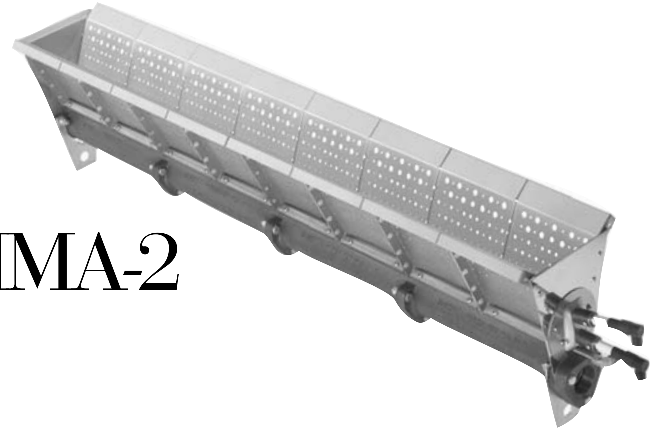
Midco INTERNATIONAL



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 stand alone heating systems or operating in combination with central heating plants systems can be cost effective in three ways: 1) reducing the 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 or improvement of the old, but a completely new approach to direct-fired combustion. The two-stage combustion improves control of the flame process, 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 emissions levels and allowing for higher temperature rise and higher tolerance to varying conditions when placed in the profile opening.

Features and Benefits

- **Reduced NO_2 and CO Emissions:** Lower emissions 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. (See page 3)
- **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 gas[1], reducing burner inventory.
- **Reduced Shipping Costs:** A smaller, lighter casting than the competition's, can cut your freight costs 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.

Midco International Inc.
4140 West Victoria Street Chicago, Illinois 60646
tel 773.604.8700 fax 773.604.4070
web www.midco-intl.com e-mail sales@midco-intl.com

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8471 34
Printed in USA

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.
Air Velocity Across the Burner	800 to 4,000 FPM
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.

*Burner Configurations

		Part #
6 inch Straight Section	(15.24cm)	1050700
6 inch Straight Section with Back Inlet	(15.24cm)	1230700
12 inch Straight Section	(30.48cm)	1010700
12 inch Straight Section with Back Inlet	(30.48cm)	1060700
Elbow Section		1070700
Tee Section		1080700

*Pilot Configurations

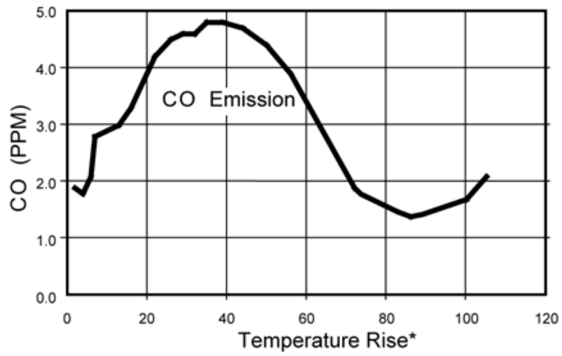
	Part #
Spark rod and flame rod	1190800
Spark rod and UV	1200300
Remote flame rod	1220800
Remote UV	1240800
Pilot with spark rod only	1210800
Flame rod	1360-03
Spark rod	1342-00

Table 1 - Burner and Pilot Configurations

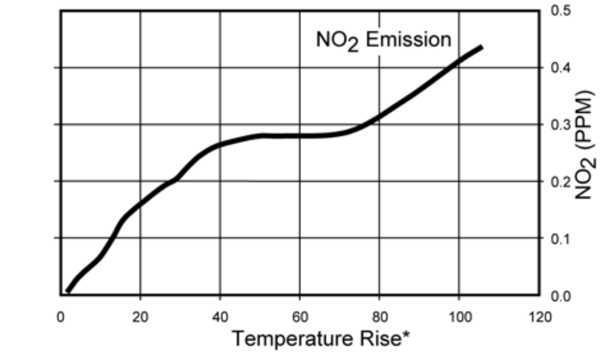
* See Page 15, Figure 1b for configuration reference.

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

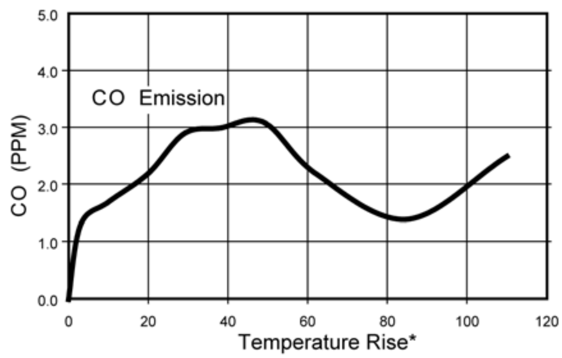
All information is based on laboratory testing. Different unit size and/or configurations may affect data.



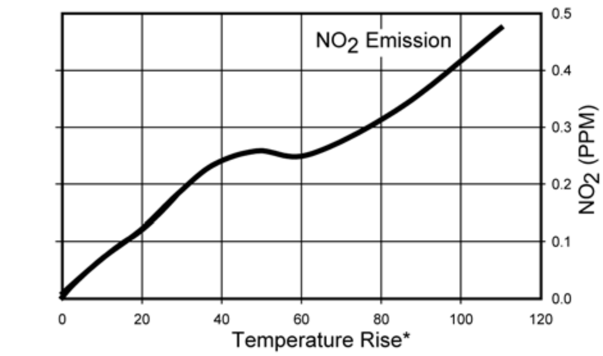
750,000 Btu/hr/ft at 1.4 " W.C. pressure drop across the burner



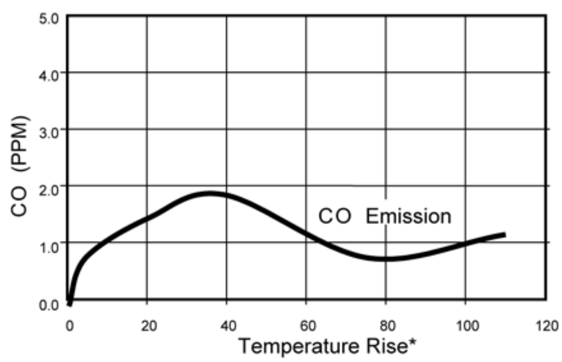
750,000 Btu/hr/ft at 1.4 " W.C. pressure drop across the burner



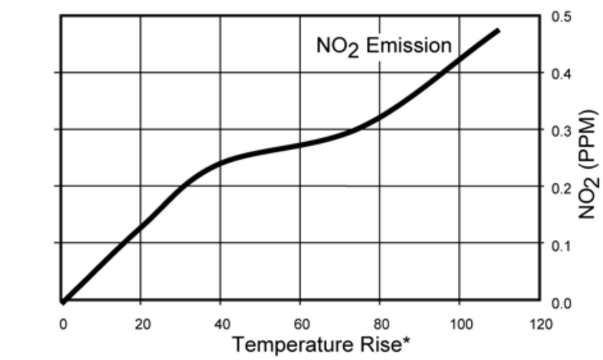
550,000 Btu/hr/ft at 0.6 " W.C. pressure drop across the burner



550,000 Btu/hr/ft at 0.6 " W.C. pressure drop across the burner



350,000 Btu/hr/ft at 0.2 " W.C. pressure drop across the burner



350,000 Btu/hr/ft at 0.2 " W.C. pressure drop across the burner

Chart 1 - CO and NO_2 Emissions Data

*For temperature rise up to 160°F that meets the ANSI Z83 standards contact Midco.

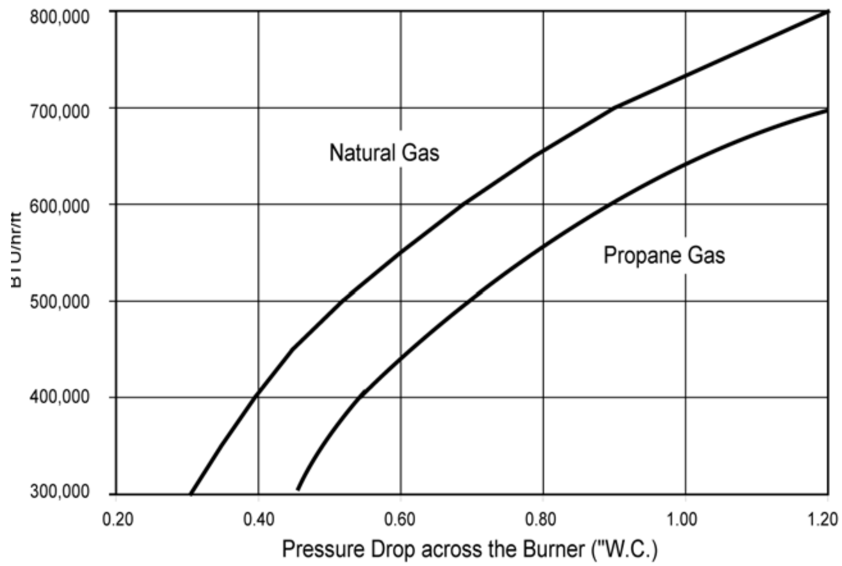


Chart 2 - BTU's verses Pressure Drop

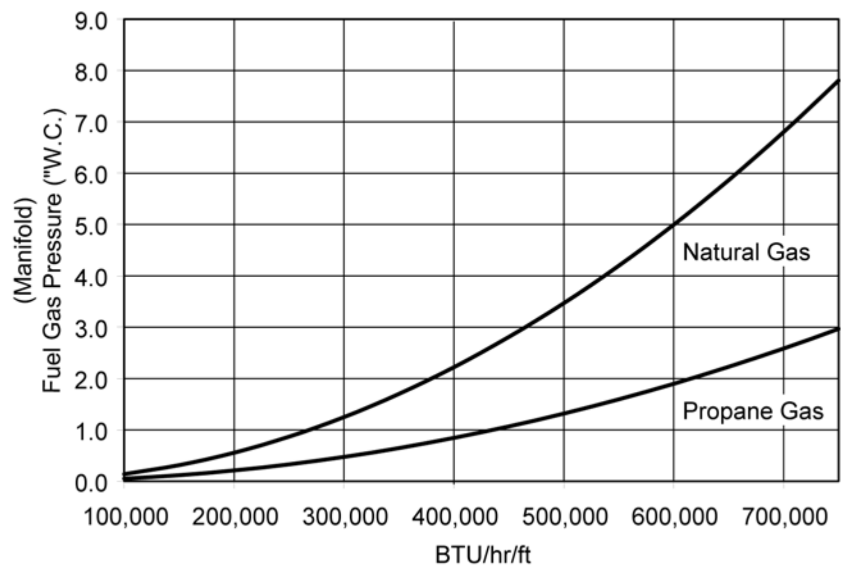


Chart 3 - BTU's verses Gas Pressure (" W.C.)

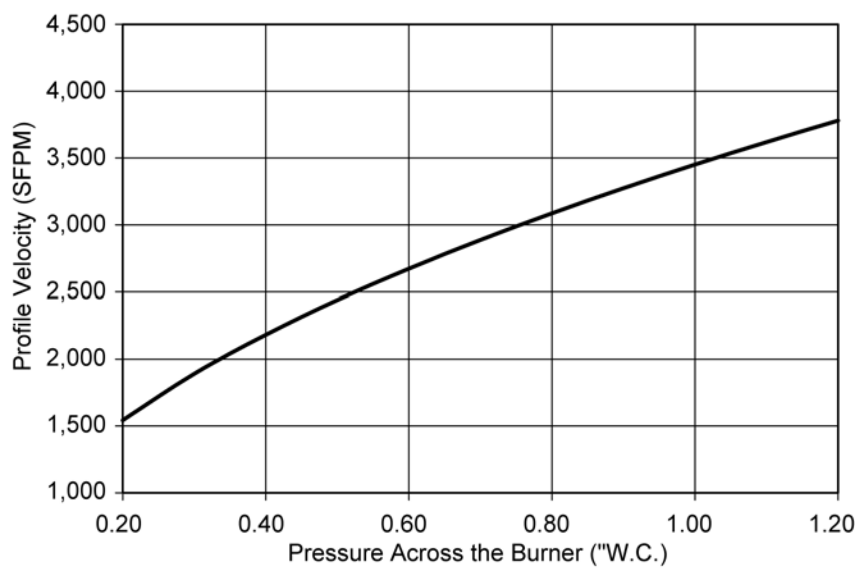


Chart 4 - Pressure Across the Burner verses Profile Velocity

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 2*.
3. Required Profile Area:
   Total Burner Area = Number of 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:

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

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

   BTU/hr =5,000 (SCFM) x 115 (ΔT) x1.08 = 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 per ft, or we can fire the burner at 414,000 BTU/hr per ft (1.5 feet of burner). Refer to *Chart 3* for the fuel pressures requirements at different firing rates.

3. Required Profile Area:

   Total Burner Area = Number of 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

Profile Setup Example Continued

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 4* or use the following equation.

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

For the 621,000 BTU/hr/ft

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

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

For the 414,000 BTU/hr/ft

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

Net Profile Area = 5000 (SCFM) ÷ 2182 (SFPM)=2.29ft^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 case
12 inch + 4 inch (2 inch on each side) = 16 inch (1.3ft)
For the 414,000 BTU/hr/ft case
18 inch + 4 inch (2 inch on each side) = 22 inch (1.83ft)

To calculate the height of the profile opening divide the profile area by the profile length:

For the 621,000 BTU/hr/ft case
2.27 ft^2 ÷ 1.3 ft = 1.75 ft (21 inch)
For the 414,000 BTU/hr/ft case
3.265 ft^2 ÷ 1.83 ft = 1.78ft (21.5 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 simple but important assembly procedures must be followed to insure 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.

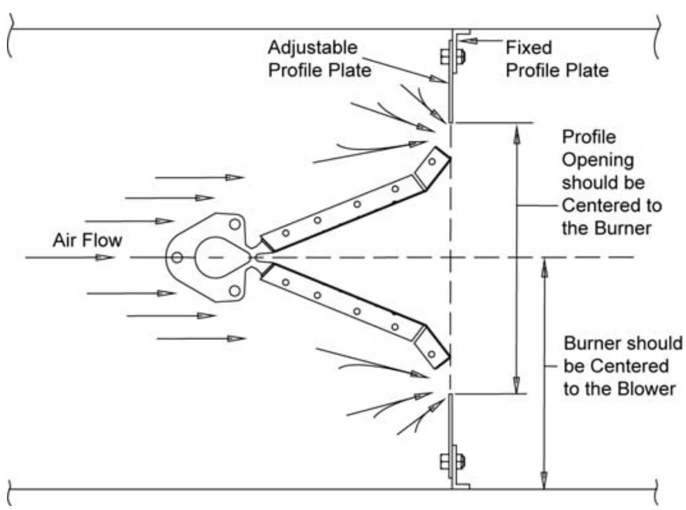
2. Assemble individual burner cast iron sections first.
3. When joining the baffle sections to the burner casting, place a gasket between the casting and the baffles, do not tighten the cast iron sections until the entire unit is assembled. Baffles can be riveted together with stainless steel rivets 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 all 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 from 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.



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

Figure 1a - Burner Placement in the Profile

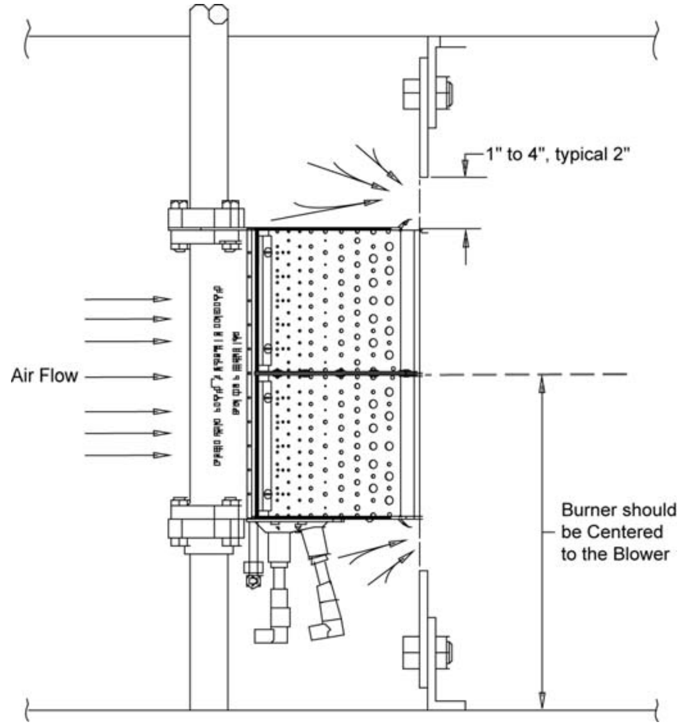


Figure 1b - Burner Placement in the Profile

Pull-Thru System

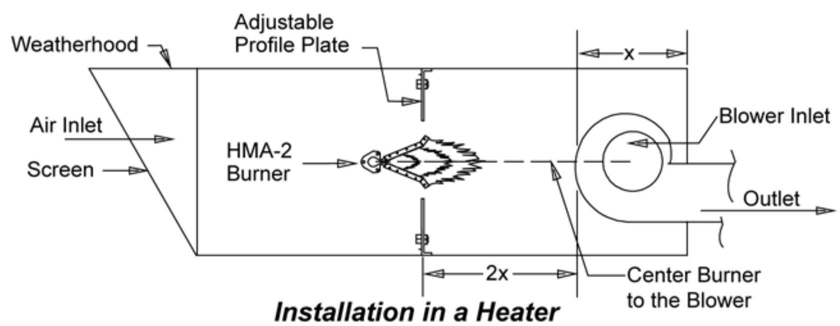


Figure 2a - Pull-Thru System

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.

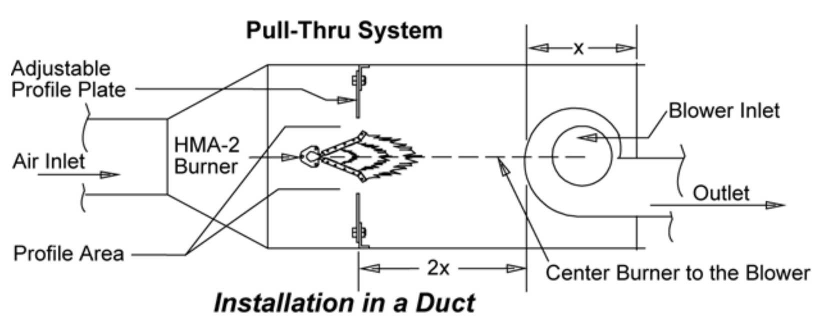


Figure 2b - Pull-Thru System

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 insure 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 CFM will vary due to the expansion of air.

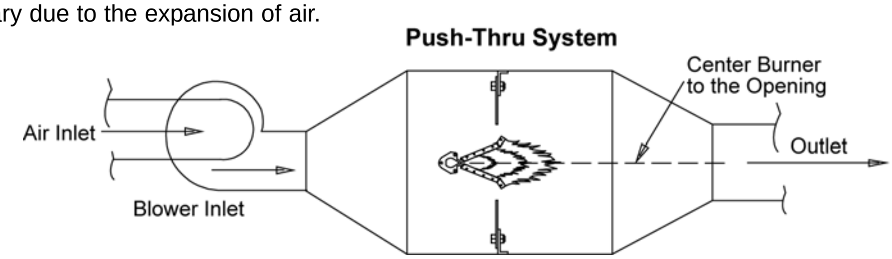


Figure 3 - Push-Thru System

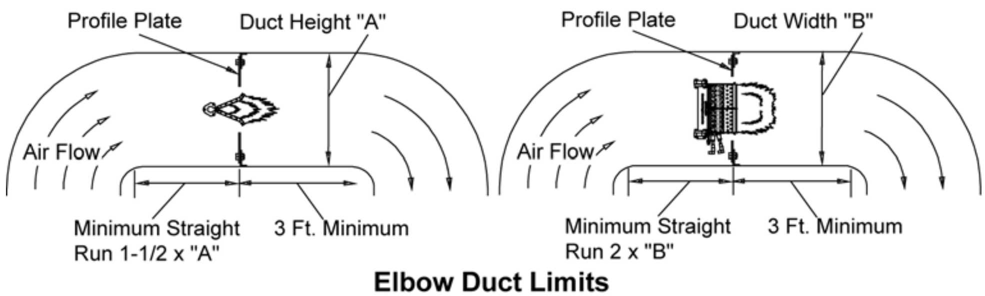


Figure 4 - Installation in a Duct

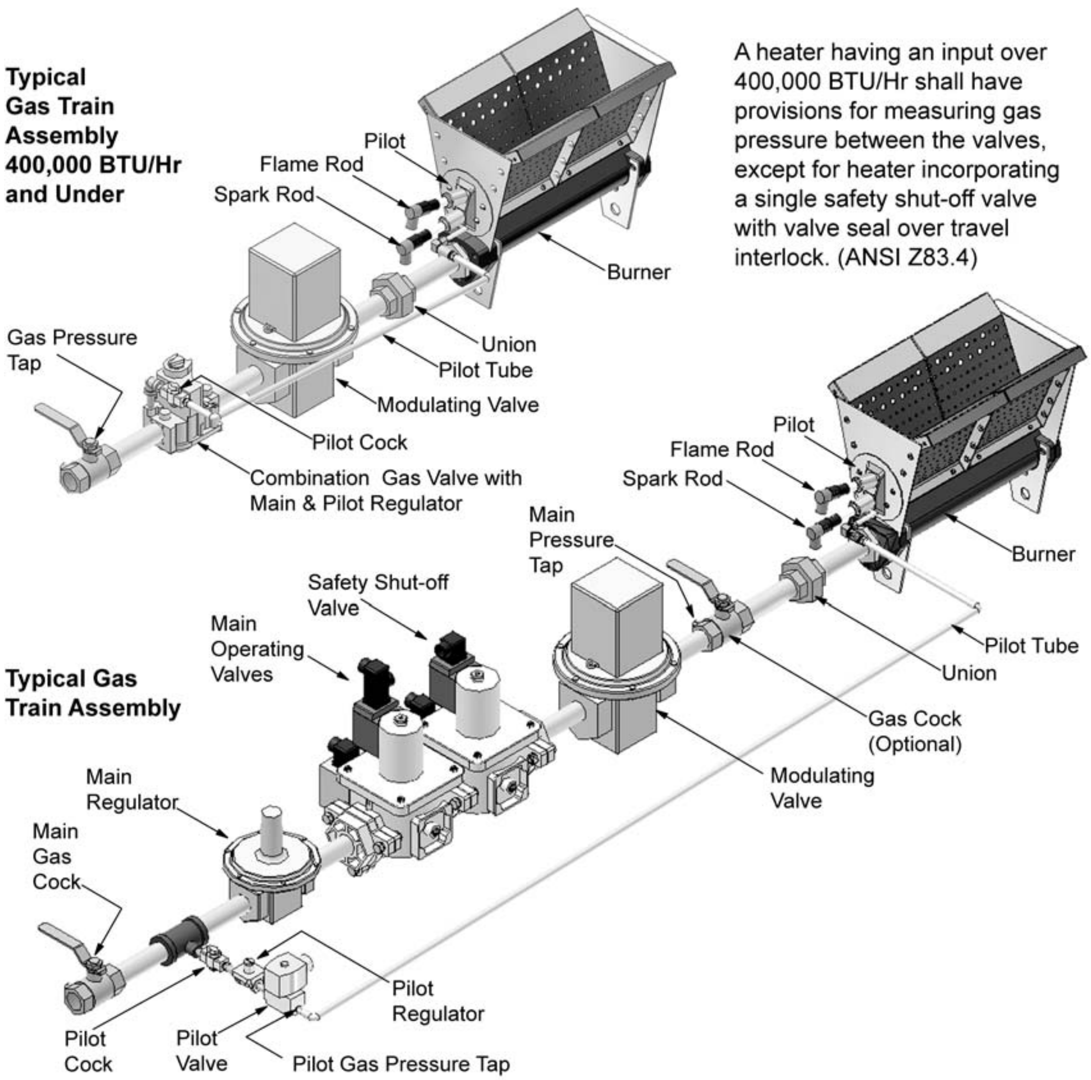


Figure 5a - Gas Train Assemblies

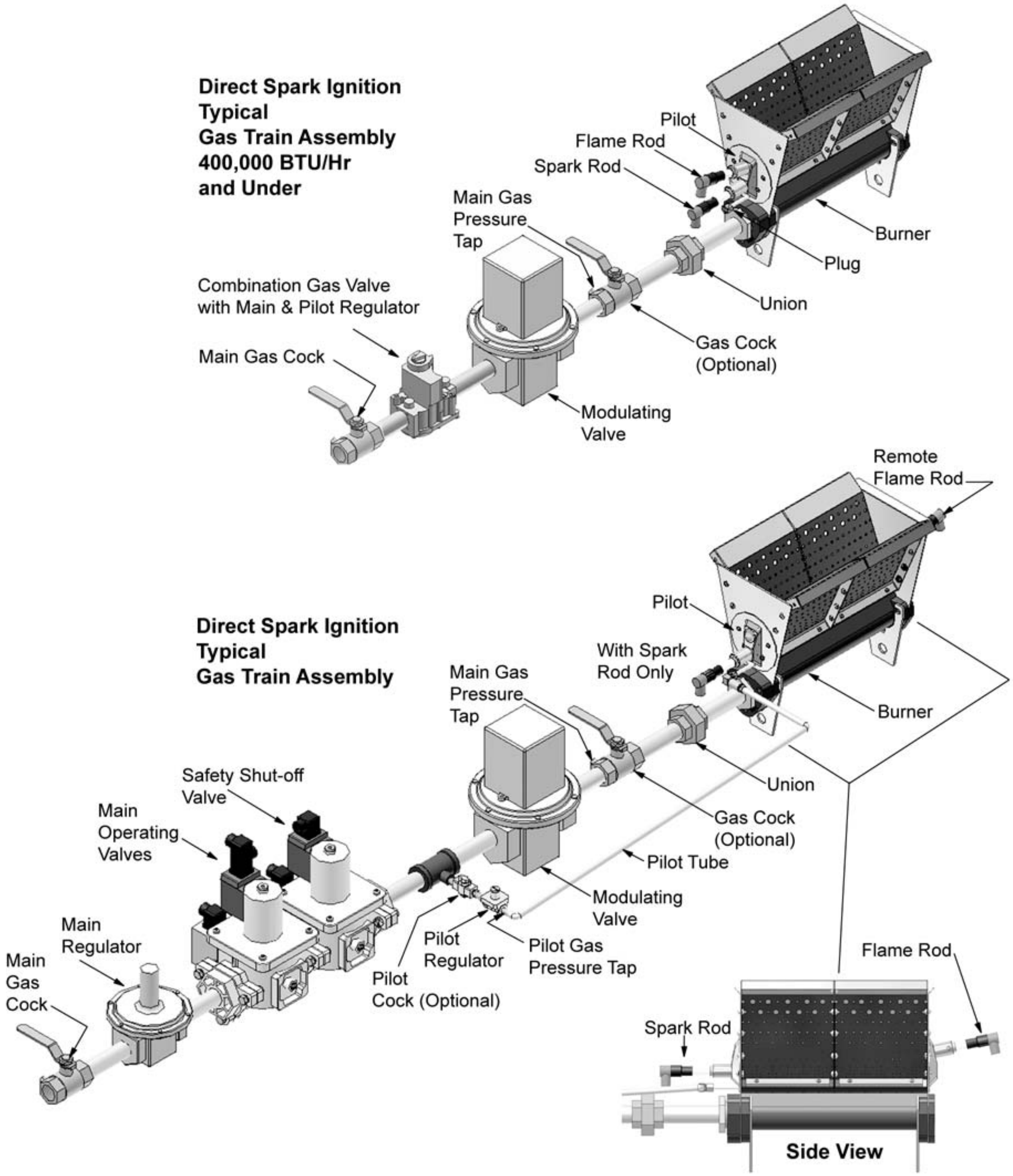


Figure 5b - Direct Spark Gas Train Assemblies

Gas Inlet Capacities

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

Table 2 - Gas Inlet Capacities

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 3*. 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 pilot gas supply line up stream 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 on page 16.
   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
   Close the manual gas valve.
   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 2*.
      · 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 3.* 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.

Burner Installation Continued

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 page 7 (Burner Assembly) and see Figure 8 - *Pilot Configuration.*

Slight redness and warpage 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 change 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 might not be sufficient for the air to cool the end plates. Profile readjustments might be necessary.

Burner Maintenance

Annual maintenance of HMA-2 burner 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 1/8" (0.125") drill size and air ports with a number 43 (0.089") 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.

Trouble Shooting

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

II. If the pilot 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 valve 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*.

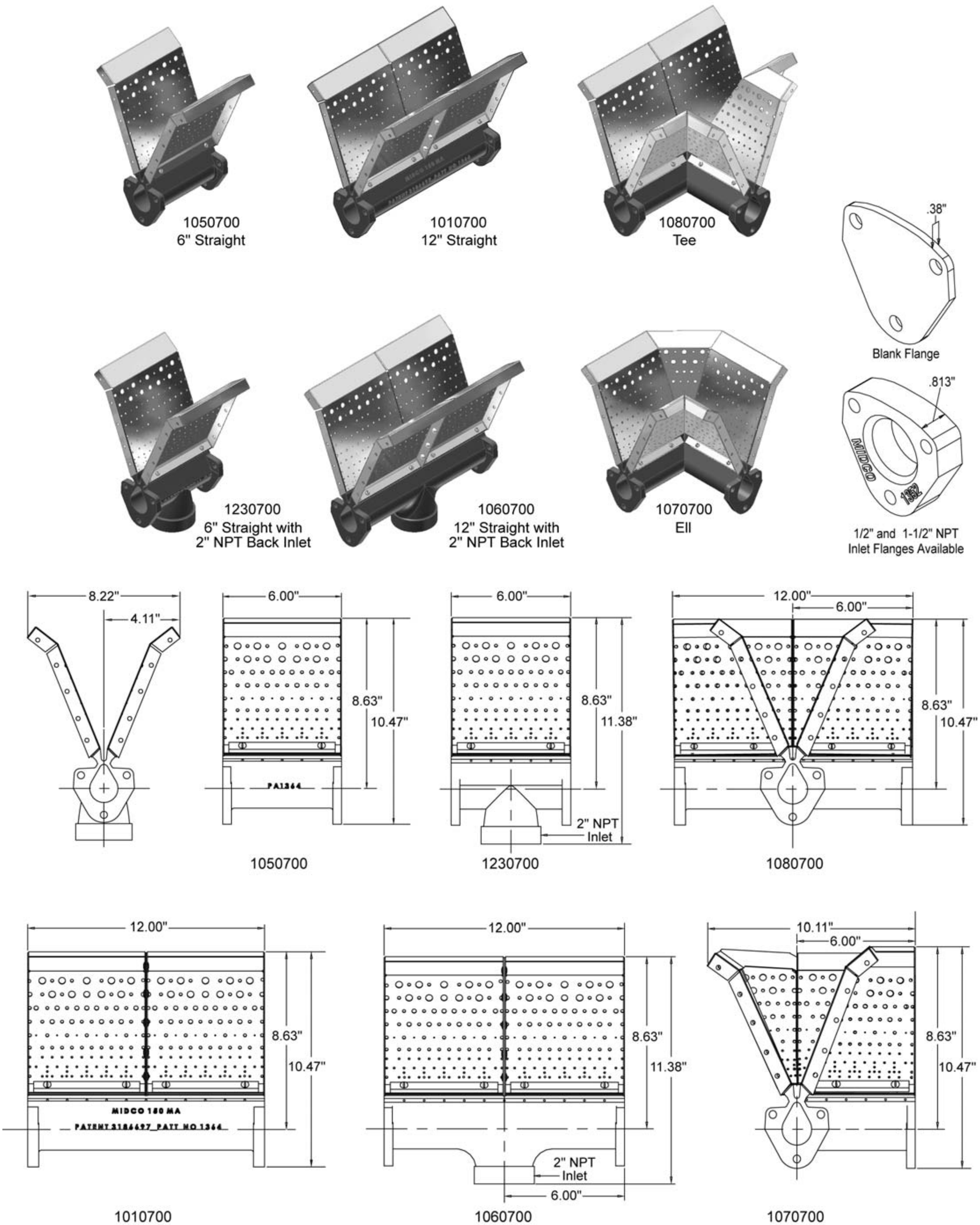


Figure 6 - Burner Sections - Assembly

Parts - Isometric View

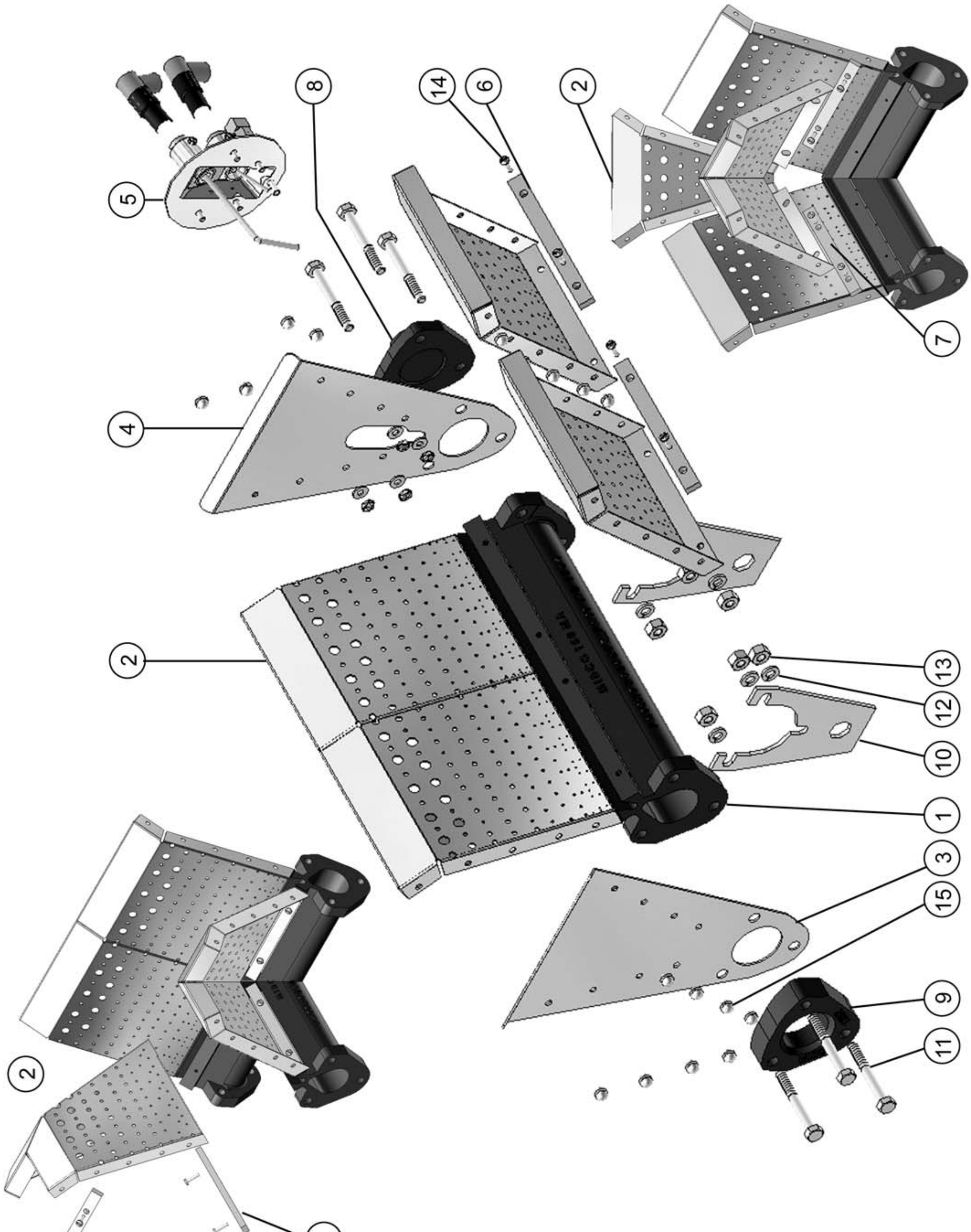


Figure 7 - Burner Assembly Parts - Isometric View

Item No.	Burner Configuration Part Number / Part Description	Part No	6" Straight 1359-09 Quantity	6" Back Inlet 1398-05 Quantity	12" Straight 1364-05 Quantity	12" Back Inlet 1361-07 Quantity	Ell Section 1362-07 Quantity	Tee Section 1365-06 Quantity
1	Burner Casting		1	1	1	1	1	1
2	HMA-2 6" Baffle	1395-23	2	2	4	4	2	2
	HMA-2 Tee Baffle	1395-11					1	2
	HMA-2 Outside Corner Baffle	1395-35					1	
3	HMA Blank End Plate	1354-50	1	1	1	1	1	2
4	HMA Pilot End Plate	1354-60	1	1	1	1	1	1
5	Pilot		See pilot listing on Page 16 - Pilot Configuration (For selection)					
6	Baffle Clamp	1356-00	2	2	4	4	2	2
7	Inside Baffle Clamp	1356-10					2	4
8	Blank Flange	1372-02	1	1	1	1	1	2
9	Inlet Flange (Tapered)	1352-02	1	1	1	1	1	1
10	Support Bracket	1374-00	2	2	2	2	2	3
11	5/16-18x1-1/2 Hex Head Cap Screw		6	6	6	6	6	9
12	5/16 Lock Washer		6	6	6	6	6	9
13	5/16-18 Brass Hex Nut		6	6	6	6	6	9
14	10-24x9/16 Phillips Rd Hd S.S. Mach Screw		4	4	8	8	8	12
15	S62 Steel Rivet Body		12	12	22	22	22	25

Table 3 - Burner Assembly Parts List

Parts - Pilot Configuration & Mounting / Equation Reference

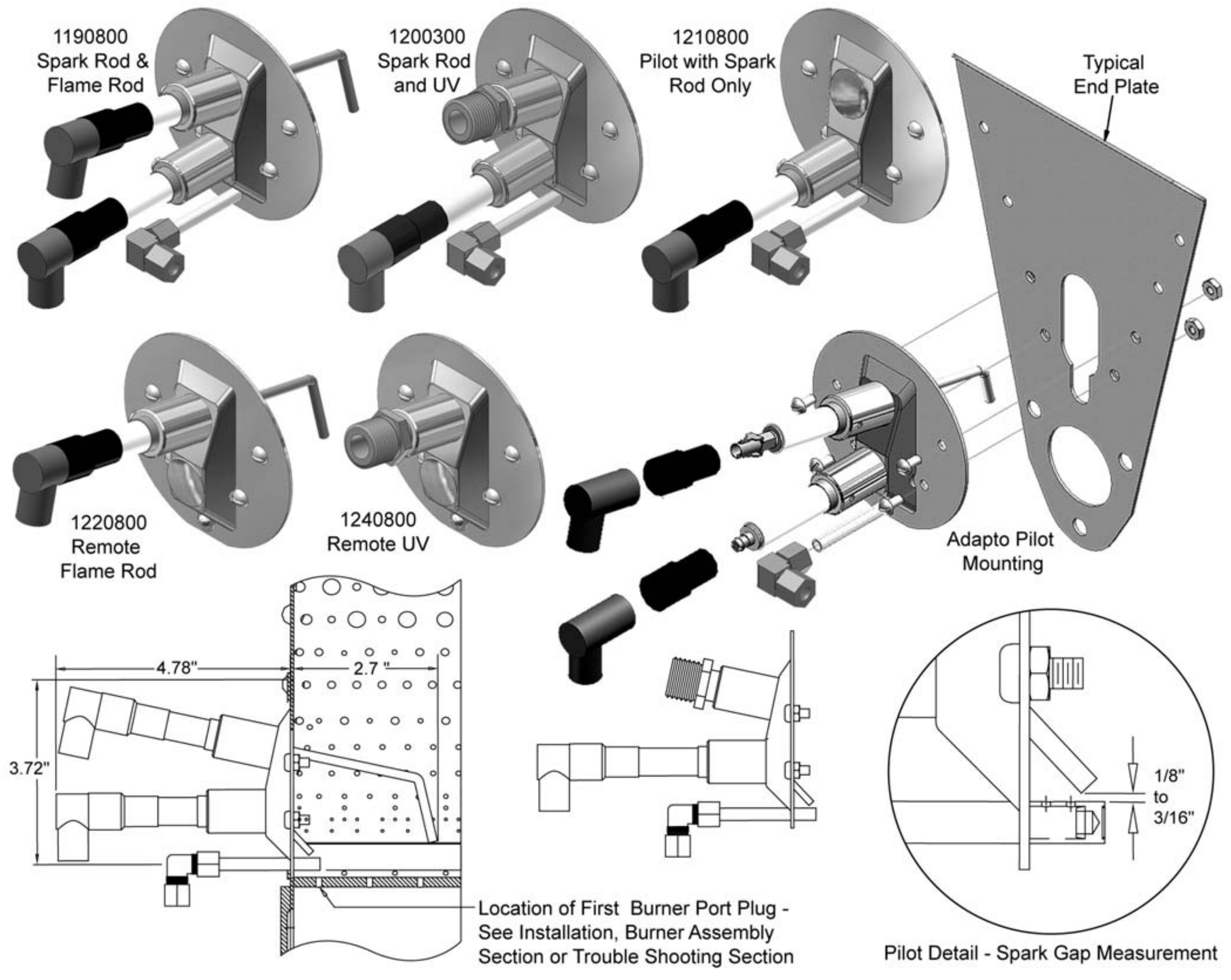


Figure 8 - Pilot Configuration

Equation Reference

1. Conversion of SCFM to Actual CFM of air

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

2. Air density as a function of Temperature -- $\rho = 1.35 \times \dfrac{\textit{Barometric Pressure (in Hg)}}{T_{(out)} + 460}$

3. Change in Standard Barometric Pressure as a function of Altitude

   Barometric Pressure (in.Hg) = 29.921x (1–6.8753 x 0.000001x *altitude (ft)*)^5.2559

4. Temperature difference -- Temperature Rise = $T_{(out)} - T_{(in)}$

5. Energy equation - - BTU/hr = SCFM x Temperature Rise x 1.08

   Where: 1.08 is a sensible heat equation constant

   $$1.08 = 0.2397 \left(\frac{BTU}{lb}\right) \times 60 \left(\frac{min}{H}\right) \times 0.075 \left(\frac{lb}{ft^3}\right)$$

Midco International Inc. 4140 West Victoria Street * Chicago, Illinois 60646
tel 773.604.8700 fax 773.604.4070 web www.midco-intl.com email sales@midco-intl.com