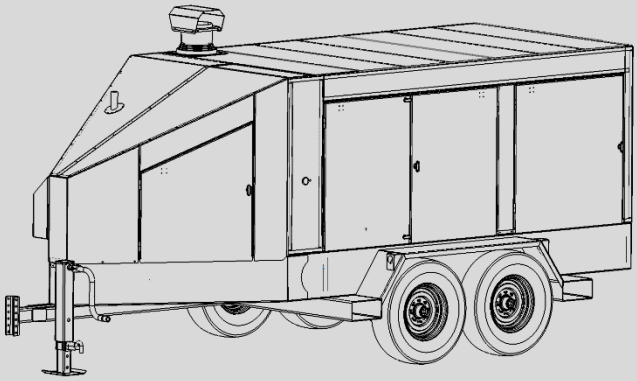
# OPERATORS MANUAL

## HYDRONIC HEATER WITH GENERATOR

## MODEL
## Thaw Boss, ES3000-2



### SPECIFICATIONS

| | | |
|---|---|---|
| No Fuel weight: | | 10,580 LB [4799 KG] |
| Wet weight: | | 12,000 LB [5443 KG] |
| Boiler Firing Rate: | | 3.0 GPH [11.4 LPH] |
| Total Fuel use: | | 3.55 GPH [13.4 LPH] |
| Fuel Type: | | ULSD |
| Fuel Storage: | Capacity | 200 GAL [757 L] |
| | Secondary containment | 200% |
| Heater: | Heater output (net) | 334,000 BTU/Hr |
| | Heat exch. material | 304 Stainless |
| | Burner | Riello 40 F15 |
| | Boiler | Buderus GE 315 |
| Normal hose pressure | | 150 psi [1034 kPa] |
| HTF flow | | 1920 gph [7267 l/hr] |
| Generator: | Engine | Kubota D1505 |
| | Generator | Mecc Alte |
| | Engine continuous power | 12 kW |
| | Main breaker rating | 45A |
| | Voltage | 120V |
| | Aux power | 2x 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 Thaw Boss is a mobile boiler system powered by a diesel generator, it has a maximum heat output of approximately 334,000 BTUs/hour. The heater system is intended for outdoor use and is trailer mounted for jobsite portability. The heater has an integral 200-gallon [757 L] fuel storage tank with secondary containment. The heater is designed to operate reliably at extremely low temperatures and has been proven in Alaska's winters. Multiple 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 |
|---|---|---|
| Thaw Boss | 103326 | Hydronic Heater System |

This manual should be kept with the machine at all times. Immediately contact Equipment Source Incorporated (manufacturer) 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). 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 clothing and combustibles away.
- Wear protective clothing, such as gloves, appropriate to the jobsite.
- Observe changes in the operating environment and respond accordingly.
- 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 (no fuel) | 10,580 LB [4799 KG] |
| | Wet | 12,000 LB [5443 KG] |
| | Trailer Max GVW | 12,000 LB [5443 KG] |

*All weights are approximate

  

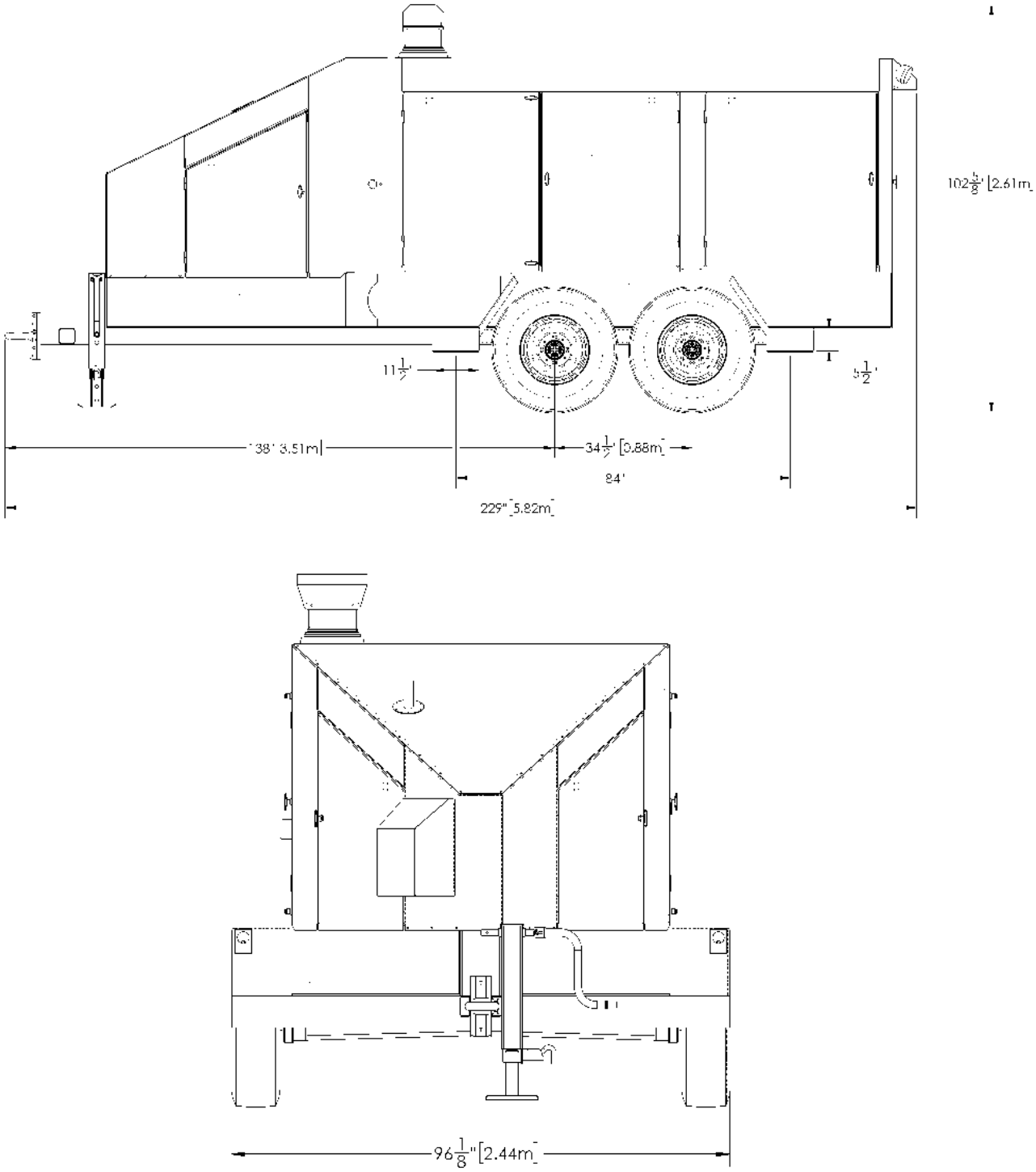


**Figure 1. Machine dimensions PN 103326.**

  

## 3.2 Lifting

**⚠CAUTION**

- Crane lifting may be done using the forklift pockets **and a spreader bar**.
- A fork truck with adequate lifting capacity may be used.

## 3.3 Transporting on a Flatbed Truck

1. Lift the machine following the guidelines presented in Section 3.2 *Lifting.*
2. Adjust the trailer jack stand to make the trailer approximately level before securing on a flatbed trailer.
3. Use the forklift pockets for chaining the trailer down.
4. Ensure all doors are closed and latched.

## 3.4 Transporting by towing

**⚠CAUTION** The transport vehicle and hitch adapters must be rated to tow a trailer GVW of 12,000 LB (5443 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.
2. Connect trailer lights. Always check trailer lights for proper operation.
3. Connect safety chains to vehicle.
4. Connect electric break away brake lanyard to vehicle.
5. Lock doors. This prevents them from inadvertently opening during transport.
6. Walk around the machine to check for wheel chocks, verify tire pressure, ensure the jack stand is fully retracted, and check for other safety concerns.

  

## 3.5 Storage

### 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 the 12 VDC disconnect switch is 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 and hose reel containment
5. After the boiler has cooled sufficiently, cover the chimney with a durable material to prevent animal intrusion or snow/ice buildup.
6. Verify freeze point of boiler and load loop fluids. If a glycol mixture was used that may freeze in expected storage conditions then drain the system (both boiler and load sides) .
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 has been 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. Check all hoses and quick disconnects for damage and replace as necessary
8. Clean out Y strainer on load loop
9. Fill boiler and load loop with fluids and remove any air (while running)
10. Repack wheel bearings
11. Replace fuel filters
12. Verify burner electrode position
13. Verify fuel pump pressure
14. Verify combustion quality
15. Check all lights and replace as necessary
16. Check tire pressure (if applicable)
17. Run heater for 1 hour to verify operation of all components

  

# 4 Operation

**⚠WARNING** Check all distribution hoses for leaks while under pressure and before leaving system unattended

***NOTICE*** Avoid overlapping distribution hoses while heated as this will create hot spots on the hose and decrease hose life


**Figure 1. Thaw Boss Controls**

  

## 4.1 Hose Layout

### 4.1.1 General Guidelines

The ES3000-2 heater is an outdoor heater designed to deliver heated propylene glycol through hoses to a desired location. The standard hose connections are no leak quick disconnects on both the outlet and return panels. The hoses can be either directly applied to where heat is needed or be run through a remote heat exchanger/manifold. Do not overlap hoses on the ground as this will cause hot spots on the hose.

Hose layout will vary by application. Refer to Appendix for guidelines.

Hose sizes

Standard hose size and length .....5/8" x 750' (4x = 3000 ft)

Optional hose sizes .....1-1/2" (1x)

### 4.1.2 Hose Removal and Stowage

**⚠CAUTION** Keep your hands and arms away from the hose reel while winding hose, do not allow anything other than the hose to be wound up. The operator should stand several feet back while winding the hoses. This job is ideally done by **TWO people**, one to run the reel and the other to layout/feed the hose to the desired location

The hose is removed from the reel by placing the switch on the control panel that says "HOSE REEL" in the "UNWIND" position. If removed by a single person plug the foot operated switch into the left side of the control panel. The hose reel can also be activated by the "HOSE REEL PRESS ON" button on the control panel.

The hoses are stowed in reverse of the removal. Two hoses at a time are wound up. Try not to stretch the hoses. After the first set of hoses is wound up, overlap the second set and tie with straps (included). Do not couple the hoses as this will cause a straight portion that will not bend properly around the reel and cause stress on the joint. Care should be taken to wind the hose up as neatly as possible to ensure the entire hose fits on the reel. It is easiest to have a neat reel if it is started that way.

## 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 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 (±3°) and length.

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. There is a pigtail located on the curb side of the machine below the Emergency Stop button to plug the engine preheater into.

  

### 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. **Glycol tanks are at least ½ to 3/4 full**
10. **Valves are in proper position for running**

- **Fill tank valves open**
- **Manifold valves open**

### 4.7 Startup

Use the following checklist to start and operate the machine.

1. **Turn DC disconnect switch to "On" (bottom of control panel)**
2. **Turn key on, wait for glow plug light to go off then turn to crank position**
3. **Let generator engine warm for at least 5 minute**
4. **Press the green "Start" button on upper left of system controls**

- **Startup sequence is automatic. If system fails to start read trouble shooting section for more information.**

5. **Set desired supply temperature**
6. **Check manual air vent on supply side manifold, just above control panel, after several minutes of pumping. If there is air then do it again in a few minutes.**

  

## 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
- Observe recommended maintenance schedule
- Check for any leaks in hoses. Has the fluid height in the fill tanks changed more than anticipated?

### 4.9.2 Adjusting Heat Output

- Push the “Target Outlet Temperature” button and adjust the output temperature up or down using the + or – button.

## 4.10 Shutdown

Shutdown procedure:

1. **Press the red “System Stop” button**
2. **Let the generator and fan run for 1 minute**
3. **If job is finished rewind hoses**
4. **Turn off generator and turn off 12VDC disconnect switch.**

## 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).

## 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<br>*Weekly | ▪ Check primary fuel filters for water and drain as necessary<br>▪ Check Glycol fill tank levels<br>▪ Check hoses for damage or leaks | ▪ Applies to both burner and engine filters<br>▪ Both boiler and load side use propylene glycol 60% for heat transfer fluid |
| Monthly | ▪ Check grease level on main pump auto greaser | ▪ Kubota Synthetic Extreme Duty Grease. NLGI Grade 2 with PTFE |
| Every 1000 hours<br>Or 12 months | ▪ Change all fuel filters<br>▪ Check air filter<br>▪ Check engine fan belt<br>▪ Clean supply line “Y” strainer screen (road side near the back) | ▪ Use Racor R12S Engine and Boiler<br>▪ Check engine air filter every 500 hours if operating in a dusty environment<br>▪ Grease hose reel bearings and oil chain |
| Every 3000 hours<br>Or 12 months | ▪ Change oil and oil filters<br>▪ Change Fuel Filters<br>▪ Change engine fan belt<br>▪ Replace burner nozzle and adjust electrodes<br>▪ Service trailer | ▪ Engine oil: SAE30, SAE10W-30 or 15-40<br>Engine oil must meet API Spec: CF, CF-4, CG-4, CH-4 or CI-4<br>▪ Oil Capacity: 12 GAL [45 L]<br>▪ Use Kubota 16121-32430 for engine oil<br>▪ Use Racor R12S for fuel filters |
| Every 6000 hours<br>Or 3 years | ▪ Change engine coolant | ▪ Use Rottella ELC or equivalent |
| Every 9000 hours | ▪ Injection pump service<br>▪ Valve clearance service | ▪ 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

The fan inlet should be periodically checked for icing when operated in winter conditions. If necessary, open the front curb side door to access inlet to clear ice. Do not attempt to clean the fan/inlet unless the heater is shutdown using the shutdown procedure.

## 5.4 Burner Maintenance

Refer to the Riello 40 F15 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 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 4080 LB (3640 dual) each [1850 KG] for a combined dual load capacity of 14560 LB [6618 KG]. New machines are shipped with 235/85 R16 Load Range G 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 ES3000-2 heater. Contact your service representative or refer to the attached operations manual specific to the burners, engine or boiler if the problem cannot be resolved using this guide.

There are two pages under the “settings and tools” page. The “diagnostics” page is for controller based errors and the “machine alerts” is for machine based alerts and errors. By looking at these pages, mostly machine alerts, you will find out what is wrong with the machine.

The machine can be controlled manually for trouble shooting purposes but as soon as the manual controls page is exited the system will shut down and return to automatic control. The manual controls are intended for trouble shooting only, not running the machine.

If the controller shows temperatures of -100 F try cycling power to the controller by either turning off generator or turning the breaker (inside panel) on and off. If this does not work then a temperature sensor may be faulty.

The system has an automatic startup cycle and check list where all pressures etc. are checked. If after the startup cycle period it fails to start an alert may be given. View the alert. You can try to run the start cycle again by pressing the start button. If this does not work after the second time then start looking at the individual alerts/errors in the controls and use the manual controls under “tools and diagnostics” to determine the problem. From the manual controls (see figure) the following can be controlled.

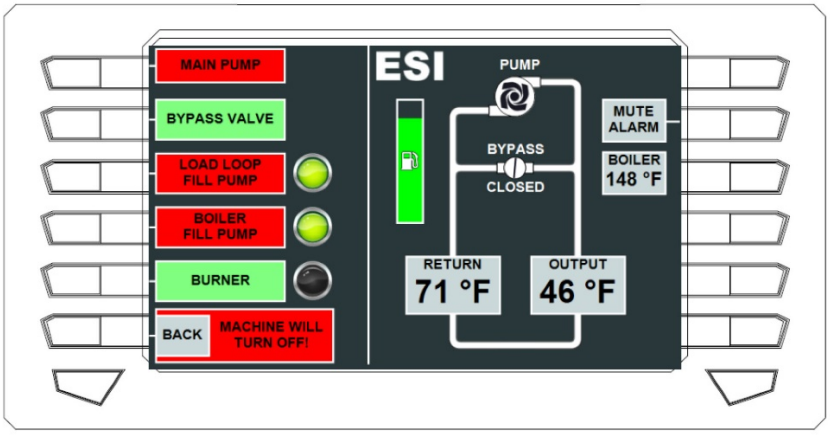


**Figure 2 Manual Controls**

  

## 6.1 Burner Trouble Shooting

**⚠WARNING** Never defeat the burner safeties such as the thermostats or PSV's (pressure safety valves) on boiler

**Table 2. Burner Trouble Shooting**

| Problem | Check/Solution |
|---|---|
| Boiler over temperature lockout. An alert message will appear saying "Boiler Overtemp" | The boiler may over heat if there was no load and the high limit set point was overshot. Wait till the boiler temperature falls below 195 $^{o}$F. Acknowledge any alerts on the controller. |
| If burner will not come on | Try turning burner on manually with manual controls. If this does not work check burner fuel supply and internal burner problems (see burner manual) |

## 6.2 Load Side Circulation Pumping

**Table 3. Circulation Pump Trouble Shooting Guide**

| Problem | Check/Solution |
|---|---|
| Pump tries to start but trips the soft start and fails to start | ▪ Verify that bypass valve will open and shut (should automatically). This can be done in the manual controls page. A clicking sound can be heard if it is activating. A graphic on the screen shows the current position of the valve.<br>▪ Reset soft start inside panel |
| Multiple start attempts and main pump does not start | ▪ Check to make sure fill tanks have fluid and pumps are working. Pumps may have air in them that needs to bleed out.<br>▪ Check load loop pressure on manual gauge. |

  

| | |
|---|---|
| Pump is not pumping | ▪ If the hoses don't get warm the pump may not be pumping due to air in the system. Open the manual air vents on the output side (curb side). Run for a few minutes and tighten vent screws again. During normal flow air will be removed using the automatic bleed valve.<br>▪ A flow circuit can be achieved without deploying all the hoses by using a short jumper hose (no included) between an outlet port and a return port.<br>▪ Pump may shut off due to low line pressure. Check pressure gage and for leaks/punctures in the hoses. Pressure on load loop should be over 10 psi. If pressure is low and pumps are not primed you may have to bleed air out and use the manual controls to get the system up to pressure. Controls will not allow over filling the system. |
| Return temperatures are low or differ significantly line to line | ▪ If the machine sat out for a long time in very cold weather (-40 F) it can take 5-10 minutes to push the very thick fluid through the lines. Check to make sure the output pressure is ~150 psi. If so then try to force the fluid through one line at a time by shutting the other return valves. Once you feel each line is warm to the touch don't forget to open up all the lines again. |

## 6.3 Generator Engine Trouble Shooting

**Table 4. Engine Trouble Shooting Guide**

| Problem | Solution |
|---|---|
| Engine controller fails | ▪ Check position of battery main disconnect<br>▪ Check condition of battery<br>▪ Reset 30A breaker on controller panel. If repeatedly tripping, refer to 12V electrical schematics and check for a ground fault<br>▪ Check 40A fuse near the starter terminal. Replace if necessary, and check for ground fault if repeatedly failing. |
| Starter fails to engage<br>Note: Engine preheat (glow plug) timer prevents engagement of starter until the 15 second cycle is complete | ▪ Check if engine controller is functioning (see "Engine controller fails")<br>▪ Check condition of battery<br>▪ Reset the 15A 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 | ▪ Check fuel level<br>▪ 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!<br>▪ Check for water in fuel and drain completely if present.<br>▪ Check electric fuel pump. The pump should audibly engage when the controller tries to start the engine.<br>▪ If cold (less than 0F [-18C]), the engine block/oil pan heater should be plugged in for 4-hours prior to starting.<br>▪ Check engine preheat (glow plug) circuit. Circuit should draw 15-25A for 15 seconds during the controllers preheat sequence.<br>▪ Check power supply to fuel solenoid on the engine fuel pump |
| Engine stops after 20 seconds | ▪ Check engine oil pressure switch<br>▪ 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].<br>▪ 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 | ▪ Check 12V cooling fan for correct operation. See below “12V cooling fan failed” if fan has failed.<br>▪ Check coolant level. CAUTION! Wait until engine has cooled completely before opening the radiator cap.<br>▪ Check coolant condition<br>▪ Check fan belt<br>▪ Check sensor for ground fault<br>▪ Check for air in coolant circuit (See Figure 4) |
| 12V cooling fan failed<br>(Fan fails to engage when the enclosure temperature is over 70F [20C]) | ▪ If the engine controller is functioning, check 30A breaker on the engine control panel.<br>▪ If the engine controller fails to activate, see “Engine controller fails”<br>▪ Check fan thermostat circuit<br>▪ The fan should draw approximately 17-20A if operating correctly.<br>▪ Check/replace the exhaust fan relay in the engine control panel.<br>▪ Replace fan |

  

| | |
|---|---|
| Engine can't maintain RPM or quits with "speed loss" error | ▪ Check controller to see if generator frequency is 60 Hz. If frequency is not 60 Hz or if the controller says "speed loss" check "speed fuse" inside of generator and replace if necessary. Fuse is located inside generator top behind bolt shown below. Shut down engine before opening.<br>  |

  

The ES3000-2 uses a heat exchanger to recover engine heat. If for some reason the engine loop has air in the system it will not cool properly and will shut down. If air is suspected in the engine coolant jacket check coolant level (Figure 4-A). Bleed air from the top of the thermostat housing using screw (Figure 4-B) while the engine is running. When no more bubbles come out tighten the screw.

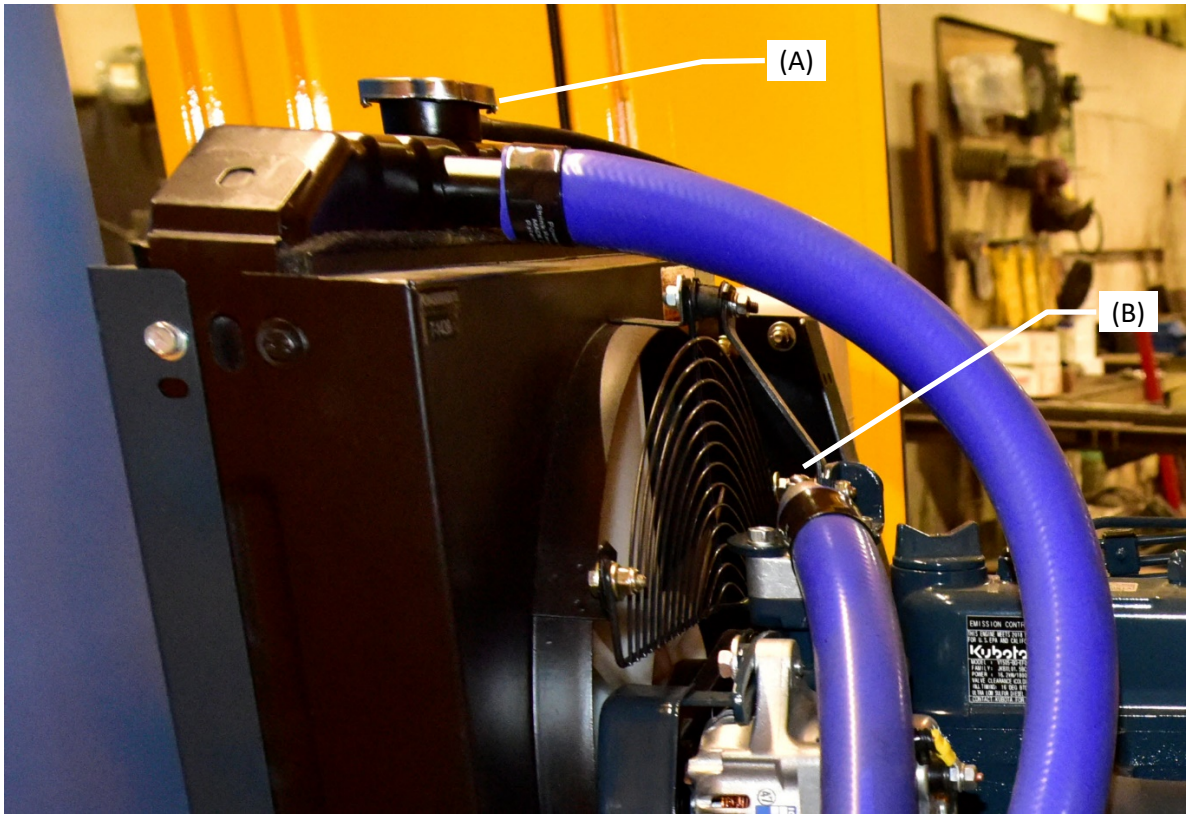


**Figure 3. Radiator cap (A) and air bleed screw (B)**

  

# 7 Electrical Schematics

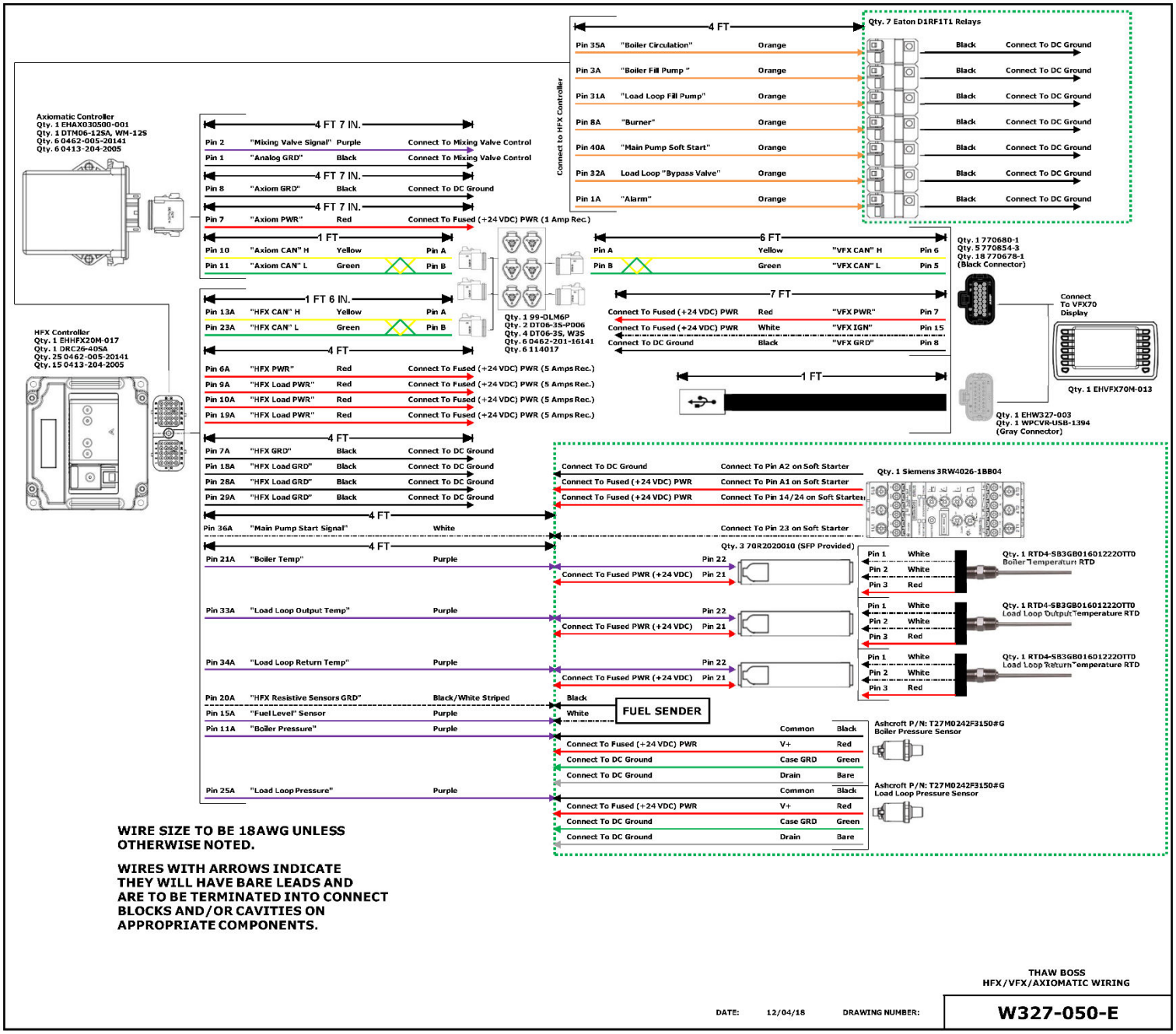


**Figure 4. Controls**

  

**Figure 5. High voltage**

**Figure 6. 12V Engine Control Schematic**

  

# 8 Maintenance Records

**Table 5. Machine Data**

| | |
|---|---|
| **Machine Serial Number** | |
| **Engine Serial Number** | |
| **Generator Serial Number** | |
| **Trailer Serial Number** | |

**Table 6. Maintenance Records**

| ▪ Date<br>▪ Engine Hours<br>▪ Service Personnel<br>▪ Service Location | **Description of work completed** |
|---|---|
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# 9 Appendix 1 Thawing Soils and Concrete Curing

**Ground Thawing**

The amount of energy required to thaw soils varies primarily by the amount of moisture in the soil. Different soils can support more moisture than others. Gravel and sand normally have less moisture with silts and clays usually having more. The following table has the approximate energy needed to thaw one cubic foot of soil. Note that ice rich soils may have a water content even higher than what is shown in this table and would take significantly more energy/time to thaw. It should be noted that there is stored heat in the ground below the frozen soil as well so once insulation blankets and a heat source is applied the stored heat in the earth also contributes to thawing the ground.

**Thaw rates of 12+ inches a day are typical.**

| Soil Moisture Content % (W) | BTU/ft$^3$ |
|---|---|
| 6 | 950 |
| 8 | 1300 |
| 10 | 1600 |
| 15 | 2400 |
| 20 | 3200 |
| 30 | 4800 |
| 40 | 6400 |
| 50 | 7200 |

It is important to correctly prepare a site to be thawed.

1. Remove excess snow and ice from the surface. Placing a vapor barrier of poly plastic sheeting down before placing the hose will keep the hose cleaner after thawing and will dramatically speed the thaw. Moisture is needed for heat transfer and if the ground dries out to much on the surface then heat transfer will be limited greatly. While putting the vapor barrier under the hose keeps the hose clean it won't hurt to place it above if you are worried about damaging the plastic while laying out the hose.
2. Lay out the hoses in a serpentine fashion. Avoid overlapping the hoses as much as possible as this will reduce hose life due to hot spots. Plan your layout as much as possible before spooling the hose out. This will help your layout and will make it easier to wind the hose back in later.

**Recommended Hose Spacing**

| Frost Depth | Hose Spacing |
|---|---|
| 1'-3' | 24" apart |
| 4' | 16" apart |
| 5'+ | 12-14" apart |

  

3. After putting down the hose and vapor barrier, place insulation blankets over the area. An R value of at least R15 should be used. Secure the blankets with weights around the edges so that wind can't blow it away.
4. Start thawing the ground. Excess water should soak down into the ground as thawing continues.

**Concrete Curing**

Depending on the situation the following steps are typical for concrete cure jobs.

1. Preheat the ground to 85 $^{o}$F
2. Rewind the hose
3. Pour the concrete (usually around 75 $^{o}$F) and wait for it to set
4. Put vapor barrier over concrete
5. Place hoses 20" on centers **or less**. If you have excess hose use it to **keep the spacing to a minimum if you can**. This will give more even heating.
6. Place R15+ blankets down
7. Set the outgoing temperature to 85-90 $^{o}$F. Check the return temperature and make sure it is 65-75 $^{o}$F. Keep this heat on until the design strength has been achieved.

Note that the above is a general guideline. A Structural or Civil engineer should provide an approved plan based on the particular site requirements and concrete mix.

  