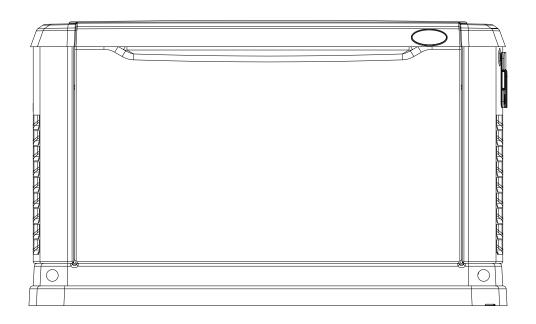
Owner's Manual

10 & 13 KVA Air-cooled, 50 Hertz Automatic Standby Generators



DO NOT LIFT UNIT BY ROOF!

 \triangle

Not intended for use as Primary Power in place of utility or in life-support applications.





DEADLY EXHAUST FUMES. OUTDOOR INSTALLATION ONLY!

INTRODUCTION

Thank you for purchasing this compact, high performance, aircooled, engine-driven generator. It is designed to automatically supply electrical power to operate critical loads during a utility power failure.

This unit is factory installed in an all-weather, metal enclosure that is intended exclusively for outdoor installation. This generator will operate using either vapor withdrawn liquid propane (LP) or natural gas (NG).

NOTE:

This generator is suitable for supplying typical residential loads such as Induction Motors (sump pumps, refrigerators, air conditioners, furnaces, etc.), Electronic Components (computer, monitor, TV, etc.), Lighting Loads and Microwaves.

♦ READ THIS MANUAL THOROUGHLY

If any portion of this manual is not understood, contact the nearest Dealer for starting, operating and servicing procedures.

Throughout this publication, and on tags and decals affixed to the generator, DANGER, WARNING, CAUTION and NOTE blocks are used to alert personnel to special instructions about a particular operation that may be hazardous if performed incorrectly or carelessly. Observe them carefully. Their definitions are as follows:



DANGER A



After this heading, read instructions that, if not strictly complied with, will result in serious personal injury, including death.



-A WARNING A-



After this heading, read instructions that, if not strictly complied with, could result in serious personal injury, including death.



CAUTION A



After this heading, read instructions that, if not strictly complied with, might result in minor or moderate injury.

NOTE:

After this heading, read instructions that, if not strictly complied with, may result in damage to equipment and/or property.

These safety warnings cannot eliminate the hazards that they indicate. Common sense and strict compliance with the special instructions while performing the service are essential to preventing accidents.

Four commonly used safety symbols accompany the DANGER, WARNING and CAUTION blocks. The type of information each indicates follows:



↑ This symbol points out important safety information that, if not followed, could endanger personal safety and/or property of others.



This symbol points out potential explosion hazard. This symbol points out potential fire hazard.



This symbol points out potential electrical shock hazard.

The operator is responsible for proper and safe use of the equipment. The manufacturer strongly recommends that the operator read this Owner's Manual and thoroughly understand all instructions before using this equipment. The manufacturer also strongly recommends instructing other users to properly start and operate the unit. This prepares them if they need to operate the equipment in an emergency.

◆ CONTENTS

This manual contains pertinent owner's information for these models:

- 10 KVA, V-twin GT-990 Engine
- 13 KVA. V-twin GT-990 Engine

◆ OPERATION AND MAINTENANCE

It is the operator's responsibility to perform all safety checks, to make sure that all maintenance for safe operation is performed promptly, and to have the equipment checked periodically by a Dealer. Normal maintenance service and replacement of parts are the responsibility of the owner/operator and, as such, are not considered defects in materials or workmanship within the terms of the warranty. Individual operating habits and usage contribute to the need for maintenance service.

Proper maintenance and care of the generator ensures a minimum number of problems and keep operating expenses at a minimum. See a Dealer for service aids and accessories.

◆ HOW TO OBTAIN SERVICE

When the generator requires servicing or repairs, contact a Dealer for assistance. Service technicians are factory-trained and are capable of handling all service needs.

When contacting a Dealer about parts and service, always supply the complete model number and serial number of the unit as given on its data decal, which is located on the generator. See section "The Generator" for decal location.

Model No.	Serial No.	

Rea Cor Op	ductionInside Front Cover ad This Manual ThoroughlyIFC ntentsIFC eration and MaintenanceIFC
Ho	w to Obtain ServiceIFC
Table	of Contents1
Safet	y Rules2
	ndards Index3
Secti	on 1 – General Information4
1.1	Unpacking/Inspection4
1.2	Protection Systems4
1.3	Emission Information4
1.4	The Generator5
1.5	Specifications5
1.6	System Set6
1.7	Fuel Requirements and Recommendations6
1.8	Fuel Consumption6
1.9	Reconfiguring the Fuel System6
1.10	Location7
1.11	Battery Requirements8
1.12	Battery Installation8
1.13	The Battery8
1.14	Battery Charger9
Secti	on 2 – Post Installation Start-up
	and Adjustments9
2.1	Before Initial Startup9
2.2	Electrical Checks9
2.3	Generator Tests Under Load10
2.4	Checking Automatic Operation10
2.5	Additional Corrosion Protection11

Voltage Regulator Adjustment......11

2.6

Secti	ion 3 – Operation	11
3.1	Control Panel Interface	11
3.2	Automatic Transfer Operation	12
3.3	Sequence of Automatic Operation	13
3.4	Manual Transfer Operation	14
3.5	Side Compartment	14
3.6	Protection Systems	15
Secti	ion 4 – Maintenance	15
4.1	Fuse	
4.2	Checking the Engine Oil Level	15
4.3	Changing the Engine Oil	
4.4	Changing the Engine Air Cleaner	17
4.5	Spark Plug(s)	17
4.6	Battery Maintenance	18
4.7	Adjusting GH-990 Valve Clearance	18
4.8	Cooling System	19
4.9	Attention After Submersion	19
4.10	Corrosion Protection	19
4.11	Out of Service Procedure	19
4.12	Service Schedule	21
Secti	ion 5 – Troubleshooting	22
5.1	Troubleshooting Guide	22
Secti	ion 6 – Appendix	23
6.1	Menu System Navigation	
Secti	ion 7 – Installation Diagrams	25
Secti	ion 8 – Notes	28





SAVE THESE INSTRUCTIONS – The manufacturer suggests that these rules for safe operation be copied and posted near the unit's installation site. Safety should be stressed to all operators and potential operators of this equipment.





WARNING:



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



WARNING:



This product contains or emits chemicals known to the state of California to cause cancer, birth defects or other reproductive harm.

Study these SAFETY RULES carefully before installing, operating or servicing this equipment. Become familiar with this *Owner's Manual* and with the unit. The generator can operate safely, efficiently and reliably only if it is properly installed, operated and maintained. Many accidents are caused by failing to follow simple and fundamental rules or precautions.

The manufacturer cannot anticipate every possible circumstance that might involve a hazard. The warnings in this manual, and on tags and decals affixed to the unit are, therefore, not all-inclusive. If using a procedure, work method or operating technique the manufacturer does not specifically recommend, ensure that it is safe for others. Also make sure the procedure, work method or operating technique utilized does not render the generator unsafe.



DANGER



Despite the safe design of this generator, operating this equipment imprudently, neglecting its maintenance or being careless can cause

possible injury or death. Permit only responsible and capable persons to install, operate and maintain this equipment.



Potentially lethal voltages are generated by these machines. Ensure all steps are taken to render the machine safe before attempting to work on the generator.





A running generator gives off carbon monoxide, and odorless, colorless poison gas. Breathing in carbon monoxide can cause headaches, fatigue, diziness, nausea, vomitting, confusion, fainting, siezures or death.

\triangle GENERAL HAZARDS \triangle

- For safety reasons, the manufacturer recommends that this equipment be installed, serviced and repaired by a Service Dealer or other competent, qualified electrician or installation technician who is familiar with applicable codes, standards and regulations. The operator also must comply with all such codes, standards and regulations.
- The engine exhaust fumes contain carbon monoxide, which can be DEADLY. This dangerous gas, if breathed in sufficient concentrations, can cause unconsciousness or even death. Do NOT alter or add to the exhaust system or do anything that might render the system unsafe or in noncompliance with applicable codes and standards.
- Install a battery operated carbon monoxide alarm indoors, according to manufacturer's instructions/recommendations.
- Adequate, unobstructed flow of cooling and ventilating air is critical to correct generator operation. Do not alter the installation or permit even partial blockage of ventilation provisions, as this can seriously affect safe operation of the generator. The generator MUST be installed and operated outdoors only.
- Keep hands, feet, clothing, etc., away from drive belts, fans, and other moving or hot parts. Never remove any drive belt or fan guard while the unit is operating.
- When working on this equipment, remain alert at all times.
 Never work on the equipment when physically or mentally fatiqued.
- Inspect the generator regularly, and contact the nearest Dealer for parts needing repair or replacement.
- Before performing any maintenance on the generator, disconnect its battery cables to prevent accidental start up. Disconnect the cable from the battery post indicated by a NEGATIVE, NEG or (–) first, then remove the POSITIVE, POS or (+) cable. When reconnecting the cables, connect the POSITIVE cable first, the NEGATIVE cable last.
- Never use the generator or any of its parts as a step. Stepping
 on the unit can stress and break parts, and may result in dangerous operating conditions from leaking exhaust gases, fuel
 leakage, oil leakage, etc.

⚠ ENGINE EXHAUST HAZARDS ⚠

- Generator engine exhaust contains DEADLY carbon monoxide, an odorless, colorless poisonous gas. Breathing carbon monoxide can cause: dizziness, throbbing temples, nausea, muscular twitching, headache, vomiting, weakness and sleepiness, inability to think clearly, fainting, unconsciousness or even death. If you experience any carbon monoxide poisoning symptoms, move into fresh air and immediately seek medical attention.
- Never operate the generator set with the vehicle inside any garage or other enclosed area.



♠ ELECTRICAL HAZARDS

- All generators covered by this manual produce dangerous electrical voltages and can cause fatal electrical shock. Utility power delivers extremely high and dangerous voltages to the transfer switch as does the standby generator when it is in operation. Avoid contact with bare wires, terminals, connections, etc., while the unit is running. Ensure all appropriate covers, guards and barriers are in place, secured and/or locked before operating the generator. If work must be done around an operating unit, stand on an insulated, dry surface to reduce shock hazard.
- Do not handle any kind of electrical device while standing in water, while barefoot, or while hands or feet are wet. DANGEROUS ELECTRICAL SHOCK MAY RESULT.
- The National Electrical Code (NEC) requires the frame and external electrically conductive parts of the generator to be connected to an approved earth ground. Local electrical codes also may require proper grounding of the generator electrical system.
- After installing this home standby electrical system, the generator may crank and start at any time without warning. When this occurs, load circuits are transferred to the STANDBY (generator) power source. To prevent possible injury if such a start and transfer occur, always set the generator's AUTO/OFF/MANUAL switch to its OFF position before working on equipment and remove the 15A fuse from the generator control panel.
- In case of accident caused by electric shock, immediately shut down the source of electrical power. If this is not possible, attempt to free the victim from the live conductor. AVOID DIRECT CONTACT WITH THE VICTIM. Use a nonconducting implement, such as a dry rope or board, to free the victim from the live conductor. If the victim is unconscious, apply first aid and get immediate medical help.
- Never wear jewelry when working on this equipment. Jewelry can conduct electricity resulting in electric shock, or may get caught in moving components causing injury.

♠ FIRE HAZARDS ♠

- For fire safety, the generator must be installed and maintained properly. Installation must always comply with applicable codes, standards, laws and regulations. Adhere strictly to local, state and national electrical and building codes. Comply with regulations the Occupational Safety and Health Administration (OSHA) has established. Also, ensure that the generator is installed in accordance with the manufacturer's instructions and recommendations. Following proper installation, do nothing that might alter a safe installation and render the unit in noncompliance with the aforementioned codes, standards, laws and regulations.
- Keep a fire extinguisher near the generator at all times. Extinguishers rated "ABC" by the National Fire Protection Association are appropriate for use on the standby electric system. Keep the extinguisher properly charged and be familiar with its use. Consult the local fire department with any questions pertaining to fire extinguishers.

EXPLOSION HAZARDS

- Do not smoke around the generator. Wipe up any fuel or oil spills immediately. Ensure that no combustible materials are left in the generator compartment, or on or near the generator, as FIRE or EXPLOSION may result. Keep the area surrounding the generator clean and free from debris.
- Gaseous fluids such as natural gas and liquid propane (LP) gas are extremely EXPLOSIVE. Install the fuel supply system according to applicable fuel-gas codes. Before placing the home standby electric system into service, fuel system lines must be properly purged and leak tested according to applicable code. After installation, inspect the fuel system periodically for leaks. No leakage is permitted.

◆ STANDARDS INDEX

In the absence of pertinent standards, codes, regulations and laws, the published information listed below may be used for installation guidance for this equipment.

- 1. NFPA No. 37, STATIONARY COMBUSTION ENGINES AND GAS TURBINES, available from the National Fire Protection Association, 470 Atlantic Avenue, Boston, MA 02210.
- 2. NFPA No. 76A, ESSENTIAL ELECTRICAL SYSTEMS FOR HEALTH CARE FACILITIES, available same as Item 1.
- 3. NFPA No. 54, NATIONAL FUEL GAS CODE, available same as Item 1.
- NFPA No. 58, AMERICAN NATIONAL STANDARD FOR STORAGE AND HANDLING OF LIQUEFIED PETROLEUM GAS, available same as Item 1.
- NFPA No. 70, NFPA HANDBOOK OF NATIONAL ELECTRIC CODE, available same as Item 1.
- Article X, NATIONAL BUILDING CODE, available from the American Insurance Association, 85 John Street, New York, N.Y. 10038.
- AGRICULTURAL WIRING HANDBOOK, available from the Food and Energy Council, 909 University Avenue, Columbia, MO 65201.
- 8. ASAE EP-3634, INSTALLATION AND MAINTENANCE OF FARM STANDBY ELECTRICAL SYSTEMS, available from the American Society of Agricultural Engineers, 2950 Niles Road, St. Joseph, MI 49085.
- 9. NFPA No. 30, FLAMMABLE AND COMBUSTIBLE LIQUIDS CODE, available same as Item 1.





Only qualified electricians or contractors should attempt such installations, which must comply strictly with applicable codes, standards and regulations.

1.1 UNPACKING/INSPECTION

After unpacking, carefully inspect the contents for damage.

 This standby generator set is ready for installation with a factory supplied and pre-mounted base pad and has a weather protective enclosure that is intended for outdoor installation only.



If this generator is used to power electrical load circuits normally powered by a utility power source, it is required by code to install a transfer switch. The transfer switch must effectively isolate the electrical system from the utility distribution system when the generator is operating (NEC 700, 701 & 702). Failure to isolate an electrical system by such means will result in damage to the generator and also may result in injury or death to utility power workers due to backfeed of electrical energy.

If any loss or damage is noted at time of delivery, have the person(s) making the delivery note all damage on the freight bill or affix their signature under the consignor's memo of loss or damage.

If a loss or damage is noted after delivery, separate the damaged materials and contact the carrier for claim procedures.

"Concealed damage" is understood to mean damage to the contents of a package that is not in evidence at the time of delivery, but is discovered later.

To properly open the roof, press down on the center top lip and release the latch. If pressure is not applied from the top, the roof may appear stuck. Always verify that the side lock is unlocked before attempting to lift the roof.

1.2 PROTECTION SYSTEMS

Unlike an automobile engine, the generator may have to run for long periods of time with no operator present to monitor engine conditions. For that reason, the engine is equipped with the following systems that protect it against potentially damaging conditions:

- Low Oil Pressure Sensor
- High Temperature Sensor
- Overcrank
- 4. Overspeed
- 5. RPM Sensor
- Low Battery

There are readouts on the control panel to notify personnel that one of these failures has occurred. There is also a System Set Status message on the display that displays when all of the conditions described in the "System Set" section are true.

1.3 EMISSION INFORMATION

The Environmental Protection Agency requires that this generator complies with exhaust emission standards. This generator is certified to meet the applicable EPA emission levels. Additional information regarding the requirements set by the EPA is as follows:

The generator is certified for use as a stationary engine for standby power generation. Any other use may be a violation of federal and/or local laws. It is important that to follow the maintenance specifications in the "Maintenance" section to ensure that the engine complies with the applicable emission standards for the duration of the engine's life. This engine is certified to operate on Liquid Propane fuel and pipeline Natural Gas. The emission control system on the generator consists of the following:

- · Fuel Metering System
 - Carburetor/mixer assembly
 - Fuel regulator
- · Air Induction System
 - Intake pipe/manifold
 - Air cleaner
- Ignition System
 - Spark plug
 - · Ignition module

The Emissions Compliance Period referred to on the Emissions Compliance Label indicates the number of operating hours for which the engine has been shown to meet Federal emission requirements. See the table below to determine the compliance period for the generator. The displacement of the generator is listed on the Emissions Compliance Label.

Displacement	Category	Compliance Period
	А	300 Hours
< 66 cc	В	125 Hours
	С	50 Hours
> 66 cc -	А	500 Hours
≥ 60 CC - < 225 CC	В	250 Hours
< 225 00	С	125 Hours
	А	1000 Hours
≥ 225 cc	В	500 Hours
	С	250 Hours

1.4 THE GENERATOR

Figure 1.1 – 10 and 13 KVA, GT-990 Engine (door removed)

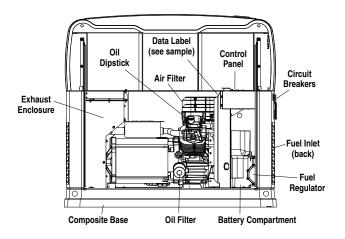
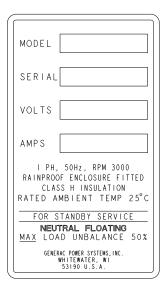


Figure 1.2 - Data Label Sample



1.5 SPECIFICATIONS

◆ 1.5.1 GENERATOR

Model	10 KVA	13 KVA	
Rated Maximum	10,000 NG	13,000 NG	
Power Capacity (Watts*)	10,000 LP	13,000 LP	
Rated Voltage	22	20	
Rated Maximum Load Curi	rent (Amps)		
220 Volts (NG/LP)	45.5/45.5	59.1/59.1	
Main Circuit Breaker	50 Amp	60 Amp	
Phase	1		
Number of Rotor Poles	2		
Rated AC Frequency	50 Hz		
Battery Requirement	Group 26R, 12 volts and 525 CCA Minimu		
Weight (unit only in lbs.)	439	455	
Enclosure	Steel	Steel	
Normal Operating Range	-20° F (-28° C) to 77° F (25° C)		

^{*} Maximum wattage and current are subject to and limited by such factors as fuel Btu content, ambient temperature, altitude, engine power and condition, etc. Maximum power decreases about 3.5 percent for each 1,000 feet above sea level; and also will decrease about 1 percent for each 6 C (10 F) above 16 C (60 F) ambient temperature.

◆ 1.5.2 ENGINE

Model	10/13 KVA
Type of Engine	GT-990
Number of Cylinders	2
Rated Horsepower @ 3,600 rpm	32
Displacement	992cc
Cylinder Block	Aluminum w/Cast Iron Sleeve
Valve Arrangement	Overhead Valves
Ignition System	Solid-state w/Magneto
Recommended Spark Plug	RC14YC
Spark Plug Gap	1.02 mm (0.040 inch)
Compression Ratio	9.5:1
Starter	12 VDC
Oil Capacity Including Filter	Approx. 1.7 Qts
Recommended Oil Filter	Part # 070185F
Recommended Air Filter	Part # 0C8127
Operating RPM	3,000



1.6 SYSTEM SET

The "System Set" or "Ready to Run" on the display is ready when all of the following conditions are true:

- 1. The AUTO/OFF/MANUAL switch is set to the AUTO position.
- The utility voltage being supplied to the unit is being sensed by the PCB. If the utility sense voltage is not connected to the unit or if it is below approximately 150-160 volts AC, then the system set light will flash rapidly. This indicates that if the AUTO/OFF/MANUAL switch is placed in the Auto position, the generator will start.
- 3. No alarms are present, for example, low oil pressure, high temperature, etc.

1.7 FUEL REQUIREMENTS AND RECOMMENDATIONS

With LP gas, use only the vapor withdrawal system. This type of system uses the vapors formed above the liquid fuel in the storage tank.

The engine has been fitted with a fuel carburetion system that meets the specifications of the 1997 California Air Resources Board for tamper-proof dual fuel systems. The unit will run on natural gas or LP gas, but it has been factory set to run on natural gas. Should the primary fuel need to be changed to LP gas, the fuel system needs to be reconfigured. See the reconfiguring the Fuel System section for instructions on reconfiguration of the fuel system.

Recommended fuels should have a Btu content of at least 1,000 Btus per cubic foot for natural gas; or at least 2,520 Btus per cubic foot for LP gas. Ask the fuel supplier for the Btu content of the fuel.

Required fuel pressure for natural gas is five (5) inches to seven (7) inches water column (0.18 to 0.25 psi); and for liquid propane, 10 inches to 12 inches of water column (0.36 to 0.43 psi). The primary regulator for the propane supply is NOT INCLUDED with the generator.

NOTE:

All pipe sizing, construction and layout must comply with NFPA 54 for natural gas applications and NFPA 58 for liquid propane applications. Once the generator is installed, verify that the fuel pressure NEVER drops below four (4) inches water column for natural gas or 10 inches water column for liquid propane.

Prior to installation of the generator, the installer should consult local fuel suppliers or the fire marshal to check codes and regulations for proper installation. Local codes will mandate correct routing of gaseous fuel line piping around gardens, shrubs and other landscaping to prevent any damage.

Special considerations should be given when installing the unit where local conditions include flooding, tornados, hurricanes, earthquakes and unstable ground for the flexibility and strength of piping and their connections.

Use an approved pipe sealant or joint compound on all threaded fitting.

All installed gaseous fuel piping must be purged and leak tested prior to initial start-up in accordance with local codes, standards and regulations.

1.8 FUEL CONSUMPTION

Unit	Nat.	Gas	LP Vapor	
UIII	1/2 Load	Full Load	1/2 Load	Full Load
10 KVA	152	215	1.53/56	2.08/76
13 KVA	156	220	1.56/58	2.30/84

^{*} Natural gas is in cubic feet per hour.

Verify that gas meter is capable of providing enough fuel flow to include household appliances.

◆ 1.8.1 BTU FLOW REQUIREMENTS - NATURAL GAS

BTU flow required for each unit based on 1000 BTU per cubic foot

- 10 KVA 215,000 BTU/Hour
- 13 KVA 220,000 BTU/Hour





Gaseous fuels such as natural gas and liquid propane (LP) gas are highly explosive. Even the slightest spark can ignite such fuels and cause an explosion. No leakage of fuel is permitted. Natural gas, which is lighter than air, tends to collect in high areas. LP gas is heavier than air and tends to settle in low areas.

NOTE:

A minimum of one approved manual shut-off valve must be installed in the gaseous fuel supply line. The valve must be easily accessible. Local codes determine the proper location.

1.9 RECONFIGURING THE FUEL SYSTEM

NOTE:

Use an approved pipe sealant or joint compound on all threaded fittings to reduce the possibility of leakage.

◆ 1.9.1 10 AND 13 KVA, V-TWIN ENGINES

To reconfigure the fuel system from NG to LP, follow these steps: **NOTE**:

The primary regulator for the propane supply is NOT INCLUDED with the generator. A fuel pressure of 10 to 12 inches of water column (0.36 to 0.43 psi) to the fuel inlet of the generator MUST BE SUPPLIED.

- Open the roof.
- 2. Remove the air cleaner cover.
- 3. Slide the selector lever out towards the back of the enclosure (Figures 1.3 and 1.4).

^{**} LP is in gallons per hour/cubic feet per hour.

^{***} Values given are approximate.

GENERAL INFORMATION

- Return the air cleaner cover and tighten the two thumb screws.
- Close the roof.
- 4. Reverse the procedure to convert back to natural gas.

Figure 1.3 - 10 & 13 KVA, GT-990 (Airbox Cover Removed)

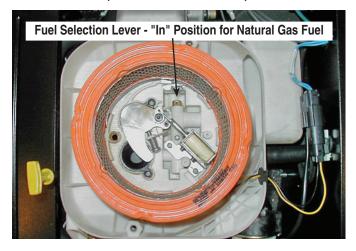
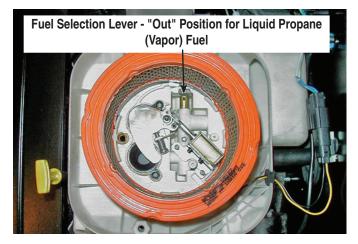


Figure 1.4 - 10 & 13 KVA, GT-990 (Airbox Cover Removed)



1.10 LOCATION

— A DANGER A—

- The engine exhaust fumes contain carbon monoxide, which can be DEADLY. This dangerous gas, if breathed in sufficient concentrations, can cause unconsciousness or even death.
- The exhaust system must be installed properly, in strict compliance with applicable codes and standards. Following installation, do nothing that might render the system unsafe or in noncompliance with such codes and standards.

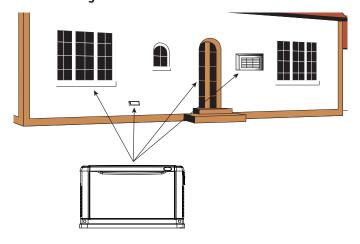
- Operate the generator outdoors ONLY.
- Keep exhaust gases from entering a confined area through windows, doors, ventilation or other openings.

◆ 1.10.1 GENERATOR

Install the generator set, in its protective enclosure, **outdoors**, where adequate cooling and ventilating air is always available (Figure 1.5). Consider these factors:

- The installation of the generator must comply strictly with NFPA 37, NFPA 54, NFPA 58, and NFPA 70 standards.
- Install the unit where air inlet and outlet openings will not become obstructed by leaves, grass, snow, etc.. If prevailing winds will cause blowing or drifting, consider using a windbreak to protect the unit.
- Install the generator on high ground where water levels will not rise and endanger it.
- Allow sufficient room on all sides of the generator for maintenance and servicing. This unit must be installed in accordance with current applicable NFPA 37 and NFPA 70 standards; as well as any other federal, state and local codes for minimum distances from other structures. DO NOT install under wooden decks or structures unless there is at least four (4) feet of clearance above the generator, three (3) feet of clearance on sides and front, and 18 inches of clearance at back of unit.
- Install the unit where rain gutter down spouts, roof run-off, landscape irrigation, water sprinklers or sump pump discharge does not flood the unit or spray the enclosure, including any air inlet or outlet openings.
- Install the unit where services will not be affected or obstructed, including concealed, underground or covered services such as electrical, fuel, phone, air conditioning or irrigation.
- Where strong prevailing winds blow from one direction, face the generator air inlet openings to the prevailing winds.
- Install the generator as close as possible to the fuel supply, to reduce the length of piping.
- Install the generator as close as possible to the transfer switch.
 REMEMBER THAT LAWS OR CODES MAY REGULATE THE DISTANCE AND LOCATION.

Figure 1.5 – Generator Clearances





- The genset must be installed on a level surface. The base frame must be level within two (2) inches all around.
- The generator is typically placed on pea gravel or crushed stone. Check local codes if a concrete slab is required. If a concrete base slab is required, all federal, state and local codes should be followed. Special attention should be given to the concrete base slab which should exceed the length and width of the generator by a minimum of six (6) inches (0.152 meters) on all sides.

1.11 BATTERY REQUIREMENTS

See the Specifications section for correct battery size and rating.



If the AUTO/OFF/MANUAL switch is not set to its OFF position, the generator can crank and start as soon as the battery cables are connected. If the utility power supply is not turned off, sparking can occur at the battery posts and cause an explosion.

1.12 BATTERY INSTALLATION

Fill the battery with the proper electrolyte fluid if necessary and have the battery fully charged before installing it.

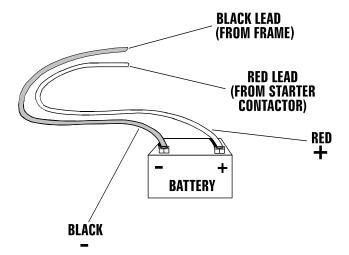
Before installing and connecting the battery, complete the following steps:

- 1. Set the generator's AUTO/OFF/MANUAL switch to OFF.
- 2. Turn off utility power supply to the transfer switch.
- 3. Remove the 7.5A fuse from the generator control panel.

Battery cables were factory connected at the generator (Figure 1.5). Connect cables to battery posts as follows:

- 4. Connect the red battery cable (from starter contactor) to the battery post indicated by a positive, POS or (+).
- 5. Connect the black battery cable (from frame ground) to the battery post indicated by a negative, NEG or (—).

Figure 1.5 – Battery Cable Connections



NOTE:

Dielectric grease should be used on battery posts to aid in the prevention of corrosion.

NOTE:

Damage will result if battery connections are made in reverse.

NOTE:

In areas where temperatures regularly fall below 10° F (-12° C) it is recommended that a pad type battery heater be installed to aid in cold climate starting.

1.13 THE BATTERY



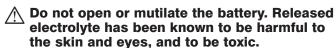


Do not dispose of the battery in a fire. The battery is capable of exploding.

A battery presents a risk of electrical shock and high short circuit current. The following precautions are to be observed when working on batteries:

- Remove the 7.5A fuse from the generator control panel.
- Remove watches, rings or other metal objects;
- Use tools with insulated handles;
- Wear rubber gloves and boots:
- Do not lay tools or metal parts on top of the battery; and
- Disconnect charging source prior to connecting or disconnecting battery terminals.





The electrolyte is a dilute sulfuric acid that is harmful to the skin and eyes. It is electrically conductive and corrosive.

The following procedures are to be observed:

- Wear full eye protection and protective clothing;
- Where electrolyte contacts the skin, wash it off immediately with water;
- Where electrolyte contacts the eyes, flush thoroughly and immediately with water and seek medical attention; and
- Spilled electrolyte is to be washed down with an acid neutralizing agent. A common practice is to use a solution of 1 pound (500 grams) bicarbonate of soda to 1 gallon (4 liters) of water. The bicarbonate of soda solution is to be added until the evidence of reaction (foaming) has ceased. The resulting liquid is to be flushed with water and the area dried.





Lead-acid batteries present a risk of fire because they generate hydrogen gas. The following

procedures are to be followed:

- DO NOT SMOKE when near the battery;
- DO NOT cause flame or spark in battery area; and
- Discharge static electricity from body before touching the battery by first touching a grounded metal surface.



Be sure the AUTO/OFF/MANUAL switch is set to the OFF position before connecting the battery cables. If the switch is set to AUTO or MANUAL, the generator can crank and start as soon as the battery cables are connected.



Be sure the utility power supply is turned off and the 7.5A fuse is removed from the generator control panel, or sparking may occur at the battery posts as the cables are attached and cause an explosion.

Servicing of the battery is to be performed or supervised by personnel knowledgeable of batteries and the required precautions. Keep unauthorized personnel away from batteries.

See the Specifications section for the correct size and rating when replacing the battery. Have these procedures performed at the intervals specified in the "Service Schedule." A negative ground system is used. Battery connections are shown on the wiring diagrams. Make sure the battery is correctly connected and terminals are tight. Observe battery polarity when connecting the battery to the generator set.

1.14 BATTERY CHARGER

NOTE:

These generators DO NOT contain an internal battery charger.

NOTE:

The manufacturer provides a battery trickle charger that is active when the unit is set up for automatic operation. With the battery installed and utility power source voltage available to the transfer switch, the battery receives a trickle charge to prevent self-discharge. The trickle charger is designed to help extend the life of the battery by maintaining the battery. The trickle charge feature cannot be used to recharge a discharged battery.

(For battery charger installation, see the Generator Install Guidelines and Battery Charger Instructions included with the unit.)

2.1 BEFORE INITIAL START-UP

NOTE:

These units have been run and tested at the factory prior to being shipped and do not require any type of break-in.

NOTE:

This unit comes filled with oil from the factory. Check the oil level and add the appropriate amount if necessary.

Before starting, complete the following:

- Set the generator's main circuit breaker to its OFF (or OPEN)
 position.
- Set the generator's AUTO/OFF/MANUAL switch to the OFF position.
- Turn OFF all breakers on the load center of the transfer box (T1 and T2).
- Turn OFF all loads connected to the transfer switch terminals T1 and T2.
- Check the engine crankcase oil level and, if necessary, fill to the dipstick FULL mark with the recommended oil. Do not fill above the FULL mark.
- 6. Check the fuel supply. Gaseous fuel lines must have been properly purged and leak tested in accordance with applicable fuel-gas codes. All fuel shutoff valves in the fuel supply lines must be open.

During initial start up only, the generator may exceed the normal number of start attempts and experience an "over crank" fault (See the "Overcrank" section). This is due to accumulated air in the fuel system during installation. Reset the control board and restart up to two more times, if necessary. If unit fails to start, contact the local dealer for assistance.



CAUTION



Never operate the engine with the oil level below the "Add" mark on the dipstick. Doing this could damage the engine.

2.2 ELECTRICAL CHECKS

Complete electrical checks as follows:

- 1. Set the generator's main circuit breaker to its OFF (or OPEN) position.
- Set the generator's AUTO/OFF/MANUAL switch to the OFF position.
- 3. Turn OFF all breakers on the load center of the transfer box (T1 and T2).
- Turn on the utility power supply to the transfer switch using the means provided (such as a utility main line circuit breaker).



DANGER



The transfer switch is now electrically "hot." Contact with "hot" parts will result in extremely hazardous and possibly fatal electrical shock. Proceed with caution.



- Use an accurate AC voltmeter to check utility power source voltage across transfer switch terminals N1 and N2. Nominal line-to-line voltage should be 220 volts AC.
- 6. When certain that utility supply voltage is compatible with transfer switch and load circuit ratings, turn OFF the utility power supply to the transfer switch.
- On the generator panel, set the Auto/Off/ Manual switch to MANUAL. The engine should crank and start.
- 8. Let the engine warm up for about five minutes to allow internal temperatures to stabilize. Then, set the generator's main circuit breaker to its ON (or closed) position.



- Proceed with caution! Generator power voltage is now supplied to the transfer switch.
 Contact with live transfer switch parts will result in dangerous and possibly fatal electrical shock.
- Connect an accurate AC voltmeter and a frequency meter across transfer switch terminal lugs E1 and E2. Voltage should be 223-255 at a frequency of 49-50 Hertz.
- 10. Set the generator's main circuit breaker to its OFF (or OPEN) position. Let the engine run at no-load for a few minutes to stabilize internal engine generator temperatures.
- 11. Set the generator's AUTO/OFF/MANUAL switch to OFF. The engine should shut down.

NOTE:

It is important not to proceed until certain that generator AC voltage and frequency are correct and within the stated limits. If frequency is correct, but voltage is high or low, the generator's voltage regulator requires adjustment.

2.3 GENERATOR TESTS UNDER

To test the generator set with electrical loads applied, proceed as follows:

- Set generator's main circuit breaker to its OFF (or OPEN) position
- Turn OFF all breakers on the load center of the transfer box (T1 and T2).
- 3. Set the generator's AUTO/OFF/MANUAL switch to OFF.
- 4. Turn OFF the utility power supply to the transfer switch, using the means provided (such as a utility main line circuit breaker).



Do not attempt manual transfer switch operation until all power voltage supplies to the transfer switch have been positively turned off. Failure to turn off all power voltage supplies will result in extremely hazardous and possibly fatal electrical shock.

- 5. Manually set the transfer switch to the STANDBY position, i.e., load terminals connected to the generator's E1/E2 terminals. The transfer switch operating lever should be down.
- Set the generator's AUTO/OFF/MANUAL switch to MANUAL. The engine should crank and start immediately.
- 7. Let the engine stabilize and warm up for a few minutes.
- 3. Set the generator's main circuit breaker to its ON (or CLOSED) position. Loads are now powered by the standby generator.
- 9. Turn ON the load center of the transfer switch (T1 and T2).
- 10. Connect an accurate AC voltmeter and a frequency meter across terminal lugs E1 and E2.
 - Voltage should be greater than 220 volts and frequency should be 50 Hz.
- Let the generator run at full rated load for 20-30 minutes. Listen for unusual noises, vibration or other indications of abnormal operation. Check for oil leaks, evidence of overheating, etc.
- 12. When testing under load is complete, turn OFF electrical loads
- Set the generator's main circuit breaker to its OFF (or OPEN) position.
- 14. Let the engine run at no-load for a few minutes.
- Set the AUTO/OFF/MANUAL switch to OFF. The engine should shut down.

2.4 CHECKING AUTOMATIC OPERATION

To check the system for proper automatic operation, proceed as follows:

- Set generator's main circuit breaker to its OFF (or OPEN) position
- 2. Check that the AUTO/OFF/MANUAL switch is set to OFF.
- 3. Turn OFF the utility power supply to the transfer switch, using means provided (such as a utility main line circuit breaker).
- 4. Manually set the transfer switch to the UTILITY position, i.e., load terminals connected to the utility power source side.
- Turn ON the utility power supply to the transfer switch, using the means provided (such as a utility main line circuit breaker).
- 6. Set the generator's main circuit breaker to its ON (or CLOSED) position.
- 7. Set the AUTO/OFF/MANUAL switch to AUTO. The system is now ready for automatic operation.
- 8. Turn OFF the utility power supply to the transfer switch.

With the AUTO/OFF/MANUAL switch at AUTO, the engine should crank and start when the utility source power is turned OFF after a 10 second delay. After starting, the transfer switch should connect load circuits to the standby side after a five (5) second delay. Let the system go through its entire automatic sequence of operation.



With the generator running and loads powered by generator AC output, turn ON the utility power supply to the transfer switch. The following should occur:

- After about 15 seconds, the switch should transfer loads back to the utility power source.
- About one minute after re-transfer, the engine should shut down.

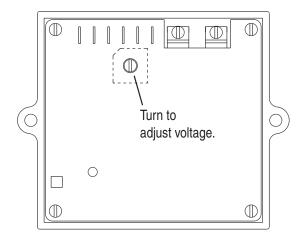
2.5 ADDITIONAL CORROSION PROTECTION

Periodically spray all engine linkage parts and brackets with corrosion inhibiting spray such as WD-40 or a comparable product.

2.6 VOLTAGE REGULATOR ADJUSTMENT

With the frequency between 49-51 Hertz at no-load, slowly turn the slotted potentiometer (Figure 2.1) until line voltage reads 223-225 volts.

Figure 2.1 – Voltage Adjustment Potentiometer



NOTE:

The access panel on top of the control panel must be removed to adjust the voltage regulator.

NOTE:

The voltage regulator is housed behind the generator's control panel. The regulator maintains a voltage in direct proportion to frequency at a 2-to-1 ratio. For example, at 50 Hertz, line-to-line voltage will be 224 volts.

3.1 CONTROL PANEL INTERFACE

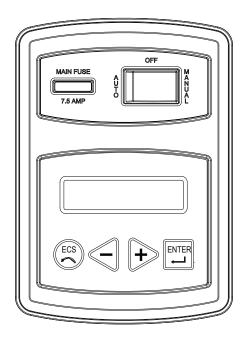
◆ 3.1.1 USING THE AUTO/OFF/MANUAL SWITCH (FIGURE 3.1)

- "AUTO" Position Selecting this switch activates fully automatic system operation. It also allows the unit to automatically start and exercise the engine every seven days with the setting of the exercise timer (see the Setting the Exercise Timer section).
- 2. "OFF" Position This switch position shuts down the engine. This position also prevents automatic operation.
- 3. "MANUAL" Position Set the switch to MANUAL to crank and start the engine. Transfer to standby power will not occur unless there is a utility failure.



With the switch set to AUTO, the engine may crank and start at any time without warning. Such automatic starting occurs when utility power source voltage droops below a preset level or during the normal exercise cycle. To prevent possible injury that might be caused by such sudden starts, always set the switch to OFF and remove the fuses before working on or around the generator or transfer switch. Then, place a "DO NOT OPERATE" tag on the generator panel and on the transfer switch.

Figure 3.1 – Generator Control Panel





◆ 3.1.2 SETTING THE EXERCISE TIMER

This generator is equipped with an exercise timer. Once it is set, the generator will start and exercise every seven days, on the day of the week and at the time of day specified. During this exercise period, the unit runs for approximately 12 minutes and then shuts down. Transfer of loads to the generator output does not occur during the exercise cycle unless utility power is lost.

NOTE:

The exerciser will only work in the AUTO mode and will not work unless this procedure is performed. The exerciser will need to be reset every time the 12 volt battery is disconnected and then reconnected, and when the fuse is removed and/or replaced.

+ INSTALLATION ASSISTANT

Interconnect System Self-test Feature (follow the on-screen prompts)

Upon power up, this controller will go through a system self test which will check for the presence of utility voltage on the DC circuits. This is done to prevent damage if the installer mistakenly connects AC utility power sense wires into the DC terminal block. If utility voltage is detected, the controller will display a warning message and lock out the generator, preventing damage to the controller. Power to the controller must be removed to clear this warning.

Utility voltage must be turned on and present at the N1 and N2 terminals inside the generator control panel for this test to be performed and pass.

NOTE:

DAMAGE CAUSED BY MISWIRING OF THE INTERCONNECT WIRES IS NOT WARRANTABLE!

This test will be performed each time the controller is powered up.

Also, upon first power up of the generator, the display interface will begin an installation assistant. The assistant will prompt the user to set the minimum settings to operate. These settings are simply: Current Date/Time and Exercise Day/Time. The maintenance intervals will be initialized when the exercise time is entered (Figure 3.2).

The exercise settings can be changed at any time via the "EDIT" menu (see Appendix, "Menu System").

If the 12 volt battery is disconnected or the fuse removed, the Installation Assistant will operate upon power restoration. The only difference is the display will only prompt the customer for the current Time and Date.

IF THE INSTALLER TESTS THE GENERATOR PRIOR TO INSTALLATION, PRESS THE "ENTER" KEY TO AVOID SETTING UP THE EXERCISE TIME. THIS WILL ENSURE THAT WHEN THE CUSTOMER POWERS UP THE UNIT, HE WILL STILL BE PROMPTED TO ENTER AN EXERCISE TIME.

NOTE:

The exerciser will only work in the AUTO mode and will not work unless this procedure is performed. The current date/time will need to be reset every time the 12 volt battery is disconnected and then reconnected, and/or when the fuse is removed.

◆ 3.1.3 DISPLAY INTERFACE

→ DISPLAY INTERFACE MENUS

The LCD display is organized as detailed below:

- The "Home" page, this page is the default page which will be displayed if no keys are pressed for 30 seconds. This page normally shows the current Status message and the current date and time. The highest priority active Alarm and/or Warning will be automatically posted on this page as well as flashing the backlight when such an event is detected. In the case of multiple Alarms or Warnings, only the first message will be displayed. To clear an Alarm or Warning, see the Protection Systems section Clear Alarm.
- The display backlight is normally off. If the user presses any key, the backlight will come on automatically and remain on for 30 seconds after the last key was pressed.
- The "Main Menu" page will allow the user to navigate to all other pages or sub-menus by using the Left/Right and Enter keys. This page can be accessed at any time with several presses of the dedicated Escape key. Each press of the Escape key takes you back to the previous menu until the main menu is reached. This page displays the following options: HISTORY; STATUS; EDIT; AND DEBUG. (See the Appendix - "Menu System".)

3.2 AUTOMATIC TRANSFER OPERATION

To select automatic operation, do the following:

- Make sure the transfer switch main contacts are set to their UTILITY position, i.e., loads connected to the utility power source (Figure 3.2).
- 2. Be sure that normal UTILITY power source voltage is available to transfer switch terminal lugs N1 and N2 (Refer to the Electrical Data section).
- 3. Set the generator's AUTO/OFF/MANUAL switch to AUTO.
- Set the generator's main circuit breaker to its ON (or CLOSED)
 position.

With the preceding steps complete, the generator will start automatically when utility source voltage drops below a preset level. After the unit starts, loads are transferred to the standby power source. Refer to the Sequence of Automatic Operation section.



3.3 SEQUENCE OF AUTOMATIC OPERATION

◆ 3.3.1 UTILITY FAILURE

Initial Conditions: Generator in Auto, ready to run, load being supplied by utility source. When utility fails (below 65% of nominal), a 10 second line interrupt delay time is started. If the utility is still gone when the timer expires, the engine will crank and start. Once started, a five (5) second engine warm-up timer will be initiated. When the warm-up timer expires, the control will transfer the load to the generator. If the utility power is restored (above 75% of nominal) at any time from the initiation of the engine start until the generator is ready to accept load (5 second warm-up time has not elapsed), the controller will complete the start cycle and run the generator through its normal cool down cycle; however, the load will remain on the utility source.

◆ 3.3.2 **CRANKING**

The system will control the cyclic cranking as follows: 16 second crank, seven (7) second rest, 16 second crank, seven (7) second rest followed by three (3) additional cycles of seven (7) second cranks followed by seven (7) second rests.

+ Choke Operation

1. The 990 engines have an electric choke in the air box that is automatically controlled by the electronic control board.

+ Failure to Start

This is defined as any of the following occurrences during cranking.

- Not reaching starter dropout within the specified crank cycle. Starter dropout is defined as four (4) cycles at 1,000 RPM.
- Reaching starter dropout, but then not reaching 2200 RPM within 15 seconds. In this case the control board will go into a rest cycle for seven (7) seconds, then continue the rest of the crank cycle.

During a rest cycle the start and fuel outputs are de-energized and the magneto output is shorted to ground.

Cranking Conditions

The following notes apply during cranking cycle.

- 1. Starter motor will not engage within five (5) seconds of the engine shutting down.
- 2. The fuel output will not be energized with the starter.
- 3. The starter and magneto outputs will be energized together.
- Once the starter is energized the control board will begin looking for engine rotation. If it does not see an RPM signal within three (3) seconds it will shut down and latch out on RPM sensor loss.
- Once the control board sees an RPM signal it will energize the fuel solenoid, drive the throttle open and continue the crank sequence.
- Starter motor will disengage when speed reaches starter dropout.

- If the generator does not reach 2200 RPM within 15 seconds, re-crank cycle will occur.
- 8. If engine stops turning between starter dropout and 2200 RPM, the board will go into a rest cycle for seven (7) seconds then re-crank (if additional crank cycles exist).
- 9. Once started, the generator will wait for a hold-off period before starting to monitor oil pressure and oil temperature (refer to the Alarm Messages section for hold-off times).
- 10. During Manual start cranking, if the Mode switch is moved from the Manual position, the cranking stops immediately.
- 11. During Auto mode cranking, if the Utility returns, the cranking cycle does NOT abort but continues until complete. Once the engine starts, it will run for one (1) minute, then shut down.

◆ 3.3.3 LOAD TRANSFER

The transfer of load when the generator is running is dependent upon the operating mode as follows:

- Manual
 - · Will not transfer to generator if utility is present.
 - Will transfer to generator if utility fails (below 65% of nominal for 10 consecutive seconds.
 - Will transfer back when utility returns for 15 consecutive seconds. The engine will continue to run until removed from the Manual mode.
- Auto
 - Will start and run if Utility fails for 10 consecutive seconds.
 - Will start a five (5) second engine warm-up timer.
 - · Will not transfer if utility subsequently returns.
 - Will transfer to generator if utility is still not present.
 - Will transfer back to utility once utility returns (above 75% of nominal) for 15 seconds.
 - Will transfer back to utility if the generator is shut down for any reason (such as the switch is in the OFF position or a shutdown alarm.
 - After transfer, will shut down engine after one (1) minute cool-down time.
- Exercise
 - Will not exercise if generator is already running in either Auto or Manual mode.
 - During exercise, the controller will only transfer if utility fails during exercise for 10 seconds, and will switch to Auto mode.

◆ 3.3.4 UTILITY RESTORED

Initial Condition: Generator supplying power to customer load. When the utility returns (above 75% of nominal), a 15 second return to utility timer will start. At the completion of this timer, if the utility supply is still present and acceptable, the control will transfer the load back to the utility and run the engine through a one (1) minute cool down period and then shut down. If utility fails for three (3) seconds during this cool down period, the control will transfer load back to the generator and continue to run while monitoring for utility to return.



3.4 MANUAL TRANSFER OPERATION

◆ 3.4.1 TRANSFER TO GENERATOR POWER SOURCE

To start the generator and activate the transfer switch manually, proceed as follows:

- 1. Set the generator's AUTO/OFF/MANUAL switch to OFF.
- 2. Set the generator's main circuit breaker to its OFF (or OPEN) position.
- Turn OFF the utility power supply to the transfer switch using the means provided (such as a utility main line circuit breaker).

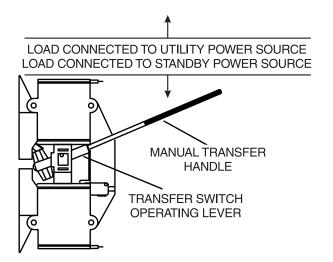


- Do not attempt to activate the transfer switch manually until all power voltage supplies to the switch have been positively turned off. Failure to turn off all power voltage supplies may result in extremely hazardous and possibly fatal electrical shock.
- 4. Use the manual transfer handle inside the transfer switch to move the main contacts to their STANDBY position, i.e., loads connected to the standby power source (Figure 3.2).
- To crank and start the engine, set the AUTO/OFF/MANUAL switch to MANUAL.
- 6. Let the engine stabilize and warm up for a few minutes.
- 7. Set the generator's main circuit breaker to its ON (or CLOSED) position. The standby power source now powers the loads.

NOTE:

A typical transfer switch is shown. Verify manufacture's manual for instructions.

Figure 3.2 – Manual Transfer Switch Operation



◆ 3.4.2 TRANSFER BACK TO UTILITY POWER SOURCE

When utility power has been restored, transfer back to that source and shut down the generator. This can be accomplished as follows:

- Set the generator's main circuit breaker to its OFF (or OPEN) position.
- 2. Let the engine run for a minute or two at no-load to stabilize the internal temperatures.
- 3. Set the generator's AUTO/OFF/MANUAL switch to its OFF (or OPEN) position. The engine should shut down.
- Check that utility power supply to the transfer switch is turned OFF



- Do not attempt to activate the transfer switch manually until all power voltage supplies to the switch have been positively turned off. Failure to turn off all power voltage supplies may result in extremely hazardous and possibly fatal electrical shock.
- 5. Use the manual transfer handle inside the transfer switch to move the main contacts back to their UTILITY position, i.e., loads connected to the utility power source (Figure 3.2).
- 6. Turn ON the utility power supply to the transfer switch using the means provided.
- Set the system to automatic operation as outlined in Automatic Transfer Operation section.

3.5 SIDE COMPARTMENT

(FIGURES 3.3 & 3.4)

Local codes may require this compartment to be locked. A hasp is provided so the owner can secure the compartment with their own padlock. Check local codes in the area.

◆ 3.5.1 MAIN CIRCUIT BREAKER

This is a 2-pole breaker rated according to the Specifications section.

◆ 3.5.2 EXTERIOR READY LIGHTS

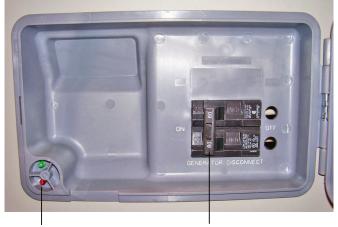
- Green LED 'Ready' light is on when utility is present and switch is in AUTO indicating the generator is ready and when the generator is running.
- Red LED 'Alarm' light is on when the generator is OFF or a fault is detected. (See the Protections Systems section.)







Figure 3.4 – Open Side Compartment



LED Indicator Lights

Main Circuit Breaker

3.6 PROTECTION SYSTEMS

◆ 3.6.1 ALARMS

Highest Priority (Latching) Displayed on the control panel and the external red LED. They must be cleared before the alarm message goes away. The alarm log records each occurrence (see Appendix - "Menu System").

+ Low Oil Pressure (Shutdown Alarm)

A five (5) second delay on start-up and seven (7) second delay once the engine is running.

This switch (Figure 3.5) has normally closed contacts that are held open by engine oil pressure during operation. Should the oil pressure drop below the five (5) PSI range, switch contacts close and the engine shuts down. The unit should not be restarted until oil level is verified.

High Engine Temperature (Shutdown Alarm – Auto Reset)

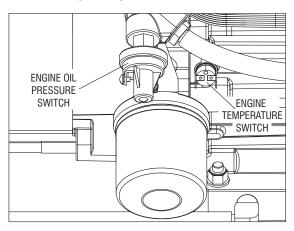
A 10 second delay on start-up and one (1) second delay before shutdown. Auto reset when the condition clears and restart the engine if a valid start signal is still present.

This switch's contacts (Figure 3.5) close if the temperature should exceed approximately 144° C (293° F), initiating an engine shutdown. Once the oil temperature drops to a safe level the switch's contacts open again.

→ Over Crank (Shutdown Alarm)

This occurs if the engine has not started within the specified crank cycle. (See "Cranking" section.)

Figure 3.5 – Low Oil Pressure and High Temperature Switches



NOTE:

The oil drain hose may be routed in the opposite direction as shown in figure.

→ Over Speed (Shutdown Alarm)

4320 RPM for three (3) seconds or 4500 RPM immediately. This feature protects the generator from damage by shutting it down if it happens to run faster than the preset limit. This protection also prevents the generator from supplying an output that could potentially damage appliances connected to the generator circuit. Contact the nearest Dealer if this failure occurs.

→ RPM Sense Loss (Shutdown Alarm)

During cranking, if the Control Board does not see a valid RPM signal within three (3) seconds, it will shut down and lock out on RPM sense loss. While engine is running, if RPM signal is lost for one (1) second the Control Board will shut the engine down, wait 15 seconds, then re-crank the engine. If no RPM signal is detected within the first three (3) seconds of cranking, the Control Board will shut the engine down and latch out on RPM sensor loss. If the RPM signal is detected, the engine will start and run normally. If the RPM signal is subsequently lost again, the Control Board will try one more re-crank attempt before latching out and displaying the RPM sensor failure message.



→ Under-frequency (Shutdown Alarm)

After starting, if the generator stays under frequency for more than 30 seconds it will shut down. The under-frequency setting is 40 Hz.

→ Internal Fault (Shutdown Alarm)

This alarm cannot be cleared, call service dealer.

CLEAR ALARM

 Clear the alarm by setting the AUTO/OFF/MANUAL switch to the OFF position. Press the ENTER key to unlatch any active fault and clear the corresponding alarm message.

4.1 FUSE

The 7.5 amp fuse on the control panel protects the DC control circuit against overload (Figure 3.1). This fuse is wired in series with the battery output lead to the panel. If this fuse element has melted open, the engine will not be able to crank or start. Replace this fuse using only an identical 7.5 amp replacement fuse. Whenever the fuse is removed or replaced, the exercise timer needs to be reset.

4.2 CHECKING THE ENGINE OIL LEVEL

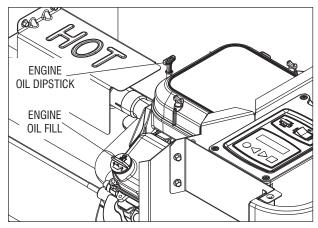
For oil capacities, see the Specifications section. For engine oil recommendations, see the Engine Oil Recommendations section. To check the engine oil level, proceed as follows (Figures 4.1):

- 1. Move the AUTO/OFF/MANUAL switch to the OFF position.
- 2. Remove the dipstick and wipe it dry with a clean cloth.
- 3. Completely insert the dipstick; then, remove it again. The oil level should be at the dipstick "Full" mark. If necessary, add oil to the "Full" mark only. DO NOT FILL ABOVE THE "FULL" MARK.



Never operate the engine with the oil level below the "Add" mark on the dipstick. Doing this could damage the engine.

Figure 4.1 — Oil Dipstick and Fill



- 4. Install the dipstick.
- 5. Reset the AUTO/OFF/MANUAL switch to its original position.

4.3 CHANGING THE ENGINE OIL



A CAUTION A



↑ Hot oil may cause burns. Allow engine to cool before draining oil. Avoid prolonged or repeated skin exposure with used oil. Thoroughly wash exposed areas with soap.

◆ 4.3.1 OIL CHANGE INTERVALS

See the "Service Schedule" section.

◆ 4.3.2 ENGINE OIL RECOMMENDATIONS

All oil should meet minimum American Petroleum Institute (API) Service Class SJ, SL or better. Use no special additives. Select the oil's viscosity grade according to the expected operating temperature.

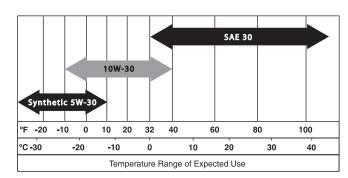
- SAE 30 → Above 32° F
- 10W-30 → Between 40° F and -10° F
- Synthetic 5W-30 → 10° F and below



A CAUTION



Any attempt to crank or start the engine before it has been properly serviced with the recommended oil may result in an engine failure.



◆ 4.3.3 OIL & OIL FILTER CHANGE PROCEDURE

To change the oil, proceed as follows:

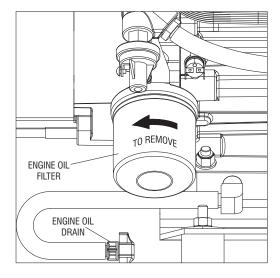
- 1. Start the engine by moving the AUTO/OFF/MANUAL switch to MANUAL and run until it is thoroughly warmed up. Then shut OFF the engine by moving the switch to the OFF position.
- 2. Immediately after the engine shuts OFF, pull the oil drain hose (Figure 4.2) free of its retaining clip. Remove the cap from the hose and drain the oil into a suitable container.
- After the oil has drained, replace the cap onto the end of the oil drain hose. Retain the hose in the clip.



Change the engine oil filter as follows:

- With the oil drained, remove the old oil filter by turning it counterclockwise.
- Apply a light coating of clean engine oil to the gasket of the new filter. See the Specifications section for recommended filter.
- 3. Screw the new filter on by hand until its gasket lightly contacts the oil filter adapter. Then, tighten the filter an additional 3/4 to one turn (Figure 4.2).

Figure 4.2 – Oil Drain Hose and Filter



- Refill with the proper recommended oil (see the Engine Oil Recommendations section). See the Specifications section for oil capacities.
- 5. Start the engine, run for one (1) minute, and check for leaks.
- Shutdown and recheck oil level, add as needed. DO NOT OVER FILL.
- 7. Reset the AUTO/OFF/MANUAL switch to the AUTO position.
- 8. Dispose of used oil at a proper collection center.

NOTE:

The oil drain hose may be routed in the opposite direction as shown in figure.

4.4 CHANGING THE ENGINE AIR CLEANER

◆ 4.4.1 10 & 13 KVA GENERATORS

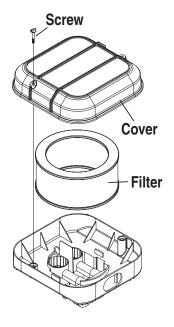
See "The Generator" section for the location of the air cleaner. Use the following procedures (Figure 4.3):

- 1. Lift the roof and remove the door.
- 2. Turn the two screws counterclockwise to loosen.
- 3. Remove the cover and air filter.
- 4. Wipe away dust or debris from inside of the air box and around edges.
- 5. Install the new air cleaner into the air box.

Install the cover. Turn the two cover screws clockwise to tighten.

See the Service Schedule section for air cleaner maintenance. See the Specifications section for air filter replacement part number.

Figure 4.3 — 10 & 13 KVA Engine Air Cleaner

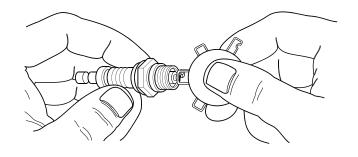


4.5 SPARK PLUG(S)

Reset the spark plug(s) gap or replace the spark plug(s) as necessary. See the Service Schedule section for maintenance requirements.

- 1. Clean the area around the base of the spark plug(s) to keep dirt and debris out of the engine.
- Remove the spark plug(s) and check the condition. Replace
 the spark plug(s) if worn or if reuse is questionable. See the
 Service Schedule section for recommended inspection. Clean
 by scraping or washing using a wire brush and commercial
 solvent. Do not blast the spark plug(s) to clean.
- 3. Check the spark plug gap using a wire feeler gauge. Adjust the gap to **1.02 mm (0.040 inch)** by carefully bending the ground electrode (Figure 4.4).

Figure 4.4 – Setting the Spark Plug Gap





4.6 **BATTERY MAINTENANCE**

The battery should be inspected per the "Service Schedule" section. The following procedure should be followed for inspection:

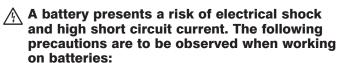
- Inspect the battery posts and cables for tightness and corrosion. Tighten and clean as necessary.
- Check the battery fluid level of unsealed batteries and, if necessary, fill with Distilled Water Only. Do not use tap water in batteries.
- Have the state of charge and condition checked. This should be done with an automotive-type battery hydrometer.

DANGER





Do not dispose of the battery in a fire. The battery is capable of exploding.



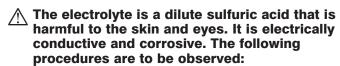
- Remove the 7.5A fuse from the generator control panel.
- Remove watches, rings or other metal objects;
- Use tools with insulated handles;
- · Wear rubber gloves and boots;
- Do not lay tools or metal parts on top of the battery; and
- Disconnect charging source prior to connecting or disconnecting battery terminals.



· WARNING A-



Do not open or mutilate the battery. Released electrolyte has been known to be harmful to the skin and eyes, and to be toxic.



- Wear full eye protection and protective clothing;
- Where electrolyte contacts the skin, wash it off immediately with water;
- · Where electrolyte contacts the eyes, flush thoroughly and immediately with water and seek medical attention; and
- Spilled electrolyte is to be washed down with an acid neutralizing agent. A common practice is to use a solution of 1 pound (500 grams) bicarbonate of soda to 1 gallon (4 liters) of water. The bicarbonate of soda solution is to be added until the evidence of reaction (foaming) has ceased. The resulting liquid is to be flushed with water and the area dried.
- Lead-acid batteries present a risk of fire because they generate hydrogen gas. The following procedures are to be followed:

- DO NOT SMOKE when near the battery;
- DO NOT cause flame or spark in battery area;
 - Discharge static electricity from body before touching the battery by first touching a grounded metal surface.
- Be sure the AUTO/OFF/MANUAL switch is set to the OFF position before connecting the battery cables. If the switch is set to AUTO or MANUAL, the generator can crank and start as soon as the battery cables are connected.
- Be sure the utility power supply is turned off and the 7.5A fuse is removed from the generator control panel, or sparking may occur at the battery posts as the cables are attached and cause an explosion.

ADJUSTING GH-990 VALVE 4.7 **CLEARANCE**

After the first six (6) months of operation, check the valve clearance in the engine, adjust if necessary.

Important: If feeling uncomfortable about doing this procedure or the proper tools are not available, please contact the Dealer for service assistance. This is a very important step to ensure longest life for the engine.

To check valve clearance:

- The engine should be cool before checking. If valve clearance is 0.002" - 0.004" (0.05 - 0.1mm), adjustment is not needed.
- Remove spark plug wires and position wires away from plugs.
- Remove spark plugs.
- Make sure the piston is at Top Dead Center (TDC) of its compression stroke (both valves closed). To get the piston at TDC, remove the intake screen at the front of the engine to gain access to the flywheel nut. Use a large socket and socket wrench to rotate the nut and hence the engine in a clockwise direction. While watching the piston through the spark plug hole. The piston should move up and down. The piston is at TDC when it is at its highest point of travel.

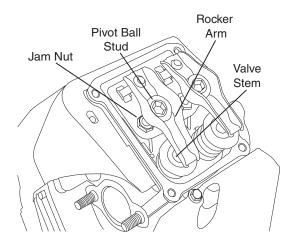
To adjust valve clearance (if necessary) (Figure 4.5):

- Make sure the engine is at 60° to 80° F.
- Make sure that the spark plug wire is removed from the spark plug and out of the way.
- Remove the four screws attaching the valve cover.
- Loosen the rocker jam nut. Use an 10mm allen wrench to turn the pivot ball stud while checking clearance between the rocker arm and the valve stem with a feeler gauge. Correct clearance is 0.002-0.004 inch (0.05-0.1 mm).

Hold the rocker arm jam nut in place as the pivot ball stud is turned.



Figure 4.5 - Valve Clearance Adjustment



When valve clearance is correct, hold the pivot ball stud in place with the allen wrench and tighten the rocker arm jam nut. Tighten the jam nut to 174 in/lbs. torque. After tightening the jam nut, recheck valve clearance to make sure it did not change.

- · Install new valve cover gasket.
- · Re-attach the valve cover.

NOTE:

Start all four screws before tightening or it will not be possible to get all the screws in place. Make sure the valve cover gasket is in place.

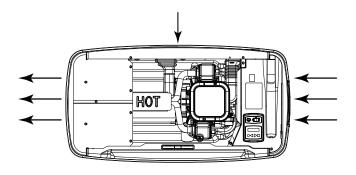
- · Install spark plugs.
- · Re-attach the spark plug wire to the spark plug.
- · Repeat the process for the other cylinder.

4.8 COOLING SYSTEM

Air inlet and outlet openings in the generator compartment must be open and unobstructed for continued proper operation. This includes such obstructions as high grass, weeds, brush, leaves and snow.

Without sufficient cooling and ventilating air flow, the engine/generator quickly overheats, which causes it to quickly shut down. (See Figure 4.6 for vent locations.)

Figure 4.6 – Cooling Vent Locations



Make sure the doors and roof are in place during operation as running the generator with them removed can effect cooling air movement.



The exhaust from this product gets extremely hot and remains hot after shutdown. High grass, weeds, brush, leaves, etc. must remain clear of the exhaust. Such materials may ignite and burn from the heat of the exhaust system.



The maximum ambient temperature for the generator is 25° C (77° F).

4.9 ATTENTION AFTER SUBMERSION

If the generator has been submerged in water, it **must not** be started and operated. Following any submersion in water, have a Dealer thoroughly clean, dry and inspect the generator. If the structure (ex. home) has been flooded, it should be inspected by a certified electrician to ensure there won't be any electrical problems during generator operation or when utility is returned.

4.10 CORROSION PROTECTION

Periodically wash and wax the enclosure using automotive type products. Frequent washing is recommended in salt water/coastal areas. Spray engine linkages with a light oil such as WD-40.

4.11 OUT OF SERVICE PROCEDURE

◆ 4.11.1 REMOVAL FROM SERVICE

If the generator cannot be exercised every seven days, and will be out of service longer than 90 days, prepare the generator for storage as follows:

- 1. Start the engine and let it warm up.
- 2. Close the fuel shutoff valve in the fuel supply line and allow the unit to shut down.
- 3. Once the unit has shut down, switch to the OFF position.
- Set the generator's main circuit breaker to its OFF (or OPEN)
 position.
- Set the AUTO/OFF/MANUAL switch to OFF and turn off the utility power to the transfer switch. Remove the 7.5A fuse from the generator control panel. Disconnect the battery cables as outlined in "General Hazards".
- While the engine is still warm from running, drain the oil completely. Refill the crankcase with oil. See "Engine Oil Recommendations".
- Attach a tag to the engine indicating the viscosity and classification of the oil in the crankcase.

Section 4 — Maintenance



Air-cooled Generators

- 8. Remove the spark plug(s) and spray fogging agent into the spark plug(s) threaded openings. Reinstall and tighten the spark plug(s).
- Remove the battery and store it in a cool, dry room on a wooden board. Never store the battery on any concrete or earthen floor.
- 10. Clean and wipe the entire generator.

◆ 4.11.2 RETURN TO SERVICE

To return the unit to service after storage, proceed as follows:

- Verify that utility power is turned off and that the AUTO/OFF/ MANUAL switch is set to OFF.
- 2. Check the tag on the engine for oil viscosity and classification. Verify that the correct recommended oil is used in the engine (see the Engine Oil Recommendations section). If necessary, drain and refill with the proper oil.
- 3. Check the state of the battery. Fill all cells of unsealed batteries to the proper level with distilled water. DO NOT USE TAP WATER IN THE BATTERY. Recharge the battery to 100 percent state of charge, or, if defective, replace the battery. See "Specifications," for type and size.
- 4. Clean and wipe the entire generator.
- 5. Make sure the 7.5A fuse is removed from the generator control panel. Reconnect the battery. Observe battery polarity. Damage may occur if the battery is connected incorrectly.
- Open the fuel shutoff valve.
- 7. Insert the 7.5A fuse into the generator control panel. Start the unit by moving the AUTO/OFF/MANUAL switch to MANUAL. Allow the unit to warm up thoroughly.

- Stop the unit by setting the AUTO/OFF/MANUAL switch to OFF.
- 9. Turn on the utility power to the transfer switch.
- 10. Set the AUTO/OFF/MANUAL switch to AUTO.
- 11. The generator is now ready for service.

NOTE:

If the battery was dead or disconnected, the exercise timer (single cylinder), current date and time (v-twin) must be reset.

◆ 4.11.3 ACCESSORIES

There are performance enhancing accessories available for the air-cooled generators.

- Cold Weather Kits are recommended in areas where temperatures regularly fall below 10° F (-12° C).
- Scheduled Maintenance Kits include all pieces necessary to perform maintenance on the generator along with oil recommendations.
- Auxiliary Transfer Switch Lockout enables any of the transfer switches to completely lock out one large electrical load by tying into its control system.
- Touch-up Paint Kits are very important to maintain the look and integrity of the generator enclosure. These kits include touch-up paint and instructions if the need should arise.

For more details on accessories, please contact a Dealer.



4.12 SERVICE SCHEDULE

ATTENTION: It is recommended that all service work be performed by the nearest Dealer.

SYSTEM/COMPONENT		PROCEDURE		FREQUENCY
X = Action				W = Weekly
R = Replace as Necessary	Inspect	Change	Clean	M = Monthly
* = Notify Dealer if Repair is Needed.	Inspect	Onlange	Glean	Y = Yearly
FUEL		•		
Fuel lines and connections*	Х			M
LUBRICATION				
Oil level	Х			M or 24 hours of continuous operation.
Oil		Х		2Y or 200 hours of operation.**
Oil filter		Х		2Y or 200 hours of operation.**
COOLING				
Enclosure louvers	Χ		Х	W
BATTERY				
Remove corrosion, ensure dryness	Χ		Х	М
Clean and tighten battery terminals	Χ		Х	M
Check charge state	Χ	R		EVERY 6 M
Electrolyte level	Χ	R		EVERY 6 M
ENGINE AND MOUNTING				
Air cleaner	Χ	R		2Y or 200 hours
Spark plug(s)	Χ	R		2Y or 200 hours
GENERAL CONDITION				
Vibration, Noise, Leakage, Temperature*	Χ			M
COMPLETE TUNE-UP*	TO B	E COMPLETED BY A D	EALER	2Y or 200 hours

^{*} Contact the nearest dealer for assistance if necessary.

^{**} Change oil and filter after first eight (8) hours of operation and then every 200 hours thereafter, or 2 years, whichever occurs first. Change sooner when operating under a heavy load or in a dusty or dirty environment or in high ambient temperatures.

Problem	Ca	iuse	Co	orrection
The engine will not crank.	1.	Fuse blown.		Correct short circuit condition, replace 7.5A fuse in generator control panel.
	2.	Loose, corroded or defective battery cables.	2.	Tighten, clean or replace as necessary.
	3.	Defective starter contactor. (8 kW)	3.	*
	4.	Defective starter motor.	4.	*
	5.	Dead Battery.	5.	Charge or replace battery.
The engine cranks but	1.	Out of fuel.	1.	Replenish fuel/Turn on fuel valve.
will not start.	2.	Defective fuel solenoid (FS).	2.	*
	3.	Open #14 wire from engine control board.	3.	*
	4.	Fouled spark plug(s).	4.	Clean, re-gap or replace plug(s).
	5.	Valve lash out of adjustment.	5.	Reset valve lash.
	6.	Choke not operating.	6.	Verify choke plate moves freely.
The engine starts hard and runs rough.	1.	Air cleaner plugged or damaged.	1.	Check, replace air cleaner.
and rano rough.	2.	Fouled spark plug(s).	2	Clean, re-gap or replace plug(s).
	3.	Fuel pressure incorrect.	3.	
	4.	Fuel selector in wrong position.	4.	Move selector to correct position.
	5.	Choke remains closed.	5.	Verify choke plate moves freely.
The AUTO/OFF/MANUAL	1.	Defective switch.	1.	*
switch is set to OFF, but	2.		2.	*
the engine continues to run.	3.	wired incorrectly. Defective control board.	3.	*
There is no AC output	1.	Main line circuit breaker is in	1.	Reset circuit breaker
from the generator.		the OFF (or OPEN) position.		to ON (or CLOSED).
	2.	Generator internal failure.	2.	*
There is no transfer to	1.	Defective transfer switch coil.	1.	*
standby after utility	2.	Defective transfer relay.	2.	*
source failure.	3.	Transfer relay circuit open.	3.	*
	4.	Defective control logic board.	4.	*
Unit consumes large	1.	Engine over filled with oil.	1.	Adjust oil to proper level.
amounts of oil.	2.	Improper type or viscosity of oil.	2.	See "Engine Oil Recommendations".
	3.	Damaged gasket, seal or hose.	3.	Check for oil leaks.
	4.	Engine breather defective.	4.	*

^{*}Contact the nearest Dealer for assistance.



6.1 MENU SYSTEM NAVIGATION

To get to the MENU, use the "Esc" key from any page. It may need to be pressed many times before getting to the menu page. The currently selected menu is displayed as a flashing word. Navigate to the menu required by using the \pm -keys. When the menu required is flashing, press the ENTER key. Depending on the menu selected, there may be a list of choices presented. Use the same navigation method to select the the desired screen (refer to the Menu System diagram).

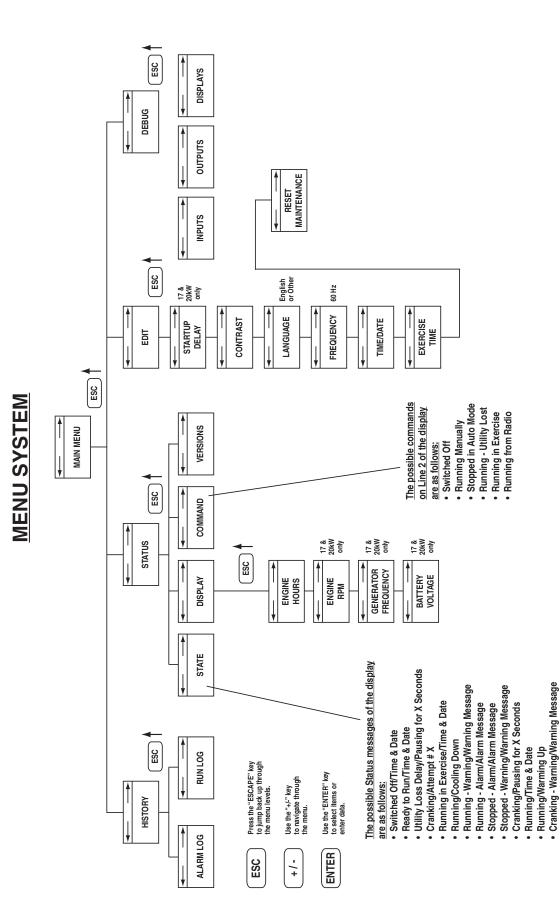
◆ 6.1.1 CHANGING SETTINGS (EDIT MENU)

To change a setting such as display contrast, go to the EDIT menu and use the \pm -keys to navigate to the setting to change. Once this setting is displayed (e.g. Contrast), press the ENTER key to go into the edit mode. Use the \pm -keys to change the setting, press the ENTER key to store the new setting.

NOTE:

If the ENTER key is not pressed to save the new setting, it will only be saved temporarily. The next time the battery is disconnected, the setting will revert back to the old setting.

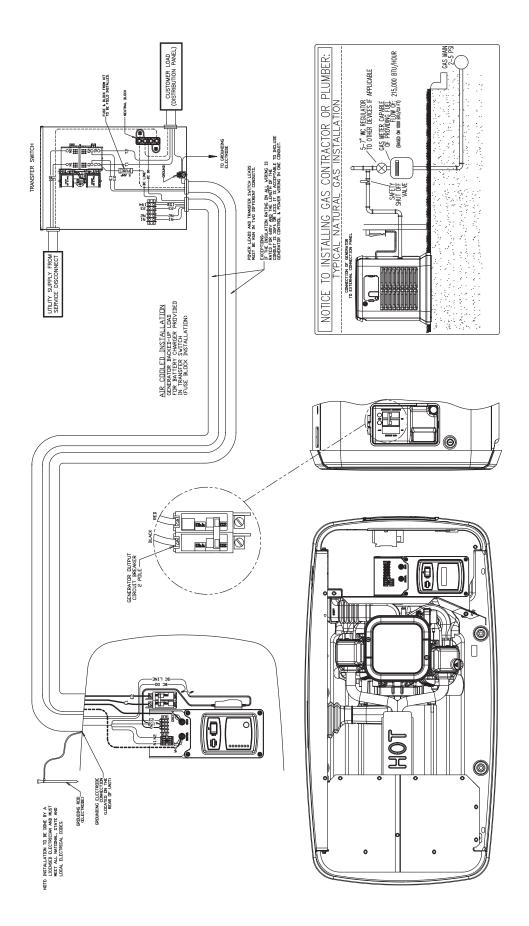




· Cranking - Alarm/Alarm Message

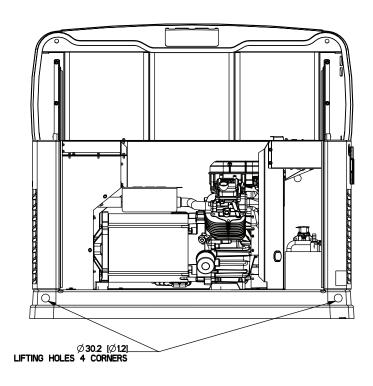
Air-cooled Generators Circuit Breakers - Drawing No. 0H4213-A



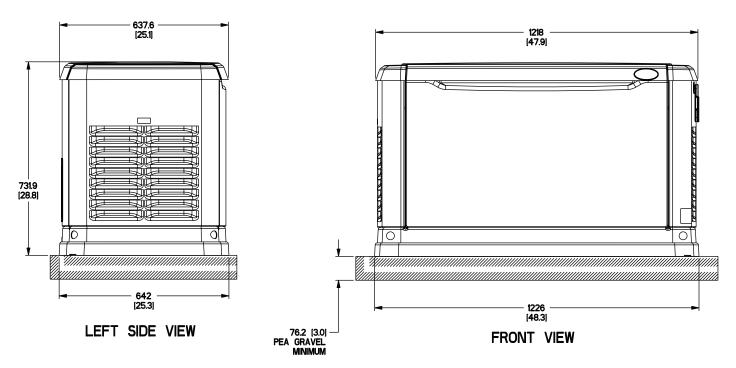




Air-cooled Generators Generator - Drawing No. 0H4214-B

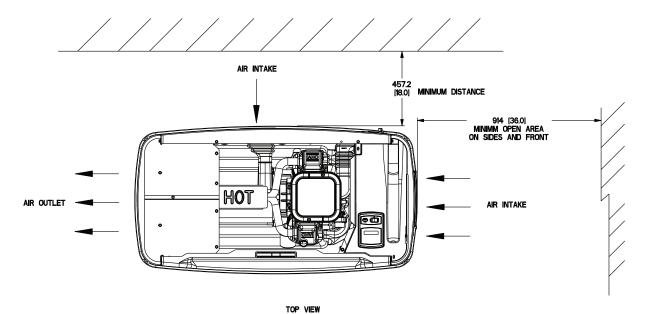


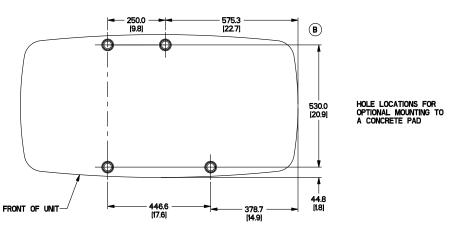
"DO NOT LIFT BY ROOF"

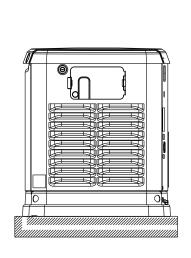


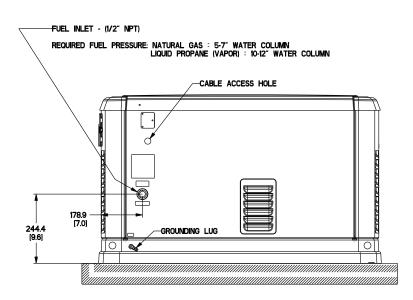
Air-cooled Generators Generator - Drawing No. 0H4214-B











RIGHT SIDE VIEW

REAR VIEW

"ALL DIMENSIONS IN: MILLIMETERS [INCHES]

<u>NOTES</u>	Section 8 — Notes

Section 8 — Notes	NOTES