resistance is not as specified in Section 7.
5. Replace the genset control PCB (see Section 8).

TABLE 10-1. TROUBLESHOOTING (CONT.)

⚠ WARNING Some genset service procedures present hazards that can result in severe personal injury or death. Only qualified service personnel with knowledge of fuels, electricity, and machinery hazards should perform genset service. See Safety Precautions.

OVERFREQUENCY FAULT—CODE NO. 14

(Controller not able to regulate to rated frequency)

Corrective Action:

1. Check the governor linkage for binding and service as necessary (see Governor Linkage and Actuator in Section 6).
2. Check the governor controller board (see Section 9).

UNDERFREQUENCY FAULT—CODE NO. 15

(Controller not able to regulate to rated frequency)

Corrective Action:

1. Turn the genset line circuit breaker OFF. If the genset runs without shutting down, run the genset with fewer connected loads.
2. Fill the LPG fuel tank if less than half full. On cold days the LPG container may have to be kept at least half full to provide the rate of vaporization required to keep up with genset fuel demand. LPG with more than 2.5 percent butane will not vaporize below 32° F (0° C). Use HD-5 grade LPG.
3. Inspect/secure the spark plug cable on the spark plugs.
4. Service the air cleaner.
5. Check fuel solenoid valve operation (see Fuel System in Section 6).
6. Check the gas supply pressure and adjust as necessary (see Fuel System in Section 6).
7. Conduct the ignition system tests and service as necessary (see Ignition System in Section 6).
8. Check for a blocked exhaust system and service as necessary.
9. Check the governor linkage for binding and service as necessary (see Governor Linkage and Actuator in Section 6).
10. Check magnetic pick-up for proper operation (See Section 6-5).
11. Check the governor controller board (see Section 9).
12. Conduct a cylinder compression test and service the engine if it is worn or malfunctioning.
13. Replace the genset control PCB (see Section 8).

AC OUTPUT SENSE FAULT—CODE NO. 27

(Controller unable to sense output voltage)

Corrective Action:

1. Check AC sense circuitry (Voltage Sense Input signal to genset control PCB) for continuity. See Wiring Diagram in Section 11.
2. Check resistance of AC sense transformer:
 - H1 to H2 - 309 ohms $\pm 10\%$
 - X1 to X2 - 391 ohms $\pm 10\%$
3. Replace the genset control PCB (see Section 8).

TABLE 10–1. TROUBLESHOOTING (CONT.)

⚠ WARNING Some genset service procedures present hazards that can result in severe personal injury or death. Only qualified service personnel with knowledge of fuels, electricity, and machinery hazards should perform genset service. See Safety Precautions.

HIGH BATTERY VOLTAGE FAULT—CODE NO. 29

(Voltage across battery system greater than 17.5 volts)

Corrective Action:

1. Test the battery charging system and service as necessary.

LOW CRANKING SPEED FAULT—CODE NO. 32

(Cranking speed less than 180 rpm for more than 2 seconds)

Corrective Action (When engine is cranking slowly):

1. Clean and tighten the positive (+) and negative (–) battery cable connections at the battery and at the genset.
2. Recharge or replace the battery. See the battery manufacturer's recommendations.
3. Replace the engine oil with oil of proper viscosity for the ambient temperature (p. 2–1). (High oil viscosity can slow cranking speed.)
4. Test the battery charging system and service as necessary.

Corrective Action (When engine appears to be cranking normally):

1. Disconnect genset control connector **P1** (refer to Section 8 to remove connector **P1**) and check for electrical continuity across pins **P1-1** and **P1-10** (field windings). If the circuit is open, service the generator brush block and slip rings and repeat the test. Service or replace the generator rotor if the circuit is still open (Section 7). (Speed sense signal is generated from this circuit.)
2. Disconnect genset control connector **P1** and check for electrical continuity across pins **P1-3** and **P1-9** (quadrature windings). Replace the generator stator assembly if the circuit is open (Section 7).
3. Replace the genset control PCB (see Section 8).

CONTROL CARD FAILURE FAULT—CODE NO. 35

(Microprocessor EEPROM error during self-test)

Corrective Action: Replace the genset control PCB (See Section 8).

TABLE 10-1. TROUBLESHOOTING (CONT.)

⚠ WARNING Some genset service procedures present hazards that can result in severe personal injury or death. Only qualified service personnel with knowledge of fuels, electricity, and machinery hazards should perform genset service. See Safety Precautions.

MECHANICAL FAULT—CODE NO. 36

(Engine stopped without command by controller)

Corrective Action:

1. Fill the LPG fuel tank if less than half full. On cold days the LPG container may have to be kept at least half full to provide the rate of vaporization required to keep up with genset fuel demand. LPG with more than 2.5 percent butane will not vaporize below 32° F (0° C). Use HD-5 grade LPG.
2. Inspect/secure the spark plug cable on the spark plugs.
3. Service the air cleaner.
4. Check continuity through S5 switch at idle and during operation.
5. Check fuel solenoid valve operation (see Fuel System in Section 6).
6. Check the gas supply pressure and adjust as necessary (see Fuel System in Section 6).
7. Disconnect genset control connector **P1** (refer to Section 8 to remove connector **P1**) and check for electrical continuity across pins **P1-1** and **P1-10** (field windings). If the circuit is open, service the generator brush block and slip rings and repeat the test. Service or replace the generator rotor if the circuit is still open (Section 7). (Speed sense signal is generated from Q1 - Q2 circuit.)
8. Check pin connections to controller.
9. Conduct the ignition system tests and service as necessary (see Ignition System in Section 6).
10. Check magnetic pick-up for proper operation (see Section 6).
11. Conduct a cylinder compression test and service the engine if it is worn or malfunctioning.
12. Replace the genset control PCB (see Section 8).

FIELD OVERLOAD FAULT—CODE NO. 38

(To many low power factor loads)

Corrective Action:

1. Reduce the number of appliances running at the same time, especially those with high motor starting loads such as air conditioners.
2. Have air conditioners and other appliances checked for proper operation. (A locked compressor rotor can cause very low power factor.)
3. Check pin connections.
4. Check brushes (see Section 7).
5. Test Rotor (see Section 7).

GENERATOR ROTOR FAULT—CODE NO. 41

(Controller failed to sense field voltage)

Corrective Action:

1. Check brushes (see Section 7).
2. Test rotor (see Testing the Generator in Section 7).

PROCESSOR FAULT—CODE NO. 42

(Microprocessor ROM error during self-test)

Corrective Action: Replace the genset control PCB (see Section 8).

TABLE 10–1. TROUBLESHOOTING (CONT.)

⚠ WARNING Some genset service procedures present hazards that can result in severe personal injury or death. Only qualified service personnel with knowledge of fuels, electricity, and machinery hazards should perform genset service. See Safety Precautions.

PROCESSOR FAULT—CODE NO. 43

(Microprocessor RAM error during self-test)

Corrective Action: Replace the genset control PCB (see Section 8).

SPEED SENSE FAULT—CODE NO. 45

(Controller failed to sense quadrature frequency)

Corrective Action:

1. Check all pin connections and pin condition. Replace as necessary.
2. Disconnect genset control connector **P1** (see Section 8 to remove connector **P1**) and check for electrical continuity across pins **P1-1** and **P1-10** (field windings). If the circuit is open, service the generator brush block and slip rings and repeat the test. Service or replace the generator rotor if the circuit is still open (Section 7).
3. Disconnect genset control connector **P1** and check for electrical continuity across pins **P1-3** and **P1-9** (quadrature windings). Replace the generator stator assembly if the circuit is open (Section 7).
4. Replace the genset control PCB (see Section 8).

FIELD SENSE LOST FAULT—CODE NO. 48

(Controller failed to sense field voltage)

Corrective Action: Replace the genset control PCB (see Section 8).

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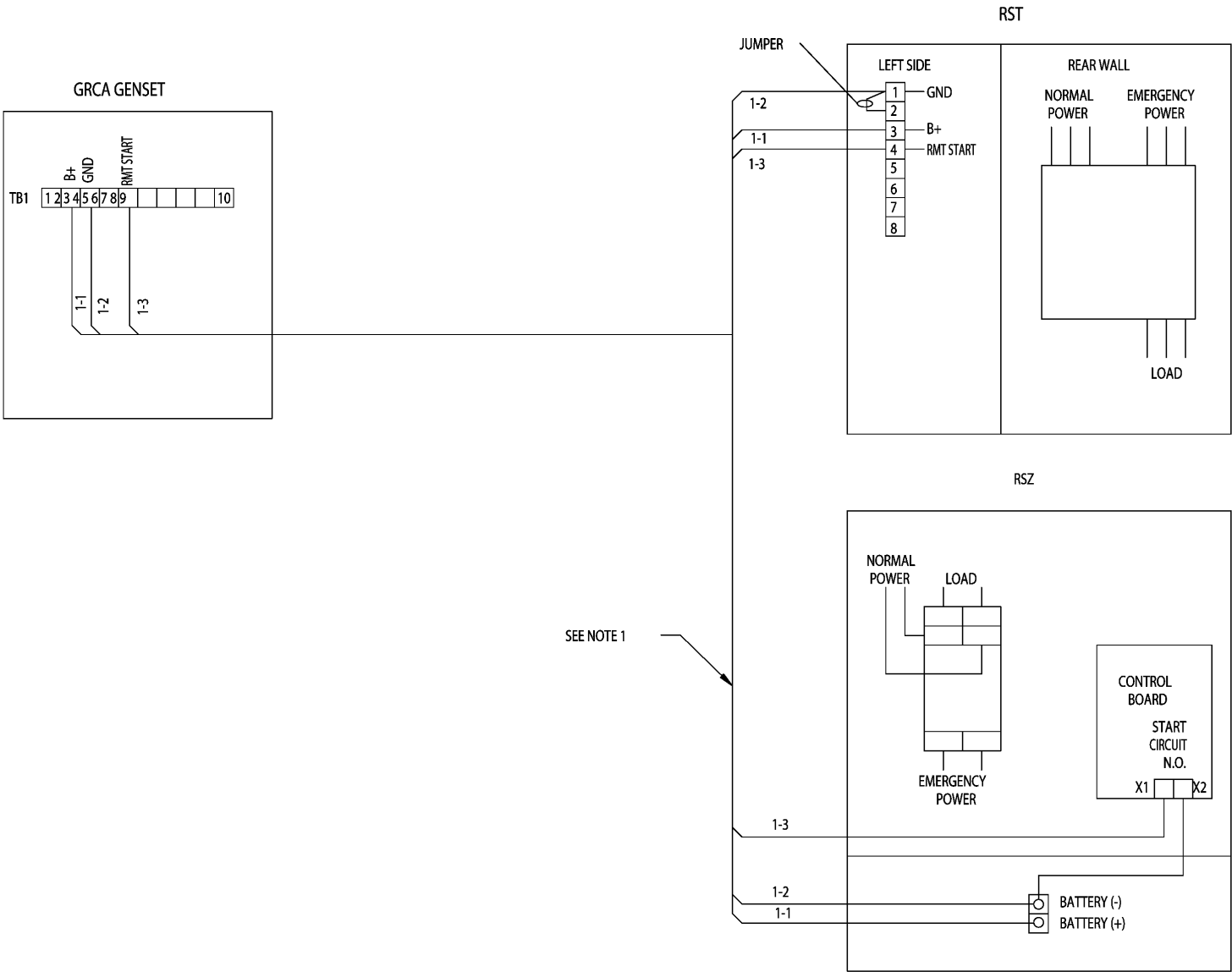
11. Wiring Diagrams

GENERAL

This section consists of the schematic and wiring diagrams referenced in the text. the following drawings are included:

- Page 11–2, Transfer Switch
- Page 11–3, Schematic Diagram
- Page 11–4, Genset Harness
- Page 11–5, Control Harness

REL NO	LTR	NO	REVISION	ZONE	DR	CHKD	APPROVED	DATE
FRD10379	A	1	PRODUCTION RELEASE	-	DD	JM	MILLER	10-02-01
FRD11143	B	1	UPDATED PER ECOR	-	DD	JM	MILLER	11-19-01
FRD11572	C	1	REVISED SHEET 5	-	DD	JM	MILLER	01-04-02
FRD20449	D	1	ADDED SHEET 6	-	LJK	JTM	MILLER	06-16-04

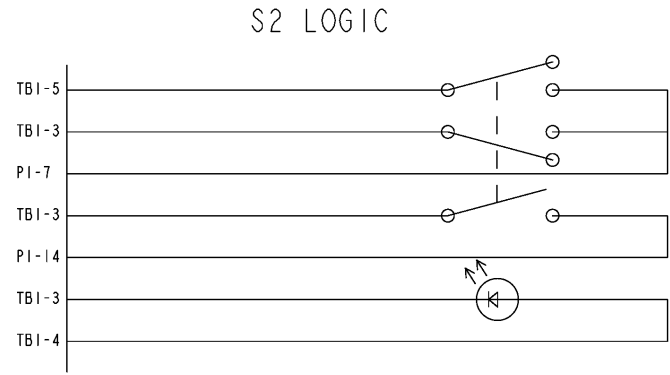


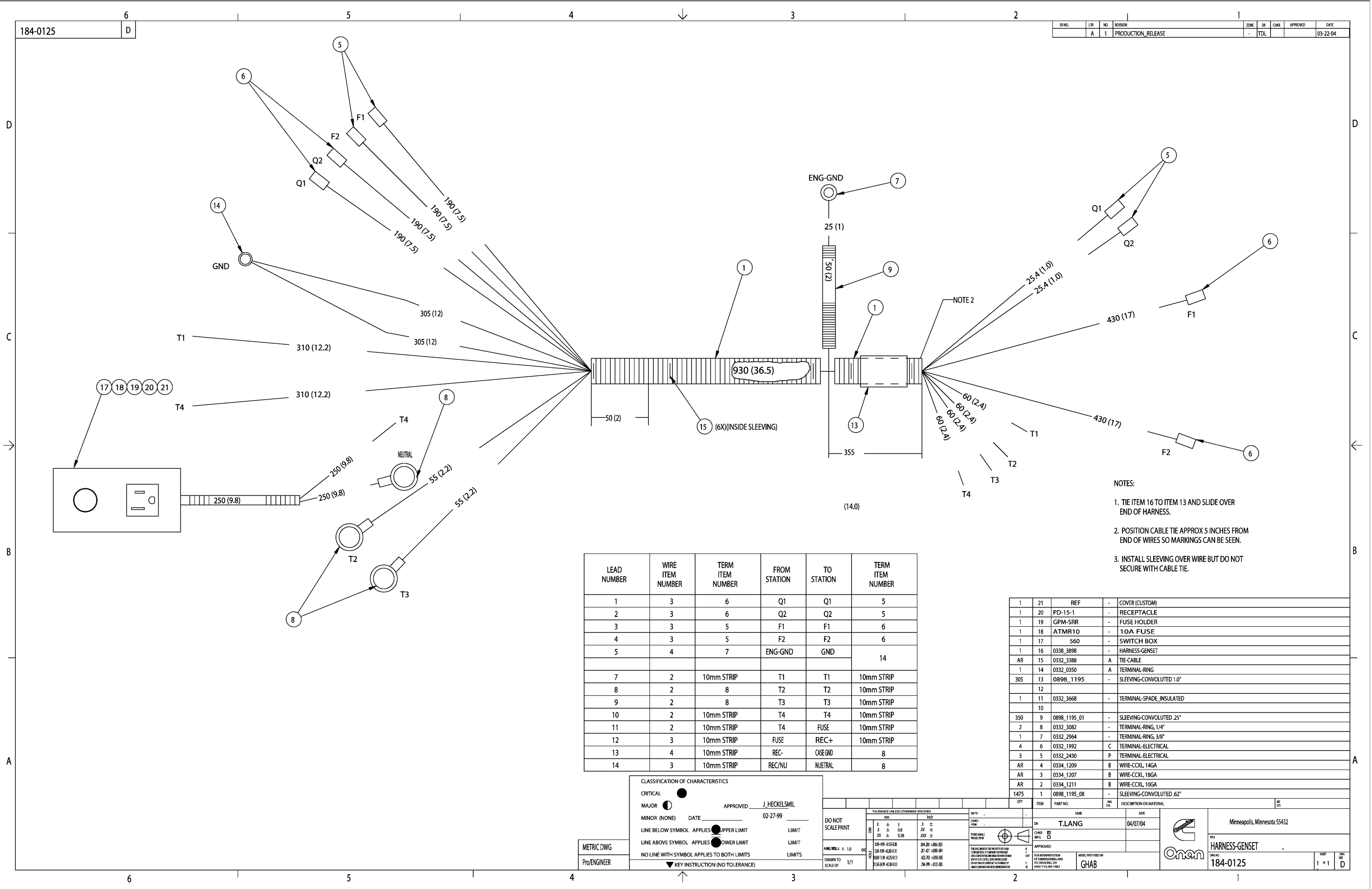
NOTE:
1. SIZE WIRES AS FOLLOWS:

WIRE SIZE (AWG)	DISTANCE IN FEET (ONE WAY)
16	125
14	200
12	300
10	500

2. NORMAL/EMERGENCY LEADS ARE SIZED FOR
LOAD AND LENGTH.

DO NOT SCALE PRINT		TOLERANCE UNLESS OTHERWISE SPECIFIED		QTY		ITEM		PART NO		DESCRIPTION OR MATERIAL		REV	
		mm		Inch		DRAW TO		NAME		DATE			
		X ± 1		X ±		COPY		OR		DDAHLHEIMER			
		X ± 0.8		XX ±		FROM		CHR		J. MILLER		10-02-01	
		XX ± 0.38		XXX ±		PROJECTION		MFG				10-02-01	
ANG TOL: 1.0		0.08 ± 0.08		0.08 ± 0.08		THIS DOCUMENT IS THE PROPERTY OF CUMMINS INC. IT IS TO BE USED ONLY FOR THE PURPOSES SPECIFIED AND IS NOT TO BE REPRODUCED OR TRANSMITTED IN ANY FORM OR BY ANY MEANS WITHOUT THE WRITTEN PERMISSION OF CUMMINS INC.		APPROVED		J. MILLER		10-02-01	
DRAWN TO SCALE OF 1/1		0.08 ± 0.08		0.08 ± 0.08		FOR INTERPRETATION OF DIMENSIONS AND TOLERANCES, SEE ANSI Y14.5M-1982		MODAL FIRST USED ON		HOME_STNDBY		SHEET 1 OF 6	
		0.08 ± 0.08		0.08 ± 0.08						PGA		0630_2252	





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