

Installation & Operation Guide

Industrial Non Re-circulating Direct-Fired Heaters

Horizontal / Vertical and Single / Twin Blowers



<p style="text-align: center;"><u>FOR YOUR SAFETY</u></p> <p>If you smell gas:</p> <ol style="list-style-type: none"> 1. Open windows 2. Don't touch electrical switches 3. Extinguish any open flames 4. Immediately call your gas supplier 	<p style="text-align: center;"><u>FOR YOUR SAFETY</u></p> <p>The use and storage of gasoline or other flammable vapors and liquids in open containers in the vicinity of this appliance is hazardous!</p>
<p><u>WARNING!!</u></p> <p>Improper installation, adjustment, alteration, service or maintenance can cause property damage, injury or death. Read the installation, operating and maintenance instructions thoroughly before installing or servicing this equipment. ALWAYS disconnect power and gas before working on heater.</p>	
<p><u>RECEIVING AND INSPECTION</u></p> <p>Upon receiving unit, check for any interior or exterior damage, and if found, report it immediately to the carrier. Also check that all accessory items are accounted for and are damage free. Turn the blower wheel by hand to verify free rotation and check the damper (if supplied) for free operation.</p>	
<p style="text-align: center;"><u>NOTE TO INSTALLER</u></p> <p>Please complete and return the Start-Up Checklist on the back of this manual to validate warranty</p>	<p style="text-align: center;"><u>NOTE TO INSTALLER</u></p> <p>This manual should be reviewed with the customer and left with the equipment user</p>

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WARRANTY

This equipment is warranted to be free from defects in materials and workmanship, under normal use and service, for a period of 24 months from date of shipment. This warranty shall not apply if:

- The equipment is not installed by a qualified installer per the manufacturer's installation instructions shipped with the product.
- The equipment is not installed in accordance with federal, state and local codes and regulations.
- The equipment is misused or neglected.
- The equipment is not operated within its published capacity.
- The invoice is not paid within the terms of the sales agreement.
- The Start-Up Checklist has not been filled in by a qualified technician and returned to the Factory Service Department.

The manufacturer shall not be liable for incidental and consequential losses and damages potentially attributable to malfunctioning equipment. Should any part of the equipment prove to be defective in material or workmanship within the 24 month warranty period, upon examination by the manufacturer, such part will be repaired or replaced by manufacturer at no charge. The buyer shall pay all labor costs incurred in connection with such repair or replacement. Equipment shall not be returned without manufacturer's prior authorization and all returned equipment shall be shipped by the buyer, freight prepaid to a destination determined by the manufacturer.

NOTE TO INSTALLER

Please complete and return the
Start-Up Checklist on the back of this manual to validate warranty

INSTALLATION

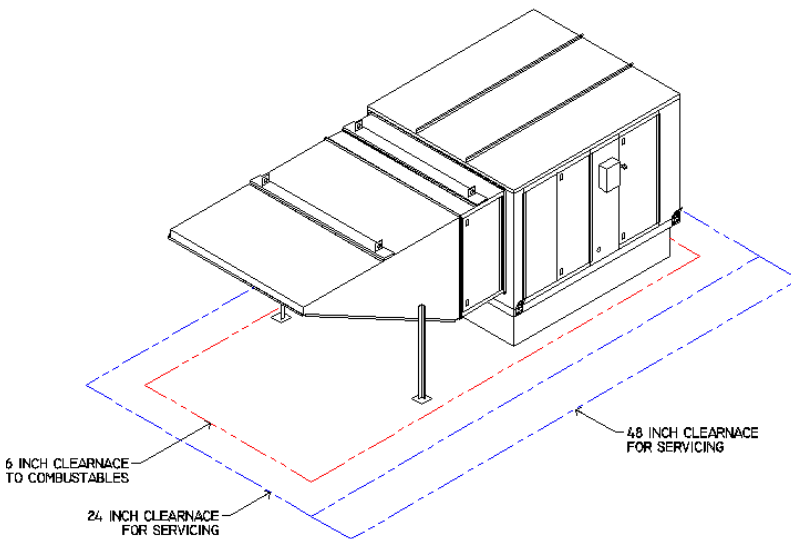
It is imperative that this unit is installed and operated with the designed airflow, gas, and electrical supply in accordance with this manual. Any variance to these instructions may cause the unit to not perform to specifications and may cause severe damage to the unit or jobsite. Please call the service department at **866-784-6900** for assistance on warranty issues and technical support.

Inspection on Arrival

1. Inspect the unit on delivery.
2. Photograph any visible damage.
3. Report any damage to the delivery carrier.
4. Request written inspection report from the Claims Inspector to substantiate a claim.
5. File claim with delivery carrier
6. Check unit's rating plate to verify proper electric and fuel type meet job requirements.
7. Compare unit received to description of product ordered.

Unit Location

1. Do not locate any gas-fired equipment near corrosive or explosive vapors such as chlorinated or acid vapors
2. Avoid overhead power lines, or other utility access to prevent accidental contact or damage.
3. Provide clearance around the installation site to safely rig and lift the equipment into its final position onto adequate supports. Refer to the manufacturer's estimated weights.
4. Consider general service and installation space when locating the unit.
5. Locate the unit close to the space it will serve to reduce long, twisted duct runs.
6. Do not allow the air intake to face prevailing winds. The air flow switch may trip in high winds.
7. Situate the unit above ground or at roof level high enough to prevent precipitation from being drawn into its inlet.
8. The inlet must also be located at least 10 feet away from any exhaust vents.
9. The heater inlet must be located in accordance with the applicable building code provisions for ventilation air.
10. All air to the heater must be ducted from the outdoors.
11. Recirculation of room air is not permitted. If in doubt regarding the application, consult the manufacturer.
12. The unit must have adequate structural support or the equipment or building could be damaged.
13. Do not alter or otherwise restrict combustion or ventilation openings.
14. Direct-fired units should not be installed downstream from cooling systems which use refrigerants for cooling.



COMBUSTABLE CLEARANCES

The top, back, and front surfaces of this heater may not be installed less than 6 inches from combustible materials. The heater base may be installed on combustible surfaces.

SERVICE CLEARANCES

Allow 24 inches or greater minimum service clearance on all sides of this heater. Allow 48 inches or greater on the vestibule and blower door side.

Rigging

1. Horizontal units are supplied with four lifting lugs on the bottom corners of the casing.
2. Vertical units are supplied with four lifting lugs at the top corners of the casings.
3. Lift the unit and accessories separately, attach the accessories to the unit once the unit is in place.
4. The following diagrams represent the proper methods for lifting the unit and accessories.
5. Always use spreader bars to prevent damage to the unit casing.

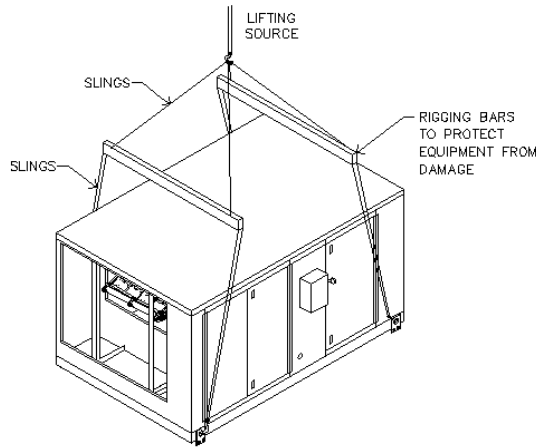


FIGURE 1: SIZE 10, 12, 15, & 18

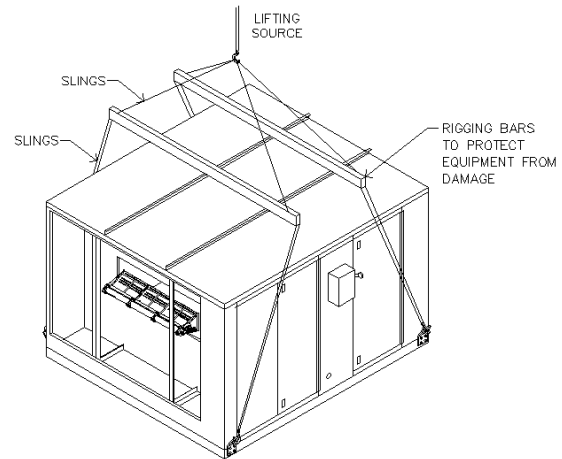


FIGURE 2: NO SPREADER BARS

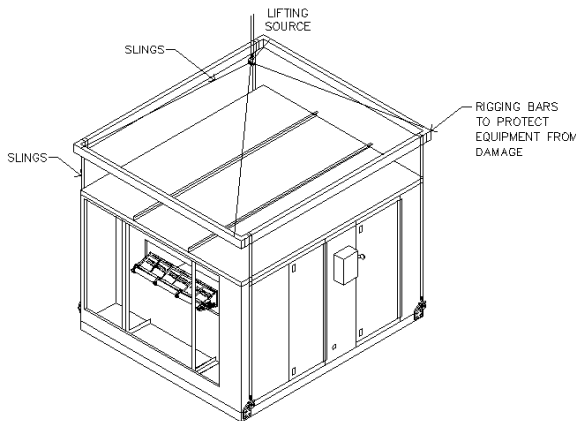


FIGURE 3: WITH SPREADER BARS

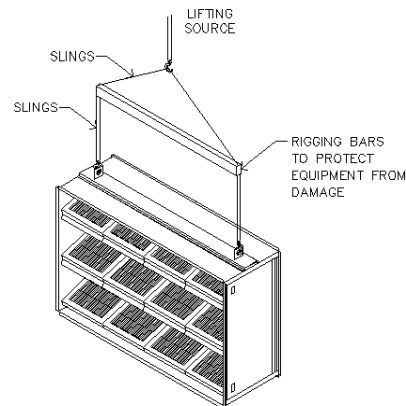


FIGURE 4: ACCESSORIES

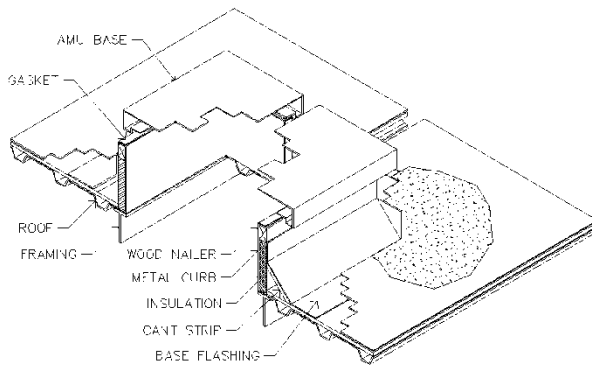
CAUTION!!
THESE ARE UNBALANCED LOADS. LIFT EQUIPMENT GENTLY. DO NOT JERK.

WARNING!!
Spreader bars must be used and should extend past the edges of the equipment to avoid damage to the casing. Not using spreader bars may cause damage to the casing.

WARNING!!
Damage will result if the equipment is raised by the intake hood, blower, motor shaft, or bearings
Use the provided lifting eyes and brackets on the unit.

Curbs

The unit must have adequate structural support or the equipment or building could be damaged. The curb and unit must be leveled or the unit may leak or be damaged. Use gasketing and caulk between the curb and unit. Use shims if necessary to level the unit. Screw or weld the unit's base to the curb to avoid damage to the equipment.



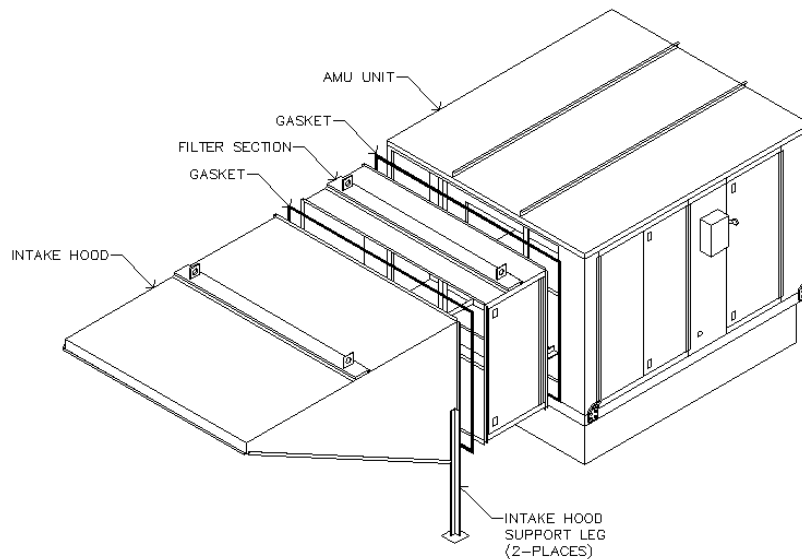
WARNING!!
The unit must have adequate structural support or the equipment or building could be damaged.

WARNING!!
Screw or weld the unit's base to the curb to avoid damage to the equipment.

WARNING!!
The curb and unit must be leveled or the unit may leak or be damaged.

Accessories

Intake and discharge accessories are shipped loose and unassembled. When attaching the accessories to the unit use gasketing, caulk, and #10 sheet metal screws on all seams. All accessories must be level.



WARNING!!
Use gasketing, caulk, and #10 sheet metal screws on all component intersections. Leaking may result if the intersections are not completed properly.

WARNING!!
The accessories must be level and support legs attached to the hood and solid part of the roof. Equipment that is not level or properly supported may leak or be damaged.

Split Units

1. Apply weather-proof gasketing to the seam of the vertical or horizontal unit if not present
2. Use provided fasteners to secure the seam of the unit using the provided pre-punched holes
 - Horizontal units have internal channels and a formed frame
 - Vertical units have angles on the outside of the casing
3. Apply silicone to the outside edge of the seam
4. Field wire the discharge air sensor using a minimum 22 gauge wire
5. Mount the high temperature limit bulb to the blower housing
6. Mount the (optional) freeze control sensor to the blower housing

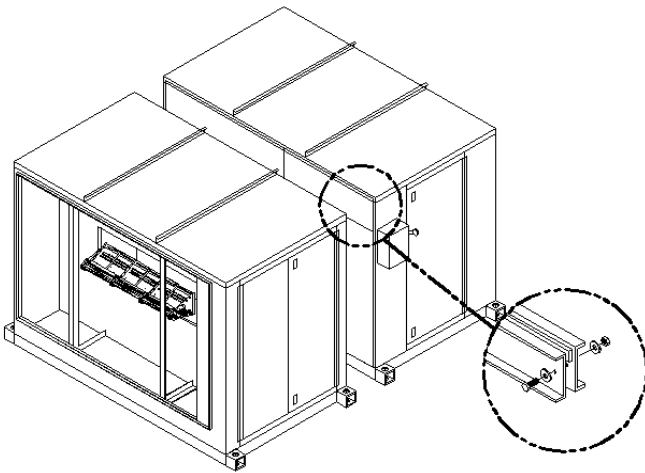


FIGURE 1: HORIZONTAL SPLIT ASSEMBLY

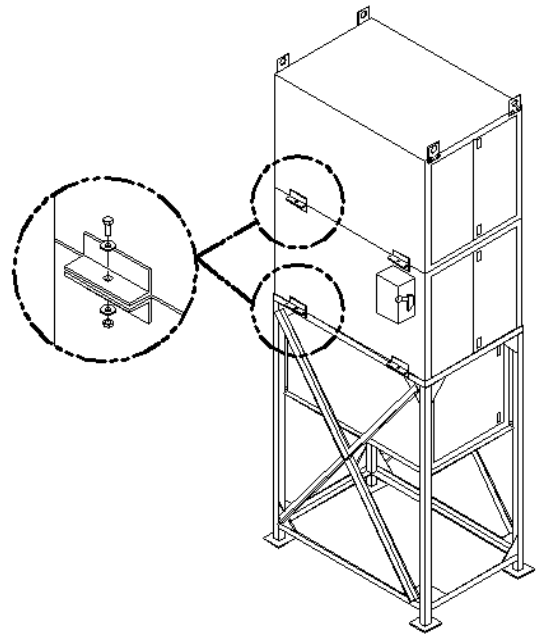


FIGURE 2: VERTICAL SPLIT ASSEMBLY

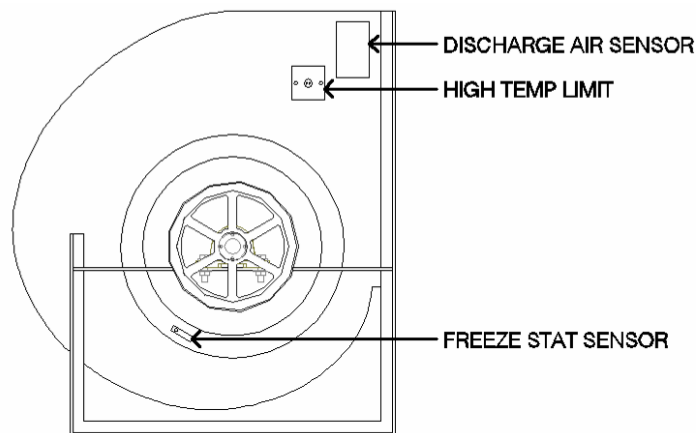


FIGURE 3: BLOWER SENSOR FIELD ASSEMBLY

Loose Shipped Intake or Discharge Dampers

In some cases an intake or discharge damper may be shipped loose. This may be requested by the customer or can be required because of larger units shipping size restrictions. Follow these instructions to attach and wire the loose shipped damper. Factory mounted dampers may be attached on the unit and will not require assembly or field wiring.

1. Attach the damper to the intake or discharge using gasketing, caulk, and #10 sheet metal screws.
2. Up discharge units should have a damper installed at building wall.
3. Field wire the damper using the as built wiring schematic for the specific unit. Wiring may be different depending on the model and options selected.
4. Refer to the factory supplied wiring print to verify the field wiring terminals.

Ductwork

This fan was specified for a specific CFM and static pressure. The ductwork attached to this unit will significantly affect the airflow performance.

WARNING!!

- **Flexible ductwork and square elbows should not be used.**
- **Transitions and turns in ductwork near the fan outlet will cause system effect and will drastically increase the static pressure and reduce airflow.**
- **The Ductwork Sizing Chart shows the minimum fan outlet duct sizes and straight lengths required for optimal fan performance.**
- **Units with twin blowers must have a common discharge plenum.**
- **Do not use unit to support ductwork in any way. This may cause damage to the unit.**

Follow SMACNA guides and manufacturer's requirements for the remaining duct run. Fans designed for rooftop installation should be installed on a prefabricated or factory-built roof curb. Follow the curb manufacturer's instructions for proper curb installation. It is recommended that an outdoor unit be installed on a curb and/or rail elevated so the intake is not less than 20" above any surface. Be sure the duct connection and fan outlet are properly aligned and sealed.

Adequate building relief is necessary in order to prevent over-pressurizing the building when the heater is operating at capacity. This can be accomplished by establishing properly-sized relief openings, an interlocked exhaust system, or both.

Heaters installed with intake ductwork must be purged to replace at least four air changes of the volume of the intake duct.

In order to avoid hazards to other fuel-burning equipment in the building (i.e., when the heater is providing make-up air to a boiler room), the unit should be interlocked to open inlet air dampers or other such devices.

On outdoor installations, it is recommended that the discharge duct be insulated to prevent condensation during the "OFF" cycle in cold weather.

Units being installed in **airplane hangars** should be installed in accordance with the Standard for Aircraft Hangars, ANSI/NFPA 409. Units being installed in **public garages** should be installed in accordance with the Standard for Parking Structures, ANSI/NFPA 88A, or the Standard for Repair Garages, ANSI/NFPA 88B, and with CAN/CGA B149 Installation Codes.

Flexible connectors should be employed on all ductwork connections. Vibration isolators are optional and can be supplied in the loose parts package.

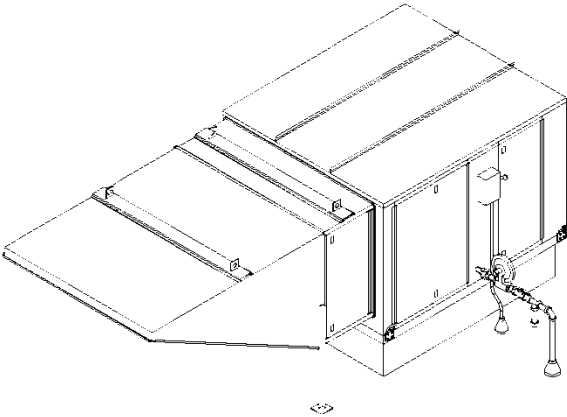
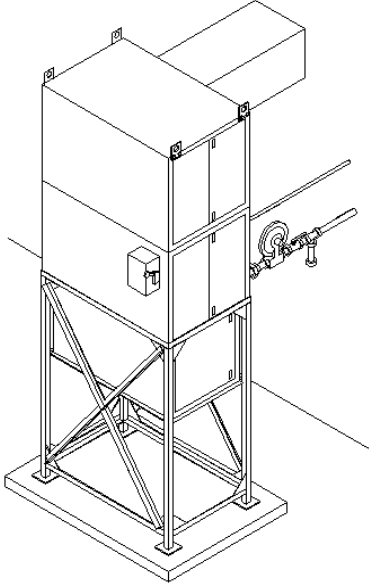
Ductwork Sizing Chart Single Blower		
Blower Size	Duct Size (Inches)	Duct Length (Inches)*
10	14 x 14	54
12	16 x 16	54
15	20 x 20	54
18	24 x 24	78
20	26 x 26	102
22	30 x 30	114
25	32 x 32	156
27	36 x 36	162
30	38 x 38	174
33	44 x 44	174
36	44 x 44	198

Ductwork Sizing Chart Dual Blowers		
Blower Size	Duct Size (Inches)	Duct Length (Inches)*
222	77 x 28	156
225	88 x 32	168
227	96 x 36	180
230	104 x 38	198
233	116 x 44	204
236	122 x 44	222

WARNING!!
 Failure to properly size the ductwork may cause system effects and reduce the performance of the equipment.
 Do not use the unit to support the ductwork, this may cause damage to the unit's casing.

*Minimum straight discharge duct length required before fitting/transition.

Installation Examples

	
<p>Figure 1: Horizontal Roof Top Installation</p> <ul style="list-style-type: none"> <input type="checkbox"/> Down discharge AMU reduces ductwork <input type="checkbox"/> Hood weight supported by support legs <input type="checkbox"/> Union, regulator, and shut-off <input type="checkbox"/> Roof curb supports unit <input type="checkbox"/> Intake facing away from prevailing winds 	<p>Figure 2: Vertical Outdoor Ground Installation</p> <ul style="list-style-type: none"> <input type="checkbox"/> Side discharge AMU reduces ductwork <input type="checkbox"/> Support stand on concrete pad <input type="checkbox"/> Union, regulator, and shut-off <input type="checkbox"/> Filter section inside support stand <input type="checkbox"/> Ease of serviceability on ground

Gas

Gas piping must be installed to conform with local building codes, or in the absence of local codes, the National Fuel Gas Code, ANSI Z223.1 (NFPA 54) – latest edition. In Canada, gas piping must be installed in accordance with CAN/CGA-B149.1 for natural gas units and CAN/CGA-B149.2 for propane units.

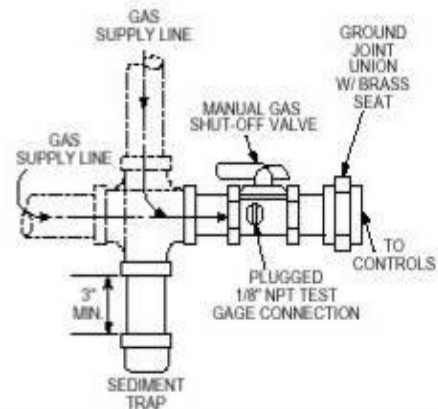
WARNING

Inlet gas pressure must not exceed pressure indicated on the name plate.

Refer to the heater rating plate for determining the minimum gas supply pressure for obtaining the maximum gas capacity for which this heater is specified.

1. Always **disconnect power** before working on or near a heater. Lock and tag the disconnect switch or breaker to prevent accidental power-up.
2. Piping to the unit should conform to local and national requirements for type and volume of gas handled, and pressure drop allowed in the line. Refer to the Gas Engineer's Handbook for gas line capacities.
3. The incoming pipe near the heater should be sized to match the connection on the outside of the unit. Unit inlet sizes are shown in the table to the right. Avoid multiple taps in the gas supply so the unit has a steady supply of gas at all times.
4. Install a ground joint union with a brass seat and a manual shut-off valve external to the unit casing, as shown below, adjacent to the unit for emergency shut-off and easy servicing of controls.
5. Provide a sediment trap, as shown below, before each unit and where low spots in the pipe line cannot be avoided.
6. Blow out the gas line to remove debris before making connections. Before starting the unit, purge the line to remove air. Purge air from gas lines according to ANSI Z223.1-latest edition "National Fuel Gas Code," or in Canada: CAN/CGA-B149.
7. All field gas piping must be pressure/leak tested prior to operating the unit. Use a soap solution or equivalent for leak testing. The heater and its individual shut-off valve must be disconnected from the gas supply piping system during any pressure testing of that system at test pressures in excess of ½ PSI. During any pressure testing of the gas supply piping system at test pressures equal to or less than ½ PSI, the heater must be isolated from the gas supply piping system and its individual manual shutoff valve closed.
8. This unit requires the gas pressure to be within the unit's minimum and maximum gas pressure ratings. If the pressure is greater than the maximum, the internal valve components will be damaged. If the pressure is below the minimum, the heater will not perform to specifications.
9. If installing on a paint booth application, a manual shutoff should be located for access in case of a fire or explosion at the heater.

Gas Connection Diagram



Electrical

Before connecting power to the heater, read and understand this entire section. Wiring diagrams are furnished with each fan by the factory, and are attached to the door of the unit.

WARNING!!

Disconnect power before installing or servicing fan. High voltage electrical input is needed for this equipment. This work should be performed by a qualified electrician.

Electrical wiring must be done in accordance with local ordinances and the National Electric Code, ANSI/NFPA70. Be sure the voltage and phase of the power supply and the wire amperage capacity conform to those listed on the motor nameplate. For additional safety information, refer to AMCA publication 410-96, "Recommended Safety Practices for Users and Installers of Industrial and Commercial Fans."

1. Always **disconnect power** before working on or near a heater. Lock and tag the disconnect switch or breaker to prevent accidental power-up.
2. A dedicated circuit should supply the units electrical disconnect with circuit protection, according to the National Electric Code.
3. Make certain that the power source is compatible with the requirements of your equipment. The heater nameplate identifies the **proper phase and voltage** of the motor.
4. Units shipped with an optional remote panel have two electrical circuit. It is important to run the motor wires in a conduit separate from the remote control wiring. The DC wires from the unit temperature controller, located in the control drop, should be either in shielded cable or run in a separate conduit.
5. Before connecting the heater to the building power source, verify the power line wiring is de-energized.
6. Secure the power cables to prevent contact with sharp objects.
7. Do not kink power cable and never allow the cable to come in contact with oil, grease, hot surfaces or chemicals.
8. Before powering up the heater, check fan wheel for free rotation and make sure that the interior of the heater is free of loose debris or shipping materials.
9. If necessary, the original wire supplied with the heater may be replaced with type TW wire or the equivalent.

Copper Wire Ampacity

Wire Size AWG	Maximum Amps
14	20
12	25
10	30
8	40
6	55
4	70

Remote Control Panel

For units with the remote control panel, **a terminal strip inside the panel matches the terminals in the heater unit.** Consult the as built wiring print supplied with the equipment. Most remote panels and VAV applications have signal wiring which needs to be shielded cable or in a separate conduit to avoid voltage interference.

Power Supply Wiring

The unit's input power supply is listed on the unit nameplate. If the unit's power supply does not match the unit nameplate, contact the service department for a new wiring print and parts.

Variable Frequency Drive (VFD) Installation Instructions

Input AC Power

1. Circuit breakers feeding the VFDs are recommended to be thermal-magnetic and fast acting. They should be sized based on the VFD amperage and according to the table below. Refer to the installation schematic for exact breaker sizing.
2. Each VFD should be fed by its own breaker. If multiple VFDs are to be combined on the same breaker, each drive should have its own protection measure (fuses or miniature circuit breaker) downstream from the breaker.
3. Input AC line wires should be run in conduit from the breaker panel to the drives. AC input power to multiple VFDs can be run in a single conduit if needed. **Do not combine input and output power cables in the same conduit.**
4. The VFD should be grounded on the terminal marked PE. A separate insulated ground wire must be provided to each VFD from the electrical panel. This will reduce the noise being radiated in other equipment.

ATTENTION!

DO NOT CONNECT INCOMING AC POWER TO OUTPUT TERMINALS U, V, W. SEVERE DAMAGE TO THE DRIVE WILL RESULT. INPUT POWER MUST ALWAYS BE WIRED TO THE INPUT L TERMINAL CONNECTIONS (L1, L2, L3)

VFD Output Power

1. Motor wires from each VFD to its respective motor **MUST** be run in a **separate steel** conduit away from control wiring and incoming AC power wiring to avoid noise and crosstalk between drives. An insulated ground must be run from each VFD to its respective motor. Do not run different fans output power cables in the same conduit.
2. Load reactors: If the distance between the VFD and the motor is great, a load reactor should be used between the VFD and the motor. The output reactor should be sized accordingly and installed within 10 feet of the output of the VFD. 208/230V – Load reactor should be used when distance exceeds 250 feet. 460/480V – Load reactor should be used when distance exceeds 50 feet. 575/600V – Load reactor should be used when distance exceeds 25 feet.
3. If the distance between the VFD and the motor is extremely long, up to 1000 FT, a dV/dT filter should be used and the VFD should be increased by 1 HP or to the next size VFD. The dV/dT filter should be sized accordingly and installed within 10 feet of the output of the VFD.
208/230V – dV/dT filter should be used when distance exceeds 400 feet.
460/480V – dV/dT filter should be used when distance exceeds 250 feet.
575/600V – dV/dT filter should be used when distance exceeds 150 feet.
4. No contactor should be installed between the drive and the motor. Operating such a device while the drive is running can potentially cause damage to the power components of the drive.
5. When a disconnect switch is installed between the drive and motor, the disconnect should only be operated when the drive is in a STOP state.

Paint Booth Applications

If a low temperature control is not an integral part of the heater, it is recommended that one be installed in areas where freeze protection is needed in the event of a burner shutdown. The space should be ventilated (100% outside air) preceding/proceeding a bake cycle a minimum 3 minutes or 4 air changes, whichever is greater to purge any contaminants and cool product prior to personnel entering the space. If the unit was supplied with paint booth controls from the factory, refer to the schematic for installation of the interlock to disable spraying equipment unless the heater is operating in ventilation mode. Refer to electrical schematic for interlock to disable facility lighting within the process space during the bake cycle.

SEQUENCE OF OPERATIONS

Description of Operation

Designed for indoor or outdoor installation, the Direct Fired Gas Heater draws fresh outside air over a gas-fired burner. The unit is equipped to fire with natural or propane gas. Units are designed for modulated firing of the burner, based on the discharge-air temperature or room temperature requirement.

Standard Sequence of Operation

1. With disconnect in the ON position and the remote control panel (or other device) calling for unit operation, power is supplied to the damper motor, if equipped.
2. When the damper motor approaches the OPEN position, the damper-end switch closes, energizing the motor contactor and powering the blower motor or enabling the VFD if equipped.
3. Power is supplied to the damper motor through the low-temperature limit control, if equipped. After ten minutes, the low-temperature limit control disables the unit if discharge temperature is continually below the temperature setting on the low limit control.
4. When the low airflow switch and high airflow switch (VFD only) are proven, the flame safety relay is energized through the high-temperature limit control, the optional low and/or high gas pressure switches, and the burner on/off intake air thermostat. The pilot valve opens, and the ignition transformer energizes.
5. After the flame rod detects flame, the main valves are energized and the ignition transformer de-energizes.
6. The temperature control system monitors the discharge air and modulates DC voltage to the modulating valve to maintain desired discharge temperature.

Additional Sequence of Operation – All VFD Motor Control

1. During lower speeds, the low-speed potentiometer increases the resistance going to the modulating valve to limit temperature rise.
2. VFD contacts are included in the burner control circuit to disable the burner should a fault condition occur in the VFD.

VFD by Others Profile Bypass Damper

As the VFD increases and decreases speed the profile air flow switch modulates the VAV bypass damper motor to maintain proper pressure drop across the burner profile.

Factory VFD Profile Bypass Damper

The VFD produces a 0-10vdc or a 4-20ma signal to the profile damper motor which modulates the profile damper's opening to maintain the burner profile pressure drop. The range of this modulation must coincide with the VFD operating range.

VFD Preset Speeds

Inputs are made to the VFD to engage programmable pre-set speeds. A factory-supplied VFD wiring and programming instruction sheet comes with every unit. Consult the as-built schematics and the VFD manual for additional information.

Manual Potentiometer Adjustment – VFD

A 10k-15k ohm potentiometer may be field supplied and installed if the remote manual control is required for the VFD. See VFD manual for proper installation.

Static Pressure Control (Photohelic) – VFD

The VFD can be controlled by a building static pressure control. This controller will sense the difference between pressure inside the building, and pressure outside the building and will control the operating speed of the VFD to maintain the pressure setting on the controller. The controller has two set points and an indicator. The two set points are a minimum desired static pressure point, and a maximum static pressure point.

When building static pressure is below the minimum setting, the VFD will increase the blower RPM to increase airflow. If the building static is above maximum setting, the VFD will decrease the blower RPM. When building static pressure is between the minimum and maximum settings, no signal is given to change VFD speed.

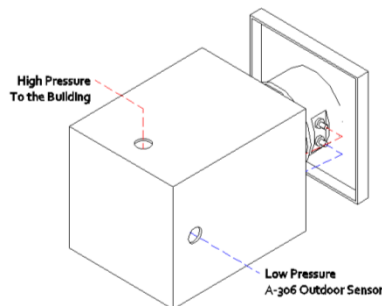
See additional wiring and installation information on the static pressure controller and outdoor sensor. The static pressure controller can be ordered to be shipped loose or mounted inside the unit to reduce field wiring and assembly.

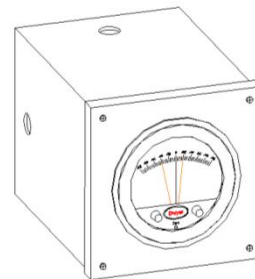
Static Pressure Controller Installation Instructions

Avoid locating the front of the static pressure controller in sun light or other areas with high ambient light or corrosive levels. Bright light shining on the photocells can cause false actuation of the load relays.

The static pressure controller should be zeroed out before attaching the low and high pressure hoses. The zero adjustment is located between the minimum and maximum dials.

Using the supplied rubber tubing, the high side of the static pressure controller should be plumbed to the inside of the building. The low side of the static pressure controller should be plumbed to an outdoor sensor.





Outdoor Sensor

Use the installation instructions shipped with the outdoor sensor.

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PROFILE ADJUSTMENTS & TEST/BALANCE

Test and Balance

The burner profile area has been set according to the design conditions submitted with the order. At the design SCFM, the profile pressure drop will be 0.45 in w.c. Any variations of the design conditions will lead to a variance of the unit's CFMs. Increase or decrease the rpms as needed to achieve the design burner profile pressure drop, or follow the below profile adjustments. An accurate duct traverse is not possible without an adequate length of straight ductwork available.

VAV Profile

The Direct-Fired Gas, make-up heater requires the correct air flow velocity across the burner. The air flow switch monitors the profile pressure differential, and will open the burner circuit if pressure difference is not within the allowed range. The air flow switches have low and high pressure settings for variable air volume units. The pressure drop should not be near the minimum and maximum of the air flow switch. Profile adjustment may be required to fine tune the burner profile pressure drop. See the specifications and instructions below on air balancing a 100% fresh air heater.

Single-Speed Profile

The pressure drop should be checked with the burner OFF if ambient temperature is greater than 60 degrees Fahrenheit. If the ambient temperature is lower than 60 degrees Fahrenheit, the burner should be operating and discharging approximately 70 degrees Fahrenheit. An extra set of airflow probes have been installed to ease in checking profile differential.

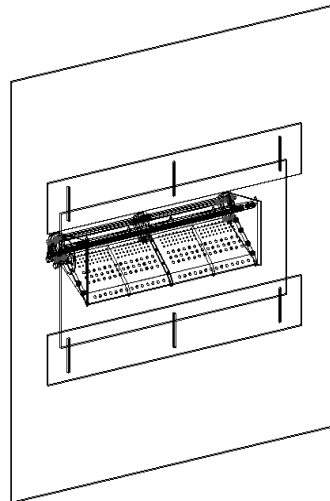
WARNING!!

Disconnect power and close all gas valves before and while making burner profile adjustments.

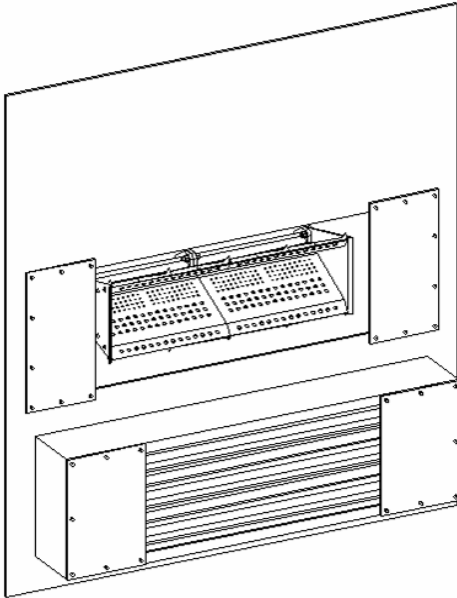
Single-Speed Profile

If the pressure drop is too low, adjust the profile opening to be smaller, which will increase the pressure drop.

If the pressure drop is too high, adjust the profile opening to be larger, which will decrease the pressure drop

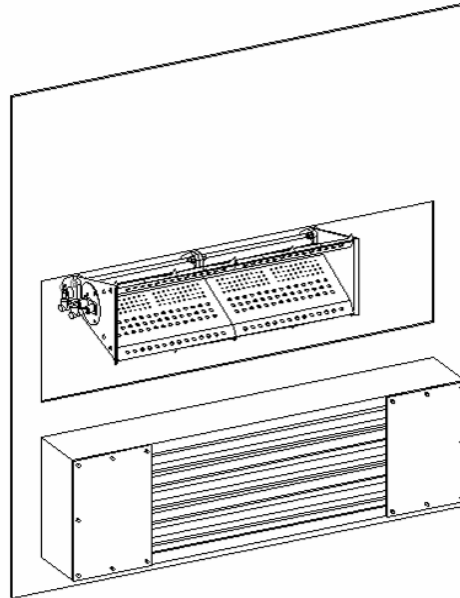


Variable Air Volume Profile



VAV Profile

In low speed, adjust the burner profile opening smaller to increase pressure drop or larger to lower pressure drop.



VAV Profile

In high speed, adjust the bypass damper opening larger to decrease the pressure drop and smaller to increase the pressure drop.

START-UP PROCEDURE

- Check for signs of damage. Do not operate if damage exists and contact your manufactures sales representative. Units are easier to fix before the equipment is installed.
- Check all installation clearances.
 - Clearance from Combustibles
Top: 6" Sides: 6" Base: 0"
 - Clearance for Serviceability
Unit: 24" Service Accesses: 48"
- Check that the unit has been set level and secured.
 - Unit must have adequate structural support or the equipment or building may be damaged.
 - Curb and unit must be leveled or the unit may leak or be damaged.
 - Gasket and caulk the seam between the curb and unit base
 - Screw or weld the unit's base to the curb to avoid damage to the equipment.
- Check that the accessories are set level and secured.
 - Accessories must have adequate structural support or the equipment or building may be damaged
 - Gasket, caulk, and screw each accessory to unit seam
- Check that the unit's intake and discharge are free of debris
- Check that the filters are installed in the (optional) filter section or intake hood in accordance to the air flow direction
- Check that the unit's ductwork size and length match the minimum ductwork size chart
- Check that all field wiring has been completed in accordance to the factory supplied wiring diagram
 - Field wires are shown as dashed lines on the wiring prints
- Check that all terminal screws are tight and that wires are in place

- Check pulley alignment. Correct if necessary



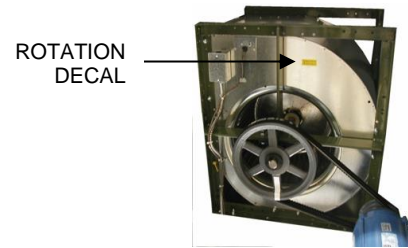
- Check that the power supply matches the nameplate voltage, phase, and amperage
 - Record the voltage on the Start-Up Sheet
- Check that the gas type and pressure matches the nameplate type and pressure
 - Check that the gas type and pressure matches the nameplate type and pressure
 - Contact the service department if the power or gas supply needs to be changed in the field. Different parts might be necessary for the change
- Turn the remote panel switch to OFF if blower and burner service switches were supplied
- Set the temperature set point dial to the maximum
- Turn the main power disconnect ON
 - Bump the blower motor starter to check the blower wheel rotation
 - The decal is located on the blower housing
 - If the rotation is backwards turn off the power and correct the wiring
 - The rotation can be corrected by interchanging two legs of 3 phase (must be between VFD and motor on VAV units)
- Turn the blower service switch or remote control device to ON. The (optional) intake or discharge damper motor will start to open. Once the damper is 90% open the damper motor internal end switch will close and energize the blower motor starter.
- Check that the motor amp draw is less than the FLA (full load amps) of the blower motor.

CTI DIRECT INDUSTRIAL AIR HEATER FOR INDUSTRIAL/COMMERCIAL USE
 RUPP Air Systems (800)-291-2452
 101 North Industrial Parkway
 West Union, IA 52175

9000000 CONFORMS TO ANSI 514 263.4 MODEL # RAH 27
 Certified to CSA 514 37 Non-Recirculating Direct Industrial Air Heaters Job # 402032 01HS2006 Fan # 1 - 1 of 1
 Accepted for Use City of New York Unit Tag: MAU-4
 Department of Buildings
 MEA 7-03-E

MOTOR				
H.P.	Volts	Phase	Hz	FLA
20.00	200	3	60	55.4

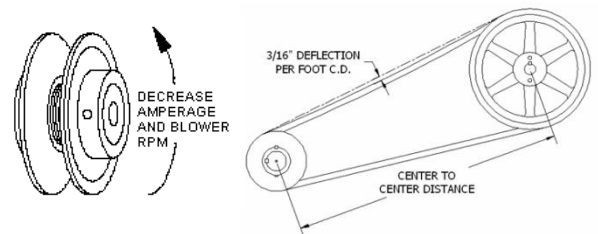
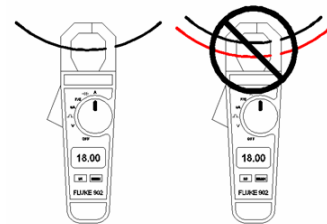
Min. Circuit Ampacity: 72.13 amps
 Hourly B.T.U. Rate (Min./Max.): 73337 / 1496000
 Gas Inlet Pressure (Min./Max.): 1 lb. - 5 lb.
 Max. Manifold Pressure: 5 in. w.c.
 Max. Discharge Temp.: 30° F Min. Gas Supply Pressure for Max. Input Adjustment: 1 lb.



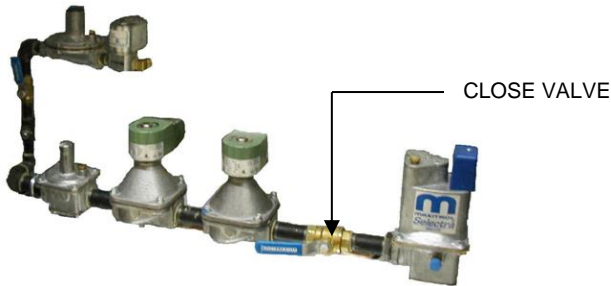
BLOWER SERVICE SWITCH



- The fan RPM may need to be reduced to decrease motor amps.
 - Opening the driver (motor) pulley decreases RPM and motor amps.
 - Closing the driver pulley increases RPM and motor amps.
 - Record the motor amps on the Start-Up Sheet.
- If the RPM was adjusted in the field use a tachometer to record the new RPM on the Start-Up Sheet.
- Check the belt tension after any RPM adjustments. See the belt tension detail.



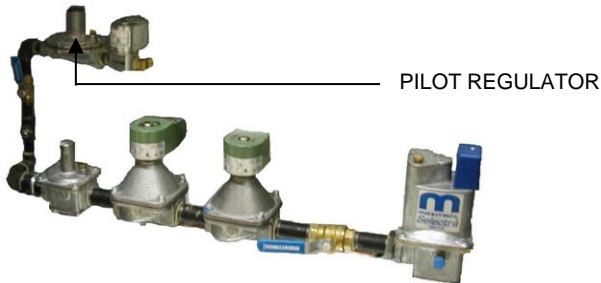
- Check the burner profile pressure differential via the extra airflow probes provided.
 - The air flow switch on single speed units is a low air flow switch only and opens below 0.15 in w.c.
 - The target pressure drop range for the single speed unit is 0.40 – 0.50 in w.c.
 - **Do not adjust airflow switches**
 - Use the profile plates or blower RPM to increase or decrease the pressure drop. If adjusting by blower RPM, you will need to adjust the blower pulley or VFD, if equipped.
 - Record the pressure drop on the Start-Up Sheet.
- Close the burner gas shut off valve
 - This will allow the unit to fire the pilot only and will be opened at a later time



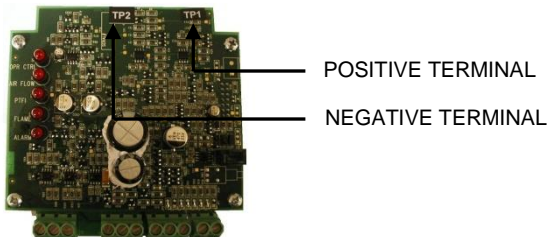
- Set the Burner Intake On Off Switch is set above the outside air temperature



- Turn the burner service switch or remote control to ON
- The Fireeye Flame Safety Control energizes the ignition transformer and pilot gas valve
- After the pilot flame is established, the main gas valves will open
 - At this time the pilot will be the only flame in the burner
- The pilot regulator should be adjusted so the pilot flame signal is stable 6-18 VDC



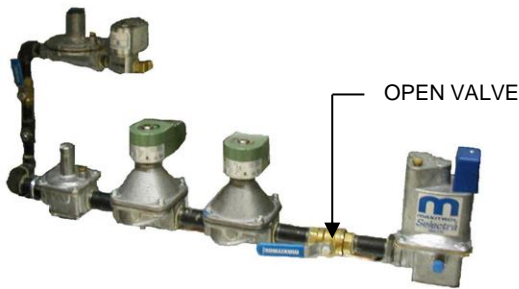
- Use the DC terminals on the flame safety to read the pilot flame signal



- Record the pilot flame signal in the Start-Up Sheet
- Record the low and high fire flame signal on the Start-Up Sheet

Setting High Fire

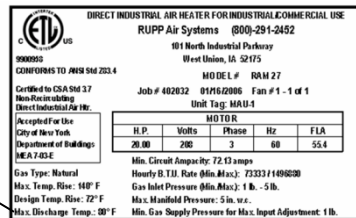
- Open the Burner Gas Shut Off Valve



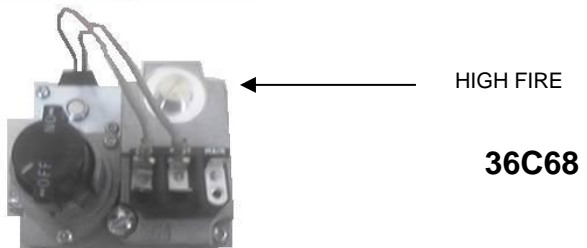
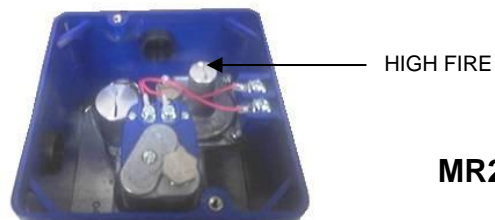
- Measure the intake air temperature.
- Add the intake air temperature to the units nameplate design temperature rise.
- This result will be the desired high fire discharge temperature.

Example: Intake Temp 70 F
Design Temp Rise 72 F
 Discharge Temp **142 F**

GAS TYPE: NATURAL
 MAX. TEMP. RISE: 140 F
 DESIGN TEMP. RISE: 72 F
 MAX. DISCHARGE TEMP.: 80



- Use the Amplifier to override the heater into high fire.
 - On discharge temperature control amplifier remove the #4 wire
 - On the space temperature control amplifier remove the #2 and #4 wire
 - On the M-Series adjust the set-point to be 160 F
- Adjust the manifold gas pressure to achieve the desired discharge air temperature.
 - See the details for the high fire pressure adjustment locations.
 - On manifolds with an MR212 modulation valve, adjust the small regulator inside the MR212 modulation valve
 - On manifolds with either an M511 or M611 modulation valve, adjust the regulator located before the main gas valves
 - On manifolds with a combination gas valve, adjust the regulator under the brass cap on the combination gas valve.
- Measure the discharge temperature using a thermometer. Laser thermometers are not as accurate as a thermocouple type.
- If the discharge ductwork outlet is hard to reach, you may feed a thermocouple into the mixing tube inside the blower discharge.



Setting High Fire – Manifold Pressure Method

- ❑ Turn the burner service switch OFF
- ❑ Measure the manifold pressure with the burner in high fire as described above
- ❑ Adjust to match the design manifold pressure on nameplate
- ❑ Measure the discharge temperature and calculate the temperature rise as described above to account for variances in the airflow from design

GAS TYPE: NATURAL
 MAX. TEMP. RISE: 140 F
 DESIGN TEMP. RISE: 72 F
 MAX. DISCHARGE TEMP.: 80

DIRECT INDUSTRIAL AIR HEATER FOR INDUSTRIAL/COMMERCIAL USE				
RUPP Air Systems (800)-291-2452				
181 North Industrial Parkway West Union, IA 52175				
900095 CONFORMS TO ANSI Std Z39.4		MODEL # RAM 27		
Certified to CSA Std 37 Non-Ferrous tubing		Job # 402032 0116/2006 Fan # 1 - 1 of 1		
Accepted For Use City of New York Department of Buildings MEAT 7.03.E		Unit Tag: MAB-1		
MOTOR				
H.P.	Volts	Phase	Hz	FLA
20.00	208	3	60	55.4
Min. Circuit Ampacity: 72.13 amps				
Hourly B.T.U. Rate (Min./Max.): 73333 / 149600				
Max. Temp. Rise: 140° F				
Design Temp. Rise: 72° F				
Max. Discharge Temp.: 80° F				
Gas Type: Natural				
Gas Inlet Pressure (Min./Max.): 1 lb. - 5 lb.				
Max. Manifold Pressure: 5 in. w.c.				
Min. Gas Supply Pressure for Max. Input Adjustment: 1 lb.				

Setting Low Fire

- ❑ Disconnect power to the amplifier or modulating valve
- ❑ Adjust the low fire setting on the modulation valve so the flame is the full length of the burner without dark spots
 - ❑ See the details for the low fire pressure adjustment locations
 - ❑ Use the burner observation port on the end of the unit to view the flame size
- ❑ Replace all amplifier wires in the place they were removed to set high and low fire
- ❑ Additional capacity is provided via a low fire bypass when MR212 low fire capacity is insufficient. Additional adjustment is made via the R400S regulator installed in the low fire bypass.

LOW FIRE →



MR212

M511 & M611

LOW FIRE →



Final Start-Up

- ❑ Set the Burner Intake On-Off Thermostat to the desired temperature to disable burner
 - ❑ This will automatically open the burner circuit when the outside air is above the selected temperature
- ❑ Turn the blower and burner service switches OFF
 - ❑ Now the unit will be operated from the control panel only
- ❑ Operate the unit from the remote panel checking the lights, switches, set-points, and optional thermostats or timers
- ❑ Review the proper operation and sequence of operation with the customer to ensure that the unit is operated properly and that the customer does not misuse the equipment
- ❑ Complete the Start-Up Sheet and fax it to the service department to validate the warranty

START-UP PROCEDURE VARIABLE AIR VOLUME

The Start-Up procedure for variable air volume units is the same as the single speed unit except there are additional steps for checking the burner pressure drop and setting high/low fire. Use the single speed procedure along with these additional steps for the VAV start-up procedure.

- Check the air flow pressure drop through entire airflow range.
 - The air flow switch on VAV units is a low (0.15) and (0.65) high switch
 - **Do not adjust airflow switches**
 - Use the profile plates or blower RPM to increase or decrease the pressure drop. Blower RPM can be adjusted by the VFD.
 - Record the pressure drops on the Start-Up Sheet.
 - Verify the flame limiting device is functioning properly in low speed on units with a VFD.
 - Verify the low fire setting at minimum flow rate as well.

VFD Drive Installation & Programming Instructions

WARNING!!

- Before installing the VFD drive, ensure the input power supply to the drive is OFF
- The power supply and motor wiring of the VFD must be completed by a qualified electrician
- The programming of the VFD must be completed by a qualified HVAC technician

Consult the VFD manual and all documentation shipped with the unit for proper installation and wiring of the VFD. The VFD has been programmed by the factory with order specific parameters.

Check Installation:

√	Check
	The installation environment conforms to the VFD manual.
	The drive is mounted securely.
	Space around the drive meets the drive's specification for cooling.
	The motor and driven equipment are ready for start.
	The drive is properly grounded.
	The input power voltage matches the drive's nominal input voltage.
	The input power connections at U1, V2, and W1 are connected and tight.
	The input power protection is installed.
	The motor power connection at U2, V2, and W2 are connected and tight.
	The input, motor, and control wiring are run in separate conduit runs.
	The control wiring is connected and tight.
	NO tools or foreign objects (such as drill shavings) are in the drive.
	NO alternative power source for the motor (such as a bypass connection) is connected - NO voltage is applied to the output of the drive.

TEMPERATURE CONTROL SYSTEMS

401M

- The 401M replaces building-exhaust air with tempered make-up air.
- A discharge-sensing controller that compensates for intake air temperature changes modulates the burner flame.
- A manual, remote selector switch controls the unit's operation.

402M

- The 402M is used primarily in door-heater applications. The space override thermostat increases the discharge-air temperature when needed to maintain temperature.
- The amount of override temperature is controlled via a 0-40 degree potentiometer on the side of the temperature set point dial.
- A manual, remote selector switch may control the unit's operation.

403M

- The 403M maintains a constant space temperature.
- A modulating space thermostat adjusts the burner to maintain the supply-air temperature necessary to compensate for changes in the building's heat requirement.
- The amplifier limits the maximum and minimum temperature of the supply air the unit delivers.
- A manual, remote selector switch may control the unit's operation.

404M

- The 404M maintains a constant space temperature, day or night. During day operation, a modulating-space thermostat adjusts the burner to maintain the supply-air temperature necessary to compensate for changes in building's heat requirements.
- The amplifier limits the maximum and minimum temperature of the supply air the unit delivers.
- During night operation, a space thermostat cycles the unit ON or OFF to maintain the space temperature.
- A manual remote selector switch may control unit operation.
- The DAY/NIGHT mode is automatically controlled via a programmable thermostat or time clock.

Signal Conditioner

- When computer or other process controls are specified, the signal conditioner provides compatibility with modulator / modulator-regulator valves.
- This system requires a field supplied 4 to 20 milliamp or 0 to 10 DC voltage signal.

OTHER UNIT COMPONENTS

Flame Safety Control

The first system to understand is the **Flame Safety Control**. The FSC is there **only** to monitor the flame, NOT to control temperature. The FSC uses a flame rectification sensor (flame rod) mounted on the pilot assembly to detect the presence of flame in the burner. Flame strength and presence can be measured at the FSC by reading the rectified flame signal using a DC voltage meter in the test jacks. Flame is present when the DC voltage reads between **6 and 18 VDC**. Ideal flame intensity produces a signal of **12 VDC** or greater. The FSC controls the opening of the main and pilot gas valves and the operation of the spark igniter to initiate a pilot flame upon start-up.

The **OPR CTRL** LED indicates that there is power to the FSC. Next, the **AIRFLOW** LED will come on if there is proper airflow through the unit. Third, the unit will pause to purge any gasses or combustible vapors before attempting flame ignition. Then, there is a Pilot Trial For Ignition (PTFI) and the **PTFI** LED comes on. During PTFI, the FSC opens the pilot gas valve and allows gas to flow to the pilot assembly. At the same moment, the spark igniter is started, causing the spark to ignite the pilot gas. When the flame rod sensor detects the flame, it turns on the **FLAME** LED, turns off the PTFI LED. This is the normal operating mode. The last LED on the FSC is the **ALARM** LED. This will turn on when the FSC determines an unsafe condition has occurred, and will not allow the unit to recycle for heat until it has been properly reset. Anytime the FSC has gone into "Alarm" mode, the problem must be diagnosed and corrected to avoid future lockouts after resetting. To reset the FSC, cycle power to the control. This will clear the alarm from the flame safety.

High Temperature Limit

One of the safety devices is the **high temperature limit** switch. This switch is a mechanical thermostat that measures the temperature inside the unit downstream of the burner. If the factory-set temperature is exceeded, it will disable the burner. This requires a manual reset of the high temperature limit.

Electric Cabinet Heater

On units shipped with an optional electric cabinet heater, ensure that the heater is wired to a **separate** 120V, 15 amp input, the thermostat sensing bulb is mounted correctly in the control vestibule where the heater is located, and the **thermostat set to 0 Degrees Fahrenheit**

Flame Safety Controller



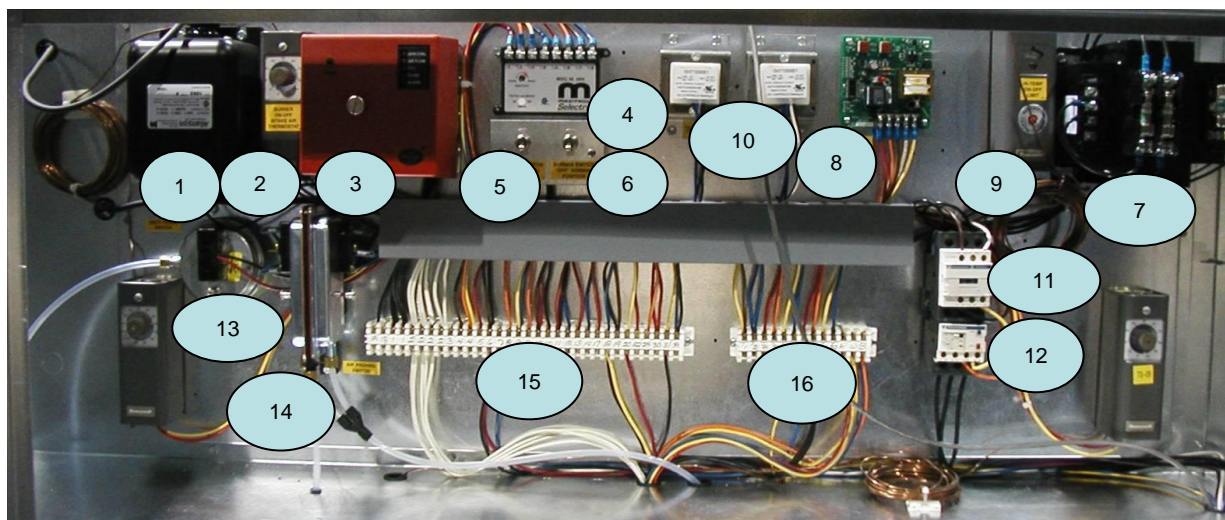
DC Flame Signal

DC Voltage	Flame Status
0 to 5 VDC	No Flame
6 to 11 VDC	Weak Flame
12 to 18 VDC	Strong Flame

High Temperature Limit

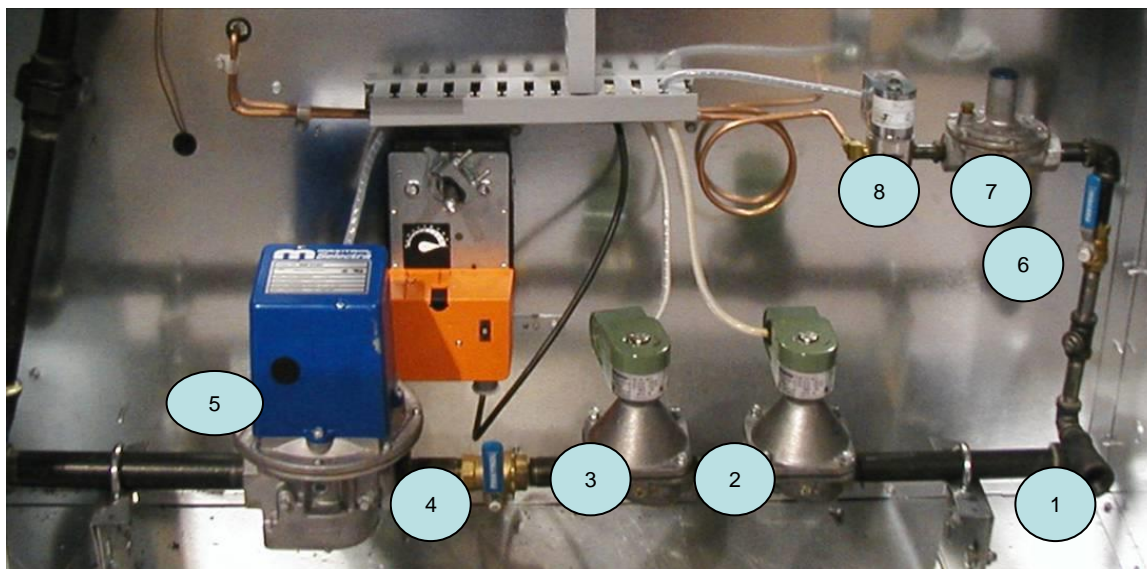


ELECTRICAL VESTIBULE



- | | |
|--------------------------|-----------------------------|
| 1. IGNITION TRANSFORMER | 9. HIGH TEMPERATURE LIMIT |
| 2. INTAKE AIR THERMOSTAT | 10. POWER TRANSFORMER |
| 3. FLAME SAFETY CONTROL | 11. MOTOR STARTER |
| 4. MODULATING AMPLIFIER | 12. MOTOR OVERLOAD |
| 5. BLOWER SERVICE SWITCH | 13. CLOGGED FILTER SWITCH |
| 6. BURNER SERVICE SWITCH | 14. AIR FLOW PROVING SWITCH |
| 7. CONTROL TRANSFORMER | 15. 120 VOLT TERMINALS |
| 8. FREEZE CONTROL | 16. 24 VOLT TERMINALS |

MANIFOLD VESTIBULE



- | | |
|-----------------------------------|-------------------------|
| 1. GAS INLET | 5. MODULATING GAS VALVE |
| 2. 1 ST MAIN GAS VALVE | 6. PILOT SHUT OFF VALVE |
| 3. 2 ND MAIN GAS VALVE | 7. PILOT REGULATOR |
| 4. BURNER SHUT OFF VALVE | 8. PILOT GAS VALVE |

TROUBLESHOOTING

The following tables list causes and corrective actions for possible problems with direct fired heater units. Review these lists prior to consulting the manufacturer.

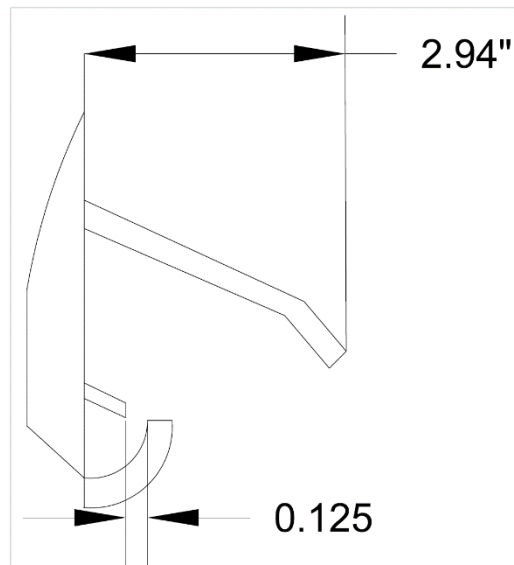
Airflow Troubleshooting Chart

Problem	Potential Cause	Corrective Action
Fan inoperative	Blown fuse or open circuit breaker	Replace fuse or reset circuit breaker and check amps
	Disconnect switch in "OFF" position	Turn to "ON" position
	Motor wired incorrectly	Check motor wiring against wiring diagram located on fan motor
	Broken fan belt	Replace belt
	Motor starter overloaded	Reset starter and check amps
	Remote panel set to "OFF" position	Set Remote Panel to "MANUAL" or "AUTO" Position
Motor overload	Fan rotating in the wrong direction	Be sure fan is rotating in the direction shown on rotation label
	Fan speed is too high	Reduce fan RPM
	Motor wired incorrectly	Check motor wiring against wiring diagram located on fan motor
	Overload in starter set too low	Set overload to motor FLA value
	Motor HP too low	Determine if HP is sufficient for job
	Duct static pressure lower than design	Reduce fan RPM
Insufficient airflow	Fan rotating in the wrong direction	Be sure fan is rotating in the direction shown on rotation label
	Poor outlet conditions	There should be a straight, clear duct at the outlet
	Intake damper not fully open	Inspect damper linkage and replace damper motor if needed
	Duct static pressure higher than design	Improve ductwork to eliminate or reduce duct losses
	Blower speed too low	Increase fan RPM. Do not overload motor
	Supply grills or registers closed	Open and adjust
	Dirty or clogged filters	Clean and/or replace
	Belt slippage	Adjust belt tension
Excessive airflow	Blower speed too high	Reduce fan RPM
	Filters not installed	Install filters
	Duct static pressure lower than design	Reduce fan RPM
Excessive vibration and noise	Misaligned pulleys	Align pulleys
	Damaged or unbalanced wheel	Replace wheel
	Fan is operating in the unstable region of the fan curve	Refer to performance curve for fan
	Bearings need lubrication or replacement	Lubricate or replace
	Fan speed is too high	Reduce fan RPM
	Belts too loose, worn, or oily	Inspect and replace if needed

Burner Troubleshooting Chart

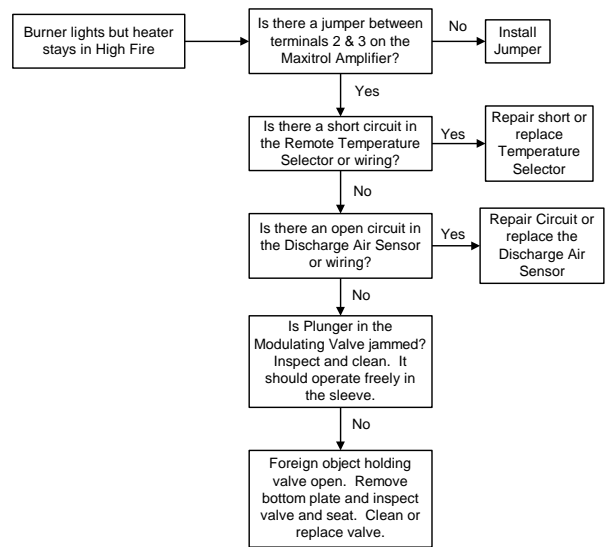
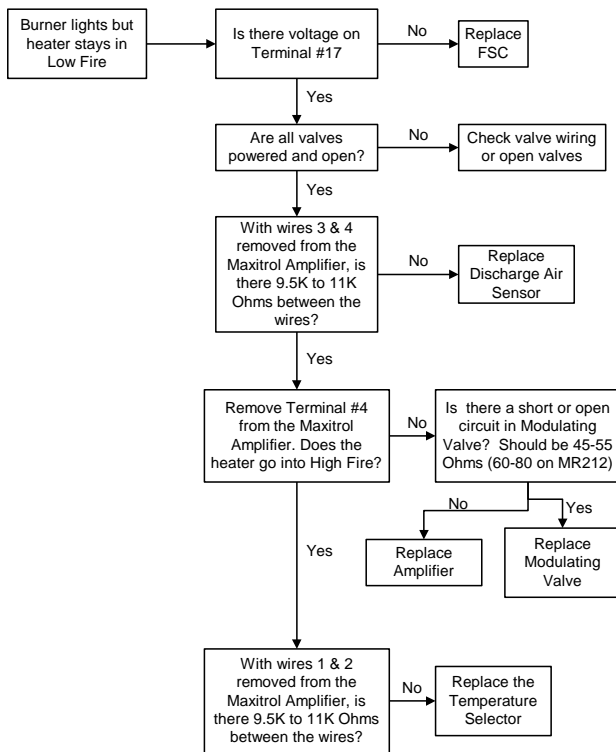
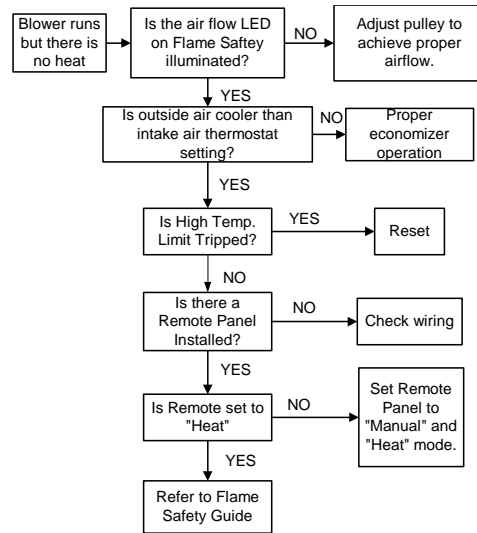
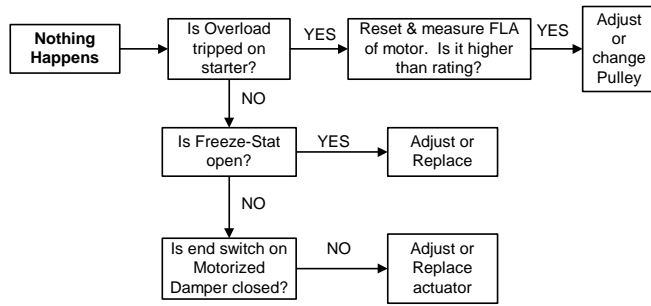
Problem	Potential Cause	Corrective Action
Pilot does not light/stay lit	Main gas is off	Open main gas valve.
	Air in gas line	Purge gas line.
	Dirt in pilot orifice	Clean orifice with compressed air.
	Gas pressure out of range	Adjust to proper gas pressure.
	Pilot valve is off	Turn pilot valve on.
	Leaking pilot orifice fitting	Tighten pilot orifice.
	Excessive drafts	Re-direct draft away from unit.
	Safety device has cut power	Check limits and airflow switch.
	Dirty flame sensor	Clean flame sensor.
	Remote panel in "Vent" mode	Change to "Heat" mode.
	No spark at igniter	Check wiring, sensor, and ignition controller. Check spark gap as shown below.
Main burner does not light (Pilot is lit)	Defective valve	Replace combination valve.
	Loose valve wiring	Check wiring to valve.
	Defective pilot sensor	Replace pilot sensor.
	Shut-off valve closed	Open shut off valve.
	Defective flame safety controller	Replace flame safety controller.
	Pilot fails as main gas valves open and main gas begins to flow	Plug the first burner port next to the pilot gas tube with burner cement.
Not enough heat	Main gas pressure too low	Increase main gas pressure – do not exceed 14 in. w.c. inlet pressure (5 psi. on size 4-5 heater).
	Too much airflow	Decrease airflow if possible.
	Burner undersized	Check design conditions.
	Gas controls not wired properly	Check wiring.
	Thermostat setting too low	Increase thermostat setting.
	Thermostat malfunction	Check/replace thermostat.
	Unit locked into low fire	Check wiring.
Too much heat	Defective modulating gas valve	Check/replace modulating valve.
	Thermostat setting too high	Decrease thermostat setting.
	Unit locked into high fire	Check wiring.
	Thermostat wired incorrectly	Check thermostat wiring.

Proper Spark Gap



Light Indication	Condition	Possible Cause
No lights	Power not available to Remote Panel	Bad voltage to unit
		Main Disconnect in "OFF" position
		Circuit breaker tripped
		Bad main transformer
POWER light only	Proper unit Off Operation	No problem
	No power to motor starter	Manual/Off/Auto switch in "OFF" position (3-position Remote Panels only)
		Improper damper function
		Low Temperature Thermostat timed out (option)
POWER light and BLOWER ON light	Proper ventilation operation	No problem
	No power to flame safety controller	Manual/Off/Auto switch in "OFF" position (2-position Remote Panels only)
		Heat/Vent switch in "VENT" position
		Gas pressure switch Tripped (option)
		High Temperature Limit Thermostat tripped
		Manual/Off/Auto Switch in "AUTO" position and Intake Air Thermostat not satisfied
		Improper airflow
	Excessive airflow	
	Bad airflow switch	
	Problem with air probes	
Problem with airflow tubing	Problem with airflow tubing	
	Broken belt	
POWER light and BLOWER ON light and BURNER ON light	Proper heating operation	No problem
CLOGGED FILTER light on (optional)	Filters clogged	Filters dirty or need replacement
FLAME FAILURE light on	Flame safety alarm activated No flame detected during pilot establishment period	Combination valve in "OFF" position (Unit sizes 1-3)
		Stuck closed gas valve
		No or low gas pressure
		Bad spark electrode
		Bad ignition transformer
		Flames sensor malfunction
Clogged pilot orifices		

Troubleshooting Flowcharts



Maxitrol Preliminary Circuit Analysis Series 14 System

The basic Series 14 system consists of an amplifier, a discharge-air sensor and mixing tube, a remote-temperature selector, and a modulating valve or a modulator-regulator valve.

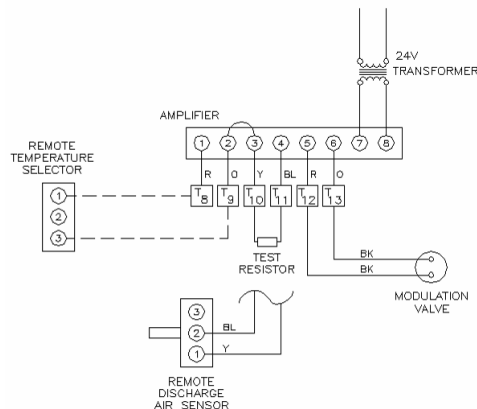
Series 14 Preliminary Wiring Testing Procedures:

- Disconnect the discharge-air sensor and replace with a 10,000-Ohm, 1/4-watt test resistor at Terminals 3 & 4.
- Connect a dc-volt meter on the modulator-regulator or modulator-valve terminals.
- Set the temperature to 55° F. Voltage should read 0-V.
- Rotate dial to 90° F. Voltage should gradually increase to a minimum of 20-V.
- If these voltages are obtained, the valve function can now be checked out.
- In the event proper voltages are obtained, and the valve responds correctly to these voltages, the problem could be in the wiring to the discharge-air sensor or the discharge-air sensor itself.
- If the proper voltages are not obtained when wired as shown above, the problem can be isolated to the electronics.

After these preliminary tests are completed, remove the test resistor and reconnect the discharge air sensor to Terminals 3 and 4 and continue checking system, following the Series 14 Troubleshooting Steps.

The operation of the modulating-valve regarding voltage is as follows:

- 0 to 5-V The heater should be at bypass or low.
 - 5 to 15-V The heater should respond to various input rates.
 - 15-V and up The heater is at maximum input.
- If the voltage is obtained on the valve terminals, but the heater does not respond as described, the problem can be isolated to the valve itself or to the gas-control manifold of the heater.



Maxitrol Series 14 Troubleshooting

Symptom	Possible Cause	Field Test	Remedy
No Gas Flow	Modulating valve improperly installed	Arrow on side of valve should point in direction of gas flow	Install properly
Continuous low fire (electronics problem)	Short circuit or no voltage to the amplifier Open circuit in TD114 remote temperature selector or wiring Short circuit in TS114 remote temperature circuit or wiring	Check for 24-V at amplifier terminals 7 & 8 Check wire connections between amplifier terminals 1 and 2 and remote temperature selector terminals 1 and 3 Follow test procedures as outlined in the preliminary testing section of this manual	Prove power source Tighten connections or replace wiring If modulating voltages are obtained, check TS114 if necessary. If these items check out and modulating voltages are still not obtained, amplifier may be assumed defective. Install replacement.
Continuous low fire (electronics OK)	Faulty amplifier Open circuit in modulator coil Plunger missing, jammed, or improperly installed	Check Td114 for internal open circuits. Maximum 11,500 ohms across terminals 1 and 3 with external wiring disconnected. Measure resistance across modulator terminals with interconnecting wires disconnected. Inspect: Plunger should operate freely in solenoid sleeve.	Replace modulator head if not approximately 45 to 55 ohms for the M611 and M511 and 60 to 80 ohms for the MR212. Clean or replace plunger if necessary.
Incorrect minimum fire	Incorrect by-pass metering valve adjustment Excessive negative burner pressure	Re-set low fire (see start-up instructions) Close main-gas supply and measure manifold pressure with blower opening. Reading should be less than 1.5-in wc negative pressure.	Adjust to proper low fire If reading is greater than 1.5-in wc negative pressure, check for clogged filters or other inlet air restrictions.
Continuous high fire (electronics problem)	Short circuit in remote temperature selector circuit Open Circuit in the TS114 discharge air sensor circuit Jumper not connected across amplifier terminals 2 and 3	Inspect for shorts at or between amplifier terminals 1 and 2 and at TD114 terminals 1 and 3. Check TS114 for terminal shorts, minimum 8,000 ohms across terminals 1 and 3 with external wiring disconnected. Connect test resistor as described in the preliminary circuit test.	Correct wiring if a short is present. Replace TD114 if defective. If modulating voltages are obtained, check TS114 circuit for shorts. Replace TS114 if necessary. Correct if necessary.

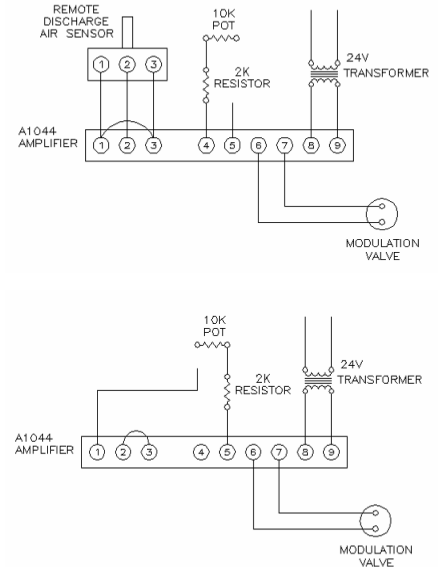
Symptom	Possible Cause	Field Test	Remedy
Continuous high fire (electronics OK)	Foreign object holding valve open or plunger jammed	Inspect: plunger should be smooth and clean, and operate freely in the solenoid valve.	Clean or, if necessary, replace plunger
Incorrect maximum fire	Inlet pressure too low Incorrect outlet pressure adjustment of pressure regulator Hunting	Read pressure at inlet to modulating valve using a manometer with unit operating at high fire. Pressure should be equal to the sum of the outlet pressure setting plus pressure drop of the valve. Read manifold pressure using manometer and compare with recommendation of the heater manufacturer. Adjust sensitivity control counter clockwise.	Increase inlet pressure, if possible. If flame stabilizes, adjust sensitivity control to maintain an even flame
Erratic or pulsating flame	Erratic air patterns or improper TS114 location TD114 wiring is run next to high voltage switching circuits causing induced voltages Faulty amplifier or erratic voltage supply	Connect test resistor as described in the preliminary circuit analysis section. Turn TS114 selector dial so heater goes through its entire modulating range. Temporarily remove TD114 from its remote locating and reconnect at valve location. Observe heater observation. With test resistor connected as described in the preliminary tests, and TD114 locally connected as described above, turn TD114 selector dial through entire modulating range. Observe voltage across modulator terminals.	If the flame is steady thought-out the entire modulating range, the TS114 must be relocated. If smooth operation results, isolate TD114 wiring from source of induced voltage. If erratic or unstable voltages are obtained throughout the modulating range, the amplifier may be assumed defective. Replace. If erratic operation is noted only over a small range, the voltage source may contain surges.
Incorrect discharge air temperature	Incorrect wiring Improper TS114 location	Check installation according to the diagram in the preliminary circuit analysis section. Sensed temperature does not represent average discharge air temperature.	Correct wiring Move TS114 to location where average representative temperature can be sensed.

Maxitrol Preliminary Circuit Analysis Series 44 System

The basic Series 44 system consists of an amplifier, a discharge-air monitor with mixing tube, a selectostat, and a modulating valve or a modulator-regulator valve.

Series 44 Wiring for Preliminary Testing Procedures:

- Turn the test potentiometer to 2,000-Ohm minimum resistance. The dc voltage should read 0-V. Slowly turn the test potentiometer to maximum resistance or 12,000-Ohms. The dc voltage should gradually increase to at least 18-V.
- If proper voltages are observed, continue with the following test procedures.
- If proper voltages are not observed, the problem is identified with the amplifier, the 24-V ac power supply, or the circuit connected to Terminals 6 and 7.
- Turn the power OFF. Wire system as shown. Turn the power back ON.
- Turn the test potentiometer to minimum resistance. The dc voltage should read 0-V. Slowly turn the test potentiometer to maximum resistance. The dc voltage should gradually increase to at least 18-V.
- If proper voltages are observed, continue with the following test procedures.
- If proper voltages are not observed, the problem is identified with the amplifier, the 24-V ac power supply, or the circuit connected to Terminals 6 and 7.
- Observe the burner flame and burner pressure as test potentiometer is turned through full range.
 - 0 to 5-V The heater should be at bypass or low.
 - 5 to 15-V The heater should respond to various input rates.
 - 15-V and up The heater is at maximum input.
- If proper voltages are observed, continue procedures to check operation of sensing and selecting components.
- If proper voltages are not observed, see troubleshooting on the following page to test the MR212 or M611 modulating valve and connecting wiring.
- With proper voltages present and modulator responding correctly, return to the wiring configuration as shown below, except have the TS144 discharge-air monitor connected in place of the jumper. Set minimum-temperature selector at least 10° F above outdoor temperature. Set maximum-temperature selector at mid-range. The heater is now under control of the discharge-air monitor.
- Turn the test potentiometer to maximum resistance. Air temperature should be at maximum-temperature setting. Turn the test potentiometer to minimum resistance. The delivered air temperature should be at the minimum temperature setting.
- If proper voltages are not observed, check calibration. Refer to troubleshooting information on the following page.
- If proper voltages are observed, the problem is identified with the space temperature sensing and temperature selecting components and circuits.
- After these preliminary test procedures are completed, remove all test equipment and reconnect components.



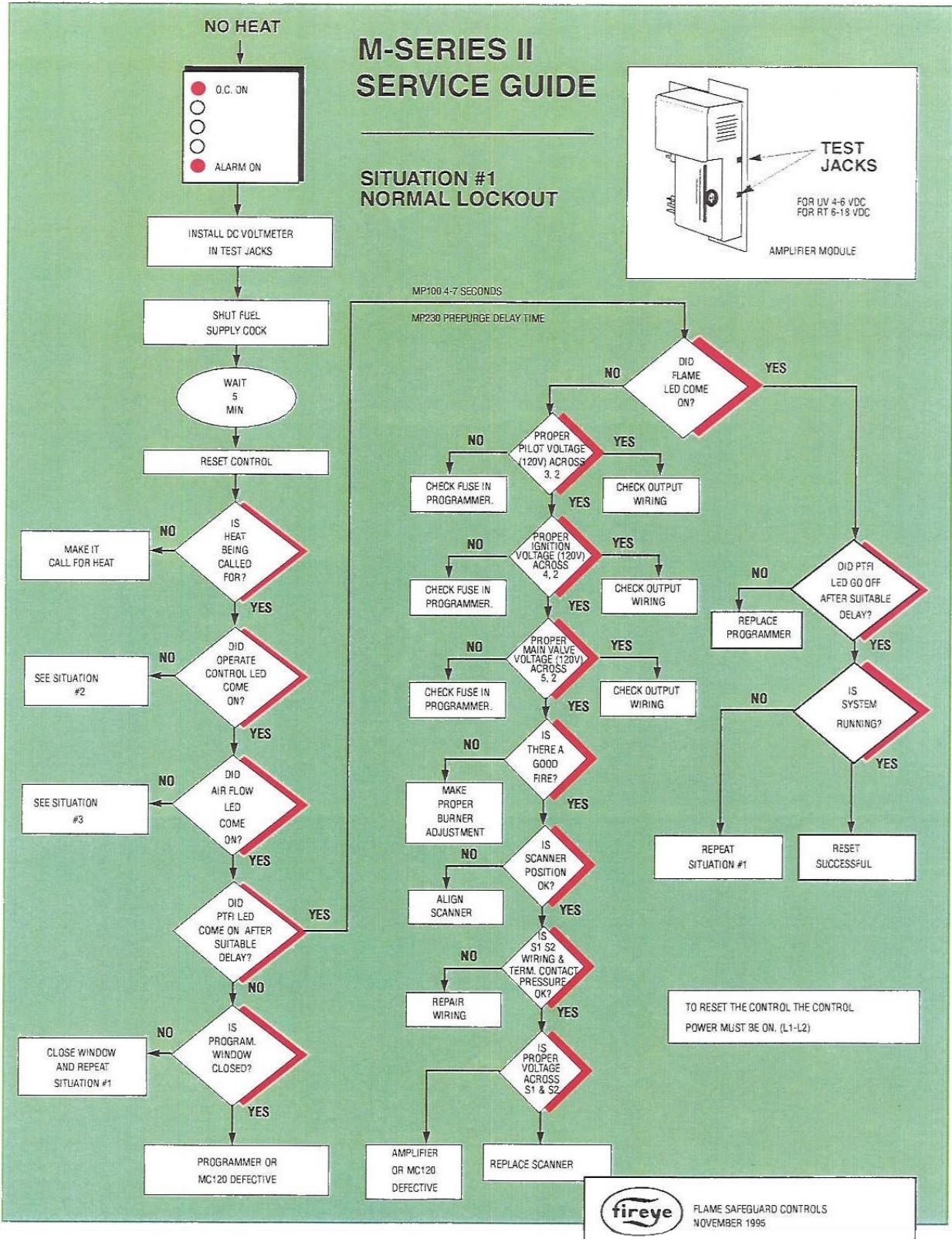
Maxitrol Series 44 Troubleshooting

Symptom	Possible Cause	Field Test	Remedy
No gas flow	Modulating valve installed improperly	Arrow in side of valve should point in direction of gas flow.	Install properly
Continuous low fire (electronics problem)	No voltage to amplifier	Check for 24-v ac at amplifier terminals 8 and 9	Provide 24-v ac to amplifier
	Short in modulator coil circuit	Remove wires connected to amplifier terminals 6 and 7; measure resistance MR212: 60 – 80 ohms M611 & M511: 45 to 55 ohms	If proper resistance values are not observed; replace modulator head or repair wiring.
	Short in TS144 circuit	Remove wires connected to amplifier terminals 1, 2, and 3. Measure resistance across wires 1 and 3, then across 2 and 3. Meter should read greater than 2500 ohms.	If readings are incorrect, replace the TS114 or repair wiring.
Continuous low fire (electronics OK)	Defective amplifier	Follow procedures in the preliminary circuit analysis section	After following the preliminary circuit analysis test without satisfactory results, the amplifier can be assumed defective. Install replacement.
	Open in modulator coil circuit	Remove wires connected to amplifier terminals 6 and 7 measure resistance MR212: 60 – 80 ohms M611 & M511: 45 to 55 ohms	If proper resistance values are not observed, replace modulator head or repair wiring
Incorrect minimum fire	Plunger missing, jammed or improperly installed	Inspect: plunger should operate freely in solenoid sleeve.	Clean or replace plunger if necessary
	Incorrect by-pass metering valve adjustment	Re-set low fire (see start-up instructions)	Adjust to proper low fire
Continuous minimum discharge temperature	Excessive negative burner pressure	Close main-gas supply and measure manifold pressure with blower opening. Reading should be less than 1.5-in wc negative pressure.	If reading is greater than 1.5-in wc negative pressure, check for clogged filters or other inlet air restrictions.
	Defective amplifier	Refer to the preliminary circuit analysis section	If amplifier is proven defective, install replacement
	Short in T244 or TS244/TD244 circuit	Remove wires to amplifier terminals 4 and 5. Set T244 or TD244 to maximum setting. Measure resistance across wires. Meter should read 6000 ohms +/- 1000 ohms. If TS244/TD244 are used, meter should read 4500 ohms +/- 1000 (TS244) and 2100 ohms +/- 150 (TD244)	If reading is incorrect, replace T244, TS244/TD244 or repair wiring

Symptom	Possible Cause	Field Test	Remedy
Incorrect minimum or maximum discharge air temperature	Improper TS144 location Incorrect discharge air temperature control calibration	Compare sensed temperature at TS144 with average discharge air temperature Refer to the preliminary circuit analysis section	Move TS144 to location where average temperature can be sensed If proper temperatures are not observed, refer to control calibration of this manual
Continuous high fire (electronics problem)	Open in TS144 circuit	Remove wires to amplifier terminals 1, 2, and 3. Measure resistance between terminals 1 and 3, then between terminals 2 and 3. Meter should read greater than 2500 ohms	If readings are incorrect, replace TS114 or repair wiring
Continuous high fire (electronics OK)	Foreign material holding valve open Plunger jammed	Remove bottom plate and inspect valve and seat Inspect: plunger should be smooth and clean, and operate freely in solenoid valve	Clean and replace valve and seat. Replace if necessary Clean, or if necessary, replace plunger
Incorrect high fire	Inlet pressure too low Incorrect outlet pressure adjustment	With heater operating at full fire, take pressure reading at inlet to modulation valve. Pressure should meet or exceed the units minimum gas pressure Read outlet pressure using a manometer and compare with recommendation of unit capacities	Increase inlet pressure if possible, or change to a larger modulation valve. Contact manufacturer for increasing valve size. See control calibration of this manual
Continuous maximum discharge air temperature	Defective amplifier Open in T244 or TS244/TD244 Incorrect space temperature control calibration	Refer to the preliminary circuit analysis section Remove wires to amplifier terminals 4 and 5. Set T244 or TD244 to maximum setting. Measure resistance across wires. Meter should read 6000 ohms +- 1000 ohms. If TS244/TD244 are used, meter should read 4500 ohms +- 1000 (TS244) and 2100 ohms +- 150 (TD2440) See control calibration section of this manual	Replace amplifier if defective If reading is incorrect, replace T244, TS244/TD244 or repair wiring If proper action is obtained, see calibration section of this manual

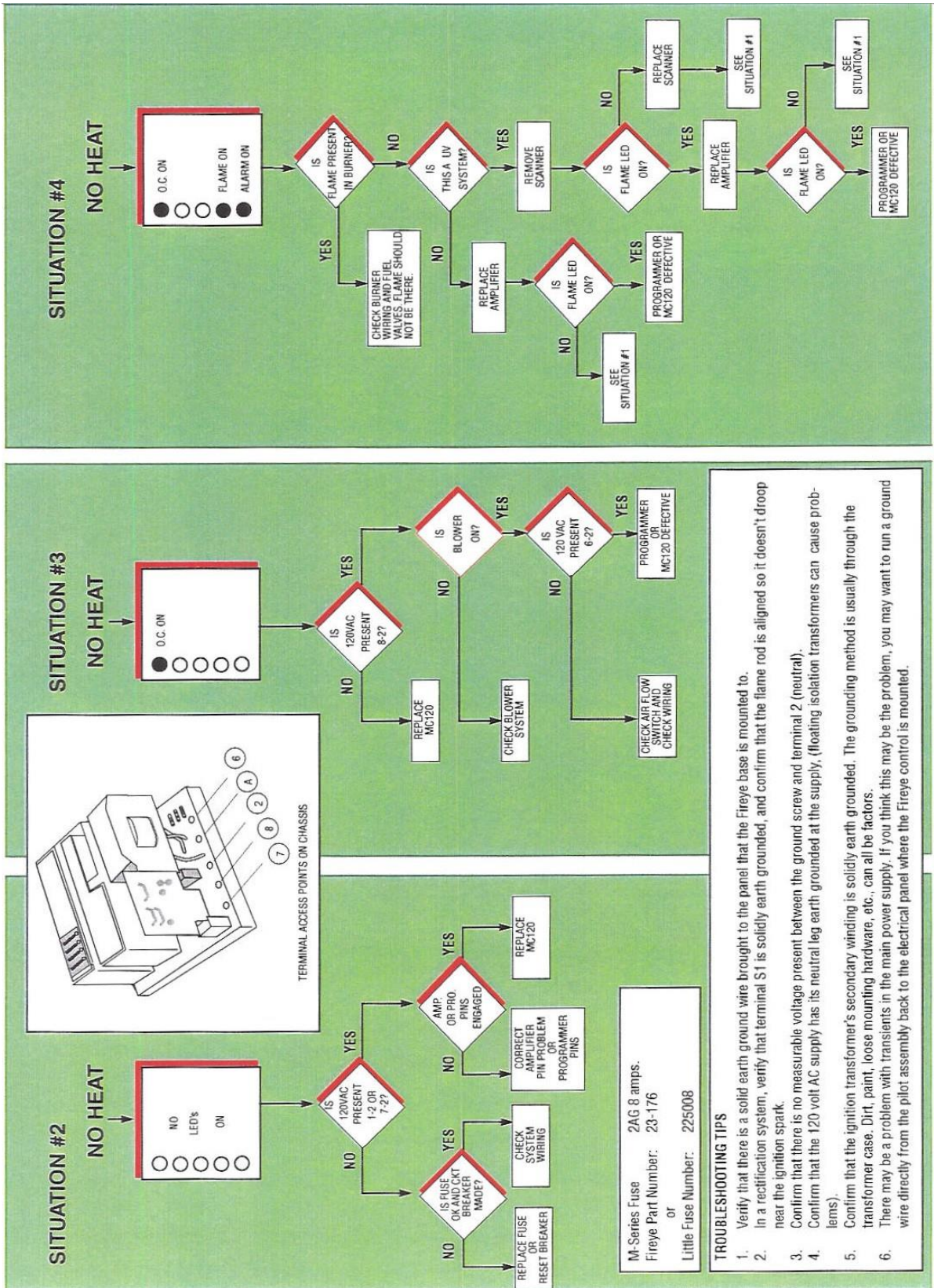
Flame Safety Service Guide

(Airflow LED may or may not be illuminated)



Flame Safety Service Guide (continued)

(Airflow LED may or may not be illuminated)



MAINTENANCE

To guarantee trouble free operation of this heater, the manufacturer suggests following these guidelines. Most problems associated with fan failures are directly related to poor service and maintenance.

WARNING!!

DO NOT ATTEMPT MAINTENANCE ON THE HEATER UNTIL THE ELECTRICAL SUPPLY HAS BEEN COMPLETELY DISCONNECTED AND THE MAIN GAS SUPPLY VALVE HAS BEEN TURNED OFF.

General Maintenance

1. Fan inlet and approaches to ventilator should be kept clean and free of any obstructions.
2. Motors are normally permanently lubricated. Check bearings periodically. If they have grease fittings, lubricate each season. Use caution when lubricating bearings. Wipe the fittings clean. The unit should be rotated by hand while lubricating. **Caution: Use care when touching the exterior of an operating motor. Motors normally run hot and may be hot enough to be painful or cause injury.**
3. Before starting a unit after maintenance checks, check all fasteners for tightness.
4. Blowers require very little attention when moving clean air. Occasionally oil and dust may accumulate, causing imbalance. If the fan is installed in a corrosive or dirty atmosphere, periodically inspect and clean the wheel, inlet and other moving parts to ensure smooth and safe operation.

Re-Setting Of The Unit

If the flame safety control is locked out (alarm light on), reset the unit by:

1. Turn OFF power to the unit.
2. Turn power to the unit back ON.

Emergency shutdown of unit

To shut down the unit in the event of an emergency do the following:

1. Turn the power OFF to the unit from the main building disconnect.
2. Turn the external disconnect switch to the OFF position.
3. Close the inlet gas valve located on the heater.

Prolonged shutdown of the unit

For prolonged shutdown the following steps should be done:

1. Turn the external disconnect switch to the OFF position.
2. CLOSE the inlet gas valve located on the heater.

To re-start the unit the following steps should be done:

1. Turn the external disconnect switch to the ON position.
2. OPEN the inlet gas valve located on the heater.

Lubricating Blower Bearings

Blower bearings require little lubrication. A general rule is one half pump from a grease gun for ½" to 1 7/16" shaft diameters and one pump for 1 11/16" and large diameter shafts for every 1500 to 3000 hours of operation. A lithium based grease should be used. Bearings should be rotated as they are lubricated to evenly distribute the grease, either by hand or via extended grease lines. Do not attempt to grease bearings from inside the enclosure while the motor is energized.

2 Weeks after Start-Up

1. Belt tension should be checked after the first two weeks of fan operation. Belts tend to stretch and settle into pulleys after an initial start-up sequence. **Do not tighten the belts by changing the setting of the motor pulley.** This will change the fan speed and may damage the motor.

To re-tension belts, turn the disconnect switch OFF. Loosen the fasteners that hold the blower scroll plate to the blower. Rotate the motor to the left or right to adjust the belt tension. Belt tension should be adjusted to allow 1/64" of deflection per inch of belt span. Exercise extreme care when adjusting V-belts as not to misalign pulleys. Any misalignment will cause a sharp reduction in belt life and produce squeaky noises. Over-tightening will cause excessive belt and bearing wear as well as noise. Too little tension will cause slippage at startup and uneven wear. **Whenever belts are removed or installed, never force belts over pulleys without loosening the motor first to relieve belt tension.** Use the same type belt as originally supplied by the manufacturer when replacements are needed. On units shipped with double groove pulleys, matched belts should always be used.

2. Before restarting a unit after maintenance checks, all fasteners on blower housings, bearings, motors and sheaves should be checked for tightness.

Every 3 months

1. Belt tension should be checked quarterly. See instructions in the previous maintenance section. Over-tightening will cause excessive bearing wear and noise. Too little tension will cause slippage at startup and uneven wear.
2. Filters need to be cleaned and/or replaced quarterly, and more often in severe conditions. Washable filters can be washed in warm soapy water. When re-installing filters, be sure to install with the **airflow in the correct direction** as indicated on the filter.

Yearly

1. Inspect bearings for wear and deterioration. Replace if necessary.
2. Inspect belt wear and replace torn or worn belts.
3. Inspect bolts and set screws for tightness. Tighten as necessary.
4. Inspect motor for cleanliness. Clean exterior surfaces only. Remove dust and grease from the motor housing to ensure proper motor cooling. Remove dirt and grease from the wheel and housing to prevent imbalance and damage.
5. Check for gas leaks and repair if present.
6. Clean flame sensor by rubbing with steel wool to remove any rust build-up,
7. Clean burner with a wire brush and ensure burner ports are free of debris. Then wipe the burner with a clean rag.

Burner Orifice Drill Size

Orifice	Drill Size
Gas Port	31
Air Port	43

START-UP CHECKLIST

WARNING!!

- The Start-Up must be completed after all field wiring and air balancing has been completed
- The Start-Up must be completed by a qualified HVAC technician
- The Start-Up Check list must be faxed into the Service Department to validate the product warranty

JOB INFORMATION	
Job Name	
Address	
City	
State	
Zip	
Phone Number	
Fax Number	
Contact	
Purchase Date	

TECHNICIAN INFORMATION	
Service Company	
Address	
City	
State	
Zip	
Phone Number	
Fax Number	
Contact	
Start-Up Date	

Refer to the start-up procedure in this manual to complete this section.

Name Plate and Unit Information	
Model Number	
Serial Number	
Motor Volts	
Motor Hertz	
Motor Phase	
Motor FLA	
Motor HP	
Blower Pulley	
Motor Pulley	
Belt Number	
Gas Type	
Min. Btu/Hr	
Max. Btu/Hr	

Field Measured Information		
Motor Voltage		
Motor Amperage*		
Low Speed RPM **		
High Speed RPM		
Low Speed Differential Pressure **		in. w.c.
High Speed Differential Pressure		in. w.c.
Pilot Flame Signal		VDC
Low Fire Flame Signal		VDC
High Fire Flame Signal		VDC
Gas Type	Natural	
	Propane	
High Fire Inlet Gas Pressure		in. w.c.
Low Fire Manifold Gas Pressure		in. w.c.
High Fire Manifold Gas Pressure		in. w.c.
Temperature Control	Discharge	
	Space	
Airflow Direction	Correct	
	Incorrect	

*If measured amps exceed the FLA rating on the nameplate, fan RPM must be reduced to decrease the measured amps below the nameplate FLA rating.

**Low speed readings used on variable air volume units.

Factory Service Department
Phone: 866-784-6900
Fax: 919-554-9374