



IMPORTANT INSTRUCTIONS - SAVE THESE INSTRUCTIONS

Read all instructions before installing or using the heater. Please adhere to instructions published in this manual. Failure to do so may be dangerous and may void certain provisions of your warranty.



Gas Fired Railway Switch Heater

2014 HELLFIRE 400

Installation, Operation, & Maintenance Instructions



ANSI Z83.7-2017/CSA 2.14-2017 Gas Fired Unvented Construction Heaters (Unattended Type)

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A. IMPORTANT NOTICES AND WARNING SYMBOLS

Keep this manual with the machine at all times. The purpose of this manual is to provide owners, operators, and installers with the precautions and procedures essential for the safe and proper operation for its intended purpose.



CAUTION

CAUTION. This symbol indicates a potentially hazardous situation, which, if not avoided, may result in personal injury or damage to the equipment.



WARNING

WARNING. This symbol indicates an imminently hazardous situation, which, if not avoided, can result in serious injury or damage to the equipment.






DANGER

DANGER. Read and adhere to the following. Failure to do so may result in severe or fatal injury. Warranty will be void.

NOTE: "NOTE:" indicates information or a company policy that relates directly or indirectly to the safety of personnel or protection of property.

Table 1 – Operation Warning/Avertissements (Intended for Signal Maintainers)

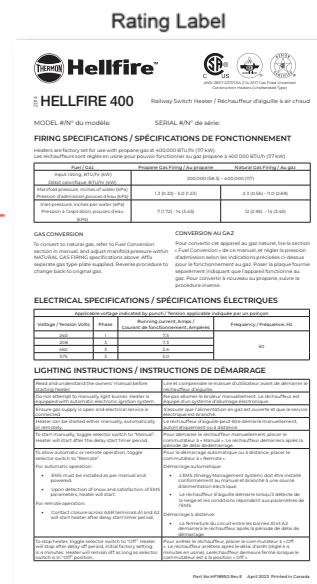
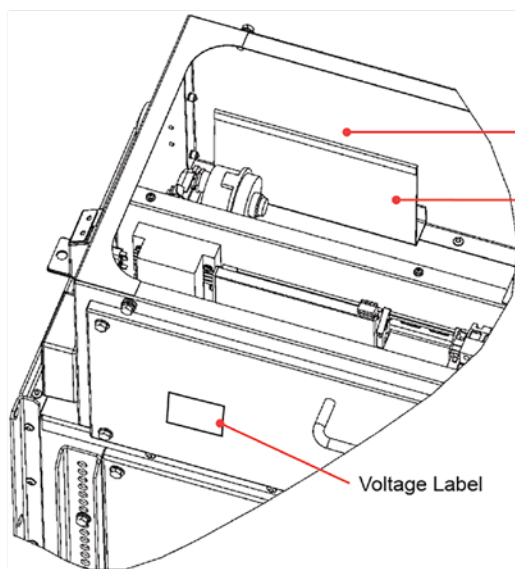
Symbol	Description	
	English	French
	Risk of electrical shock or electrocution. Disconnect electrical power prior to servicing.	Risque de choc électrique ou d'électrocution. Couper le courant avant d'entreprendre l'entretien.
	The heater is designed and approved for use as a commercial heater (gas) – railway switch, class 2902 05 in accordance with ANSI Z83.7 / CSA 2.14. Check with local authority, if you have questions about applications.	Cet appareil a été conçu et approuvé pour être utilisé comme radiateur commercial (gaz) - aiguillage de voie ferrée de classe 2902 05, conformément à la norme ANSI Z83.7 / CSA 2.14. Communiquez avec les autorités locales pour plus de renseignements sur le lieu d'utilisation de cet appareil.
	General hazard warning failure to comply with the precautions and instructions provided with this heater, can result in death, serious 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 use or service this heater. If you need assistance or heater information such as an instructions manual label, etc. Contact the manufacturer.	Mises en garde générales le non-respect des mises en garde et des instructions fournies avec ce radiateur peut entraîner la mort, des graves blessures et des pertes matérielles ou des dommages à la propriété résultant d'un incendie, d'une explosion, de brûlures, d'asphyxie, d'empoisonnement au monoxyde de carbone et/ou d'un choc électrique. Seules les personnes aptes à comprendre et à suivre les instructions devraient se servir de ce radiateur ou le réparer. Si vous avez besoin d'aide ou d'informations concernant ce radiateur, soit une notice d'instructions, une étiquette, etc., Prière de communiquer avec le fabricant.

Symbol	Description	
	English	French
	Fire, burn, inhalation, and explosion hazard. Keep solid combustibles, such as building materials, paper, or cardboard, a safe distance away from the heater as 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.	Risque d'incendie, de brûlures, d'inhalation et d'explosion. Garder les combustibles solides, tels les matériaux de construction, le papier et le carton, à bonne distance de ce radiateur, comme il est recommandé dans les instructions. Ne jamais utiliser cet appareil dans des endroits qui contiennent ou pourraient contenir des combustibles volatiles ou en suspension dans l'air tels l'essence, les solvants, les diluants pour peinture, les particules de poussières ou des produits chimiques inconnus.
	Not for home or recreational vehicle use.	Ne pas utiliser dans une maison ou un véhicule de camping.
	All persons employed in handling propane or natural gas shall be trained in proper handling and operating procedures, as required by local authorities having jurisdiction.	Toute personne qui manipule le propane ou le gaz naturel doit avoir suivi une formation sur les bonnes procédures de manipulation et d'utilisation qui est conforme aux exigences des autorités locales compétentes.
	If you smell gas; immediately extinguish all sources of ignition and turn off gas source. Call qualified service technician to repair leak.	S'il y a une odeur de gaz : fermer immédiatement toute source d'allumage et de gaz. Faire réparer la fuite par un technicien qualifié.
	Do not attempt to manually light burner. Heater equipped with an automatic electronic ignition system.	Ne pas allumer le brûleur manuellement. Radiateur équipé d'un système d'allumage électronique.
	Risk of cutting fingers or hand. Disconnect fan power prior to removing combustion chamber access panel or air intake.	Risque d'amputation des doigts ou de la main. Couper le courant au ventilateur avant d'enlever le panneau d'accès à la chambre de combustion ou l'entrée d'air.
	Heater can start automatically. Exercise caution when in close proximity.	Attention : le radiateur peut démarrer automatiquement. Faire preuve de prudence près du radiateur.
	Burn hazard / hot surfaces. Do not touch track ducts, nozzles or any non-insulated duct connected downstream of heater during operation.	Surface chaude; risque de brûlure. Ne pas toucher les conduits latéraux à la voie ferrée, les buses ni aucun conduit non isolé branchés en aval d'un radiateur en marche.
	Sheet metal edges can be sharp. Wear protective clothing when handling track duct, insulated ducts and any other sheet metal components.	Risque de coupure. Les rebords de la tôle sont coupants. Porter des vêtements protecteurs lors de la manipulation des conduits isolés et tout autre composant en tôle.
	For use with ductwork only.	Pour utilisation avec réseau de gaines seulement.
	Retain manual for future reference.	Conserver le manuel pour consultation ultérieure.

B. IDENTIFICATION

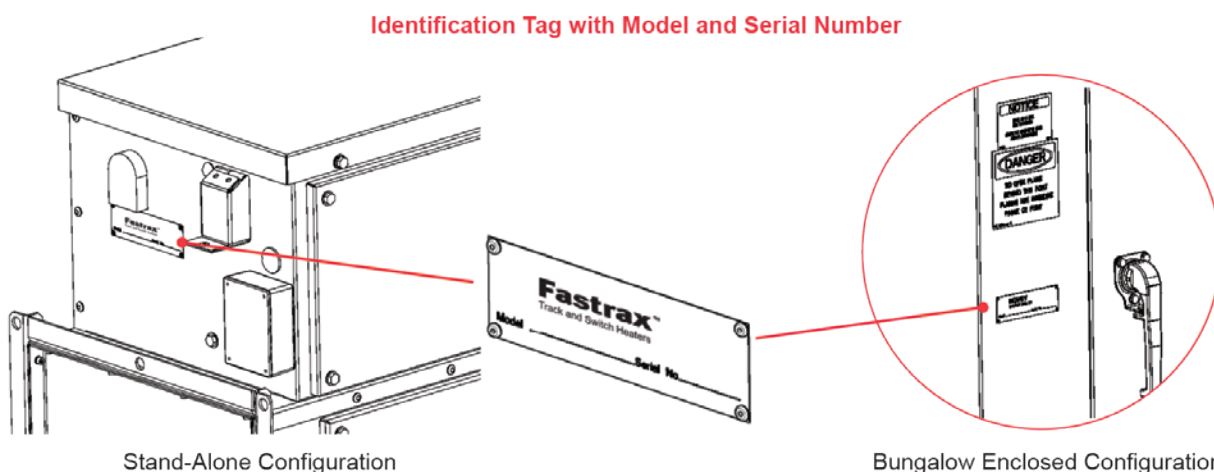
B.1 Heater Labels

1. Each heater has a ratings label, a logo label, a model and serial number tag and a voltage label.
2. The ratings label contains all identification and safety information. It is fastened by a lanyard and stored in the manual pocket inside the control enclosure next to the gas manifold. The electrical specifications are indicated with a punch mark.
3. The logo, located on the side of the air intake hood identifies the series as HELLFIRE, and the size, either 400 or 900.
4. The model / serial number tag is a blue aluminum plate. The model number is applied to an adhesive backed label bonded to the tag, and the serial number is engraved. The serial number is a sequential 6-digit number. The tag is located in one of two spots depending on the configuration.



B.2 Model and Serial Number Tag

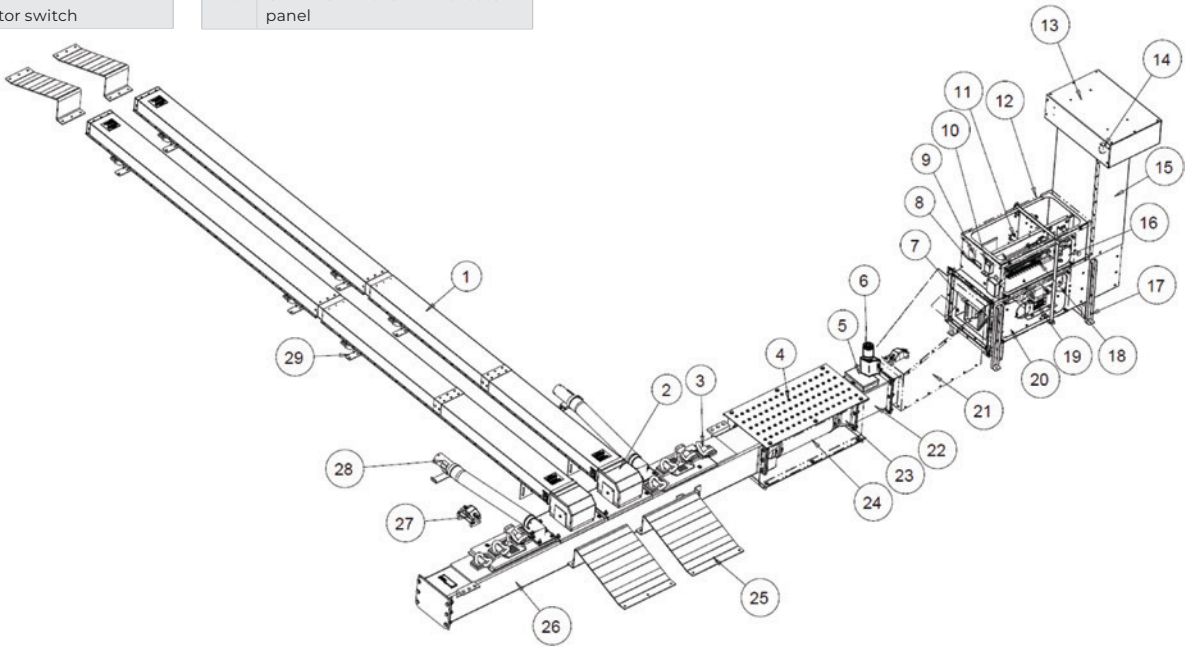
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|----|---------------------------------------------------------------------------------------------------------------------------------------|----|----------------------------------------------------------------------------------------------------------------------------------------------|
| 1. | There are two basic configurations, stand-alone and bungalow enclosed. | | |
| 2. | The tag is located on the front of stand-alone configurations and to the left of the door handle on bungalow enclosed configurations. | 4. | The operating voltage label is found on the electrical access panel. Have this information available when requesting parts or service. |
| 3. | Stand-alone configurations are identified on the tag as model "HF 400" followed by a 5-digit number, | | an optional 2-digit dash number and a revision letter. For example, HF400 12345-01A (HF 400 BUNG XXXXX-XXX - for bungalow enclosed heaters). |



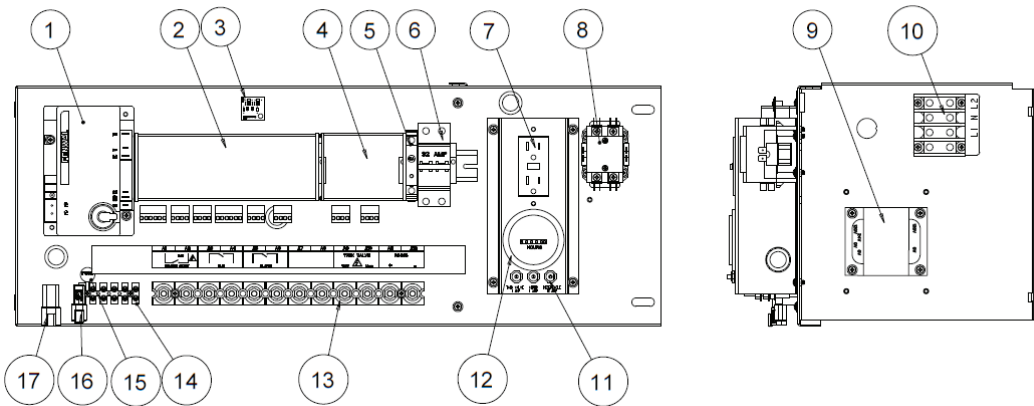
B.3 Components Diagram

The following component names are referred to in this manual. See Section L - Parts for part numbers and ordering.

No.	Label	No.	Label	No.	Label
1	Track duct	11	Gas manifold	21	Transition duct
2	Track duct elbow	12	Control cabinet lid	22	Sensor duct
3	Rail mounting spring clip and pad	13	Air intake hood	23	Square to round adapter
4	Ballast retainer	14	Ambient air temperature sensor	24	Flex duct
5	Thermostat box	15	Air intake extension	25	Track duct deflector
6	Precipitation detector	16	Electrical control access panel	26	Tie duct
7	Burner	17	Leveling leg	27	Rail thermostat
8	Identification tag	18	Control panel	28	Point nozzle
9	Condensation vent	19	Motor/Impeller/Base	29	Track duct mounting bracket
10	Mode selector switch	20	Combustion chamber access panel		



B.4 Control Panel Diagram - 240V Single Phase Example Shown



1	Direct Spark Ignition control module
2	Controller
3	Programming key
4	EMS module
5	Control circuit breaker
6	Motor circuit breaker

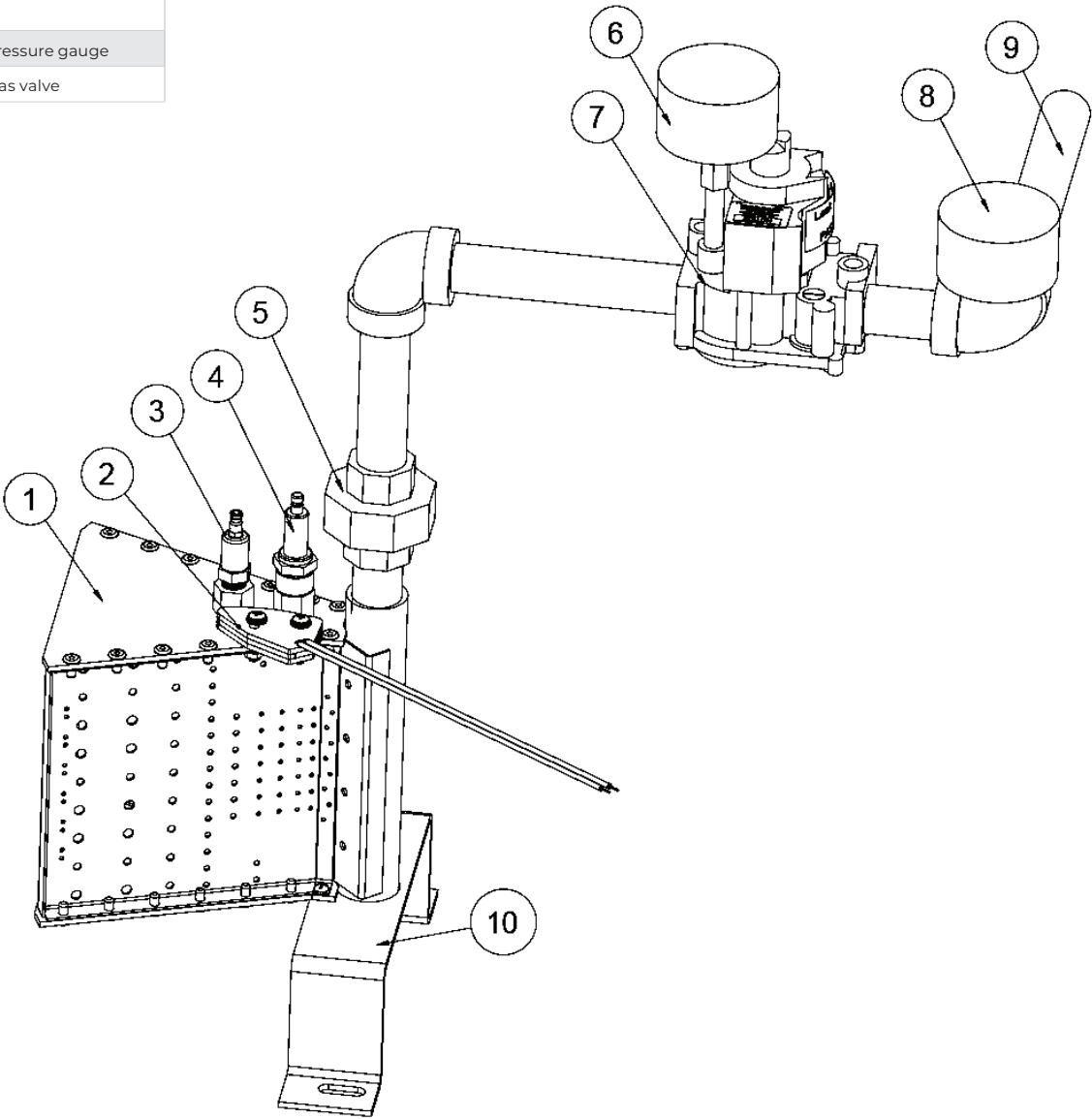
7	120V receptacle
8	Contactor
9	Control transformer
10	Power terminal block
11	Circuit interrupters
12	Hour meter

13	Control and indication terminal block
14	Manifold terminal block
15	Resetable fuse, burner defroster
16	Rail thermostat receptacle
17	Precipitation detector receptacle

B.5 Gas Manifold Diagram

No.	Label
1	Burner
2	Defroster
3	Flame rod
4	Igniter
5	Union
6	Manifold gas pressure gauge
7	Combination gas valve

No.	Label
8	Gas supply pressure gauge
9	Gas supply inlet
10	Burner mounting bracket



C. PRE-OPERATION INSPECTION

C.1 Important Notices

To ensure trouble free operation during the winter months, inspect the system annually at the start of the season.



WARNING. All persons employed in handling propane or natural gas shall be trained in proper handling and operating procedures, as required by local authorities having jurisdiction.

Gas leaks shall be repaired immediately or, gas supply valve closed until repairs can be made.

All work performed on railway property must be carried out in accordance with local railway authorities instructions.



CAUTION. Do not operate this machine until it has been installed and commissioned according to requirements specified in the installation section of this manual.

NOTE: Perform inspection and operations in accordance with the instructions provided in the service section of this manual.

NOTE: This inspection guide assumes that all applicable service bulletins have been implemented on the heater being inspected.

NOTE: The outcome of any inspection items that differ from that expected indicates further service is required.

C.2 Prior to Heater Start-Up

Table 1 – Heater Inspection List

Inspect	Action
Condition of all ducting, particularly any flex ducts	Repair or replace damaged ductwork.
Inside of all tie duct and cross ducts	Remove any blockages, such as debris and mud.
Track duct vents	Close vents that do not direct air at tie plates or rods. Set vent openings to 1/8" - 1/4" maximum.
Track duct mounting	Verify track ducts do not interfere with normal movement of the switch points and do not interfere with the signal system.
Flame rod and spark igniter	Remove and visually inspect for cracks in the ceramic, and evidence of soot. Replace any with cracked ceramic. If evidence of soot is found, clean rod and investigate condition of burner, gas manifold, and inspect tie duct, cross ducts and air intake for blockage.
Flame rod and ignition wires	Inspect boot for degradation, cracks and poor seals. Replace if necessary. Inspect connectors for signs of corrosion. Clean connections, or replace wire if necessary.
Combustion chamber	Verify it is clear of any obstructions or debris, ie. animal nests.
Cycling and high limit thermostat installation	Verify thermostats are fastened and are in full contact with duct surface. Replace any with damaged wire insulation. Verify thermostat enclosure is sealed and dry inside.
Service surge protection	Verify electric service has functioning surge protection.
Air switch port and vent	Remove any obstruction.
DSI control module	Verify it is installed.

Inspect	Action
Gas source	Verify propane tank is filled, or natural gas service is open and has pressure. Open all manual gas shut off valves and inspect all gas lines for leaks.
Electrical service	Verify electric service power is on. Close supply circuit breakers.
Electrical supply	Verify correct line voltages at each heater. Must be within +/- 5% of nominal voltage. Verify current draw is less than or equal to nameplate rating.
Gas supply	Verify supply and manifold gas pressures are within nameplate limits when heater and all connected loads are operating.
Flame signal strength	Verify flame signal strength is stable (+/- 0.5) and between 3.0 and 8.0 micro amps DC. If signal strength is low: Clean or replace flame rod. Clean flame rod wire connections, or replace wire. If cleaning or replacement of flame rod and wire does not increase strength, have burner serviced or replaced.
Burner operation	Note current manifold pressure. Set manifold pressure to maximum nameplate setting, measure point nozzle temperature, if point nozzle temperature is 140°F or less above ambient air temperature have burner serviced or replaced. Return manifold pressure back to desired setting.
Air switch calibration	Block air intake 80%. Verify heater still operates. Then block 90% and verify FSR alarms. If heater fails with 80% or less blockage, recalibrate air switch.
Control and indication wiring	Verify the correct control and indication wiring between the heater and the signal bungalow.
Energy Management System (EMS)	If heater is operated automatically by an Energy Management System: <ul style="list-style-type: none"> – Verify EMS module is installed and connected with POWER LED lit. – Verify controller is in AUTO mode. – Verify precipitation detector and ambient temperature sensor installed and connected. – Verify rail thermostat is mounted on rail and connected to surge isolator. – Verify its operation.
Aggressive retry	Verify operation. Turn gas supply off, toggle heater to "Manual". Verify three attempts made followed by lockout. Return heater to desired operating mode. Open gas supply. Reset controller.

D. OPERATION

D.1 Introduction

The switch heater is a gas fired, hot air heating system that keeps a turnout clear of ice and snow during winter storms by blowing hot air, between the stock rail and moving points, at the tie plates on which the points slide, and at the gage rods.

D.2 Modes

The heater can be operated in the following modes:

1. **MANUAL** - by toggling the mode selector switch to "MANUAL", the heater will turn on and operate continuously. If installed, the rail thermostat will cycle the burner on and off as required to maintain the rail temperature.
2. **AUTO** - With the controller configured for LOCAL AUTO MODE, toggling the mode selector switch to "AUTO/REMOTE", and with an EMS module, precipitation and ambient temperature sensor installed, the heater will turn on or off as required based on the weather conditions. If installed, the rail thermostat will cycle the burner on and off as required to regulate the rail temperature.
3. **REMOTE RTC**- by toggling the mode selector switch to "AUTO/REMOTE" and with a Rail Traffic Control, RTC (dispatcher) operated control relay contact wired to terminals A1 and A2 of the control and indication terminal block. With RTC timer disabled, the heater will operate continuously while the RTC contact is closed, if the RTC timer is enabled, the heater will run for the duration of the RTC timer then stop. RTC can restart the heater for additional run time by resetting the request. If installed, the rail thermostat will cycle the burner on and off as required to maintain the rail temperature.
4. **REMOTE SCADA** - With the controller configured for REMOTE SCADA MODE, toggling the mode selector switch to "AUTO/REMOTE" with the heater connected to a Supervisory Control and Data Acquisition, SCADA, network via the controllers' RS-485 communications port, and configured with a Remote Control and Monitoring System, RCMS, software, the heater will operate automatically.

If installed, the EMS module, precipitation detector, ambient temperature sensor and rail thermostat provides inputs to the RCMS software.
5. **OFF** - to disable the heater, toggle selector switch to "OFF".

D.3 Start-Up Sequence (All Modes)

Once a start request is received the control sequence begins.

NOTE: If the controller is in 'REMOTE RTC' mode then it waits for the 'DELAY START' time before initiating.

Table 1 – All Modes

Conditions/Sequence	Status LED
Heater is in an operational mode not OFF.	ENABLE
Cycling thermostat is cold or closed.	CYCLING
Motor contactor closed, fan starts.	MOTOR
Air pressure develops, air switch closes.	AIR SW
DSI requested.	HEAT
Main gas valve opens.	FSR CHECK
Run indication contact closed.	RUN
To confirm the heater operation, the burner remains lit and the rail thermostat status is ignored for the first 2 minutes.	
Normal operation Heater runs as long as requested.	

D.4 Occurrences During Normal Operation

NOTE: The rail thermostat closes when the rail temperature is above 9°C (49°F) and opens when below 3°C (37°F).

1. As long as the rail is cold and the thermostat is open, the burner remains lit. Once the rail warms and the thermostat closes, the burner is extinguished. This cycle repeats as required while the heater operates. If the rail temperature remains warm for more than the post purge time then the fan is turned off. The run indication is maintained during this time.
2. If the heater is in 'REMOTE SCADA' mode and the 'RCMS' software is requesting performance operation, the burner will remain lit regardless of rail thermostat status.

NOTE: The cycling thermostat limits the heated air temperature to a maximum of 193°C (380°F). Under normal circumstances the air temperature remains below this limit.

3. If the heated air temperature becomes excessively hot, the cycling thermostat limit opens, and the burner is extinguished immediately. Once the air cools and the thermostat closes the burner is lit and heating resumes. Run indication is maintained during this time.

D.5 Heat Output Adjustment

1. Depending on the length of switch points, its' priority, local climate conditions, and experience, the operator can increase or decrease the heat output accordingly. The recommended heat output is in the range of 10,000 to 22,000 BTU/hr per foot of turnout length.
2. The factory default setting is 400,000 BTU/hr when operated on LPG, or 260,000 BTU/hr on NG. The heater can be fueled with LPG or NG with no component change.
3. Adjust the heat output as follows:
 - 3.1 Using a flat blade screwdriver, remove the regulator adjustment screw cap (shown).
 - 3.2 Turn on the gas supply, turn on the heater and set the manifold pressures as per the natural gas limits on the heater nameplate. Rotate the adjustment screw clockwise to increase pressure.
 - 3.3 If the burner fails to light after repeated attempts, it may be necessary to purge the main gas line of air.
 - 3.4 After 15 minutes of running, verify the nozzle temperatures are in the range of 38°C - 88°C (100°F - 190°F) above ambient.



WARNING. Do not operate above maximum manifold pressure as this can produce carbon monoxide in excess of maximum allowable of 0.08 air free carbon monoxide (AFCO).



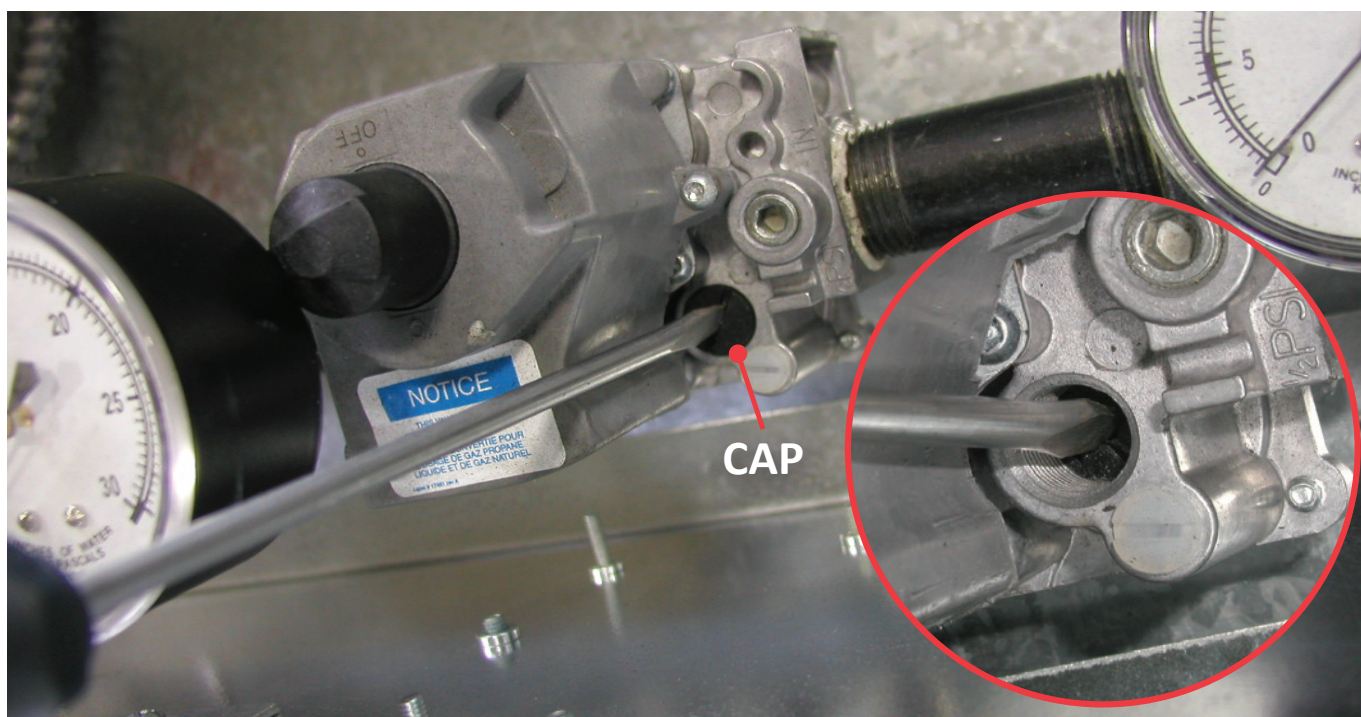
WARNING. Do not operate above or below the rated manifold pressure limits. Operating outside limits will result in weak flame signal and unreliable operation.

- 3.5 Reinstall the cap to cover the regulator adjustment screws.
- 3.6 The heat output can be estimated from the manifold pressure and the following formulas:

$200,000 + ((\text{Manifold pressure} - 1.3) / 3.7) * 200,000$ for LPG or
 $200,000 + ((\text{Manifold pressure} - 2.3) / 8.7) * 200,000$ for NG

Pressure is in inches of water column.

NOTE: These formulas are simplified, assume the equipment is in good condition, and are strictly for estimation only.



E. CONTROLS & INDICATIONS

E.1 AAR Signal Wiring - For non SCADA installations

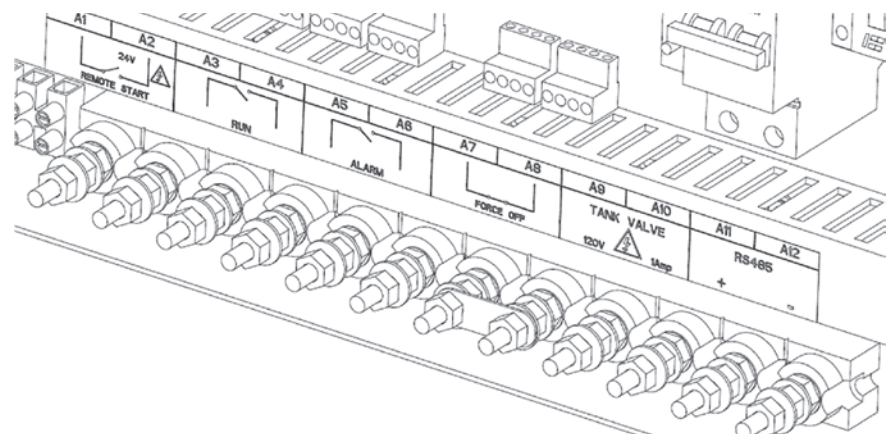


Table 1 – AAR Signal Wiring

Terminals	Label	Description
A1 - A2	REMOTE START	A contact closure across these terminals starts the heater when the heater is in REMOTE RTC mode.
A3 - A4	RUN	Dry contact closes to provide a run indication.
A5 - A6	ALARM	Dry contact closes to provide alarm indication.
A7 - A8	FORCE OFF	Default is closed. If FORCE OFF function is desired, remove shorting link and replace with customer supplied relay contact. Open contact disables heater.
A9 - A10	TANK VALVE	These terminals are intended to operate a 120Vac gas supply solenoid shut off valve. They energize when the motor contact closes.
A11	RS-485 (+)	Communications, RS-485 positive terminal (for RCMS operation only)
A12	RS-485 (-)	Communications, RS-485 negative terminal (for RCMS operation only)

E.2 Controller

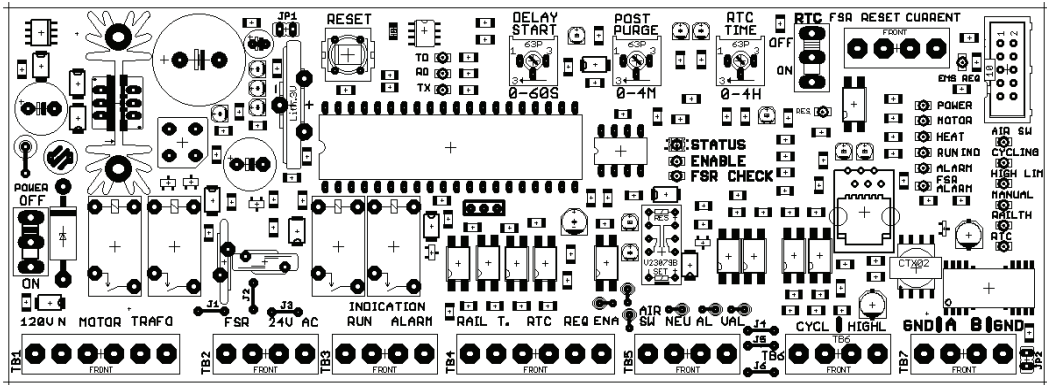
1. The controller manages the operation of the heater and allows it to either operate on its own or be part of a network of heaters.

2. The controller monitors various inputs, controls the heater functions, communicates status and provides indication LEDs.

3. The controller is DIN rail mounted and all wiring connections are made with plug connectors to allow quick replacement in the event of a failure.
4. With the addition of the EMS package, a stand alone heater can operate automatically based on weather conditions, or when connected to a network, act as a weather station providing input to a SCADA system.

5. Its' RS-485 serial communications port allows the heater to interface with SCADA systems, and be operated and managed by a Remote Control and Monitoring System.,

NOTE: Controllers are not interchangeable between HELLFIRE 400 (24Vac) and HELLFIRE 900 (120Vac).



E.3 Controls

1. **Power:** This switch turns the power supply to the board 'ON' or 'OFF'.



WARNING. TB1 and TB2 120Vac inputs to controller can remain energized.

2. **Reset:** This push button is used to reset the controller in case of a lockout.
3. **Delay Start:** This dial sets the length of the delay, 0 to 60 seconds, before starting the heater. It is intended to allow the stagger start of multiple heaters connected to one power service thereby reducing the maximum current draw. This setting is true for REMOTE RTC mode only. Under MANUAL, AUTO and REMOTE SCADA modes there is no delay.

NOTE: This setting is overridden when operated in REMOTE SCADA mode by the corresponding Fastrax® RCMS software parameter.

4. **Post Purge:** This dial sets the length of the delay, 5 seconds to 4 minutes, once the heater is no longer requested, before stopping the fan. It is intended to purge the remaining heat and moisture from the combustion and duct system. This setting is true for all modes.
5. **RTC Time:** (RTC stands for Rail Traffic Control dispatch) This dial limits the run time between 20 minutes to 4 hours, when requested by RTC dispatcher, and with the RTC SW switch ON, and the heater is in REMOTE RTC mode. When the RTC request exceeds the time

limit, the heater turns off, and the run indication is maintained as long as the heater is requested.

Timer is reset once the RTC request is removed. RTC can then request the heater for another cycle.

It is intended to save fuel by avoiding unnecessary heater operation by the dispatcher. This setting is true for RTC MODE only. Under MANUAL, AUTO, and REMOTE SCADA modes there is no limit.

6. **RTC SW:** This switch enables the RTC TIME function when in the ON position. When switched OFF, RTC TIME is disabled and the heater runs as long as requested.
7. **JUMPER, JP1:** Used to configure controller parameters.

E.4 Indications

1. There are a number of status LEDs on the controller intended to aid the user's understanding of the heater state of operation. See Table 6 - Controller LED Descriptions for full description.

NOTE: With the exception of the communications TD, RD, and TX LED's. Solid green, solid green with a red pulse, or yellow LED's indicates normal status. Solid red and alternating LED's indicate a failure. This is true for the controller only, not the EMS module.

2. Refer to Section F - Troubleshooting for explanation of problem condition LED codes.
3. The LEDs listed can be found on the controller from top left to bottom right on the board.

Table 1 – Controller LED Descriptions

LED Name	Description	State	Indication
TD, RD, TX	RS-485 communications	TD, RD on and pulsing TX off and pulsing	Heater in REMOTE SCADA mode.
		TX off TD and RD on	Heater in LOCAL AUTO mode.
		TD, TX off and pulsing RD on	8N1 COM communications mode.
Status	Processor status	Solid green with a red pulse	Normal operation.
		Alternating red and green	FSR failure alarm. Aggressive retry mode in process.
		Solid red	Failure alarm. Note any alternating LEDs and refer to Section F - Troubleshooting. Controller must be reset.
		Solid green or off	Processor has stopped functioning.
ENABLE	Heater enable	On	Mode selector switch is either in MANUAL or REMOTE/AUTO position. Heater can be started in AUTO REMOTE RTC or REMOTE SCADA modes.
		Off	Mode selector switch is in OFF position. Heater is in OFF mode and will not start.
FSR CHECK	Flame Safety Relay/DSI check	On	Gas valve energized. Used to confirm correct operation of DSI.
		Alternating	The DSI did not energized the main gas solenoid valves when expected.

LED Name	Description	State	Indication
RES	FSR Reset	On	Controller clears DSI control module alarm.
EMS REQ	EMS request	On	EMS module request for heater to run. Heater only acts on this request if in AUTO mode.
		Pulsing	Local EMS mode. Installed EMS module can request heater operation ON or OFF.
POWER	Power supply	On	Controller energized.
MOTOR	Motor	On	Contactor closed, motor turned on.
HEAT	Controller request for heat	On	DSI control module requested. Ignition sequence started or burner operating.
RUN IND	Heater run indication	On	Indication contact closed. Turns on after 60 seconds of normal operation.
ALARM	Heater alarm indication	On	Alarm indication contact closed. Heater off and locked out. Controller must be reset manually.
FSR ALARM	Flame safety relay/DSI alarm	On	DSI control module in ALARM, or controller is preventing its operation.
		Alternating	DSI control module in ALARM. Heater failed 4 times in 5 minutes.
AIR SW	Air pressure switch	On	Contact closed. Sufficient air flow to allow burner operation.
		Alternating	Air switch did not operate as intended. Air switch either did not close with fan ON or did not open with fan OFF.
		On or off with pulse	FAN MODE enabled locally.
		On or off with 2 pulses	FAN MODE enabled remotely by SCADA CEMS.
CYCLING	Cycling thermostat	On	Thermostat closed. Heated air temperature is BELOW set point.
		Alternating	Cycling thermostat open for more than 10 minutes.
HIGH LIM	High limit thermostat	On	Thermostat closed. Heated air temperature ABOVE set point.
		Alternating	High limit thermostat closed momentarily indicating air temperature exceeded set point.
MANUAL	Manual operation	On	Selector switch in "MANUAL" position. Heater in MANUAL mode.
RAIL TH	Rail thermostat	On	Thermostat open. Rail temperature is BELOW set point (normal mode COR).
		On or off with pulse	Rail thermostat configured for OOR (reverse mode).
RTC	Rail traffic control mode	On	Indicates selector switch is in "REMOTE/AUTO" position and AAR terminals 1 and 2 are closed.
		On or off with pulse	Indicates selector switch is in "REMOTE/AUTO" position and requested by RCMS.

E.5 Terminal Blocks

The controller interconnects with the control panel by means of 8 board level headers, TB1 to TB8, which accept the various wire harness plug connectors. The controller and EMS module connect via a ribbon cable that plugs into the 10-pin header found on each.

Table 1 – Terminal Block Description

Name	Description
JP1	Jumper. Used to configure EEPROM settings
TB1	120V power, transformer primary and motor contactor coil output
TB2	Transformer secondary 24V power and FSR request output
TB3	RTC run and alarm indication contacts outputs
TB4	Rail thermostat, RTC request, Manual, and Enable inputs
TB5	Air switch, FSR/DSI alarm, gas valve inputs
TB6	Cycling and high limit thermostats inputs
TB7	Communication port, RS-485
TB8	FSR reset and current transformer inputs
10-pin header*	EMS module power and signal connection

*Located in the upper right corner next to TB8.

E.6 Data Communications

1. The RS-485 serial communications port, and an EEPROM, allows the heater to be part of a Supervisory Control and Data Acquisition (SCADA) network and Remote Control and Monitoring System (RCMS) software.
2. The RS-485 port runs at 9600 baud and allows communication over long distances of up to 1000' and possibly longer.

NOTE: Cable construction: Cat5 24 AWG twisted pair is a very common cable type used for RS-485 systems. Adding shielding to the cable enhances noise immunity, and thereby allows greater distance. If used, connect one end only of shield to ground.

3. The 8-bit memory address allows a maximum of 254 heaters to connect to the same communications bus.

E.7 Controller EEPROM Memory

1. EEPROM memory chip stores parameters and an address.
2. EEPROMs can be switched between controllers. In the event a controller needs to be replaced the EEPROM can be removed from the old and put in the replacement. The parameters and address remain with the heater and no RCMS software modifications are required.



WARNING. Electrostatic discharge can damage ICs. Have qualified personnel remove and install EEPROM IC.

3. Parameters activated locally or remotely by the RCMS software are stored on the EEPROM.

NOTE: There are two parameter types, 'COMMUNICATION' and 'MODE'.

Table 1 – Communication Parameters (Activated Locally)

Name	Setting ¹	Function
LOCAL AUTO MODE	1	Disables communications and enables local EMS control.
REMOTE SCADA MODE	2	Enables RS-485 MODBUS communication. Disables local EMS control. Enables weather station mode.
DEFAULT ADDRESS	3	Writes 254 to processor address. ²
ADDRESS SET	4	Writes new address to EEPROM. ²
8N1 COM	5	Enables 8N1 communication. ³ Enables local EMS control.
LOCAL EMS, enabled	6	Enables local EMS control.
LOCAL EMS, disabled	7	Disables local EMS control.
FAN MODE	----	When enabled, the fan runs continuously. ⁴ When disabled, the fan runs only when heating is requested.

¹ Setting number equals alarm LED/relay count.

² One time functions.

³ The 8N1 configuration allows the heater to send status information only and is intended to aid service technicians. This configuration does not allow the heater to be part of a network.

⁴ See CONTINUOUS FAN MODE section for instructions.

E.8 Activating a COMMUNICATION Parameter

NOTE: Read and understand the following procedure before starting. COMMUNICATION parameters require a hardware programming key to make changes, MODE parameters do not.

1. Toggle mode selector switch to "OFF". If installed, disconnect EMS cable from controller. Plug programming key into the mating EMS 10-pin connector. Then the red LED on the key lights.
2. Press the RESET button, and short jumper JP1.
3. Release the RESET button. The RTC, MANUAL, CYCLING, and AIR SWITCH LEDs will each pulse, one after the other for one sequence. Then the RUN indication LED pulses and the green LED on the programming key alternates on and off.
4. After five RUN indication pulses, the red ALARM LED lights for 3 seconds. This cycle continues as long as the jumper, JP1, is shorted.
5. Count the number of times the red ALARM LED lights.
6. Once the count equals the parameter number, remove the jumper before the ALARM LED turns off. For example, when the ALARM LED lights for the second time removing the jumper will activate REMOTE SCADA MODE, parameter #2.
7. Function performed.
8. Parameter or new address is stored on the EEPROM.
9. Repeat sequence as required to activate other parameters.

E.9 Mode Parameters

Table 1 – Mode Parameters

Name	Parameter ¹	Function
FAN MODE ENABLE	1	Turns the motor on and keeps it running continuously.
FAN MODE DISABLE	2	Motor runs only when heater is requested.
LOCAL EMS MODE ENABLE	3	Local EMS controls the heater.
LOCAL EMS MODE DISABLE	4	The local EMS will not turn the heater on.
RAIL THERMOSTAT MODE NORMAL	5	Configures operation to new thermostat, open when cold, closes on temperature rise (COR).
RAIL THERMOSTAT MODE REVERSED	6	Configures operation to older rail thermostats that are closed when cold, open on temperature rise (OOR).

¹ Parameter number equals alarm LED/relay count.

E.10 Activating MODE Parameter

NOTE: Read and understand the following procedure before starting.

1. The controller must be powered on for a minimum of 60 seconds, the mode selector switch toggled OFF, and terminals A1 A2 open (i.e. no RTC request).
2. Short jumper JP1. The RUN indication relay and LED pulses on and off. After five RUN indication pulses, the red ALARM LED lights for 3 seconds. This cycle continues as long as the jumper, JP1, is shorted.
3. Count the number of times the red ALARM LED lights.
4. Once the count equals the parameter number, remove the jumper before the ALARM LED turns off. For
5. I.e. when the ALARM LED lights for the second time removing the jumper will activate FAN MODE DISABLE, parameter #2.
6. Function performed.
7. Parameter or new address is stored on the EEPROM.
8. Repeat sequence as required to activate other parameters.

E.11 Fan Mode

1. When enabled for continuous operation, this mode can be beneficial for locations with difficult to detect drifting snow conditions that cause snow accumulation in the turnout and or in the duct system.
2. When enabled, and with the mode selector switch in either the MANUAL or REMOTE/AUTO position, the fan will run continuously, with heating requested or not.

NOTE: The fan will stop when the mode selector switch is in the OFF position.

3. This parameter can be set, either, locally, or remotely by the RCMS software.
4. Refer to RCMS documentation for remote activation.

E.12 Local EMS Mode

1. This parameter enables the locally installed EMS module to control the heater according to the module set points. If connected to a SCADA system, all weather data will be transmitted to the system. No other functions are affected by this mode.
2. The HEAT LED pulses to indicate that the local EMS module can turn on the heater.
3. When disabled, the HEAT LED will not pulse. It will light up when conditions are met, but it will not turn on the heater.

E.13 RAIL THERMOSTAT Mode, Normal

1. With the introduction of the 2014 model Hellfire, the rail thermostat operation was reversed. The thermostat now opens when cold and closes when warm.
2. When enabled, the controller is configured to operate with the new, close on rise, COR, thermostat.

E.14 RAIL THERMOSTAT Mode, Reverse

1. When enabled, the controller is configured to operate with the previous, open on rise, OOR, thermostat.

E.15 Failure Shutdowns and Alarm Indications

1. In the event of a failure, the controller ceases the heater operation and indicates alarm.
 2. While the heater is shutdown and indicating alarm the controller continues communications with the RCMS software. All start requests, local or through the RCMS software, are ignored until the problem is resolved.
 3. The controller indicates the nature of the failure in three ways. LED's on the controller, an alarm contact closure, and error codes communicated via the RS-485 serial port when under RCMS control.
- NOTE:** With the exception of the communications TD, RD, and TX LED's. Solid green, solid green with a red pulse, or yellow LED's indicates normal status. Solid red and alternating LED's indicate a failure. This is true for the controller only, not the EMS module.
4. There are two types of failure alarms, minor and major. Both cease the heater operation, however, minor alarms clear when the condition that caused the failure rectifies itself. Major alarms, which are more serious and require inspection, must be manually reset.

E.16 Indications and Conditions

1. A failure exists when the STATUS and the ALARM LED's are solid red.
2. In addition, an alternating LED of equal duration on and off, or red and green indicates the failure condition.
3. Heaters connected via the RS-485 port to a network and RCMS software will communicate fault codes.

Table 1 – Fault Condition Codes and LED States

Code	Alarm Type	Fault Condition	LED	State
1	Minor	Selector switch left in OFF position for more than 60 minutes.	ENABLE	Dark
2	Major	Air switch does not open after fan motor turned off.	AIR SW	Alternating
3	Major	Air switch does not close after fan motor turned on.	AIR SW	Alternating
10	Major	Flame failure at start up.	FSR ALARM	Alternating
11	Major	Loss of flame signal while running.	FSR ALARM	Alternating
12	Major	4 FSR alarms within 2 minutes.	FSR ALARM	Alternating
13	Major	Gas valve does not energize when expected.	FSR CHECK	Alternating
14	NA	FSR in alarm.	FSR ALARM	Solid Red
20	Minor	Cycling thermostat failed to close after 10 minutes.	CYCLING	Alternating
21	Major	Maximum output air temperature exceed. High limit thermostat closed momentarily.	HIGH LIM	Alternating
30	Minor	Controller in configuration mode. JP1 jumper shorted.	(none)	
31	Minor	EMS module TEST switch on.	SENSOR WET	Solid Red

E.17 Aggressive Retry Feature

1. The controller has an aggressive retry feature. It is intended to avoid nuisance failure shutdowns and alarm indications due to temporary conditions, such as condensation on the igniter and or flame rod, which are rectified with repeated attempts.
2. In the event of an DSI alarm, as indicated by the FSR ALARM LED, occurring at start up or under normal operation, this feature will reset the FSR and allow up to 4 trials for ignition attempts within 2 minutes.
3. Between attempts the STATUS LED alternates red and green and after 20 seconds the DSI is reset, as indicated by a pulse of the RES LED and the clearing of the FSR ALARM LED.
4. After 4 failures within 2 minutes, the heater ceases operation, the controller locks out, the STATUS LED turns solid red, the run indications are removed and the alarm indications applied with the ALARM FSR LED alternating on and off.

E.18 Reset

1. Prior to performing a reset:



WARNING. If you smell gas; Immediately extinguish all sources of ignition and turn off gas source.

Call qualified service technician to repair leak.

- 1.1 Toggle the selector switch to OFF.
- 1.2 Gain access to the controller by removing the electrical access panel.

NOTE: Note the status of the controller LEDs, contactor thermal overload relay reset (three phase models only), control panel circuit breaker, and motor circuit breaker.

- 1.3 Close any tripped or open breakers. Green means safe and red means danger circuit energized.
- 1.4 In the case of three phase models, if found tripped, reset the thermal overload relay located on the panel and connected to the contactor.



WARNING. Risk of cutting fingers or hand.

Open motor circuit breaker before opening combustion chamber access panel. Keep clear of fan.

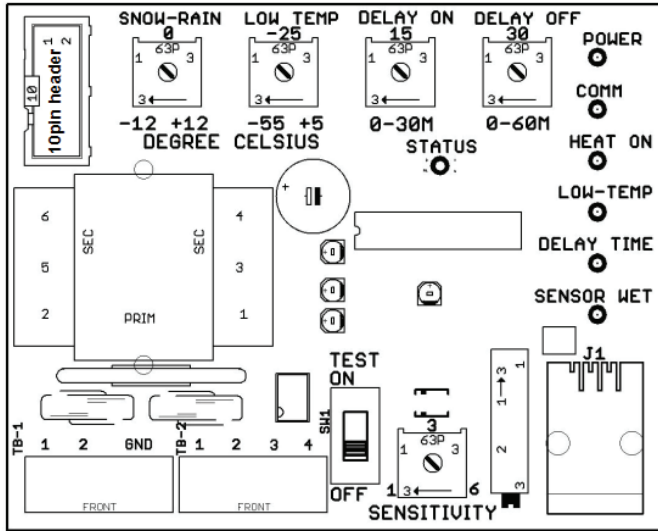
- 1.5 In the case of single phase models, OPEN THE MOTOR CIRCUIT BREAKER. Remove the combustion chamber access panel and, if tripped, reset the thermal overload switch found on the motors junction box. Close the combustion chamber access panel and close the motor circuit breaker.

2. Press and release the controller reset.

E.19 Energy Management System (EMS)

Adding the EMS allows a heater to operate automatically, or to act as a weather station when part of a network of heaters controlled by the Fastrax® RCMS.

The system includes a module, a precipitation detector, ambient temperature sensor, and rail thermostat. Once installed, the controller recognizes the EMS module and works in conjunction with it.



Controls:

NOTE: These settings are true for AUTO mode only, with the exception of the TEST switch.

These settings are overridden when operated in REMOTE SCADA mode by the corresponding Fastrax® RCMS software parameter.

1. SNOW-RAIN:

- 1.1 This dial adjusts the temperature set point between -12°C to +12°C.
- 1.2 Precipitation detected when the ambient temperature is below this set point is considered snow or above it is rain.

2. LOW TEMP:

- 2.1 This dial adjusts the temperature set point between -55°C to +5°C.
- 2.2 The EMS will not request the heater to operate when the ambient temperature is below this set point and snow is detected.

3. DELAY ON:

- 3.1 This dial sets the length of the delay, 0 to 30 minutes, before making the heater request.
- 3.2 When snow is sensed continuously for the duration of the delay on period the heater request is made. If at any time during the delay snow is not sensed the timer is reset.

4. DELAY OFF:

- 4.1 This dial sets the length of the delay, 0 to 60 minutes, before removing the heater request.

- 4.2 When snow is no longer sensed the heater request is held for the duration of the timer. If at any time during the delay snow is sensed the timer is reset.

5. TEST:

- 5.1 This switch simulates precipitation when ON. Used to test the module operation.

6. SENSITIVITY:

- 6.1 This dial adjusts the precipitation detector sensitivity between the least, 1, and most, 6. For example, when set at 1 the detector has to be very wet to indicate precipitation.

7. INDICATIONS:

- 7.1 On the module are a number of status LED's intended to aid the user's understanding of the state of operation. See table for full description.

Table 1 – Status LED's

LED Name	Description	State	Indication
STATUS	Processor status	Green with a red pulse	Processor functioning normally.
		Off	
		Solid green	Processor failed.
		Solid red	
POWER	Power supply	On	Module energized.
COMM	Communications	Flashing	Indicates communications with controller.
HEAT ON	Heater request	On	EMS request to turn on heater.
LOW TEMP	Low Temperature	On	Ambient temperature is below set point. Heater will turn off or not turn on if requested.
DELAY TIME	Delay Time	On with a pulse off	Delay active. Delay on when HEAT ON is off. Delay off when HEAT ON is on.
		Off with a pulse on	No delay.
SENSOR WET	Precipitation sensor wet	On	Precipitation above set point.

E.20 Terminal Blocks

- 1. The controller interconnects with the control panel by means of 2 board level headers, TB-1 and TB-2, which accept wire harness plug connectors.
- 2. The controller and EMS module connect via a ribbon cable that plugs into the 10-pin header found on each. The ambient temperature sensor connects via the RJ11 header.

Table 1 – Terminal Blocks

Name	Description
TB-1	Precipitation detector 24Vac power supply
TB-2	Precipitation detector
JP1	Ambient air temperature sensor RJ11 header
10-Pin header*	EMS power and signal connection

* Located in the upper left corner.

E.21 Inputs and Outputs

- 1. PRECIPITATION DETECTOR: As its name implies, it senses precipitation that can be in the form of rain or snow.

Snow landing on the detector's heated sensing head melts to form water drops. The 360° sensing surfaces detect blowing snow detect blowing snow as well as falling snow.

See the installation section for mounting instructions. There are no adjustments on the detector itself. Sensitivity adjustments are made on the controller.
- 2. AMBIENT TEMPERATURE SENSOR: The ambient temperature sensor is mounted beneath the air intake hood. The controller compares the measured temperature to the SNOW-RAIN and the LOW TEMP set point.
- 3. RAIL THERMOSTAT: The rail thermostat optimizes fuel consumption and performance while the heater is requested. It functions independently of the EMS module, cycling the heater off when the rail temperatures rises above 9°C (49°F) then back on again once the temperature drops below 3°C (37°F).

F. TROUBLESHOOTING

*The resets made by aggressive retry function are not described in the conditions.

**Reset controller only after observing the condition of all status indicators then follow reset instructions.

Problem	Conditions*	Possible Cause	Remedy**
Heater not running when expected. NO alarm indications.	No LEDs are on.	No line power.	<ul style="list-style-type: none"> Verify panel and motor breakers are closed. Verify supply voltage at power terminal block.
	<ul style="list-style-type: none"> Selector switch in manual position. Controller POWER LEDs are on. RUN LED on. Ambient temperature is above 3°C (37°F). 	Rail thermostat is closed.	<ol style="list-style-type: none"> Wait for ambient temperature to drop and the rail to cool. To verify heater operation, toggle selector switch OFF, then back to MANUAL. The heater starts, disregarding the rail thermostat status for the first 2 minutes of operation.
	<ul style="list-style-type: none"> Selector switch in REMOTE/AUTO. EMS module installed. Controller, EMS POWER LEDs are on. Controller in AUTO mode. Snowing. 	EMS module SNOW-RAIN set point below -1°C (30°F) and ambient temperature sensor disconnected.	Install ambient temperature sensor. Raise set point above 0°C (32°F).
		SNOW-RAIN set point too low, i.e. -12°C (10°F).	Raise set point, i.e. 3°C (37°F).
		Precipitation detector damaged.	Replace detector head and/or cable.
		Precipitation detector disconnected.	Verify connection to panel.
		Controller / EMS ribbon cable disconnected.	Verify presence of cable and connections.
		SENSITIVITY set point too low, i.e. 1°C (34°F).	Raise set point to increase sensitivity.
	<ul style="list-style-type: none"> Selector switch in REMOTE/AUTO. EMS module installed. Controller, EMS POWER LEDs are on. Snowing. LOW TEMP LED on. 	Controller in AUTO mode and LOW TEMP set point too high.	<ul style="list-style-type: none"> Verify set point. For natural gas installations set to minimum, -55°C (-67°F). For LPG installations without tank heaters, set to -30°C (-22°F).
	<ul style="list-style-type: none"> Selector switch in REMOTE/AUTO. Controller and POWER LEDs are on. 	Controller in REMOTE SCADA mode and RCMS has not requested heater.	Contact RCMS software operator and verify status.
Fan running. No heat. No alarm.	<ul style="list-style-type: none"> Controller LEDs <ul style="list-style-type: none"> POWER on. RUN on. HEAT on. CYCLING off 	<p>Cycling thermostat open.</p> <p>(Heater will operate for 10 minutes before controller indicates alarm).</p>	<ul style="list-style-type: none"> Inspect cycling thermostat and wiring connections. Replace failed thermostat. Repair any damaged wiring. Connect any disconnected terminals.

Problem	Conditions*	Possible Cause	Remedy**
Heater operating but does not deliver adequate heat. No alarm.	Manifold pressure at maximum for propane.	Heater connected to natural gas.	The as delivered heater is set for LPG operation. Increase manifold pressure to within natural gas limits.
	Manifold pressure at maximum for appropriate fuel.	Corrosion, dirt or other debris restricts burner orifices.	<ul style="list-style-type: none"> Service burner. Drill out each orifice with #48 drill (0.076" diameter)
		Duct system restricted.	Inspect tie duct or cross ducts for mud.
	Gas manifold and supply pressure slowly drop while operating.	Vapour withdrawal causes refrigeration effect that lowers LPG tank pressure.	Remove snow accumulation on propane tanks.
Heater fails to start. Alarm indicated.	<ul style="list-style-type: none"> Fan does not start. Controller LEDs <ul style="list-style-type: none"> POWER on. ALARM red. AIR SW alternating. 	Motor thermal overload relay open.	<ol style="list-style-type: none"> 240V single-phase models: Reset overload located on motor junction box. Three-phase models: Reset thermal overload relay located on control panel below contactor.
		Motor breaker open.	Close breaker.
		<ul style="list-style-type: none"> Air switch closed when expected open. Air switch jumped. Air switch frozen. Air switch out of calibration. 	Inspect air switch.
			Remove jumper.
			Clear any ice or debris from air switch ports.
	<ul style="list-style-type: none"> Fan does not start. Controller LEDs <ul style="list-style-type: none"> POWER on. ALARM red. AIR SW alternating. High limit exceeded. 	Cycling thermostat loose inside sensor duct and high limit thermostat limit reached.	Fasten thermostats in place.
		Cycling thermostat leads shorted and high limit thermostat limit reached.	<ol style="list-style-type: none"> Remove any test jumper shorting thermostat leads. Verify leads are not shorted together between sensor box and control panel. Inspect wire insulation for damage and verify no shorts to ground. Verify manifold pressure is within nameplate limits.
		High limit thermostat leads shorted.	<ol style="list-style-type: none"> Remove any test jumper shorting thermostat leads. Verify leads are not shorted together between sensor box and control panel. Inspect wire insulation for damage and verify no shorts to ground. Verify interior of sensor box is dry. Seal or replace any damaged or missing gasket. Close lid.

Problem	Conditions*	Possible Cause	Remedy**
Heater fails to start. Alarm indicated. (cont'd)	<ul style="list-style-type: none"> Fan starts, runs briefly then stops. 	Heater NOT connected to duct system.	Complete heater installation.
	<ul style="list-style-type: none"> Controller LEDs <ul style="list-style-type: none"> POWER on. ALARM red. AIR SW alternating. 	Air intake severely blocked.	Clear intake screen of blockage, i.e. ice, snow, paper.
		Air switch fails to close when fan operating.	Calibrate air switch. See manual for instructions.
	<ul style="list-style-type: none"> Fan starts. Controller LEDs <ul style="list-style-type: none"> POWER on. MOTOR on. HEAT on. 	Inadequate gas pressure.	<ul style="list-style-type: none"> Verify supply pressure is within nameplate rating. Verify manual shutoff valve on top of combination valve is open. Arrow in line with body.
	Followed by: <ul style="list-style-type: none"> HEAT off. ALARM red. FSR ALARM alternating. 	Air in line.	Purge air from gas supply line.
	<ul style="list-style-type: none"> Fan runs for post purge duration then stops. MOTOR off. 	No spark.	<ul style="list-style-type: none"> Inspect igniter and ignition wire. Replace any damaged items, fouled igniter, corroded wire or cracked boot.
		Inadequate flame signal.	Inspect flame rod and wiring. Replace any damaged items, fouled rod, corroded wire or cracked boot.
	<ul style="list-style-type: none"> Controller LEDs <ul style="list-style-type: none"> POWER on. ALARM red. FSR CHECK alternating. 	DSI missing.	Install DSI control module.
		DSI failed. DSI LED lit. Unable to energize combination gas valve.	Replace DSI control module.
		Open circuit between DSI 'VALVE' terminals and combination gas valve.	Trace wiring. Repair damaged wires. Tighten any loose connections.
Heater starts, runs for 10 minutes with no heat, stops and then alarm indicated.	<ul style="list-style-type: none"> Controller LEDs <ul style="list-style-type: none"> POWER on. ALARM red. CYCLING alternating. 	Cycling thermostat failed open.	Replace thermostat. NOTE: If thermostat closes the alarm is cleared and the heater resumes normal operation.
		Cycling thermostat disconnected.	<ul style="list-style-type: none"> Connect thermostat. Inspect for damaged wiring between control panel and thermostat box.

Problem	Conditions*	Possible Cause	Remedy**
Heater cycles excessively. (Less than 30 second cycle time). No alarm.	<ul style="list-style-type: none"> Fan starts. Controller LEDs <ul style="list-style-type: none"> POWER on. MOTOR on. Run on. HEAT LED cycles off and on indefinitely. 	Marginal flame signal. Signal drops below 1.5 micro amps.	Inspect flame rod and wiring. Replace any damaged items, fouled rod, corroded wire or cracked boot.
		Manifold gas pressure set too high.	Reduce gas pressure to within nameplate setting.
		Air intake blocked.	Clear intake screen.
		Duct system blocked.	Remove any blockage such as mud, ice, or debris from: <ol style="list-style-type: none"> Cross duct. Tie duct. Nozzles. Rodent screens.
		Insufficient number of track duct vents open.	Open vents as per "Switch Heater Track Duct Field Modifications Manual" 11237.
Heater starts and runs normally for a period of time then stops unexpectedly. Alarm indicated.	<ul style="list-style-type: none"> Controller LEDs <ul style="list-style-type: none"> POWER on. ALARM red. FSR ALARM alternating. DSI LED 3 flashes. 	<ul style="list-style-type: none"> Marginal flame signal. Signal occasionally dropping below 1.5 micro amps. 	<ul style="list-style-type: none"> Measure flame signal. Inspect flame rod and wiring. Replace any damaged items, fouled rod, corroded wire, or cracked boot.
		Gas manifold and supply pressure slowly drop while operating. Vapour withdrawal causes refrigeration effect to lower LPG tank pressure.	Reduce gas pressure to within nameplate rating. Remove snow accumulation on propane tanks.
Heater runs continuously. NO alarm.	Unable to stop the heater remotely. Mode selector switch in manual position.	Heater accidentally left on.	Toggle selector switch to REMOTE/AUTO.
	<ul style="list-style-type: none"> Mode selector switch in REMOTE/AUTO position. Controller LEDs <ul style="list-style-type: none"> Power on. MOTOR on. HEAT on. RUN on. RTC on. 	RTC has heater requested.	Notify RTC dispatcher.

G. INSTALLATION



WARNING. Install and use Heater in accordance with owners manual and local codes.

In the absence of local codes, installation must comply with CAN/CSA-B149 Installation code and National Fuel Gas Code ANSI Z223.1 / NFPA 54, or Standard for the Storage and Handling of Liquefied Petroleum Gases, ANSI / NFPA 58.

For outdoor use only.

For use with ductwork only. Only duct work supplied by shall be used with the heater. Minimum clearance from combustibles: 2 inches.

Failure to comply with warnings may lead to serious personal injury or death.

To be installed in accordance with railroad and all applicable local governing regulations by persons approved by the railroad having authority.

Lift only in accordance with recognized safe lifting practices, as defined by applicable local laws and regulations.

Read and fully understand these instructions prior to attempting installation.

NOTE: Open combustion chamber access panel and remove loose packaged contents including large gasket kit, and if included with order, the precipitation detector, rail thermostat and flexible gas line.

G.1 Overview

The following are general guidelines for the installation of typical HELLFIRE gas fired systems. They should be followed in conjunction with the specific site layout drawings provided with each heater.

Instructions are intended for track forces, construction, gas technicians, electricians, and signal maintainers.

G.2 Recommended Tools

- A source of power to operate drills (portable generator)
- Impact Drill, 1/2" drive with 1/2", 9/16" and 3/4" sockets
- Drill, 3/8" drive
- Two 9/16" wrenches and/or socket wrench
- Lining and Tamping bars
- Sledge hammer
- Shovels
- Cold chisel and hammer
- 3" duckbill pliers
- Measuring tape
- 4 foot level
- Pipe wrenches
- Pipe thread sealant

G.3 Site Preparation - Typical Clearances

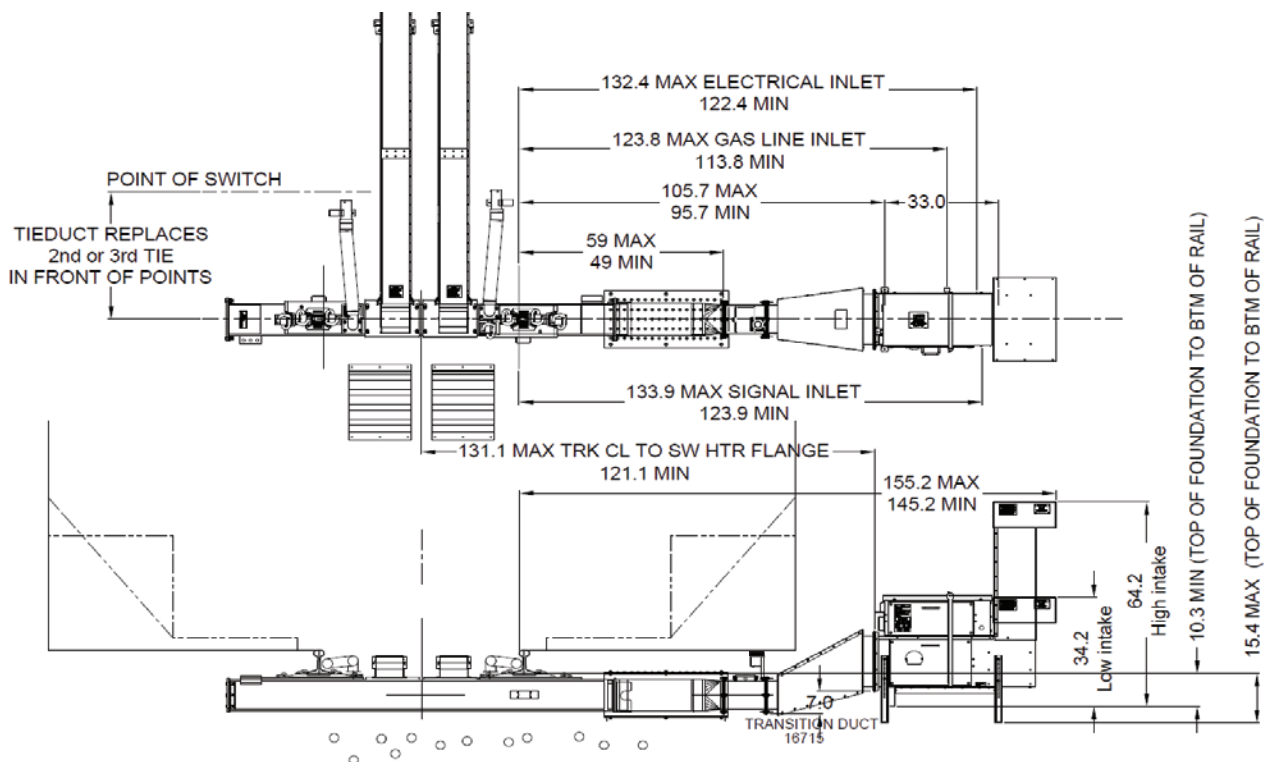


Figure 1 – 131" Clearance

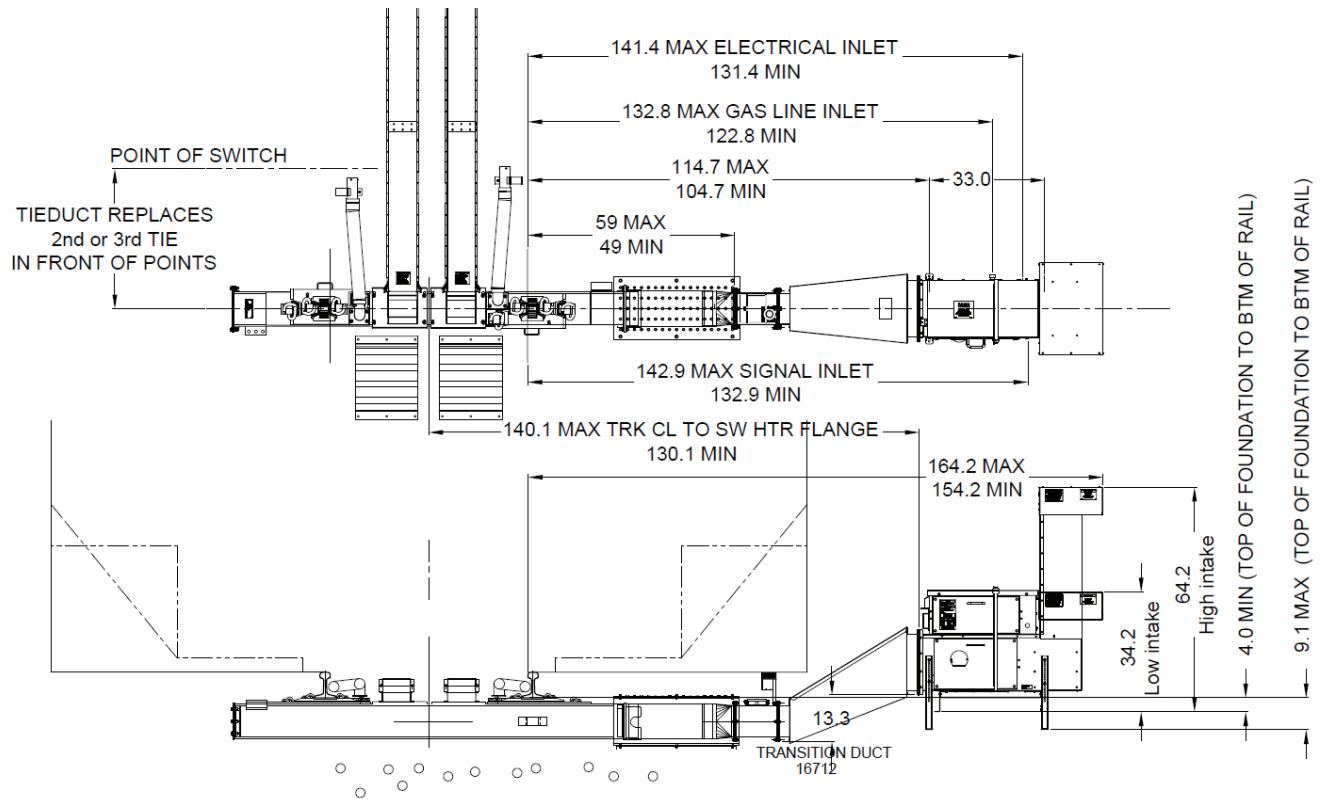


Figure 2 - 140" Clearance

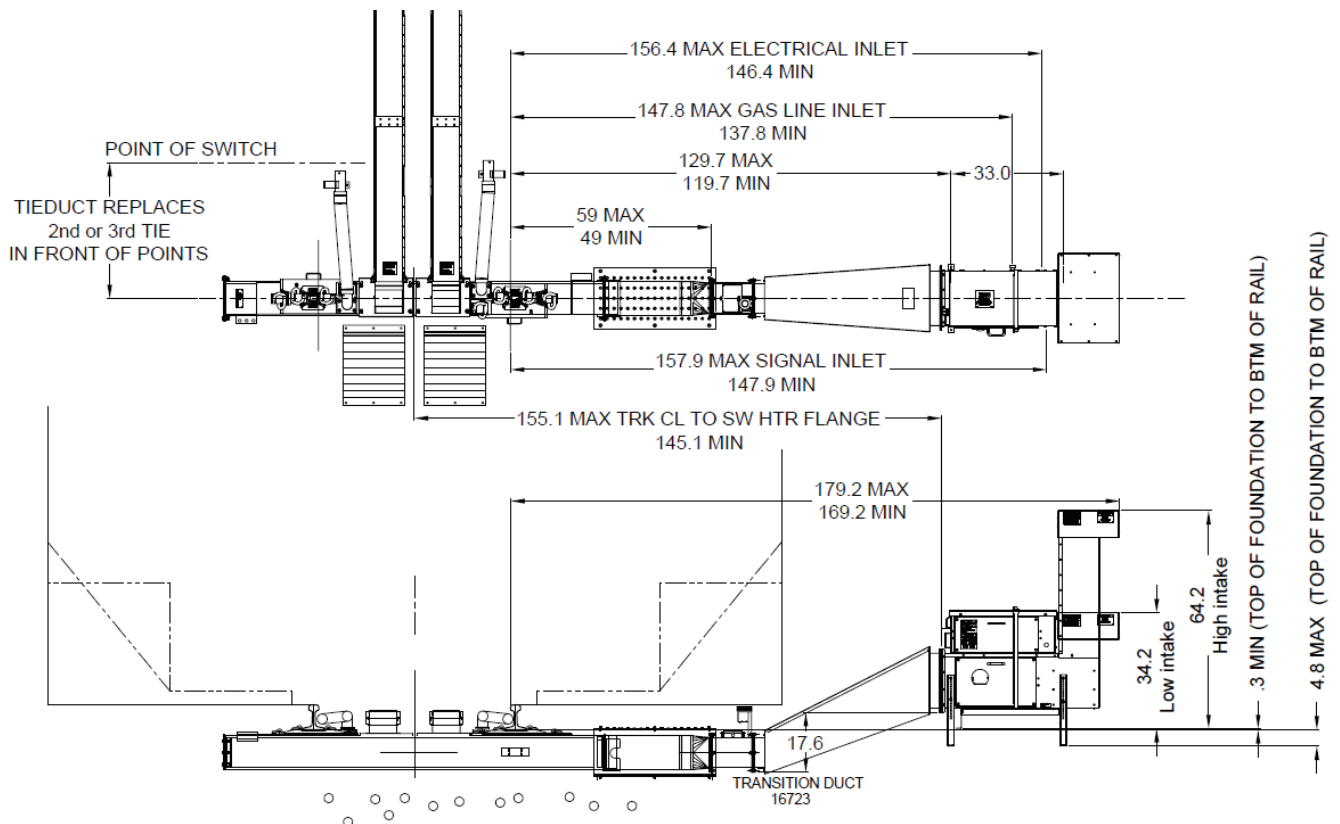


Figure 3 - 155" Clearance

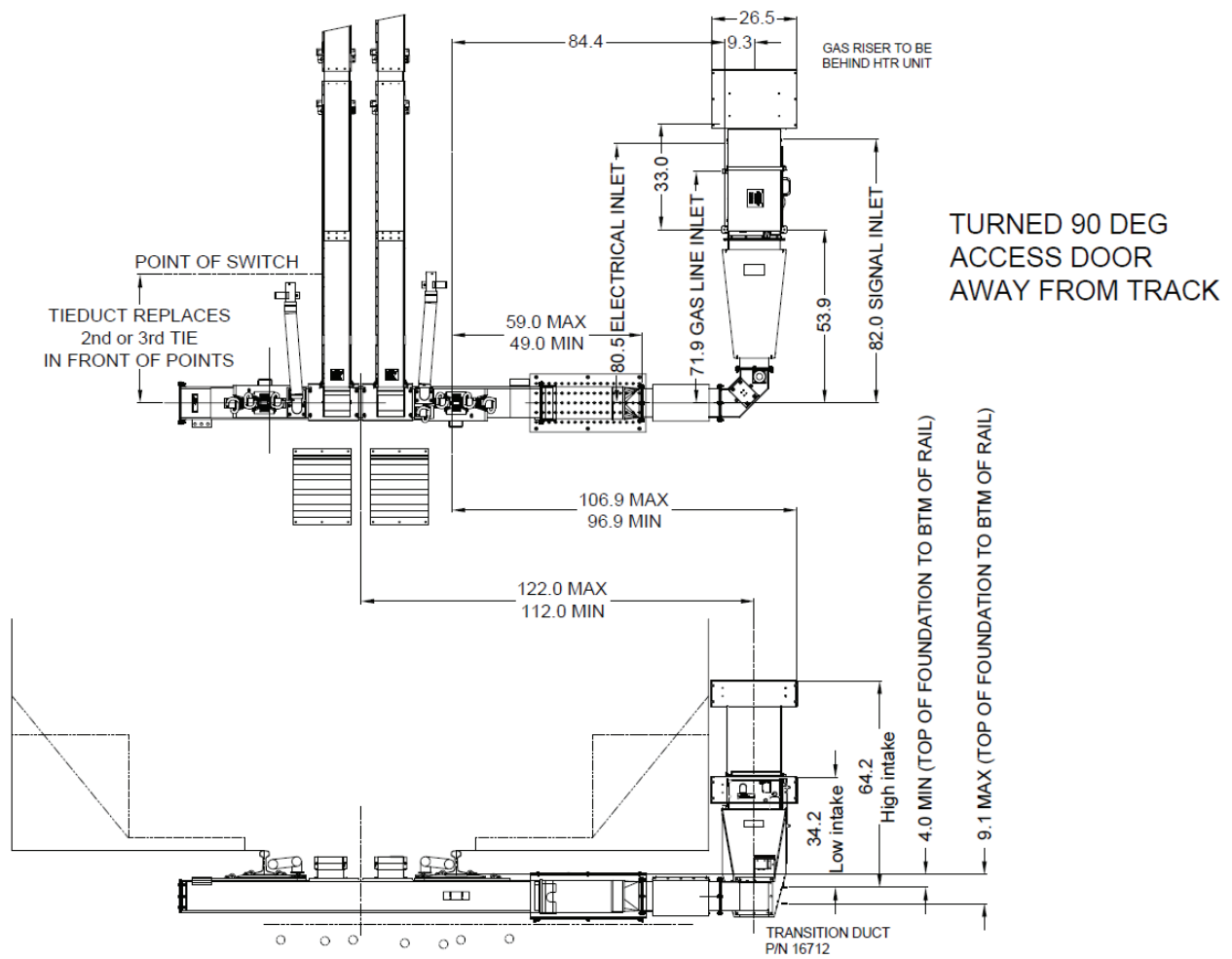


Figure 4 - Clearance, Turned 90 Degrees

G.4 Site Preparation

1. Identify the tie to be replaced by the tie duct, or the crib for the crib ducts. Relative to the appropriate tie or crib, prepare a foundation for the heater with ties, concrete pad, or other suitable level mounting structure.
2. Note the location for the gas, electrical supply, and the signal cable lines.
3. Refer to the local gas and electrical authority in order to determine gas pipe and electrical line sizes.
4. At the heater, the gas inlet is a female 3/4" NPT pipe thread, the power terminal block accepts #14 - #2 AWG wire sizes, and the control and indicate wires connect to AAR 1/4" post terminals.

G.5 Heater Installation

1. A typical complete system is composed of 4 parts, the heater, a transition duct, a tie duct or crib duct set, and a track duct set, each packaged separately.
2. Install the duct system components first, as per Switch Heater Duct Installation Manual, part number 16359.
3. Remove shipping cover attached to combustion chamber flange. Remove thermostat box from shipping cover and discard cover.
4. Remove banding strap securing access panels. Open combustion chamber access panel and remove loose packaged contents including large gasket kit, and if included with order, the precipitation detector, rail thermostat and flexible gas line.
5. Lift heater, (375 lbs), using lift pockets and place on the foundation.
6. Level heater, adjust leveling legs, and align with the transition duct flange.
7. Fasten the heater and transition flanges together with the supplied gasket kit.
8. Fasten heater legs to foundation using lag screws supplied or suitable fasteners.

G.6 Gas Supply Piping and Minimum Pressure Drop



WARNING. Personnel approved by the local gas authority must perform gas line connection.

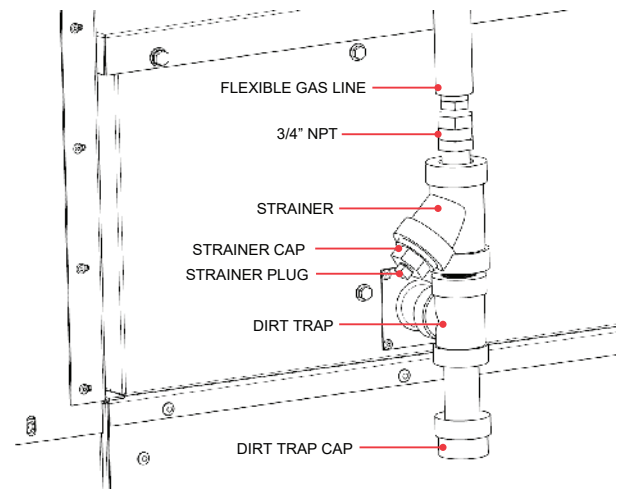
1. Nominal supply pressure, 14 inches water column, with no more than 20% pressure drop, with all connected loads operating.
2. The minimum recommended supply pipe size is 3/4". Determine required pipe size based on supply pressure, length of run, and the total demand of all connected loads.



CAUTION. Undersized gas piping will affect the light off reliability of any connected appliance.

3. Install dirt trap and strainer to supply inlet.
4. Install a flexible gas line between the gas line riser shutoff valve and the dirt trap / strainer inlet.

5. Prior to firing the heater, purge the gas lines of any air and dirt through the opened dirt trap cap.
6. Reinstall the dirt trap cap and check all joints for leaks.



G.7 Electrical Power Connections



WARNING. Risk of electrical shock or electrocution. Disconnect power at service.

Heaters must be wired in accordance with local electrical codes.

The electrical grounding of the appliance shall be in compliance with CSA C22.1, Canadian electrical code, Part 1, or National Electrical Code, ANSI/NFPA 70.

Personnel approved by the local electrical authority must perform electrical power connection.

IMPORTANT NOTE

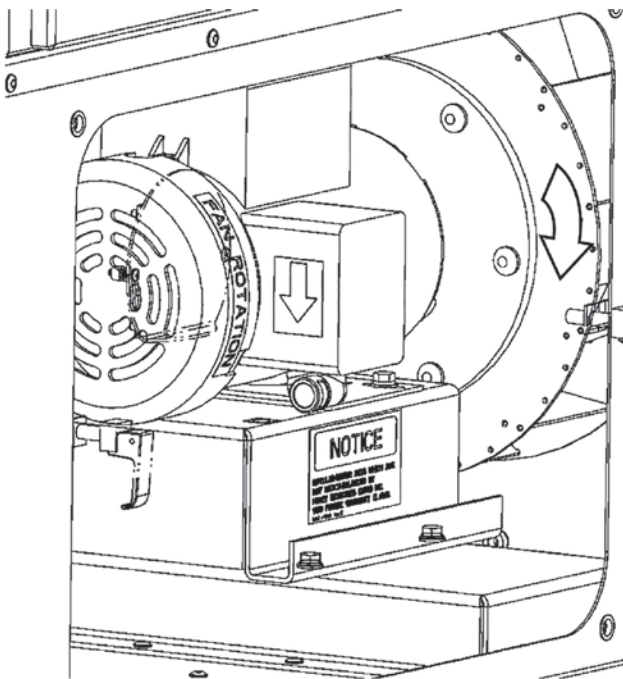
Surge Protection Recommendations

This switch heater utilizes a number of processor-based control systems, all of which are susceptible to damage from lightning and other electrical surges. While every effort has been made to ensure that the control systems have been adequately 'hardened', Thermon Heating Systems' surge mitigation efforts can only be effective if ALL external remote circuits connecting to the switch heater have been protected by primary surge protection devices in accordance with the following generally accepted requirements for surge protection of wayside signal equipment:

- Provide primary surge protection devices (standard signal air gap arresters) on all external switch heater control I/O circuits. These arresters should be located "upstream" of the switch heater housing (within the signal housing, which interfaces to the switch heater). It is essential to protect ALL circuits entering or leaving the signal housing.
- Provide a primary surge protection device (commercial high capacity MOV type) on the external switch heater ac power feed. This surge protection device should be located "upstream" of the switch heater in conjunction with the electrical service entrance panel and main disconnect. Observe primary surge protector manufacturer's instructions for installation and circuit breaker protection (if required).

-

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POWER CONDUIT
HOLE LOCATION

4.4 Manually close the motor contactor momentarily, enough to spin the motor. Verify the correct rotation. If the rotation needs to be reversed, open the service breaker and interchange two of the supply phase wires at the heaters power terminal block.

- ## Installation

5. Conductor Sizing

- 5.1 Using the following table to aid in the selection of the appropriate size conductors between the heater and service.

Table 1 – Conductor Sizing

Voltage	Phase	Current	Circuit Breaker¹	Wire Size									
				#10		#8		#6		#4		#2	
				Maximum Distance²,³									
				m	ft	m	ft	m	ft	m	ft	m	ft
240	1	7.5	20	213	698	339	1110	538	1764	855	2806	1360	4462
208	3	7.3	15	320	1048	508	1668	808	2650	1285	4215	2043	6702
440	3	3.6	15	1430	4691	2275	7646	3616	11861	5750	18863	9144	29993
575	3	3	15	2442	8011	3886	12748	6176	20257	9821	32214	15616	51222

¹ As per Canadian Electrical Code, Part 1.

² Assumed voltage drop of 5%.

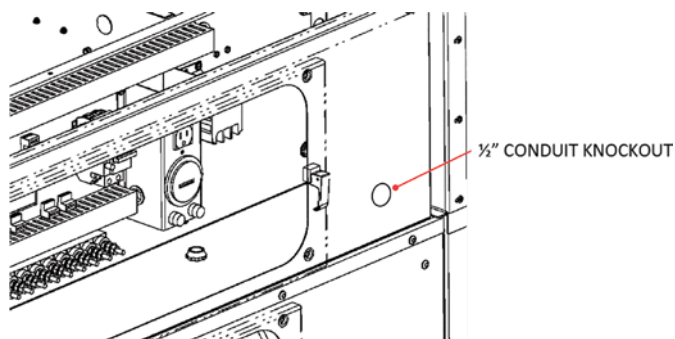
³ Allowable voltage drop to be determined by local authority.

6. Local Safety Grounding

- 6.1 The service ground electrically grounds the heater. If a local safety ground is required, drive in at least one ground rod and connect it with a suitably sized stranded copper conductor, of at least #8 AWG, to one of the leveling leg bolts.

7. Signal and Communications Connections

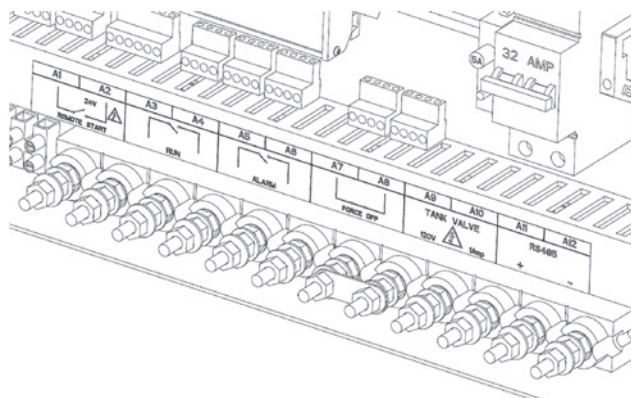
- 7.1 Use the 1/2" conduit knockout, or punch a suitable size hole for the signal cable.



- 7.2 All signal and communications connections are made to the 1/4" AAR control and indicate terminal block. The terminals are labeled A1 to A12.

Table 1 – Terminals

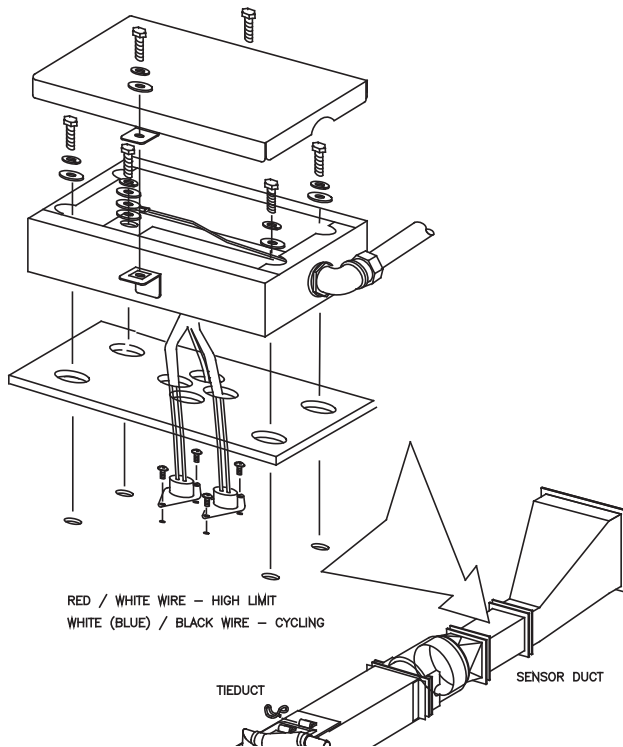
Terminals	Label	Description
A1 - A2	REMOTE START	A contact closure across these terminals starts the heater when the heater is in REMOTE RTC mode.
A3 - A4	RUN	Dry contact closes to provide a run indication.
A5 - A6	ALARM	Dry contact closes to provide alarm indication.
A7 - A8	FORCE OFF	Default is closed. If FORCE OFF function is desired, remove shorting link and replace with customer supplied relay contact. Open contact disables heater.
A9 - A10	TANK VALVE	These terminals are intended to operate a 120Vac gas supply solenoid shut off valve. They energize when the motor contact closes.
A11	RS-485 (+)	Communications, RS-485 positive terminal.
A12	RS-485 (-)	Communications, RS-485 negative terminal.



G.9 Thermostat Installation

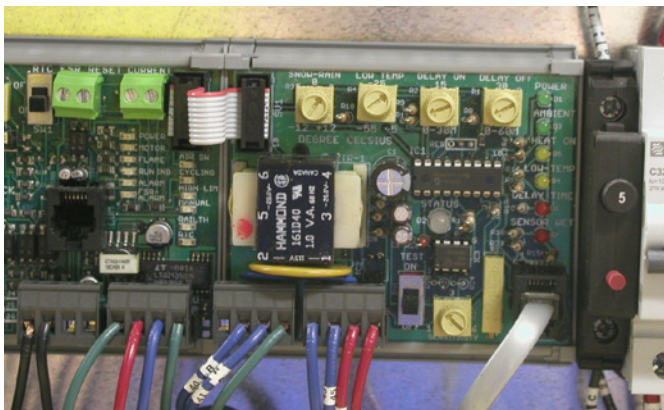
Install the thermostat sensor box as per instructions below:

1. Remove combustion chamber shipping cover.
2. Detach thermostat box from shipping cover.
3. Secure thermostats to the duct using SST machine screws - ensure colour coded wires match.
4. Secure thermostat box to the sensor duct as depicted, with the ground wire under the head of a bolt and washers.
5. Install thermostat cover to box using hardware supplied.

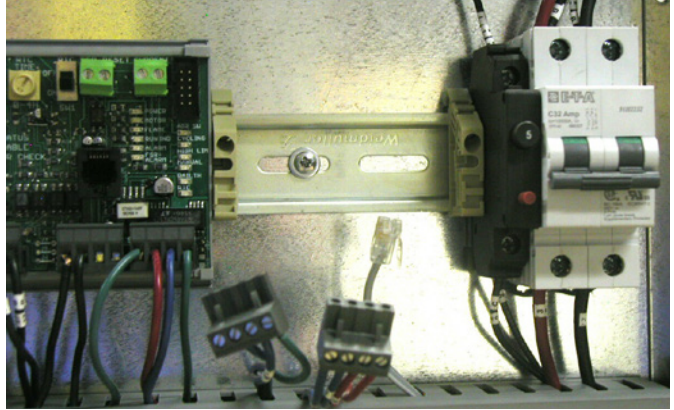


G.10 Energy Management System (EMS) Options

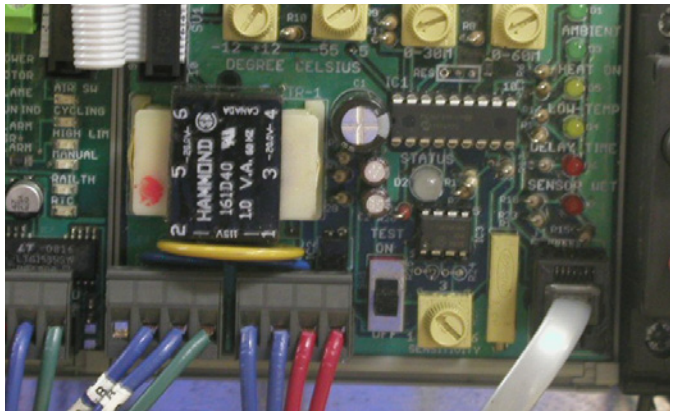
1. EMS Module (applies to heaters without EMS module)
 - 1.1 The module mounts onto the DIN rail to the right of the controller in the space provided, and a communication cable connects the two together.



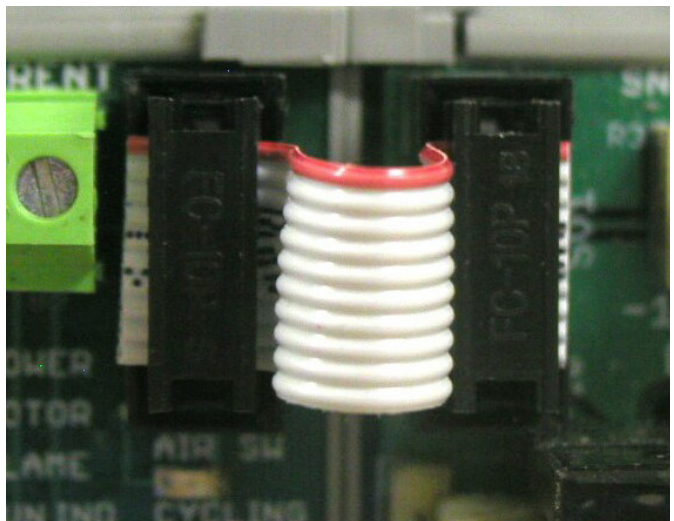
- 1.2 As received panel with no EMS module.



- 1.3 Remove the stops holding the controller and the circuit breaker.
- 1.4 Install module onto DIN rail. Plug in 4-pin connectors and ambient temperature RJ11 jack.



- 1.5 Connect module to controller with supplied ribbon cable.



NOTE: The precipitation detection and ambient temperature sensor options require the EMS module be installed.

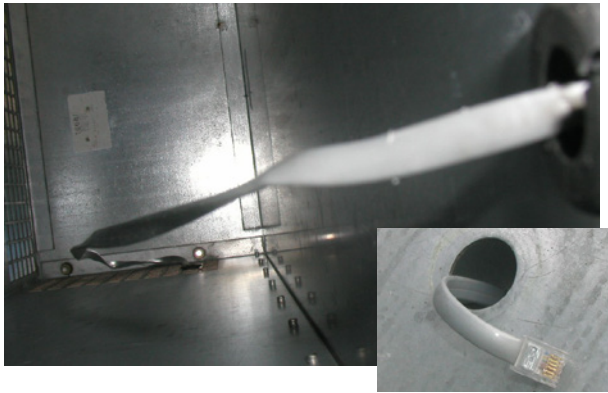
2. Ambient Temperature Sensor

To route the sensor cable it is necessary to remove the air intake.

- 2.1 Remove the 4 screws holding the extension to the elbow. Leave the hood and extension fastened together. Remove intake.
- 2.2 Mount the ambient temperature sensor inside the air intake hood with a pair of 8-32 screws, nuts and washers, in the location shown.



- 2.3 Route the cable through the screen, and down the inside of the extension.

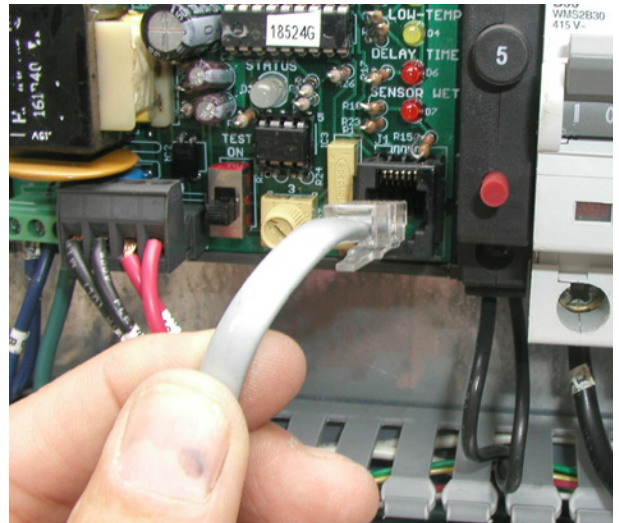


- 2.4 Pass the cable through the hole at the base of the extension.
- 2.5 Cut the diaphragm grommet, as shown, and push the connector and cable through. Insert grommet and cable into hole. Reinstall intake.



- 2.6 Pass cable through hole into control panel and repeat procedure for grommet install.

- 2.7 Remove wire through cover and route cable to a point directly beneath the EMS module. Insert connector into mating receptacle.



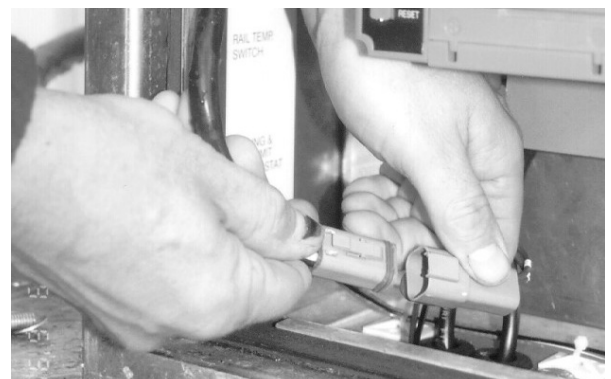
- 2.8 Draw the excess cable into the control cabinet. Place the excess neatly into the wire trough and replace the lid.

3. Precipitation Indicator

Remove the plug from the top hole marked 'Precipitation Sensor'. Pass the 4-pin connector through the hole, install lock nut and tighten.



- 3.1 Insert jack into mating connector.



- 3.2 Mount the detector on the transition duct to sensor duct flange facing forward as shown, use the mounting holes and slots provided. Heat from the duct will keep it clear of ice and snow build up.



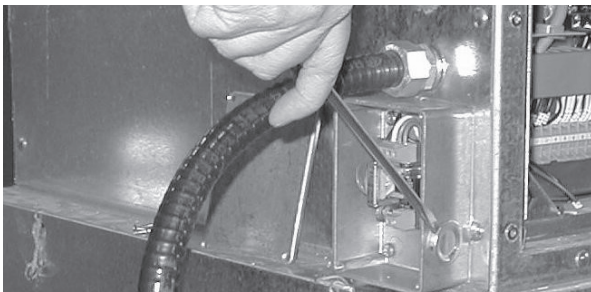
4. Rail Thermostat

Mount the rail thermostat on the field or gage side of the stock rail ahead of the points and tie duct, as shown. Select a location shaded from the sun. Provide strain relief in the cable, by leaving adequate slack, as shown, to allow for rail pumping.

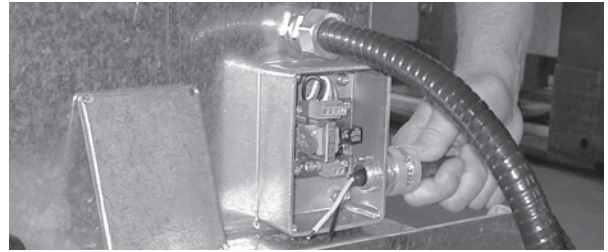


Remove the yellow shim washers when installed on 115 lb rail or lighter. Loosen the two mounting bolts and attach the rail thermostat to the rail flange by tapping it on with a hammer. Once in place tighten mounting bolts to maximize grip.

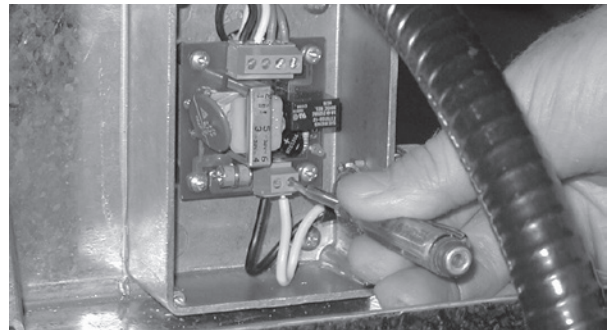
- 4.1 Remove the four (4) Phillips screws, the cover, and the plug from the hole in the rail temperature surge protection box.



- 4.2 Pass the two (2) wires from the rail temperature sensor through the hole, install the locknut and tighten.



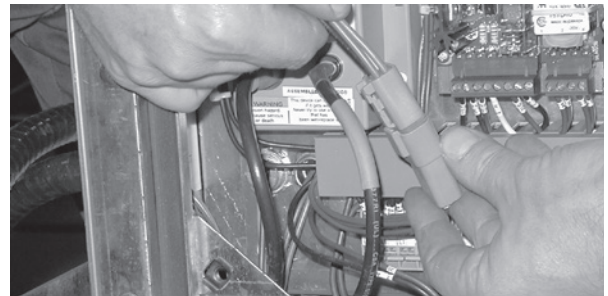
- 4.3 Insert, one each of the bared wires into the two terminals on the surge suppression circuit board, and tighten. There is no polarity.



- 4.4 Replace the cover, and tighten the four (4) Phillips screws.



- 4.5 Connect the surge isolator two pin connector with the mating plug located inside the electrical component area, hanging immediately under the DSI.



G.11 Inspection and Commissioning

Once the installation is complete review it against the following checklist.

Point Nozzles

- ☐ Installed.
- ☐ Directed at, and tip within 2" to 6" of points, and clear of rail head by 2.0".
- ☐ Rodent screens installed between duct and silicone gasket under adaptor collars.
- ☐ Electrical isolation shoulder washers installed.

Track Duct

- ☐ Installed.
- ☐ Rodent screens installed between duct and silicone gasket under elbows.
- ☐ Access joint gap of 3".
- ☐ Appropriate vents open and directing air at switch plates and rods. Keep all openings closed between the ducts, except where the switch rods are located. Open vent openings no more than ¼".
- ☐ Ductwork below top of rail and not interfering with switch operation.
- ☐ Track duct deflectors installed, 18" wide at points protecting point nozzles and track duct and 8" at heel protecting track duct.

Tie Duct

- ☐ All clips and insulators installed.
- ☐ Flex ducts and ballast retainer installed.

Electrical Power

- ☐ Voltage between 85% and 115% of nominal voltage with all connected loads operating.
- ☐ Ground installed.

Gas System

- ☐ Supply pressure at rated supply pressure with all connected loads operating.
- ☐ Gas supply leak tested.

Heater

- ☐ Level.
- ☐ Heater functions in "Manual".
- ☐ "Run" indication function. With the heater running, the contact between terminals A3 and A4 will close. Check for continuity.
- ☐ "Alarm indication function. Put the heater into alarm by turning the gas supply off. The heater retries three times. Then the FSR will indicate alarm, and the alarm LED on the controller will light. The contact between terminals A5 and A6 will close. Check for continuity.
- ☐ Heater functions in "Remote" control. Toggle mode selector switch to "REMOTE/AUTO". If connected to dispatch, have dispatch start heater.
- ☐ With heater running for at least 15 minutes, temperature at closest point nozzle is 38°C - 88°C (100°F - 190°F) above ambient.

EMS

- ☐ Precipitation detector installed on the transition duct, as low to the ground and as close to the switch as possible, and in the heated zone.
- ☐ Drop snow (or water) on precipitation detector sensing grid. Snow melts and "SENSOR WET" LED lights on EMS module.
- ☐ Ambient temperature sensor installed.
- ☐ Raise "SNOW-RAIN" set point, if required, above the ambient temperature. The "AMBIENT" LED lights.
- ☐ Rail thermostat, if supplied, installed on rail flange.
- ☐ Return set points to desired settings.

H. HEATER SPECIFICATIONS

H.1 Performance

- Clears ice and snow from switches with up to 28-foot points or longer. (Recommended heating, 10,000 to 22,500 BTU/hr per foot of track coverage, based on severity of local climate).
- 1500 scfm of heated air delivered via a duct system, point nozzles and track duct vents.
- Heat output range 200,000 to 400,000 BTU/hr LPG or NG, field adjustable.
- Output air temperature limited to 193°C (380°F) maximum.
- Burner efficiency, minimum 95%.
- SCADA network connectivity via RS-485 communications port.

H.2 Gas Firing

Table 1 – Gas Firing

	Propane	Natural Gas
Input rating, BTU/hr (kW)	200,000 - 400,000 (58 - 117)	
Manifold pressure, inches of water (kPa)	1.3 - 5.0 (0.32 - 1.23)	2.3 - 11.0 (0.56 - 2.69)
Supply pressure in/w.c. ^{1,2} (kPa)	7 - 14 (1.72 - 3.45)	12 - 14 (2.95 - 3.45)

¹ With no more than 20% pressure drop, with all connected loads operating.

² Inlet gas fitting, ¾" NPT female.

H.3 Gas Conversion

1. Heaters are factory set for use with propane gas.
2. To convert to natural gas change main gas pressure regulator spring with the one supplied separately. Adjust within specifications detailed in the table above. Affix separate gas type plate supplied. Reverse procedure to change back to original gas.

H.4 Electrical

Table 1 – Electrical

Voltage	Phase	Wiring	Running Amps ^{1,2,3}	Frequency (Hz)
240	1	3 wire, L1, L2, N	7.5	60
208	3	4 wire, L1, L2, L3, N	7.3	60
460	3	3 wire, L1, L2, L3	3.6	60
575	3	3 wire, L1, L2, L3	3.0	60

¹ On start up, peak in rush current is usually 6-8 times the running amp.

² Current drops to running amperage after 4 seconds.

³ Two horsepower fan drive motor for all configurations.

H.5 Controls

Table 1 – Controls

Feature	Description
Remote Start	Provide dry contact, rated for 24Vac 0.5 amp
Run and Alarm Indication Contacts	Maximum 240Vac or 24Vdc, 10 amp
Magnetic Motor Starter	Coil voltage 120Vac.
Motor Thermal Overload Protection	Single phase, reset located on motor.
	Three phase, thermal overload relay fastened to contactor.
Thermostatically limited output air temperature, cycling	380°F maximum, open on rise, automatic reset.
Thermostatically limited output air temperature, high limit	420°F maximum, close on rise, manual reset.
Direct Spark Ignition Control Module	Fenwal 35 - 60
SCADA	RS-485 MODBUS RTU
Rail Thermostat	9°C (49°F) close on rise, automatic reset.

H.6 Wiring Terminations

Table 1 – Wiring Terminations

Function	Size Range	Termination Type
Power	#14 to #2 AWG copper	Barrier Terminal Block, Tubular with clamping screw.
Control	#22 to #4 AWG	AAR terminal posts, #14-24 UNS
RS-485 Communications	#22 to #4 AWG or #26-#12 AWG	AAR terminal posts, #14-24 UNS or PCB plug in connector. Tubular with clamping screw.

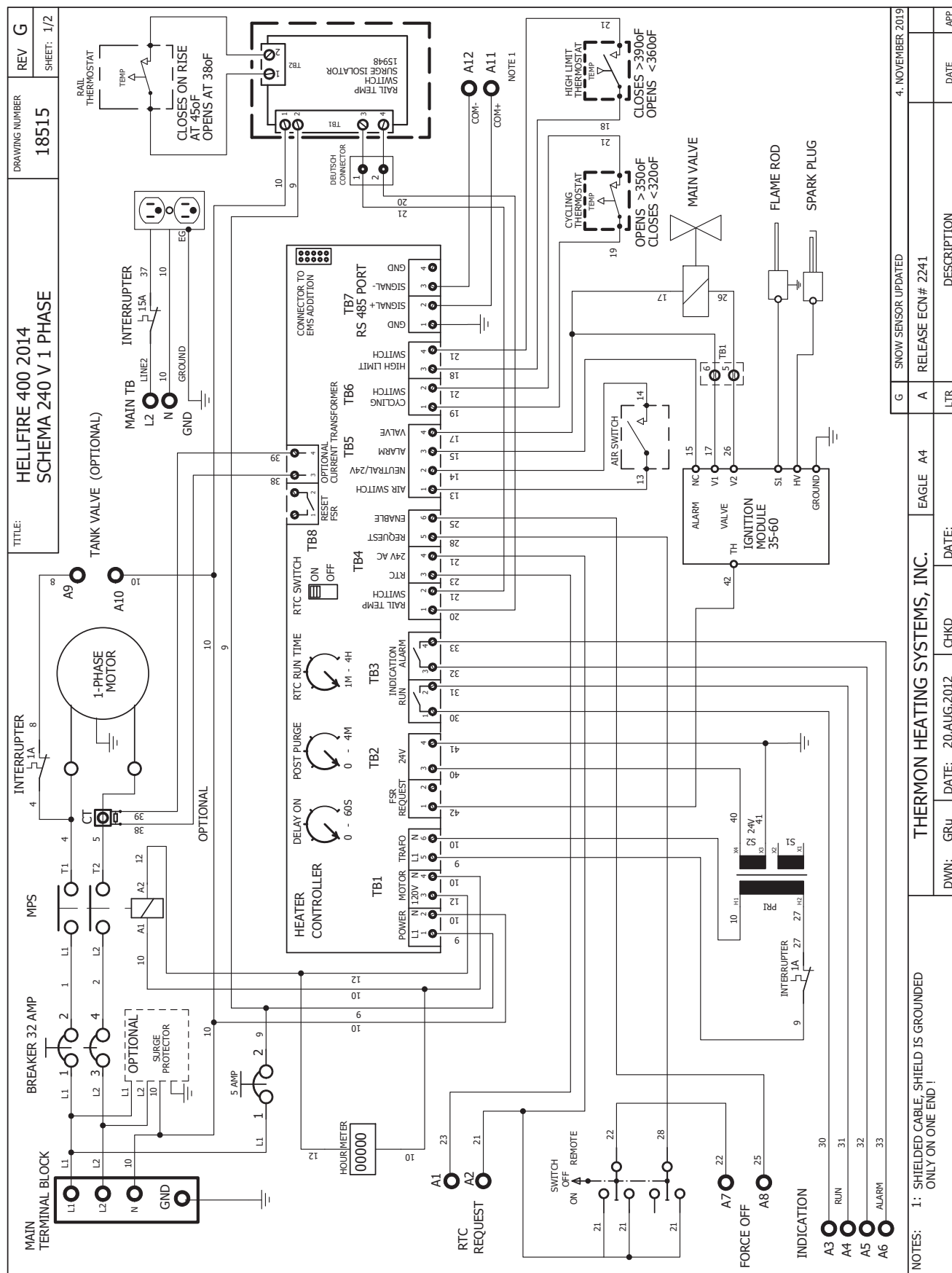
H.7 Safety Features

1. **Minimum Air Pressure:** Upon start up and request for heat, the trial for ignition does not start until adequate air pressure is developed. Burner is extinguished immediately upon loss of air pressure.
2. **High Temperature Limit:** In the event the heated air temperature exceeds 216°C (420°F), the burner is extinguished, the heater is shut down and locked out. A manual reset is required.
3. **Loss of Flame:** If, upon start up and request for heat, the trial for ignition fails to light the burner, or the flame signal is lost while heating, the burner is extinguished immediately.
4. **Ductwork Electrical Isolation:** As per, AAR standards part 14.5.1D, "Recommended Design Criteria for Assembly and Test of Insulated Track Fittings, Dielectric Requirements", ducting and nozzle connections are electrically isolated to withstand a maximum of 3000 Vac for 60 seconds to eliminate possible interference with track circuits.

H.8 Controller Terminal Identification

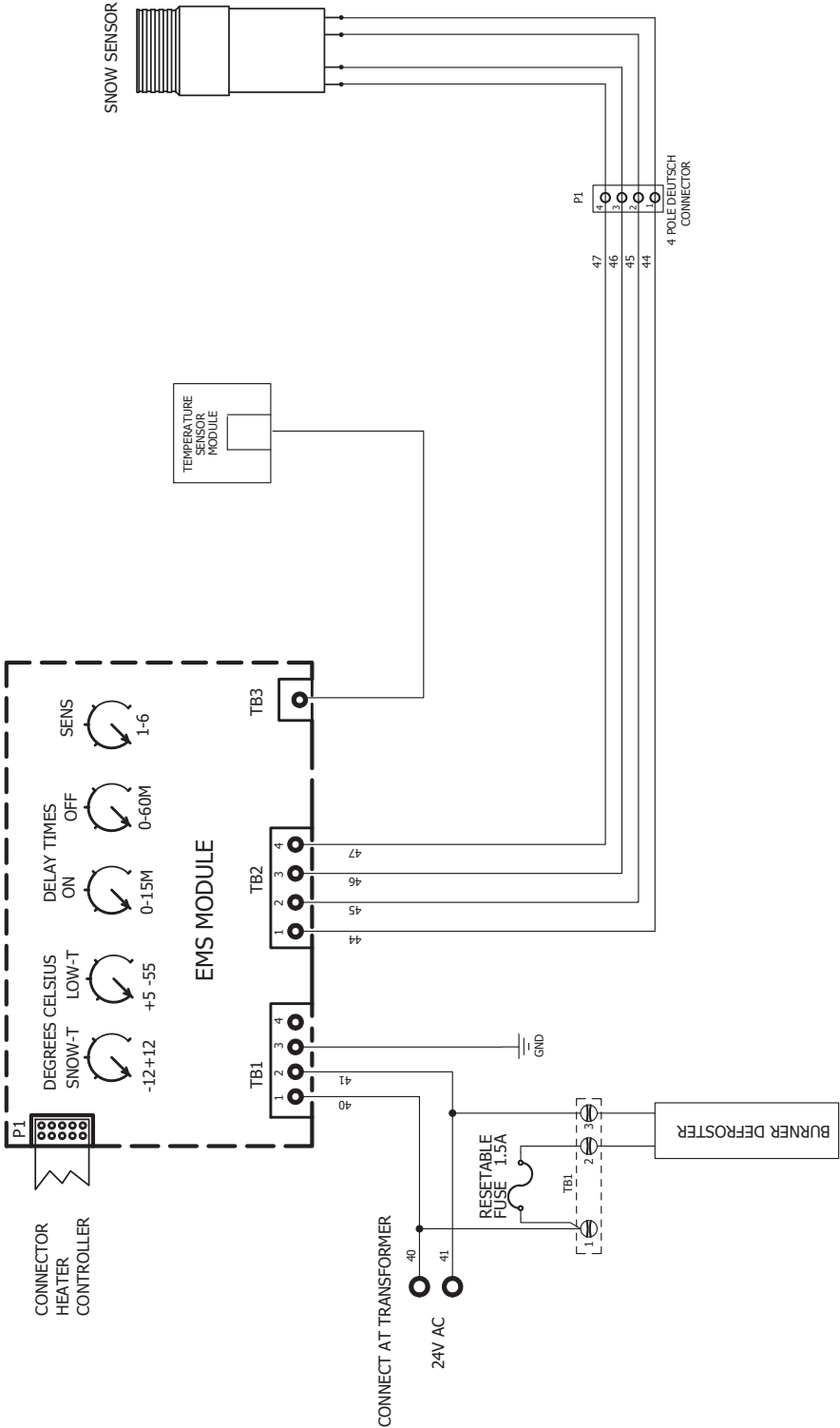
Table 1 – Controller Terminal Identification

Terminal Block	PIN	Input	Output	Power Source
TB1	1	120Vac		120Vac
	2	Neutral		120Vac
	3		Motor Contactor	120Vac
	4		Neutral	120Vac
	5		120Vac Transformer	120Vac
	6		Neutral	120Vac
TB2	1	120Vac		120Vac
	2		FSR Request	120Vac
	3	24Vac		24Vac From Transformer
	4	24Vac		24Vac From Transformer
TB3	1		Run Indication	Dry Relay Contact
	2		Run Indication	Dry Relay Contact
	3		Alarm Indication	Dry Relay Contact
	4		Alarm Indication	Dry Relay Contact
TB4	1	Rail Thermostat		24Vac
	2		24Vac	24Vac
	3	RTC A1-A2		24Vac
	4		24Vac	24Vac
	5	Manual		24Vac
	6	Enable		24Vac
TB5	1	Air Switch		24Vac
	2		Neutral	24Vac
	3	ALRM FSR		24Vac
	4	Valve Feedback		24Vac
TB6	1		24Vac	24Vac
	2	Cycling SW		24Vac
	3		24Vac	24Vac
	4	High Limit SW		24Vac
TB7	1		GND	GND
	2	POS Signal RS 485		Communication
	3	NEG Signal RS 485		Communication
	4		GND	GND
TB8	1	FSR Reset +		From FSR
	2	FSR Reset -		From FSR
	3	Current		Current Transformer
	4	Current		Current Transformer

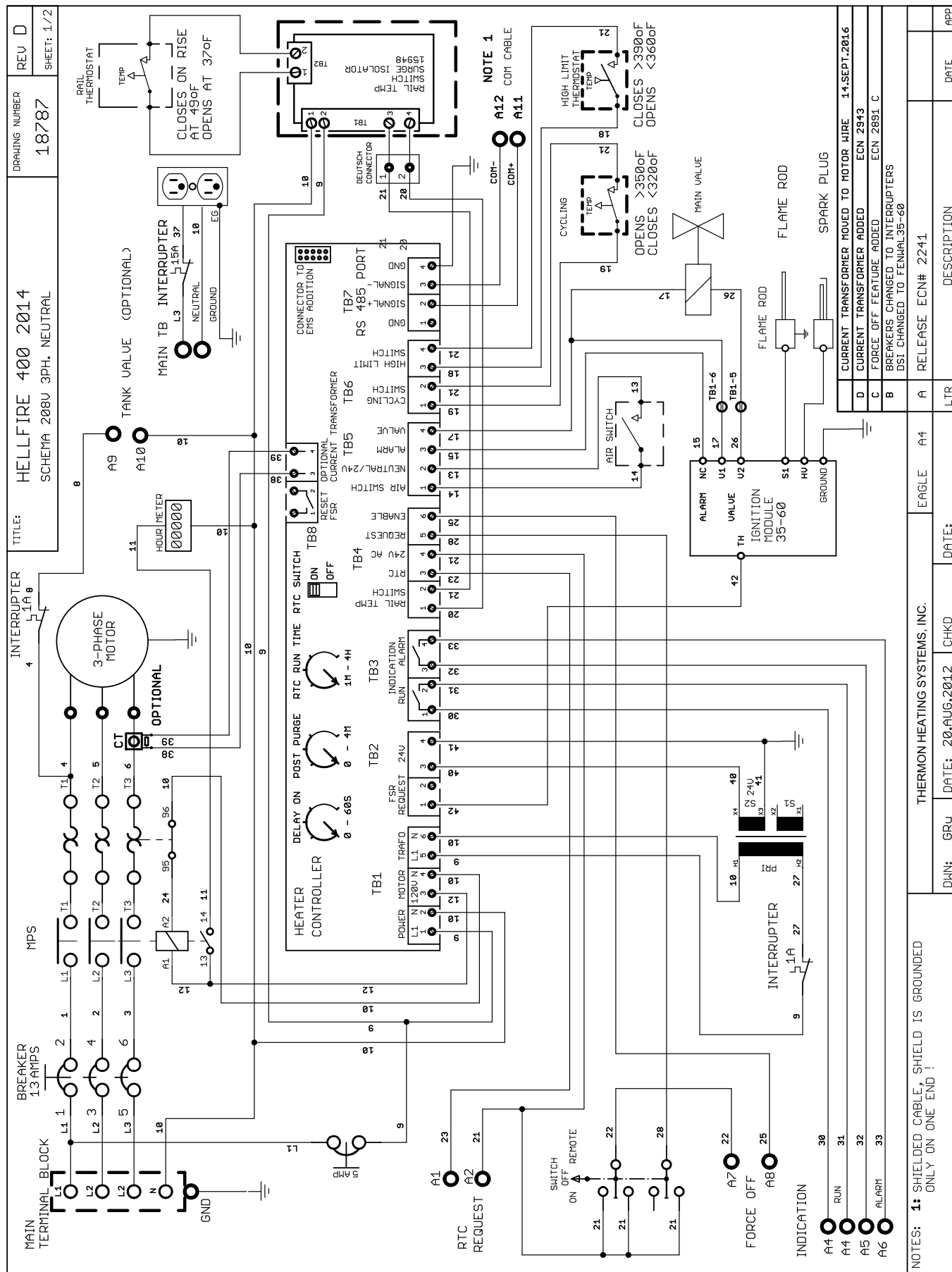


TITLE:	HELLFIRE 400 2014 SCHEMA 240 V 1 PHASE	DRAWING NUMBER 18515	REV G
			SHEET: 2/2

EMS BOARD OPTION PRINCIPAL CONNECTION



NOTES: SCHEMATIC AND PANEL WIRE NUMBERS ARE AT THE SAME ELECTRICAL POTENTIAL PANEL WIRE INCLUDES LETTER TO IDENTIFY SPECIFIC WIRE INTENDED FOR PRODUCTION USE ONLY	THERMON HEATING SYSTEMS, INC.				EAGLE	A4					
					DWN:	G.Ru	DATE:	20.AUG.2012	CHKD	DATE:	
					</						

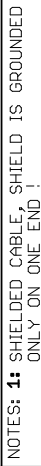


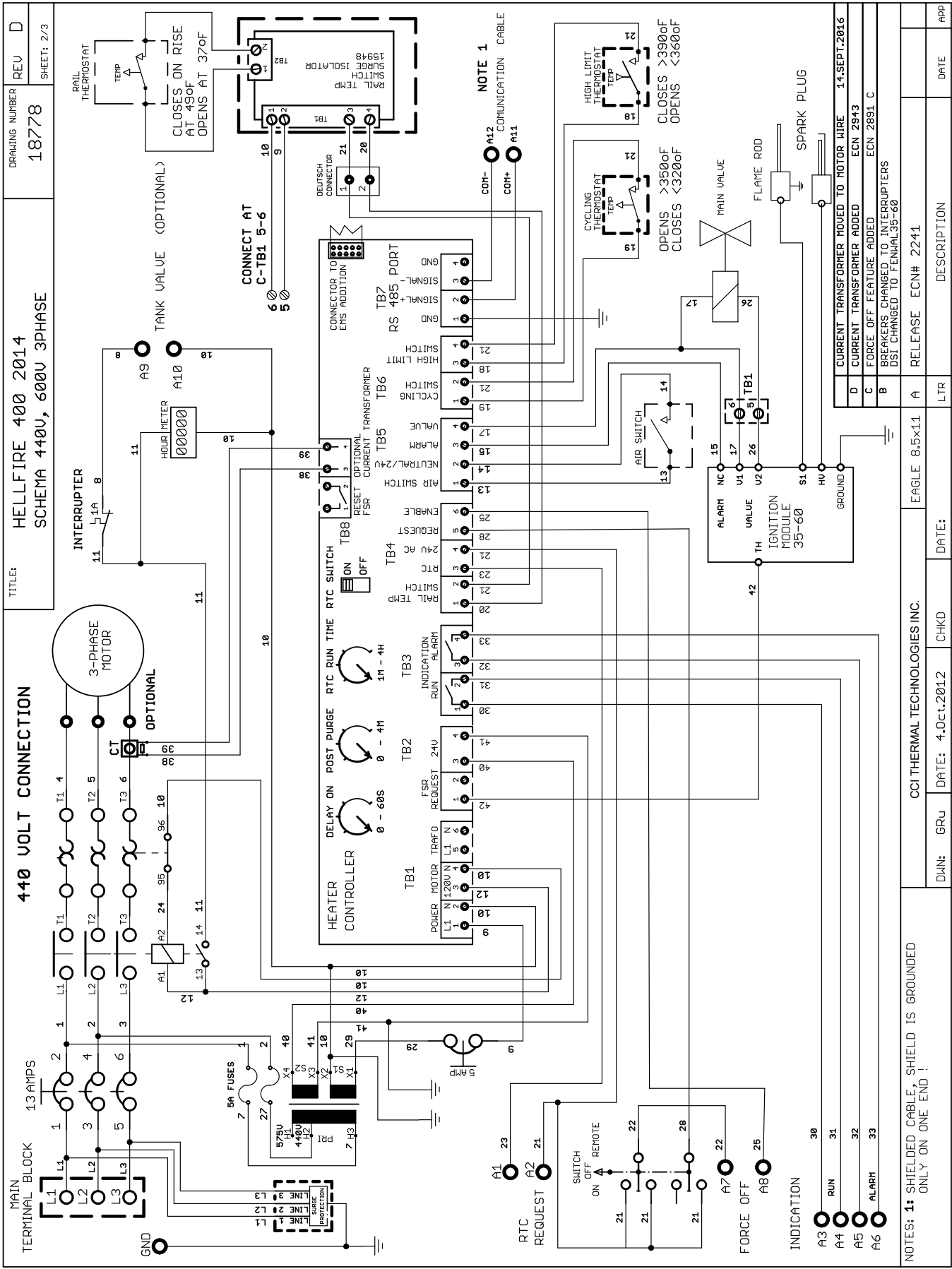
NOTES: **1:** SHIELDED CABLE, SHIELD IS GROUNDED ONLY ON ONE END !

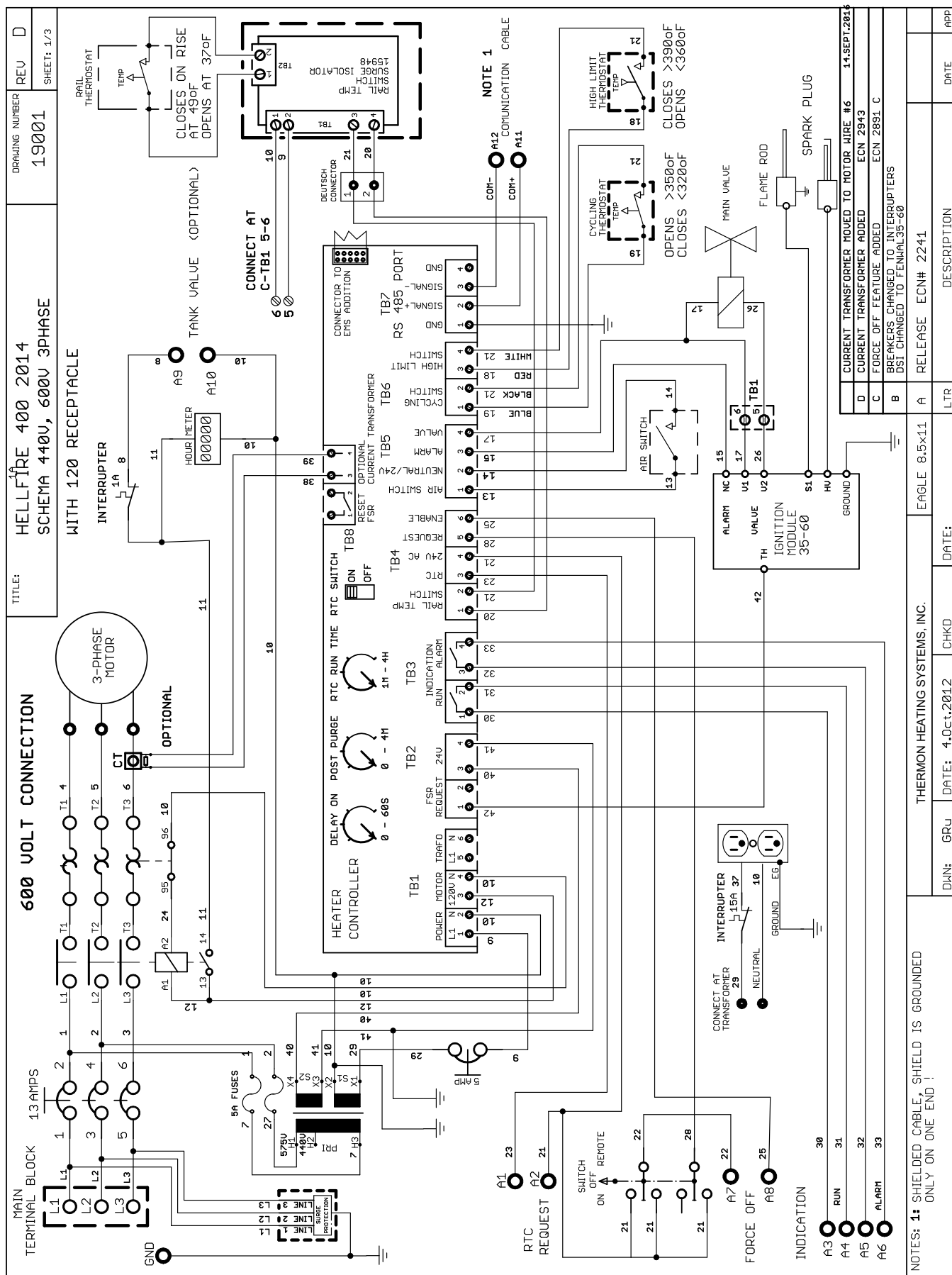
THERMON HEATING SYSTEMS, INC.			EAGLE	A4	A
DIN:	GR4	DATE: 20 AUG. 2012	CHKD	DATE:	LTR

		D31 CONTINUED TO TENDR03-06	
A	RELEASE ECN# 2241		
LT	DESCRIPTION	DATE	APP

			APP







I. MAINTENANCE



WARNING. Install and use Heater in accordance with owners manual and local codes.

In the absence of local codes, installation must comply with CAN/CSA-B149 Installation code and National Fuel Gas Code ANSI Z223.1 / NFPA 54, or Standard for the Storage and Handling of Liquefied Petroleum Gases, ANSI / NFPA 58.

For outdoor use only.

For use with ductwork only. Only duct work supplied by Thermon Heating Systems shall be used with the heater. Minimum clearance from combustibles: 2 inches.



WARNING. To be installed in accordance with railroad and all applicable local governing regulations by persons approved by the railroad having authority.



WARNING. If you smell gas; immediately extinguish all sources of ignition and turn off gas source. Call qualified service technician to repair leak.



WARNING. Do not attempt to manually light burner. Heater equipped with an automatic electronic ignition system.



WARNING. Risk of cutting fingers or hand. Disconnect fan power prior to removing combustion chamber access panel or air intake.



WARNING. Heater can start automatically. Exercise caution when in close proximity.



WARNING. Burn hazard / hot surfaces. Do not touch track ducts, nozzles or any non-insulated duct connected downstream of heater during operation



WARNING. Cut hazard. Sheet metal edges can be sharp. Wear protective clothing when handling track duct, insulated ducts and any other sheet metal components.

I.1 Thermostat Removal

1. Remove cover from thermostat box to gain access to the thermostats. There are two thermostats. The high limit, which has a red and a white wire connected to it, and the cycling thermostat, which has a black and a blue wire, connected to it.

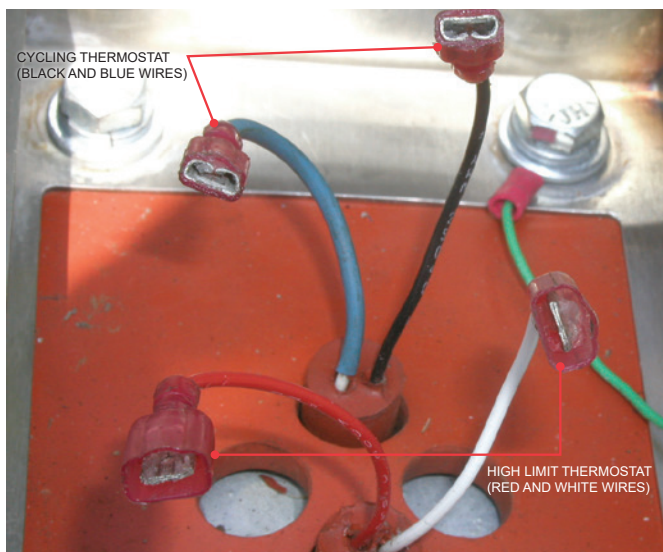


Figure 5 - Thermostat Wire Connections

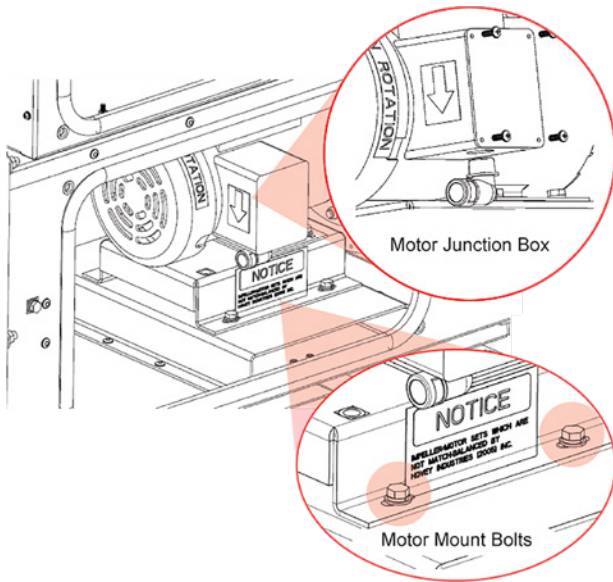
2. The wires are connected by means of quick disconnects. To disconnect, grip the terminals on each side of the connection and pull firmly.
3. Using a 9/16" socket, remove the 4 mounting bolts that hold the enclosure to the sensor duct. Remove the thermostat box and gasket.
4. Remove the two screws that fasten each thermostat to the sensor duct. Remove thermostats.
5. The high limit and cycling thermostats are not interchangeable. Each has unique connectors to prevent interchange.
6. Reverse procedure to install.

1.2 Motor/Impeller/Base Removal



WARNING. Risk of cutting fingers or hand. Disconnect fan power prior to removing combustion chamber access panel or air intake.

1. Remove the combustion chamber access panel to gain access to the motor.
2. Open the motor junction box and disconnect all wiring and conduit elbow.
3. Remove the four motor mount bolts and remove the motor/impeller assembly from the combustion chamber.
4. Install replacement motor/impeller/base assembly, following reverse order.

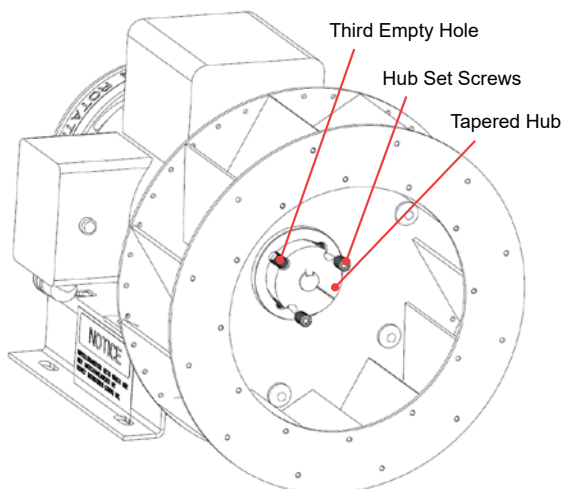


1.3 Impeller Removal

NOTE: Motor/impeller sets not match balanced by Thermon Heating Systems void future warranty claims.

NOTE: Replacement of motor or impeller only. Dynamically balance the motor/impeller and base assembly to vibration levels of 0.2 in/sec or less in the bearing planes.

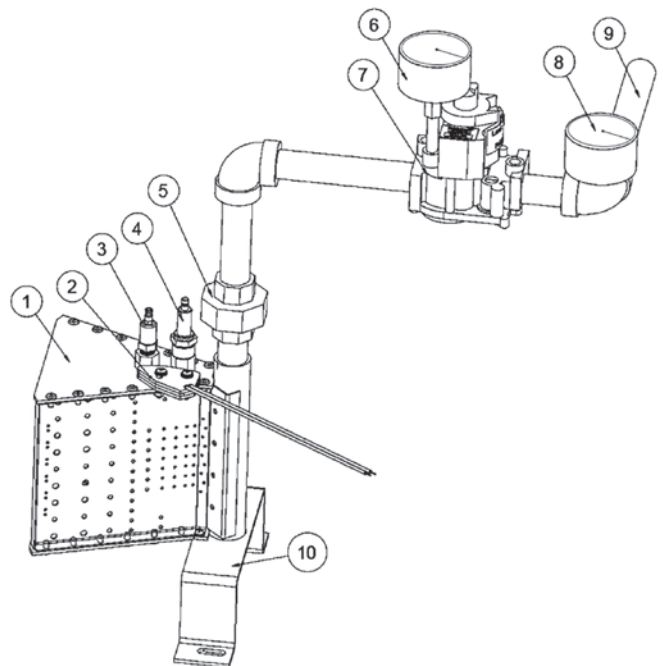
NOTE: Mark the position of the impeller on the shaft before removing.



The impeller is fitted with a taper lock bushing. To remove impeller from motor shaft:

1. Clamp the motor and anchor the impeller using a suitable bar.
2. Remove the two hub set screws.
3. Insert a set screw into the third previously empty hole and tighten.
4. Tap the outer half of the hub with a hammer and bar to knock the impeller off the tapered hub.
5. Slide hub off shaft, then remove impeller.
6. To install the impeller, reverse sequence except step 4.

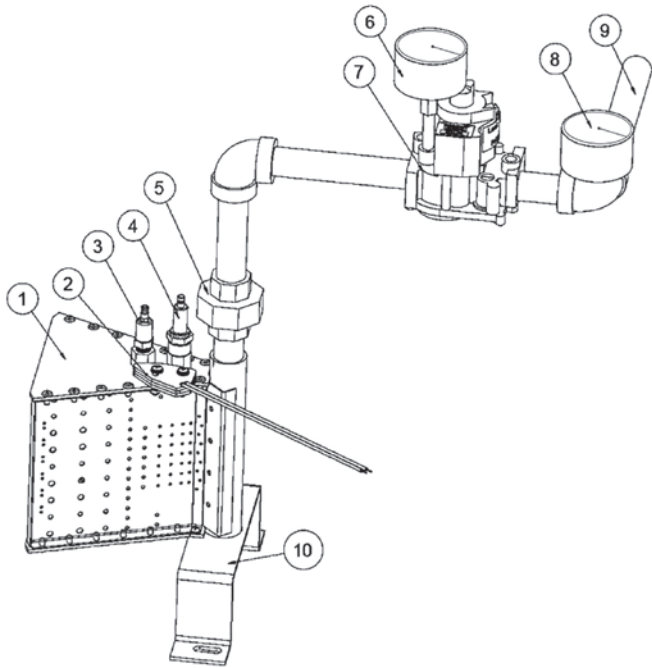
1.4 Flame Rod and Spark Igniter Removal



If the flame rod (3) or spark igniter (4) requires inspection or replacement, remove them as follows:

1. Gain access to the burner (1) by first removing the combustion chamber access panel.
2. The flame rod is to the left of the spark igniter. Gently pull the wire from the terminal. Use a 7/8" deep socket to unscrew and remove the flame rod. Apply a high temperature anti-seize compound to threads prior to reinstallation.
3. The spark igniter is to the right of the flame rod. Gently pull the wire from the terminal. Using a 13/16" deep socket, unscrew and remove the spark igniter. Apply a high temperature anti-seize compound to threads prior to reinstallation.
4. Reinstall the flame rod and ignition wires. A red band identifies the flame rod wire.

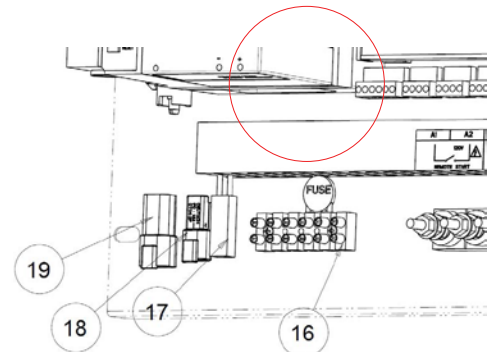
I.5 Burner Removal



1. Turn heater OFF and disconnect power.
2. Once impeller is at a complete stand still, remove combustion chamber access panel.
3. Remove nut and bolts holding defroster (2). Remove cable straps holding wire to pipe. Let defroster hang.
4. Open pipe union (5).
5. Remove bolts fastening both mounting brackets (10) to the combustion chamber. Leave brackets attached to the burner.

6. Remove burner.
7. Reverse procedure to reinstall.

I.6 Burner Defroster Removal



NOTE: The defroster circuit is protected with a reset-enabled fuse. If tripped, open then close the panel breaker to reset.

1. Turn heater OFF and disconnect power.
2. Once impeller is at a complete stand still, remove combustion chamber access panel.
3. Remove nut and bolts holding defroster (2). Remove cable straps holding wire to pipe. Let defroster hang.
4. Open electrical access panel. Trace defroster wires to terminal block (16), terminals 5 and 6, circled. Disconnect last two wires on the bottom furthest right of terminal block.
5. Reverse procedure to reinstall.

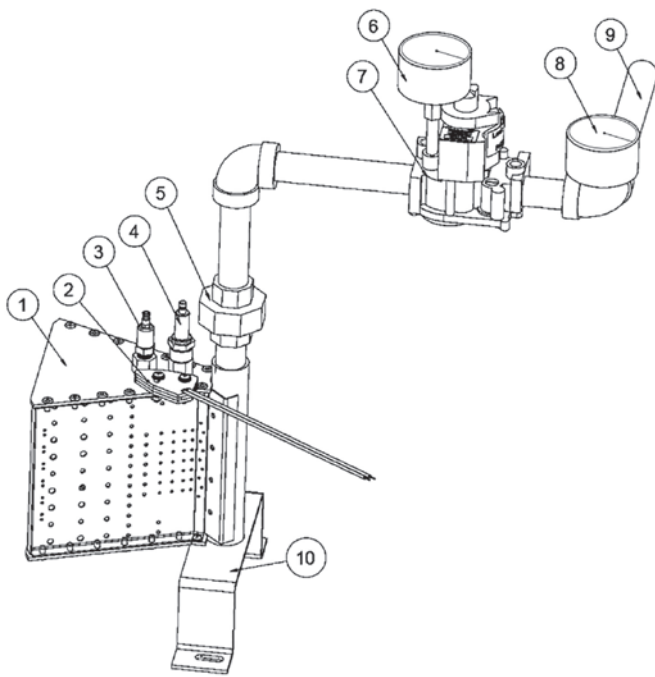
J. SERVICE

J.1 Recommended Service Schedule

Item	Annually	Every 5 Years
Inspect flame rod	X	
Inspect flame rod wire and boot	X	
Inspect igniter	X	
Inspect igniter wire and boot	X	
Inspect ductwork	X	
Measure motor vibration	X	
Inspect and tighten all electrical terminations	X	
Inspect and replace any damaged access panel gaskets	X	
Inspect and replace any damaged duct gaskets	X	
Inspect gas supply pressure	X	
Perform gas supply leak test	X	
Perform manifold leak test	X	
Inspect burner	X	
Service burner		X

1. Inspect heater annually.
2. Ensure the air intake and all ductwork are not obstructed.
3. Keep area around heater clear and free from combustible material, gasoline and other flammable vapours and liquids.
4. Replace all damaged ducts, including intake, crossducts, point and track duct nozzles.
5. Damaged ducts will degrade switch clearing ability.
6. With the supply power turned off, tighten all mounting and electrical connections to the recommended tightening torque.

Thread Size	Tightening Torque (in./lbs)
8 - 32	19
10 - 32	31
1/4 - 20, Power Terminal Lugs and AAR Terminals	75



J.2 Gas Supply Pressure



WARNING. All persons employed in handling propane or natural gas shall be trained in proper handling and operating procedures, as required by local authorities having jurisdiction.

1. Heater is factory tested on propane at 15 in/w.c supply pressure.
2. With the heater on and all connected loads operating, verify that the supply pressure, indicated on supply pressure gage (8), is between 12 - 20 in/w.c.
3. Natural gas pressures below 12 in/w.c or LPG pressures below 7 in/w.c will limit the maximum capacity of the heater.

J.3 Gas Supply Leak Test

1. With the heater "OFF", paint all the gas pipe connections between the supply inlet (6) to the gas source with leak testing solution. If a gas leak is detected, replace any cracked fittings or components, tighten any leaking pipe connection, or disassemble, reapply pipe thread sealant, and reassemble.

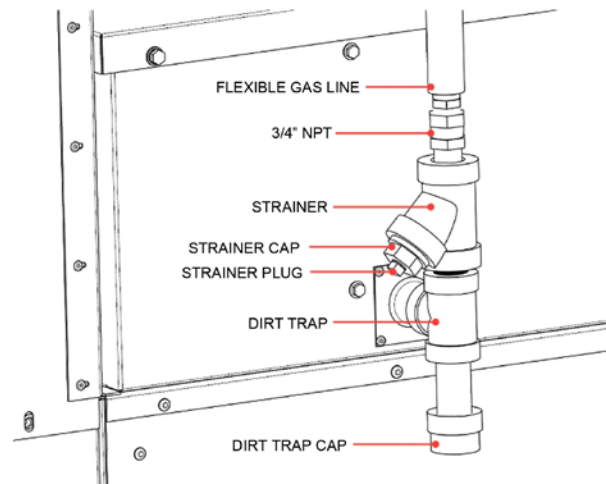
J.4 Manifold Leak Test

1. With the heater "OFF", paint all the gas pipe connections between the main (8), pilot (3) gas solenoid valves and the supply inlet (6) with leak testing solution.
2. With the heater operating in "MANUAL" mode and the burner lit, paint all pipe connections between the main and pilot gas solenoid valves to the elbow with leak test solution.

3. If a gas leak is detected, turn heater "OFF". Replace any cracked fittings or components, tighten any leaking pipe connection, or disassemble, reapply pipe thread sealant, and reassemble.

J.5 Combination Gas Valve Seat Leak Test

1. Turn heater OFF.
2. Verify supply pressure is between 14–20 inches water column.
3. Close the manual shut off on top of valve (7). Close the supply manual shutoff external to heater, typically mounted on the gas line riser.
4. After 10 minutes there should be no decrease of pressure on the supply pressure gauge. If there is, refer to the Honeywell gas valve manual in the component bulletin section at the end of this manual, for service information.



J.6 Dirt Trap And Strainer



WARNING. All persons employed in handling propane or natural gas shall be trained in proper handling and operating procedures, as required by local authorities having jurisdiction.

1. If a dirty supply line is suspected, turn off the local gas supply, remove the dirt trap cap and inspect for dirt and moisture.
2. If a strainer is installed, remove center plug and inspect for blockage. If evidence is found, locate source and correct problem.
3. If the strainer screen is clogged, remove the cap and screen. Old gasket is not reusable. Clean screen. Apply sealant to plug threads. Reinstall cleaned screen, cap with new gasket, and plug.
4. Inspect manifold and clean if necessary.
5. Empty cap of any dirt or moisture. Apply thread sealant and reinstall cap.
6. Turn on gas supply and leak test dirt trap.
7. Perform Combination Gas Valve Leak Test to ensure valve seats seal.

J.7
Motor

Running amps greater than 115% of the motor rated full load amps can indicate failed bearings, excessive air leaks in the ductwork, inadequately sized power supply wires, or poor electrical connections.

Voltage	Phase	Motor FLA Rating*	FLA X 1.15**
240	1	7.5	8.6
208	3	7.3	8.4
460	3	3.6	4.1
575	3	3.0	3.5

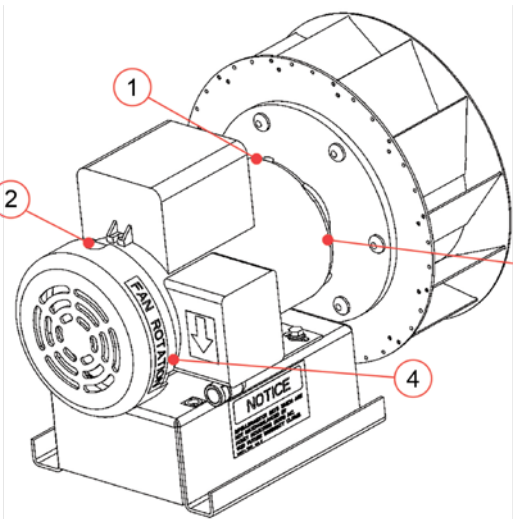
*FLA (Full Load Amperage), as shown on motor nameplate.

**Maximum current draw under design operating conditions of -40°C/°F ambient temperature at sea level and supply voltage. Current draw drops with temperature, elevation or voltage increase.

NOTE: Measure current between motor and contactor, not at the supply terminals.

J.8
Vibration Specifications and Measurement

1. All motor/impeller/base sets are match balanced with vibration levels lower than 0.20 in./sec RMS, at the four points depicted.



2. Do not measure on covers or guards.
3. Mark locations 1, 2, 3 and 4 on motor to ensure repeatable measurements for trend analysis.
4. Take measurements vertically at points 1 and 2, and horizontally at 3 and 4.

Vibration Level (in./sec)	
Acceptable	Less than 0.20
Tolerable	0.21 to 0.29
Excessive	0.30 to 0.71
Extreme	0.72 or more

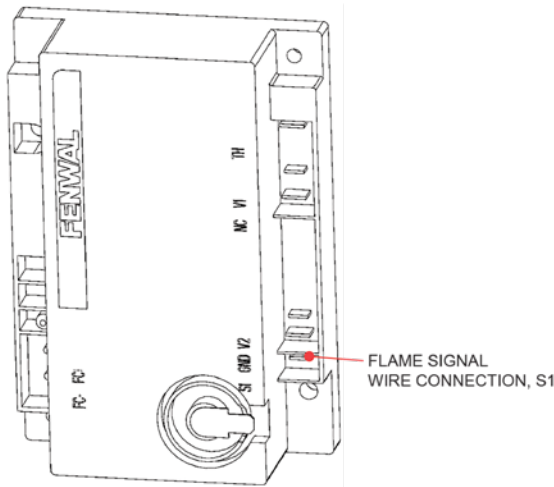
J.9
Lubrication

1. The motor has sealed bearings and does not require lubrication.
2. When installing flame rod or igniter always apply high temperature anti seize compound to threads.

J.10
Direct Spark Ignition Control Module (DSI)

1. This module has no serviceable parts.
2. To replace, disconnect the flame rod and ignition wires. Remove 4 mounting screws that fasten it to the panel. Install new DSI by reversing sequence.
3. For further information see the Fenwal 35-60J manual in the component bulletins section at the end of this manual.

J.11 Flame Signal



NOTE: Flame signal strengths:

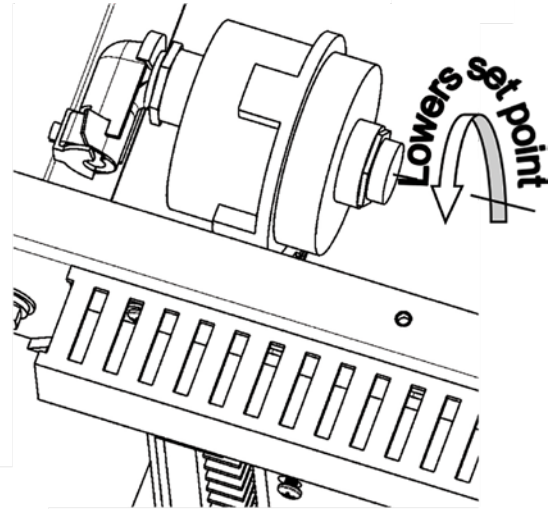
GOOD - 3.0 or greater, fluctuating less than 0.5 micro amps DC

WEAK – between 0.8 and 2.9 micro amps and / or fluctuating more than 0.5 micro amps DC

INSUFFICIENT – below 0.7 micro amps DC

1. The flame signal strength can be monitored using a voltmeter set to measure 0 - 10 micro amps DC, or using the Honeywell W136 test meter.
2. When using an ammeter, disconnect the flame rod wire and connect the red (+) lead to the DSI flame signal terminal, S1, and the black (-) into the flame rod wire.
3. Amperage is 0.0 with no flame, and a maximum of 10.0 with flame.
4. Signals between 1.5 to 2.9 micro amps and / or fluctuating more than 0.5 micro amps are weak. They allow the heater to continue to operate, however investigation and probable maintenance of flame rod, wiring, manifold pressure and burner is required. Expect irregular nuisance shutdowns.
5. Flame signals dropping below 1.5 micro amps cause the DSI to extinguish the burner and indicate alarm. DSI LED will flash 3 times every 3 seconds.
6. Inspection and probable maintenance of flame rod, wiring, manifold pressure and burner is required.

J.12 Air Switch



1. To check the air switch operation, while operating the unit, block 80% of the air intake screens openings with a sheet of cardboard. The heater continues to operate.
2. Now block 90%. The DSI extinguishes the burner and indicates alarm with the "FSR ALARM" LED lit.
3. Remove the blockage and reset the controller. The heater starts.

J.13 Air Switch Calibration

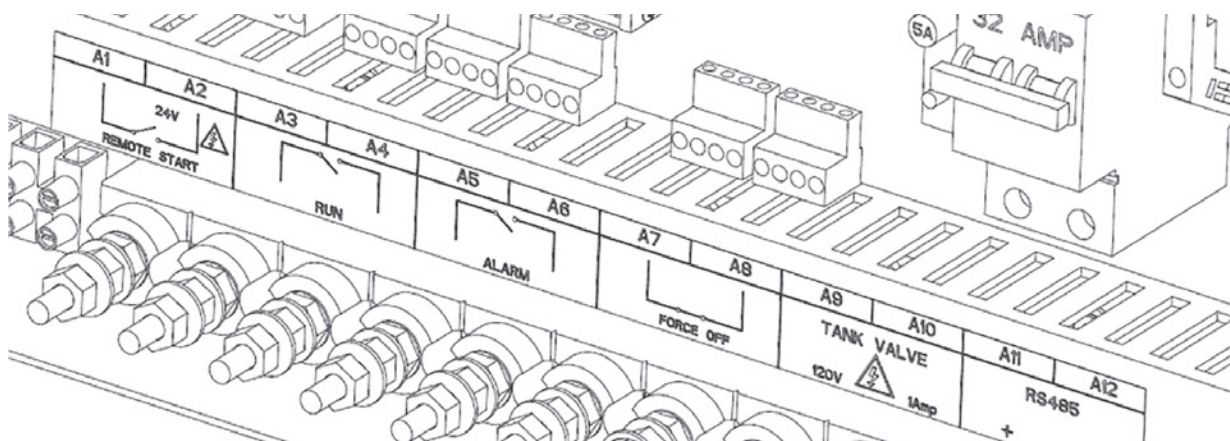
1. With the heater operating, remove the red dust cover cap on the air switch set screw, and turn the set screw counter clockwise to lower the set point. Block 90% of the air intake with cardboard.
2. Raise the set point by turning the screw clockwise until the switch opens and causes the DSI to extinguish the burner.
3. Remove blockage and reset controller.

J.14 High Temperature Limit

NOTE: The heater can not under normal circumstances raise the air temperature to the point of closing the high limit thermostat.

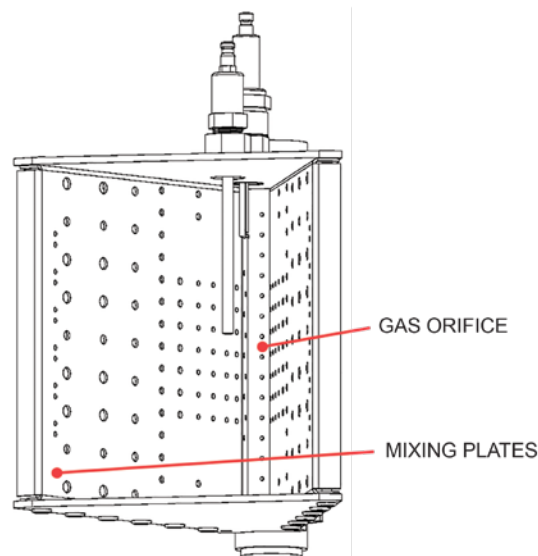
The thermostat and teh circuit can be individually tested as follows:

1. Turn the mode selector switch "OFF".
2. Open the thermostat box located on the sensor duct. Disconnect the red and white leads of the high limit thermostat.
3. At temperatures below 210°C (410°F) the high limit thermostat contact is open. Use a multimeter to measure continuity. Replace it if it is closed.
4. To verify the circuit and controller operation, simulate a high limit by shorting the red and white wires that connect to the panel. The controller indicates alarm with STATUS LED red, FSR ALARM LED red, ALARM LED red and HIGH LIM LED alternating.
5. Reconnect the thermostat and reset the controller.
6. Return the mode selector switch to desired mode.



J.15 AAR Terminals, Signals, and Communications

1. To verify REMOTE START:
 - 1.1 Place the heater in REMOTE RTC mode, and make a contact closure across AAR terminals A1 A2. The heater starts after the delay on period.
2. To verify RUN indication:
 - 2.1 Measure continuity across AAR terminals A3 A4.
 - 2.2 Closed contact indicates run, open indicates stopped. Confirm against actual heater state.
3. To verify ALARM indication:
 - 3.1 Measure continuity across AAR terminals A5 A6.
 - 3.2 Closed contact indicates alarm, open indicates normal operation. Confirm against actual heater state.
4. To verify FORCE OFF:
 - 4.1 Place the heater in MANUAL mode, open contact closure across AAR terminals A7 A8.
 - 4.2 The heater will stop after the post purge period.
5. To verify the tank valve switch:
 - 5.1 Measure the voltage across terminals A9 A10. With fan running the voltage is 120Vac.
6. To verify RS-485 communications:
 - 6.1 Refer to controller LED indications for TD, RD, and TX.



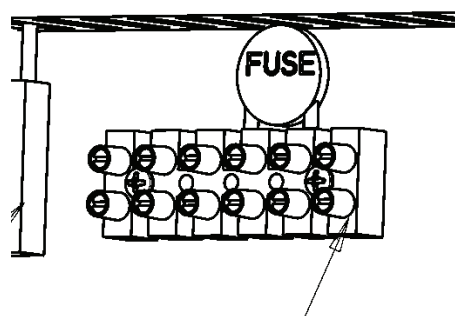
J.16 Burner

1. Visually inspect mixing plates for cracks or blockage. Remove any blockages. If cracks are found replace the burner.
2. Over time corrosion and or dirt restrict the burner orifice.
3. Inspect burner for blocked gas orifice, if:
 - 3.1 Signal strength is low even after replacing the flame rod and wire,
 - 3.2 Pilot pressure has to be raised significantly to get a good signal,
 - 3.3 Manifold pressure is above the maximum pressure setting, a minimum 60°C (140°F) increase of output air temperature can not be achieved.

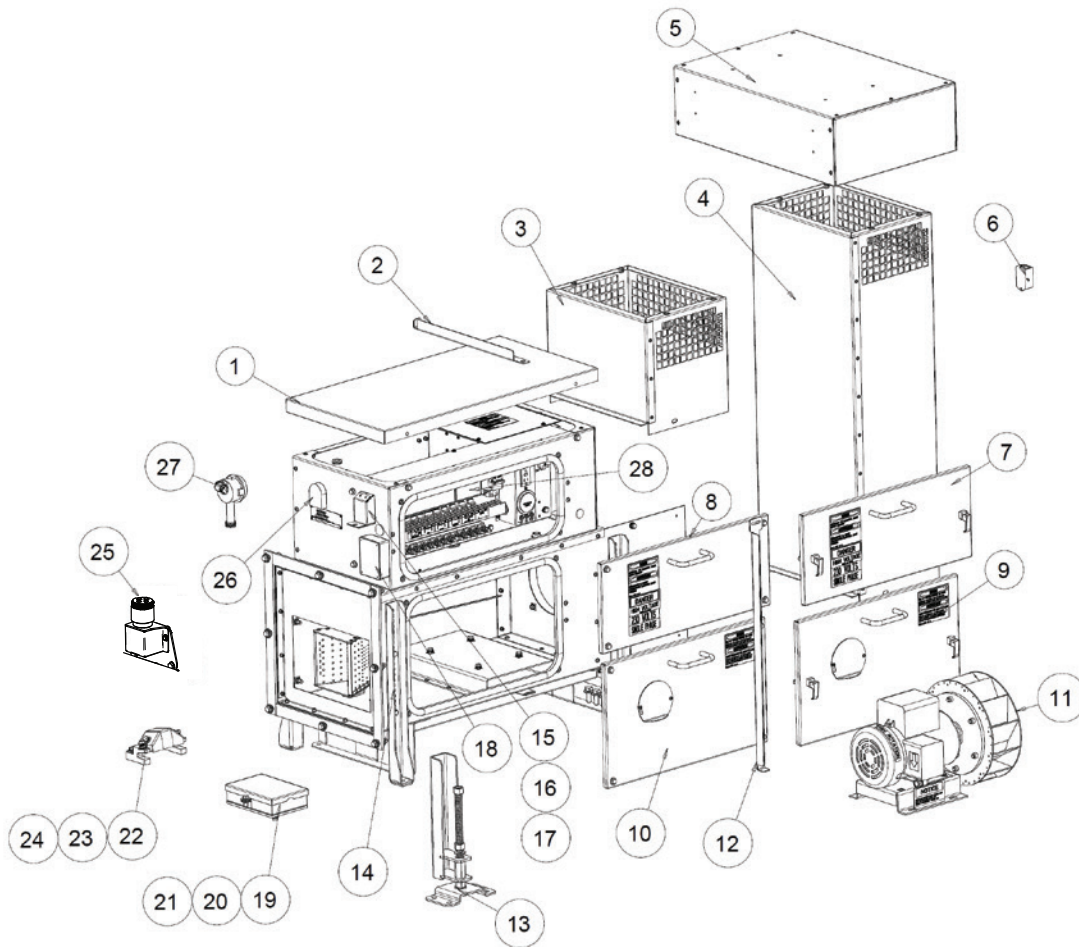
4. To correct the problem, remove the burner, flame rod and igniter, following the removal instructions in the maintenance section.
5. Drill out any blocked gas orifice using a #48 (.076) drill bit.

J.17 Defroster

1. The defroster applies 25 watts of heat to the burner next to the flame rod and igniter. This is enough to raise the temperature of the end plate by approximately 32°C (90°F). It can be difficult to tell it is heating by sense of touch, therefore measure the current draw using a clip on ammeter. The current draw is 0.9 amps. A "Reset Enabled" fuse mounted on the terminal block protects this circuit.
- If there is no current draw, open the 5-amp panel breaker, then close it to reset the fuse. If there is still no current draw, inspect defroster for damage.



K. PARTS



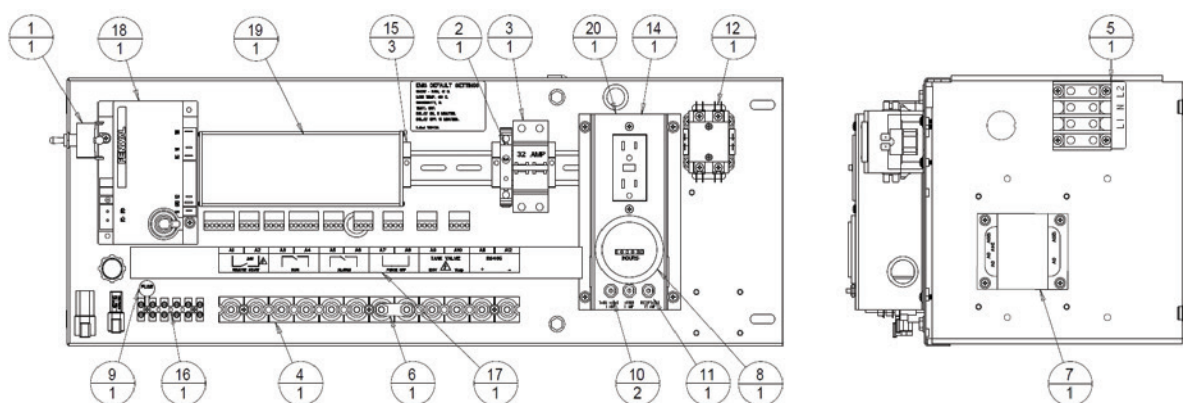
K.1 Parts - Heater Body

Table 1 – Heater Body Parts List

Index	Part No.	Description
1	13746	LID, ELECTRICAL COMPARTMENT
2	17436-03	LOCKING BAR, TOP
3	16679	EXT, INTAKE W/SCREEN, 13\"H HF400
4	16679-04	EXT, INTAKE W/SCREEN, 43\"H HF400
5	16680	HOOD, INTAKE, HF400, 26.5\"18.18\"W
6	16426	TEMP SNSR ASSY, AMB W/ ATTACHED WIRING
7	14516-XX	PANEL, ACCESS, ELEC. CHMBR, ASSY., QIK. RLSE.
	-01	240V Single phase
	-02	208V 3 Phase
	-03	460V 3 Phase
8	14517-XX	PANEL, ACCESS, ELEC. CHMBR, ASSY., BOLT ON
	-01	240V Single phase
	-02	208V 3 Phase
	-03	460V 3 Phase
9	14519	PANEL, ACCESS, COMB CHMBR, ASSY., QIK. RLSE.
10	14520	PANEL, ACCESS, COMB CHMBR, ASSY., BOLT ON
11	19293-01	MOT/IMPLR ASSY, HF400 240VAC 1PH
	19293-02	MOT/IMPLR ASSY, HF400 208/230/460VAC 3PH
	19293-03	MOT/IMPLR ASSY, HF400 575VAC 3PH
12	17436-02	LOCKING BAR, FRONT

Index	Part No.	Description
13	16685	LVL LEG ASSY, HF900/400, SCREW
14	16076	LEG, FRONT, HF400/900, BOLT ON
15	17344	BOX, TOGGLE SW LOCK OUT
16	9038-0057	SW TOGGLE, SPDT ON-OFF-ON
17	9038-0060	SW BOOT, BLACK NEOPRENE
18	15948	SURGE ISOLATOR, RAIL THERMO W/ CMPNTS
19	13032	BOX, TEMP PROBE
20	13340-01	THERMO ASSY, TEMP CNTRL, HI LIMIT
21	13340-02	THERMO ASSY, TEMP CNTRL, CYCLING
22	17895	ENCL, SNAP SW, RAIL W/ MTG
23	13340-04	THERMOSTAT ASSY, RAIL, COR
24	17056	THERMOSTAT ASSY, RAIL, COR, C/W 40' CABLE
25	13849-01	PPT SNSR, C/W 6' CABLE ASSY
26	9021-0005	VENT, CONDENSATION
27	16708-03	SW AIR, HF400, CALIBRATED
28	18784	EMS MODULE

Note: This list identifies the major components only. Recommended spare parts highlighted red.



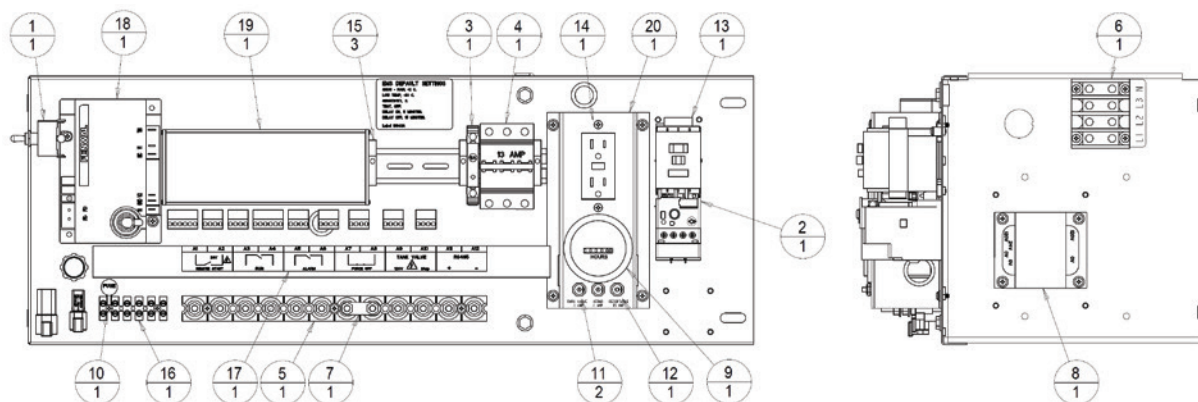
K.2 Parts-Control Panel, 240V Single Phase

Table 2 – Control Panel Parts List

Index	Part No.	Description
1	9038-0067	SW TOGGLE, DPDT ON-OFF-ON, SCREW TERM
2	9042-0044	CB, 1 POLE 5 A
3	9042-0046	CB, 2 POLE 32 A DIN RAIL MNT
4	9043-0004	BLOCK, TERM AAR 12 POLE C/W HDW
5	9043-0025	BLOCK, TERM 4 POLE, 600V 115A
6	9043-0027	JUMPER, AAR TERMINAL BLOCK
7	9064-0030	TRFRMR, CONT 120>24V & 120V 100 VA
8	9069-0015	METER, ELAPSED TIME HRS, 120VAC 60HZ
9	9077-0033	FUSE, RESETTABLE, 1.85AHOLD, 60V MAX, 3.7 TRIP CURRENT
10	9077-0034	CIRCUIT BREAKER, 1 AMP, PANEL MOUNT
11	9077-0035	CIRCUIT BREAKER, 15 AMP, PANEL MOUNT
12	9078-0043	CONTACTOR, DEFINITE PURPOSE, 2 POLE, 25AMP, 3HP, 1PH

Index	Part No.	Description
13	9078-0044	PROTECTIVE COVER, CONTACTOR, 2 POLE
14	9079-0004	RCPT, DUPLEX 15A-125V, GFCI SMARTLOCK
15	9088-1001	STOP, END, PLASTIC, 10MM W, DIN RAIL
16	17968	TB, TUBULAR, 6 POLE
17	18532	LABEL, AAR CONNECTOR, VINYL
18	18666	IGNTR MDL, GAS CNTRL W POTTED IGNITION TERMINAL
19	18679	CONTROLLER, HEATER, 24VAC I/O C/W DIN RAIL CARRIER
20	18931	BRKT, CIRCUIT INTERRUPTS & HR METER

Note: This list identifies the major components only. Recommended spare parts highlighted red.



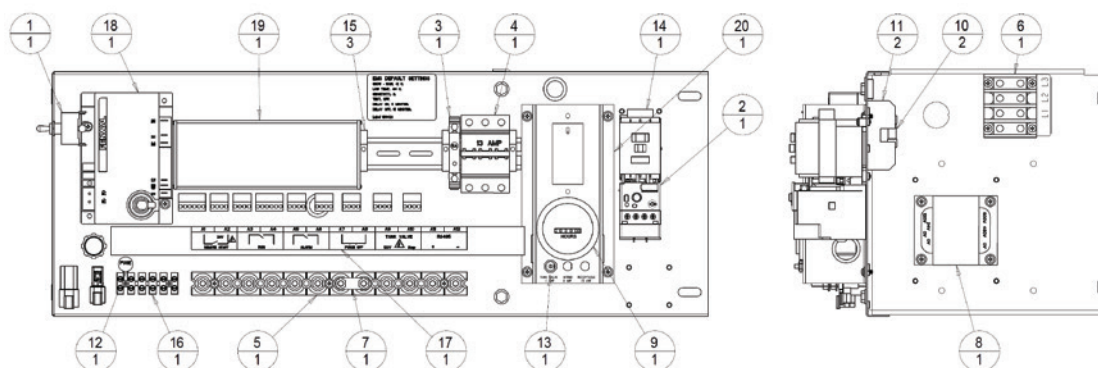
K.3 Parts - Control Panel, 208V Three Phase

Table 3 – Control Panel Parts List

Index	Part No.	Description
1	9038-0067	SW TOGGLE, DPDT ON-OFF-ON, SCREW TERM
2	9040-0151	THERMAL OVERLOAD RELAY, 3.2 - 16.0 A, 3PHASE
3	9042-0044	CB, 1 POLE 5 A
4	9042-0049	CB, 3 POLE 13A
5	9043-0004	BLOCK, TERM AAR 12 POLE C/W HDW
6	9043-0025	BLOCK, TERM 4 POLE, 600V 115A
7	9043-0027	JUMPER, AAR TERMINAL BLOCK
8	9064-0030	TRFRMR, CONT 120>24V & 120V 100 VA
9	9069-0015	METER, ELAPSED TIME HRS, 120VAC 60HZ
10	9077-0033	FUSE, RESETTABLE, 1.85AHOLD, 60V MAX, 3.7 TRIP CURRENT
11	9077-0034	CIRCUIT BREAKER, 1 AMP, PANEL MOUNT
12	9077-0035	CIRCUIT BREAKER, 15 AMP, PANEL MOUNT

Index	Part No.	Description
13	9078-0126	CONTACTOR, 12A C/W 120V COIL
14	9079-0004	RCPT, DUPLEX 15A-125V, GFCI SMARTLOCK
15	9088-1001	STOP, END, PLASTIC, 10MM W, DIN RAIL
16	17968	TB, TUBULAR, 6 POLE
17	18532	LABEL, AAR CONNECTOR, VINYL
18	18666	IGNTR MDL, GAS CNTRL W POTTED IGNITION TERMINAL
19	18679	CONTROLLER, HEATER, 24VAC I/O C/W DIN RAIL CARRIER
20	18931	BRKT, CIRCUIT INTERRUPTS & HR METER

Note: This list identifies the major components only. Recommended spare parts highlighted red.



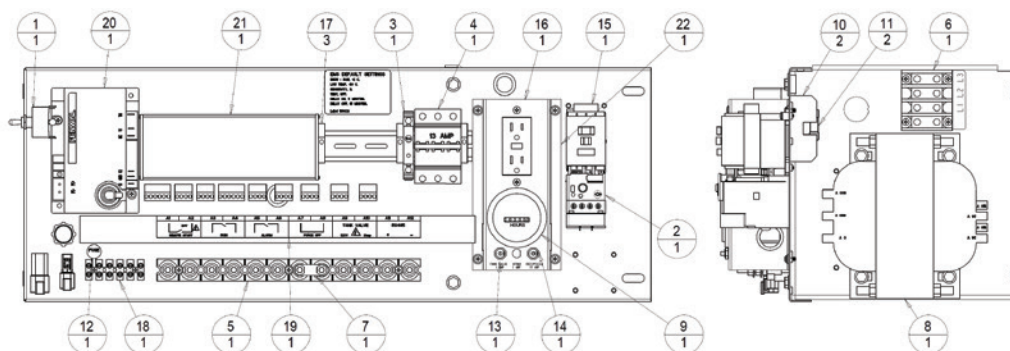
K.4 Parts - Control Panel, 460-575V Three Phase

Table 4 – Control Panel Parts List

Index	Part No.	Description
1	9038-0067	SW TOGGLE, DPDT ON-OFF-ON, SCREW TERM
2	9040-0150	THERMAL OVERLOAD RELAY, 1.0 - 5.0 A, 3PHASE
3	9042-0044	CB, 1 POLE 5 A
4	9042-0049	(For 460V) CB, 3 POLE 13A
	9042-0071	(For 575V) CB, 3 POLE 13A
5	9043-0004	BLOCK, TERM AAR 12 POLE C/W HDW
6	9043-0025	BLOCK, TERM 4 POLE, 600V 115A
7	9043-0027	JUMPER, AAR TERMINAL BLOCK
8	9064-0032	TRFRMR, CONT 460/575>24V 4A/120V .166A
9	9069-0015	METER, ELAPSED TIME HRS, 120VAC 60HZ
10	9077-0015	FUSE, 1/2 AMP 600V
11	9077-0028	FUSE HOLDER, PANEL MOUNT
12	9077-0033	FUSE, RESETTABLE, 1.85AHOLD, 60V MAX, 3.7 TRIP CURRENT

Index	Part No.	Description
13	9077-0034	CIRCUIT BREAKER, 1 AMP, PANEL MOUNT
14	9078-0126	CONTACTOR, 12A C/W 120V COIL
15	9088-1001	STOP, END, PLASTIC, 10MM W, DIN RAIL
16	17968	TB, TUBULAR, 6 POLE
17	18532	LABEL, AAR CONNECTOR, VINYL
18	18666	IGNTR MDL, GAS CNTRL W POTTED IGNITION TERMINAL
19	18679	CONTROLLER, HEATER, 24VAC I/O C/W DIN RAIL CARRIER
20	18931	BRKT, CIRCUIT INTERRUPTS & HR METER

Note: This list identifies the major components only. Recommended spare parts highlighted red.



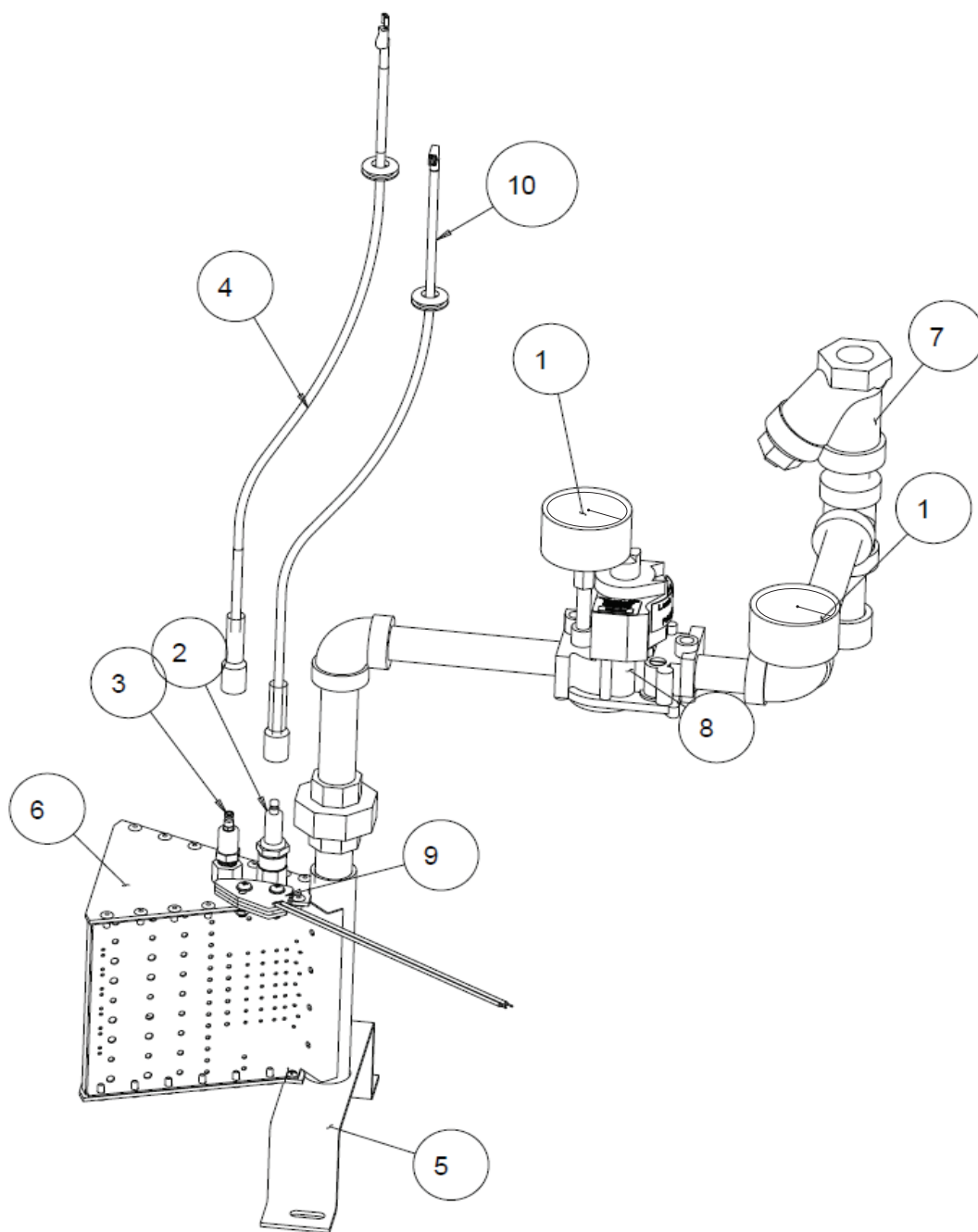
K.5 Parts - Control Panel, 460-575V Three Phase with 120V Duplex Receptacle

Table 5 – Control Panel Parts List

Index	Part No.	Description
1	9038-0067	SW TOGGLE, DPDT ON-OFF-ON, SCREW TERM
2	9040-0150	THERMAL OVERLOAD RELAY, 1.0 - 5.0 A, 3PHASE
3	9042-0044	CB, 1 POLE 5 A
4	9042-0049	(For 460V) CB, 3 POLE 13A
	9042-0071	(For 575V) CB, 3 POLE 13A
5	9043-0004	BLOCK, TERM AAR 12 POLE C/W HDW
6	9043-0025	BLOCK, TERM 4 POLE, 600V 115A
7	9043-0027	JUMPER, AAR TERMINAL BLOCK
8	9064-0033	TRFRMR, CONT 460/575>120V 15A/24V 4A
9	9069-0015	METER, ELAPSED TIME HRS, 120VAC 60HZ
10	9077-0028	FUSE HOLDER, PANEL MOUNT
11	9077-0032	FUSE, 5 AMP 600V TIME DELAY FUSE
12	9077-0033	FUSE, RESETTABLE, 1.85AHOLD, 60V MAX, 3.7 TRIP CURRENT

Index	Part No.	Description
13	9077-0034	CIRCUIT BREAKER, 1 AMP, PANEL MOUNT
14	9077-0035	CIRCUIT BREAKER, 15 AMP, PANEL MOUNT
15	9078-0126	CONTACTOR, 12A C/W 120V COIL
16	9079-0004	RCPT, DUPLEX 15A-125V, GFCI SMARTLOCK
17	9088-1001	STOP, END, PLASTIC, 10MM W, DIN RAIL
18	17968	TB, TUBULAR, 6 POLE
19	18532	LABEL, AAR CONNECTOR, VINYL
20	18666	IGNTR MDL, GAS CNTRL W POTTED IGNITION TERMINAL
21	18679	CONTROLLER, HEATER, 24VAC I/O C/W DIN RAIL CARRIER
22	18931	BRKT, CIRCUIT INTERRUPTS & HR METER

Note: This list identifies the major components only. Recommended spare parts highlighted red.



K.6 Parts - Gas Components

Table 6 – Gas Components

Index	Part No.	Description
1	9069-1020	GAUGE, PRESS, 0-30"WC 1/8NPT
2	14970	IGNTR, SPARK GENERAL, COATED W/BORON
3	14978	ROD, FLAME 3"L 1/4"NPT
4	15165-05	CABLE ASSY, FLAME ROD 22"L P/NG HF400
5	16659	BRKT, BURNER, HF400 COMB CHMBR
6	16729	BURNER ASSY, 400 KBTU/HR
7	16984	DIRT TRAP GAS INTAKE 3/4" NPT C/W Y-STRN

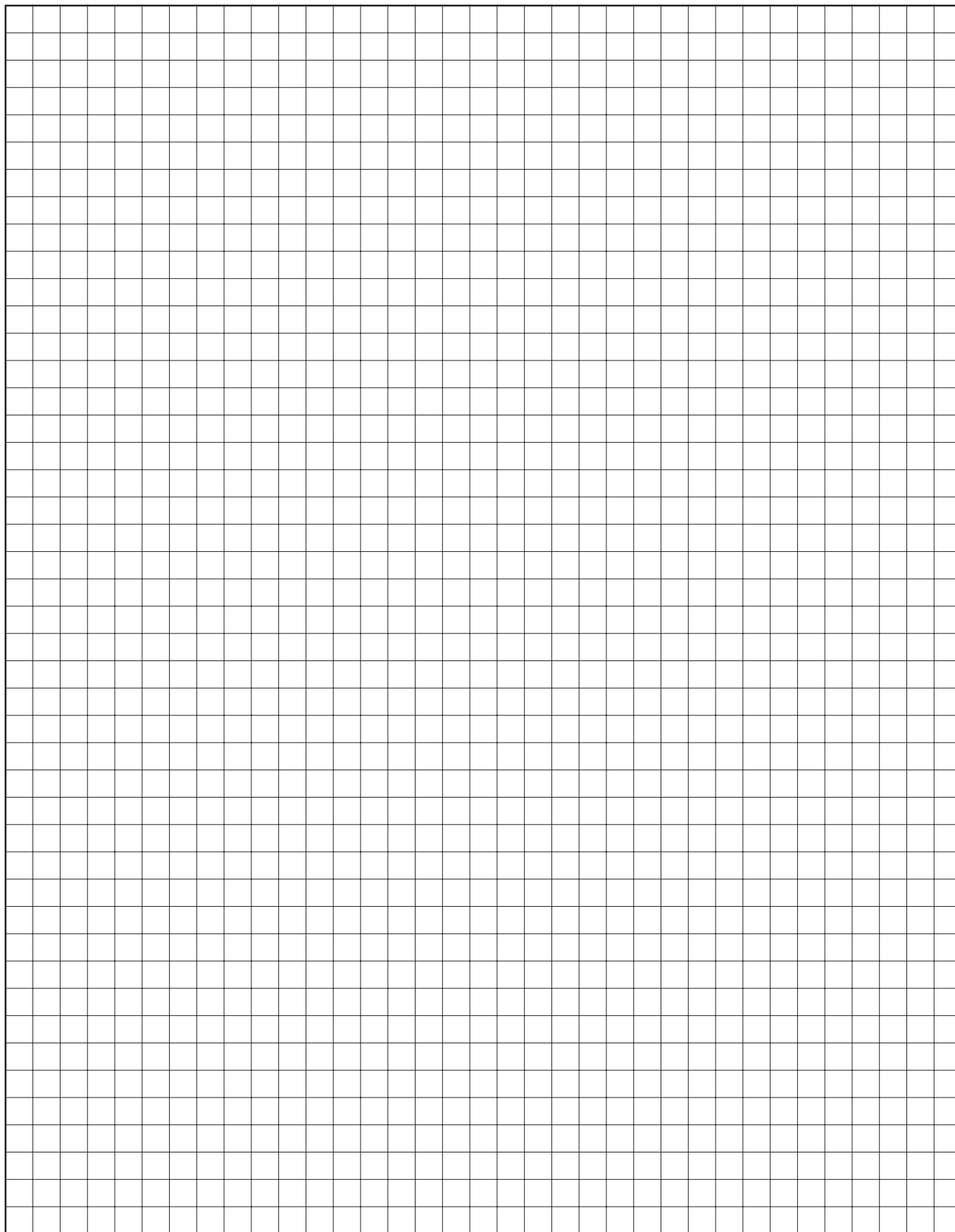
Index	Part No.	Description
8	17450	VALVE, GAS CONTROL, DIRECT SPARK IGN
9	17981	HEATER, SURF. MNT. 30W, 24VAC W/ LEADS
10	19033	CABLE ASSY, IGN 17"L P/NG HF400 2014, FENWAL

Note: This list identifies the major components only. Recommended spare parts highlighted red.

NOTES

This image shows a full page of blank graph paper. The grid consists of small, equal-sized squares formed by thin black lines. There are no margins, text, or other markings on the page.

NOTES





Hellfire™

PLEASE ADHERE TO INSTRUCTIONS IN THIS MANUAL

Failure to do so may be dangerous and may void certain provisions of your warranty.

For further assistance, please call 1.855.244.3128

WARRANTY: Under normal use the Company warrants to the purchaser that defects in material or workmanship will be repaired or replaced without charge (from date of shipment) for a period of:

- 84 months - SwitchBlade® Heaters
- 60 months - DC Heaters
- 36 months - DC Control Panels
- 36 months - HELLFIRE Heaters, FEB Heaters
- 12 months - All other Fastrax® Products

Any claim for warranty must be reported to the sales office where the product was purchased for authorized repair or replacement within the contract terms.

Subject to State or Provincial law to the contrary, the Company will not be responsible for any expense for installation, removal from service, transportation, or damages of any type whatsoever, including damages arising from lack of use, business interruptions, or incidental or consequential damages.

The Company cannot anticipate or control the conditions of product usage and therefore accepts no responsibility for the safe application and suitability of its products when used alone or in combination with other products. Tests for the safe application and suitability of the products are the sole responsibility of the user.

This warranty will be void if, in the judgment of the Company, the damage, failure or defect is the result of:

- Vibration, radiation, erosion, corrosion, process contamination, abnormal process conditions, temperature and pressures, unusual surges or pulsation, fouling, ordinary wear and tear, lack of maintenance, incorrectly applied utilities such as voltage, air, gas, water, and others or any combination of the aforementioned causes not specifically allowed for in the design conditions
- Or, any act or omission by the Purchaser, its agents, servants or independent contractors which for greater certainty, but not so as to limit the generality of the foregoing, includes physical, chemical or mechanical abuse, accident, improper installation of the product, improper storage and handling of the product, improper application or the misalignment of parts.

No warranty applies to paint finishes except for manufacturing defects apparent within 30 days from the date of installation.

The Company neither assumes nor authorizes any person to assume for it any other obligation or liability in connection with the product(s).

The Purchaser agrees that all warranty work required after the initial commissioning of the product will be provided only if the Company has been paid by the Purchaser in full accordance with the terms and conditions of the contract.

The Purchaser agrees that the Company makes no warranty or guarantee, express, implied or statutory, (including any warranty of merchantability or warranty of fitness for a particular purpose) written or oral, of the Article or incidental labour, except as is expressed or contained in the agreement herein.

LIABILITY: Technical data contained in the catalog or on the website is subject to change without notice. The Company reserves the right to make dimensional and other design changes as required. The Purchaser acknowledges the Company shall not be obligated to modify those articles manufactured before the formulation of the changes in design or improvements of the products by the Company.

The Company shall not be liable to compensate or indemnify the Purchaser, end user or any other party against any actions, claims, liabilities, injury, loss, loss of use, loss of business, damages, indirect or consequential damages, demands, penalties, fines, expenses (including legal expenses), costs, obligations and causes of action of any kind arising wholly or partly from negligence or omission of the user or the misuse, incorrect application, unsafe application, incorrect storage and handling, incorrect installation, lack of maintenance, improper maintenance or improper operation of products furnished by the Company.