INDUSTRIAL COMMERCIAL
EQUIPMENT MANUFACTURING LTD.

BMA SERIES
DIRECT GAS-FIRED MAKE-UP AIR
INSTALLATION, OPERATION AND MAINTENANCE MANUAL

READ MANUAL CAREFULY BEFORE INSTALLING
OR OPERATING THE FURNACE

FOR YOUR SAFETY	**FOR YOUR SAFETY**
If you smell gas follow these instructions, 1) Open windows. 2) Do not touch electrical switches. 3) Extinguish any open flame. 4) Call the gas supplier immediately.	The use and storage of gasoline or other flammable vapors and liquids in open containers in the vicinity of this appliance is hazardous.

MODEL: _____ **SERIAL NUMBER:** _____

JOB: _____ **DATE OF INSTALLATION:** _____

WARNING
IMPROPER INSTALLATION, ADJUSTMENT, SERVICE OR MAINTENANCE CAN CAUSE PROPERTY DAMAGE, INJURY OR DEATH. PLEASE READ THE INSTALLATION, OPERATING AND MAINTENANCE INSTRUCTION THOROUGHLY.

THIS UNIT IS TO BE SERVICED BY QUALIFIED PERSONNEL
****DO NOT TAMPER WITH THE UNIT OR CONTROLS****

INSTALLER'S RESPONSIBILITY

Installer please note: This equipment has been test fired and inspected. It has been shipped free from defects from our factory. However, during shipment and installation, problems such as loose wires, leaks or loose fasteners may occur. It is the installer's responsibility to inspect and correct any problems that may be found.

THIS EQUIPMENT SHALL BE INSTALLED AND WIRED IN ACCORDANCE WITH THE REGULATIONS OF THE NATIONAL BOARD OF FIRE UNDERWRITERS, CANADIAN ELECTRIC CODE AND LOCAL GOVERNING BODIES. THE INSTALLAION CODE FOR "GAS BURNING, APPLIANCES AND EQIPMENT, CAN 1-B149", AND APPLICALBLE PROVINCIAL REGULATIONS FOR THE CLASS, WHICH SHOULD BE FOLLOWED CAREFULLY IN ALL CASES.

INSTALLER/SERVICE CONTRACTOR

NAME: _____
ADDRESS: _____
TELEPHONE: _____
CONTACT: _____

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GENERAL INFORMATION

GENERAL NOTES

This Direct Fired BMA Series is used to provide make-up air to satisfy an exhaust system within a building. Normal discharge temperature is in the 65°F –110°F range, with the exception of the paint booth unit which can discharge at up to 170°F in the cure mode (booth unoccupied and booth lights off). The Sequence of Operation and Wiring Diagram are located in the weatherhousing on outdoor units and control compartment on indoor units.

WARNING!

Fire or Explosion hazard can cause property damage, severe injury or death. Ensure that all air taken into the unit is free from the presence of:

a) Flammable solids, liquids, and gases.
b) Explosive materials. Example: grain dust, coal dust, gunpowder, etc.
c) Substance that may become toxic when exposed to heat or passing through a gas flame.

INSTALLATION AND SERVICE INSTRUCTIONS

The information provided is a guide to the proper installation, operation, and troubleshooting of the unit. Retain the manual as a reference for operation and maintenance personnel. Should contact with the factory be necessary, provide the unit model number and serial number. Install and wire the equipment in accordance to the applicable national and local governing bodies codes. Consult the authorities having jurisdiction before making the installation. Local codes may require additional safety controls and/or interlocks.

UNIT LOCATION

Prior to locating the unit, check with the authorities having jurisdiction. The unit should be positioned to allow adequate clearance to open access doors and remove filters. Ensure that the unit is installed level. Provide adequate clearance on either side of the unit to service the blower, bearings, motors, drives and filters. Ensure that the position of the heater relative to support beams is correct so as to provide adequate support for the equipment. For roof mounted units, check the spacing of the roof structure beams to avoid interference with air ducts.

LOCATION OF ACCESSORIES

The remote panel will be shipped as a separate package. Mount the panel and have an electrical contractor install wiring.

FACTORY TESTING & STARTUP CHECKLIST

All BMA series units are factory fired and tested prior to shipping. Each unit is shipped with the tester's report and a start-up checklist. Complete the start-up checklist and return one copy to the factory.

INSPECTION OF EQUIPMENT

All shipments are made F.O.B. the factory. The unit is securely strapped or blocked to prevent shipping damage and each shipment inspected prior to leaving the plant. All parts, where feasible, are strapped to or included in the unit. Upon receipt of goods, check the shipment against the bill of lading to ensure all items have been received. Carefully check the unit for physical damage in the presence of the carrier's representative. Should parts be missing or damage noted, file a claim immediately with the carrier. ICE does not assume responsibility for the handling of the goods in transit and is **not responsible for the initiation of freight claims.**

INHERENT FEATURES OF THIS UNIT

Hard-coded low limit of 40°F (option to turn off low limit available).

The low limit is monitored after 3 minutes of runtime; this allows the unit to warm up. If discharge temperature is below the low limit set point after this time (for a minimum period of 5 seconds) the system is turned off and the fault light is activated.

An error results if the flame fails.

Hard-coded discharge temperature of 55°F-110°F.

Software high limit is set at 160°F as read at the discharge of the blower. If the high limit is reached, the unit shuts down. Note: If unit locks out on high limit "Manual Reset High Limit" (located on unit control panel) must also be reset.

Discharge temperature monitored to set value.

Remote Set Point (RSP) adjustment range of 55°F – 90°F.

Adjustable summer/winter transition point between 50°F – 70°F allows the user to set the point at which the system will automatically turn on the burner. If the unit is equipped with an ambient sensor the circuit board will monitor the ambient temperature, and automatically turn on the burner if the ambient temperature drops below the "AUTO SEASON" temperature set point as set by the user adjustable potentiometer (located on circuit board).

Offset adjustment potentiometer (+/- 5°F, located on circuit board) allows the user to fine tune the discharge temperature to match the remote temperature selectors set point.

Purge time of 10 seconds.

Sample time of 1 second.

Optional resistor allows for BMS modulation (0-10Vdc or 4-20mA).

System fails if pressure is not within allowable range (0.2 – 1.4 in. W.C.) when summer/winter switch is activated.

INSTALLATION AND SERVICE INSTRUCTIONS FOR DIRECT GAS FIRED MAKE-UP AIR HEATERS

LOCATION OF UNIT AND DISTRIBUTION

INLET

All air handled by this unit must be brought directly from outdoors. The intake shall be designed and located to prevent snow, rain, flammable gas, toxic gases and other deleterious materials from entering the unit. (Less than 500 F.P.M. is an accepted velocity.)

INSTALLATION

Smaller models are shipped as one total unit. All other models are shipped in sections that are easily erected on the job site. The main section consists of a burner damper section that contains the motor and a blower section. The secondary sections are the filter, louver, mixing box, etc., which are added in sections as required.

1. All sections are pre-drilled and are bolted together in the field (as per figure 1).
2. Belts must be installed on the motor and limit and discharge controls may have to be mounted and/or wired.
3. Where clearance is not a factor, ensure that the unit is adequately protected from obstruction.

NOTE: On roof top units, the joint will have to be caulked to prevent rain from entering the unit.

INDOOR SUSPENSION

On indoor models holes at the base of the units are provided for 5/8" suspension rods (see drawing No. BMA-HD). When suspending it from the ceiling, the unit must be lifted and handled from the lifting holes provided at each end of the channel iron. The unit must be supported if it is to be lifted from the bottom for mounting on a platform (as with a fork lift).

NOTE: DO NOT LIFT CABINET WITHOUT THIS SUPPORT.

ROOFTOP INSTALLATION

Support rails (minimum of 4" high) must be provided underneath the unit. In some cases, more height may be required when installing the supply duct through the roof (see figure 1) or if a unit is a bottom discharge (see figure 2).

CLEARANCE

Minimum clearance from the unit, to combustible construction, is clearly marked on the rating plate attached to the unit.

No source of flammable vapors, gases or dust shall be within 20 feet horizontally of any unit unless that source is separated from the unit by an enclosure of fire and vapor resistive materials.

On indoor suspended units, when necessary to provide working clearance beneath the unit, the installation shall be made at a suitable height above the floor.

CONNECT DUCTWORK

1. On indoor units, install fresh air duct to inlet of unit. Install intake hood or louvers with screen.
   a) Make required opening in wall and line with angle frame inside. Should be completed before outside is started to avoid crumbling.
   b) Insert insulated fresh air "collar" through opening with flanges turned out to provide rigidity.
   c) Anchor intake hood with bird screen to wall.
   d) Caulk perimeter of opening to make rain-tight.
2. Connect discharge air duct or discharge grille to unit outlet. If unit is installed on the roof, be sure that the duct going through the roof is adequately flashed and sealed to prevent leakage (see figure 1).
3. Where a ductwork system or other enclosure is directly connected to the inlet or outlet of the heater in such as way as to cause a possible gas trap and accumulation of a flammable mixture, a pre-purge cycle shall be incorporated to provide not less than 4 complete air changes of the duct work or enclosure by volume prior to ignition.
4. Where additional automatically operated inlet or discharge air louvers are used, they shall be electric interlocked to ensure the maximum designed opening before either starting or running circuits may be energized.

FIRE DAMPER

Fire dampers installed in inlet or outlet duct systems shall be interlocked to shut down the unit in case of fire in the duct work and should be arranged so that the unit will only be electrically energized when in the wide open position.

HAZARDOUS CONDITIONS

In the event that the failure of the make-up air heater creates a hazard to other fuel-burning equipment in the building, the unit shall be interlocked to open balancing inlet air dampers. These dampers can be of motorized type, (see wiring diagram).

EXHAUST INTERLOCK

a) This unit shall be electrically interlocked so that it will operate only when the associated exhaust system(s) is functioning. An exhaust airflow proving switch shall be used (Refer to sheet exhaust interlock) for typical application, and (wiring diagram) for electric hookup.
b) The total air discharge capacity of the unit cannot exceed by more than 10% the total discharge capacity of the exhaust systems in conjunction with which it is used. Where the tempered air is discharged directly into a booth, the total air discharge capacity of the booth cannot be exceeded.
c) The exhaust air proving switches should be set as to open when the volume of exhaust drops by more than 10% (dirty exhaust filters, etc.)

CONNECT GAS SUPPLY

a) Run correctly sized gas line to the unit. Install a manual shut off valve plug-cock type, approved for the application at the gas inlet to the make-up air heater.

NOTE: Gas line pressure must be at least 7" W.C. when unit is operating at full input. Check rating plate on unit for maximum gas input and manifold pressure.

b) Bleed and vent lines shall be installed in accordance with the applicable requirements.

COMPLETE WIRING

1. Install remote supervisor panel or summer-off-winter switch (if used) in the desired location.
2. Complete wiring to supervisor panel or summer-off-winter switch as shown on wiring diagram.
3. Voltage must correspond to voltage marked on rating plate.
4. Complete all wiring to accessories (interlocks) as per wiring diagram provided on the unit.

NOTE: It is recommended that filters be removed during winter operation, if upstream from burner.

WARNING!

FIRE OR EXPLOSION HAZARD CAN CAUSE PROPERTY DAMAGE, SEVERE INJURY, OR DEATH.
Check for gas leaks with rich soap and water solution any time work is done on a gas control.

START-UP PROCEDURE

1. Remove shipping blocks from blower if rubber or spring isolated.
   Check to be sure that damper opens, if tied down, remove wire.
   Check modulating discharge controller, on units, to ensure that it is in the blower air stream. On some units this control may be mounted external from the unit. If so, check to see that the sensor is installed in the discharge air stream of the make-up air heater and that the controller is wired to the modulating motor, regulating gas supply to burner.

2. Make sure that the main firing valve is closed, but that gas is available in the service line.

3. Check to ensure exhaust fans are wired into the control panel and that there is power to the exhaust starter relays. Check to ensure exhaust fans interlock switches are installed and wired to the control panel.

4. Familiarize yourself with the sequence of operation and wiring diagrams. This will give you information as to how the unit operates.

5. Check voltage to ensure it matches the voltage stamped on the unit rating plate, and all wires are connected between unit and remote panel.

6. Normal setting of high limits is 110°F on roof of cabinet, and 160°F in blower.

7. If supplied, turn the system switch on the remote panel to the “on” position.
   Turn the control switch (located on the unit) to the “on” position.
   On the remote panel, set the summer/winter switch to the “summer” position.
   The damper should open.
   The end switch is made, and the blower should spin. Check to ensure that the blower is spinning in the proper direction.
8. Pilot.
   The Protector relay monitors the pilot flame through the flame rod. A minute current is sent from the relay through the flame rod, and through the pilot frame to “ground”. The relay detects the current flow and acts to open the safety valve as required. When no flame exists, current cannot flow and the relay acts to close the valve. NOTE: Current flow depends only on flame contact with rod: temperature of the rod is of no importance.

   Since the flame rod is a current-carrying conductor, it must be free of any contact with conductive parts of the pilot burner. The insulator must be clean, dry and free from cracks. While the flame rod is made of a heat resistant alloy, it may, after long service, deteriorate to the point of failure. Check for serious corrosion or any loss of metal. The flame rod must be tight enough in the insulator to maintain its position. Do not use too much force or the insulator may crack.

   Measuring the flame rod current can check proper operation of the flame rod; refer to flame safeguard instruction sheet with unit. Lacking a micro amp meter, a check can be made by operating the burner through all of its normal phases. Relay response should be prompt with no chattering or drop out.

   The spark rod (Midco Burner, see figure 5 for gap setting, Maxon Burner spark igniter No. 18075) produces a high-tension arc at the correct location for lighting the pilot. Ignition transformer must be rated for 6000 Volts, 20 Miliamperes secondary, minimum.

   The spark rod or spark igniter must be free of contact with conductive parts of the pilot burner. Insulator must be clean, dry and free of cracks. Check the spark rod for serious corrosion or loss of metal. It must be held tightly enough in the insulator to maintain its position.

   Gap must be 1/16” to 3/32” (see figure 5). Cycling the pilot can also change this setting. Ignition must be prompt and positive. Do not allow careless positioning to cause arc of flame rod; serious relay damage would result.

Replace the complete spark igniter on Maxon burners if the spark igniter shows deterioration of igniter (Part No. 18075).

9. If pilot tries for ignition and locks out, check the air proving switches (high and low) that are mounted across the profile plate to ensure that the proper amount of air is flowing through the unit. If the pressure drop is between .2" W.C., and 1.4" W.C., these switches are made. Check pilot to ensure proper flame. Check instruction sheet for flame safeguard system. Pilot adjustment screw is in the Thermax shut-off valve. When setting, adjust for best reading, and then open pilot setscrew slightly.

10. Main flame supervision: With units that have more than three feet of burner from point of supervision, a second flame rod will be on the main burner. This switching is done with a time delay relay (see wiring diagram). This can be disconnected for testing the pilot, or you have to ensure main flame by opening up the firing valve within 15 seconds after pilot solenoid is powered, as supervision will switch from pilot to main flame in that time. Check to ensure that unit will lockout in the event of main flame failure on low-fire by closing main firing valve.

11. Gradually open firing valve to start main flame. Check for flame over entire burner length. Adjust the pressure regulator as per the rating plate.

12. Check gas pressure switch setting.

    High gas pressure switch……6" W.C.
    Low gas pressure switch…….2" W.C.

NOTE: The high and low gas pressure switches may be the manual reset type on some units.

FLAME SUPERVISION CHECK

a) The flame supervision should be checked periodically to ensure that the controls are operational. With the unit on full operation and firing, close the main manual firing valve and pilot manual firing valve. This should lockout the unit.
b) The units with more than 3 feet of burner from the point of supervision have dual flame rod and a delay timer for main flame supervision. Closing the main flame firing valve should lockout the safety relay and the unit should shutdown.
c) The main safety valve should be checked for gas tightness by placing a manometer in the manifold between the safety valve and the manual firing valve (a 1/8" plug is provided for this). If there is a buildup of pressure with the unit locked out and the manual valve closed, the safety valve should be replaced.
d) The complete gas line and manifold should be checked for gas tightness.

C.F.M.

a) This unit depends upon an adequate supply of air for good combustion and operation. Care should be taken to ensure that properly sized inlet hood and ductwork are installed and that the unit is discharging the right amount of air.

EXAMPLE FOR CALCULATING C.F.M.

Example for Calculating the Amount of Air and Gas in a Direct Fired Make-Up Air Unit Pull Through Type

YOU WILL NEED: - **A** pressure differential gauge (Manometer, Magnehelic)
- Thermometer (-30°F to 200°F)

All units are factory set with a burner profile opening sized for approximately 3000 F.P.M. velocities for 100% make-up air units and approximately 3750 F.PM. for dual volume units. The velocity may not be within this range on startup of unit due to more or less external static pressure. The pressure drop should be checked to ensure the unit is operating around this velocity.

Perform a pulley adjustment or drive change to bring the velocity within operating range. If an air balance has been performed, the C.F.M. verified as matching the value stamped on the rating plate, and the velocity across the burner is still not correct, the profile area should be adjusted.

If velocity is higher than 3000 FPM, increase the profile area. This can be achieved by readjusting the side profile plates. NOTE: The side profile plates must be moved the same amount (ex. 1" each). The burner **MUST** remain centered in the profile.

The profile area is stamped on the rating plate, but to get to the free area you will have to deduct the space taken up by the burner.

If Midco burner is used deduct .65 sq. feet for each 1-foot section, or .33 sq. feet for each 6" section.
If Maxon burner is used deduct .8 sq. feet for each 1-foot section, or .4 sq. feet for each 6" section.

Using a magnehelic differential gauge across the burner profile will give you the pressure drop and using the burner capacity chart will tell you what velocity you have through the profile. If the unit is operating between .45" W.C. and .65" W.C. it is considered to be within operating range, as the low air switch is factory set to make at .2" W.C. and the high profile switch is set to open at 1.4" W.C.

This should allow for a wide leeway before the unit will lockout due to low air / high air velocity across the profile plate. Under normal servicing the tubes from the air switch should be checked to ensure they are free of any moisture or dirt as this could cause the burner to lockout on the flame safeguard relay as both switches are in the flame rod circuit.

If moisture is entering the tubes they may have to be repositioned to a lower area on the cabinet. Care must be taken to ensure that they will operate to shutdown the unit if the velocity is out of the operating set points.

OPERATING PRINCIPLES OF THE RAW GAS BURNER

The raw gas burner is designed to operate in a duct of flowing fresh air. Fuel gas is fed directly to the burners; kinetic energy of the air stream furnishes combustion air. The burner must be installed to fire with, and parallel to, the airflow. By virtue of velocity impact and suction generated by the diverging shape of the combustion baffles, air is induced into the air ports in the combustion zone. The supply air is constant, though only that which mixes with the gas flowing from the burner ports takes part in combustion.

When a very small quantity of gas is admitted to the burner, sufficient mixing takes place in the low fire slot within the burner; casting and combustion takes place in this zone. Since the low fire zone is contained within the burner casting it is effectively shielded from the fire being disrupted by uncontrolled air entry.

As the gas is increased, the flame progresses into the intermediate fire zone where an additional supply of air is available. At high or full capacity, mixing occurs at the larger air ports of the high fire zone augmented by air spilling over the end of the baffles.

On a reduction of gas supply the reverse sequence takes place; the flame recedes to a location of lesser air supply until the low fire zone is reached. The system above is suitable for a turn down range of approximately 30 to 1.

With the suction by the blower there is a pressure in the gas manifold of less than zero at low fire. Therefore, when checking the manifold pressure you will find that the pressure will range from approximately 4" W.C. to less than zero, when the unit is modulating from high to low fire.

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USING SYSTEM TUNE TO ADJUST LOW FIRE

1) a. Insure that the main manifold firing valve is closed.
b. Press and hold the Service Button on the circuit board until the yellow service light (L7 light) is energized (approximately 2 seconds, see the MAKE-UP AIR CONTROL BOARD WIRING DIAGRAM for the location of this button.)
c. The following LED's should be illuminated on the circuit board.

L1	
	L8

d. You are now in Low-Fire Range. Note that depending on the position of the low fire potentiometer, the modulating gas valve may stroke to the full open position.
e. In the event that this happens turn POT #1 Clockwise until the signal to the gas valve actuator is approximately 3.2Vdc and/or the ball valve is only open a small amount.
f. Slowly open main manifold firing valve.
g. Now use POT #1 to adjust low fire to the desired value. Using a multi-meter the low fire setting should be approximately 3.2Vdc signal to the modulating gas valve actuator or visually insure that there is constant flame across the whole burner. If the flame is pulsing and/or not a complete flame across the burner then you will need to increase the gas valve signal.

2) a. Once low fire is set, press the service button on the circuit board once. The circuit board is now cycling through the last 10 alarm codes that the circuit board recorded.
b. After all 10 alarm coded have been displayed ALL 8 LED lights will energize. This indicates that all 10 alarm coded has been displayed and the board will once again start displaying alarm coded 1 through 10 again.
c. To exit the alarm history, press and hold the service button on the circuit board until the led's switch do normal operation mode.

2) a. The following LED's should be illuminated on the circuit board depending on operation mode (winter/summer).

WINTER MODE

	L2
L3	**L4**
L5	

SUMMER MODE

L1	**L2**
	L4

b. You have exited system tune, and are now back in run mode.

4) a. Turn the unit off and then restart to confirm that low fire will spread across the entire burner on initial start-up.
b. If flame does not spread across the burner then repeat steps 1 through 3.

FORCING UNIT TO CONTINUOUS HIGH FIRE

1) a. To force the unit to full fire, remove the Remote Temperature Selector wire from the pin connection marked "RSP IN". This will cause an open circuit forcing the unit to full fire.

2) a. Use the factory mounted Maxitrol Gas Pressure Regulator (RV Series) located at the inlet of the manifold to adjust your full fire gas pressure.
b. Once you are finished replace Remote Temperature Selector wire back onto "RSP IN" pin connection.

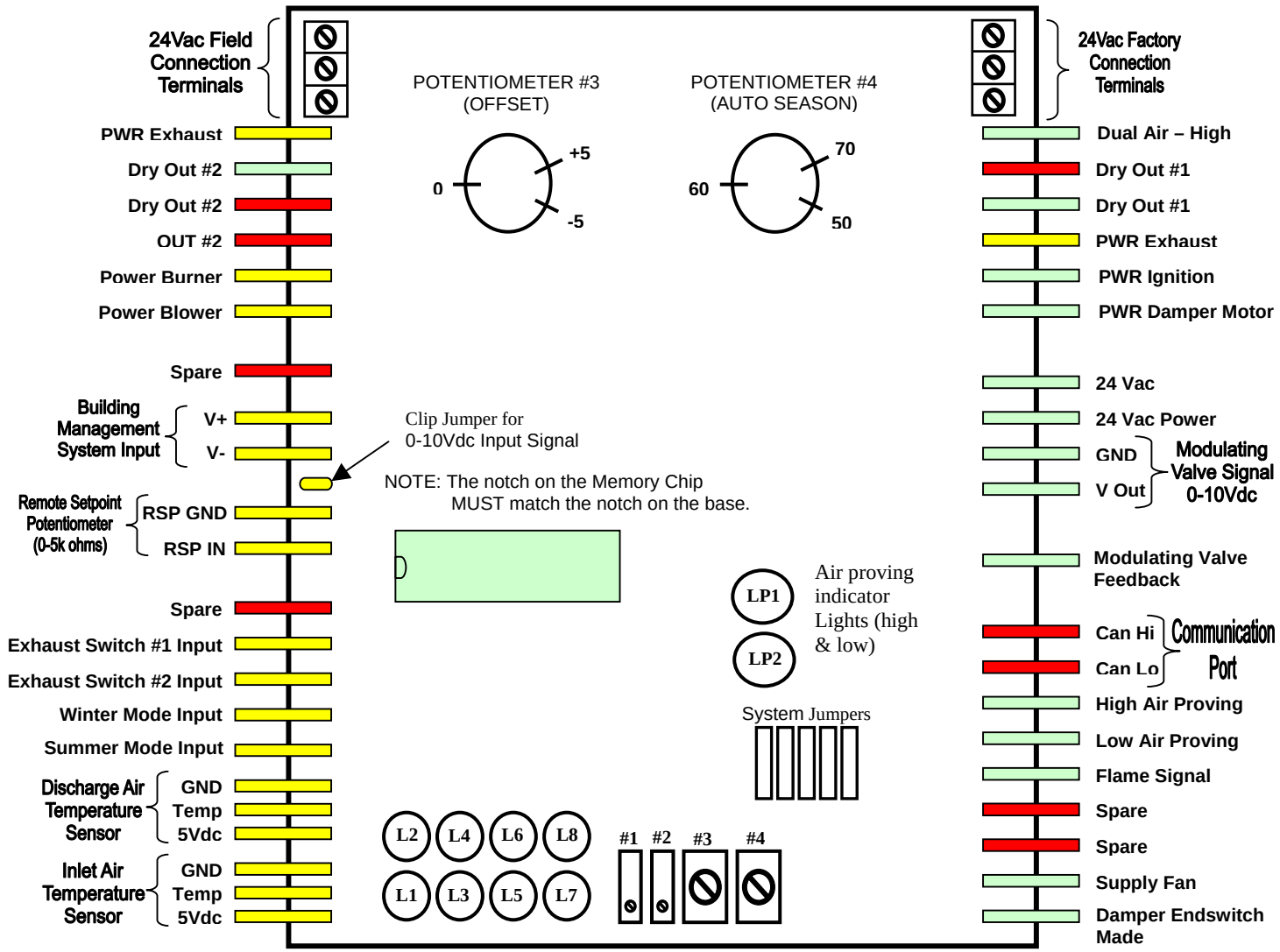
LEAVE PAGE BANK FOR FUTURE USE

MAKE-UP AIR CONTROL BOARD LAYOUT DIAGRAM

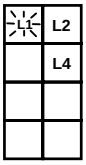
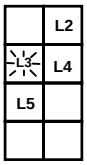
INPUTS ARE 24Vac (HOT)
OUTPUTS ARE 24Vac (HOT)
BOARD SIZE: 7” x 8”

POTENTIOMETER CONFIGURATION	
POT 1	Adjusts LOW FIRE
POT 2	--- For Future Expansion, not currently used ---
POT 3	Adjusts Discharge Offset
POT 4	Adjusts the Summer/Winter Transition Set Point

BMA CIRCUIT BOARD



SYSTEM JUMPERS	
JMP# 1	Not Clipped – Auto Low Limit
	Clipped – No Low Limit
JMP# 2	Not Clipped – Standard Operation
	Clipped – Delay Exhaust Start
JMP# 3	Not Clipped – Remote Selector
	Clipped – BMS Signal
JMP# 4	Not Clipped – 100% Make-up
	Clipped – Dual Air

SUMMER/WINTER AUTO CHANGEOVER	
	**WHEN INLET AIR SENSOR IS INSTALLED AND UNIT SWITCH IS IN WINTER POSITION. IF AMBIENT TEMPERTURE IS ABOVE SETPOINT FOR MORE THEN 30 SEC. BURNER CIRCUIT WILL DE-ENERGIZE. L2 & L4 – ON AND L1 FLASHES CONTINUOUSLY**
	**WHEN INLET AIR SENSOR IS INSTALLED AND UNIT SWITCH IS IN SUMMER POSITION. IF AMBIENT TEMPERTURE IS BELOW SETPOINT FOR MORE THEN 30 SEC. BURNER CIRCUIT WILL ENERGIZE. L2, L4 & L5 – ON AND L3 FLASHES CONTINUOUSLY.** *** SEE NOTE ***

NOTE:
L5 light will only be energized when Remote Temperature Selector is used. If resistor #3 is clipped (BMS Mode) L5 light will not be energized in heat mode.

STARTUP OPERATION CODES (INITIAL POWER UP)	
LED	**INDICATION**
L2 – ON	**POWER ON**
L3 - ON	**10 SECOND INTERNAL WATCH DOG TIMER INITIALIZED.**
L5 - ON	**WAITING FOR Vdc FEEDBACK FROM BALL VALVE FOR PROOF OF CLOSURE (2.2Vdc)**
L7 – ON	**WAITING FOR EXHAUST INPUT SIGNAL**
L3 - ON	**PILOT LIT INDICATION – FLASHES ON/OFF INDICATED PILOT TRYING TO LIGHT**

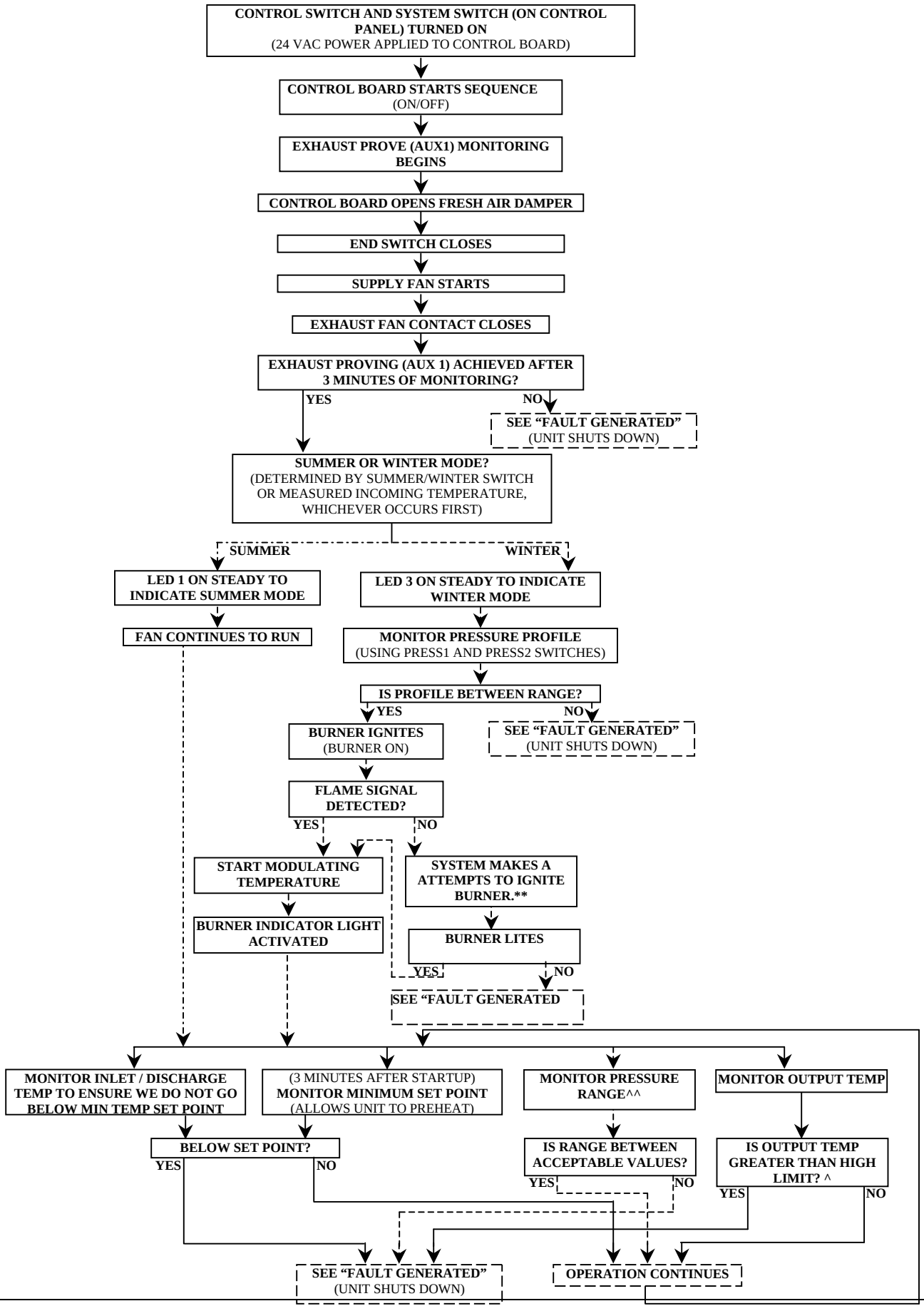
LED OPERATION CODES		
LED	**RUN MODE**	**SERVICE MODE**
L1 – ON	**SUMMER MODE**	**ADJUST LOW FIRE**
LP2 - ON	**POWER ON**	**POWER ON**
L2 - FLASH	**STANDBY MODE**	**-**
L3 - ON	**WINTER MODE**	**ADJUST HIGH FIRE**
L4 – ON	**IN RUN MODE**	**-**
L5 - ON	**MODULATION MODE**	**-**
L6 - ON	**FAULT – SEE CODES**	**-**
L7 - ON	**V-in MODE**	**"IN SERVICE" MODE**
L8 - ON	**-**	**-**
LP1 - ON	**LOW PRESSURE**	**-**
LP2 - ON	**HIGH PRESSURE**	**-**

ERROR CODES

L1 L6	FLAME ERROR	L3 L6	EXHAUST INPUT FAILURE MORE THAN 3 MINUTES
L1 L2 L3 L6	HIGH DISCHARGE TEMPERATURE ALARM	L2 L5 L6	MODULATING GAS VALVE FEEDBACK FAULT – VALVE STUCK OPEN
L1 L3 L4 L6	LOW LIMIT TEMPERATURE ALARM	L4 L5 L6	MODULATING GAS VALVE FEEDBACK FAULT – VALVE FAULTY
L2 L6 L7	PROFILE AIR PRESSURE – HIGH ERROR	L1 L2 L6 L7	DISCHARGE SENSOR OPEN CIRCUIT
L4 L6 L7	PROFILE AIR PRESSURE – LOW ERROR	L1 L4 L6 L7	DISCHARGE SENSOR SHORT CIRCUIT
L2 L4 L6 L7	PROFILE AIR PRESSURE – SWITCH FAILURE	L1 L4 L5 L6	INLET AIR SENSOR SHORT CIRCUIT
L1 L2 L5 L6	INLET AIR SENSOR OPEN CIRCUIT * SEE NOTE *		

NOTE:
"INLET AIR SENSOR OPEN CIRCUIT" **ALARM WILL ONLY OCCUR IF THE INLET SENSOR IS INSTALLED AND THE BOARD VERIFIES ITS INPUT SIGNAL WHEN THE CIRCUIT BOARD IS FIRST POWERED.**

TYPICAL SEQUENCE OF OPERATIONS FOR MANITOBA UNITS



MANITOBA SEQUENCE OF OPERATION MAKE-UP AIR
With Supervisor Panel

1. Control switch and system switch on control panel are turned on (24 VAC Power applied to control board).
2. Control board starts sequence (ON/OFF).
3. Exhaust prove (AUX1) monitoring begins.
4. Control board opens fresh air damper.
5. End switch closes.
6. Supply fan starts.
7. Exhaust fan contact closes.
8. If exhaust proving (AUX1) is achieved after 3 minutes of monitoring, unit operation continues. If proving fails, a fault is generated and the unit shuts down.
9. The system then enters either summer or winter mode (This is determined by the summer/winter switch, or measured incoming temperature, whichever occurs first).

SUMMER OPERATION:

a. LED1 is on steady, indicating summer mode.
b. Fans continue to run.

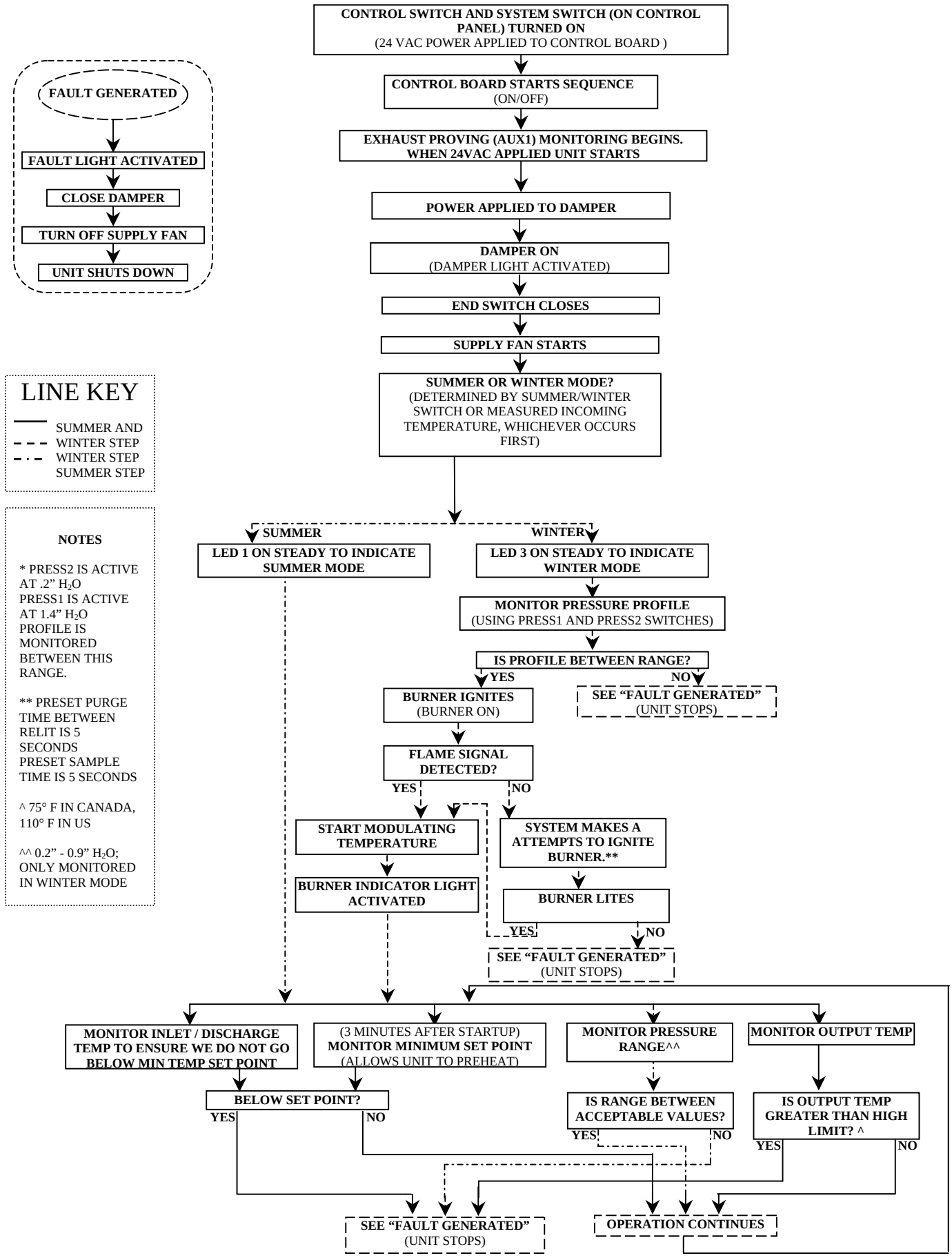
WINTER OPERATION:

a. LED 3 is on steady to indicating winter mode.
b. The pressure profile is monitored using PRESS1 and PRESS2 pressure switches. If the profile is within the allowable range, unit operation continues. If not, a fault is generated, and the unit stops.
c. The burner ignites.
d. If a flame signal is detected, unit operation continues. If not, the system makes 1 attempt to ignite the burner. If these attempts are successful and a flame signal is detected, unit operation continues. If not, a fault is generated and the unit stops.
e. The unit begins modulating temperature.
f. The burner indicator light is activated.

10. The unit monitors for unsafe conditions:
    a. Monitor low limit temperature to ensure we do not go below minimum temperature set point.
    b. 3 minutes after startup, monitor minimum set point to ensure we do not go below set point (this allows the unit to preheat).
    c. If in winter mode, monitor the pressure profile to ensure it stays within the acceptable range.
    d. Monitor output temp to ensure it is below the high limit.

If such a condition is found, a fault is generated and the unit shuts down. If one of these conditions is not found, unit operation continues normally.

TYPICAL SEQUENCE OF OPERATIONS



TYPICAL SEQUENCE OF OPERATION MAKE-UP AIR
With Supervisor Panel

1. Control switch and system switch on control panel is turned on (24 VAC Power applied to control board).
2. Control board starts sequence (ON/OFF).
3. Exhaust prove (AUX1) monitoring begins.
4. Power applied to damper.
5. Damper on (damper light activated).
6. Supply fan starts.
7. The system then enters either summer or winter mode (this is determined by the summer/winter switch, or measured incoming temperature, whichever occurs first).

SUMMER OPERATION:

a. LED1 is on steady, indicating summer mode.
b. Fan continues to run.

WINTER OPERATION:

a. LED3 is on steady, indicating winter mode.
b. The pressure profile is monitored using PRESS1 and PRESS2 pressure switches. If the profile is within the allowable range, unit operation continues. If not, a fault is generated, and the unit stops.
c. The burner ignites.
d. If a flame signal is detected, unit operation continues. If not, the system makes 1 attempt to ignite the burner. If these attempts are successful and a flame signal is detected, unit operation continues. If not, a fault is generated and the unit stops.
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   c. If in winter mode, monitor the pressure profile to ensure it stays within the acceptable range.
   d. Monitor output temp to ensure it is below the high limit.

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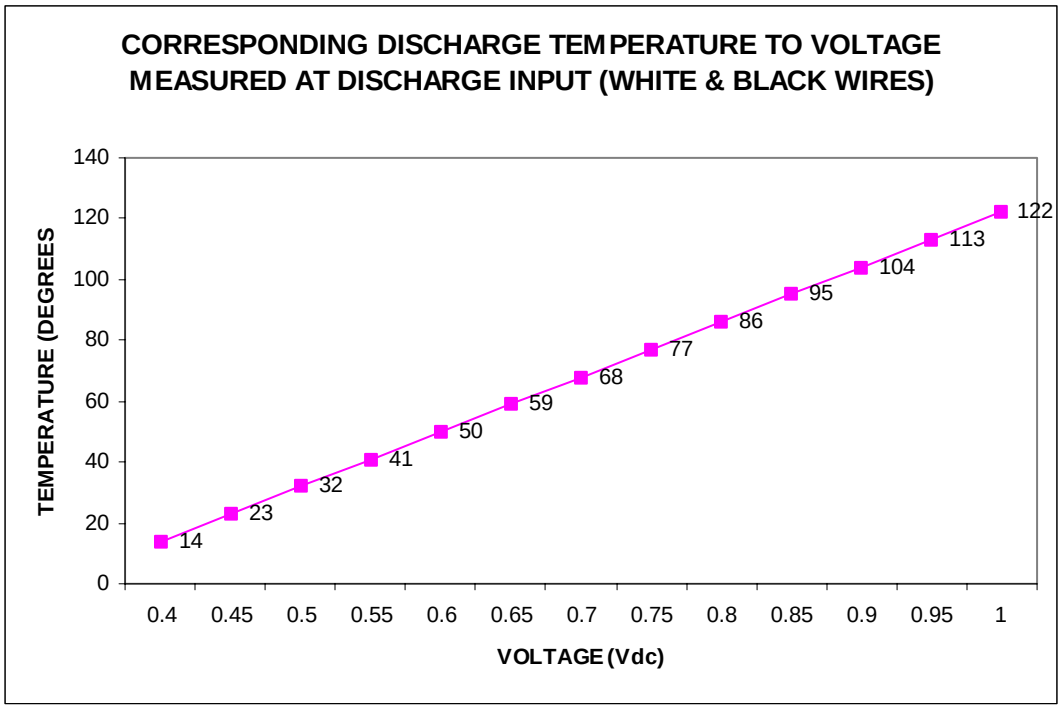
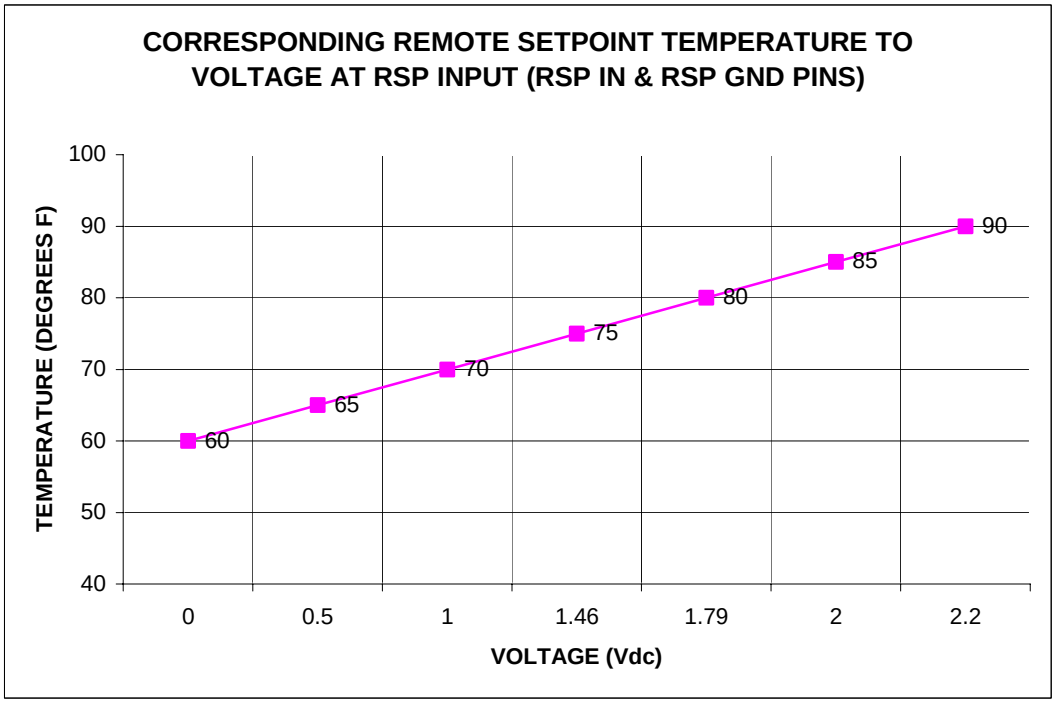
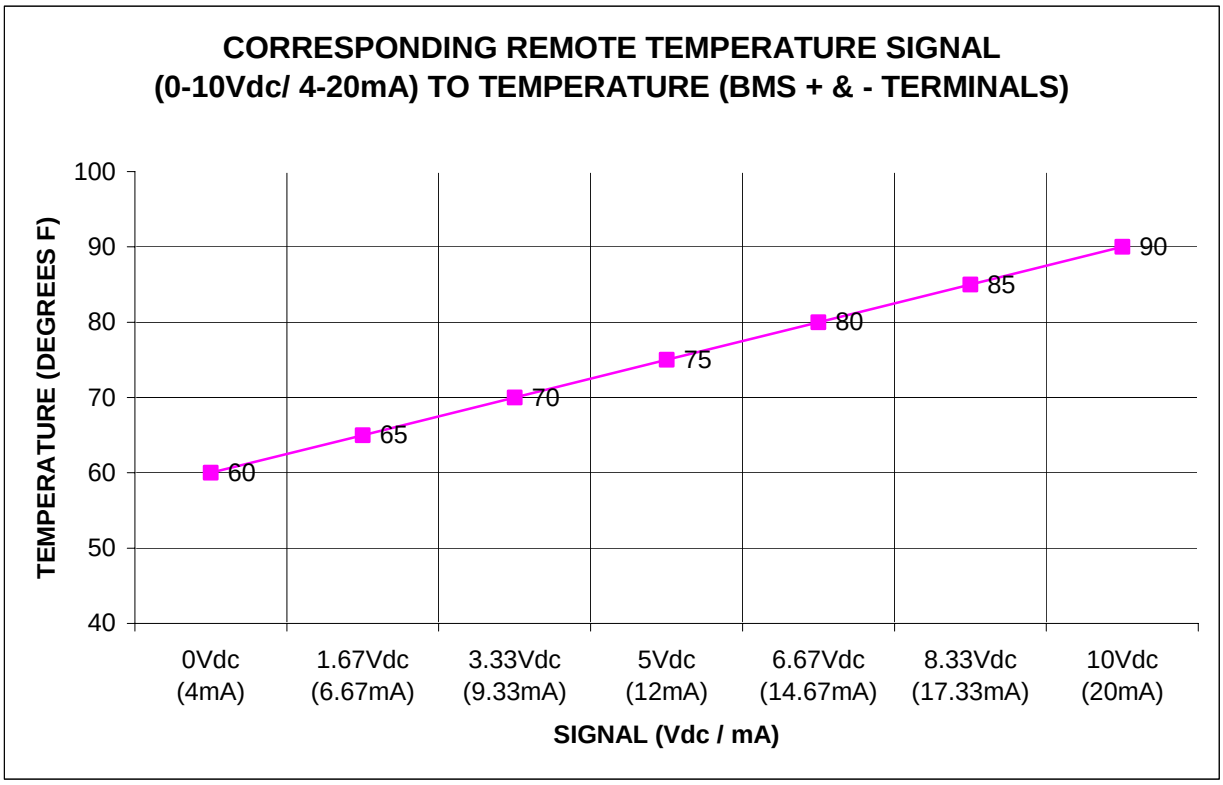

CORRESPONDING DISCHARGE TEMPERATURE TO VOLTAGE MEASURED AT DISCHARGE INPUT (WHITE & BLACK WIRES)
TEMPERATURE (DEGREES
140
120
100
80
60
40
20
0
14
23
32
41
50
59
68
77
86
95
104
113
122
0.4
0.45
0.5
0.55
0.6
0.65
0.7
0.75
0.8
0.85
0.9
0.95
1
VOLTAGE (Vdc)


CORRESPONDING REMOTE SETPOINT TEMPERATURE TO VOLTAGE AT RSP INPUT (RSP IN & RSP GND PINS)
TEMPERATURE (DEGREES F)
100
90
80
70
60
50
40
60
65
70
75
80
85
90
0
0.5
1
1.46
1.79
2
2.2
VOLTAGE (Vdc)


CORRESPONDING REMOTE TEMPERATURE SIGNAL
(0-10Vdc/ 4-20mA) TO TEMPERATURE (BMS + & - TERMINALS)
TEMPERATURE (DEGREES F)
100
90
80
70
60
50
40
60
65
70
75
80
85
90
0Vdc (4mA)
1.67Vdc (6.67mA)
3.33Vdc (9.33mA)
5Vdc (12mA)
6.67Vdc (14.67mA)
8.33Vdc (17.33mA)
10Vdc (20mA)
SIGNAL (Vdc / mA)

LEAVE PAGE BANK FOR FUTURE USE

MAINTENANCE

Regular maintenance is necessary to ensure the efficient operation and long life of this unit. This maintenance should be performed by, or supervised by, qualified service personnel. A maintenance schedule should be prepared for the unit based on its application and location.

RECOMMENDED MONTHLY MAINTENANCE

1. Check for loose connections in the wiring.
2. Check the voltage at the unit while it is in operation.
3. Check motor amperage draws against the rating plate values.
4. Inspect all contactors to ensure that they are clean and making good contact.
5. Check all fittings, valves, and lines for leaks.
6. Check the burner; clean if necessary.
7. Check the flame sensor; clean if necessary.
8. Check the fuel supply pressure to the unit.
9. On gas fired units, check the manifold pressure.
10. Clean or replace air filters if necessary. Replace filters only with type equivalent to those supplied with the unit by the factory.
11. Check all damper, linkages and damper actuators; adjust and tighten as required.
12. Check all belts; adjust or replace as necessary.
13. Check operation of all safety controls.

RECOMMENDED YEARLY MAINTENANCE

1. Perform the monthly maintenance recommended.
2. Inspect blower wheels and housing; clean if necessary.
3. Inspect all setscrews on blower wheels and pulleys to ensure that they are secured to their respective shafts.
4. Check ignition spark and adjust gap if necessary.
5. Inspect and clean ignition electrodes.
6. Check flame supervisor relay.
7. Inspect all operating and safety controls; clean and replace if necessary.
8. Clean the burner.

NOTE: Refer to manufacturer literature provided for maintenance requirements of optional equipment.

BEARING INSTALLATION AND MAINTENANCE

NOTE: To prevent premature failure – please ensure greasing instructions below are applied. As well, tighten bearing set screws, collars, and wheel lugs every four to six months.

ENGINEERING – BALL & ROLLER BEARINGS LUBRICATION

For bearings that are equipped with a hydraulic grease fitting threaded into the housing for ease of lubrication, the proper amount of lubricant in the bearing is important. Both excessive and inadequate lubrication may cause failure. The bearings should be re-lubricated while they are rotating (if it is safe to do so); the grease should be pumped in slowly until a slight bead forms around the seals. The bead in addition to acting as an indicator of adequate re-lubrication provides additional protection against the entry of foreign matter and helps flush out contaminates in the bearing.

By the time the slight bead has formed, it will be noticed that the bearing temperature will rise. It is not uncommon for the temperature to raise as much as 30°F after re-lubrication. If necessary to re-lubricate while the bearing is idle, refer to the recommended re-lubrication grease chart tables on the following page for various sizes of the bearings.

LUBRICANT-STANDARD BEARINGS

All bearing units are pre-lubricated at the factory with lithium soap grease, which is compatible with multi-purpose grease readily available from local suppliers. The lubricant selected for factory lubrication uses a highly refined mineral oil with a high viscosity index, thickened with lithium soap to conform to NLGI grade 2 consistency. A suitable additive package is added to protect the highly polished rolling contact surfaces from corrosion and oxidation of the lubricant. The lubricant is satisfactory for an operating temperature range of -30°F to +250°F.

Select standard industrial grade greases that conform to the following specifications for optimum bearing performance:

General Duty Ball & Roller;

58-75	SUS @ 210°F
450-750	SUS @ 100°F

Premium Duty Ball & Roller;

68-75.1	SUS @ 210°F
600-750	SUS @ 100°F

Heavy Duty Roller Bearing;

82	SUS @ 210°F
886	SUS @ 100°F

NOTE: For heavy loaded roller bearing applications, grease with EP additives is often recommended for optimum performance.

TABLE: RECOMMENDED LUBRICATION

Ball Bearings		Roller Bearing	
Shaft Size (inches)	Grease Charge (ounces)	Shaft Size (inches)	Grease Charge (ounces)
¼ to 3/16	0.03	1-3/16 to 1-1/4	0.1
½ to ¾	0.1	1-3/8 to 1-7/16	0.22
1-1/4 to 1-1/2	0.15	1-1/2 to 1-11/16	0.32
1-11/16 to 1-15/16	0.2	1-3/4 to 2	0.5
2 to 2-7/16	0.3	2 to 2-3/16	0.55
2-1/2 to 2-15/16	0.5	2-1/4 to 2-1/2	0.65
3 to 3-7/16	0.85	2-11/16 to 3	0.85
3-1/2 to 4	1.5	3-3/16 to 3-1/2	1.25
-	-	3-15/16 to 4	2.5
-	-	4-7/16 to 4-1/2	3.1

Frequency of re-lubrication depends on operating conditions. The bearing operating temperature is the best index for determining a re-lubrication schedule. The following chart gives the frequency of re-lubrication based upon continuous operation for various operating temperatures and can be used as a satisfactory guide for determining when bearings should be re-lubricated.

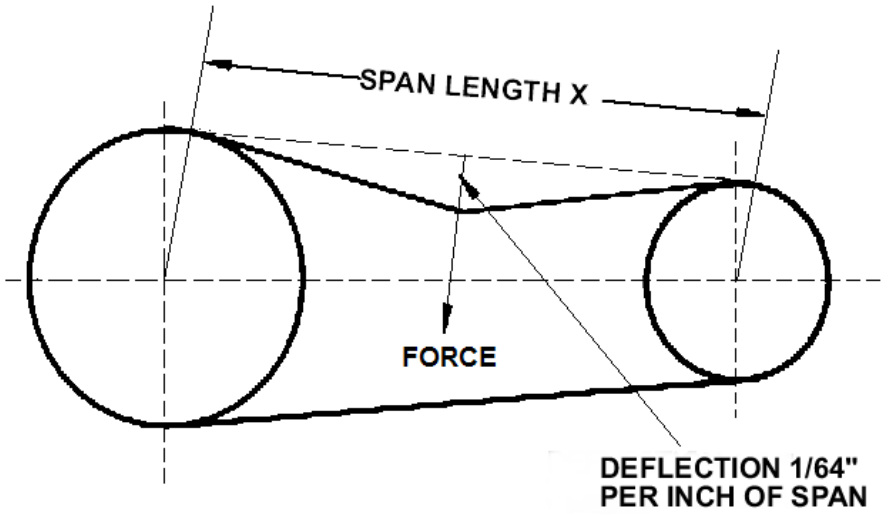
TABLE: LUBRICATION FREQUENCY

Speed	Temperature	Cleanliness	Greasing Interval
100 RPM	Up to 120 °F	Clean	5 months
500 RPM	Up to 130 °F	Clean	2 months
1000 RPM	Up to 210 °F	Clean	2 weeks
1500 RPM	Over 150 °F	Dirty	Weekly
Any speed	Up to 150 °F	Dirty	1 week to 1 month
Any speed	Over 150 °F	Dirty	Daily to 1 week
Any speed	Any temperature	Very dirty	Daily to 1 week
Any speed	Any temperature	Extreme Conditions	Daily to 1 week

TENSIONING V-BELT DRIVES

1. Ideal tension is the lowest tension at which the belt will not slip under peak load conditions.
2. Check tension frequently during the first 24-48 hours of operation.
3. Over-tensioning shortens the belt and bearing life.
4. Keep belts free from foreign material that may cause slip.
5. Make V-drive inspection on a periodic basis. Tension when slipping. Never apply belt dressing as this will damage the belt and cause early failure.

Check and tighten belt tension. The following procedure is recommended for tightening belts:
a. Measure span "X" shown in Figure A.
b. At the center of span length "X", apply a force perpendicular to the span and large enough to deflect belt 1/64" for each inch of span length. Example – the required deflection for a 40" span would be 40/64" or 5/8".
c. Compare the force applied with the values given in the table below. If the force is between the minimum and maximum range shown, the drive tension should be satisfactory. A force below the minimum value indicates an under tightened belt and a force that exceeds the maximum value indicates an over tightened belt.



BELT CROSS SECTION (Marked on Belt)	MOTOR PULLEY PITCH DIAMETER	DEFLECTION FORCE	
		MINIMUM	MAXIMUM
A	3.0" – 3.6"	2.62 lbs	3.25 lbs
	3.8" – 4.8"	3.0 lbs	4.0 lbs
	5.0" – 7.0"	3.25 lbs	5.0 lbs
B	3.4" – 4.2"	3.0 lbs	5.0 lbs
	4.4" – 5.6"	4.0 lbs	5.87 lbs
	5.8" – 8.6"	5.25 lbs	7.87 lbs

DIRECT FIRED WARRANTY

The warranty on the ICE Manufacturing Direct Gas Fired Make-up Air Units are one (1) year from installation date or 15 months from date of shipment from our factory.

Our warranty applies for original shipment on all parts and components fabricated by or installed by us with the exception of air filters, flame rods, igniters, and blower belts.

Within the one year warranty, replacement parts will be shipped collect and charged to customer account with credit being issued after receipt of, and examination of the returned parts: freight prepaid to the factory.

This warranty does not include freight, labor, or sales tax that may be incurred by the purchasers and is subject to the following conditions:

1) The unit shall be installed by a qualified heating contractor in accordance with the provisions of the service manual.
2) The unit shall have been installed in accordance with all provincial and local codes.
3) The unit shall have been subject to only normal use in service and shall not have been misused, neglected, altered or otherwise damaged.
4) The unit shall have been operated within its published capacity and with the prescribed fuel.
5) All automatic controls shall have been operative at all times.
6) The unit has not been allowed to exceed its proper temperature limits due to control malfunction or inadequate air circulation.
7) There is no evidence of tampering or deliberate destruction.

No representative of ICE or any of its distributors or dealers is authorized to assume for ICE any other obligations or liability in connection with this product, nor alter the terms of this warranty in any way. This warranty is limited to the express provisions contained herein and does not extend to liability for labor costs incurred in replacing defective parts.

Authorization to return any alleged defective parts must be obtained from the factory before the part is transported and the owner shall prepay the transportation charges for any alleged defective parts. ICE will not accept charges for parts purchased unless the conditions of this warranty have been satisfied.

The express warranties herein contained are in lieu of other warranties, expressed or implied, including the warranty of merchantability and of fitness for any particular purpose. ICE shall not be liable for damages, including special, incidental, or consequential damages arising out of or in connection with the performance of the Direct Gas Fired Make-up Air Units, or its use by the owner. ICE liability is limited exclusively to repair and or replacement of the defective part. Parts can be obtained from ICE Manufacturing, 51 Aikins Street, Winnipeg, Manitoba, R2W 4E3, on the basis that credit will be issued if defective parts returned qualify for replacement pursuant to the terms and conditions of this warranty.

HONEYWELL INTERMITTENT PILOT MODULE: S8610B

APPLICATION

These ignition modules provide ignition sequence, flame monitoring and safety shutoff for intermittent pilot central furnaces and heating appliances.
S8610 provides up to 1.0A pilot and 2.0A main valve current rating.
Minimum ambient temperature rating is -40°F [-40°C].
Maximum ambient rating is +175°F [+79°C] for S8610 used with 1.0A or less main valve.
Maximum ambient rating for S8610 used with 1.0 to 2.0A main valve is +165°F [+74°C].

Model	Igniter-Sensor Type	Type of Gas	Prepurge Timing	100 Percent Shutoff	Lockout Timing	Ignition Sequence[a]
S8610B	Separate	Natural or LP	None	Yes, at lockout	15 or 90 sec. Max., as ordered	Spark on until pilot light off or lockout; pilot valve closes on lockout.

[a] If established flame lost, all models restart ignition trial.

PLANNING THE INSTALLATION

Intermittent pilot systems are used on a wide variety of central heating equipment and on heating appliances such as commercial cookers, agricultural equipment, industrial heating equipment, and pool heaters. Some of these applications may make heavy demands on the controls, either because of frequent cycling, or because of moisture, corrosive chemicals, dust or excessive heat in the environment. In these situations, special steps may be required to prevent nuisance shutdowns and premature control failure. These applications require Honeywell Residential Division Engineering review; contact your Honeywell Sales Representative for assistance.

CAUTION!

HIGH HUMIDITY OR DRIPPING WATER
Over time, dripping water or high ambient humidity can create unwanted electrical paths on the module circuit board, causing the module to fail. *Never* install an appliance where water can drip on the controls. In addition, high ambient humidity can cause the gas control to corrode, and finally to fail.
Where the appliance may be installed in a humid atmosphere, make sure air circulation around the module and gas control is adequate to prevent condensation. It's also important to regularly check out the system. A NEMA 4 enclosure may be needed; see the Electronic Ignition Service Manual, form 70-6604.

CORROSIVE CHEMICALS
Corrosive chemicals can also attack the module and gas control and eventually cause a failure. Where chemicals may be routinely used for cleaning, make sure the cleaning solution cannot reach the controls. Where chemicals are likely to become suspended in air, as in some industrial and agricultural applications, protect the ignition module from exposure with a NEMA 4 enclosure; see the Electronic Ignition Service Manual, form 70-6604.

DUST OR GREASE ACCUMULATION
Heavy accumulation of dust or grease may cause the controls to malfunction. Where dust or grease may be a problem, provide covers for the module and gas control that will limit environmental contamination. A NEMA 4 enclosure is recommended for the ignition module; see the Electronic Ignition Service Manual, form 70-6604.

HEAT
The controls can be damaged by excessively high temperatures. Make sure the maximum ambient temperature at the control locations will not exceed the rating of the control. If the appliance normally operates at very high temperatures, insulation, shielding, and air circulation may be necessary to protect the controls. Proper insulation or shielding should be provided by the appliance manufacturer; make sure adequate air circulation is maintained when the appliance is installed.

INSTALLATION

WHEN INSTALLING THIS IGNITION SYSTEM…

1. Read these instructions carefully. Failure to follow them could damage the components or cause a hazardous condition.
2. Check the ratings given in the instructions and on the components to make sure they are suitable for your application.
3. Installer must be a trained, experienced service technician.
4. After installation is complete, check out component operation as provided in these instructions.

WARNING!

FIRE OR EXPLOSION HAZARD.
CAN CAUSE SERIOUS INJURY OR DEATH.

1. The ignition module can malfunction if it gets wet, leading to accumulation of explosive gas.
   - Never install where water can flood, drip or condense on module
   - Never try to use a module that has been wet – replace it.

Liquid petroleum (LP) gas is heavier than air and will not vent upward naturally.
- Do not light pilot or operate electrical switches, lights, or appliances until you're sure the appliance area is free of gas

CAUTION!

1. Disconnect power supply before beginning wiring to prevent electrical shock or equipment damage.
2. If a new gas control is to be installed, turn off has supply before starting installation. Conduct Gas Leak Test according to gas control manufacturer's instructions after the gas control is installed.
3. If module must be mounted near moisture of water, provide suitable waterproof enclosure.

PERFORM PREINSTALLATION SAFETY INSPECTION

The preinstallation checks described in ANSI Standard Z21.71 on page 19 *must* be done before the replacement module is installed. If a condition which could result in unsafe operation is detected, the appliance should be shut off and the owner advised of the unsafe condition. Any potentially unsafe condition must be corrected before proceeding with the installation.

MAINTENANCE REQUIREMENTS IN SEVERE ENVIRONMENTS

Regular preventative maintenance is important in any application, but especially so in commercial cooking, agricultural, and industrial applications because:

- In many such applications, particularly commercial cooking, the equipment operates 100,000-200,000 cycles per year. Such heavy cycling can wear out the gas control in one to two years. A normal forced air furnace, for which the controls were originally intended, typically operates less than 20,000 cycles per year.
- Exposure to water, dirt, chemicals, and heat can damage the module or the gas control and shut down the control system. A NEMA 4 enclosure can reduce exposure to environmental contaminants. See Electronic Ignition Service Manual, form 70-6604.

The maintenance program should include regular checkout of the system as outlined under CHECKOUT.

WARNING!

FIRE OR EXPLOSION HAZARD
MAY CAUSE PROPERTY DAMAGE, SEVERE INJURY, OR DEATH
Do not attempt to take the module apart or to clean it. Improper reassembly and cleaning may cause unreliable operation.

Maintenance frequency must be determined individually for each application. Some considerations are:
- *Cycling frequency.* Appliances that may cycle more than 20,000 times annually should be checked monthly.
- *Intermittent use.* Appliances that are used seasonally should be checked before shutdown and again before the next use.
- *Consequence of unexpected shutdown.* Where the cost of an unexpected shutdown would be high, the system should be checked more often.
- *Dusty, wet, or corrosive environment.* Since these environments can cause the controls to deteriorate more rapidly, the system should be checked more often.

Any control should be replaced if it does not perform properly on checkout or troubleshooting. In addition, replace any module if it is wet or looks like it has ever been wet. Protective enclosures as outlined under "Planning the Installation" are recommended regardless of checkout frequency.

MOUNT IGNITION MODULE
Select a location close enough to the burner to allow a short (3 ft. [0.9 m] max.), direct cable route to the igniter. Ambient temperature at the module must be within the range listed under APPLICATION. The module must be protected from water, moisture, corrosive chemicals and excessive dust and grease.
We recommend mounting the module with the terminals down to protect them from dripping water and dust. It can also be mounted with the terminals on either side. DO NOT MOUNT with terminals pointing up. Fasten securely with four No. 6-32 machine or No. 8 sheet metal screws.

MOUNT THE SYSTEM CONTROLS
Mount any required controls, such as the gas control, spark igniter, flame sensor, thermostat, limit and transformer according to manufacturer's instructions.

WIRE THE SYSTEM

CAUTION!

1. Check the wiring diagram furnished by the appliance manufacturer, if available, for circuits differing from the wiring hookups shown. Carefully follow any special instructions affecting the general procedures outlined below.
2. Disconnect the power supply before making wiring connections to prevent electrical shock or equipment damage.

IMPORTANT!

1. As shown in the wiring diagrams, a common ground is required on:
a. The pilot burner mounting bracket, and
b. The GND (BURNER) terminal on the ignition module. Failure to use the GND (BURNER) terminal may result in intermittent loss of spark and/or loss of flame current sensitivity.
2. Make sure the flame transformer has adequate VA. The ignition module requires at least 0.2 A at 24 Vac. Add the current draws of all other devices in the control circuit, including the pilot and main valves in the gas control, and multiply by 24 to determine the total VA requirement of these components. Add this total to 4.8 VA (for the ignition module). The result is the minimum transformer VA rating. Use a Class II transformer if replacement is required.

CONNECT IGNITION CABLE

Use Honeywell ignition cable or construct an ignition cable that conforms to suitable national standards such as Underwriters Laboratories Inc. (See tables below.)

HONEYWELL PREASSEMBLED IGNITON CABLES (UL STYLE 3257).			
CABLE PART NUMBER	LENGTH	MODULE END	IGNITER END
394800-30	30 in.	¼ in. quick connect, insulated	Rajah connector receptacle, 90 deg. rubber boot
394801-30	30 in.	¼ in. quick connect, insulated	Rajah connector receptacle, straight rubber boot

HONEYWELL PREASSEMBLED IGNITION CABLE FOR FIELD ASSEMBLY			
CABLE TYPE	VOLTAGE RATING (rms)	TEMPERATURE RATING	
		°C	°F
UL Style 3217	10,000	150	302
UL Style 3257	10,000	250	484

To construct a cable, fit one end of ignition cable with ¼ in. diameter Rajah connector receptacle and the other with a ¼ in. female quick connect. Protect both ends with insulated boots.

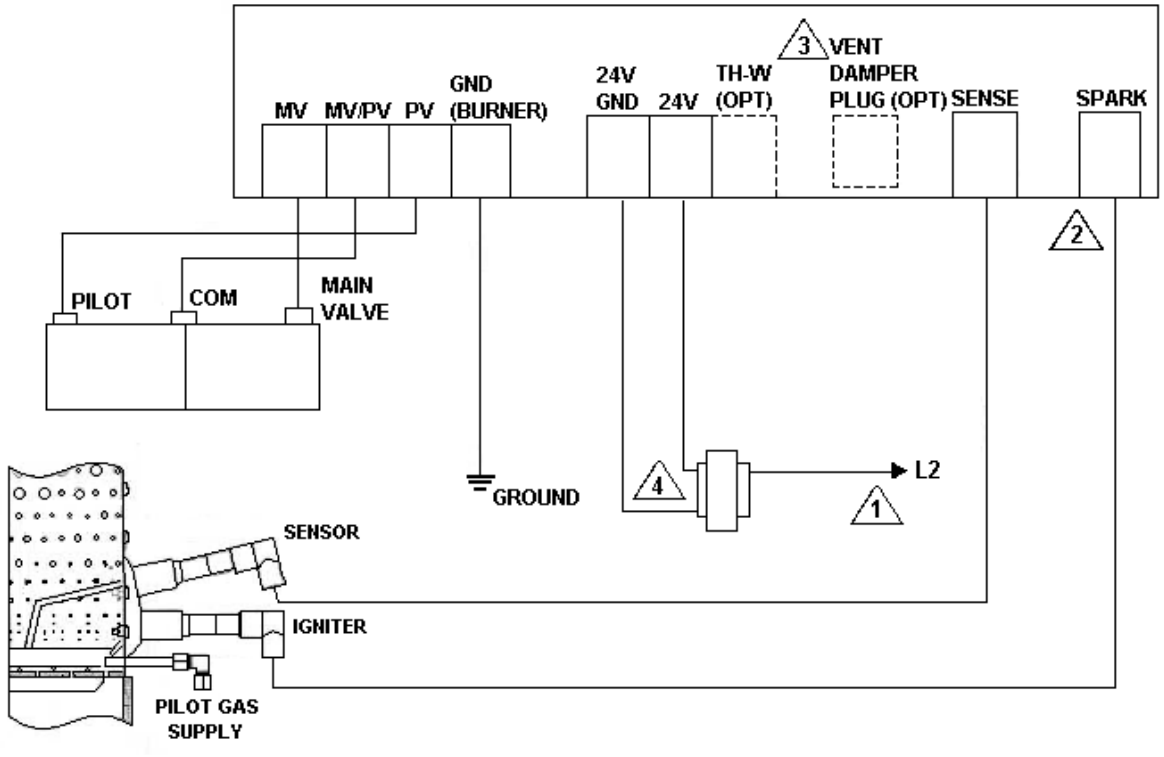
NOTE: The cable must not run in continuous contact with a metal surface or spark voltage will be greatly reduced. Use ceramic or plastic standoff insulators as required.

To Install:
1. Connect on end of the cable to the male quick connect SPARK terminal on the ignition module.
2. Connect the other end of the cable to the igniter or igniter-sensor stud on the pilot burner/igniter-sensor.

CONNECT IGNITION MODULE

1. Connect remaining system components to the ignition module terminals as shown in the appropriate wiring diagram, (shown on the next page).
2. Refer to heating appliance manufacturer's instructions for wiring auxiliary controls.
3. Adjust the thermostat heat anticipator to match system current draw. The current draw equals the total current required for the ignition module (0.2 A) plus the gas control and any other auxiliary equipment in the control circuit.

S8610B CONNECTIONS IN A HEATING SYSTEM WITH AN ATMOSPHERIC BURNER



1 POWER SUPPLY. PROVIDE DISCONNECT MEANS AND OVERLOAD PROTECTION AS REQUIRED.

2 MAXIMUM CABLE LENGTH 3 ft [0.9 m].

3 FOR MODULE WITH TH-W TERMINAL AND VENT DAMPER PLUG, CONNECT THERMOSTAT TO TH-W. LEAVE 24 V OPEN. DO NOT REMOVE VENT DAMPER PLUG.

4 CONTROLS IN 24V CIRCUIT MUST NOT BE GROUND LEG TO TRANSFORMER

CONNECT GAS CONTROL.

Use No. 18 gauge solid or stranded wire. Use ¼ in. female quick connects for module connections. Connect to gas control terminals as shown in wiring diagrams, using terminals appropriate to the gas control.

GROUND CONTROL SYSTEM

The igniter, flame sensor and ignition module must share a common ground with the main burner. Use thermoplastic insulated wire with a minimum rating of 105°C [221°F] for the ground wire; asbestos insulation is not acceptable. If necessary, use a shield to protect the wire from radiant heat generated by the burner. Connect the ground wire as follows:

1. Fit one end of the ground wire with a female ¼ in quick-connect terminal and connect it to the male quick-connect GND (BURNER) terminal on the ignition module.
2. Strip the other end of the wire and fasten it under the ignition bracket mounting screw. If necessary, use a shield to protect the ground wire from radiant heat.
3. The burner serves as the common grounding area. If there is not good metal-to-metal contact between the burner and ground, run a lead from the burner to ground.

NOTE: “Earth” ground is not required.

CHECKOUT

Check out the gas control system:
- At initial installation of the appliance.
- As part of regular maintenance procedures. Maintenance intervals are determined by the application. See PLANNING THE INSTALLATION, for more information.
- As the first step in troubleshooting.
- Any time work is done on the system.

WARNING!

FAILURE TO HEED THESE WARNINGS MAY CAUSE FIRE OR EXPLOSION WITH PROPERTY DAMAGE, INJURY, OR LOSS OF LIFE.
1. If you smell gas or suspect a gas leak, turn off gas at manual service valve and evacuate the building. Do not try to light any appliance; do not touch any electrical switch or telephone in the building until you are sure no spilled gas remains.
2. Gas leak test must be done as described in Steps 1 and 5 below on initial installation and any time work is done involving the gas piping.

STEP 1: Perform Visual Inspection.
- With the power off, make sure all wiring connections are clean and tight.
- Turn on power to appliance and ignition module.
- Open manual shutoff valves in the gas line to the appliance.
- Do gas leak test ahead of gas control if piping has been disturbed.

GAS LEAK TEST: Paint pipe joints with rich soap and water solution. Bubbles indicate gas leak. Tighten joists to stop leak. Recheck with soap and water.

STEP 2: Review Normal Operating Sequence and Module Specifications.
- See OPERATION, and APPLICATION.

STEP 3: Reset the Module.
- Turn the thermostat to its lowest setting.
- Wait one minute.

As you do steps 4 and 5, watch for points where operation deviates from normal. Refer to Troubleshooting Chart to correct problem.

STEP 4: Check Safety Shutoff Operation.
This step applies to lockout and continuous retry modules only.
- Turn gas supply off.
- Set thermostat or controller above room temperature to call for heat.
- Watch for spark at pilot burner either immediately or following prepurge. (See device label.)
- Time spark from start to shutoff.
- Open manual gas cock and make sure no gas is flowing to pilot or main burner.
- Set the thermostat below room temperature and wait one minute before continuing.

STEP 5: Check Normal Operation.
- Set thermostat or controller above room temperature to call for heat.
- Make sure pilot lights smoothly when gas reaches the pilot burner.
- Make sure main burner lights smoothly without flashback.
- Make sure burner operates smoothly without floating, lifting, or flame rollout to the furnace vestibule or heat buildup in the vestibule.
- If gas line has been disturbed, complete gas leak test.

GAS LEAK TEST: Paint gas control gasket edges and all pipe connections downstream of gas control, including pilot tubing connections, with rich soap and water solution. Bubbles indicate gas leaks. Tighten joints and screws or replace component to stop gas leak. Recheck with soap and water.

- Turn thermostat or controller below room temperature. Make sure main burner and pilot flames go out.

OPERATION

Module operation can be conveniently divided into two phases for the S8610. The phases are:
- Trial for ignition.
- Main burner operation.

The next figure summarizes the normal operating sequences of the module.

S8610 Normal Operating Sequence

START

❶ THERMOSTAT (CONTROLLER) CALLS FOR HEAT

STAGE 1
TRIAL FOR IGNITION

❷ SPARK GENERATOR POWERED
First valve (pilot) operator opens

❸ PILOT BURNER OPERATION

Pilot burner lights.

Module senses flame current

OR

Pilot burner does not light.

Module	Response
S8610B	After 15 or 90 sec[a] system locks out; must be manually reset.

[a] Shutoff/lockout timing is stamped on module.

STAGE 2
MAIN BURNER

❹ FLAME CURRENT SENSED
- Spark generator off.
- Second valve operator (main) opens.

❺ MAIN BURNER OPERATION
Module monitors pilot flame current

POWER INTERRUPTION
System shuts off, restarts when power is restored.

PILOT FLAME FAILURE
Main valve closes.
Module starts trial for ignition

❻ THERMOSTAT (CONTROLLER) SATISFIED
Valves close, pilot and main burners are off.

END

TRIAL FOR IGNITION

PILOT IGNITION

On the call for heat, the module energizes the first main valve operator. The first main valve opens, which allows gas to flow to the pilot burner. At the same time, the electronic spark generator in the module produces an over 10,000 volt spark pulse output. The voltage generates a spark at the igniter that lights the pilot.

If the pilot does not light, or the pilot flame current is not at least 1.0 μA and steady, the module will not energize the second (main) valve and the main burner will not light.

SAFETY LOCKOUT

This module provides 100 percent shutoff and safety lockout. A timer in this model starts timing the moment the trial for ignition starts. Ignition spark continues only until the timed trial ignition period ends. Then the module goes into safety lockout. Lockout de-energizes the first main valve operator and closes the first main (pilot) valve in the gas control, stopping pilot gas flow. The control system must be reset by setting the thermostat below room temperature for one minute or by turning off power to the module for one minute.

MAIN BURNER OPERATION

When the pilot flame is established, a flame rectification circuit is completed between the sensor and burner ground. The flame sensing circuit in the module detects the flame current, shuts off the spark generator and energizes the second main valve operator. The second main valve opens and gas flows to the main burner, where it is ignited by the pilot burner. On lockout models, the flame current also holds the safety lockout timer in the reset (normal) operating condition.

When the call for heat ends, both valve operators are de-energized, and both valves in the gas control close.

TROUBLESHOOTING

IMPORTANT!

1. The following service procedures are provided as a general guide. Follow appliance manufacturer's service instructions if available.

2. On lockout and retry models, meter readings between gas control and ignition module must be taken within the trial for ignition period. Once the ignition module shuts off, lockout models must be reset by setting the thermostat down for at least one minute before continuing. On retry models, wait for retry or reset at the thermostat.

3. If any component does not function properly, make sure it is correctly installed and wired before replacing it.

4. The ignition module cannot be repaired. If it malfunctions, it must be replaced.

5. Only trained, experienced service technicians should service intermittent pilot systems.

Perform the CHECKOUT as the first step in troubleshooting. Then check the troubleshooting guide to pinpoint the cause of the problem. If troubleshooting indicates an ignition problem, see IGNITION SYSTEM CHECKS below to isolate and correct the problem.

Follow troubleshooting; perform the CHECKOUT PROCEDURE again to be sure system is operating normally.

IGNITION SYSTEM CHECKS

STEP 1: Check ignition cable.

Make sure:

- Ignition cable does not run in contact with any metal surfaces.
- Ignition cable is no more than 36 in. [0.9 m] long.
- Connections to the ignition module and to the igniter or igniter-sensor are clean and tight.
- Ignition cable provides good electrical continuity.

STEP 2: Check ignition system grounding. *Nuisance shutdowns are often caused by a poor or erratic ground.*

- A common ground, usually supplied by the pilot burner bracket, is required for the module and the pilot-burner igniter-sensor.
    - Check for good metal-to-metal contact between the pilot burner bracket and the main burner.
    - Check the ground lead from the GND (BURNER) terminal on the module to the pilot burner. Make sure connections are clean and tight. If the wire is damaged or deteriorated, replace it with No., 14-18 gauge, moisture-resistant, thermoplastic insulated wire with 221°F [105°C] minimum rating.
        - Check the ceramic flame rod insulator for cracks or evidence of exposure to extreme heat, which can permit leakage to ground. Replace pilot burner/igniter-sensor and provide shield if necessary.
        - If flame rod or bracket is bent out of position, restore to correct position.

STEP 3: Check spark ignition circuit. *You will need a short jumper wire made from ignition cable or other heavily insulated wire.*

- Close the manual gas valve.
- Disconnect the ignition cable at the SPARK terminal on the module.

WARNING!

When performing the following steps, do not touch stripped end of jumper or SPARK terminal. The ignition circuit generates over 10,000 volts and electrical shock can result.

- Energize the module and immediately touch one end of the jumper firmly to the GND terminal on the module. Move the free end of the jumper slowly toward the SPARK terminal until a spark is established.
- Pull the jumper slowly away from the terminal and note the length of the gap when sparking stops. Check table below.

ARC LENGTH	ACTION
No arc or arc less than 1/8 in. [3 mm]	Check external fuse, if provided. Verify power at module input terminal. Replace module if fuse and power okay.
Arc 1/8 in. or [3 mm] or longer.	Voltage output is okay.

STEP 4: Check pilot and main burner light off.

- Set the thermostat to call for heat.
- Watch the pilot burner during the ignition sequence. See if:
    - Ignition spark continues after the pilot is lit.
    - The pilot lights and the spark stops, but main burner does not light.
    - The pilot lights, the spark stops and main burner lights, but the system shuts down.
- If so, ensure adequate flame current as follows.
    - Turn off furnace at circuit breaker or fuse box.
    - Clean the flame rod with an emery cloth.

- Make sure electrical connections are clean and tight. Replace damaged wire with moisture resistant No. 18 wire rated for continuous duty up to 221°F [105°C].
- Check for cracked ceramic insulator, which can cause short to ground, and replace igniter-sensor if necessary.
- At the gas control, disconnect main valve wire from the TH or MV terminal.
- Turn on power and set thermostat to call for heat. The pilots should light but the main burner will remain off because the main valve actuator is disconnected.
- Check the pilot flame. Make sure it is blue, steady and envelops 3/8 to ½ in. [10 to 13 mm] of the flame rod. See the figure below for possible flame problems and their causes.

Examples of Unsatisfactory Pilot Flames	
Small blue flame 	Check for lack of gas from: - Clogged orifice filter - Clogged pilot filter - Low gas supply pressure - Pilot adjustment at minimum
Lazy yellow flame 	Check for lack of air from: - Large orifice - Dirty lint screen, if used - Dirty primary air opening, if there is one - Pilot adjustment at minimum
Waving blue flame 	Check for: - Excessive draft at pilot location - Recirculating products of combustion
Noisy lifting blowing flame 	Check for: - High gas pressure
Hard sharp flame 	This flame is characteristic of manufactured gas Check for: - High gas pressure - Orifice too small

- If necessary, adjust pilot flame by turning the pilot adjustment screw on the gas control clockwise ↷ to decrease or counterclockwise ↶ to increase pilot flame. Following adjustment, always replace pilot adjustment cover screw and tighten firmly to assure proper has control operation.
- Set thermostat to call for heat.
- Recheck ignition sequence as follows.
- Reconnect main valve wire.
- Set thermostat to call for heat.
- Watch ignition sequence at burner.
- If the spark still doesn't stop after pilot lights, replace ignition module.
- If main burner doesn't light or if main burner lights but system locks out, check module, ground wire and gas control as described in appropriate troubleshooting chart

S8610 Troubleshooting Guide

START

NOTE: Before troubleshooting, familiarize yourself with the startup and checkout

TURN GAS SUPPLY OFF.
TURN THERMOSTAT (CONTROLLER) TO CALL FOR HEAT
POWER TO MODULE (24V NOMINAL)

NO → Check line voltage power, low voltage transformer, limit controller, thermostat (controller) and wiring. Also, check air proving switch on combustion air blower system (if used) and that vent damper (if used) is open and end switch is made.

YES ↓

SPARK ACROSS IGNITER/SENSOR GAP?

NO → Pull ignition lead and check spark at module.
Spark okay?

NO → - On models with vent damper plug, make sure vent damper has not been installed, then removed. Replace vent damper if necessary.
- On other modules, replace module.

YES ↓

- Check ignition cable, ground wiring, ceramic insulator and gap, and correct.
- Check boot of the ignition cable for signs of melting or buckling. Take protective action to shield cable and boot from excessive temperatures.

YES ↓

TURN GAS SUPPLY ON
PILOT BURNER

NO → - Check that all manual gas valves are open, supply tubing and pressures are all good, and pilot burner orifice is not blocked.
- Check electrical connections between module and pilot operator on gas control.
- Check for 24 Vac across PV-MV/PV terminals on module. If voltage is okay, replace gas control. If not, replace module.

YES ↓

SPARK STOPS WHEN PILOT IS LIT?

NO → NOTE: If S8610B goes into lockout, reset system.
- Check continuity of ignition cable and ground wire.
- Clean flame rod.
- Check electrical connections between flame rod and module
- Check for cracked ceramic flame rod insulator.
- Check that the pilot flame covers flame rod and is steady and blue.
- Adjust pilot flame.

If problem persists, replace module.

YES ↓

MAIN BURNER

NO → - Check for 24 Vac across MV-MV/PV terminals. If no voltage, replace module.
- Check electrical connections between module and gas control. If okay, replace gas control or gas control operator

YES ↓

SYSTEM RUNS UNTIL CALL FOR HEAT ENDS?

NO → NOTE: If S8610B goes into lockout, reset system.
- Check continuity of ignition cable and ground wire.

NOTE: If ground is poor or erratic, shutdowns may occur occasionally even though operation is normal at the time of checkout.
- Check that pilot flame covers flame rod and is steady and blue.
- If checks are okay, replace module.

YES ↓

CALL FOR HEAT ENDS
SYSTEM SHUTS OFF?

YES ↓

TROUBLESHOOTING ENDS

Repeat procedure until trouble-free operation is obtained.

ANSI STANDARDS

EXHIBIT A OF ANSI STANDARD Z21.71 FOR AUTOMATIC PILOT IGNITION SYSTEMS FOR FIELD INSTALLATION

EXHIBIT A

RECOMMENDED PROCEDURE FOR SAFETY INSPECTION OF AN EXISTING APPLIANCE INSTALLATION AS A PRELIMINARY STEP TO APPLYING AN AUTOMATIC INTERMITTENT PILOT SYSTEM

The following is intended as a guide to aid in determining that an appliance is properly installed and is in a safe condition for continuing use.
This procedure is predicated on central furnace and boiler installations equipped with an atmospheric gas burner(s) and not of the direct vent type. Is should be recognized that generalized test procedures cannot anticipate all situations. Accordingly, in some cases, deviation from this procedure may be necessary to determine safe operation of the equipment.

a. This procedure shall be performed prior to any attempt at modification of the appliance or installation.
b. If it is determined there is a condition which could result in unsafe operation, the appliance should be shut off and the owner advised of the unsafe condition.
The following steps should be followed in making the safety inspection:

1. Conduct a Gas Leakage Test of the appliance piping and control system downstream of the shutoff valve in the supply line to the appliance.

2. Visually inspect the venting system for proper size and horizontal pitch and determine there is no blockage or restrictions, leakage or corrosion or other deficiencies which could cause an unsafe condition.

3. Shut off all gas to the appliance and shut off any other fuel-burning appliances in the same room. Use the shutoff valve in the supply line to each appliance.

4. Inspect burners and crossovers for blockage and corrosion.

5. Applicable only to warm air heating appliances. Inspect heat exchangers for cracks, openings, or excessive corrosion.

6. Applicable only to boilers. Inspect for evidence of water or combustion product leaks.

7. Insofar as practical, close all building doors and windows and all doors between he space in which the appliance is located and other spaces of the building.
Turn on clothes dryers. Turn on any exhaust fans, such as range hoods and bathroom exhausts, so they will operate at maximum speed. Do not operate a summer exhaust fan. Close fireplace dampers. If after completing steps 7 through 12, it is believed sufficient combustion air is not available, refer to 1.3.4 of the National Fuel Gas Code (Z223.1) for guidance.

8. Place in operation the appliance being inspected. Follow the lighting instructions. Adjust thermostat so appliance will operate continuously.

9. a. Determine that the pilot is burning properly and that main burner ignition is satisfactory by interrupting and re-establishing the electrical supply to the appliance in any convenient manner.
b. Determine manifold pressure in order to match input after the new control is installed.
c. Visually determine that main burner gas is burning properly; i.e., no floating, lifting or flashback. Adjust the primary air shutter(s) as required.
d. If appliance is equipped with high and low flame control or flame modulation, check for proper main burner operation at low flame.

11. Test for spillage at the draft hood relief opening after 5 minutes of main burner operation. Use a draft gauge, the flame of a match or candle, or smoke from a cigarette, cigar, or pipe.

12. Return doors, windows, exhaust fans, fireplace dampers and all other fuel-burning appliances to their previous conditions of use.

13. Applicable only to warm air heating appliances. Check both limit controller and fan controller for proper operation. Limit controller operation can be checked by temporarily disconnecting the electrical supply to the blower motor and determining that the limit control acts to shut off the main burner gas.

14. Applicable only to boilers:
a. Determine that the circulating water pumps are in operating condition.
b. Test low water cutoffs, automatic feed controls, pressure and temperature limit controls and relief valves in accordance with the manufacturer's instructions to determine they are in operating condition.

EXHIBIT B OF ANSI STANDARDS Z21.71 FOR AUTOMATIC INTERMITTENT PILOT IGNITION SYSTEMS FOR FIELD INSTALLATION.

EXHIBIT B

PROCEDURE FOR INSTALLING AUTOMATIC INTERMITTENT PILOT SYSTEMS

Prior to beginning this procedure, a preliminary examination of the appliance and the automatic intermittent pilot system should be made to determine that the automatic intermittent pilot system can be properly applied to the appliance.
This procedure is intended as a guide to aid in safely installing a listed automatic intermittent pilot system on an existing listed appliance equipped with an atmospheric gas burner(s) and not of the direct vent type.
This procedure is based on the assumption that the history of specific installation has been one of safe and satisfactory operation.
This procedure is predicated on central furnace and boiler installations, and it should be recognized that generalized procedures cannot anticipate all situations. Accordingly, in some cases, deviation from the this procedure may be necessary to determine safe operation of the equipment.
The following steps should be followed in making the modifications:

1. Perform a safety inspection of the existing appliance installation. See Exhibit A for a recommended procedure for such a safety inspection.

2. Shut off all gas and electricity to the appliance. To shut off gas, use the shutoff valve in the supply line to the appliance. Do not use the shutoff valve which is provided as part of a combination control.

3. Install the automatic intermittent pilot system in strict accordance with the manufacturer's installation instructions.

4. Turn on all gas and electricity to the appliance.

5. Determine that the appliance transformer has adequate capacity by following the steps outlined below:
   a. Compute the approximate current draw by adding the current draw of the automatic intermittent pilot system to (1) the current draw of the associated valving, and (2) the current draw of any relays or other devices operated by the transformer.
   b. Multiply the total current draw as computed above by 24 V to determine the total VA (volt-ampere) required.
   c. The total VA (volt-ampere) required should be equal to or less than the VA rating of the transformer.
   d. If the total VA required should be equal to or less than the VA rating of the transformer, the transformer must be replaced with a Class 2 transformer of adequate rating.

6. Check the heat anticipator in the comfort thermostat to determine if it is properly adjusted to the current draw of the control system. Follow the thermostat manufacturer's instructions.

7. Make certain wiring connections are tight and wires are positioned and secured so they will not be able to contact high temperature locations.

8. Conduct a Gas Leakage Test of the appliance piping and control system downstream of the shutoff valve in the supply line to the appliance.

9. a. Adjust the thermostat to its highest temperature setting, and test manifold pressure and adjust the pressure regulator to match original input as required. (refer to Exhibit A, step 9b).
   b. Visually determine that main burner is burning properly; i.e., no floating, lifting, or flashback. Adjust the primary air shutter(s) as required.

10. If the appliance is equipped with high and low flame control or flame modulation, check for proper main burner operation at both high and low flame.

11. Determine that the pilot is lighting and burning properly and that main burner ignition is satisfactory by interrupting and re-establishing the electrical supply to the appliance in any convenient manner. Make this determination with the appliance burner both cold and hot. Perform this step as many times as is necessary to satisfy yourself that the automatic intermittent pilot system is operating properly.

12. Test the pilot safety device (1) to determine if it is operating properly, and (2) for turndown characteristics according to the manufacturer's installation instructions. No adjustments should be made other than those recommended by the system manufacturer.

13. Sequence the appliance through at least three operating cycles.

14. Applicable only to furnaces. Check both the limit controller and the fan controller for proper operation. Limit control operation can be checked by blocking the circulating air inlet or temporarily disconnecting the electrical supply to the blower motor and determining that the limit controller acts to shut off the main burner gas.

15. Applicable only to boilers.
a. Determine that the circulating water pumps are in operating condition.
b. Test low water cutoffs, automatic feed water controls, pressure and temperature limit controllers and relief valves in accordance with the manufacturer's recommendation to determine if they are in operating condition.

16. Add the labels (see 1.6.1-n and –o) on the appliance.

NEPTRONIC® ACTUATOR, BBM2080A / BM080

FEATURES:

- Mounts easily on round and square shaft (with option –8).
- Clutch for manual adjustments.
- Maintenance free.
- Position indicator.
- Fully programmable control signal.
- Fail safe by *Enerdrive System*.
- Auxiliary switches.

TECHNICAL DATA

Auxiliary Switches	Yes (2)
Fail Safe - *Enerdrive*	Yes
Power Consumption	15 VA peak 6 VA
Torque	50 in.lb. [5,6 Nm] at rated voltage
Running Time Through 90°	20 to 30 sec torque depending
Feedback	4 to 20 mA or 2 to 10 VDC adjustable
Power Supply	24 VAC +/-10% or 30 DCV +/-10%
Electrical Connection	18 AWG minimum on screw terminals
Inlet Bushing	2 inlet bushing of 5/8 in [22.2 mm]
Control Signal	Analog, digital or pulse width modulation (PWM) programmable (factory set with analog control signal)
Angle of Rotation	0° to 90°, mechanically adjustable (factory set with 90° stroke)
Direction of rotation	Reversible, Clockwise (CW) or Counterclockwise (CCW) (factory set with CW direction)
Ambient Temperature	0° F to +122° F [-18° C to +50° C]
Storage Temperature	-22° F to +122° F [-30° C to +50° C]
Relative Humidity	5 to 95% non condensing
Weight	3 lbs [1.4 kg]
WARNING! DO NOT PRESS THE CLUTCH WHEN ACTUATOR IS POWERED	

CAUTION

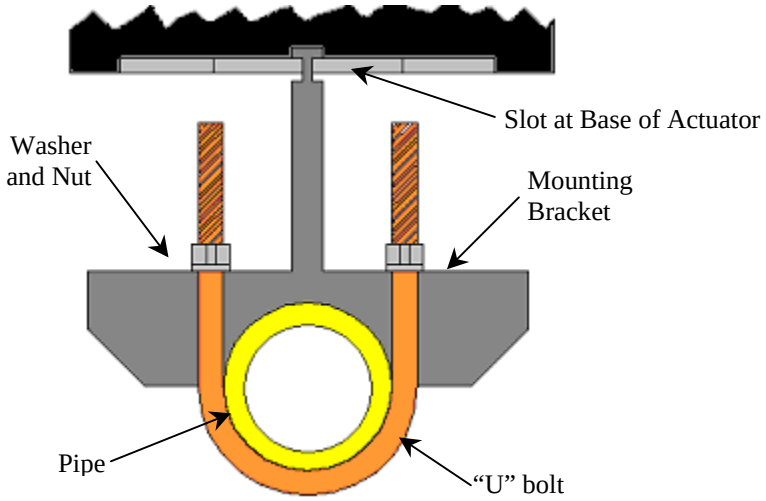
We strongly recommend that all NEPTRONIC® products be wired to a separate transformer and that transformer shall service only NEPTRONIC® products. This precaution will prevent interference with, and/or possible damage to incompatible equipment.

When multiple actuators are wired on a single transformer, polarity must be observed. Long wiring runs create voltage drop that may affect the actuator performance.

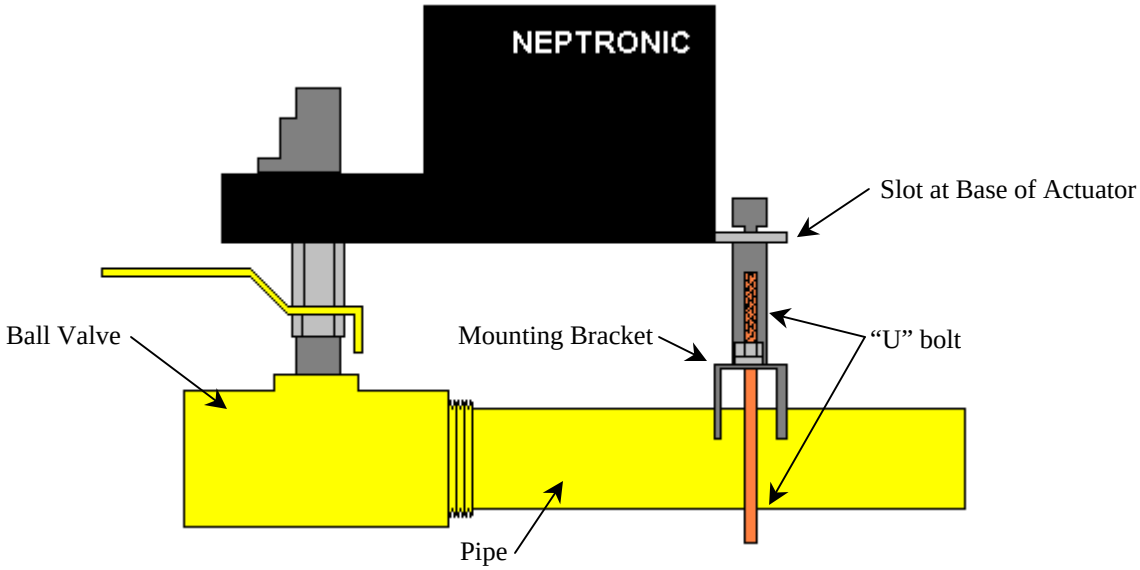
MECHANICAL INSTALLATION

1. Manually close the ball valve and position the actuator at 0° or 90°.
2. Slide the actuator onto the shaft.
3. Tighten the nuts on the "U" bolt to the shaft with an 8 mm wrench to a torque of 60 in.lb. [6,7 Nm].
4. Slide the mounting bracket under the actuator. Ensure free movement of the slot at the base of the actuator. The bracket pin must be placed in the mid-distance of the slot.
5. Fix the bracket to the ductwork with #8 self-tapping screws.

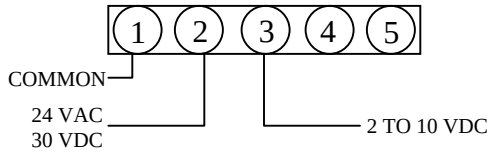
BACK VIEW



SIDE VIEW

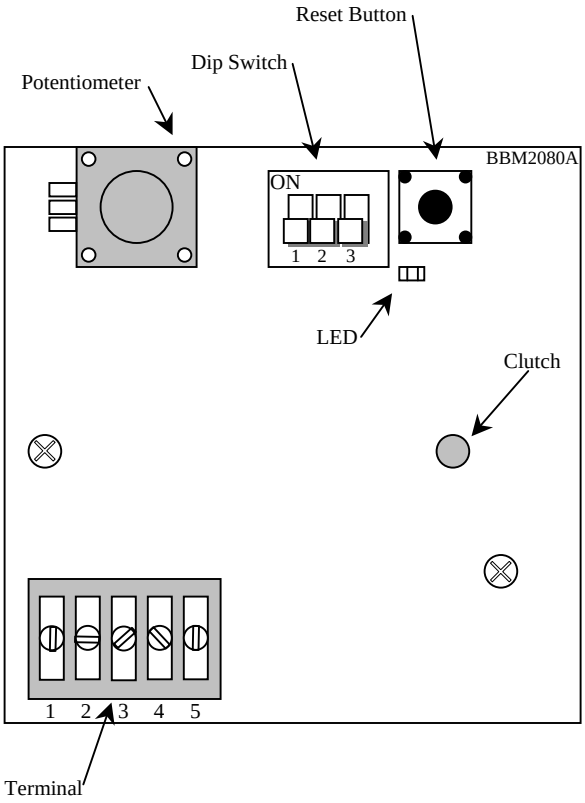


WIRING DIAGRAM - ANALOG

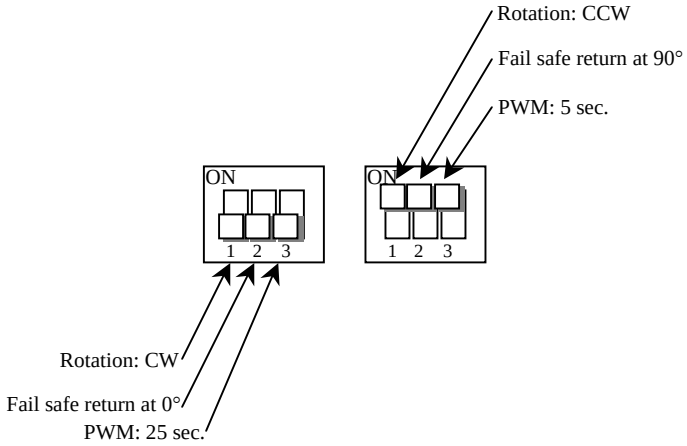


For 2 to 10 VDC output feedback, connect one of the supplied 500-ohm resistors between pins 1 and 5.

PC BOARD



DIP SWITCH SETTINGS



STROKE ADJUSTMENT – NO CONTROL SIGNAL CHANGE

1. Apply power and **wait for at least 10 seconds.**
2. Press and release the reset button to start the auto-stroke process.
   This LED should be illuminated.
   - First Option:
   The actuator will then travel in both directions to find its limit and position itself according to the demand. The LED will extinguish; the process is complete.
   - Second Option:
   When the desired end position is reached, press and release the reset button. The actuator will now return back to its original position (you can also press and release the reset button when it reaches the original position). The LED will extinguish; the process is complete.

ZERO AND SPAN CALIBRATION

This feature is applicable to analog control signal only.

1. Apply power and, **within 10 seconds** press and hold the reset button until the LED blinks once.
   The ZERO AND SPAN CALIBRATION process then starts.
2. Release the reset button. The LED is now constantly illuminated.
3. Apply new minimum voltage.
   It can be any value between 0 to 7 VDC, with an external 0 to 10 volt supply (ex: MEP).
4. Press and release the reset button to memorize the new minimum voltage. The LED blinks once.
5. Apply new maximum voltage.
   It can be any value between 3 to 10 VDC, this value should be greater than the new minimum value.
6. Press and release the reset button to memorize the new maximum voltage. The LED blinks once.
   The ZERO AND SPAN CALIBRATION process is complete.

Note: To reset zero and span to 2 to 10 VDC (factory value). You just have to reselect the analog control signal mode; see PROGRAMMING.

MIDCO INTERNATIONAL
MAKE-UP AIR ENGINEERING MANUAL HMA-2

Patent Pending #10/306, 199

THE BLUE FLAME SERIES

DIRECT FIRED MAKE-UP AIR BURNERS are used in industrial and commercial applications to maintain the desired environmental temperatures required by critical processes i.e. health purposes, production systems, quality control, comfort and loss prevention where it is necessary or required to exhaust large amounts of conditioned air.

Make-up Air Systems used as standalone heating systems or operating in combination with central heating plants systems can be cost effective in three ways: 1) reducing initial expenditures, 2) tempering incoming air which may extend the life of expensive central heating plants and 3) reducing excessive equipment cycling or premature component failures due to increased heating demands.

NEW TECHNOLOGY IN DIRECT-FIRED GAS BURNERS

Our innovative two-stage combustion burner is not just a modification of the old, but a completely new approach to direct-fired combustion. The two-stage combustion improves control of the flame process, and meets or exceeds the new ANSI Standards while outperforming the competition. By incorporating two separate flames within the burner combustion zone, the flame is more stable, shorter and cleaner, permitting the reduction of emission levels and allowing for higher tolerance to varying conditions when placed in the profile opening.

FEATURES AND BENEFITS

- Reduced NO_2 and CO Emissions: Lower emission levels that easily pass the new ANSI Z83.4 and Z83.18 standards.
- Higher Temperature Rise: The two-stage combustion process lowers NO_2 emissions, which is the limiting factor in temperature rise.
- Increased Capacity: Up to 750,000 BTU's per foot (Higher BTU levels can be achieved if ANSI Z83 Standards for CO and NO_2 emissions are not of a concern. Process heaters can fire up to 1,000,000 BTU's a foot or more).
- Increased Differential Pressure Drop and Higher Velocities: HMA-2 burners can operate between 0.05" to 1.4" W.C. differential pressure range or in air velocity between 800 fpm to 4000 fpm.
- Flame Stability: Two stage combustion provides better flame stability and emission control, allowing for a shorter flame and easier profile configuration.
- Reduced Inventory Costs: Single burner casting can be fired with natural, propane, or butane[1] gas, reducing burner inventory.
- Reduced Shipping Costs: A smaller, lighter casting than the competitions', can cut your freight cost up to 50%.
- Turndown: 30-1 Turndown can easily be achieved with proper modulating controls and valves (Higher turndown possible depending on equipment design).

[1]Consult Midco for applications using butane fuels.

SPECIFICATIONS

[*] Firing Rate …….Up to 750,000 Btu/hr/ft
750,000 + Contact Midco

Burner Manifold Pressure
Natural Gas …… …….4.2 to 8 inch W.C.
Propane Gas ……1.6 to 3 inch W.C.

Pilot Capacity ……12,000 Btu/hr
Pilot Manifold Gas Pressure
Natural Gas …… 3.5 inch W.C.
Propane Gas ……... 2.0 inch W.C. [**]

Pressure Drop Across the Burner ……0.05 to 1.4 inch W.C.

Burner Turn-down Ratio ……..30 to 1

Flame Length …….. 10 inches at a full firing rate

[*] Firing Rate is dependent on the pressure across the burner. Please see the included charts for recommended burner sizing.
[**] Using a natural gas pilot on propane.

Table 1 – Burner and Pilot Configurations

* Burner Configurations		Part #
6 inch Straight Section	(15.24 cm)	1050700
6 inch Straight Section w/ Back Inlet	(15.24 cm)	1230700
12 inch Straight Section	(30.48 cm)	1010700
12 inch Straight Section w/ Back Inlet	(30.48 cm)	1060700
Elbow Section		1070700
Tee Section		1080700

Pilot Configurations	Part #
Spark rod and flame rod	1190800
Spark rod and UV	1200300
Remote flame rod	1220800
Remote UV	1240800
Pilot with spark rod only	1210800
Flame rod	1360-03
Spark rod	1342-00

Midco International Inc. reserves the right to change the construction or configuration of its products at any time.

All information is based on laboratory testing. Different unit size and/or configurations may affect data

Chart 1 – BTU's versus Pressure Drop

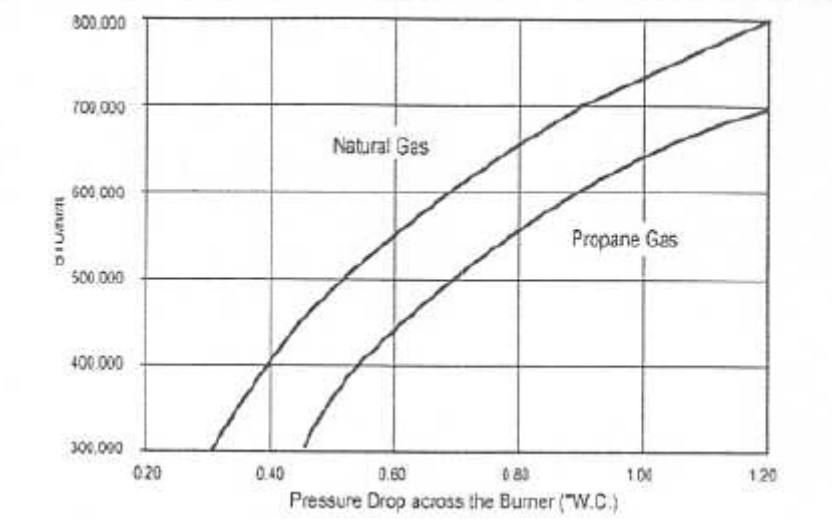


Chart 2 – BTU's versus Gas Pressure (" W.C.)

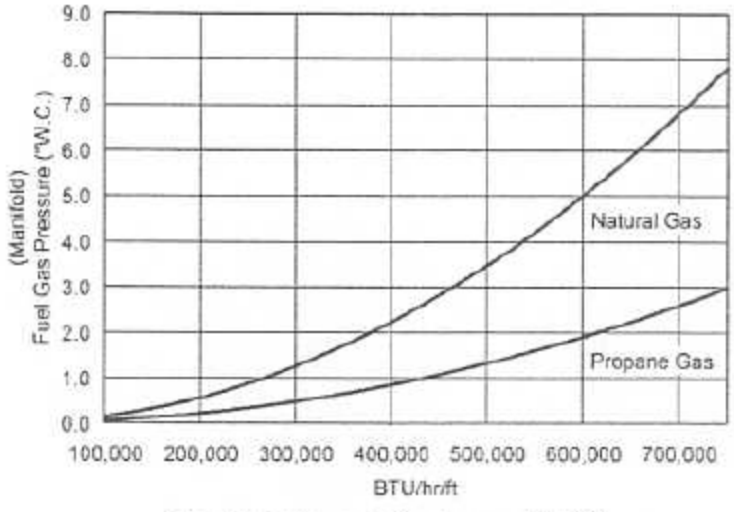


Chart 3 - Pressure Across the Burner versus Profile Velocity

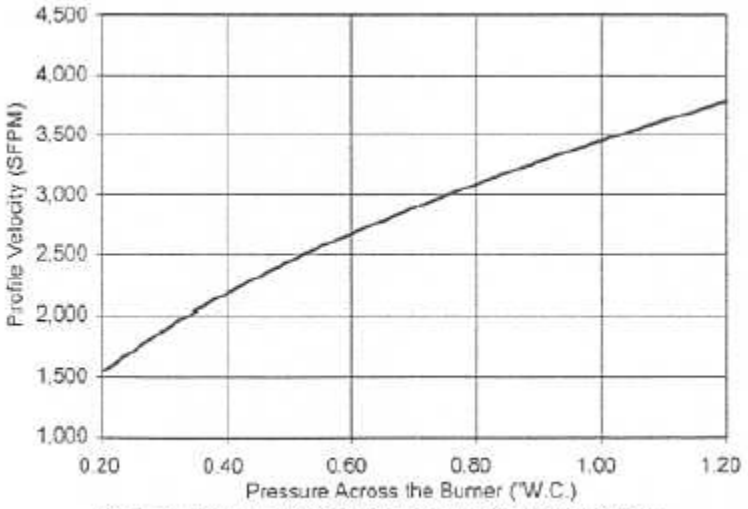


Chart 4 - Pressure Across the Burner verses Profile Velocity

PROFILE SETUP

1. Required BTU:
   BTU/hr = Blower SCFM x Desired Temp. Rise x 1.08
2. Required Burner Length:
   Feet of Burner = [Required BTU/hr] + [Burner Firing Rate (BTU/hr/ft)]
   The burner firing rate should correspond to the pressure drop across the burner shown in Chart 1.
3. Required Profile Area:
   Total Burner Area = Number if burner sections x burner area

(Burner Section)	Burner Area
6 inch	0.32 sq. ft.
12 inch	0.65 sq. ft.
T Section	0.77 sq. ft.
Ell Section	0.65 sq ft

Net Profile Area = Rated Fan (SCFM) ÷ Profile Velocity (SFPM)
The Profile Velocity can be determined from the following:

$$\text{Profile Velocity} = 945\sqrt{\frac{\Delta P}{0.075}}$$

ΔP is the pressure drop across the burner.
Profile Area = Net Profile Area + Total Burner Area

PROFILE SETUP EXAMPLE

Sizing the burner and the corresponding profile for a 5,000 SCFM and a 115 degrees temperature rise.

1. Required BTU:
   BTU/hr = Blower SCFM x Desired Temp. Rise x 1.08
   = 5,000 (SCFM) x 115 (ΔT) x 1.08 = 621,000 BTU/hr
2. Required Burner Length:
   Feet of Burner = [Required BTU/hr] + [Burner Firing Rate (BTU/hr/ft)]
   To determine the optimum burner length we can choose from a combination of 12 inch or 6 inch burner sections referring to Table 1. We can either fire the burner at a rate of 621,000 BTU/hr/ft, or we can fire the burner at 414,000 BTU/hr/ft (1.5 feet of burner). Refer to Chart 2 for the fuel pressures requirements at different firing rates.
3. Required Profile Area:
   Total Burner Area = Number if burner sections x burner area

(Burner Section)	Burner Area
6 inch	0.32 sq. ft.
12 inch	0.65 sq. ft.
T Section	0.77 sq. ft.
Ell Section	0.65 sq ft

Total Burner Area = 1.0 (ft.) x 0.65 = 0.650 ft^2
OR
Total Burner Area = 1.5 (ft.) x 0.65 = 0.975 ft^2

Net Profile Area = Rated Fan (SCFM) ÷ Profile Velocity (SFPM)
The Profile Velocity should be determined based on the burner firing rates. If we choose to fire the burner at 621,000 BTU/hr/ft then the profile opening should be sized for a pressure drop of 0.8 inch W.C. across the burner. If the firing rate is 414,000 BTU/hr/ft then the profile opening should be sized for a pressure drop of 0.4 inch W.C. across the burner. The corresponding profile velocity across the burner should be determined from Chart 3 or use the following equation.

$$\text{Profile Velocity} = 945\sqrt{\frac{\Delta P}{0.075}}$$

For the 621,000 BTU/hr/ft

$$\text{Profile Velocity} = 945\sqrt{\frac{0.8}{0.075}} = 3086(SFPM)$$

Net Profile Area = 5000 (SCFM) ÷ 3086 (SFPM) = 1.62 ft^2

For the 414,000 BTU/hr/ft

$$\text{Profile Velocity} = 945\sqrt{\frac{0.4}{0.075}} = 2182(SFPM)$$

Net Profile Area = 5000 (SCFM) ÷ 2182 (SFPM) = 2.29 ft^2

To calculate the profile area needed for both cases:
Profile Area = Net Profile Area + Total Burner Area
For the 621,000 BTU/hr/ft
Profile Area = 1.62 + 0.650 = 2.27 ft^2

For the 414,000 BTU/hr/ft
Profile Area = 2.29 + 0.975 = 3.265 ft^2

To calculate the length of the profile opening add burner length to the desired clearance:
For the 621,000 BTU/hr/ft
12 inch + 4 inch (2 inch on each side) = 16 inch (1.3 ft)

For the 414,000 BTU/hr/ft
18 inch + 4 inch (2 inch on each side) = 22 inch (1.3 ft)

To calculate the height of the profile opening divide the profile area by the profile length:
For the 621,000 BTU/hr/ft
2.27 ft^2 ÷ 1.3 ft = 1.75 ft (21 inch)

For the 414,000 BTU/hr/ft
3.265 ft^2 ÷ 1.83 ft = 1.78 ft (21 inch)

BURNER ASSEMBLY

IMPORTANT: Furnace cement must be used to join and seal all burner casting sections, and end flanges only. **If this procedure is not performed, gas leakage <u>will</u> occur.** Use 10-24x3/8" stainless steel screws and nuts or stainless steel rivets. UNDER NO CIRCUMSTANCES SHOULD STANDARD GRADE HARDWARE OR ALUMINUM RIVETS BE USED.

When assembling Make-Up Air Burners, a few but important assembly procedures must be followed to ensure Burner Performance. Care should be taken when removing, assembling, and placing the burner into the heater.
1. Examine the baffles for structural integrity; only new, undamaged components should be used.
2. Assemble individual burner cast iron sections first.
3. When joining baffle sections to the burner casting, place a gasket between the casting and the baffles, do not tighten the cast iron sections until the entire unit is assembled. Baffles can be riveted together with stainless steel rivets or joined with stainless steel screws.
4. Prepare a mixture of furnace cement thinned to the consistency of a heavy cream.
5. Apply furnace cement to both mating surfaces of the burner castings and end flanges only.
6. After sections are joined, wipe off excess furnace cement and make sure you do not clog any gas or air ports.
7. After all baffle plates are tight, secure all baffle plates to the burner casting. Make sure all bolts and rivets are tight.
8. After sections are assembled, check for potential gas or air leaks. If necessary, close up any remaining gaps with furnace cement.
9. For high fire start systems, the first adjacent gas port hole (next to the pilot) should be plugged with furnace cement. See Figure 8 – Pilot Configuration.

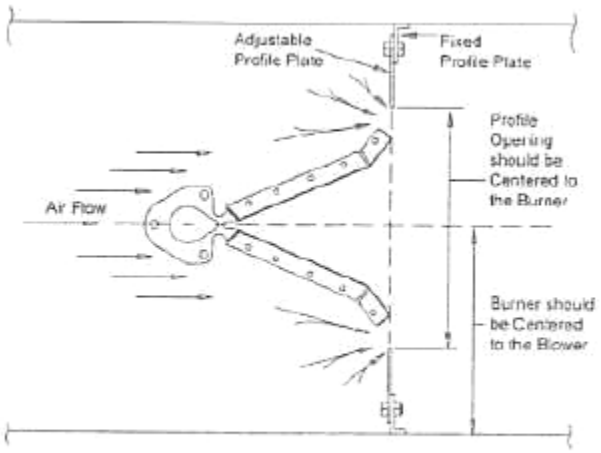
BURNER PLACEMENT IN THE PROFILE

The performance of the HMA-2 burner depends on the unit in which the burner is located.
The burner can perform differently in different units and can obtain different end results.
Maintaining a relative laminar flow around the burner and providing a sufficient space between the burner and the blower is a key factor in obtaining best burner performance.
The unit should be free of any obstructions that can create turbulent effect on the air.

The burner performance is highly dependent on its application and installation in the heater.
Factors such as airflow around the burner, burner positioning in the profile, as well as, the profile sizing have high influence on the final emissions levels. Midco does not guarantee combustion results prior to performing actual combustion tests.

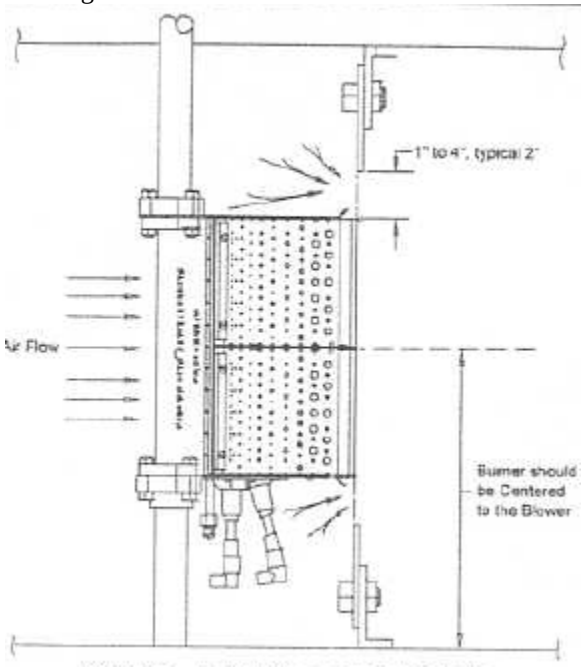
The burner should be located in the center of the profile. The profile clearance form the ends of the burner should be kept at approximately 1 to 4-inches. Typically, setting the profile 2" from the end plates is recommended. Any reinforcements used on the edge of the profile opening should be on the downstream side of the profile. The burner can be mounted either vertically or horizontally. Since the airflow varies from unit to unit best results should be determined by actual testing.

Figure 1a – Burner Placement in the Profile



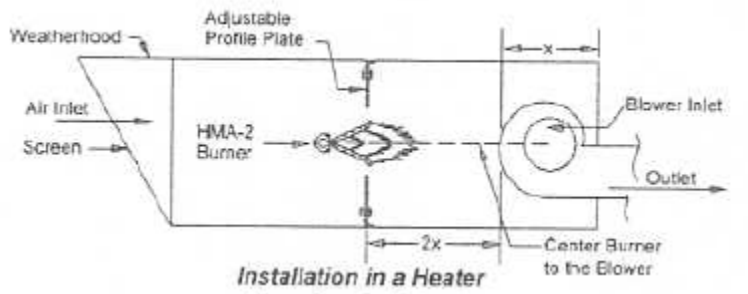
Note: Any reinforcements around the profile plates should be down stream of the profile plate

Figure 1b – Burner Placement In the Profile



PULL-THRU SYSTEM

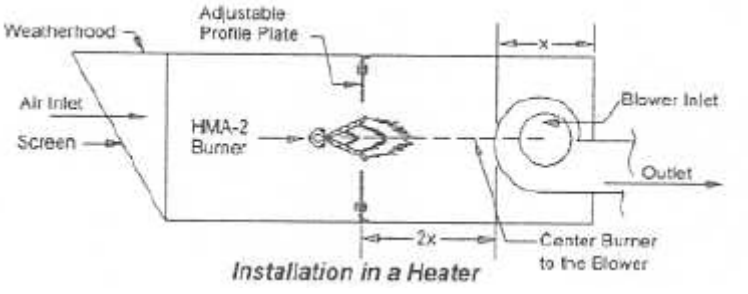
Figure 2a – Pull-Thru System



The HMA-2 Burner is designed to operate in a make-up air heater and in an air stream taken directly from outdoors. To avoid stratification of the heated air, the burners should be located on the intake side center to the blower. Such positioning will take advantage of the blower mixing effect and ensure minimum temperature stratification. It will also allow for a relatively uniform airflow across the burner resulting in a clean combustion.

The total pressure of the blower must include allowance for the resistance of the heater and pressure drop across the burner, together with pressure losses at the inlet screen, inlet louvers, filters, plus the external pressure rating of the heater, if any. Contact equipment manufacturer for proper information.

Figure 2b – Pull-Thru System



PUSH-THRU SYSTEM

The HMA-2 Burner will operate satisfactorily when located downstream of the blower. A mixing plenum may be required at the heater discharge opening to ensure minimum temperature stratification. Blower and motor selection must be made on the basis of corrections for the coldest anticipated inlet temperature. In the push-thru system the heater outlet C.F.M. will vary due to the expansion of air.

Figure 3 – Push-Thru System

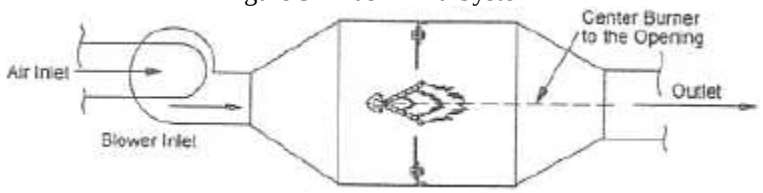


Figure 4 – Installation in a Duct

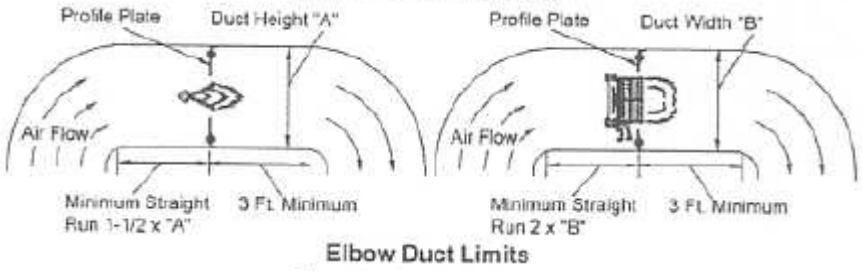


Figure 5a - Gas Train Assemblies

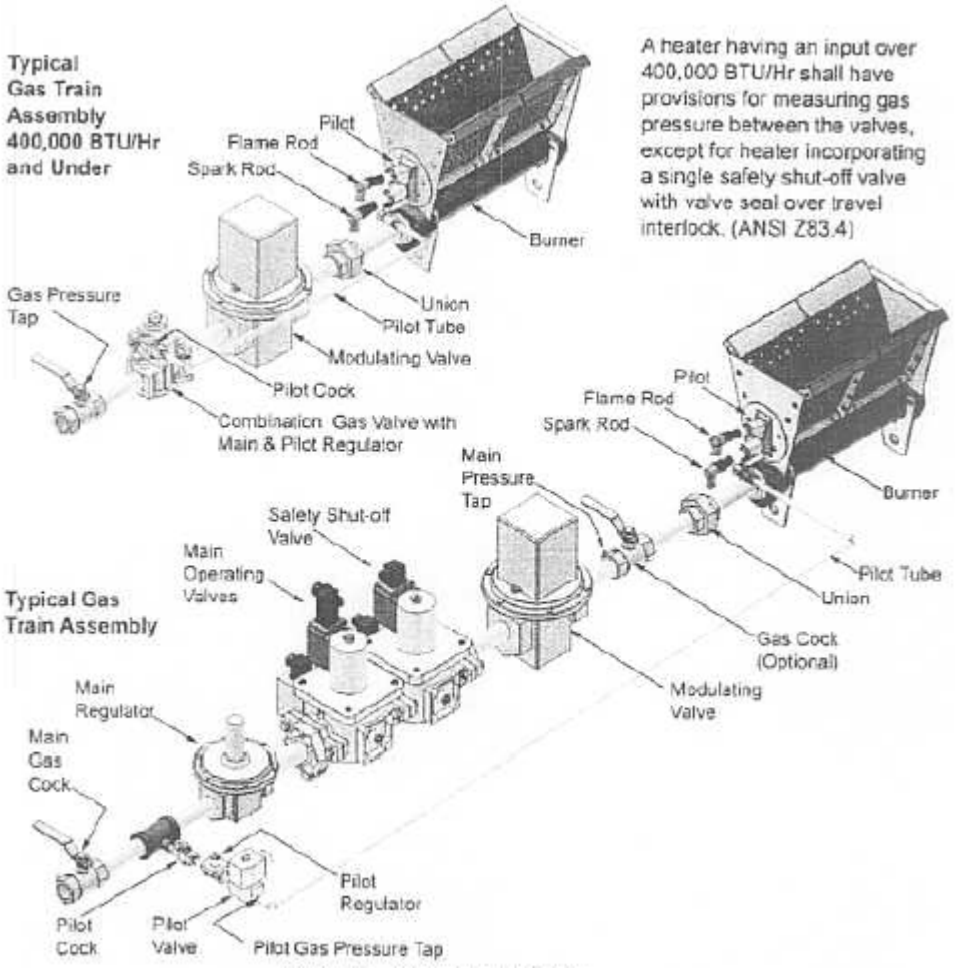


Figure 5b – Direct Spark Gas Train Assemblies

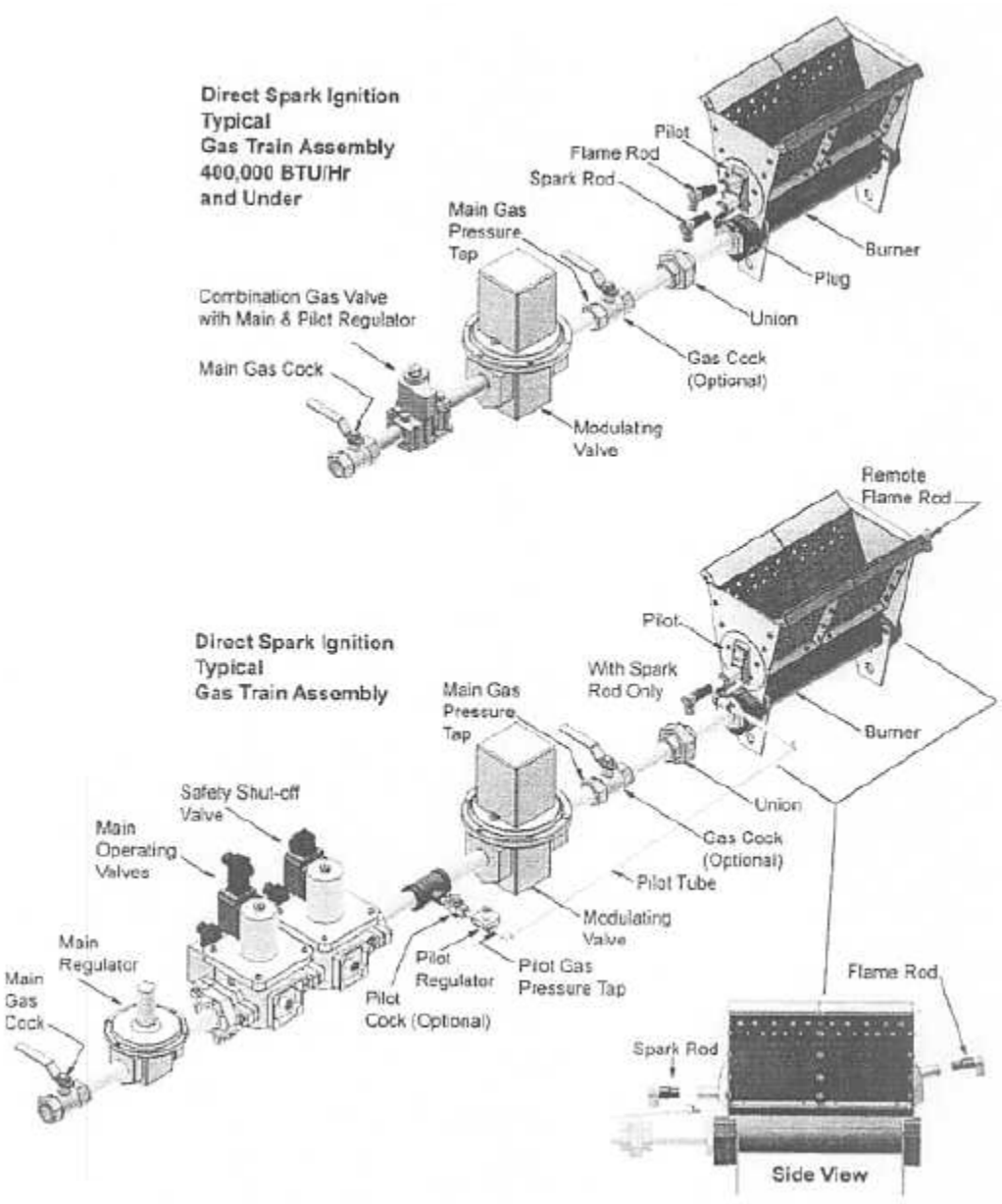


Table 2 - Gas Inlet Capacities

Inlet Size	Maximum Feet of Burner		
	Natural	Propane	Mfd.
1.5” NPT End Inlet	4’	5’	3’
2” NPT Back Inlet Centrally Located	6.5’	8’	4.5’

BURNER INSTALLATION

Burner operation depends on the unit control setup in which the HMA-2 burner is used. A typical setup should consist of a Flame Safety Control with appropriate air flow proving system and a Modulating Gas Control System.

1. Verify the pressure across the burner. The pressure across the burner can be measured by placing two static pressure probes, one downstream and one upstream of the profile opening and measure the differential pressure. The pressure should be within burner operating specifications and within the expected calculated pressure.

2. With the burner off check the Flame Safety Air Proving System
   a. Check the operation of the air proving system for low and high airflow setting.
      Refer to the Specifications of the Flame Safety Control for setup instructions and air switch operational characteristics.

3. Adjust the main gas pressure regulator to the pressure needed for the high fire according to Chart 2. Take into account pressure drops thru the gas valves and other components in the valve train.

4. For continuous, intermittent, or interrupted ignition systems
   a. Pipe the gas pilot supply line upstream of the main gas valve.
   b. Adjust the pilot pressure regulator to 3.5 inch W.C. for Natural Gas or 2.0 inch W.C. for propane gas.

5. For direct spark ignition system
   a. Pipe the pilot gas supplied line to the main gas line downstream of the main gas valve.
   b. Adjust the pilot pressure regulator to 3.5 inch W.C. for Natural Gas or 2.0 inch W.C. for propane gas.

6. Depending on the pilot configuration make following adjustments.
   a. For Spark rod and flame rod configurations
      Make sure the flame rod is pointing towards burner manifold.
      Make sure the flame rod is not touching baffles or burner manifold.
      Make sure the spark rod is positioned above the pilot gas tube and that it will spark to the end of the gas tube. See Pilot Detail Drawings for this setting.
   b. Spark rod and UV
      Make sure the spark rod is positioned above the pilot gas tube and that it will spark to the end of the gas tube.

7. Pilot Ignition
   a. Make sure the main gas valve to the burner is closed for intermittent or interrupted ignition.
   b. Observe the pilot flame, the flame should be blue and should extend approximately to the half of the burner end plate.
   c. Check the flame signal.

8. Main burner ignition
   a. Set the Modulating Gas Control System to high fire position.
      - Slowly open the manual gas valve.
      - Observe the flame at high fire; the flame should be blue approximately 10 to 12 inches long. If the flame is long, lazy and orange, the air to fuel ratio is not correctly adjusted. The pressure across the burner should be increased; refer to Chart 1.
      - Check the flame signal.
      - Check the manifold pressure to the corresponding firing rate. If the manifold pressure does not correspond to the pressures shown in Chart 2. Check for gas leaks.

   Close the manual gas valve.

   b. Set the Modulating Gas Control System to low fire position.
      Slowly open the manual gas valve.
      - The flame should be evenly extending in the burner.
      - the flame should be located in the casting of the burner.
      - Check the flame signal.

For a high fire start system the first gas port next to the pilot might require to be blocked using furnace cement to prevent potential pilot blow outs and flame failures. See Burner Assembly, and see Figure 8 – Pilot Configuration.

Slight redness and warping of the baffle plates may occur at the high and intermediate fire inputs. This will not harm the burner. Once an initial discoloration and warp has taken ("set") no further permanent damage will take place.

If the end plates redness occurs during high and intermediate fire inputs, the distance between the end plates and the profile opening may not be sufficient for the air to cool the end plates. Profile readjustments might be necessary.

BURNER MAINTENANCE

Annual Maintenance of HMA-2 is recommended to ensure trouble-free operation.

1. Make sure the system is off.
2. Inspect the burner baffles for plugged openings.
    a. Clean baffles with wire brush.
    b. Make sure the baffles are tightly attached to each other and to the burner casting.
3. Inspect the burner casting for plugged openings.
    a. Clean casting with wire brush.
    b. If necessary re-drill gas ports with a number 31 drill size and air ports with a number 42 drill size.
4. Turn the system on and visually inspect the flame.
5. For Service Bulletins on the cleaning and maintenance of burners contact Midco.

TROUBLESHOOTING

I. The Midco HMA-2 Burner is only a component of the complete system. For troubleshooting of the equipment contact the OEM (Original Equipment Manager) or the component manufacturer.

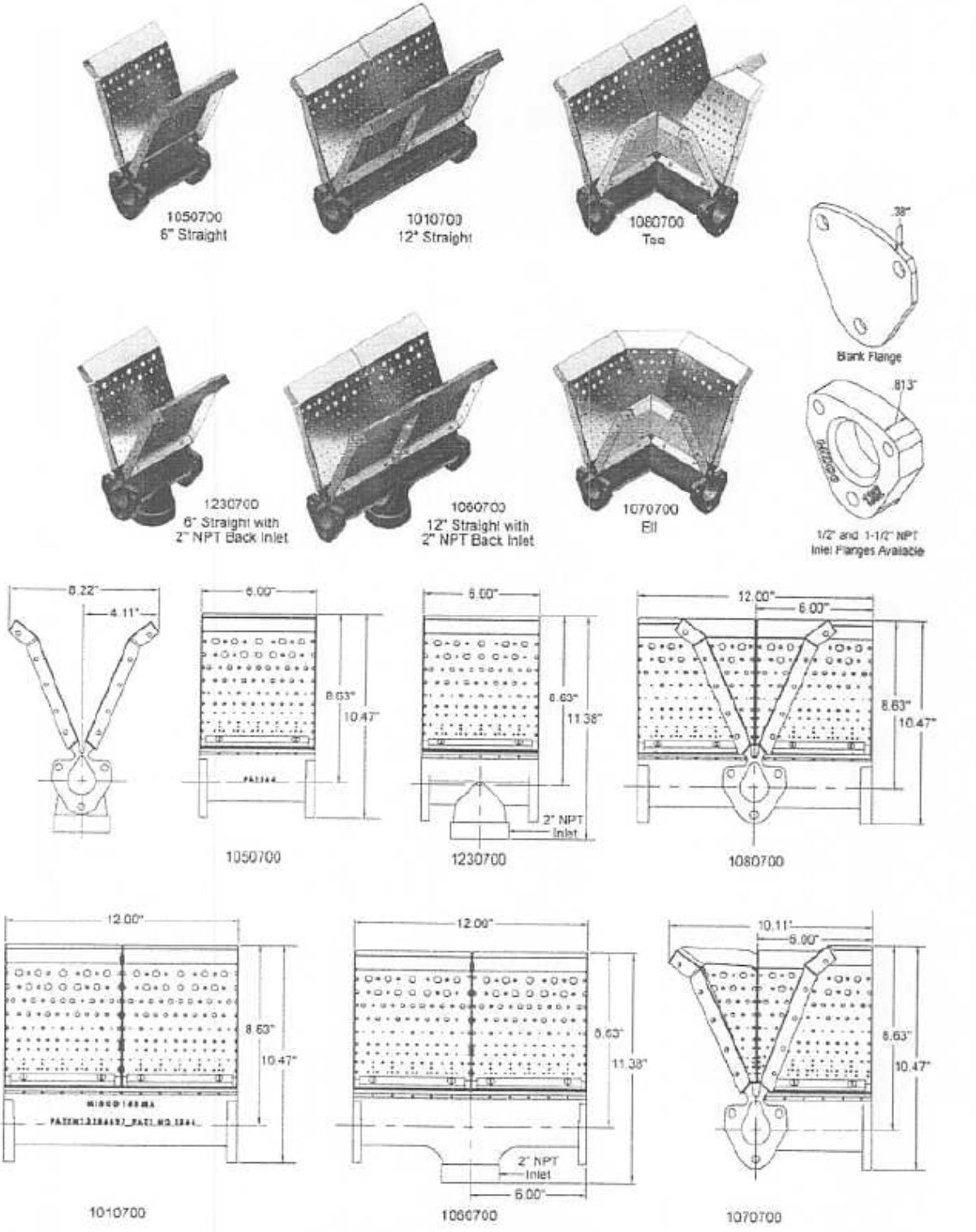
II. If the pilot light fails to light, install a manometer on the pilot pressure tap. Check for 3.5" W.C. for natural gas or 2" W.C. for propane. If no gas, check for voltage to pilot solenoid valve. If no voltage, check operating controls or primary flame safeguard. If voltage to pilot solenoid valve is present and if there is 3.5" W.C. gas pressure at pilot pressure tap then check for spark or flame rod settings. If there is no voltage to pilot solenoid valve, refer to Flame Safety control specifications or contact the original equipment manufacturer.

III. If Main Burner fails: If no main flame check manifold pressure. If no manifold pressure check for voltage to the gas solenoid valve and check if main manual valve is open. If no voltage to gas, refer to Flame Safety control specifications or contact the original equipment manufacturer.

IV. If the pilot fails as main gas valves open, the first adjacent gas port hole (next to the pilot) should be plugged with furnace cement. See Figure 8 – Pilot Configuration.

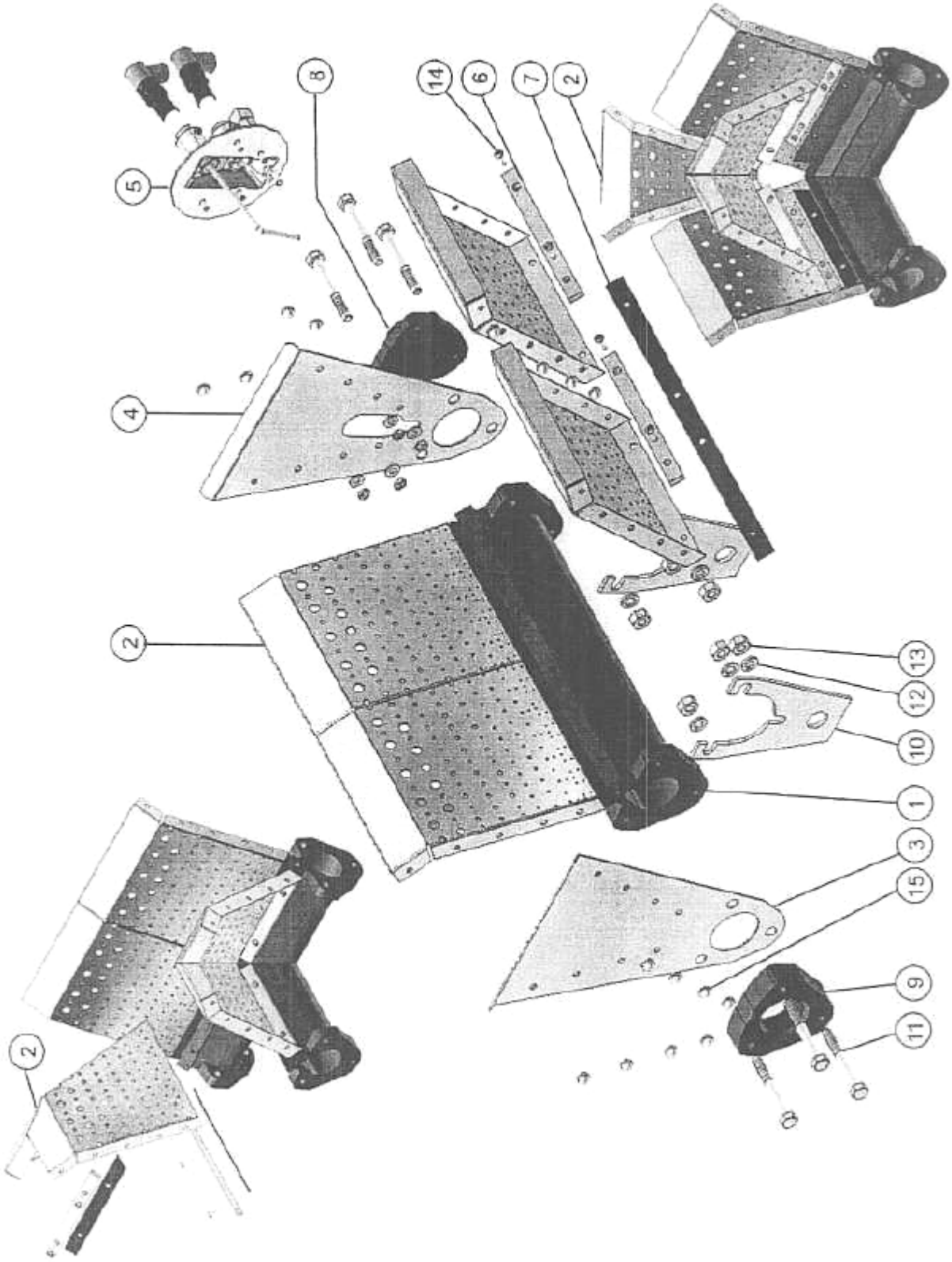
BURNER CONFIGURATION

Figure 6 – Burner Sections – Assembly



PARTS – ISOMETRIC VIEW

Figure 7 – Burner Assembly Parts – Isometric View



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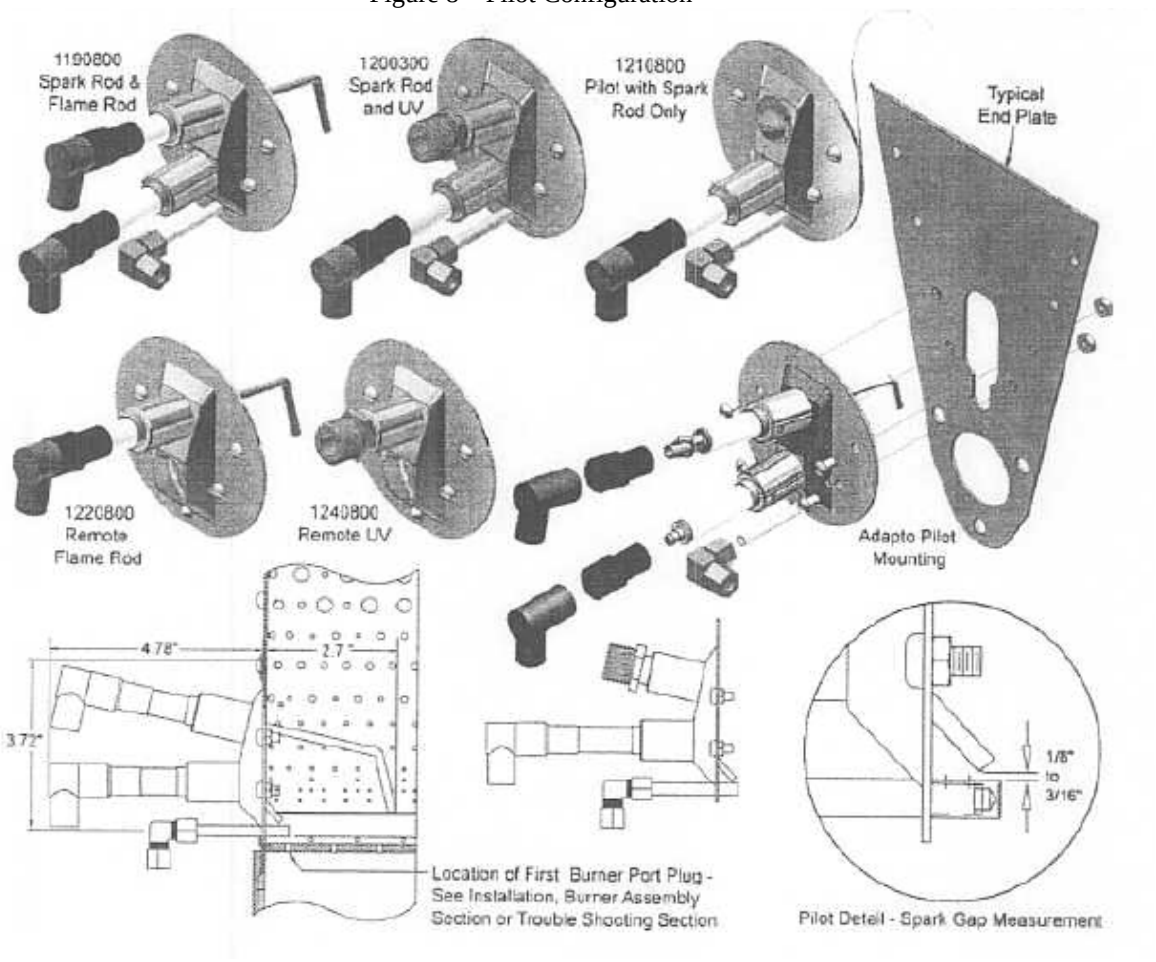
PARTS – PILOT CONFIGURATION & MOUNTING / EQUATION REFERENCE

Figure 8 – Pilot Configuration



EQUATION REFERENCE

1. Conversion of SCFM to Actual CFM of air

$$SCFM = CFM \times \frac{\rho}{0.075}$$

2. Air density as a function of temperature -- $\rho = 1.35 \times \frac{\text{Barometic Pressure (in Hg)}}{T_{(out)} + 460}$

3. Change in Standard Barometric Pressure as a function of altitude
   Barometric Pressure (in. Hg) = 29.921 x (1-6.8753x0.000001 x altitude (ft))^5.2559

4. Temperature difference – BTU/hr = SCFM x Temperature Rise x 1.08
   Where: 1.08 is a sensible heat equation constant.
   1.08 = 0.2397 (BTU/lb) x 60 (min/H) x 0.075 (lb/ft^3)

For more information, contact Midco International Inc, 4140 West Victoria Street, Chicago, Illinois 60646
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