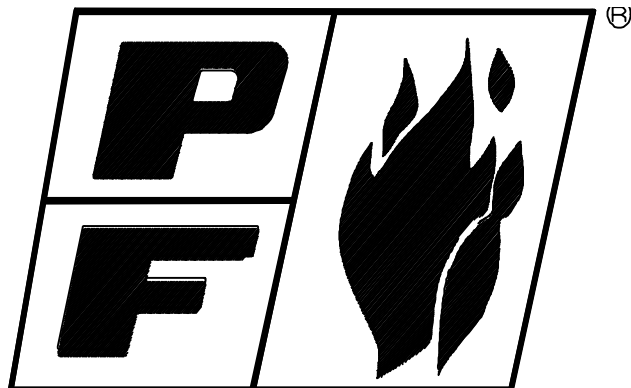


# Power Flame Incorporated



## X4 AND X4M INSTALLATION AND OPERATION MANUAL

### ***THE POWER TO MANAGE ENERGY***

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X4OM -07/01  
Rev.1007

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# POWER FLAME MODEL X4 BURNERS

## For use by Qualified Service Personnel Only

Rev. 10/07



U.S. Patent No. 6,508,645

**WARNING:** If the information in these instructions is not followed exactly, a fire or explosion may result causing property damage, personal injury, or death.

Do not store or use gasoline or any other flammable liquids in the vicinity of this or any other appliance.



### WHAT TO DO IF YOU SMELL GAS

1. Do not try to light any appliance.
2. Do not touch any electrical switch; do not use any phone in your building.
3. Immediately call your gas supplier from a neighbor's phone. Follow the gas supplier's instructions.
4. If you cannot reach your gas supplier, call the fire department.

**INSTALLATION AND SERVICE MUST BE PERFORMED BY A QUALIFIED INSTALLER, SERVICE AGENCY, OR THE GAS SUPPLIER**

### BURNER SPECIFICATIONS

|                                  |                   |
|----------------------------------|-------------------|
| <b>Input Capacity<br/>BTU/Hr</b> |                   |
| X4-400                           | 150,000 – 400,000 |
| X4-700                           | 200,000 – 725,000 |
| X4M-400                          | 150,000 – 400,000 |
| X4M-700                          | 90,000 – 725,000  |
| <b>Fuel Type</b>                 | Natural or LP Gas |
| <b>Blast Tube Length</b>         | 9", 12"           |
| <b>Inlet Gas Pressure</b>        |                   |
| X4-400                           | 5.0 – 14" w.c.    |
| X4M-400                          | 5.5 – 14" w.c.    |
| X4-700                           | 5.0 – 14" w.c.    |
| X4M-700                          | 5.5 – 14" w.c.    |
| <b>Voltage</b>                   | 120V, 60 Hz       |
| <b>Amp Rating</b>                | 5.0 Amp           |
| <b>Motor</b>                     | ¼ Hp, 3450 RPM    |
| <b>Transformer</b>               | 40VA, 24 VAC      |
| <b>Gas Valve</b>                 | Honeywell         |
| X4(M)-400<br>w/direct spark      | VR8305M           |
| w/proved pilot                   | VR8304M           |
| X4(M)-700<br>w/proved pilot      | Robert Shaw       |
| <b>Primary Control</b>           | 7000DERHC-S7A     |
|                                  | Honeywell         |
| direct spark                     | S89F              |
| proved pilot                     | S8680J            |



## 1. GENERAL INFORMATION

The X4 burner is a new generation of gas power burners designed to fire natural gas and propane against a positive furnace pressure.

The burner is a self-contained unit comprised of a blower assembly, firing head, ignition system, combination gas valve, flame safeguard and control panel. It only requires connection of 115V electrical supply, minor gas train piping, connection to gas service, and operating controls.

All Power Flame burners are operationally fire tested at the factory.

## 2. CAPACITIES & SPECIFICATIONS

| Burner Number  | X4-400          | X4-700    | X4M-400         | X4M-700   |
|--|-----------------|-----------|-----------------|-----------|
| Natural/LP Gas Flow x 1,000 BTU/HR                       | 150-400         | 200-725   | 150-400         | 90-725    |
| Gas Train Size   | 3/4"            | 1"        | 3/4"            | 1"        |
| Blower Wheel Size  | 6-1/4" x 2-3/4" | 7" x 3"   | 6-1/4" x 3-3/4" | 7" x 3"   |
| Blower Motor HP  | 1/4             | 1/4       | 1/4             | 1/4       |
| Voltage  | 120/60 hz       | 120/60 hz | 120/60 hz       | 120/60 hz |
| Maximum Inlet Pressure to Main Shut-off Cock Inches W.C. | 14.0            | 14.0      | 14.0            | 14.0      |

## 3. ACCEPTANCE PROCEDURE

Open the box and carefully remove the top cardboard packaging. Lift the burner from the box and ensure all shipped loose items are removed before discarding the box. Check all parts received against your computer generated Bill of Material that is enclosed in the owner's information envelope.

### Warranty

The Owners Information envelope packed with the burner contains a Warranty Registration Card. The Warranty Registration Card is also a request form for a Spare Parts List. An on-hand supply of spare parts is highly recommended in case of emergency shutdown. We request that you complete and return the card to Power Flame in the enclosed self-addressed envelope as soon as possible.

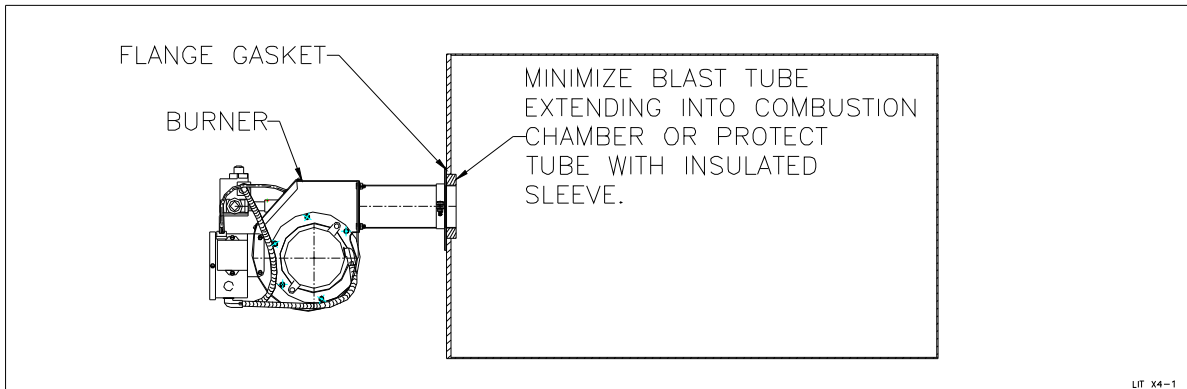
## 4. INSTALLATION

Prior to Installation, carefully study these instructions, all charts, drawings and diagrams shipped with the burner.

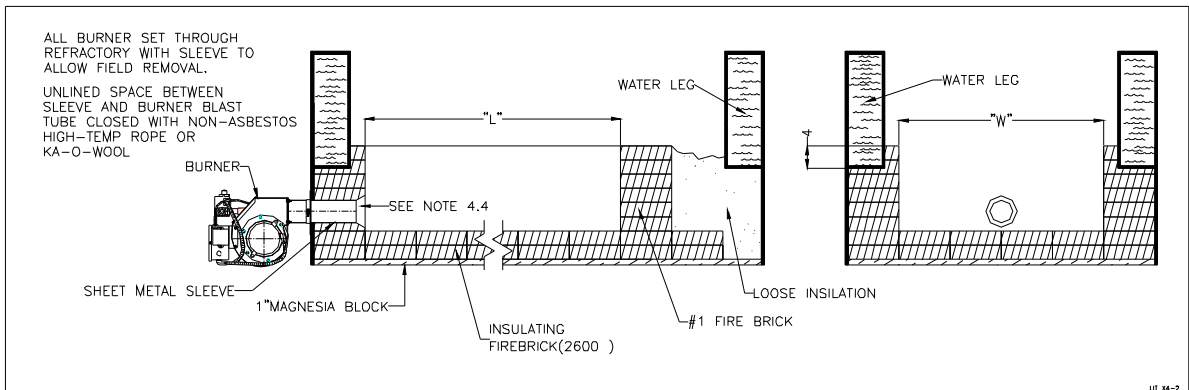
Installation must be in accordance with all local and national codes including CAN1-B149.1 or B149.2 and Canadian electrical codes for Canadian installations.

- 4.1 If the burner is to be mounted in an existing boiler or furnace, ensure that all fireside surfaces are clean and in good condition. All doors, cleanouts, cracks or other openings allowing excess air into the combustion chamber should be tightly sealed, whether the burner is to be fired under positive or negative combustion chamber conditions.
- 4.2 The burner can be mounted through a heat exchanger end wall or in the base of the boiler – see Figures 1 and 2. The opening for the burner blast tube should not be less than 4 ¼ inches in diameter to allow easy removal of the burner. The gap between the burner opening and the blast tube should be sealed with non-asbestos, high temperature rope or Ka-O-Wool. Where a new or replacement combustion chamber lining is to be used the chamber is to be built using 2300 degree F insulating firebrick or ceramic fiber blanket.

**Figure 1 Mounting in Heat Exchanger**



**Figure 2 Mounting in Boiler Base**



**4.3 COMBUSTION CHAMBER SIZING**

**Table 1 Combustion Chamber Recommended Dimensions**

| Gas Input<br>MBTU/HR | Width<br>Inches | Length<br>Inches |
|----------------------|-----------------|------------------|
| 250                  | 13              | 17               |
| 450                  | 15              | 20               |
| 600                  | 16              | 23               |
| 700                  | 17              | 25               |
| 850                  | 18              | 26               |

- 4.4 Whichever method of mounting is chosen, the burner blast tube must be recessed into the front wall surface from 0" to 1/2".

**NOTE: Serious Damage To The Burner May Result If The Blast Tube Is Extended Into The Combustion Chamber.**

- 4.5 Secure the burner to the heat exchanger or boiler, using the burner-mounting flange. The burner-mounting flange must be secured to the blast tube at the selected location for proper insertion into the end or front wall of the fired unit. A tight seal between the mounting flange and the front plate should be accomplished using the factory-furnished gasket or a ceramic or other non-asbestos fiber rope.

## 5 GAS PIPING

- 5.1 Contact your local gas service company to ensure that adequate gas service is available and to review applicable installation codes for your area. All gas piping installations must be in accordance with NFPA 54, National Fuel Gas Code, Definitions and General Field Recommendations, CGA 3.0, Canadian Natural Gas Installation Code CAN/CGA B149.1 or Propane Installation Code, CGA B 149.2. This product must be installed only by a Licensed Plumber or Gasfitter, when installed in the Commonwealth of Massachusetts.
- 5.2 Size the main gas line in accordance with Table 2. The figures shown are for straight lengths of pipe at 0.2" w.c. pressure drop, which is considered normal for low-pressure systems. Note that fittings such as elbows and tees will add to the pipe pressure drop.

**Table 2 - Gas Piping Pressure Drop Data**

| Pipe Size In Inches | EQUIVALENT LENGTH OF STRAIGHT PIPE IN FEET |      |      |      |      |      |      |      |     |
|---------------------|--|------|------|------|------|------|------|------|-----|
|                     | 20   | 30   | 40   | 50   | 60   | 80   | 100  | 150  | 200 |
| 3/4"                | 152  | 120  | 105  | 93   | 84   | 73   | 66   | 54   | 45  |
| 1"                  | 300  | 250  | 210  | 190  | 180  | 150  | 135  | 110  | 75  |
| 1-1/4"              | 520  | 425  | 360  | 325  | 300  | 260  | 230  | 190  | 165 |
| 1-1/2"              | 800  | 690  | 560  | 500  | 480  | 410  | 370  | 300  | 260 |
| 2"                  | 1700                                       | 1400 | 1200 | 1100 | 1000 | 850  | 750  | 600  | 540 |
| 2-1/2"              | 3000                                       | 2500 | 2100 | 1900 | 1800 | 1550 | 1375 | 1100 | 950 |

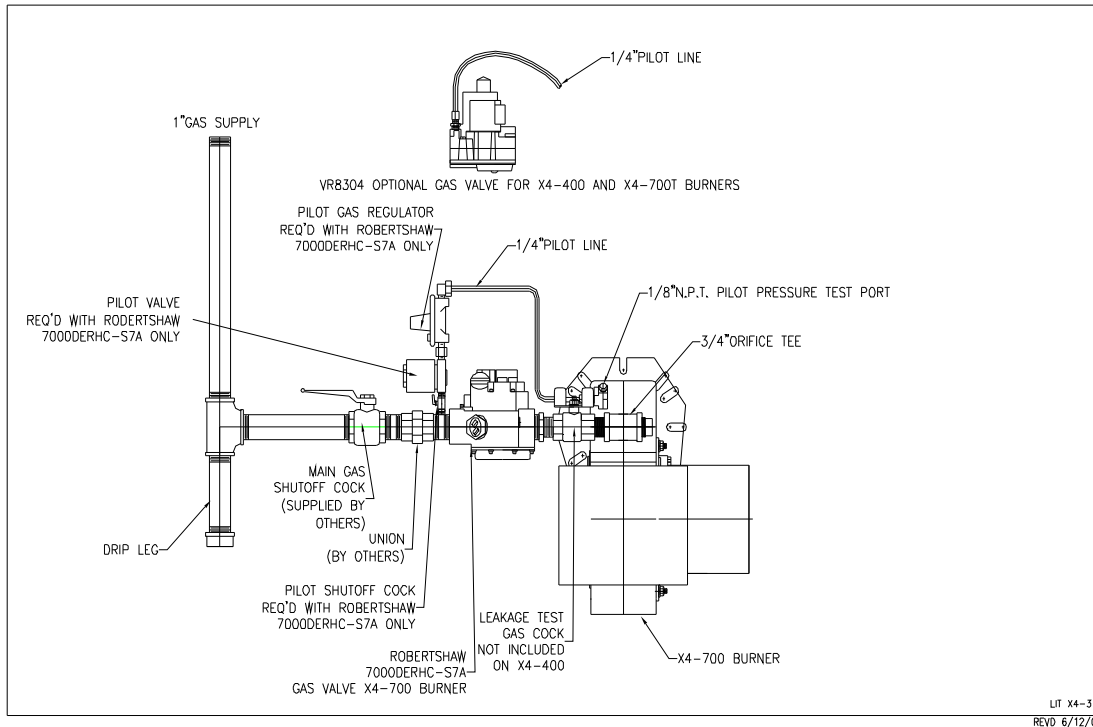
**EQUIVALENT LENGTHS OF STANDARD PIPE IN FEET FOR LISTED FITTINGS**

| Fitting Type | 3/4 | 1   | 1-1/2 | 1-1/2 | 2    | 2-1/2 | Nominal Pipe Size In Inches |
|--------------|-----|-----|-------|-------|------|-------|-----------------------------|
| Std. Tee     | 2.4 | 5.5 | 7.5   | 9.0   | 12.0 | 13.5  |                             |
| Std. Elbow   | 4.4 | 2.7 | 3.7   | 4.5   | 5.5  | 6.1   |                             |

- 5.3 Refer to Figure 3 for details of gas piping. (Also refer to any additional piping diagrams supplied for this specific unit.)
- 5.4 Mount leakage test and main gas cocks, main automatic gas valve or combination gas valve/pressure regulator, and auxiliary valves (if required and not factory mounted) per piping diagram or Figure 3.
- 5.5 Install pressure regulator (not used with combination gas valve/pressure regulator) directly upstream of main automatic gas valve(s) and fit drip leg and main gas cock upstream of regulator or automatic valve(s).
- 5.6 The pilot line should be piped into the upstream tapped nipple to minimize pilot line piping length. An optional location is in a tapping located on the main shut-off cock. Refer to Figure 3. For ease of servicing we recommend the use of a union immediately upstream of the main gas pressure regulator or combination gas valve/pressure regulator.

- 5.7 Install vent lines from main gas regulator (if used) and diaphragm gas valve where applicable. Vent lines should be run to the outside of the building, terminating clear of windows or fresh air intakes. Outside termination of vent should have a screen to prevent insects from building nests in vent pipe. The vent should terminate in a manner, which will preclude the possibility of water, dirt or other foreign matter from entering the line.

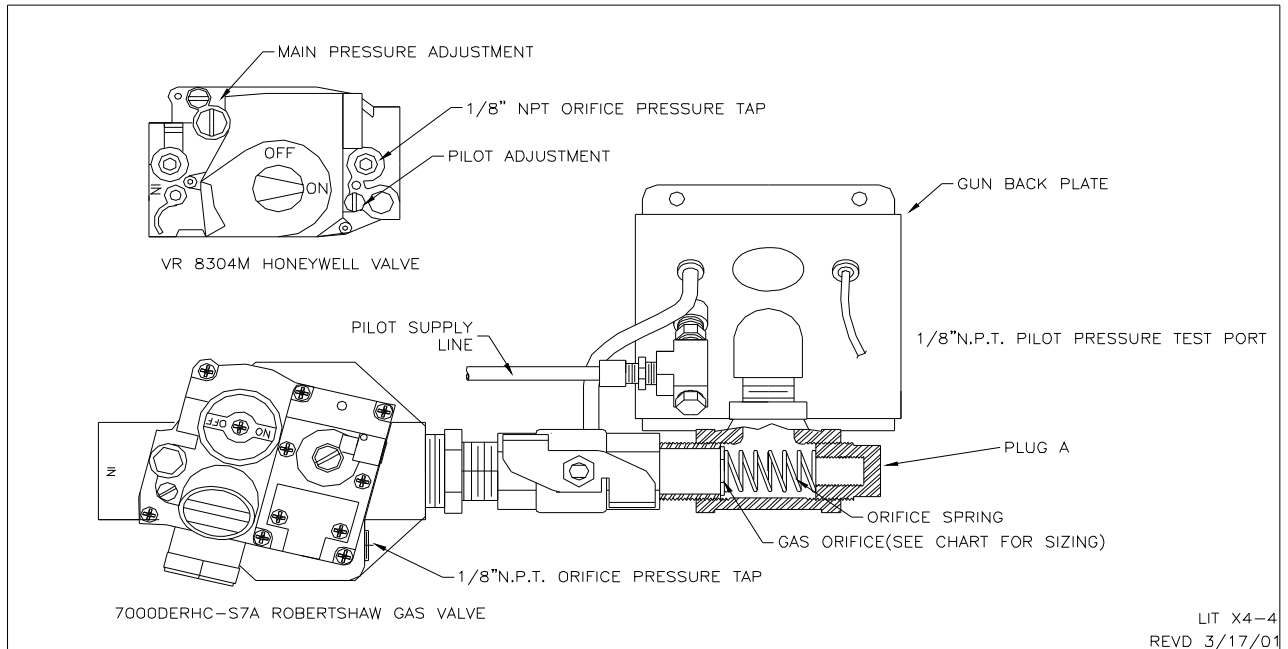
**Figure 3 UL Gas Piping Train (X4) – See Figure 11B, page 17, for X4M**



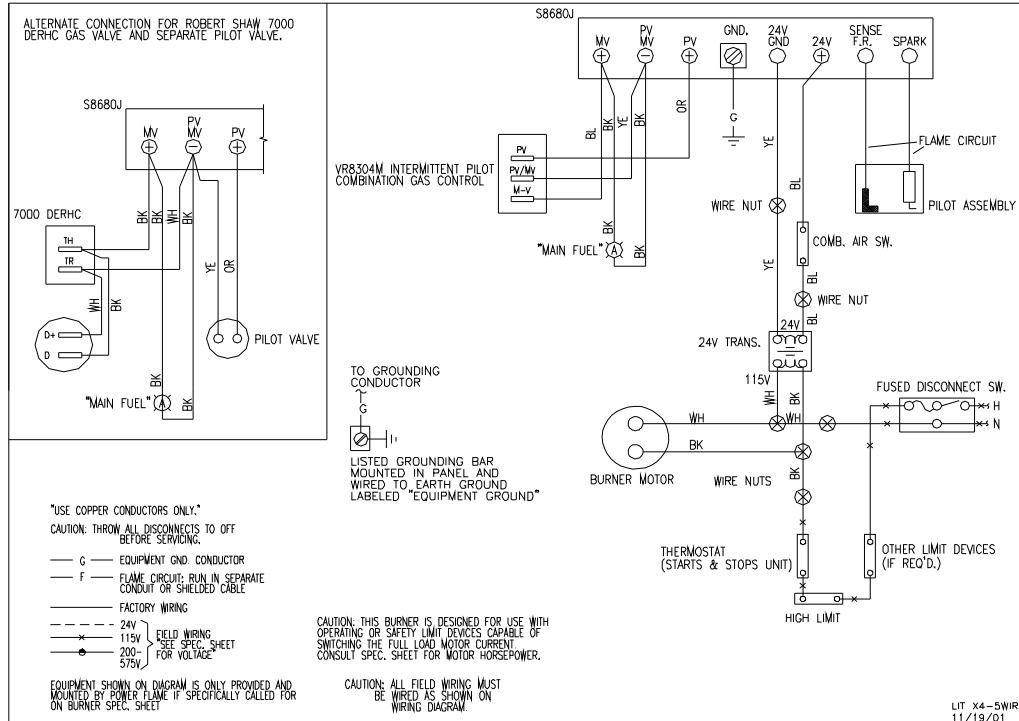
- 5.8 Test gas lines for leaks using a soap solution. Your local gas service company may wish to execute or witness this test. **CAUTION** – gas pressure above 14" w.c. may damage the standard diaphragm gas shut-off valve. Do not exceed this value when pressure testing lines unless you cap off line upstream of main gas cock and pilot take-off.
- 5.9 Check that side orifice size is correct according to burner specification sheet (See Figure 4). To gain access to orifice, remove Plug A and withdraw spring and orifice. When reinserting or replacing the orifice, ensure that it seats properly inside the tee and reinstall plug.



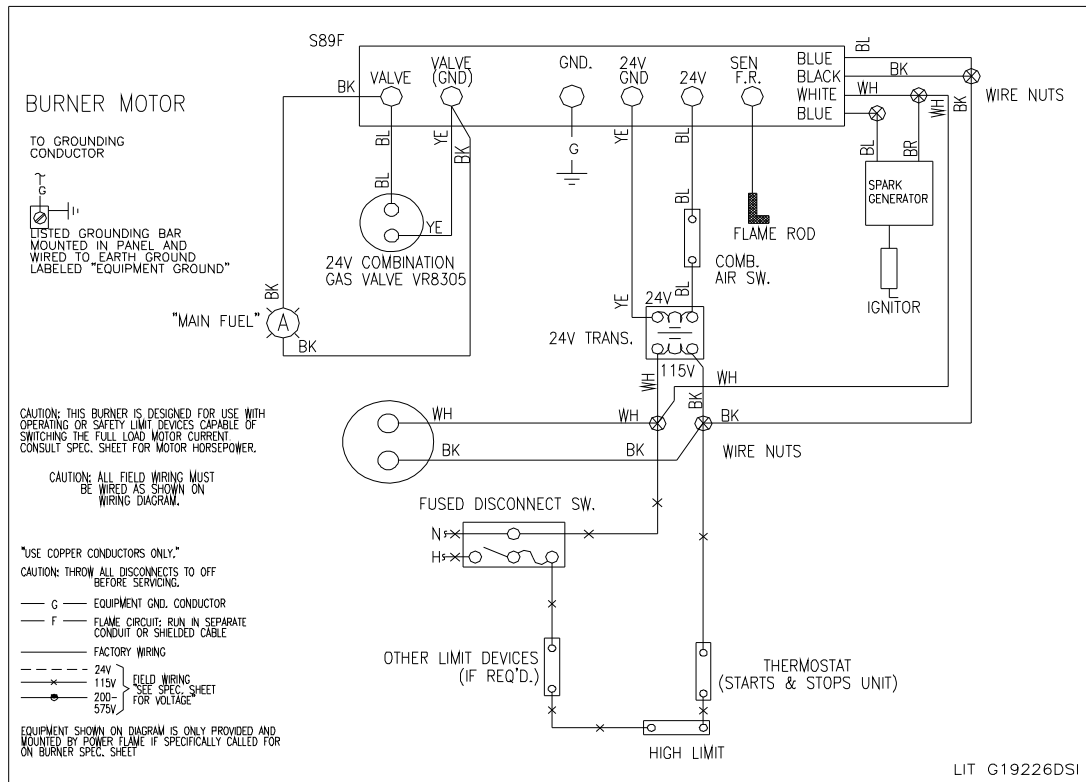
**Figure 4 Location of Side Orifice**



**Figure 5 Typical Wiring Diagram for S8680J with Proved Pilot Ignition**



**Figure 5A Typical Wiring Diagram for S89F with Direct Spark Ignition**



## 6 WIRING

- 6.1 Refer to wiring diagram shipped with burner and typical wiring diagrams Figures 5 and 5A. The two power leads (black and white) are located inside the burner panel.
- 6.2 Electrical installation must be made in accordance with the NEC NFPA 70 or Canadian Electrical Code, Part 1 and applicable local codes. If this burner is part of a boiler or furnace package system, check wiring diagram as supplied by the boiler or furnace manufacturer.

## 7 START UP

- 7.1 Before attempting a burner start up, thoroughly study and familiarize yourself with the exact sequence of operation and all other details on the specific Primary Safety Control System being used. This information will be found in bulletins supplied with the burner, as well as technical bulletins covering other components. All of these materials should be used as reference in burner start up and service.
- 7.2 Check boiler water level (if applicable).
- 7.3 Lay out combustion test equipment (see Section 8.3).
- 7.4 Attach gas pressure gauge or manometer to upstream side of main gas cock (0-35" w.c.) and to orifice pressure tap (0-10" w.c.) as well as to pilot gas pressure test tee tapping (0-10" w.c.).
- 7.5 Check the voltage at the disconnect switch to make certain that it matches that indicated on the burner label.
- 7.6 Ensure that all dampers in the flue or stack are fully open.

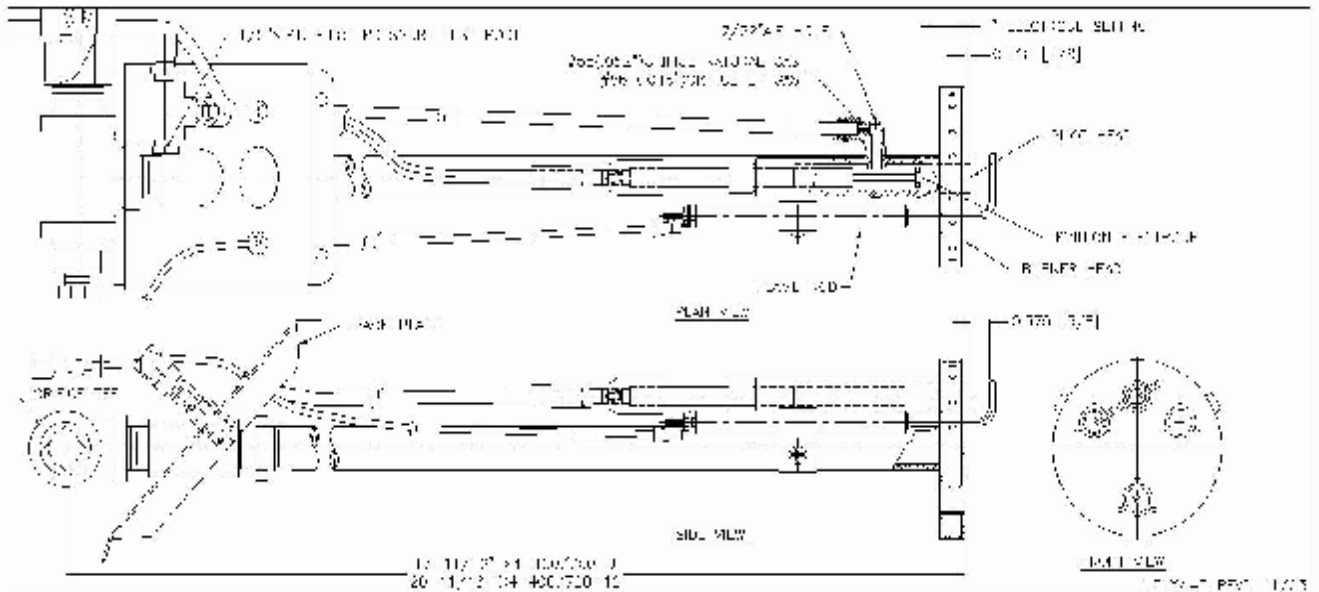
- 7.7 Install stack thermometer and Flue Gas Analyzer sample line into breeching and connect the draft gauge to combustion chamber test point.
- 7.8 Connect a microammeter to the Primary Safety Control as directed in the PSG control manufacturer's instruction bulletin to determine flame detection system values. The meter is normally connected in series with the (SENSE) terminal on the S8600 or S89F series control.
- 7.9 With the main and leak test cocks and pilot cock in OFF position, turn on the gas cock at meter. Check to make certain that pressure upstream of main and pilot cocks does not exceed 14" w.c. (1/2 PSIG) – unless special valve train components suitably rated have been furnished (Refer to Burner Specification Sheet). If pressure is acceptable, proceed to next step.

**7.10 Pilot Ignition**

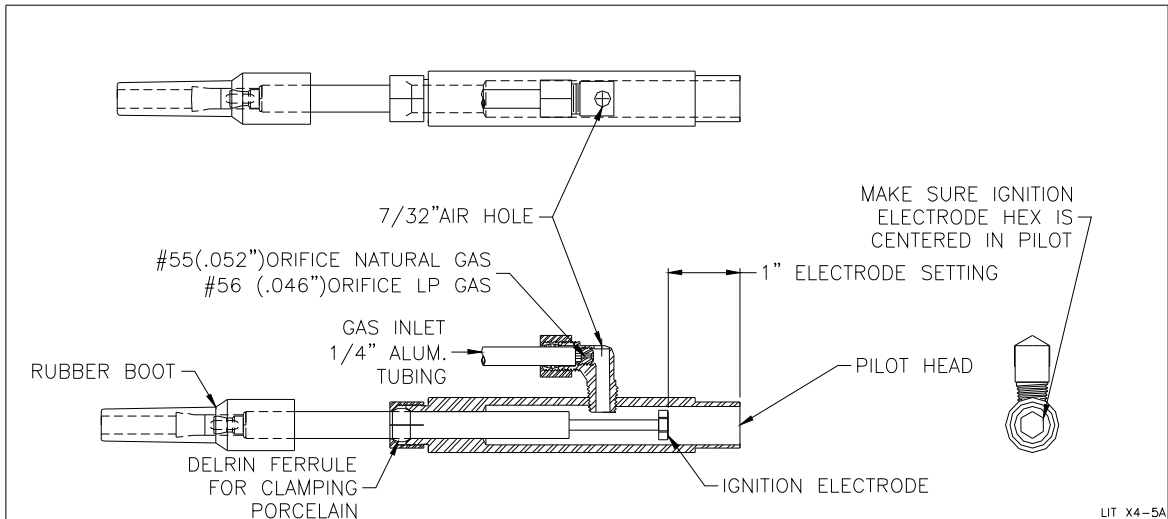
**Next check the operation of the gas pilot system. This is a very important part of the start up procedure.**

- A. Before attempting burner start up make certain that you are familiar with the operation of the Primary Safety Control and other components being used on this specific application. Refer to Fig. 6 and 6A.
- B. To prepare the pilot for proper operation, it is essential that appropriate adjustments be made to the burner air inlet damper and the pilot gas pressure. See Table 3 for the approximate air damper setting at the various firing rates. Typical pilot test pressures are 3" to 4" w.c. for natural and propane gas. Normally, lower pressures are required for air damper openings of 50% or less.

**Figure 6 Pilot/Gun Assembly – Flame Rod Type – Natural Gas/LP Gas**



**Figure 6A Detail Pilot Assembly**



C. **Frequently the cause for pilot problems relates to gas pressures that are too high and/or air dampers that are closed too far. Both conditions can cause a fuel rich mixture in the pilot chamber which can substantially delay or totally prevent pilot ignition.**

7.11 With the leak gas cock closed and pilot gas cock open (if provided); turn the burner switch ON. The blower motor will purge the heat exchanger of **any accumulated combustibles**. At the end of the purge cycle, the pilot solenoid valve will energize and spark will be initiated. The pilot will attempt to light for 15 seconds. Adjust the pilot pressure at this time. If the pilot fails to light, power must be removed from the control for 60 seconds to allow it to reset. **Note:** If the leak test cock is not provided, remove the main gas valve wire (MV) from the control to prevent the main valve from energizing during the pilot adjustment period.

**7.12 Pilot Adjustment and Main Flame Light Off Procedure**

- A. Set the air flow (see Table 3) and pilot gas pressure in order to provide instant pilot ignition, good flame stability and a strong/steady signal reading. This can be accomplished as follows: Start with the pilot pressure at the minimum adjustment on the regulator. When the pilot valve energizes begin increasing the pilot pressure. Note the pressure where a signal is obtained or the main valve energizes. This will be the minimum pilot pressure. Acceptable pilot and/or main flame current reading is 1 – 5 microamp.
- B. Raise the pilot gas pressure to the point where the signal and/or main valve drops out noting this pressure. Reduce the pressure slightly and recycle the burner for an attempt to relight the pilot at this pressure. If relight occurs this is the upper limit of the pilot pressure. Now set the pilot pressure between the minimum and maximum pressure. This range is typically 1" w.c..
- C. After attaining the proper pilot flame signal values, cycle the pilot off and on several times in order to ensure reliability (with the gas leak test cock still closed). **Turn Burner Switch Off.**
- D. Having established pilot reliability, open gas leak test cock.
- E. After burner has completed pre-purge and established a good pilot flame signal reading, the main automatic fuel valve will be energized. The main flame should light immediately. If light off does not occur, it is possible that air will need to be purged from the main gas line. Adjust main gas pressure regulator (if used) or combination valve regulator to obtain the desired firing rate pressure.
- F. Adjust burner as necessary to provide smooth ignition of main flame. If pilot flame signal drops significantly when main fuel valve opens, increase pilot gas pressure slightly to obtain a reasonably stable flame signal value.

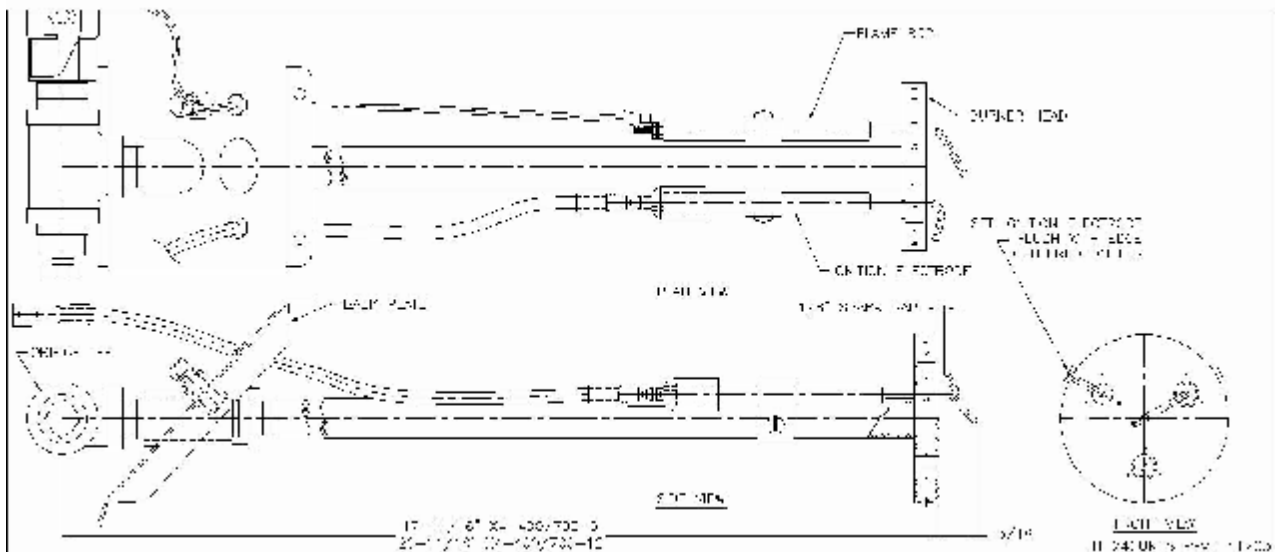
- G. Select and install the main orifice that corresponds to the desired firing rate. Make certain that the airflow setting provides the correct CO<sub>2</sub> or O<sub>2</sub> levels and other combustion values at the proper firing input rates.

See Section 8 and Table 3 for firing rate information. Generally accepted values for natural gas are 8½ to 10% CO<sub>2</sub> or 5½ to 3% O<sub>2</sub>. Equivalent CO<sub>2</sub> readings on propane gas are 10 to 11½% CO<sub>2</sub> or 5½ to 3½% O<sub>2</sub>. It is important that the CO (carbon monoxide) level is checked and held at 0% or minimum (typically under 100ppm or .01%). Check with local utility and any other authorities having jurisdiction before making final burner adjustments.

### 7.13 Direct Spark Ignition (S89F control)

- A. Before attempting burner start up make certain that you are familiar with the operation of the Primary Safety Control and other components being used on this specific application. Refer to Figure 6b to verify the correct position of the ignition electrode placement since shipment may have altered the placement.
- B. Set the burner's combustion air inlet damper to the approximate setting as shown in this manual for the desired firing rate. Also, verify that the correct main orifice is installed in the main orifice tee.
- C. Open the main manual gas valve and turn the combination gas valve to ON. Turn the burner power on. The blower motor will purge the heat exchanger of any accumulated combustibles. At the end of the purge cycle, typically 35 seconds, the combination valve will be energized and a spark will be initiated. The trial for ignition will be approximately three seconds.
- D. Complete setup in accordance with item (G) above.
- E. If ignition failure occurs the main power must be switched off for at least one minute to allow the control to reset. Refer to the Service/Maintenance section for further information on Direct Spark Ignition.

**Figure 6B Detail Direct Spark Gun Assembly**



Conduct all applicable test procedures shown in control manufacturer's bulletins included with burners. Set and check operation of low and high gas pressure switches (if applicable), all burner and heat exchanger controls, and

operating devices. Check blower airflow switch by first closing main gas cock and disconnecting motor lead wire. A properly adjusted air switch should open within 3 to 4 seconds when the power is removed from the motor.

- 7.15 Clean up area around the burner and instruct owner and/or operator.
- 7.16 Post Operating Instructions card (inside back cover) close to the burner in clearly visible position.

## 8. COMBUSTION ARRANGEMENT REQUIREMENTS

- 8.1 The X4 burner has been designed to fire with high combustion efficiency into combustion chambers with positive, balanced or negative pressures using natural or LP gas only.
- 8.2 In order to fire efficiently, the burner requires an adequate supply of combustion air. Ventilation to any enclosed area should be provided on the basis of ½ square inch of opening for each 1000 BTU/HR input. This excludes the requirement for any other fired equipment in the area. The enclosed area should not become excessively hot and under no circumstances should be under a negative pressure.

The burner should be initially set up and serviced at regular intervals (preferably at the beginning of and mid way through high use periods) by a trained serviceman using the proper test instruments. Failure to maintain the correct burner settings may result in inefficient gas consumption, premature wear of burner components or explosion hazard.

- 8.3 Approximate gas flows and pressures are shown in Table 3 for natural gas and LP gas. Actual firing rates should be verified by clocking the gas meter and applying the appropriate correction factor.

**Table 3**

Natural/LP Gas Orifice Pressure Settings/Flow Rate. NOTE: Pressure taken at Combination Valve Pressure Tap Upstream of Orifice.

### X4-400

| Main Orifice Diameter/I.D.# | MBH Natural Gas<br>1000 BTU/CF |         |         | MBH LP Gas<br>2500 BTU/CF |         |         | Approx. Damper Position   |             |
|-----------------------------|--------------------------------|---------|---------|---------------------------|---------|---------|---|-------------|
|                             | 2" w.c.                        | 3" w.c. | 4" w.c. | 2" w.c.                   | 3" w.c. | 4" w.c. | MBH   | Indicator # |
| .203 / 1                    |                                |         |         | 133                       | 180     | 198     | 150   | 1           |
| .234 / 2                    |                                |         |         | 158                       | 196     | 227     | 200   | 2           |
| .265 / 3                    | 150                            | 183     | 210     | 213                       | 250     | 287     | 300   | 3           |
| .281 / 4                    | 175                            | 215     | 248     | 219                       | 264     | 292     | 400   | 4           |
| .343 / 5                    | 200                            | 245     | 280     | 298                       | 351     | 389     |   |             |
| .406 / 6                    | 225                            | 274     | 316     | 370                       | 431     |         | Note: Pilot pressure is different at each damper position and must be set at each position. |             |
| .468 / 7                    | 275                            | 338     | 390     | 410                       |         |         |   |             |
| .500 / 8                    | 295                            | 360     | 415     |                           |         |         |   |             |
| None                        | 400                            |         |         |                           |         |         |   |             |

### X4-700

| Main Orifice Diameter/I.D.# | MBH Natural Gas<br>1000 BTU/CF |                |         | MBH LP Gas<br>2500 BTU/CF |         |         | Approx. Damper Position   |             |
|-----------------------------|--------------------------------|----------------|---------|---------------------------|---------|---------|---|-------------|
|                             | 2" w.c.                        | 3" w.c.        | 4" w.c. | 2" w.c.                   | 3" w.c. | 4" w.c. | MBH   | Indicator # |
| .203 / 1                    |                                |                |         |                           | 174     | 201     | 200   | 1           |
| .234 / 2                    |                                |                |         | 162                       | 198     | 239     | 300   | 1 3/4       |
| .265 / 3                    | 120                            | 148            | 171     | 194                       | 227     | 272     | 400   | 2           |
| .281 / 4                    | 131                            | 163            | 189     | 201                       | 250     | 285     | 500   | 3           |
| .343 / 5                    | 186                            | 230            | 269     | 273                       | 335     | 387     | 600   | 4           |
| .406 / 6                    | 246                            | 302            | 394     | 383                       | 470     | 541     | 700   | 6           |
| .468 / 7                    | 306                            | 372            | 433     | 472                       | 578     | 667     | 725   | 9           |
| .500 / 8                    | 326                            | 394            | 454     | 497                       | 609     | 725     | Note: Pilot pressure is different At each damper position and Must be set at each position. |             |
| None                        | 451                            | 563            | 652     |                           |         |         |   |             |
|                             |                                | 725 @4.8" w.c. |         |                           |         |         |   |             |

- 8.4 The correct test instruments are:
- a. O<sub>2</sub> analyzer (electronic or Fyrite absorption system)
  - b. CO indicator (Monoxor or similar)
  - c. Stack thermometer
  - d. Draft gauge or inclined manometer
  - e. U-tube manometer or calibrated 0-10" and 0-35" w.c. pressure gauge
  - f. Combination volt/ammeter
  - g. D.C. Micro-Ammeter

## 9. SERVICE/MAINTENANCE SUGGESTIONS

- 9.1 Burner Fails to start:
1. Bad fuse or switch open on in-coming power source, or motor overload out.
  2. Control circuit has an open control such as operating, limit or low water cut-off.
  3. Push the reset button on the motor or open the power circuit to the primary safety control.
  4. Loose or faulty wiring. Tighten all terminal screws. Check wiring, against wiring diagram furnished with burner.
- 9.2 Burner Motor Runs, but Pilot Does Not Light
1. Be sure gas is turned on at meter and pilot cock is open.
  2. Place hand on pilot valve to "feel" it open. Check gauge at tee in pilot line for gas pressure and prompt opening of pilot valve.
  3. Check visually or by sound for spark arcing.
  4. Refer to section 7.10 on pilot checking procedures.
  5. Check air switch and be sure its circuit closes during start.
- 9.3 Burner Motor Runs, Pilot Lights, but Main Gas Valve Does Not Open
1. Check flame signal. If signal is low, adjust pilot gas pressure and air settings for improved readings.
  2. Check gas valve circuit.
  3. Shut-off cock or test cock not open.
  4. Defective main valve.
- 9.4 Occasional Lockouts For No Apparent Reason
1. Re-check microamp readings. If insufficient, check gas pressure and air damper setting. Check electrode setting. If flame signal is low, flame rod may have to be re-positioned.
  2. Check ignition cable and electrode porcelain for damage or breaks, which could cause short.
  3. Check for loose or broken wires.
- 9.5 Burner Will Not Start – Even Though Burner Had Never Failed Before Or Had Been running On Normal Cycling Without Failure.
1. Operating Control circuit open.
  2. Defective control or loose wiring.
  3. Limit circuit open.
- 9.6 The burner must be periodically inspected to insure safety and performance. All maintenance must be performed with the main electrical power off and the main gas shutoff valve off.
1. Inspect blower inlet screen and clean any buildup of lint.
  2. Inspect blower wheel blades and clean any buildup of dirt.
  3. Inspect ignition electrodes and wiring for any cracks that may cause shorting.
  4. Oil the blower motor at the manufacturer's recommended intervals.
  5. Verify that the pilot and or direct spark electrodes are still within specifications (set per drawing 6,6A and 6B in this manual).
  6. Verify the proper operation of the Primary Safety Control, airflow switch, and operating controls.
  7. Check safety gas shutoff valves for gas tightness.

9.7 In the event of extended shutdown, the main power should be turned off and the main manual gas shutoff valve should be closed.

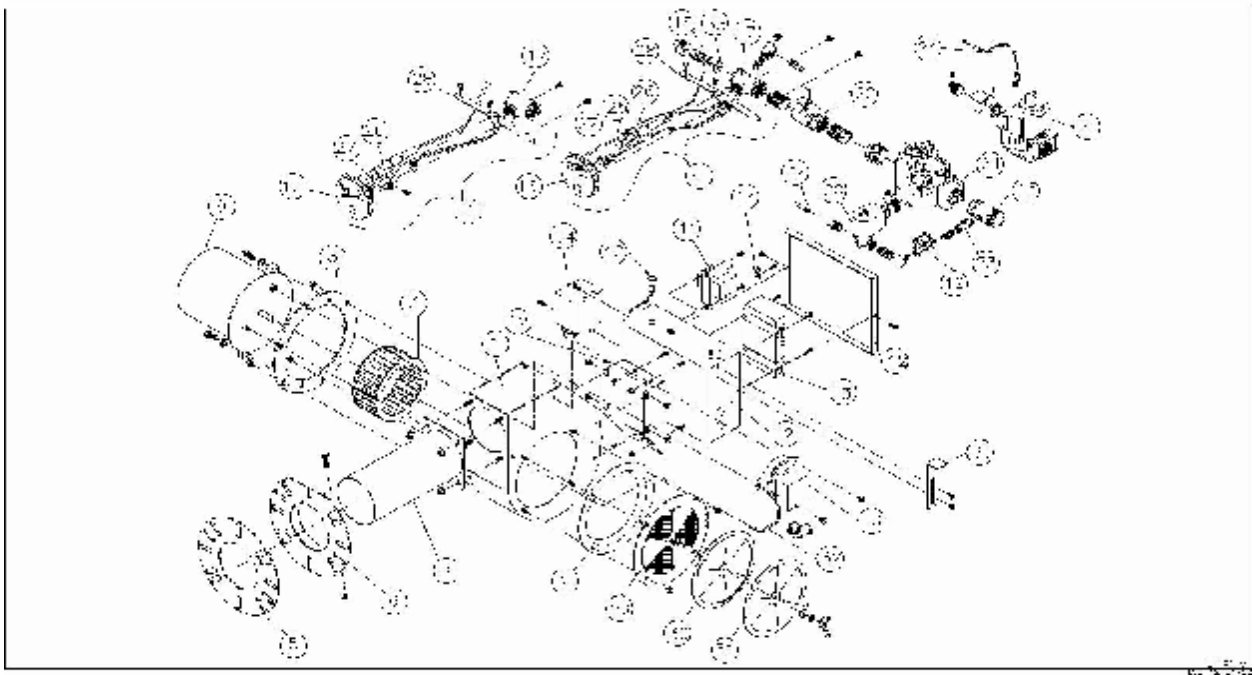
9.6 **EMERGENCY SHUTDOWN: WARNING:** Should over-heating occur: (1) shut off the manual gas valve to the appliance, (2) do not shut off the control switch to the feed water pump or blower.

An additional source of information relative to trouble shooting can be found in the Flame Safeguard Control Manual supplied with the burner.

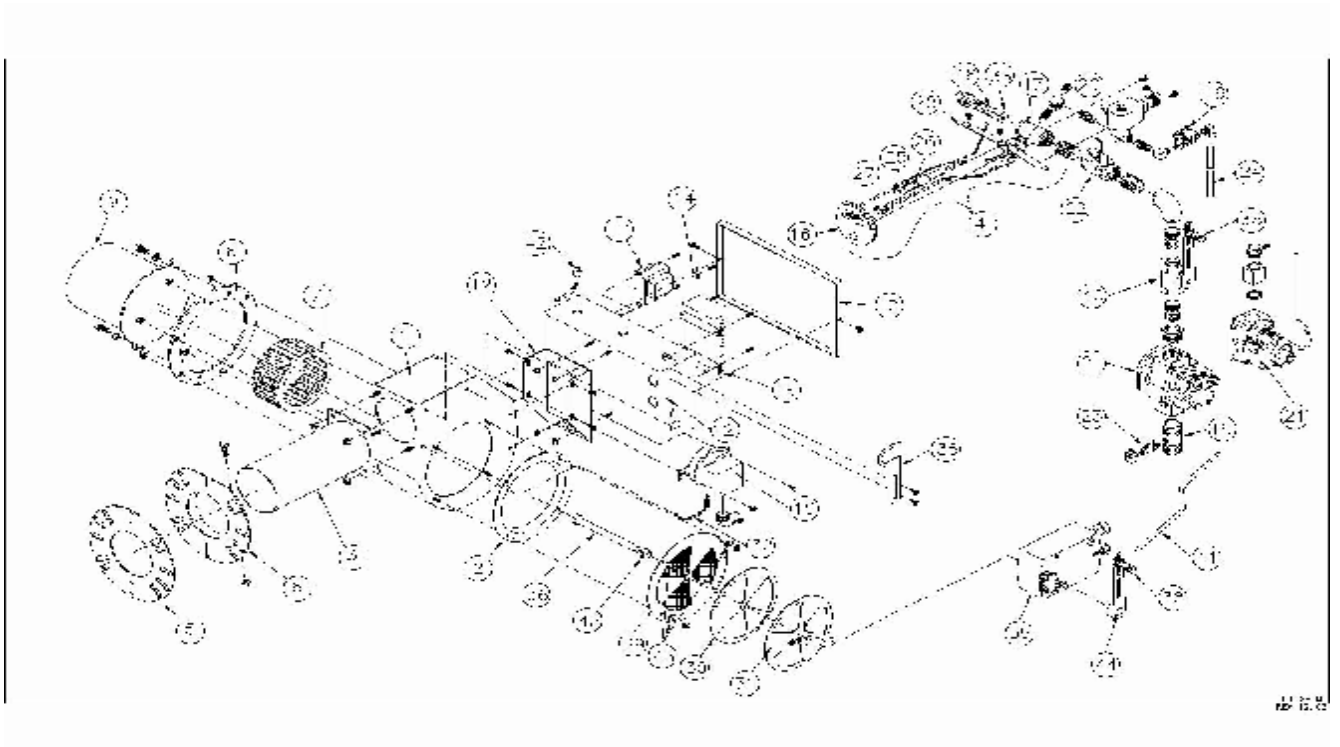
## 10. BURNER PARTS LIST – X4 and X4M

- |                             |                           |                                |
|-----------------------------|---------------------------|--------------------------------|
| 1. Burner Housing           | 16. Gun Head              | 31. Outer Damper               |
| 2. Inlet Ring               | 17. Side Orifice tee      | 32. Air Sensing Tube           |
| 3. Blast tube (6", 9", 12") | 18. Side Orifice Spring   | 33. Orifice Kit                |
| 4. Gun Assembly             | 19. Pilot Regulator       | 34. Direct Spark Transformer   |
| 5. Flange Gasket            | 20. Pilot Solenoid Valve  | 35. Gas Piping Support Bracket |
| 6. Mounting Flange          | 21. Combination Gas Valve | 36. Damper Axle                |
| 7. Blower Wheel             | 22. Main Gas Cock         | 37. Relay                      |
| 8. Motor Plate              | 23. Pilot Gas Cock        | 38. 5/16" Ball Joint Swivel    |
| 9. Blower Motor             | 24. Pilot Tubing          | 39. Mod Motor                  |
| 10. Air Switch              | 25. Pilot Assembly        | 40. Butterfly Valve            |
| 11. 24 Volt Transformer     | 26. Ignition Electrode    | 41. 5/16" Linkage Rod          |
| 12. Panel & Door            | 27. Flame Rod             | 42. Light                      |
| 13. Flame Monitor           | 28. Back Plate            | 43. Axle Bushing               |
| 14. Grounding Lug           | 29. Inner Damper          | 44. 1/2" Damper Arm            |
| 15. Nipple Tapped           | 30. Middle Damper         | 45. Pie DPR Retainer Washers   |

### X4



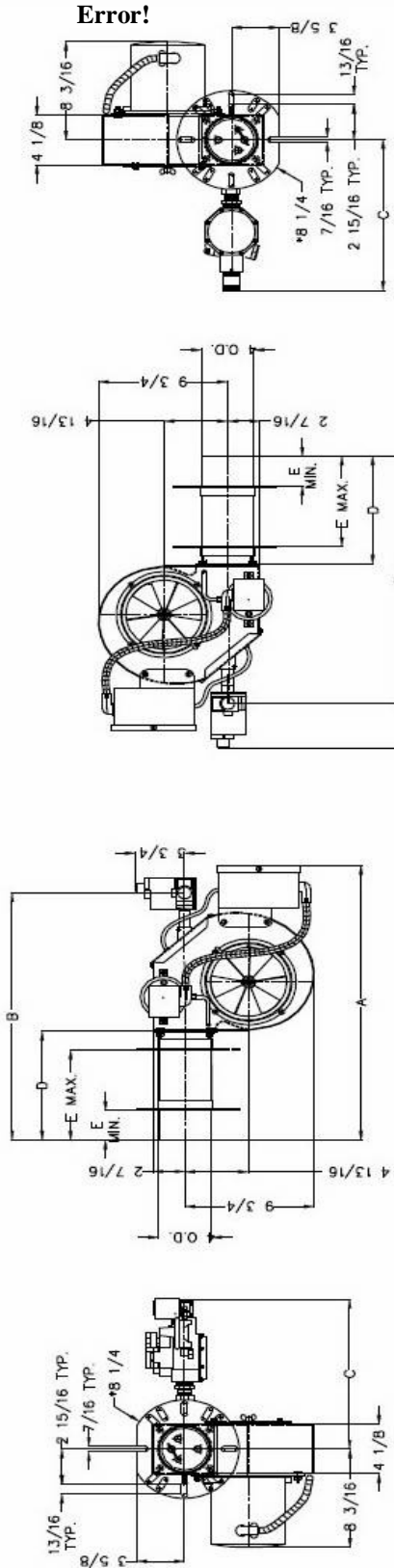




12 12 12

MODEL X4R (For low centerline applications)

MODEL X4



ADD 3/8" TO THE 4" O.D. TUBE FOR OPENING IN HEAT EXCHANGER FRONT PLATE

ADD 3/8" TO THE 4" O.D. TUBE FOR OPENING IN HEAT EXCHANGER FRONT PLATE

RATINGS & SPECIFICATIONS

| BURNER MODEL | DIMENSIONS (INCHES) STANDARD MODELS |         |         | BLAST TUBE LGTH. D | E MIN. | E MAX.  | CAPACITY             |                 | BLOWER MOTOR H.P. (3450 RPM) | STANDARD GAS TRAIN SIZE (IN.) | NAT. GAS PRESSURE REQUIRED (IN. W.C.) | LP GAS PRESSURE REQUIRED (IN. W.C.) |
|--------------|-------------------------------------|---------|---------|--------------------|--------|---------|----------------------|-----------------|------------------------------|-------------------------------|---------------------------------------|-------------------------------------|
|              | A                                   | A(R)    | B       |                    |        |         | NATURAL GAS MAX. MBH | LP GAS MAX. MBH |                              |                               |                                       |                                     |
| X4-400-9     | 23"                                 | 24-3/8" | 20-1/4" | 11-7/8"            | 1"     | 7-1/2"  | 400                  | 400             | 1/4                          | 3/4"                          | 5                                     | 5                                   |
| X4-400-12    | 26"                                 | 27-3/8" | 23-1/4" | 11-7/8"            | 1"     | 10-1/2" | 400                  | 400             | 1/4                          | 3/4"                          | 5                                     | 5                                   |
| X4-700-9     | 23"                                 | 24-3/8" | 20-1/4" | 12-9/16"           | 1"     | 7-1/2"  | 725                  | 725             | 1/4                          | 1"                            | 5                                     | 7                                   |
| X4-700-12    | 26"                                 | 27-3/8" | 23-1/4" | 12-9/16"           | 1"     | 10-1/2" | 725                  | 725             | 1/4                          | 1"                            | 5                                     | 7                                   |

REV. 03/13/02 - REFERENCE Dwg. EROS - 44 AND E205 - X4R  
REV. 10/17/05 - NATURAL GAS PRESSURE REQUIRED

LIT M-0101

# 11. SEQUENCE OF OPERATION FOR X4M BURNER

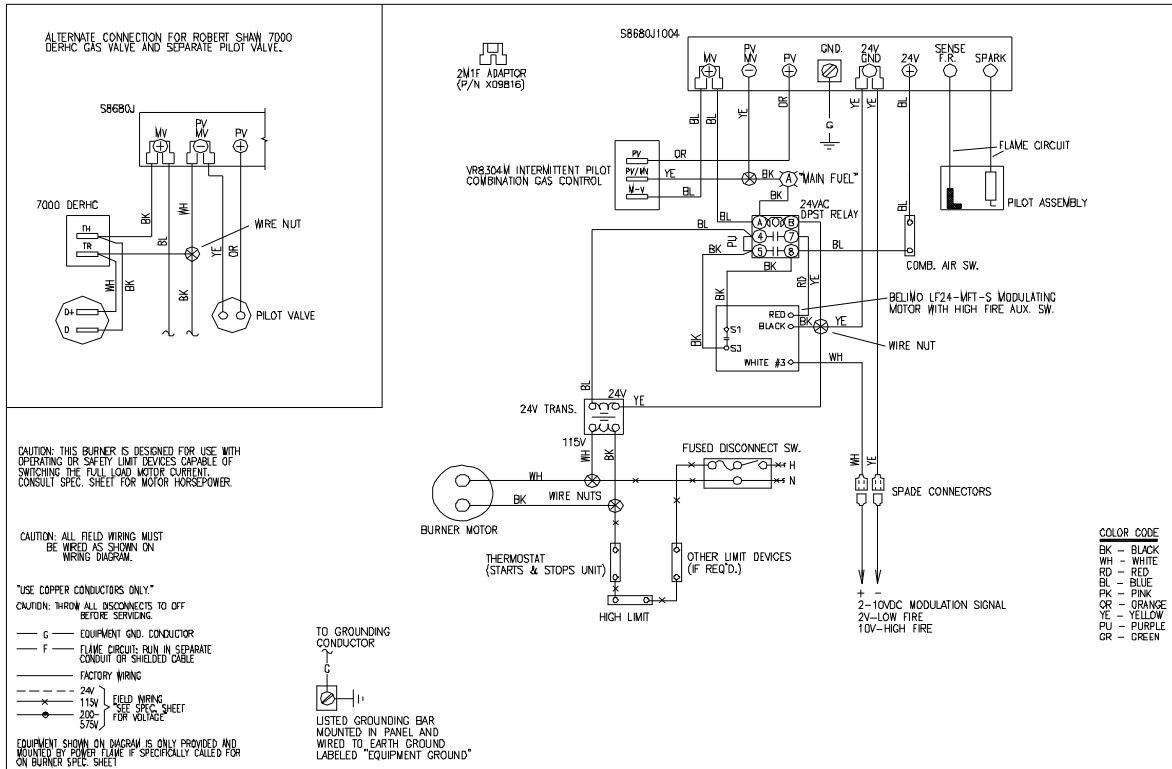
## LF-24 BELIMO ACTUATOR

- 11.1 Refer to typical wiring diagram for X4M burner (Figure 11A). Upon a call for heat, the blower motor starts, closing the combustion air switch. Power is supplied to the 24-vac transformer. Initially power to the actuator is held out through one set of normally open contacts on the 24-vac relay.
- 11.2 Since power is not supplied to the actuator it will spring return clockwise to the open damper position if not already there. When the actuator reaches the full clockwise position (full open damper) the internal auxiliary end switch closes (S1 to S3).
- 11.3 24-vac power will be supplied through the S1 – S3 contacts and the combustion air switch to the S8680 control.
- 11.4 The control will begin its pre-purge time period of approximately 30 seconds.
- 11.5 At the end of the pre-purge period, a trial for ignition will be attempted. On pilot ignited burners the pilot pressure would be set here to achieve the best pilot performance. Refer to Pilot Adjustment Procedure earlier in section 7.10 of this manual.
- 11.6 When the main gas valve is energized, after a proven pilot or during direct spark ignition on DSI burners the 24-vac relay will also be energized.
- 11.7 One set of normally open relay contacts close which interlocks the high fire auxiliary end switch. Another set of relay contacts closes and completes the modulation circuit.
- 11.8 Modulation of the burner is now accomplished by the control signal. Depending on the setting of the Direction Control Switch located on the actuator (Figure 11C), a low or high input signal can drive the actuator clockwise or counterclockwise (low fire or high fire).
- 11.9 An adjustable stop located on the actuator (Figure 11C), can be used to limit the high fire or low fire position. If the high fire damper position is changed due to a lower than maximum firing rate, the pilot should be rechecked at this new damper position.

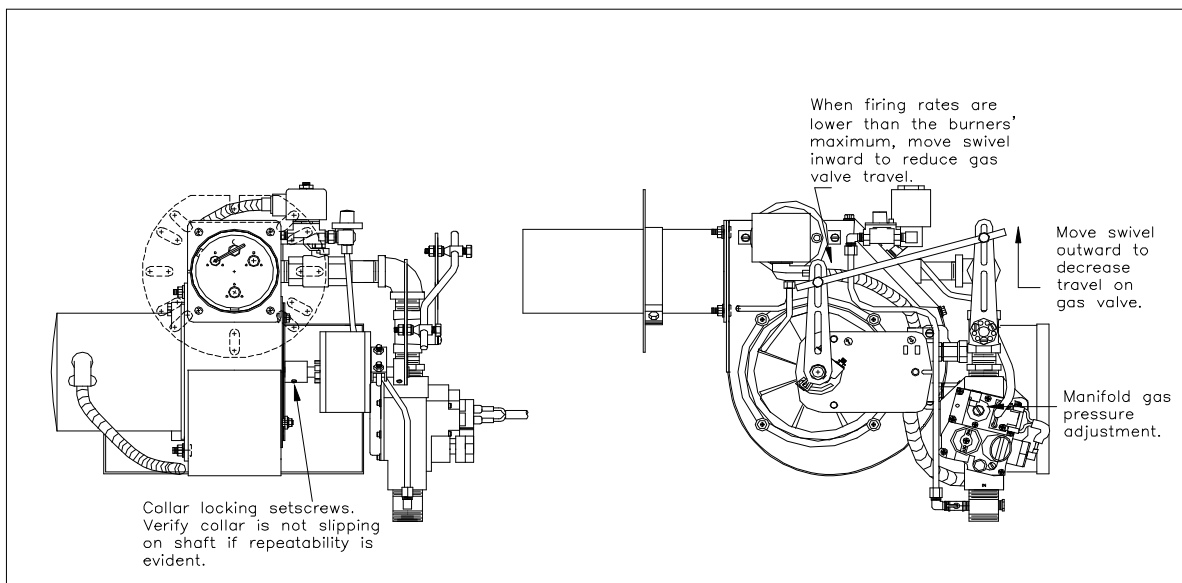
## AMCX-24 BELIMO ACTUATOR

- 11.10 The AMCX actuator is available with control signal inputs of 2-10 vdc, 4-20 mA or 0-135 ohm. Therefore, refer to the specific wiring diagram supplied with the burner.
- 11.11 Upon a call for heat, the blower motor starts, closing the combustion air switch. Power is supplied to the 24-vac transformer which powers the AMCX actuator causing it to drive to the open damper position.
- 11.12 When the damper opens to the high fire position the high fire end switch (purge switch) closes which provides power to the ignition control (S8670).
- 11.13 The control will begin its pre-purge time period of approximately 30 seconds.
- 11.14 At the end of the pre-purge period, a trial for ignition will be attempted. On pilot ignited burners the pilot pressure would be set here to achieve the best pilot performance. Refer to Pilot Adjustment Procedure earlier in section 7.10 of this manual.
- 11.15 When the main gas valve is energized, after a proven pilot or during direct spark ignition on DSI burners the 24-vac relay will also be energized.
- 11.16 One set of normally open relay contacts close which interlocks the high fire auxiliary end switch. Another set of relay contacts closes and completes the modulation circuit.
- 11.17 Modulation of the burner is now accomplished by the control signal. Depending on the setting of the Direction Control Switch located on the actuator (Figure 11C-1), a low or high input signal can drive the actuator clockwise or counterclockwise (low fire or high fire).
- 11.18 An adjustable stop located on the actuator (Figure 11C-1), can be used to limit the high fire or low fire position. If the high fire damper position is changed due to a lower than maximum firing rate, the pilot should be rechecked at this new damper position.

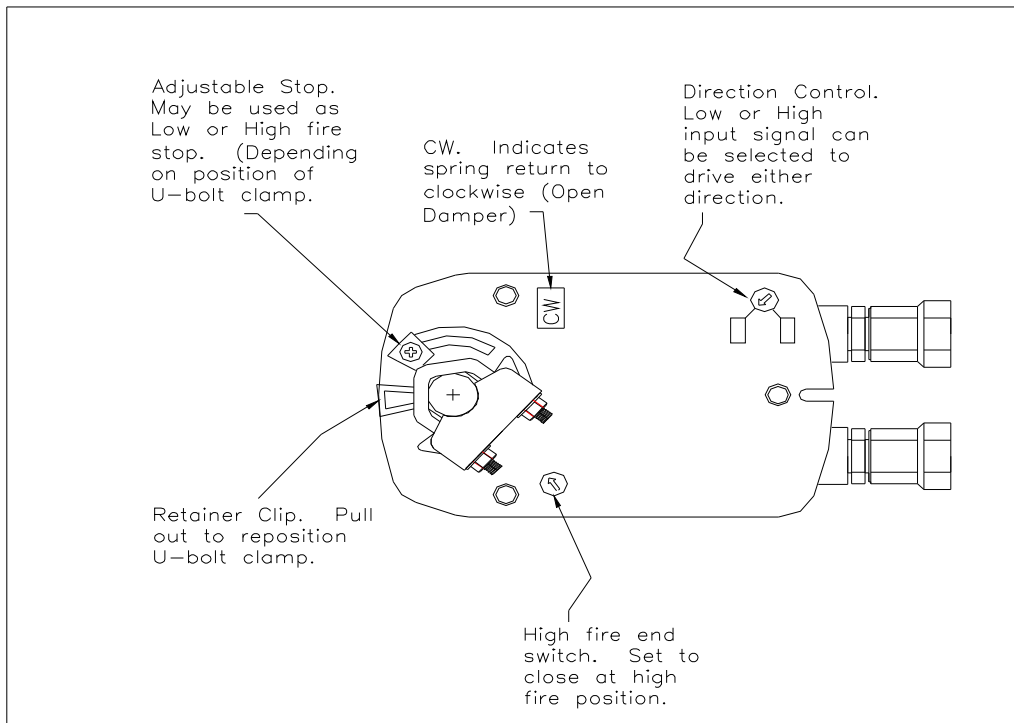
**Figure 11A - Typical Wiring Diagram For X4M with LF-24 Actuator**



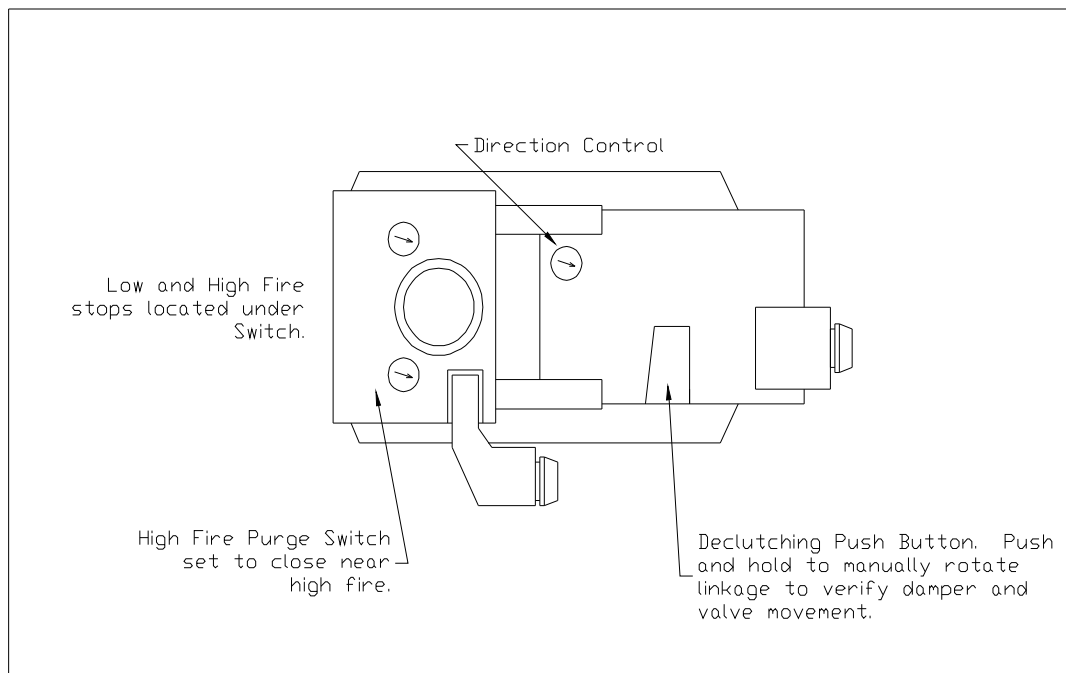
**Figure 11B – General Arrangement Diagram for X4M (LF-24)**



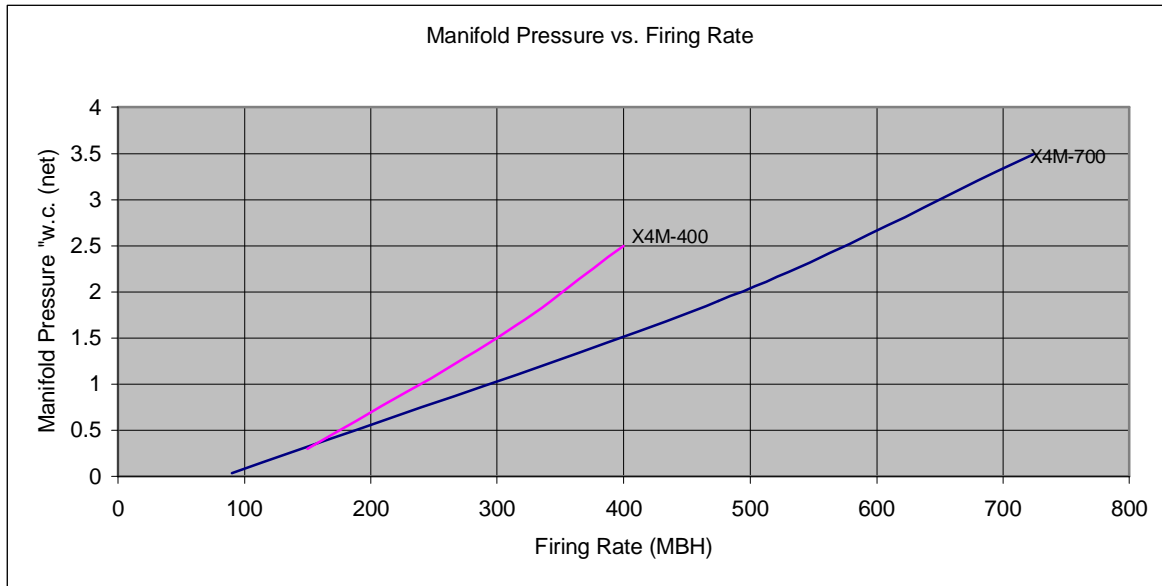
**Figure 11C - Belimo LF24-SR-S Actuator**



**Figure 11C-1 - Belimo AMCX-24 Actuator**



**Figure 11D – X4M Firing Rate vs Manifold Pressure**



The manifold pressures shown are the gas pressures taken at the 1" tee and represent a zero furnace pressure (net manifold pressure). Therefore, the actual furnace pressure must be subtracted from these pressures to obtain the correct firing rate. Example: While firing an X4M-400 the Manifold pressure is 3.0" w.c. The furnace pressure from the manometer reads 0.5" w.c. Therefore,  $3" - 0.5" = 2.5" \text{w.c.}$  The chart in Figure 11D shows 2.5" w.c. net manifold pressure is equal to 400,000 BTUH.



# POWER FLAME INCORPORATED

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## 12. OWNER OPERATING INSTRUCTIONS

### FOR YOUR SAFETY

#### If you smell gas:

1. Open windows
2. Do not touch electrical switches
3. Extinguish any open flame
4. Call you gas supplier immediately

Do not store or use gasoline or other flammable liquids and vapors in the vicinity of this or any other appliance.

### WARNING

Improper installation, adjustment, alteration, service or maintenance can cause injury or property damage. Refer to the burner manual for assistance or additional information consult a qualified installer, service agency or the gas supplier.

### IMPORTANT PRECAUTIONS

1. Never attempt to light burner with paper or other materials.
2. Never experiment with the burner.
3. Never change the fuel or air adjustments without consulting with the burner service company.
4. Never attempt to light the burner if combustion chamber contains any unburned fuel or gases.
5. Never throw waster paper, rags, garbage or other waster materials into the combustion chamber.
6. Never wash out heating equipment room without first covering the burner with waterproof material.

### START UP

#### Preparation for Start Up

---

1. Ensure that the system is in working order. If heat exchanger is a boiler, ensure that proper water level is available.
2. Set the burner control panel switch to the OFF position.
3. Turn the thermostat or operating control down to its lowest setting.
4. Check fuses and replace as necessary.
5. Depress the flame safeguard programming control reset button.

#### Start Up

---

1. Manually open and close the main gas shut off cock, leak test cock and pilot cock to determine that they operate freely. Open all three cocks. (Reset low gas pressure switch if supplied).
2. Set the main power switch and burner panel control switch to the ON position. Wait 30 seconds and turn up thermostat or operating control to the desired setting.
3. The burner blower motor will start and after a suitable pre-purge period (this will vary with the type of flame safeguard control supplied – but will usually be minimum of 30 seconds to a maximum of 90 seconds) the burner pilot will light, after which the main flame will be established.
4. If the system does not respond properly, contact your qualified burner service company.

### EXTENDED SHUT DOWN

1. Place main power switch and burner control panel switch in the OFF position.
2. Close all valves in gas lines. Cover burner to protect it from dust and dampness.
3. Cover burner to protect it from dust and dampness.

### MAINTENANCE

Burner should be maintained and serviced by a qualified service agent. See service and maintenance section of the manual for suggestions on periodic maintenance and service.