

OPERATORS MANUAL

GENERATOR WITH INDIRECT OIL FIRED FORCED AIR HEATER

MODEL ES500

SPECIFICATIONS

Dry weight:	..... 2332 LB [1058 KG]
Wet weight:	..... 2930 LB [1329 KG]
Firing Rate:	..... 3.0 GPH [11.4 LPH]
Fuel Type:	..... ULSD
Fuel Storage: Capacity	.....82 GAL [424 L]
Secondary containment	..... 200%
Heater: Max rating	..... 380,000 BTU/HR
Heat exch. material	..... 304 Stainless
Burner	..... Riello 40 F10
Fan motor	.....³ / ₄ HP, 120V
Fan capacity	..... 3300 CFM @ 1/2 in. wg
Generator: Engine	..... Kubota D1005
Generator	..... Mecc Alte
Engine continuous power 6 kW
Main breaker rating 40A
Voltage 120V
Aux power 20A, 120V, 60Hz

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1 Introduction

**WARNING**

Read and understand this manual before operating the machine to avoid serious injury or death.

1.1 General Description

The ES500 is a portable diesel engine generator set with one auxiliary indirect-fired forced-air heater with a maximum firing rate of approximately 380,000 BTUs/hour. The heater system is intended for outdoor use and is trailer mounted for jobsite portability. The heater has an integral 112-gallon [424 L] fuel storage tank with secondary containment. The heater is designed to operate reliably at extremely low temperatures and has been proven on Alaska's North Slope oil fields and in northern Canada. Large doors allow easy and safe service access in industrial environments. All heat exchanger surfaces are constructed from stainless steel for extended life.

1.2 Manual Applicability

This manual is applicable to the following Equipment Source Incorporated (ESI) machine models:

Model	ESI No.	Description
ES500	103096	Single heater trailer system

This manual should be kept with the machine at all times. Immediately contact Equipment Source Incorporated (manufacture) or an authorize dealer to obtain a copy of this manual if missing or damaged. Refer to www.equipmentsourceinc.com for current contact information.

1.3 Manual Scope

This manual contains basic operating and maintenance instructions for the above listed product(s). Specific information concerning trailers, skid frames or other transport provisions are not included in this manual. Refer to the manual provided with the transport accessory. For detailed service instructions concerning specific electrical or mechanical components, refer to the operation and maintenance manual provided by the manufacture of the component or contact an authorized service provider.



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2 IMPORTANT SAFETY INSTRUCTIONS

WARNING

- Never attempt to operate this machine indoors. Exhaust fumes from the engine and heater can kill.
- SAVE THESE INSTRUCTIONS. This manual contains important instructions that should be followed during the operation and maintenance of the generator, battery and heater.

2.1 Training

- Never allow untrained personnel to operate or service the machine. Take time to read the manual and discuss safe practices with jobsite personnel.
- Read and understand the operating section of this manual.
- Take time to familiarize yourself with the controls and instructional placards before operating or servicing.
- Contact your dealer or rental service provider if additional training is necessary.

2.2 Operating

- Some components are hot while in operation. Keep children, clothing and combustibles away.
- Wear protective clothing appropriate to the jobsite.
- Observe changes in the operating environment and respond accordingly.
- The frame of the machine shall be connected to an approved grounding electrode according to local state or provincial codes.
- Generators vibrate in normal use. During and after the use of the generator, inspect the generator as well as extension cords and power supply cords connected to it for damage resulting from vibration. Have damaged items repaired or replaced as necessary. Do not use plugs or cords that show signs of damage such as broken or cracked insulation or damaged blades.

2.3 Service

- Only trained service technicians should attempt to service the machine.
- Properly shutdown the machine and let cool completely before attempting to service any component.
- Never defeat the safety devices
- Never modify the machine



3 Transporting and Storage

3.1 Dimensions and Weights

Machine Weights *:	Dry.....2600 LB [1179 KG]
	Wet 103096 3400 [1542 KG]
	Trailer 103096 Max GVW..... 3700 [1678 KG]
*All weights are approximate	

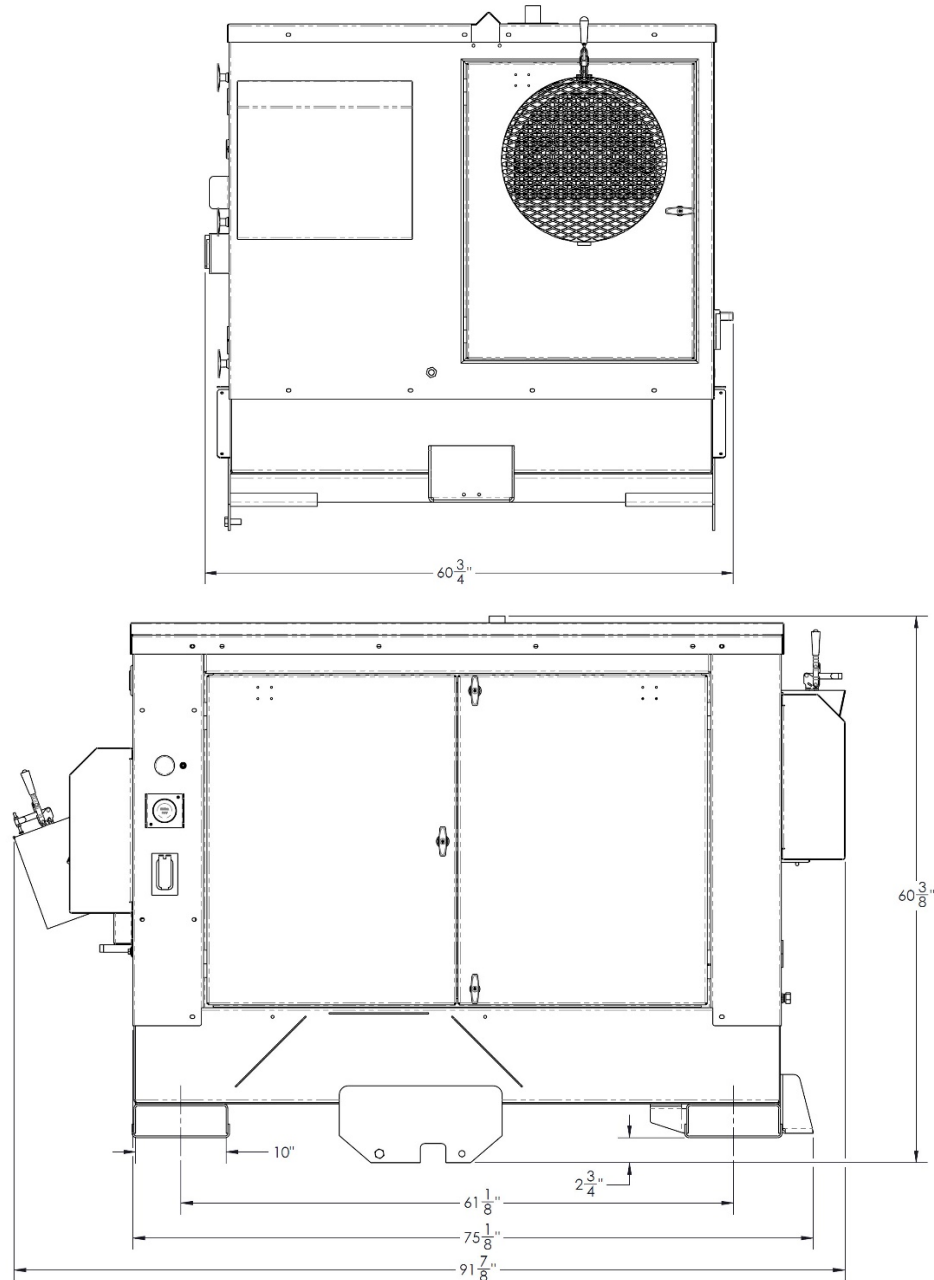


Figure 1 Compact Transport Configuration



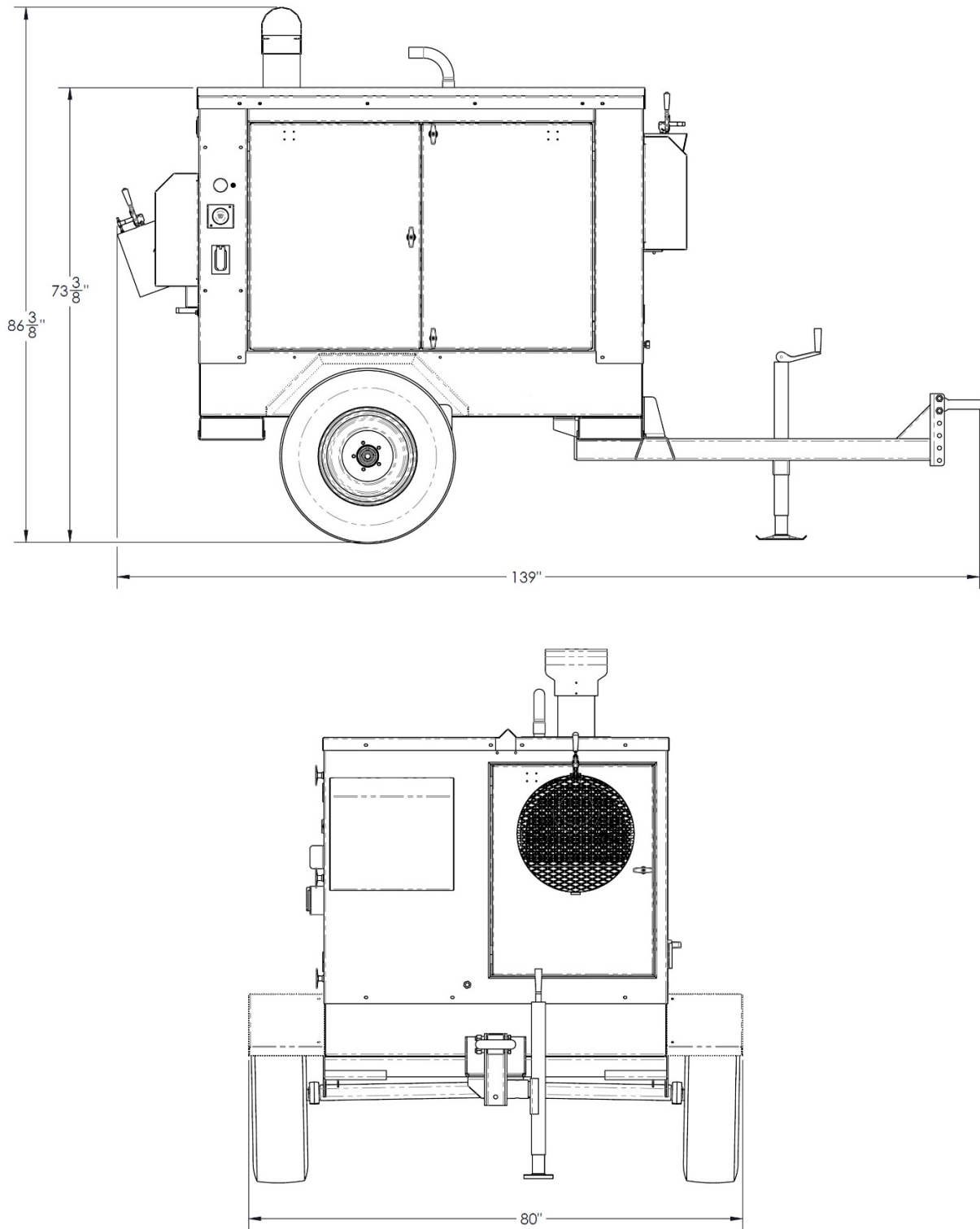


Figure 2. Machine dimensions PN 103096.



3.2 Lifting

CAUTION

- Crain lifting should use a spreader bar or similar device inserted through the forklift pockets.
- Forklift pockets are provided for lift truck usage. See figure 1 for dimensions.

3.3 Transporting on a Flatbed Truck

1. Lift the machine following the guidelines presented in Section 3.2 *Lifting*.
2. Fully retract and pivot the trailer jack stand **(A)** before securing on a flatbed trailer. The trailer can be tilted to rest directly on the hitch. Maximum packing efficiency can be obtained by sliding the tongue of one trailer under the back of another trailer.
3. Trailer tongue, axle, fenders, and wheels may be removed if desired.
4. The forklift pockets **(B)** and the axle are permissible tie down points.
5. Ensure all doors are closed and locked.

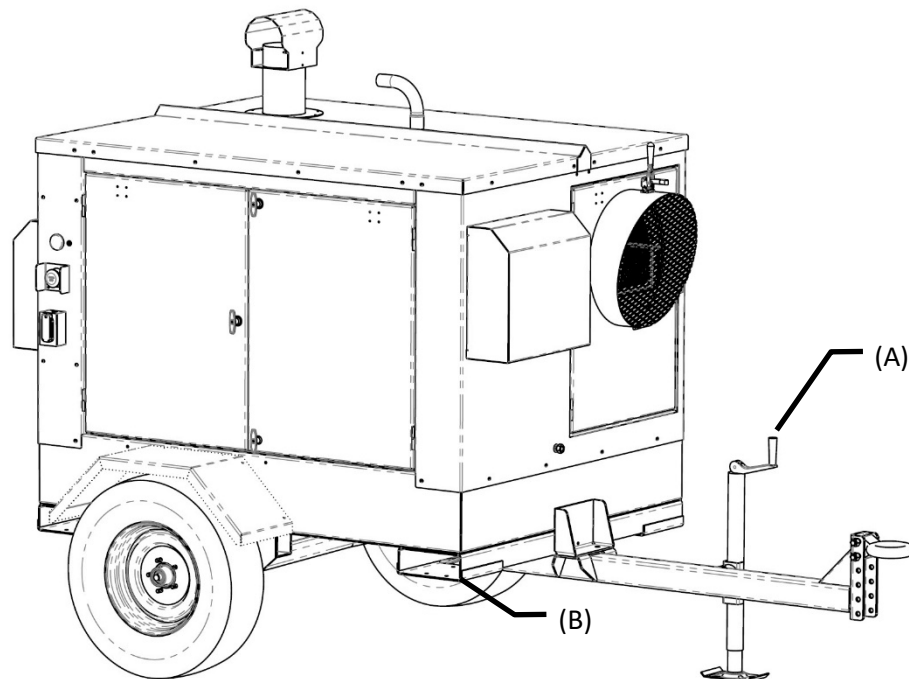


Figure 3. Machine tie-down



3.4 Transporting by towing

⚠ CAUTION

The transport vehicle and hitch adapters must be rated to tow a trailer GVW of 3700 LB (1678 KG) minimum.

NOTICE

Ensure that the trailer is registered with an applicable transport authority before towing.

Use the following procedure to prepare the machine for towing:

1. Connect trailer to the vehicle and secure hitch. The trailer should be nearly parallel to the ground; use the adjustable lunette ring or change the vehicle's hitch to level if necessary. Connect safety chains.
2. Connect trailer lights. Always check trailer lights for proper operation.
3. Lock doors. This prevents them from inadvertently opening during transport.
4. Walk around the machine to check for wheel chocks, verify tire pressure and ensure the jack stand is fully retracted.



3.5 Storage

NOTICE

Failure to follow the shutdown procedure can cause serious damage to the burner assembly.

3.5.1 Short-Term Storage (less than 90 days)

1. Shutdown the machine using the shutdown procedure (Section 4.10 *Shutdown*)
2. Verify that main breaker and control switches are in the off position
3. Close and latch doors, stow loose accessories
4. Chock tires

3.5.2 Long-Term Storage (greater than 90 days)

1. Shutdown the machine using the shutdown procedure (Section 4.10 *Shutdown*)
2. Verify that the main breaker and control switches are in the off position
3. Disconnect the battery using the master disconnect switch
4. Drain water from fuel filters
5. After the heater has cooled sufficiently, cover the chimney with a durable material to prevent animal intrusion.
6. Ensure the machine is positioned on thaw-stable ground if applicable. Add blocks to support the tongue as necessary.
7. Chock tires

3.6 Preparing the Machine for Seasonal Operation

Follow this procedure to prepare the machine for seasonal operation or any time the machine is removed from long-term storage:

1. Remove any protective coverings from the exhaust outlets
2. Clean the inside of the enclosure to remove any debris
3. Check containment for accumulation of liquids
4. Replace the burner nozzle
5. Inspect electrical system and controls for damage
6. Inspect fuel system for wear or damage
7. Repack wheel bearings if needed
8. Replace fuel filters
9. Verify burner electrode position
10. Verify fuel pump pressure
11. Verify combustion quality
12. Check all lights and replace as necessary
13. Check tire pressure (if applicable)
14. Run heater for 1 hour to verify operation of all components



4 Operation

⚠ WARNING Always install a CO gas monitor in enclosed environments that are heated with oil burning forced air heaters.

NOTICE Failure to follow the shutdown procedure can cause serious damage to the burner assembly.



Figure 4. ES500 Controls



4.1 Duct Selection

4.1.1 General Guidelines


The ES500 heater is an outdoor heater designed to safely heat enclosures using flexible duct connections. For efficient operation, keep duct lengths as short as possible. Excessive duct lengths will reduce air flow in the heat exchanger and cause the burner to cycle to control the outlet temperature. Excessive burner cycling shortens the life of the heat exchanger and should be avoided. Burner cycling can be controlled by reducing duct length, increasing the duct diameter, or adjusting the burn rate or temperature feeler gauge (see Appendix A).

An inlet duct is not required for normal operation. It can be used to circulate warm air back from an enclosure for re-heating.

4.1.2 Duct Sizes

- Minimum inlet duct size (inches) 20
- Minimum outlet duct size 12
- Available outlet duct sizes2x12, 1x16

4.2 Recommended Fuels and Fueling Instructions

 **CAUTION** Do not overfill tank. Tank should be filled to only 90% of the full volume to allow thermal expansion.

Use ULSD No.1 or ULSD No.2. For continuous duty operation, a daily refilling schedule should be established.

4.3 Access and Clearance

Ensure all sides of the machine are easily accessible. All parts of the machine should be more than 3ft [1m] from any structure. Heater is correctly placed when the operator can walk around the perimeter of the heater with minimal obstruction. Check the placement and accessibility of a fire extinguisher.

4.4 Leveling

Ensure machine is placed on firm ground and the wheels are chocked. Heater should be close to level across the width ($\pm 3^\circ$). The machine should be slightly lower in the front (generator end). It is important that the heaters run out of fuel before the generator to prevent overheating the heaters. Use the tongue jack to level the heater and then lower the tongue jack 1 to 2 inches (2.5 to 5cm).

If the machine is placed on frozen ground or ice, frequently check for shifting and reposition/level as necessary.

4.5 Engine Heat - 120V Power Input

When operating the machine in cold weather, use the 120V engine pre-heat circuit to warm the engine block and engine oil prior to starting. The engine should be pre-heated for approximately 4-hours if the ambient temperature is below -7 C (20 F). Longer preheat cycles may become necessary in extremely cold conditions.

Use a grounded flexible extension cord rated at 15A minimum to connect the machine to a 120V power supply. The electrical inlet box is located on the exterior of the machine directly below the Emergency Stop button.

4.6 Pre-Startup Checklist

Use the following checklist to determine whether the machine can be safely started and operated:

- 1. Machine is level and on stable ground (per Section 4.4)**
- 2. Wheels are chocked**
- 3. Exhaust vents are free of obstruction**
- 4. 3ft [1m] clearance from permanent structures on all sides**
- 5. Fire extinguisher is accessible**
- 6. Water is drained from fuel filters**
- 7. Engine oil and coolant levels normal**
- 8. Fuel tank filled with recommended fuel type**
- 9. Inlet and outlet ducts are free of obstruction**
- 10. Machine safeguards are connected and functioning**

4.7 Startup

Use the following checklist to start and operate the machine. Open the door labeled “Machine Controls” to access all required controls.

- 1. Turn off the Master Disconnect Breaker and the Burner Control Switches**
- 2. Turn DC disconnect switch to “On”**
- 3. Push “Auto” button**
- 4. Push “Manual Start” button**
- 5. Let generator engine warm for at least 1 minute**
- 6. Turn on Master Disconnect Breaker**
- 7. Move the heater switch to “Manual” or “Thermostat”.**
 - **If using Thermostat mode, unit must be started in Thermostat position.**
 - **When changing between manual and thermostat operation, the heater changed must be left in the “OFF” position for 30 seconds to prevent the burner from locking out.**



4.9 Monitoring and Operation

4.9.1 Daily Inspection

- Listen for abnormal sounds
- Check fluid levels
- Check containment for accumulation of liquids. Drain water if necessary.
- Observe burn quality (no smoke should be visible)
- Check if level and secure
- Check vents for icing or other obstructions
- Check fire extinguisher access.
- Observe recommended maintenance schedule

4.9.2 Adjusting Heat Output

- Connect an external thermostat (see wiring diagram) to control building heat.
- Increase the outlet temperature by constricting the outlet airflow. The outlet temperature is limited to 250F and undesirable burner cycling will occur if the ducts are excessively restricted. Increasing the outlet temperature by reducing the air flow will never increase the heat output.
- See FVOHC-400 manual in Appendix A for further heater control information

4.10 Shutdown

NOTICE

Failure to follow the shutdown procedure can cause serious damage to the burner assembly.

Shutdown procedure:

- 1. Shutdown burner by moving the control switch to the “OFF” position**
- 2. Let the generator and fan run for 5 minutes**
- 3. Turn off generator**

4.11 Combustion Air and Burner Adjustments

Proper adjustment of the burner and temperature feeler gauge is important to maximize performance and heater life. The heaters are factory set for supply air colder than 23 °F (-5 °C). For extreme low temperatures and higher temperatures see pages 9-11 of Appendix A for detailed instructions.

4.12 Auxiliary Power Connection

All machine models are equipped with a 120V, 20A, 60Hz auxiliary (AUX) GFCI receptacle. The AUX power connection can be used to run work lights and tools as needed on a construction site while the heater is operating. The primary purpose of this product is not a jobsite generator; avoid using the AUX power connection for extended periods while the heater is not operating to prevent under-loading or “wet stacking” the engine.



5 Maintenance

CAUTION

Some of the following maintenance operations should only be completed by a trained technician. Do not attempt to open electrical panels or service the burner unless you are a trained technician.

5.1 Maintenance Schedule

Table 1. Maintenance Schedule

Interval (Hours)	Maintenance Instruction	Notes
Daily *Weekly	<ul style="list-style-type: none"> Check primary fuel filters for water and drain as necessary 	<ul style="list-style-type: none"> Applies to both burner and engine filters Replace burner filter* FVO-418
Every 200 hours Or 12 months	<ul style="list-style-type: none"> Change oil and oil filter 	<ul style="list-style-type: none"> Engine Oil: SAE30, SAE10W-30 or 15-40 Must be API Spec: CF, CF-4, CG-4, CH-4 or CI-4 Oil Capacity: 1.35 GAL [5.1 L]
Every 1000 hours Or 12 months	<ul style="list-style-type: none"> Change all fuel filters Check air filter Check engine fan belt 	<ul style="list-style-type: none"> Use Racor R60S Primary Filter Check air filter every 500 hours if operating in a dusty environment
Every 3000 hours Or 12 months	<ul style="list-style-type: none"> Change oil and oil filters Change Fuel Filters Change engine fan belt Replace burner nozzle and adjust electrodes Service trailer 	<ul style="list-style-type: none"> Engine oil: SAE30, SAE10W-30 or 15-40 Engine oil must meet API Spec: CF, CF-4, CG-4, CH-4 or CI-4 Oil Capacity: 1.35 GAL [5.1 L] Use Racor R60S filters for engine, FVO-418 for burners
Every 6000 hours Or 3 years	<ul style="list-style-type: none"> Change coolant 	<ul style="list-style-type: none"> Use Rottella ELC or equivalent
Every 9000 hours	<ul style="list-style-type: none"> Injection pump service Valve clearance service 	<ul style="list-style-type: none"> Contact Kubota service rep. for valve and fuel injection service

5.2 Engine Service

Use engine operator's or service manual provided for further instruction on how to complete routine service or trouble shooting.

5.3 Cleaning/Deicing Inlet Screen

WARNING

Do not attempt to open blower inlet access unless the machine is completely shut down and cooled. Observe all lockout/tagout safety directives specific to the jobsite



The fan inlet should be periodically checked for icing when operated in winter conditions. If necessary, open both doors to access inlets to clear ice. Do not attempt to open the access doors unless the heater is shutdown using the shutdown procedure.

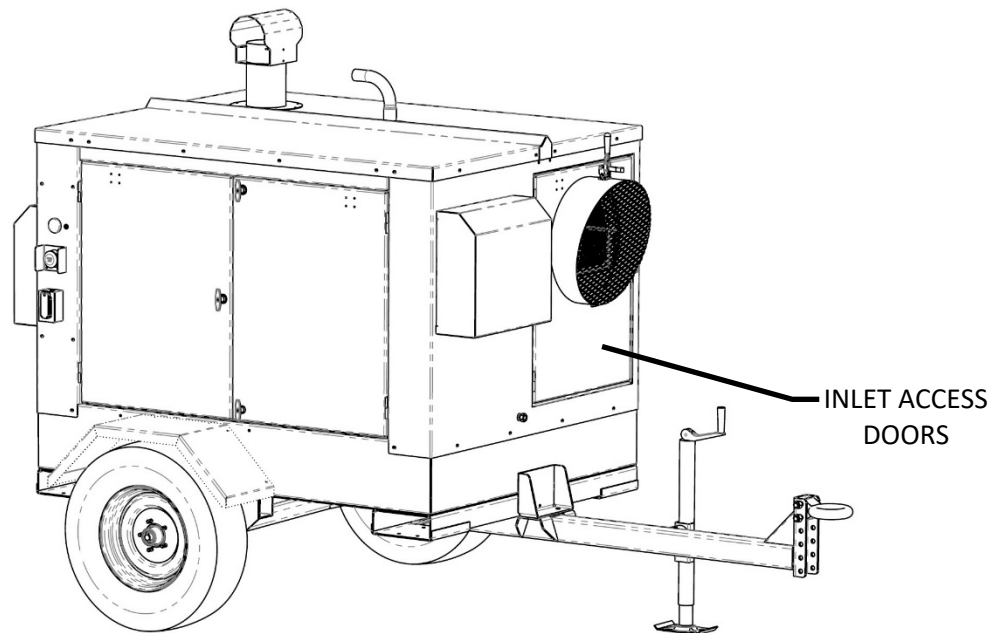


Figure 5. Heater Inlet Access

5.4 Burner Maintenance

Refer to the FV0HC-400 Instruction Manual for further instruction on how to complete routine service or trouble shooting. Only qualified technicians should attempt to service the burner.

5.5 Battery Service

The engine starting circuit is supplied by a single 12V battery. The battery is located in the engine compartment near the generator. The machine is factory equipped with an Optima Redtop 75/25 battery or equivalent. No maintenance is required other than normal charging and occasional replacement.

To replace the battery, sequentially remove the negative ground lead, positive power lead and the bracket holding the battery in the tray. Replace the battery by securing in the tray, connecting the positive lead and then connecting the ground lead.

5.6 Trailer Service

5.6.1 General inspection guidelines

A general inspection of the trailer should be completed every 6 months or whenever the machine is in a service center.



- Check tire pressure
- Test brake lights, turn signals and marker lights
- Test the breakaway battery and charge if necessary
- Check condition of the jack stand
- Check tire condition and tightness of lug nuts

5.6.2 Tire and Wheel Service

New tire and wheel combinations must have a minimum load rating of 1850 LB each [840 KG] for a combined load capacity of 3700 LB [1678 KG]. New machines are shipped with 225/75 R15 Load Range D tires. Fill tires to the maximum rated pressure indicated on the tire sidewall. Torque lug nuts to 100 ft-lb [135 N-m].

5.6.3 Wheel Bearing and Brake Service

Service wheel bearings and brakes every 12 to 24 months. This can be completed at any qualified trailer service center.



6 Basic Trouble Shooting

⚠ CAUTION Some of the following maintenance operations should only be completed by a trained technician. Do not attempt to open electrical panels or service the burner unless you are a trained technician.

Use the following troubleshooting guidelines to resolve problems that may encountered while operating the ES500 heater. Contact your service representative or refer to the attached operations manual specific to the burners, engine or fan if the problem cannot be resolved using this guide.

6.1 Burner Trouble Shooting

⚠ WARNING Never defeat the burner safeties such as the thermostats.

NOTICE Failure to follow the shutdown procedure can cause serious damage to the burner assemblies.

The heater in the ES500 uses a Riello 40 F10 burner. There are two internal thermostats (limit switches) on the heater controlling the heater and an external (panel mounted) limit switch. If the enclosure cabinet gets too hot, the panel mounted thermostat (A) will turn enclosure fan on. The 12V disconnect switch must be turned off for the auto reset relay (B) to reset. This relay trips if the fan draws too much power. This would happen if the fan seizes up for example.

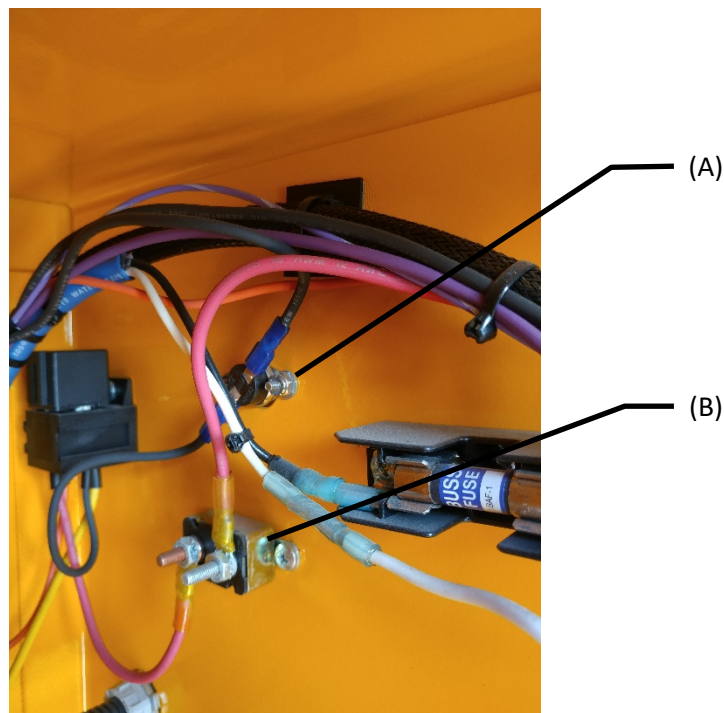


Figure 2. Enclosure over-temp thermostats (A) and fan auto reset relay (B)



Table 2. Burner Safeties/Controls

Safety	Purpose
Heat exchanger over temperature <i>See FVOHC-400 manual for location and wiring diagram.</i>	Air blockage safety: shuts down burner if the heat exchanger working air temperature exceeds 290F [143C].
(A) Enclosure over temperature NOTE: This safety must be manually reset.	Shuts down burner if the enclosure air temperature exceeds 120F [50C]

Table 3. Burner Trouble Shooting Guide

Problem	Solution
Burner cycling or outlet temperature is not hot enough (frequently starting and stopping during normal operation)	<ul style="list-style-type: none"> Check for flow restrictions in the inlet or outlet ducts Reduce duct lengths or increase duct diameters Check temperature feeler gauge adjustment. See FVOHC-400 manual page 10-11
Red LED is on	<ul style="list-style-type: none"> Reverse polarity in wiring
Both Red and Green LED are on	<ul style="list-style-type: none"> Try pressing the reset button on the burner
Red LED is blinking	<ul style="list-style-type: none"> Ground or neutral issue
Outlet temperature is too hot (above 250 °F)	<ul style="list-style-type: none"> Check high limit switch at the outlet. See FVOHC-400 manual for details.

6.2 Fan Trouble Shooting

Table 4. Fan Trouble Shooting Guide

Problem	Solution
Fan motor does not shut off after heat exchanger has cooled down	<ul style="list-style-type: none"> Check fan limit switch. See FVOHC-400 manual for details.
Fan motor won't start	<ul style="list-style-type: none"> Check reset button on back of fan motor



6.3 Generator Engine Trouble Shooting

Table 5. Engine Trouble Shooting Guide

Problem	Solution
Engine controller fails	<ul style="list-style-type: none"> ▪ Check position of battery main disconnect ▪ Check condition of battery ▪ Reset 30A breaker on controller panel. If repeatedly tripping, refer to 12V electrical schematics and check for a ground fault ▪ Check 40A fuse near the starter terminal. Replace if necessary, and check for ground fault if repeatedly failing.
Starter fails to engage Note: Engine preheat (glow plug) timer prevents engagement of starter until the 15 second cycle is complete	<ul style="list-style-type: none"> ▪ Check if engine controller is functioning (see “Engine controller fails”) ▪ Check condition of battery ▪ Reset the 30A breaker on the control panel. If tripping repeatedly, Check for ground fault in 12V system and check cooling fan current (should be <20A).
Starter engages, but engine fails to start	<ul style="list-style-type: none"> ▪ Check fuel level ▪ There may be air in the fuel line if the engine previously ran out of fuel. Bleed the air out by slightly loosening the injector lines while cranking the engine. Make sure to re-tighten the fuel line to injector connection! ▪ Check for water in fuel and drain completely if present. ▪ Check electric fuel pump. The pump should audibly engage when the controller tries to start the engine. ▪ If cold (less than 0F [-18C]), the engine block/oil pan heater should be plugged in for 4-hours prior to starting. ▪ Check engine preheat (glow plug) circuit. Circuit should draw 15-25A for 15 seconds during the controllers preheat sequence. ▪ Check power supply to fuel solenoid on the engine fuel pump
Engine stops after 20 seconds	<ul style="list-style-type: none"> ▪ Check engine oil pressure switch ▪ Extreme cold may cause the engine oil pressure switch to temporarily malfunction. Plug in engine block/oil pan heater for at least 4-hours if temperature is lower than 0F [-18C]. ▪ Check indicator lights for high temperature alarm. Check engine temperature sensor for continuity if the sensor is active when the engine is cold.



Engine fails from over temp sensor	<ul style="list-style-type: none">▪ Check 12V cooling fan for correct operation. See below "12V cooling fan failed" if fan has failed.▪ Check coolant level. CAUTION! Wait until engine has cooled completely before opening the radiator cap.▪ Check coolant condition▪ Check fan belt▪ Check sensor for ground fault
12V cooling fan failed (Fan fails to engage when the enclosure temperature is over 70F [20C])	<ul style="list-style-type: none">▪ If the engine controller is functioning, check 30A breaker on the engine control panel.▪ If the engine controller fails to activate, see "Engine controller fails"▪ Check fan thermostat circuit▪ The fan should draw approximately 17-20A if operating correctly.▪ Check/replace the exhaust fan relay in the engine control panel.▪ Replace fan



7 Electrical Schematics

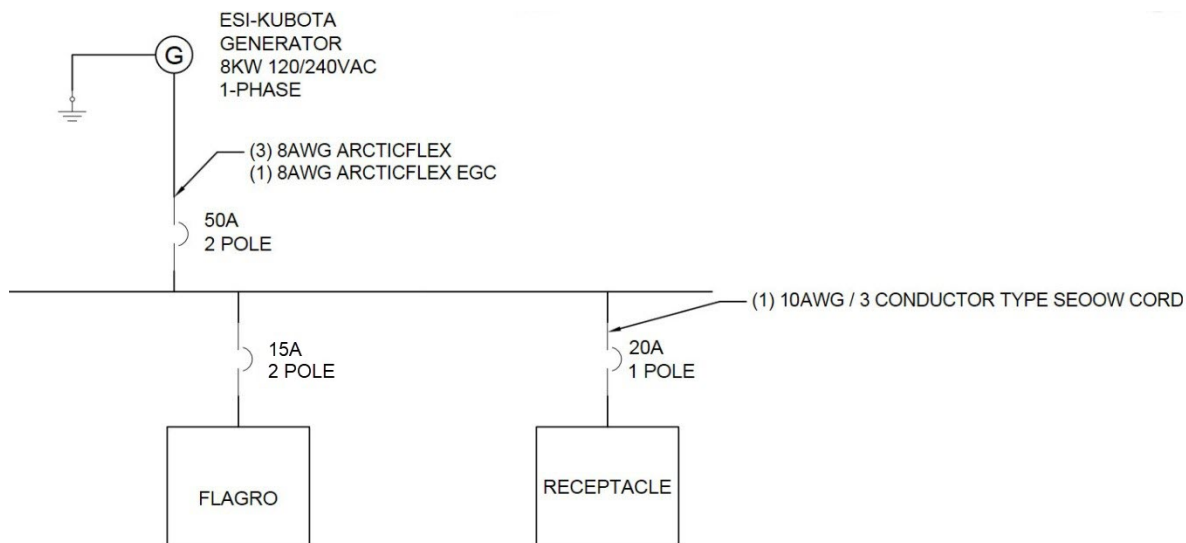


Figure 3. ES500 Generator Wiring



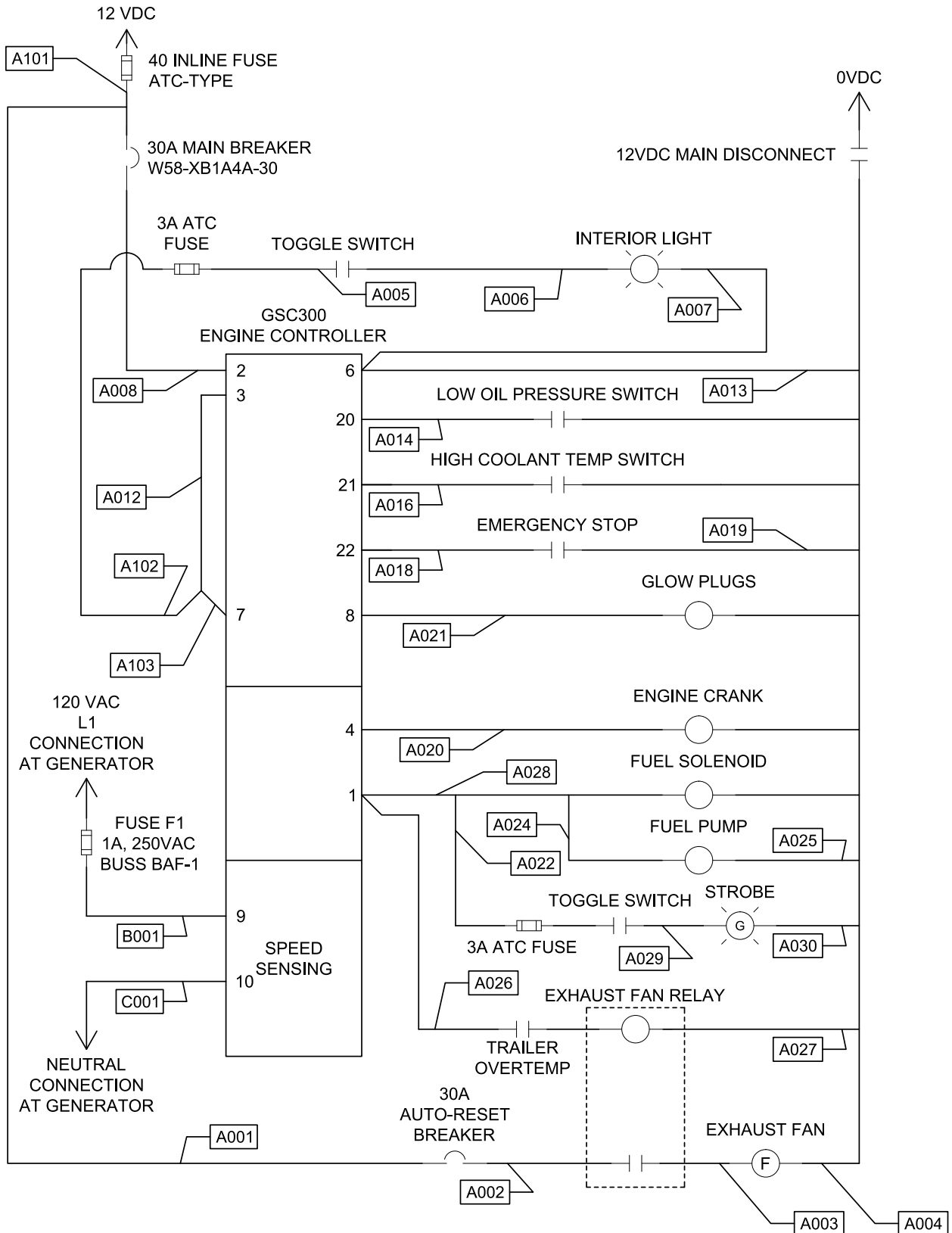


Figure 4. 12V Engine Control Schematic



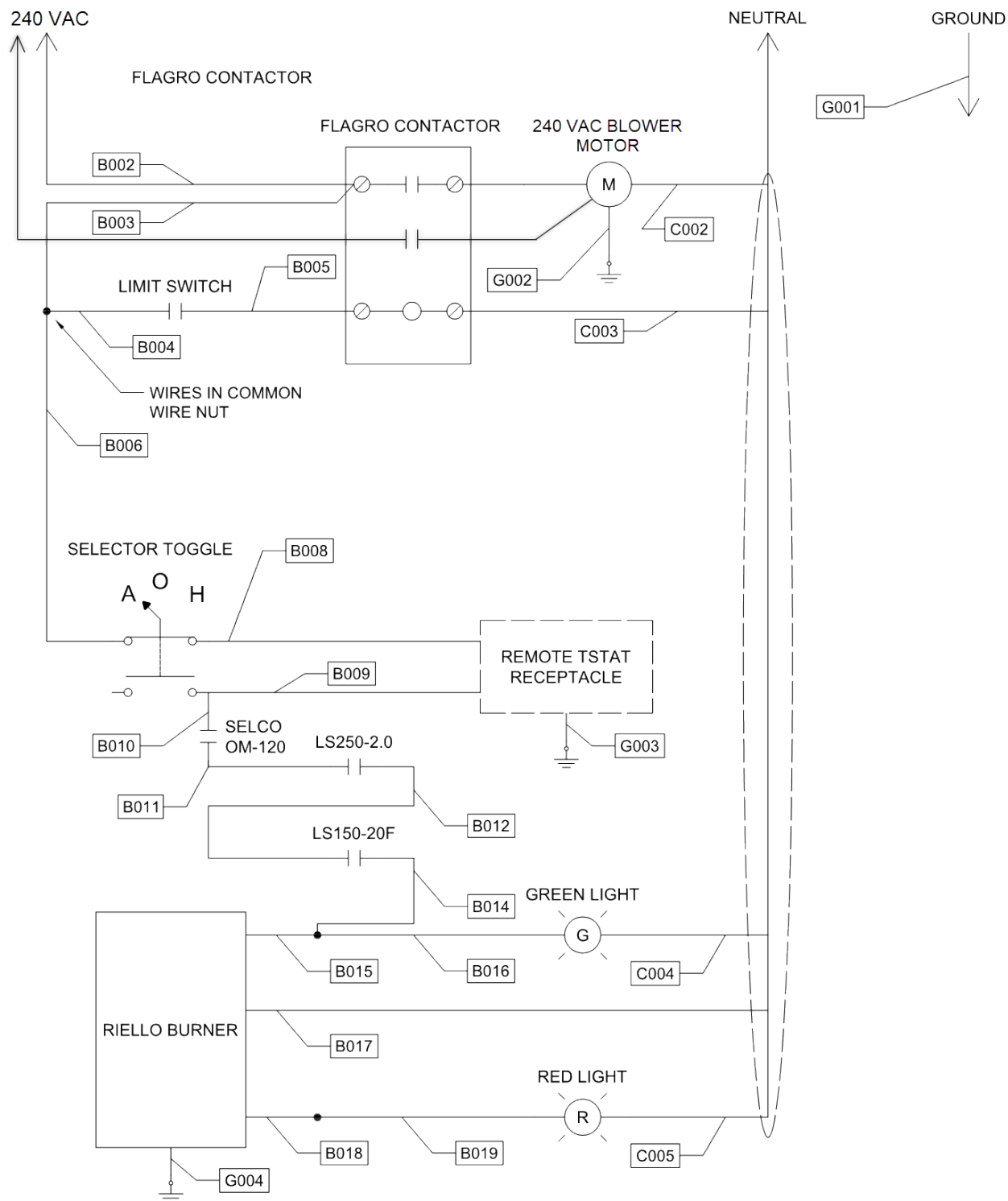


Figure 5. Heater Wiring Diagram



8 Maintenance Records

Table 6. Machine Data

Machine Serial Number	
Engine Serial Number	
Generator Serial Number	
Trailer Serial Number	

Table 7. Maintenance Records

<ul style="list-style-type: none"> ▪ Date ▪ Engine Hours ▪ Service Personnel ▪ Service Location 	Description of work completed







9 Appendix A

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OPERATING INSTRUCTIONS MANUAL

(Please retain for future reference)

For

FVO-400 INDIRECT FIRED SPACE HEATERS



CERTIFIED FOR USE IN CANADA AND U.S.A.

As per CSA B140.8 Portable Oil Fired Heaters / CSA B140.02003 Oil Burning Equipment
Construction Heaters Unattended Type.

Issue date October 1, 2008



FLAGRO INDUSTRIES LIMITED
ST. CATHARINES, ONTARIO
CANADA

