SAFETY THAW

OPERATIONS MANUAL

ST4500MA

GAS CONSTRUCTION HEATER

CERTIFIED FOR USE IN CANADA AND USA
PER FOLLOWING STANDARDS:
ANSI Z83.7 / CSA 2.14 3RD EDITION

IMPORTANT SAFETY NOTICE:

FAILURE TO COMPLY WITH THE PRECAUTIONS AND INSTRUCTIONS PROVIDED WITH THIS HEATER CAN RESULT IN DEATH,SERIES BODILY INJURY AND PROPERTY LOSS OR DAMAGE FROM HAZARDS OF FIRE EXPLOSION BURN, ASPHYXIATION, CARBON MONOXIDE POISONING, AND/OR ELECTRICAL SHOCK. ONLY PERSONS WHO CAN UNDERSTAND AND FOLLOW THE INSTRUCTIONS SHOULD U SEO R SERVICE THIS HEATER. IF YOU NEED ASSISTANCE OR HEATER INFORMATION SUCH AS AN INSTRUCTIONS MANUAL, LABEL, ETC. CONTACT THE MANUFACTURER.

WARNING:

THIS HEATER IS DESIGNED PRIMARILY FOR TEMPORARY HEATING PURPOSES DURING BUILDING CONSTRUCTION, ALTERATION, REPAIR, OR EMERGENCIES. THIS HEATER IS NOT INTENDED FOR HOME OR RECREATIONAL VEHICLE USE. ENSURE SUFFICIENT VENTILATION AT ALL TIMES. PROVIDE 1 SQUARE INCH OF FRESH AIR SUPPLY FOR EVERY 1000 BTUh OF HEAT GENERATED.

INSTALL THE HEATER IN A LOCATION WHERE IT IS PROTECTED FROM DIRECT EXPOSURE TO WATER SPRAY, RAIN, AND DRIPPING WATER.

WARNING:

WARNING: FIRE, BURN, INHALATION, AND EXPLOSION HAZARD. KEEP SOLID COMBUSTIBLES, SUCH AS BUILDING MATERIALS, PAPER, OR CARDBOARD A SAFE DISTANCE AWAY FROM THE HEATERS RECOMMENDED BY THE INSTRUCTIONS NEVER USE THE HEATER IN SPACES WHICH DO OR MAY CONTAIN VOLATILE OR AIRBORNE COMBUSTIBLES OR PRODUCTS SUCH AS GASOLINE, SOLVENTS, PAINT THINNER, DUST PARTICLES OR UNKNOWN CHEMICALS.

WARNING:

NOT FOR HOME OR RECREATIONAL VEHICLE USE

NOTICE:

THIS HEATER IS SPECIFICALLY DESIGNED AND APPROVED FOR USE AS A CONSTRUCTION HEATER IN ACCORDANCE WITH ANSI Z83.7 2011 AND CSA 2.14 2011 GAS FIRED CONSTRUCTION HEATERS STANDARDS. HOWEVER, AS IT IS NOT POSSIBLE TO ANTICIPATE EVERY POSSIBLE USE OF OUR HEATERS, WE RECOMMEND CONSULTING WITH YOUR LOCAL FIRE SAFETY AUTHORITY FOR ANY QUESTIONS OR CONCERNS REGARDING SPECIFIC APPLICATIONS.

IT'S IMPORTANT TO NOTE THAT THERE ARE OTHER STANDARDS THAT GOVERN THE USE OF FUEL GASES AND HEAT-PRODUCING PRODUCTS IN VARIOUS APPLICATIONS. YOUR LOCAL AUTHORITY IS THE BEST SOURCE OF INFORMATION TO PROVIDE GUIDANCE AND ADVICE REGARDING THESE STANDARDS.

WARNING:

FIRE, BURN, INHALATION, AND EXPLOSION HAZARD.
DO NOT PLACE OVER COMBUSTIBLE MATERIALS SUCH AS BUILDING MATERIALS, WOOD, PAPER OR CARDBOARD OR MATERIALS SUBJECT TO DISINTEGRATION DUE TO EXPANSION, SUCH AS CONCRETE.

WARNING: FOR OUTDOOR USE ONLY.

WARNING: Air Quality Hazard

- Do not use this heater for heating human living quarters
- Use of direct-fired heaters in the construction environment can result in exposure to levels of CO, CO2, and NO2 considered to be hazardous to health and potentially life threatening
- Do not use in unventilated areas
- Know the signs of CO and CO2 poisoning
    - Headaches, stinging eyes
    - Dizziness, disorientation
    - Difficulty breathing, feels of being suffocated
- Proper ventilation air exchange (OSHA 29 CFR 1926.57) to support combustion and maintain acceptable air quality shall be provided in

accordance with OSHA 29 CFR Part 1926.154, ANSI A10.10 Safety Requirements for Temporary and Portable Space Heating Devices and Equipment used in the Construction Industry or the Natural Gas and Propane Installation Codes CSA B149.1

- Periodically monitor levels of CO, CO2 and NO2 existing at the construction site - at the minimum at the start of the shift and after 4 hours.
- Provide ventilation air exchange, either natural or mechanical, as required to maintain acceptable indoor air quality

	USA 8-Hr Time weighted average (OSHA 29 CFR 1926.55 App A)	Canada 8-hr time weighted average WorkSafe BC OHS Guidelines Part 5.1 and Ontario Workplaces Reg 833
CO	50 ppm	25 ppm
CO2	5000 ppm	5000 ppm
NO2		3 ppm (Reg 833)

	USA - Ceiling Limit	Canada STEL (15 minutes Reg 833/1 hour WSBC) WorkSafe BC OHS Guidelines Part 5.1 and Ontario Workplaces Reg 833
CO		100 ppm
CO2		15000 ppm (WSBC) 30000 ppm (Reg 833)
NO2	5 ppm	1.0 ppm (WSBC) 5.0 ppm (Reg 833)

- Ensure that the flow of combustion and ventilation air exchange cannot become obstructed.
- As the building 'tightens up' during the construction phases ventilation may need to be increased.

Table of Contents:

1 - INTRODUCTION

1.1. Product Overview:

The 4.5 Million BTU Direct-Fired Makeup Air Heater is a high-capacity heating system designed to provide large-scale heating for commercial and industrial applications. It ensures efficient heating of fresh air and maintains comfortable indoor conditions in areas with high ventilation requirements.

1.2 TECHNICAL SPECIFICATIONS

MAX BTU/HR: 4,500,000 BTU (British Thermal Units)

MIN BTU/HR: 180,000 BTU (British Thermal Units)

Fuel Type: HD5 Propane or Utility Grade Natural Gas

Gas Inlet Pressure: 10-14 inches of water column, 25-35 millibar

Outlet Duct Configuration: 30.25" Wide x 37.0" Tall

Maximum Recommended Duct Length: 50 Feet

Power Supply: Variable Voltage, 208-240/480 Three Phase

Airflow: 24,700 CFM @ 2” System Back Pressure

Control System: ST4500MA control panel certified to UL 508A/CSA22.2 Standards

Dimensions: L 126.25” x W 68.25” x H 66.75”

Weight: 2750 Lbs (Pending Configuration - see rating plate on unit)

Approval: cETLus listed

2 - INSTALLATION

2.1. Unpacking:

Upon receiving the heater, carefully inspect the packaging for any signs of damage. If any damage is found, report it to the shipping carrier and the supplier immediately. Remove all packaging materials and ensure that all components are included.

2.2. Lifting Instructions:

To lift the product safely via forklift:

- Use only equipment rated to lift 5000 lbs
- Fully insert the forks through fork openings taking caution not to ram the bumpers and guards as it may cause damage to the unit.
- Ensure that the unit sits level before lifting to reduce the risk of tilting
- Lift the forks cautiously and move accordingly

To lift the product safely via crane:

- Lift only with a spreader bar system
- Ensure that the slings setup provide only vertical lifting on the lifting lugs
- Only use slings rated appropriately for rated load
- Slowly lift the unit and ensure that the unit is level before continuing lift
- Move cautiously and slowly to reduce the risk of dropping
- Take caution to prevent shock loading when placing unit

2.3. Location Selection:

This unit is designed to be mounted externally or internally to the structure it is heating, following all clearance distances recommended within this manual. Ensure the unit is only installed onto a non-combustible floor.

Select a suitable location for the heater that meets the following criteria:

- Adequate space for installation, operation, and maintenance
- Level surface with proper clearance to combustible material per requirements
- Proper ventilation to prevent the buildup of combustion byproduct, as well as to keep intake and discharge clear of obstruction/debris
- Compliance with local regulations and codes
- Access to fuel and power source with protection for fuel and electrical connections from source to the heater

Installations of this appliance at altitudes above 2000 ft shall be in accordance with local codes, or in the absence of local codes, the National Fuel Gas Code, ANSI z223.1/NFPA 54, or National Standard of Canada, Natural Gas and Propane Installation Code, CSA B149.1.

2.4. Installation Instructions:

To ensure compliance during the installation of this natural gas heater, adherence to relevant local regulations is necessary. In the absence of such regulations, the installation should align with the National Fuel Gas Code ANSI Z223.1/NFPA 54 and the Natural Gas and Propane Installation Code, CSA B149.1.

For the installation of this heater intended for use with propane tanks or cylinders, adherence to local codes is required. In cases where local codes are absent, the installation must comply with the Standard for the Storage and Handling of Liquefied Petroleum Gases, ANSI/NFPA 58, and the Natural Gas and Propane Installation Code, CSA B149.

It is imperative that this heater is positioned at a minimum distance of 10ft (3m) from any propane gas cylinder. Additionally, it should not be directed towards any propane gas container within a 20ft (6m) radius.

Setback Distances

When installing a direct-fired makeup air heater, it is essential to consider proper setback distances to ensure safe and efficient operation. The minimum recommended setback distance from any building opening (e.g., doors, windows, or vents) should be 48 inches. This setback helps prevent potential hazards and allows adequate space for air intake and exhaust.

Duct Size

Selecting the appropriate duct size is crucial for ensuring efficient air circulation and preventing excessive pressure drops. The duct size should be chosen based on the heater's rated capacity and the total airflow requirements of the system it serves. Custom ducting can be fabricated to match the units outlet duct at 30.25" Wide x 37.0" Tall. Rectangular to round transitions are available as well in multiple sized to allow use of round ducting.

Distance Limits

When designing the ductwork for the makeup air system, it's essential to adhere to distance limits to maintain the system's performance. Consider the following guidelines:

Duct Length: The total length of the duct system, including both supply and exhaust ducts, should be minimized as much as possible to reduce pressure losses and optimize the heater's performance. The recommended maximum duct length is 50 feet.

Avoid Sharp Bends: Use gradual bends instead of sharp ones in the ductwork to minimize airflow resistance. Sharp bends can lead to pressure drops and reduce the effectiveness of the makeup air system.

Straight Sections: Incorporate straight sections of duct between bends, fittings, and the heater's connection point to promote smooth airflow.

Avoid Obstructions: Ensure there are no obstructions, such as structural elements or other equipment, within the duct system that could impede airflow.

Duct Insulation: Consider insulating the ductwork, especially if it passes through unconditioned spaces, to minimize heat loss or gain and improve energy efficiency.

2.5. Gas Supply Connection:

The heater should be positioned at a distance of at least 6 ft (1.83m) in the USA or 10 ft (3m) in Canada, away from any propane gas container.

If propane cylinders are used to supply the heater, it is important to ensure that cylinders are sized appropriately for equipment and set up for proper use to supply the heater with adequate fuel. The cylinders must solely provide vapor withdrawal.

Here are the guidelines for cylinder connections:

- Tighten fittings using a wrench for all cylinder connections
- When connecting or disconnecting the cylinder(s), ensure that the cylinder(s) valve(s) are closed securely
- Apply a leak-detecting solution to all connection points to verify that the system integrity is not compromised in any way

When the heater is not in use, it is essential to turn off the gas at the propane supply cylinder(s). If the heater is to be stored indoors, disconnect the connection between the propane supply cylinder(s) and the heater. The cylinders must be removed from the heater and stored in accordance with the standards outlined in the Standard for the Storage and Handling of Liquefied Petroleum Gases, ANSI/NFPA 58, and CSA B149.1, the Natural Gas and Propane Installation Code.

To ensure proper installation, a qualified gas technician must be responsible for installing this heater in accordance with the local codes set by the relevant authority. The sizing of the supply piping should be determined based on the length of the pipe run and the total BTUh rating of the appliance(s). The appropriate piping tables must be consulted to determine the required size of the supply piping based on the length of the run from the source.

Inlet gas pressure will need to be regulated to proper inlet pressure as detailed below to ensure safe and proper function of the equipment. A regulator assembly may be purchased with the unit, or the components may be provided by the end user. The ST4500MA is equipped with a floor mounted flange in front of the burner assembly for storage of a regulator assembly during transportation.

Inlet Gas Pressure

- MIN: 10” WC / 25 mBar / 2.5 kPa
- MAX: 14” WC / 35 mBar / 3.5 kPa

Manifold Gas Pressure

- NG: 4.2”-8” W.C.
- MAX: 1.6“-3” W.C.

Fuel Type

This heater is compatible with both propane and natural gas for operation. The approval label specifies the manifold pressures required, and they are listed above as well. It is essential to achieve the correct pressure settings depending on the fuel being supplied.

A fuel selector valve is situated on the heater's manifold. It is crucial to ensure that the valve is positioned correctly according to the fuel being used, as indicated by the label on the valve. In the standard “closed” position, the valve is set for propane. In the standard “open” position, the valve is set for natural gas. Operating the heater with the valve in the incorrect position is strictly prohibited. All units ship from the factory set up for use with propane.

When connecting the heater to the fuel supply, it is essential to use Type 1 approved hose assemblies specifically designed for propane or natural gas. Using hoses that meet these specifications ensures safe and proper fuel connection for the heater.

Adjusting Manifold Pressure

After startup, if manifold pressure needs to be adjusted at the low end, the following procedure can be followed to adjust a different Minimum Setting Position on the modulating RTC valve. Execute the following steps:

Before pressing the adaption button be prepared to remove power to the actuator.

1. Once power is applied to the actuator, press the adaption button – This will first send the valve/indicator to the “Zero” position and then toward the “Fully Open” position.

When the valve/indicator stalls at the “Fully Open" position, remove power from the actuator. – This will stop the valve/indicator in its current position.

2. Remove the minimum setting clip by applying leverage against the clip with a flathead screwdriver to pop it loose (See Fig. C).
3. Once the minimum setting clip is removed, move it one notch toward the open position at a time to adjust the minimum setting (See Fig. D).
4. Reapply power to the actuator. – The indicator will first move to the “Zero” position, stall, and then to the “Fully Open” position, stall, and lastly to the commanded position of the control signal. If no control signal is connected the indicator will move to absolute zero.
5. Once the Minimum Setting Position is adjusted, press the adaption button again to obtain the new scale for the control signal.

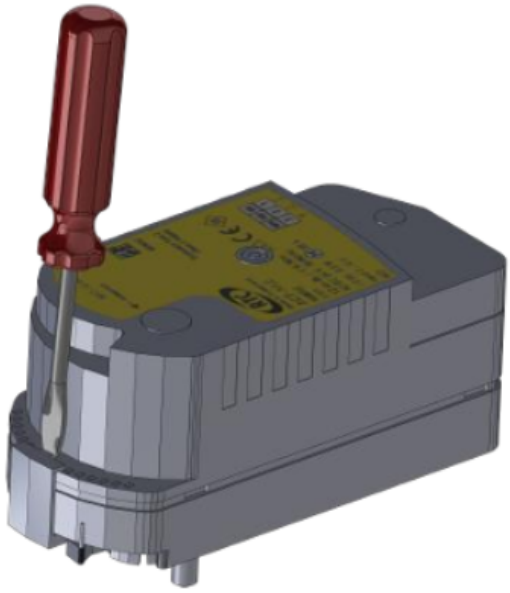
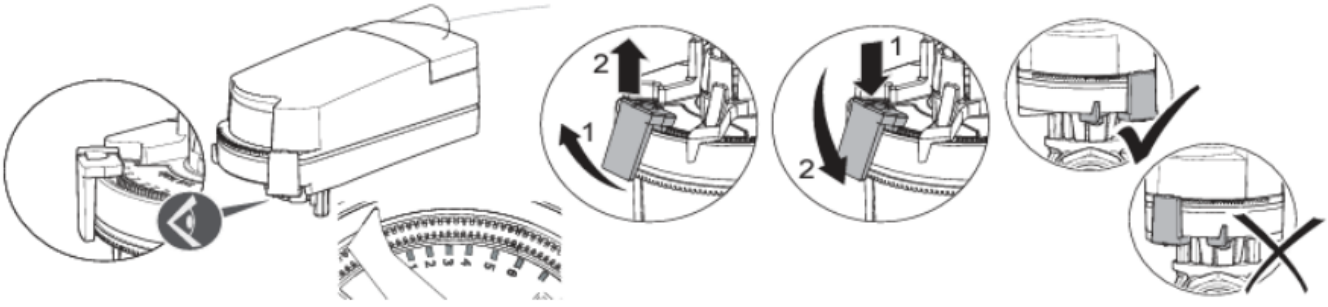


Figure C



2.6. Electrical Connection:

The heater is capable of multiple supply voltages with the use of a variable voltage switch, and may be connected to power via the camlock electrical connectors or wired directly to the inlet power distribution blocks. To switch voltage, simply adjust the rotary switch at the electrical inlet panel to the correct position for the desired voltage. NOTE: If using 208V 3Φ, an adjustment to the phase monitoring device is required as noted below.

Power Supply Requirements

208V 3Φ, 50 AMP FLA / 62.5 MCA
230V 3Φ, 45 AMP FLA / 56.25 MCA
460V 3Φ, 23 AMP FLA / 28.75 MCA

The unit is equipped with a phase monitoring device (pictured below) to prevent backwards phase connection and thus reverse motor direction. The voltage adjustment potentiometer will need to be adjusted if using 208V input power. After connecting power to the unit and closing the main disconnect, the device will power up and display an LED status. A red LED of any kind will indicate an issue with the power supply, and an adjustment of some kind will need to be made. A solid green indicates the phasing is correct and the unit is ready to operate.

PHASE MONITOR LIGHT STATUS

- GREEN SOLID - PHASING IS CORRECT, UNIT IS READY TO RUN
- GREEN BLINKING - DEVICE IS RESETTING
- RED BLINKING RAPIDLY - REVERSE PHASE
- RED 2 BLINKS WITH A PAUSE - UNBALANCED/SINGLE PHASE
- RED SINGLE BLINK WITH PAUSE - HIGH VOLTAGE
- RED SOLID - LOW VOLTAGE

Grounding Instructions

For your safety and protection against electrical shock hazards, this appliance is equipped with connection points for properly grounding the electrical system. It is important to connect the heater to a proper ground connection via the camlock connector or the ground bar in the control panel. The electrical grounding of the heater must comply with the National Electrical Code, ANSI/NFPA 70, or the Canadian Electrical Code Part I, CSA C22.1. This ensures that the heater is properly grounded according to the applicable electrical standards.

2.7 Air Switch Tuning

Safety Precautions

Before starting the tuning process, adhere to the following safety precautions:

Power Off: Ensure that the heater is powered off and disconnected from the electrical supply before attempting any adjustments or maintenance.

Qualified Personnel: Only trained and qualified personnel should perform the tuning process to avoid any accidents or damage to the equipment.

Protective Gear: Wear appropriate personal protective equipment (PPE), such as gloves and safety goggles, during the tuning process.

Required Tools

Gather the necessary tools for tuning the air switch:

Multimeter: A digital multimeter capable of measuring continuity is required for this procedure.

Screwdriver Set: You may require a screwdriver set to make adjustments to the air switch settings.

Tuning Procedure

Follow these steps to tune the air switch during commissioning:

Locate the Air Switch: The air switch is typically located near the combustion air inlet or within the unit's control panel. Refer to the manufacturer's manual to identify its exact location.

Inspect the Air Switch: Visually inspect the air switch and its connections for any signs of damage or wear. Ensure all electrical connections are secure.

Prepare the Multimeter: Set the multimeter to measure continuity.

Power On the Heater: Turn on the heater and allow it to run for a few minutes to stabilize its operation.

Access the Air Switch Contacts: Carefully access the air switch contacts. These contacts are generally accessible without disconnecting the leads

Measure Continuity: With the heater running, use the multimeter to test for continuity across the air switch contacts. Continuity should be present when there is sufficient airflow, allowing

the contacts to close. Lack of continuity indicates inadequate airflow, and the air switch should prevent the heater from operating.

Adjust the Air Switch: If there is no continuity when there should be (e.g., in the presence of adequate airflow), make the necessary adjustments to the air switch according to the manufacturer's guidelines. Use the airflow adjustments chart to set the air switch to the correct sensitivity level.

Recheck Continuity: After making adjustments, recheck the continuity across the air switch contacts to ensure they close when there is sufficient airflow.

Functional Test: Conduct a functional test to ensure the air switch interrupts the heater's operation as intended when simulating low airflow conditions.

Final Checks: Before completing the commissioning process, perform a final inspection of all components, including the air switch, to ensure everything is in proper working order. Address any issues or discrepancies that arise during this inspection.

Training: Ensure that the end-users or operators of the makeup air heater are adequately trained on its operation, including understanding the significance of the air switch and its role in maintaining safety and efficiency.

3 - OPERATION

3.1. Control Panel Overview

Hybrid Light Solutions/Safety Thaw is certified to build controls panels to UL 508A/CSA C22.2 No. 286 standards and all control panels in ST4500MA units are listed under that program. This ensures all control panels are manufactured with the utmost safety, quality, and craftsmanship in mind. Any modification of the factory electrical system in the unit will render that certification null and void.

3.2. Operating Instructions

1. Follow procedures for electrical and fuel connections.
2. Ensure the voltage selector switch is in the proper position for the supply voltage being used.
3. Ensure the fuel selector valve is in the proper position for the fuel being used. The valve handle has a decal showing correct positioning.
4. Connect the remote thermostat and place it in the area you are trying to heat and set the thermostat to the desired temperature.
    a. The heater will run at an output temperature of 180°F when the remote thermostat calls for heat. Once the remote thermostat area reaches the set temp,

the heater will adjust to low fire and run at an outlet temperature of 75°F until the remote thermostat calls for heat again.

5. Close main disconnect to energize the unit. Inspect phase monitor device to confirm phasing is correct.
6. Open fuel supply valve at source. Open fuel supply valve at exterior regulator if installed. Confirm inlet pressure into the regulator is appropriate. Confirm regulated pressure is correct.
7. Open internal fuel supply shutoff valve in the control cabinet.
    a. NOTE: At initial startup machine may need to have fuel line bled to aid in faster startup. If bleeding air out is not an option, the unit can be cycled multiple times until solenoid valves allow all air to leave the system and proper ignition occurs.
8. Turn the HEAT ENABLE switch to the on position, this will begin the trial for ignition cycle. The status of stages can be observed in the panel window on the BMS unit.
    a. CAUTION: DO NOT ATTEMPT TO LIGHT THE HEATER MANUALLY.
9. Machine will automatically modulate based on the remote thermostat temperature and run continually until shutdown is engaged. To shutdown the machine, turn the HEAT ENABLE switch to the off position. Machine will terminate the fuel supply, and go through a post purge cycle to clear and cool the combustion chamber.
10. If you wish to use the heater to move fresh air without any heating or combustion, the FAN OVERRIDE switch will activate the fan and allow fresh air to be circulated.

4 - MAINTENANCE

4.1 Regular Maintenance

- It is important to inspect every construction heater before each use, as well as have it inspected at least annually by a qualified service person.
- Before operating the heater, visually inspect the hose assembly. If there are signs of excessive abrasion, wear, cuts, or other damage, the hose must be replaced.
- Ensure that the appliance is kept clear and free from any debris or combustible materials, including gasoline, flammable vapors, and liquids.
- The flow of combustion and ventilation air must not be obstructed. Regularly check the fan assembly, motor, and blades to ensure proper operation.
- Use compressed air to remove dust and dirt build-up from components. Note that compressed air should not be used inside any piping or regulator components.
- **Note that due to the high operating temperature of the heater, it is recommended to lubricate the bearings every 2-4 weeks. Use high-quality lithium complex grease (NLGI#2) and synthetic hydrocarbon oil with ISO 220 viscosity, such as MYSTIKJT6 HI-TEMP or equivalent. If possible, lubricate the bearings while they**

are in rotation until grease purge is observed from the seals. This can be done with the fan override switch on the control panel which will spin the fan manually outside of an ignition cycle.

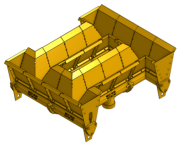
- **EXTREME CAUTION should be used when doing this as the doors can be drawn in by the vacuum the fan creates and the moving components of the fan and motor assembly are very dangerous.**

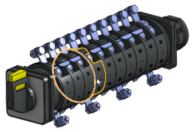
4.2. Annual Inspection

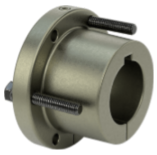
1. Follow procedures for electrical and fuel connections. Inspect the burner and use compressed air to remove any dirt or debris. The air flow holes should be free of debris and can be cleaned using a size 42 drill bit. If needed, remove the burner and manually clean the burner ports using a ⅛” drill bit. Note: Do not use a drill for this task.
2. Use a stiff wire brush to clean the burner plates. All holes must be clean so air can pass through. Inspect for cracking. Cracks between two holes are common and acceptable, but more severe cracking may warrant replacing burner plates.
3. Examine the Flame Rod and spark rod on the burner. Check for any cracks in the ceramic. If the ceramic is cracked, it must be replaced. If necessary, use an abrasive scrub pad to clean the flame rod.
4. Remove and inspect the stainless steel air pressure tubes. Use compressed air to clear any blockages in these tubes. Note: Do not attempt to clean them while they are still connected to the air pressure switch as damage to the switch could occur.
5. Inspect the Motor, Belt, and Pulleys. Ensure that the belts do not show excessive wear and are properly tensioned. Confirm that the pulley set screws are securely tightened on the motor and fan shafts.
6. Clean the pillow block bearings to remove dirt and debris. Apply MYSTIKJT6 HI-TEMP or equivalent. Check for wear, damage, and proper alignment. Monitor performance for any abnormalities and address issues promptly.
7. Examine the blower wheel, ensuring that it is positioned centrally within the housing and is free of dirt buildup and debris. Verify that the blower moves freely on the shaft. Note that any debris accumulation on the fan blade will reduce airflow and can lead to overheating.
8. Inspect all wire connections, ensuring that none are loose and that there is no corrosion present on any of the connections.
9. Check the function of all locking mechanisms and safety devices to ensure the unit is ready to operate safely for the duration of the season.
10. Test fire the unit and confirm proper operation of all components. Perform a full system leak test to ensure fuel pipeline integrity is not compromised in any way.

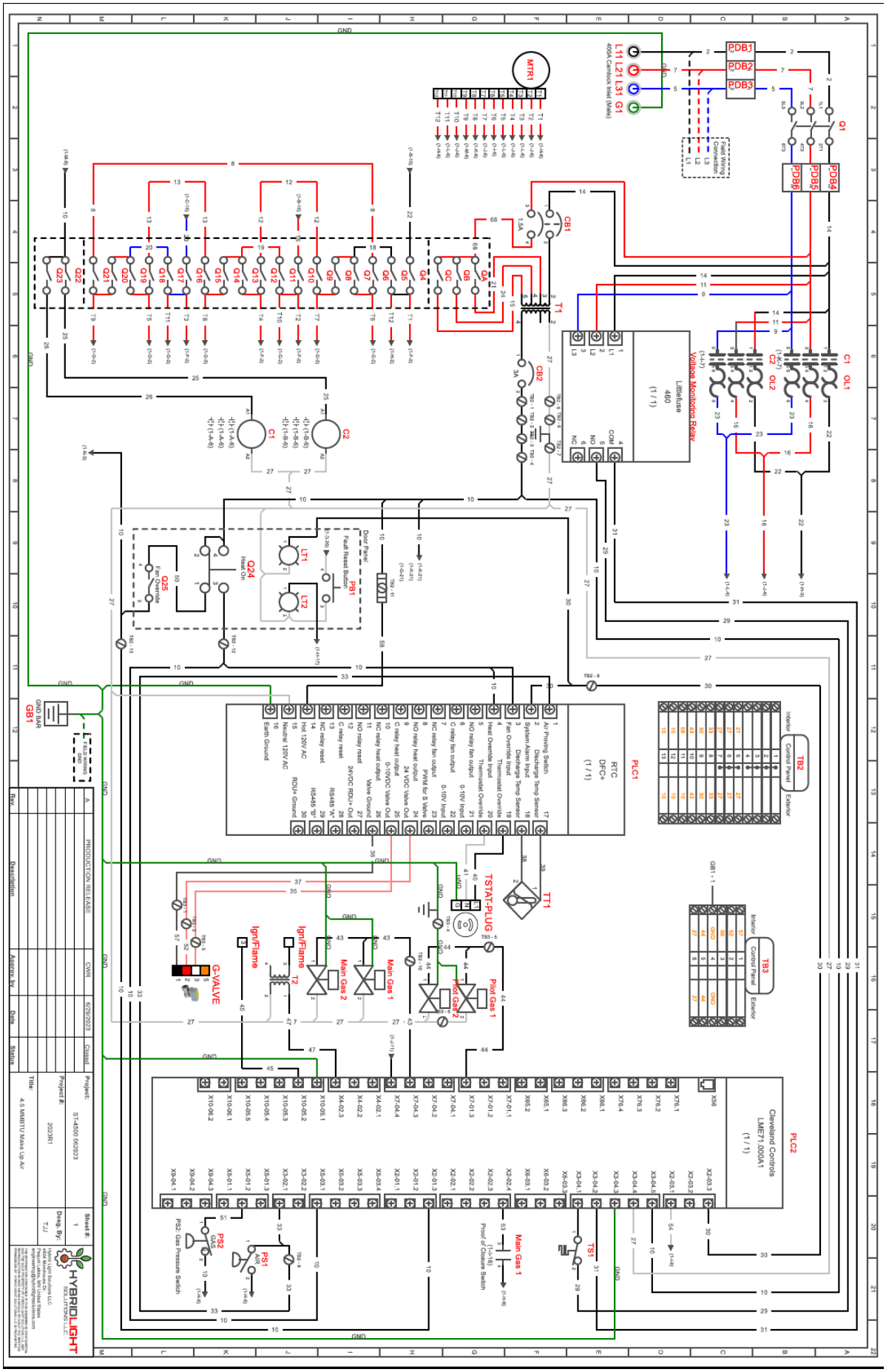
4.3. Parts List

Replacement parts for the ST4500MA are listed below. To inquire about purchasing replacement parts, please call 218-568-1188, or email support@hybridlightsolutions.com

 **4.5 Burner Assembly** **A1022**	 **Pilot/Flame Sensor Assy.** **H1087**	 **2” POC Valve Actuator** **H1081**
 **2” Modulating Valve** **H1026**	 **2” Solenoid Valve** **H1082**	 **2” POC Valve Body** **H1083**
 **⅛” Pilot Regulator** **H1086**	 **Pilot Solenoid** **H1049**	 **High Pressure Switch** **H1084**
 **Fuel Selector Valve** **H1074**	 **High Limit Switch** **H1090**	 **Air Pressure Switch** **H5539**
 **Heater Controller** **H5540**	 **Burner Management System** **H5549**	 **Discharge Air Tube** **H1023**
 **Phase Monitor** **H5542**	 **480V Contactor** **H5543**	 **230V/208V Contactor** **H5545**

 **Remote Thermostat** **H5547**	 **480V Thermal Overload** **H5544**	 **230V/208V Thermal Overload** **H5546**
 **Gas Ignitor** **H5548**	 **Control Transformer** **H5550**	 **Main Disconnect** **H5551**
 **On/Off Switch** **H5533**	 **Switch Contact Block** **H5534**	 **Main Disconnect Handle** **H5552**
 **Red Indicator Light** **H5535**	 **Green Indicator Light** **H5536**	 **Reset Button** **H5537**
 **1.5 Amp Single Pole Breaker** **H5531**	 **3 Amp Double Pole Breaker** **H5532**	 **Grounding Bar** **H5513**
 **Variable Voltage Selector** **H5553**	 **Field Wiring Terminals** **H5562**	 **Distribution Block** **H5563**
 **Black Camlock Connector** **H5554**	 **Red Camlock Connector** **H5555**	 **Blue Camlock Connector** **H5556**

 **Black Camlock Cover** **H5558**	 **Red Camlock Cover** **H5559**	 **Blue Camlock Cover** **H5560**
 **Green Camlock Connector** **H5557**	 **Green Camlock Cover** **H5561**	 **20HP Motor** **H5568**
 **Fan Pulley** **H5569**	 **Fan Pulley Bushing** **H5570**	 **Auto-Tension Motor Base** **H5567**
 **Motor Pulley** **H5571**	 **Motor Pulley Bushing** **H5572**	 **Fan Belt (2 per unit)** **H5573**
 **Inlet Cord Grip** **H5574**	 **Door Latch** **H5575**	 **Rear Grate Latch** **H5576**
 **Door Hinge** **H5577**	 **Rear Grate Latch** **H5578**	 **High Temp Fan Bearing** **H5579**
 **Remote Tstat Receptacle** **H5565**	 **Remote Tstat Plug** **H5566**	 **Blower Assembly** **H5580**


L11 L21 L31 G1
400A Camlock Inlet (Male)
PDB1
PDB2
PDB3
PDB4
PDB5
PDB6
Q1
MTR1
CB1
1.5A
CB2
3A
T1
Littelfuse
460
(1 / 1)
Voltage Monitoring Relay
C1
C2
OL1
OL2
Q1
Q2
Q3
Q4
Q5
Q6
Q7
Q8
Q9
Q10
Q11
Q12
Q13
Q14
Q15
Q16
Q17
Q18
Q19
Q20
Q21
Q22
Q23
QA
QB
QC
LT1
LT2
PB1
Fault Reset Button
Door Frame
Q24
Heat On
Q25
Fan Override
GB1
GND BAR
FIELD GROUNDING
RTC
DFC+
(1 / 1)
PLC1
TB2
Interior
Control Panel
Exterior
TB3
TSTAT-PLUG
TT1
G-VALVE
Ign/Flame
T2
Main Gas 1
Main Gas 2
Pilot Gas 1
Pilot Gas 2
PLC2
Cleveland Controls
LME71.000A1
(1 / 1)
PS1
AIR
PS2
Gas Pressure Switch
TS1
Proof of Closure Switch
Air Proving Switch
Discharge Temp Sensor
Thermostat Override
Heat Override Input
Fan Override Input
Discharge Temp Sensor
System Alarm Input
NO relay fan output
C relay fan output
NC relay fan output
0-10V Input
PWM for S Valve
24 VDC Valve Out
0-10VDC Valve Output
Valve Ground
NO relay heat output
C relay heat output
NC relay heat output
NO relay reset
C relay reset
NC relay reset
24VDC RDU+ Out
RS485 "A"
RS485 "B"
RDU+ Ground
Hot / 120V AC
Neutral 120V AC
Earth Ground
Rev
Description
Approv. by
Date
Status
PRODUCTION RELEASE
GWR
02/02/2023
Closed
Title:
4.5 MMBTU Make Up Air
Project:
Project #:
ST-4500 062823
2023R1
Sheet #:
1
Design By:
TJJ
HYBRIDLIGHT
SOLUTIONS LLC

5 - Troubleshooting

5.1. Troubleshooting

The direct-fired makeup air heater is a complex system, and occasional issues may arise during its operation. This section provides a troubleshooting guide to help identify and resolve common problems. Before attempting any troubleshooting, ensure that the heater is powered off and disconnected from the electrical supply. If you encounter issues beyond your expertise, contact a qualified technician or manufacturer's support for further assistance.

Heater Fails to Start

Possible Causes:

- Power Supply Issue: Check the power supply and ensure that the heater is receiving proper voltage and current.
- Thermostat Setting: Verify that the remote thermostat is set correctly and calling for heat.
- Ignition Failure: Check for faulty wiring or a faulty ignition transformer.

Potential Solutions:

- Check Circuit Breakers: Ensure that all circuit breakers in the heater are in the "ON" position.
- Verify Thermostat Settings: Double-check the thermostat settings and adjust the temperature as needed.
- Inspect Ignition System: Examine the ignition system components for any signs of damage or loose connections. Replace faulty components if necessary.

Insufficient Heat Output

Possible Causes:

- Restricted Airflow: Check for any obstructions in the air intake or outlet vents that may be limiting airflow.
- Dirty Burners or Heat Exchanger: A build-up of dirt or debris on the burners or heat exchanger can reduce heat output.
- Fuel Supply Issues: Insufficient fuel supply or a faulty gas valve or solenoids can lead to inadequate heat generation.

Potential Solutions:

- Clear Airflow Path: Remove any obstructions or debris from the air intake and exhaust vents to improve airflow.
- Clean Burners: If the burners are dirty, carefully clean them following the manufacturer's guidelines.
- Check Fuel Supply: Verify that there is an adequate supply of fuel and that the gas valves are functioning correctly. If necessary, consult a qualified technician to inspect and repair the gas supply system.

Unusual Noises

Possible Causes:

- Loose Components: Vibrating or rattling noises may occur due to loose panels, ductwork, or other components.
- Fan Issues: A damaged or misaligned fan can create unusual noises during operation.

Potential Solutions:

- Tighten Loose Components: Inspect all panels, ducts, and other parts of the heater for looseness and tighten any fasteners as needed.
- Check Fan: Examine the fan for damage or misalignment. If you find any issues, contact a qualified technician for repairs or replacement.

Heater Shuts Off Unexpectedly

Possible Causes:

- Air Switch Malfunction: A faulty air switch may shut off the heater if it fails to detect adequate airflow.
- Overheating: The heater's safety features may shut off the unit if it overheats.

Potential Solutions:

- Check Air Switch: Verify the air switch's operation and ensure it is calibrated correctly. Clean or replace the air switch if necessary.
- Inspect for Overheating: Check for any obstructions around the heater that could restrict airflow and cause overheating. Ensure the unit is well-ventilated and not operating in high-temperature environments.

Uneven Heating

Possible Causes:

- Ductwork Imbalance: Imbalanced or poorly designed ductwork can lead to uneven heat distribution.
- Dirty Filters: Clogged or dirty air filters can impede airflow and result in uneven heating.

Potential Solutions:

- Inspect Ductwork: Examine the ductwork for any imbalances, blockages, or restrictions. Make necessary adjustments or corrections to achieve balanced airflow.
- Clean or Replace Filters: Regularly clean or replace air filters to ensure proper airflow and efficient heating.

Pilot Light Won't Stay Lit

Possible Causes:

- Thermocouple Issues: A malfunctioning or misaligned thermocouple can cause the pilot light to go out.

- Gas Supply Problems: Low gas pressure or a closed gas valve can prevent the pilot light from staying lit.

Potential Solutions:

- Check Thermocouple: Inspect the thermocouple for proper positioning and ensure it is in good condition. Adjust or replace the thermocouple if necessary.
- Verify Gas Supply: Ensure there is an adequate supply of gas, and the gas valve leading to the pilot light is fully open. Test pilot gas pressure to determine proper gas flow exists in the pilot line.

Burner Control System

The ST4500MA utilizes a Siemens LME7 flame safeguard for burner management. This device is viewable through the viewing window in the control panel door to monitor for phase and fault conditions.

The LME7 has an extensive list of fault codes to help clarify the nature of any fault. The following describes every fault code in detail and gives guidance on how to correct it. When a fault occurs, the LME7 will alternate between displaying “Loc” and the fault number.

The fault history is stored in the 700 set of parameters. These are only accessible with an AZL23 remote display or through the ACS410 software. To access the 700 set of parameters on the AZL23, press and hold the info button until “SEr” is displayed, then let go. The LME7 stores the last 11 fault codes:
Parameter 701 displays information about the current status of the LME7.
Parameter 702 displays information about the most recent fault.
Parameter 703 displays information about the second most recent fault.
...
Parameter 711 displays information about the 10th most recent fault.

Each fault code listed has indexes that provide additional information about the fault:
Index 00 = Fault code
Index 01 = Start number
Index 02 = Phase
Index 03 = Load
Index 01 will display a value of “._._”. This means that the AZL23 display ran out of room to display the start number. When this happens, hold down the info button to display the value. An example of how the AZL23 displays a fault code in the fault history is shown below:

Navigating the Fault History

To navigate the fault history, use the following keystrokes on the AZL23.

- When the parameter number is flashing, press the “+” or “-” button to cycle through the list of faults (parameters 701-711).
- When the parameter number is flashing, press and hold the info button to move the cursor from the parameter number to the index number. This will cause the index number to begin flashing.
- When the index number is flashing, press the “+” or “-” button to cycle through the list of indexes (00-03).
- When the index number is flashing, press the “+” and “-” buttons together to escape and move the cursor from the index number to the parameter number. This will cause the parameter number to begin flashing.

Resetting Faults on the LME7 Burner Control

Faults can be reset in one of three ways on the LME7... burner control:

1. Pressing the info button on the LME7 burner control for 1-3 seconds.
    a. Note: Pressing the info button for less than a second has no effect. Pressing the info button for more than three seconds places the LME7 into diagnostic mode.
2. Pressing the info button on the AZL23 remote display until the word “rESET” appears, then releasing.
    a. Note: Releasing the info button before the word “rESET” appears has no effect. Pressing the info button too long accesses the “InFo” menu.
3. Connecting neutral to reset terminal X2-03.1 for more than one second. This is typically done with the use of a push button connected between neutral and X2-03.1.
    a. Note: Connecting neutral to X2-03.1 for less than one second has no effect.

Accessing the Service (SEr) Menu

The service (SEr) menu contains the fault history as well as the 900 series of parameters that are used for diagnostic purposes, such as flame signal (954) and incoming voltage (951).

1. From the home screen (OFF), press and hold the info button until the word “SEr” is displayed, then release. The word “InFo” will briefly be displayed before “SEr”.
2. Press the + or - button to navigate through the parameters in the “SEr” menu.
3. When finished, press the “+” and “-” buttons together to escape

Complete Fault Code List

Fault Code	Description of the Fault	Corrective Action
2	No flame at start-up	A flame failure occurred during lightoff. 1. Check the wiring of the ignition transformer, pilot valve, and main valve(s). 2. Ensure manual shutoff valves on the pilot gas line and main gas line are open. 3. Check the fuel / air ratio at lightoff. 4. Check the flame detector signal in the presence of a known flame source. Replace the flame detector if it does not produce the anticipated signal.
3	Air pressure switch open	The air pressure switch connected to terminal X3-02.1 is open, causing a fault. Ensure the setpoint of the switch is set to an appropriate value. Check the wiring of the air pressure switch. If no air pressure switch is being used, place a jumper from terminal X2-01.3 to X3-02.1.
4	Extraneous light	An extraneous light (flame signal present when there should be none) fault occurred. 1. Ensure that the source of light is not a flame. If it is, take corrective action immediately. 2. Ambient light can cause an extraneous light fault. Ensure the flame scanner is viewing a dark area. 3. UV scanners typically fail on, giving a false flame signal. Remove UV scanner and cover the bulb to ensure it is not seeing any light. Look inside the bulb and see if any purple arcs of electricity are occurring between the electrodes in the bulb. If there are, replace the UV scanner.
5	Air pressure switch closed	The air pressure switch connected to terminal X3-02.1 is closed before the blower output is energized in phase 22, causing a fault. Ensure the setpoint of the switch is set to an appropriate value. Check the wiring of the air pressure switch. If no air pressure switch is being used, place a jumper from terminal X2-01.3 to X3-02.1.
6	Actuator position fault	The required position feedback from the connected SQM... actuator was not received. 1. Ensure the potentiometer on the SQM... actuator is wired correctly. -For counter-clockwise actuators (SQM40..., SQM50...), terminal "c" on the potentiometer should be wired to terminal X66.1 on the LME7, and terminal "a" on the potentiometer should be wired to terminal X66.3 on the LME7. -For clockwise actuators (SQM41..., SQM50...R), terminal "a" on the potentiometer should be wired to terminal X66.1 on the LME7, and terminal "c" on the potentiometer should be wired to terminal X66.3 on the LME7. 2. Ensure the SQM... actuator is wired properly to the LME7, especially the position feedback on terminal X2-09.4 of the LME7. 3. Ensure no mechanical stops are preventing the actuator from reaching its expected position. 4. While not common, heavy vibration on the actuator can wear a track in the position feedback potentiometer. If the fault always occurs at the same actuator position, the actuator may need to be replaced, and the vibration needs to be reduced to avoid having a similar issue with the new actuator.

Fault Code	Description of the Fault	Corrective Action
7	Loss of flame	A flame failure occurred during normal operation. 1. Check the fuel / air ratio. 2. Check the flame detector signal in the presence of a known flame source. Replace the flame detector if it does not produce the anticipated signal.
10	Wiring or other error	This fault is a catchall and can be caused by a variety of issues. See Section 7-3 for a list of all known causes of this fault. If none of the causes listed in Section 7-3 appears to be the cause, review all wiring on the LME7 and check to see if a wire is landed on an incorrect terminal.
12	Fuel valve V2 leaking (PME73.840A1) Fuel valve V1 leaking (all other PME7s)	On PME73.840A1, the downstream gas valve V2 failed valve proving. On all other PME7 program modules, the upstream gas valve V1 failed valve proving. 1. Bubble test the gas valve to ensure the valve is not leaking. If the valve is leaking, replace the valve. 2. Ensure that the setpoint of the valve proving pressure switch is set to 50% of the inlet pressure to the upstream gas valve.
13	Fuel valve V1 leaking (PME73.840A1) Fuel valve V2 leaking (all other PME7s)	On PME73.840A1, the upstream gas valve V1 failed valve proving. On all other PME7 program modules, the downstream gas valve V2 failed valve proving. 1. Bubble test the gas valve to ensure the valve is not leaking. If the valve is leaking, replace the valve. 2. Ensure that the setpoint of the valve proving pressure switch is set to 50% of the inlet pressure to the upstream gas valve.
14	Proof-of-closure (POC) switch failure	The POC switch is not in the expected state. If a POC switch exists, ensure it is wired to terminal X2-02.4 on the LME7. On an LME75 burner control, the source of power to the common side of the POC switch must come from terminal X2-02.3. If no POC switch exists, either set parameter 237 to 0 or install a jumper between terminals X2-02.3 and X2-02.4.
20	Gas pressure fault	One of the gas pressure switches wired to terminal X5-01.2 opened, causing a fault. It is common for both the high and low gas pressure switches to be wired to terminal X5-01.2, so the fault could be either a high gas or low gas event. Check the gas supply and open any manual shutoff valves. Check the wiring of all gas pressure switches. Check the setpoint of any gas pressure switches to ensure the setpoint is set to an appropriate value.
21	High gas pressure fault	The high gas pressure switch wired to terminal X2-02.4 (PME75.811A1) or X9-04.2 (PME75.812A1) opened, causing a fault. Check the wiring of the high gas pressure switch. Check the setpoint of the high gas pressure switch and ensure it is set to an appropriate value. Check pressure regulators for ruptured diaphragms or incorrect setpoints.

Fault Code	Description of the Fault	Corrective Action
22	Safety loop open	Check all of the switches wired into the safety loop on terminal X3-04.1. One of the switches opened, causing the fault. Fix the condition that caused the switch to open and reset the fault.
60	Analog input out of range	The 4-20 mA input connected to terminal X65 is out of range. This input determines the position of the actuator or speed of the PWM blower. Check the wiring of the analog input. If a fault is not desired when the input drops below 4 mA, set parameter 654 to a 5.
83	PWM blower speed fault	The speed of the PWM blower does not match the expected speed. More specifically, the blower speed fell outside of tolerance band 1 (parameter 650.00) for a time longer than the maximum speed deviation allowed (parameter 660), or the blower speed fell outside of tolerance band 2 (parameter 650.01). There are many possible corrective actions: 1. Increase ramp time up (parameter 522) and/or ramp time down (parameter 523) to allow the blower more time to achieve the expected speed. 2. Increase the setting of tolerance band 1 (parameter 650.00) and/or tolerance band 2 (parameter 650.01). 3. Ensure that the maximum fan speed (parameter 519) and the number of pulses per revolution (parameter 644) are set correctly for the blower being used. 4. Inspect wiring from PWM blower to LME7 to ensure the tachometer speed feedback signal is wired correctly.
138	Restore process successful	There is no fault. This fault occurs when a parameter set was successfully restored from the PME7 program module to the LME7 base unit. Reset the fault.
139	No program module detected	This fault occurs when no PME7 program module is plugged into the LME7 base unit. Insert a PME7 program module into the LME7 base unit and reset the fault.
167	Manual lockout	A manual lockout is caused by pressing the info button and any other button, either on the LME7 base unit or on the AZL23 remote display. Reset the fault.
206	Inadmissible combination of units (LME7 / AZL23)	Reset the LME7. If the fault occurs continuously, replace the LME7 and / or AZL23.
225	PWM blower speed fault	The speed of the PWM blower dropped below the minimum prepurge speed (parameter 675.00) during prepurge, or the speed of the PWM blower exceeded the maximum ignition speed (parameter 675.01) during ignition. Adjust parameter 675.00 or 675.01, or adjust purge speed (503.01) or ignition speed (403.00).
226	PWM blower parameterization error	The following parameter settings are not allowed. Correct the parameter setting that is incorrect and reset the fault. 1. Speed low-fire (P1) > speed high-fire (P2) 2. Speed low-fire (P0) = 0 3. Maximum blower speed (parameter 519) = 0

Fault Code	Description of the Fault	Corrective Action
227	PWM blower parameterization error	One or more PWM blower settings are not compatible. Make sure the following three conditions on the minimum and maximum speed settings are met. 1. 516.00 ≤ P0 ≤ 516.01 2. 517.00 ≤ P1 ≤ 517.01 3. 518.00 ≤ P2 ≤ 518.01
rSt Er1	Incompatible PME7 and LME7	The PME7 program module and LME7 base unit being used are incompatible. PME71 program modules are only compatible with LME71 base units, PME73 program modules are only compatible with LME73 base units, and PME75 program modules are only compatible with LME75 base units.
rSt Er2		
rSt Er3	Fault during restore process	The PME7 program module was removed during the restore process. Re-install the PME7 program module and reset the fault to complete the restore process.
bAC Er3	Fault during backup process	The PME7 program module was removed during the backup process. Re-install the PME7 program module and reset the fault. Perform the backup process again.
Err PrC	No program module detected	This fault occurs when no PME7 program module is plugged into the LME7 base unit. Insert a PME7 program module into the LME7 base unit and reset the fault.

Known Causes of Loc 10

Loc 10 is a catchall fault that can be caused by a variety of issues. All known causes of Loc 10 are listed below in Table 7-1.

Table 7-1: All Known Causes of Loc 10

Cause #	LME71/73/75	Description	Phase	Corrective Action
1	All	Line power is directly connected to safety loop input X3-04.1	OFF	Power to the safety loop must be sourced from terminal X3-04.2
2	LME73/75 only	PV jumper missing	40	Add a jumper between terminals X2-09B.7 and X2-09B.8
3	All	Line power directly connected to blower output terminal X2-01.3	OFF	Correct feedback/wiring error
4	All	K4 relay contacts welded	21	With no power on the LME7, check continuity across pins X2-01.3 and X2-02.3. If there is continuity, replace the LME7. See Note 1 below.
5	All	Line power directly connected to POC source terminal X2-02.3	OFF	Correct feedback/wiring error
6	All	Line power directly connected to SV output terminal X6-03.3	OFF	Correct feedback/wiring error
7	All	Ambient temperature exceeds 140°F	OFF	Adjust the temperature back within the controller's acceptable range. Add enclosure cooling if necessary.
8	All	Flame failure incorrectly being logged as Loc 10	44, 50	Adjust combustion to avoid flame failures during light-off

6 - WARRANTY

6.1. Warranty Coverage

Hybrid Light Solutions, LLC/Safety Thaw Limited Warranty Statement

Hybrid Light Solutions, LLC (HLS)/Safety Thaw will, at it's discretion, repair or replace any part(s) that, upon examination, inspection and testing by HLS, is found to be defective under normal use and service during the original warranty period only. Any equipment or part thereof that the purchaser/owner claims to be defective must be examined by HLS before said claim is allowed.

Warranty Period: 1 year/unlimited hours

Warranty Guidelines:

- All warranty claims and expense allowances must be addressed and approved by HLS.
- Damage caused by the use of non-OEM parts will not be covered by this warranty.
- HLS may choose to repair or replace any parts or equipment covered by this warranty at it's discretion.
- Warranty labor rates are based on normal working hours. Additional costs for overtime, holiday or emergency labor costs will be the responsibility of the owner.

❖ **The following will not be covered by warranty:**

- ➢ Any failed components warranted by the OEM.
- ➢ Costs of normal and regular maintenance.
- ➢ Any failures caused by contaminated fuels.
- ➢ Failures caused by any act of God or external cause such as collision, theft, vandalization, windstorm, hail, flood, tornado, terrorism, or any other matters beyond the manufacturer's control.
- ➢ Failures due to normal wear and tear, accident or abuse.
- ➢ Failure due to misapplication, or misrepresentation.
- ➢ Rental equipment used while warranty repairs are being performed.
- ➢ This warranty does not cover expenses or incidental costs related to shipping, lost rentals and any damage to other property or equipment.
- ➢ Overnight or expedited freight costs for repair parts are not included.
- ➢ Normal maintenance and/or wear items i.e. bearings, belts, hoses, bulbs, filters, etc. are not included.

This warranty supersedes all other warranties, expressed or implied. Any implied warranties which are allowed by law shall be limited in duration to the express warranty provided herein. HLS only liability shall be the repair or replacement of parts as stated above. In no event shall HLS be liable for any incidental or consequential damages, even if such damages are a direct result of HLS negligence.

6.2. Contact Information

Please call 218-568-1188 or email service@hybridlightsolutions.com for any questions or concerns regarding equipment warranty.

Revised On	Version	Description	Approved By
06/30/2023	0.1	Pre-Production Release	CM
9/25/2023	0.2	Added lift instructions, ducting, air switch tuning, and troubleshooting	CM