



Webster Combustion Technology  
619 Industrial Road, Winfield, KS 67156

Installation, Startup, Operation and Maintenance Manual

# **Cyclonetic JB Series Forced Draft Burners**

**JB1 - JB2 - JB3  
Gas - Oil - Gas/Oil**



Manual Part No. 950063 - R1

[www.webster-engineering.com](http://www.webster-engineering.com)

September, 2014

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## SAFETY PRECAUTIONS

Good safety practices must be used when working on burner equipment. The potential energy in the electrical supply, fuel and related equipment must be handled with extreme care to prevent equipment failures, injuries and potential death.

Throughout this manual, the following symbols are used to identify potential problems.

### WARNING

**This indicates a potential hazardous situation, which if not avoided, could result in personal injury or death.**

### CAUTION

**This indicates a potentially hazardous situation, which if not avoided, could result in damage to the equipment.**

The following general safety precautions apply to all equipment work.

### WARNING

**IF YOU SMELL GAS, OPEN WINDOW, EXTINGUISH ANY OPEN FLAMES, STAY AWAY FROM ELECTRICAL SWITCHES, EVACUATE THE BUILDING AND IMMEDIATELY CALL THE GAS COMPANY.**

**IN ACCORDANCE WITH OSHA STANDARDS, ALL EQUIPMENT, MACHINES AND PROCESSES SHALL BE LOCKED OUT PRIOR TO SERVICING.**

**IF THIS EQUIPMENT IS NOT INSTALLED, OPERATED AND MAINTAINED IN ACCORDANCE WITH THE MANUFACTURERS INSTRUCTIONS, THIS PRODUCT COULD EXPOSE YOU TO SUBSTANCES IN FUEL OR FROM FUEL COMBUSTION WHICH CAN CAUSE DEATH OR SERIOUS ILLNESS AND WHICH ARE KNOWN TO THE STATE OF CALIFORNIA TO CAUSE CANCER, BIRTH DEFECTS OR OTHER REPRODUCTIVE HARM.**

**IMPROPER SERVICING OF THIS EQUIPMENT MAY CREATE A POTENTIAL HAZARD TO EQUIPMENT AND OPERATORS.**

**SERVICING MUST BE DONE BY A FULLY TRAINED AND QUALIFIED PERSONNEL.**

**BEFORE DISCONNECTING OR OPENING UP A FUEL LINE AND BEFORE CLEANING OR REPLACING PARTS OF ANY KIND,**

- **TURN OFF THE MAIN MANUAL FUEL SHUTOFF VALVES INCLUDING THE PILOT COCK, IF APPLICABLE. IF A MULTIPLE FUEL BURNER, SHUT OFF ALL FUELS.**
- **TURN OFF ALL ELECTRICAL DISCONNECTS TO THE BURNER AND ANY OTHER EQUIPMENT OR SYSTEMS ELECTRICALLY INTERLOCKED WITH THE BURNER.**

Service Organization Information:

Company Name \_\_\_\_\_

Address \_\_\_\_\_  
\_\_\_\_\_

Phone Number \_\_\_\_\_

Date of Startup

\_\_\_\_\_

Lead Technician

\_\_\_\_\_

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## A. INTRODUCTION

This manual covers the Models JB1, JB2 and JB3 CYCLO-NETIC burners offered by Webster Engineering & Manufacturing Co., LLC. These burners can be used in a wide variety of Cast Iron, Firebox, Firetube, Flextube and other applications. They can fire gas, oil and combination gas and oil with several different operating systems.

### READ AND SAVE THESE INSTRUCTIONS FOR REFERENCE

#### WARNING

**DO NOT ATTEMPT TO START, ADJUST OR MAINTAIN THIS BURNER WITHOUT PROPER TRAINING OR EXPERIENCE. FAILURE TO USE KNOWLEDGEABLE TECHNICIANS CAN RESULT IN EQUIPMENT DAMAGE, PERSONAL INJURY OR DEATH.**

The startup and maintenance of the JB burner requires the skills of an experienced and properly trained burner technician. Inexperienced individuals should not attempt to start or adjust this burner.

Every attempt has been made to accurately reflect the burner construction, however, product upgrades and special order requirements may result in differences between the content of this manual and the actual equipment. These special components will be described in the information provided with the burner and should be used as the controlling document.

**NOTE: This manual must be readily available to all operators and maintained in legible condition.**

### 1. Nameplate Information

Each burner has a nameplate with important job details,

similar to the nameplates shown in Figure A-1. An “X” in the model number refers to a low NOx burner, where FGR or a NOx cone is used to reduce the NOx in the combustion gases. If the burner is not a low NOx burner, there is no “X” in the model.

**Figure A-1 Nameplate**

MODEL NUMBER				SERIAL NUMBER			
JB2C-15-RM7840L-UL-IRI				U81375A-018-06			
GAS INPUT RATING				OIL INPUT RATING			
	MBTU/HR	IN.WC		GPH	PSI		
MAXIMUM	2940	2.8		21	300		
MINIMUM	1680	1.0		12	100		
FUEL				#2 FUEL OIL			
	VOLTS	AMPS	HERTZ	PHASE	HP		
CONTROL CIRCUIT	115	5.0	60	1			
BURNER MOTOR	208	5.9	60	3	1.5		
OIL PUMP MOTOR	208	4.3	60	3	1/2		

The serial number represents the unique number for that burner and is a critical number that will be needed for any communications with Webster Engineering.

The input rates define the maximum and minimum inputs for that burner, given in MBH for gas and GPH for oil. Air atomized burners show both the oil pressure and air pressure. Pressure atomized burners only list the oil pressure.

sure. For gas firing, the gas manifold pressure is given in "in wc" which is inches of water column.

The electrical ratings of the burner are given, with the voltage, current load, frequency and phase (this will either be single or 3-phase). For motors, the motor HP is listed.

## 2. Ratings

The ratings for each specific burner are given on the nameplate. The general burner ratings are given in Specification Sheets that follow this section. The maximum inputs are given, based on the type of fuel. Other conditions, like the supply gas pressure or the combination of fuels, emission requirements and control systems may prevent the burner from reaching the lowest firing rate.

## 3. Product Offering

The JB burner can fire natural gas, propane and digester gas as well as all grades of light and heavy oil (#2, #4, #5 and #6 oils as defined by ASTM D396).

### **DO NOT USE GASOLINE, CRANKCASE OIL OR ANY OIL CONTAINING GASOLINE.**

This burner is also available as a low emission burner, and will have model designation JBX. Several low NO<sub>x</sub> rates are available for all gas and light oil burners, with the standard offering of 60 ppm and 30 ppm when firing natural gas. Heavy oil is not allowed in combination with low NO<sub>x</sub>, as the high sulfur content can recirculate from the vessel through the burner when switched from heavy oil to gas. Low sulfur heavy oil can be used with gas FGR, when the sulfur is under ½% (the FGR is closed during oil firing). The burner can also be equipped with a NO<sub>x</sub> cone for low NO<sub>x</sub> on gas, which does not require FGR. (See Addendum 950064).

Figure A-2 lists the common variations and options available on this product. The minimum furnace conditions are given in Section C.

## 4. Your Complete Manual

In addition to this manual, there are several other documents that should be considered as part of the complete manual for the burner. All of these documents are needed to support the installation and startup of the unit. These additional items include:

- a. The wiring diagram, which shows the limits and inter-connection of the burner and vessel controls.
- b. The gas and oil piping schematics, which show the components and their relative positions in the piping train.
- c. The unit material list which provides an overview of the burner requirements and a complete bill of material, including the part numbers and description for each item.
- d. The flame safeguard manual provides the operating sequence for the burner management system. This will be a critical document for troubleshooting any future problems.

- e. Catalog cuts of the major components. These provide details on the installation, adjustment and maintenance of the components used on the burner.

## 5. Service, Parts and other Information

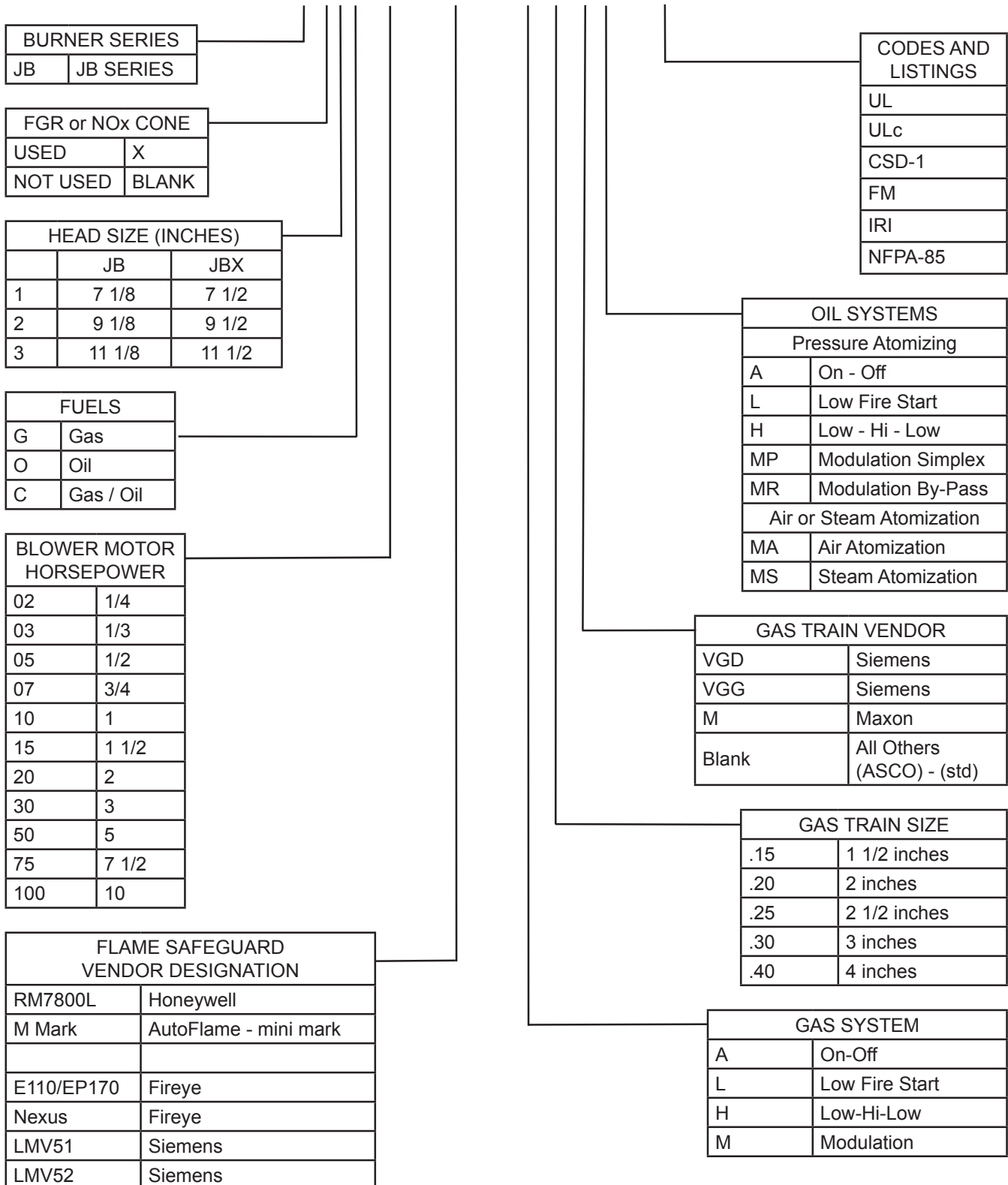
Service and parts are available from your local Webster Representative. For a list of Webster Representatives, please visit the Webster web site at:

[www.webster-engineering.com](http://www.webster-engineering.com) or call 620-221-7464.

# MODEL JB(X) BURNER MODEL CONFIGURATION

## FIGURE A-2

**JBX1G -05-RM7800L-M.25-M-A-UL/CSD-1**



The above represents the common model designations.  
Contact the factory for other options and special applications.

## Model JB1 - Specification Data (400 - 2500 MBH Input)

(1) STANDARD UL EQUIPMENT AND IMPORTANT OPTIONS		Fuel Burned		STANDARD UL EQUIPMENT AND IMPORTANT OPTIONS		Fuel Burned	
		Gas	No. 2 Oil pressure atomized			Gas	No. 2 Oil pressure atomized
General	Motor, Fan and Air Inlet Control	X	X	Gas Fuel	Main Manual Shutoff Valve	X	
	Air Flow Switch (also with oil systems using remote pump)	X			Main Safety Shutoff Valve	X	
	(2) Burner Mounted Control Panel, Switch and Indicator Lights	X	X		Second Safety Shutoff Valve	X	
	Flame Safety Control	X	X		Main Gas Regulator	X	
	Ultra Violet Scanner	X	X		Gas Checking Valve	X	
	Motor Controller (single phase voltage)	X	X		High and Low Gas Pressure Switches (st'd over 2500 MBH)	Opt.	
	Fuel Selector Switch	Duel Fuel Burners Only			Metering Valve (modulation only)	X	
Ignition	Proven Gas Pilot Ignition	X			Oil Fuel	Oil Drawer Assembly with Diffuser	
	Pilot Solenoid Gas Valve	X		Oil Nozzle(s)			X
	Pilot Gas Regulator & Manual Valve	X		Integral Oil Pump			X
	Pilot Gas Ignition Transformer	X		Main Safety Shutoff Valve			X
	Direct Spark Oil Ignition		X	Second Safety Shutoff Valve			X
	Direct Spark Oil Ignition Transformer		X	Low Oil Pressure Switch (STD when using remote oil pump)			Opt.
Optional	Inverted Housing	X	X	Oil Pressure Gauge			X
	Alternate Control Cabinet Positioning	X	X	Oil Metering Valve (modulating systems)			X
	Remote Control Panel	X	X	Future Gas Combustion Head-OPT			Opt.
	Fuel Metering CAM-NETIC II	X	X				
1. The configuration of each unit will vary with specific job requirements such as input rating, electrical specification and special agency approval codes. The above chart shows those items standard to a basic burner plus a few options that may be added.							
2. Indicator lights are "Power On", "Call for Heat", "Fuel On" and "Flame Fail" for hard wired panels. "Alarm", "Low Water", "Power", "Call for Heat", "Ignition On", and "Fuel On" for circuit board light panels.							

## Model JB1 - Sizing and Application Data (contact Webster for complete information)

Model Number	Maximum Furnace Pressure	Burner Firing Capability Range		Burner Motor HP		Gas Train			Oil Pump Motor HP
				Gas Only HP	(3) Oil or Combination	Pipe Size	(4) Inlet Pressure		
		Gas scfh	#2 Oil gph				On-Off, LFS	Modulation	
JB1-02	1.25	400 / 1000	3.0 / 7.1	1/4	1/3	1"	6 / 14"	7 / 14"	Integral
JB1-03	1.25	600 / 1500	4.0 / 10.7	1/3	1/2	1 1/4"	8 / 14"	9 / 14"	Integral
JB1-05	1.25	800 / 2100	6.0 / 14.8	1/2	1/2	1 1/2"	7 / 14"	8 / 14"	Integral
JB1-07	1.25	900 / 2500	7.0 / 17.8	3/4	3/4	1 1/2"	9 / 14"	11 / 14"	Integral

3. Larger motors may be required for single phase or 208 volts

4. Contact Webster for more complete details

The above maximum ratings are based on 0 furnace pressure, an altitude of 1000 feet, 90°F air temperature and 60 HZ electrical supply. Use the following corrections for higher temperatures and altitude. Capacity decreases by 17% for 50 Hertz.

Capacity decreases by 4% for each 1000 feet above 1000 foot altitude.

Capacity decreases by 6% for each 1 inch of furnace pressure.

Capacity decreases by 2% for each 10°F increase in air temperature over 90°F.

Gas input ratings based on 1000 BTU/cu ft. and 0.64 specific gravity. Sizes and pressure will vary with gas.

Oil input ratings are based on 140,000 BTU/gal for ASTM #2 fuel oil.

## Essential Ordering Information and Data:

Power Supply - Confirm 120-60-1 for control circuit and electrical supply for burner motor(s) (voltage, frequency and phase).

Describe Boiler or Heater to be Fired - Including the manufacturer, model number, furnace pressure and furnace size.

Firing Rate - Define firing rates in MBH for gas and GPH for oil.

Fuel to be Burned - Type of gas and/or oil, including the BTU value.

Approval Agency - UL, FM, IRI (GE GAP), CSD-1, NFPA, Mil spec and local codes, if applicable.

Flame Safety Control Preferred - Honeywell or Fireye controls.

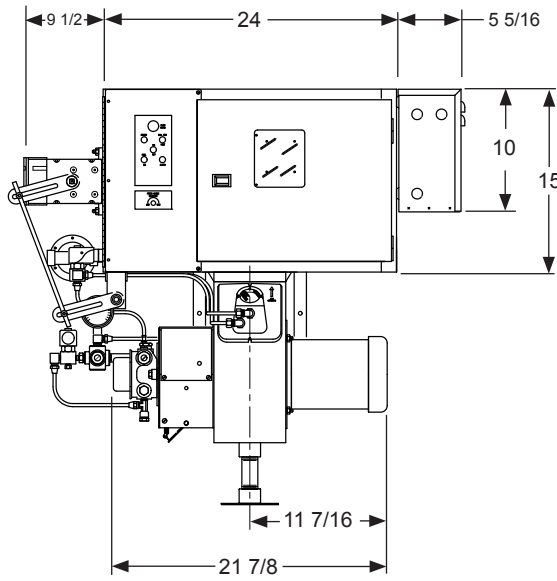
Gas Train Components Preferred - ASCO/ITT, Honeywell or Landis

Control System - ON-OFF, Low Fire Start, Low-High-Low, Modulation, Posi-Control

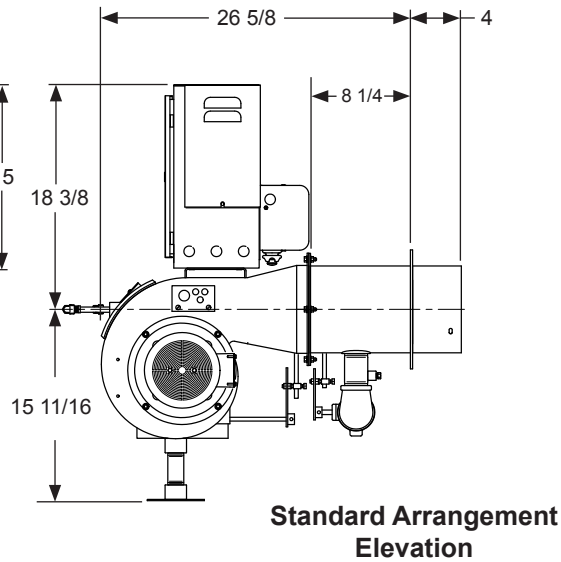
Required Options - Mounting plate, limit controls, etc.

## Model JB1 - Dimensional Data (400 - 2500 MBH Input)

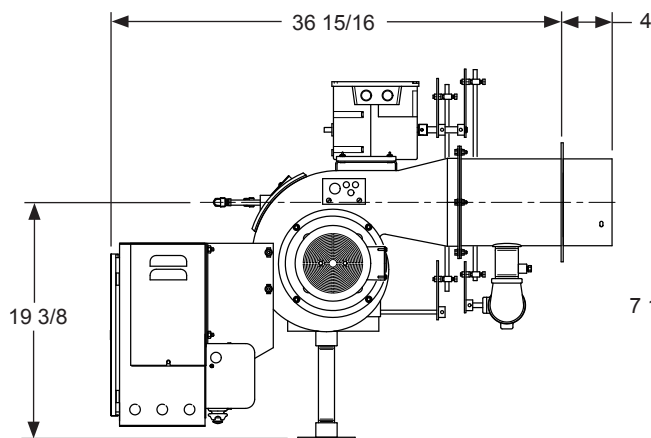
(Dimensions are +/- 1/4 inch)



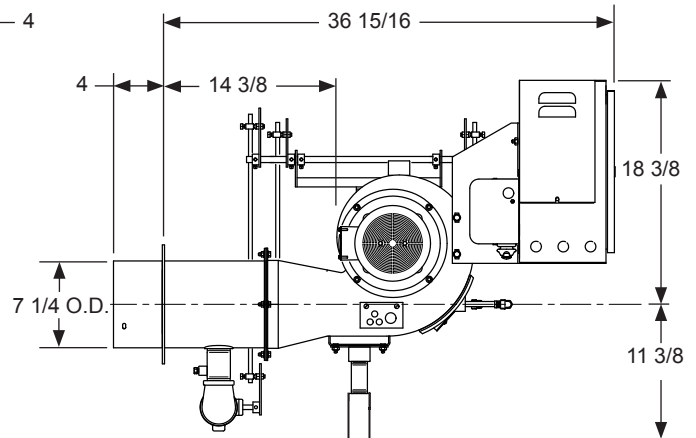
**Standard Arrangement  
End View**



**Standard Arrangement  
Elevation**



**Standard Arrangement  
Elevation  
W/ Optional Back Mount Control Cabinet**



**Inverted Arrangement  
Elevation  
(Optional)**

### Fuels Burned and Control Systems

- Natural Gas, Propane, Digester or Mixed Gases
- Light #2 Oil, Mechanical Pressure
- On-Off, Low Fire Start, Low-High-Low, Modulating or Micro Modulation
- Control Circuit Requires 120 vac, 60 Hz, Single Phase Voltage Supply

Model JB1 burners are listed by Underwriters Laboratories, Inc. (UL / ULC). Also by the State of Massachusetts Fire Marshal, City of New York Board of Standards and Appeals, State of Minnesota and can be packaged to meet specific requirements of IRI, FM, GE GAP, NFPA, MIL spec. or other special insurance or local code requirements.



## Model JB2 - Specification Data (6000 MBH Maximum Input)

(1) STANDARD UL EQUIPMENT AND IMPORTANT OPTIONS		Gas	No. 2 Oil		STANDARD UL EQUIPMENT AND IMPORTANT OPTIONS	Gas	No. 2 Oil	
			Pressure Atomized	Air Atomized			Pressure Atomized	Air Atomized
General	Motor, Fan and Air Inlet Control	X	X	X	Gas Fuel	Main Manual Shutoff Valve	X	
	Air Flow Switch	X	X	X		Main Safety Shutoff Valve	X	
	(2) Burner Mounted Control Panel, Switch and Indicator Lights	X	X	X		Second Safety Shutoff Valve	X	
	Flame Safety Control	X	X	X		Main Gas Regulator	X	
	Ultra Violet Scanner	X	X	X		Gas Checking Valve	X	
	Motor Controller (single phase voltage)	X	X	X		High and Low Gas Pressure Switches	X	
	Motor Starter w/Overloads (3 PH volt)	X	X	X		Metering Valve (modulating systems)	X	
	Fuel Selector Switch	Duel Fuel Burners Only				Normally Open Vent Valve	Opt.	
Ignition	Proven Gas Pilot Ignition	X		X	Oil Fuel	Oil Drawer Assembly with Diffuser	X	X
	JB2-30 and JB2-50	X	X	X		Oil Nozzles	X	X
	Pilot Solenoid Gas Valve	X		X		Integral Oil Pump (JB2-07 to JB2-20)	X	
	Pilot Gas Regulator & Manual Valve	X		X		Remote Oil Pump (JB2-30 to JB2-50)	X	Opt.
	Pilot Gas Ignition Transformer	X		X		Two Safety Shutoff Valves	X	X
	Direct Spark Oil Ignition		(3)			Low Air Atomizing Switch		X
	Direct Spark Oil Ignition Transformer		(3)			Low Oil Pressure Switch (STD when using remote oil pump)	X	X
Options	Inverted Housing	X	X	X		Oil Pressure Gauge	X	X
	Alternate Control Cabinet Positioning	X	X	X		Oil Metering Valve (modulating system)	X	X
	Remote Control Panel	X	X	X		Future Gas Combustion Head	Opt.	Opt.
	Fuel Metering CAM-NETIC II	X	X	X		Air Compressor		X

1. The configuration of each unit will vary with specific job requirements such as input rating, electrical specification and special agency approval codes. The above chart shows those items standard to a basic burner plus a few options that may be added.

2. Indicator lights are "Power On", "Call for Heat", "Fuel On" and "Flame Fail" for hard wired panels. "Alarm", "Low Water", "Power", "Call for Heat", "Ignition On", and "Fuel On" for circuit board panels.

3. Maximum rate for direct spark is 20 GPH at low fire or 35 GPH at high fire. (standard on straight oil burners, pressure atomized)

## Model JB2 - Sizing and Application Data (contact Webster for complete information)

Model Number	Maximum Furnace Pressure	Burner Firing Capability Range		Burner Motor HP	Gas Train			Oil Pump Motor HP		Air Compressor Motor HP
					Pipe Size	(3) Inlet Press (in wc)		Pressure Atomizing	Air Atomizing	
		Gas scfh	#2 Oil gph			LFS, LHL	Modulation			
JB2-07	2	900 / 2800	10 / 20	3/4	1 1/2"	10 / 14"	13"	Integral	N/A	N/A
JB2-10	2	900 / 3500	10 / 25	1	2"	8 / 14"	9 / 14"	Integral	Optional	2
JB2-15	2	900 / 3500	10 / 25	1 1/2	2"	8 / 14"	9 / 14"	Integral	Optional	2
JB2-20	2	1200 / 4200	12 / 30	2	2"	(4) 12 / 14"	(3) 13 / 14"	Integral	Optional	2
JB2-30	2.5	1200 / 5300	12 / 37.8	3	2 1/2"	N/A	13 / 14"	3/4	Optional	2
JB2-50	2.5	1200 / 6000	12 / 42.8	5	2 1/2"	N/A	2-5 psi	3/4	Optional	2

3. Lower pressures may apply to reduced inputs.
4. 11-14" with IRI and LFS or LHL. 12-14" with IRI and modulation.
- The above maximum ratings are based on 0 furnace pressure, an altitude of 1000 feet, 90°F air temperature and 60 HZ electrical supply. Use the following corrections for higher temperatures and altitude. Capacity decreases by 17% for 50 Hertz.
- Capacity decreases by 4% for each 1000 feet above 1000 foot altitude.
- Capacity decreases by 6% for each 1 inch of furnace pressure.
- Capacity decreases by 2% for each 10°F increase in air temperature over 90°F.
- Gas input ratings based on 1000 BTU/cu ft. and 0.64 specific gravity. Sizes and pressure will vary with different gas properties.
- Oil input ratings are based on 140,000 BTU/gal. for ASTM #2 fuel oil.
- The vessel draft must be between -0.1 and +0.1 wc.

## Essential Ordering Information and Data:

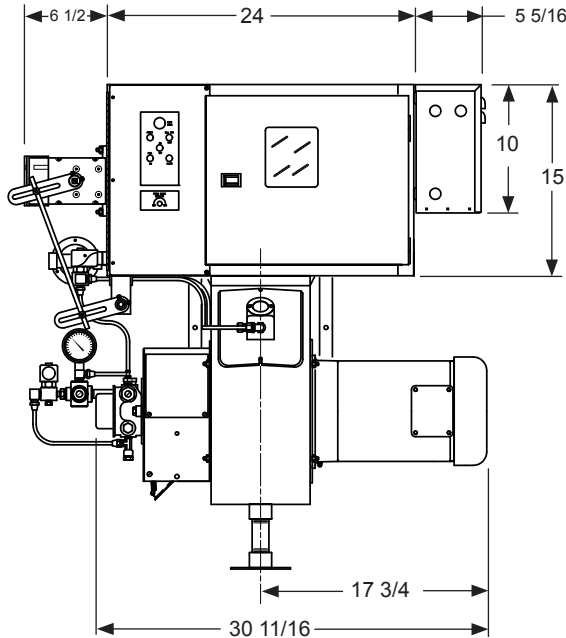
Power Supply - Confirm 120-60-1 for control circuit and electrical supply for burner motor(s) (voltage, frequency and phase).  
Describe Boiler or Heater to be Fired - Including the manufacturer, model number, furnace pressure and furnace size.  
Firing Rate - Define firing rates in MBH for gas and GPH for oil.  
Fuel to be Burned - Type of gas and/or oil, including the BTU value.  
Approval Agency - UL, FM, IRI (GE GAP), CSD-1, NFPA, Mil spec and local codes, if applicable.  
Flame Safety Control Preferred - Honeywell or Fireye controls. Gas Train Components Preferred - ASCO/ITT, Honeywell or Landis  
Control System - ON-OFF, Low Fire Start, Low High Low, Modulation, Posi-Control. Required Options - Mounting plate, limit controls, etc.



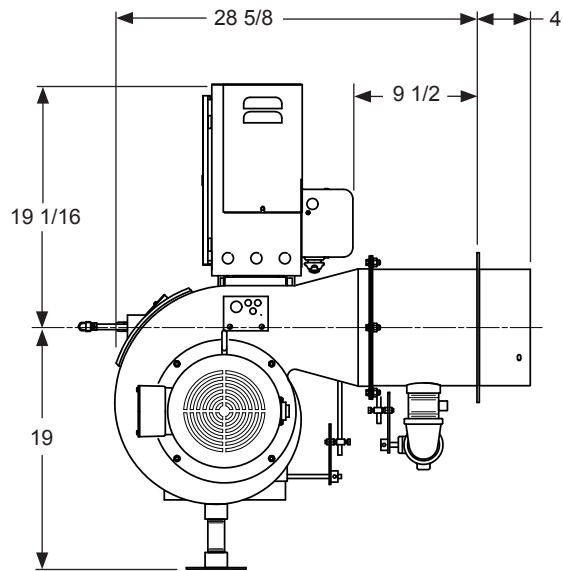
## Model JB2 - Dimensional Data

(6000 MBH Maximum Input)

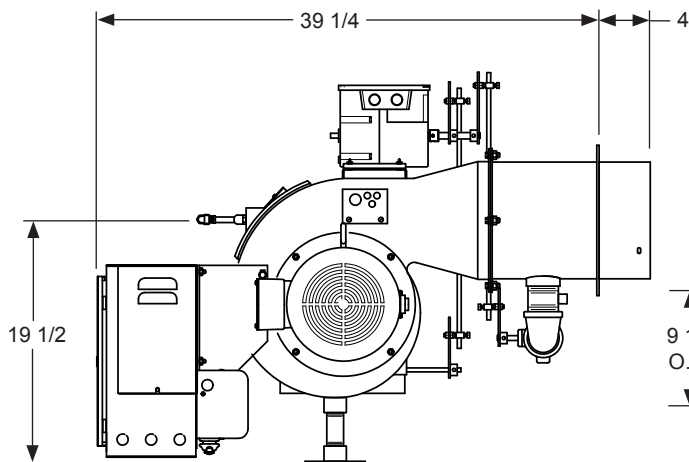
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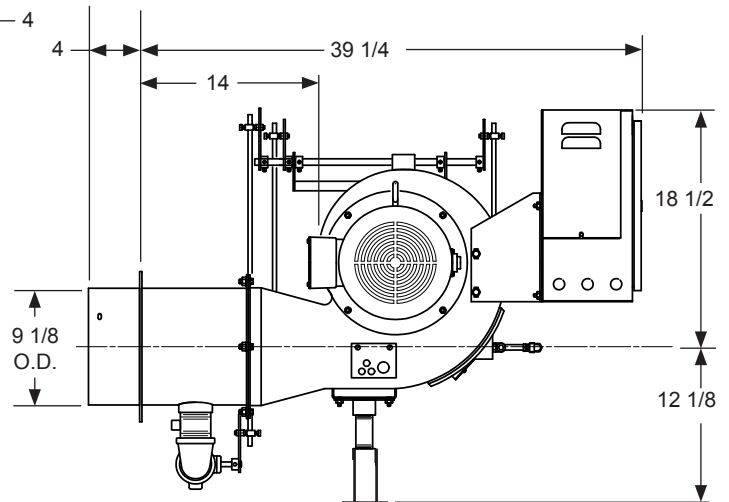
**Standard Arrangement  
End View**



**Standard Arrangement  
Elevation**



**Standard Arrangement  
Elevation  
W/ Optional Back Mount Control Cabinet**



**Inverted Arrangement  
Elevation**

### Fuels Burned and Control Systems

- Natural Gas, Propane, Digester or Mixed Gases
- Light #2 through Heavy #6 Fuel Oil
- Low Fire Start, Low-High-Low, Modulating or Micro Modulation
- Control Circuit Requires 120 vac, 60 Hz, Single Phase Voltage Supply

Model JB1 burners are listed by Underwriters Laboratories, Inc. (UL/ULC). Also by the State of Massachusetts Fire Marshal, City of New York Board of Standards and Appeals, State of Minnesota and can be packaged to meet specific requirements of IRI, FM, GE GAP, NFPA, MIL spec. or other special insurance or local code requirements.

## Model JB3 - Specification Data (12,600 MBH Maximum Input)

(1) STANDARD UL EQUIPMENT AND IMPORTANT OPTIONS		Gas	No. 2 Oil		No. 4 - 6 Oil Air Atomized
			Pressure Atomized	Air Atomized	
General	Motor, Fan and Air Inlet Control	X	X	X	X
	Air Flow Switch	X	X	X	X
	(2) Burner Mounted Control Panel, Switch and Four Indicator Lights	X	X	X	X
	Flame Safety Control	X	X	X	X
	Ultra Violet Scanner	X	X	X	X
	Motor Starter with Overloads	X	X	X	X
	Fuel Selector Switch	Duel Fuel Burners Only			
Ignition	Proven Gas Pilot Ignition	X		X	X
	Pilot Solenoid Gas Valve	X		X	X
	Pilot Gas Regulator & Manual Valve	X		X	X
	Pilot Gas Ignition Transformer	X		X	X
Options	Inverted Housing	X	X	X	X
	Alternate Control Cabinet Positioning	X	X	X	X
	Remote Control Panel	X	X	X	X
	Fuel Metering CAM-NETIC II	X	X	X	X
	Posi-Control	X	X	X	X

STANDARD UL EQUIPMENT AND IMPORTANT OPTIONS		Gas	No. 2 Oil		No. 4 - 6 Oil Air Atomized
			Pressure Atomized	Air Atomized	
Gas Fuel	Main Manual Shutoff Valve	X			
	Main Safety Shutoff Valve	X			
	Second Safety Shutoff Valve	X			
	Main Gas Regulator	X			
	Gas Checking Valve	X			
	High and Low Gas Pressure Switches	X			
	Metering Valve (modulating systems)	X			
	Normal Open Vent Valve (above 12,500 MBH)	X			
Oil Fuel	Oil Drawer Assembly with Diffuser		X	X	X
	Oil Nozzles		X	X	X
	Oil Heater with Integral Thermostat				X
	Remote Oil Pump		X	Opt.	Opt.
	Two Safety Shutoff Valves		X	X	X
	High Oil Temperature Switch				X
	Low Air Atomizing Switch				X
	Low Oil Pressure Switch		X	X	X
	Oil Pressure Gauge		X	X	X
	Oil Metering Valve		X	X	X
	Future Gas Combustion Head		Opt.	Opt.	Opt.
	Air Compressor			X	X

1. The configuration of each unit will vary with specific job requirements such as input rating, electrical specification and special agency approval codes. The above chart shows those items standard to a basic burner plus a few options that may be added.

2. Indicator lights are "Power On", "Call for Heat", "Fuel On" and "Flame Fail".

## Model JB3 - Sizing and Application Data (contact Webster for complete information)

Model Number	Maximum Furnace Pressure	Burner Firing Capability Range			Burner Motor HP	Gas Train		#2 Oil Pump Motor HP		#4 - 6 Pump Motor HP	Air Compressor Motor HP
		Gas scfh	#2 Oil gph	#4-6 Oil gph		Pipe Size	Inlet Press	Pressure Atomizing	Air Atomizing		
JB3-30	3.5	1400 / 6300	10.2 / 45	10 / 42	3	2 1/2"	12 / 27"	1	Optional	Optional	2
JB3-50	3.5	1400 / 8300	11 / 59.2	10 / 55.3	5	3"	15 / 27"	1 1/2	Optional	Optional	2
JB3-75	3.5	1600 / 10500	12.3 / 75	11 / 70	7 1/2	3"	23 / 27"	1	Optional	Optional	2
JB3-100	3.5	1800 / 12600	20.3 / 90	12 / 84	10	3"	2-5 psi	1	Optional	Optional	2

The above maximum ratings are based on 0 furnace pressure, an altitude of 1000 feet, 90°F air temperature and 60 HZ electrical supply. Use the following corrections for higher temperatures and altitude. Capacity by 17% for 50 Hertz.

Capacity decreases by 4% for each 1000 feet above 1000 foot altitude.

Capacity decreases by 6% for each 1 inch of furnace pressure.

Capacity decreases by 2% for each 10°F increase in air temperature over 90°F.

Gas input ratings based on 1000 BTU/cu ft. and 0.64 specific gravity. Sizes and pressure will vary with gas.

Oil input ratings are based on 140,000 BTU/gal. for ASTM #2 fuel oil and 150,000 BTU/gal for ASTM #4-6 fuel oil.

The vessel draft must be between -0.1 and +0.1 wc.

## Essential Ordering Information and Data:

Power Supply - Confirm 120-60-1 for control circuit and electrical supply for burner motor(s) (voltage, frequency and phase).

Describe Boiler or Heater to be Fired - Including the manufacturer, model number, furnace pressure and furnace size.

Firing Rate - Define firing rates in MBH for gas and GPH for oil.

Fuel to be Burned - Type of gas and/or oil, including the BTU value.

Approval Agency - UL, FM, IRI (GE GAP), CSD-1, NFPA, Mil spec and local codes, if applicable.

Flame Safety Control Preferred - Honeywell or Fireye controls.

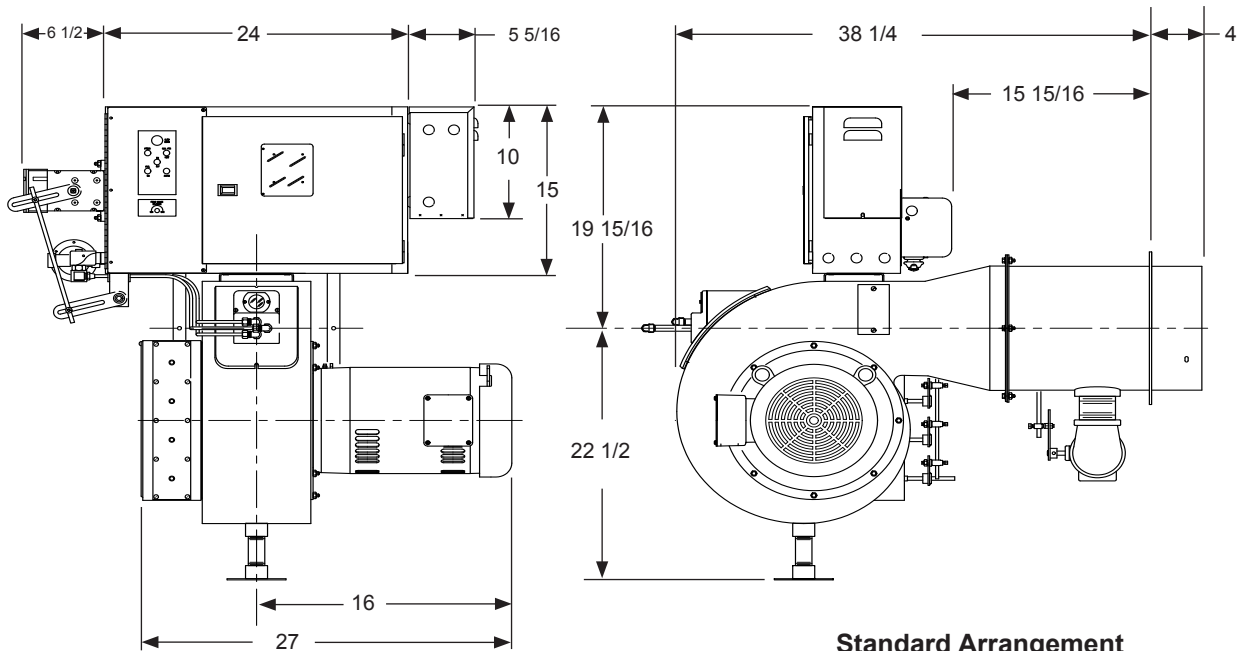
Gas Train Components Preferred - ASCO/ITT, Honeywell or Landis

Control System - ON-OFF, Low Fire Start, Low High Low, Modulation, Posi-Control

Required Options - Mounting plate, operating controls, limit controls, etc.

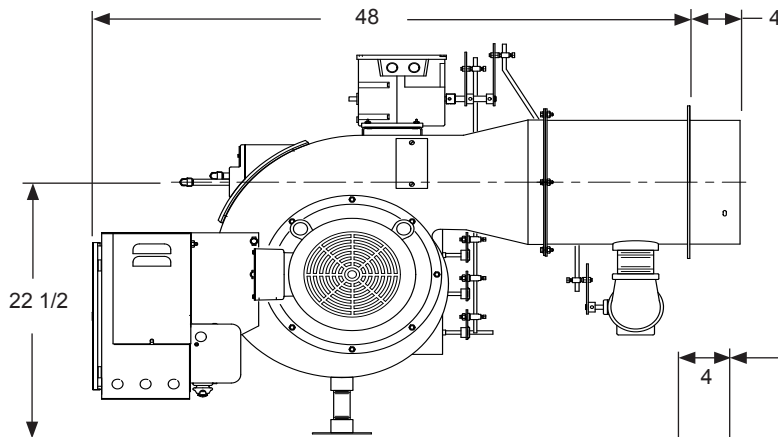
## Model JB3 - Dimensional Data (12,600 MBH Maximum Input)

(Dimensions are +/- 1/4 inch)

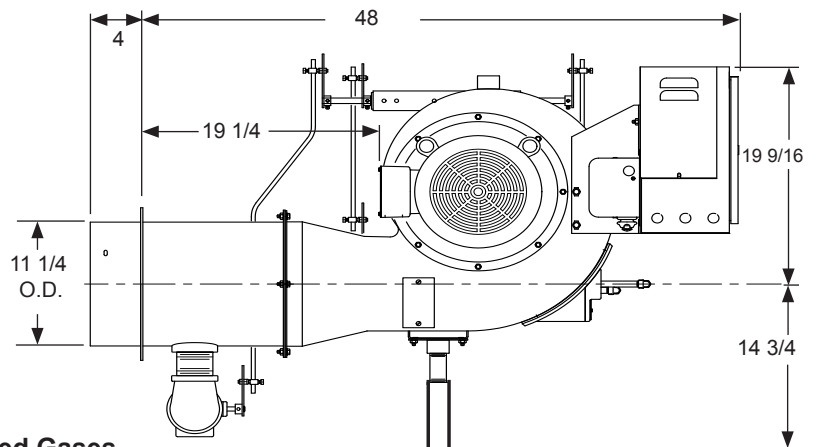


**Standard Arrangement  
End View**

**Standard Arrangement  
Elevation**



**Standard Arrangement  
Elevation  
W/ Optional Back Mount Control Cabinet**



**Inverted Arrangement  
Elevation**

### Fuels Burned and Control Systems

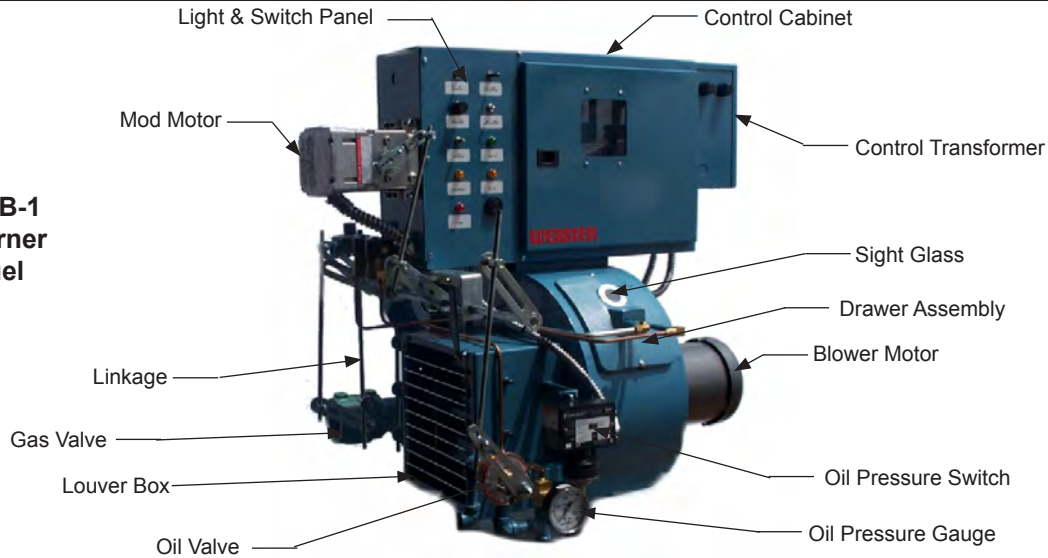
- Natural Gas, Propane, Digester or Mixed Gases
- Light #2 through Heavy #6 Fuel Oil
- Modulating Control System - Micro Modulation or Linkage
- Control Circuit Requires 120 vac, 60 Hz, Single Phase Voltage Supply

Model JB3 burners are listed by Underwriters Laboratories, Inc. (UL/ULC). Also by the State of Massachusetts Fire Marshal, City of New York Board of Standards and Appeals, State of Minnesota and can be packaged to meet specific requirements of IRI, FM, GE GAP, NFPA, MIL spec. or other special insurance or local code requirements.

## B. COMPONENT IDENTIFICATION

This section shows the different common components used in the JB burner line and should be helpful to identify parts described elsewhere in this manual.

**Figure B-1  
JB2 Burner  
Oil Fuel**



**Combustion  
Head**

**Manual Ball Valve**

**Pilot Solenoid**

**Pilot Gas Regulator**

**Gas Actuator**

**Gas Valve**

**Figure B-2  
JB1G Left Side View**

**Ignition  
Transformer**

**Air Flow Switch**

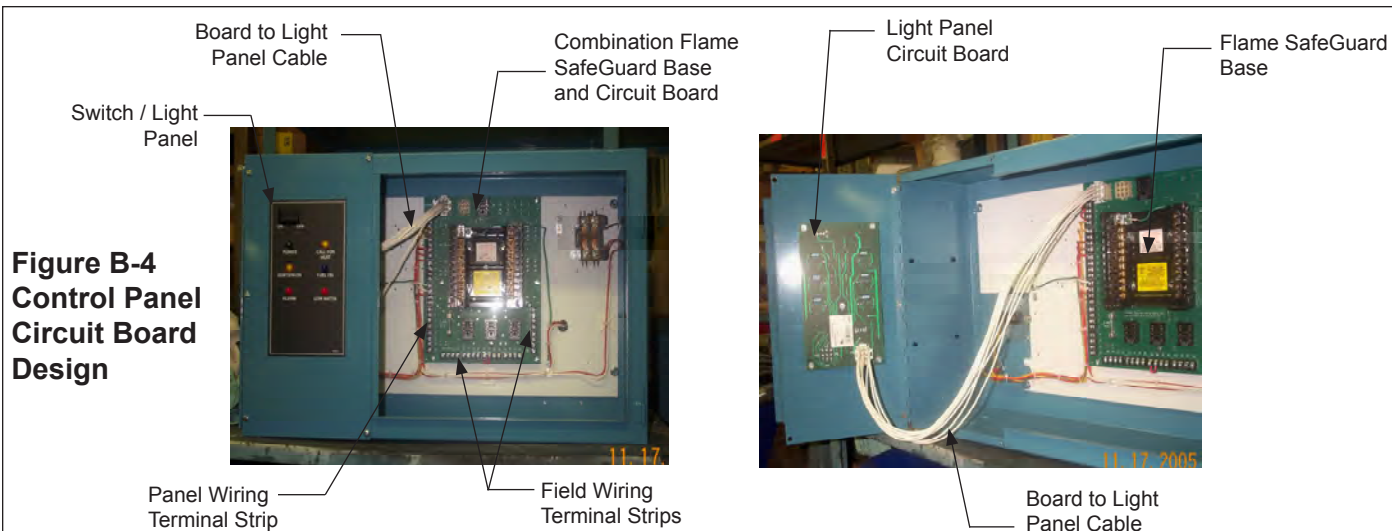
**Pilot Gas Regulator**

**Gas Actuator**

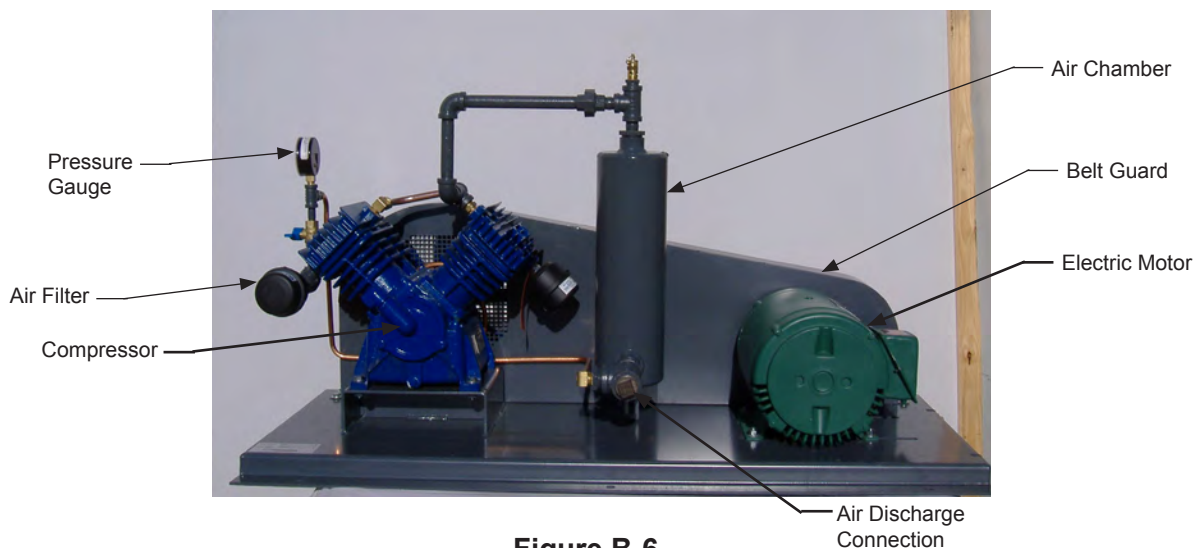
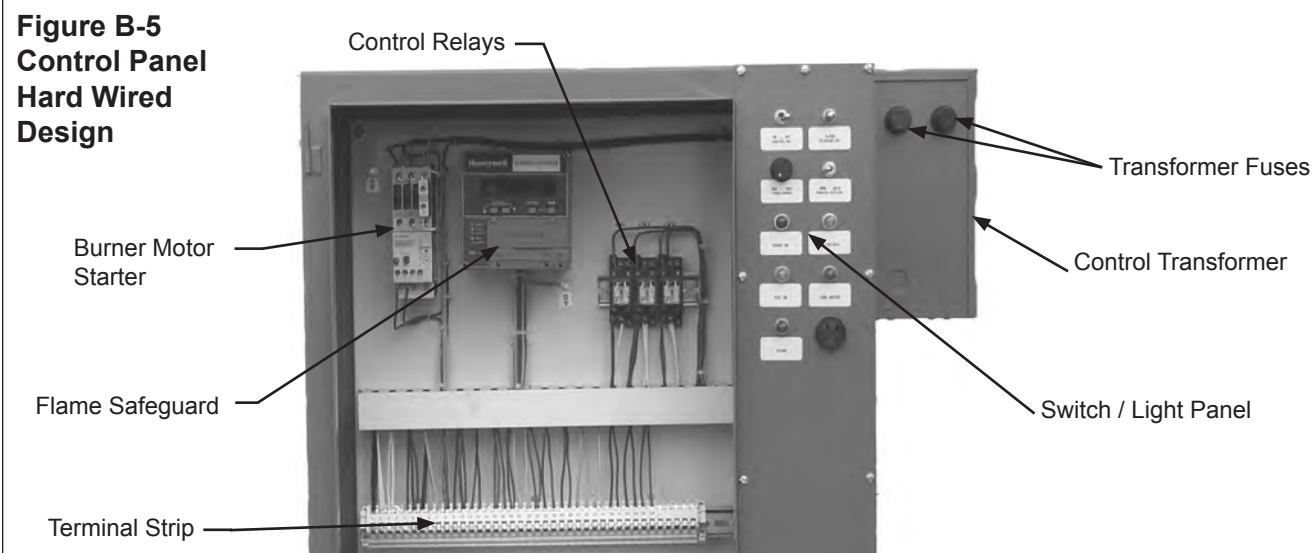
**High Gas  
Pressure Switch**

**Gas Pressure Gauge**

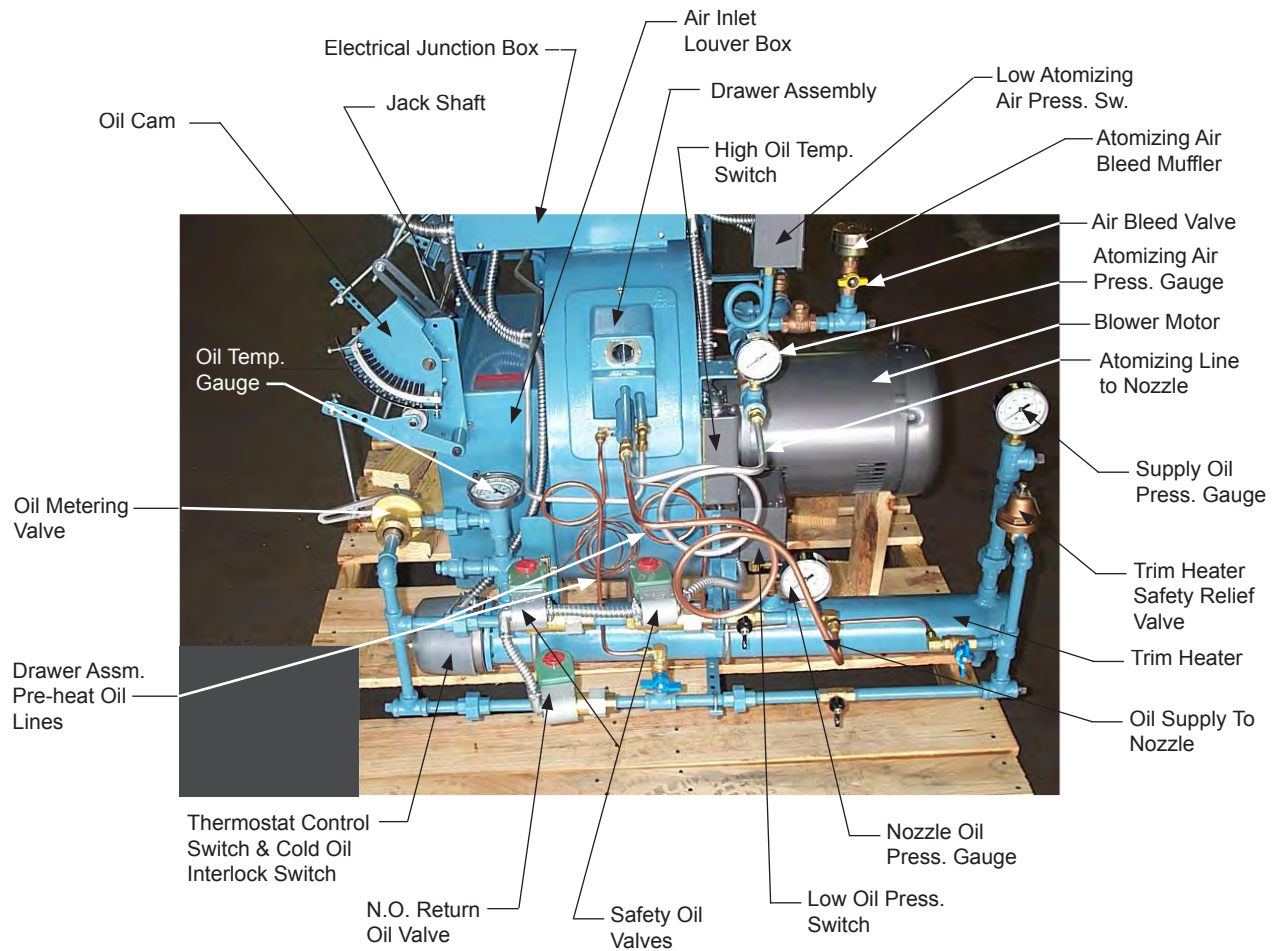
**Figure B-3  
JB1G Right Side View**



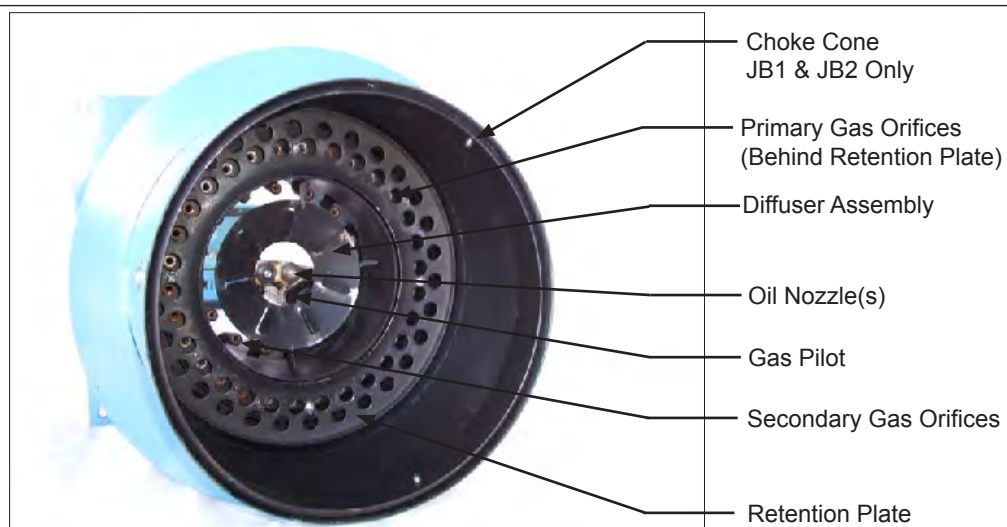
Electrical Panel Identification: The above pictures show the flame safeguard base mounted on a circuit board. Connections are wired via cable to light / switch circuit board. Picture below shows the flame safeguard (base) mounted directly to the panel back plate.



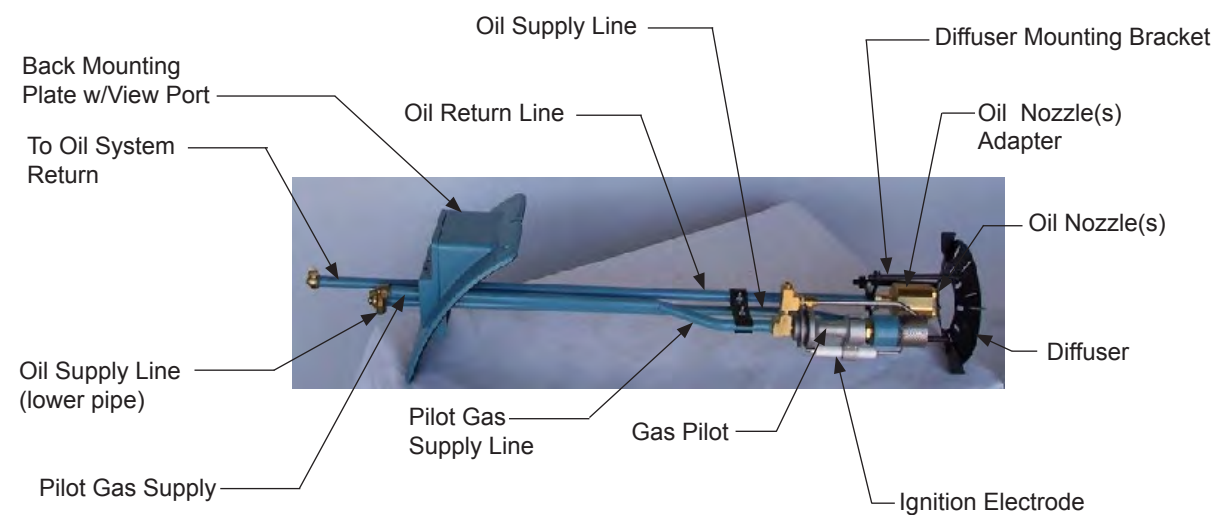
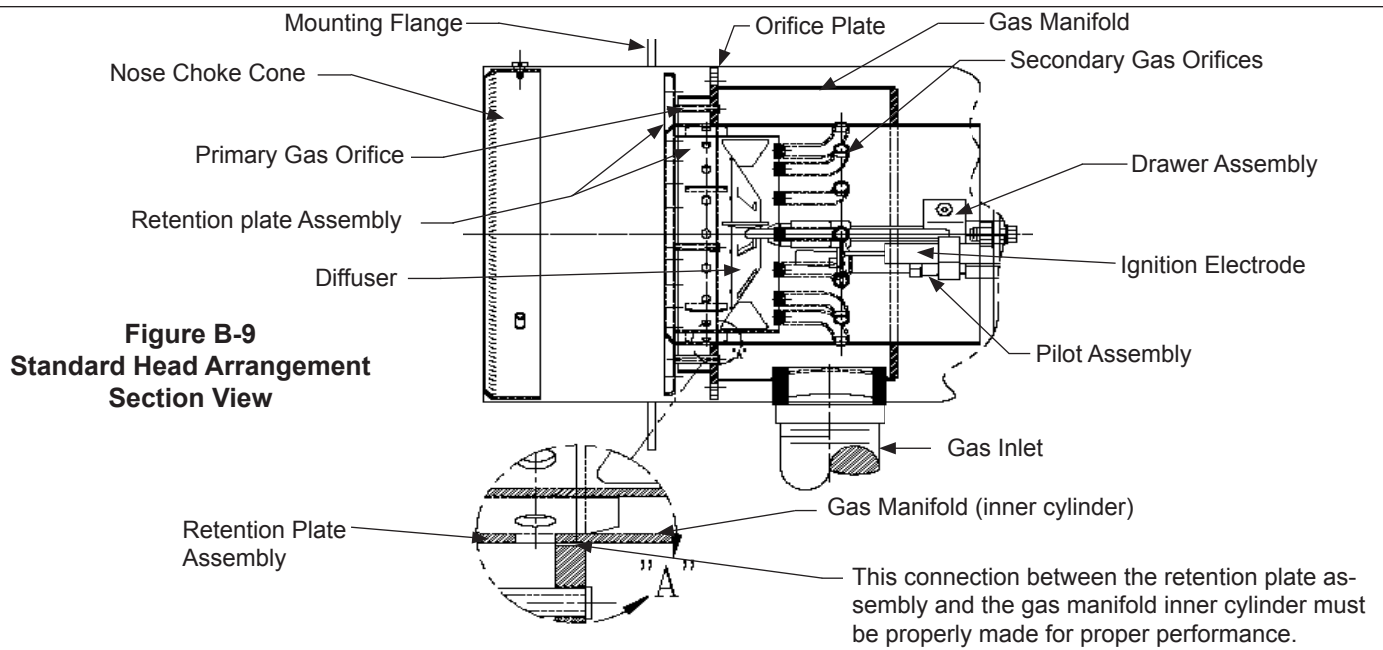




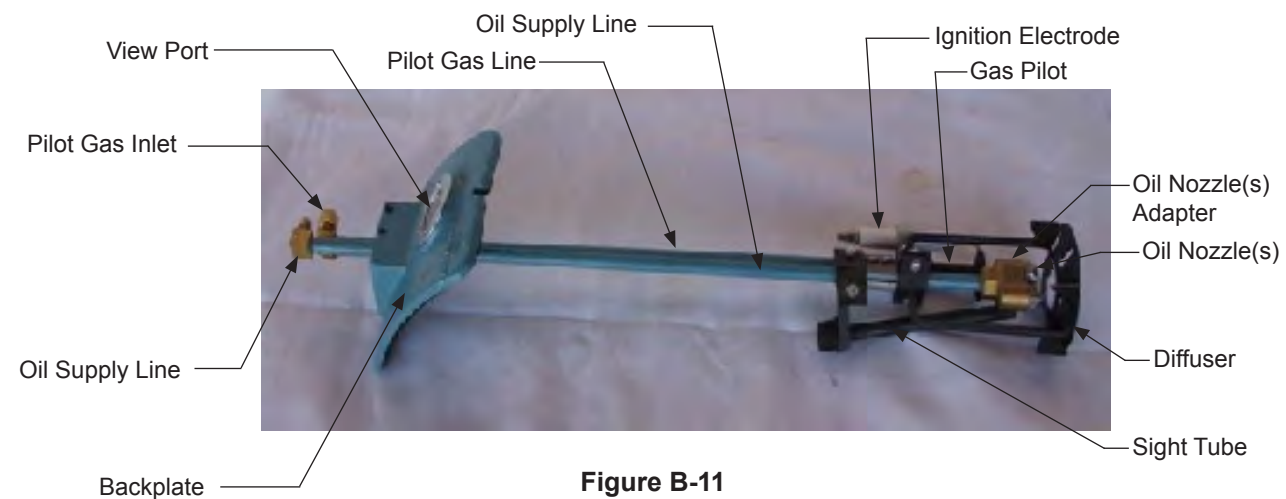
**Figure B-7**  
**JB Burner**  
**#4 - 6 Fuel Oil**



**Figure B-8**  
**JB Combustion Head - Dual Fuel**

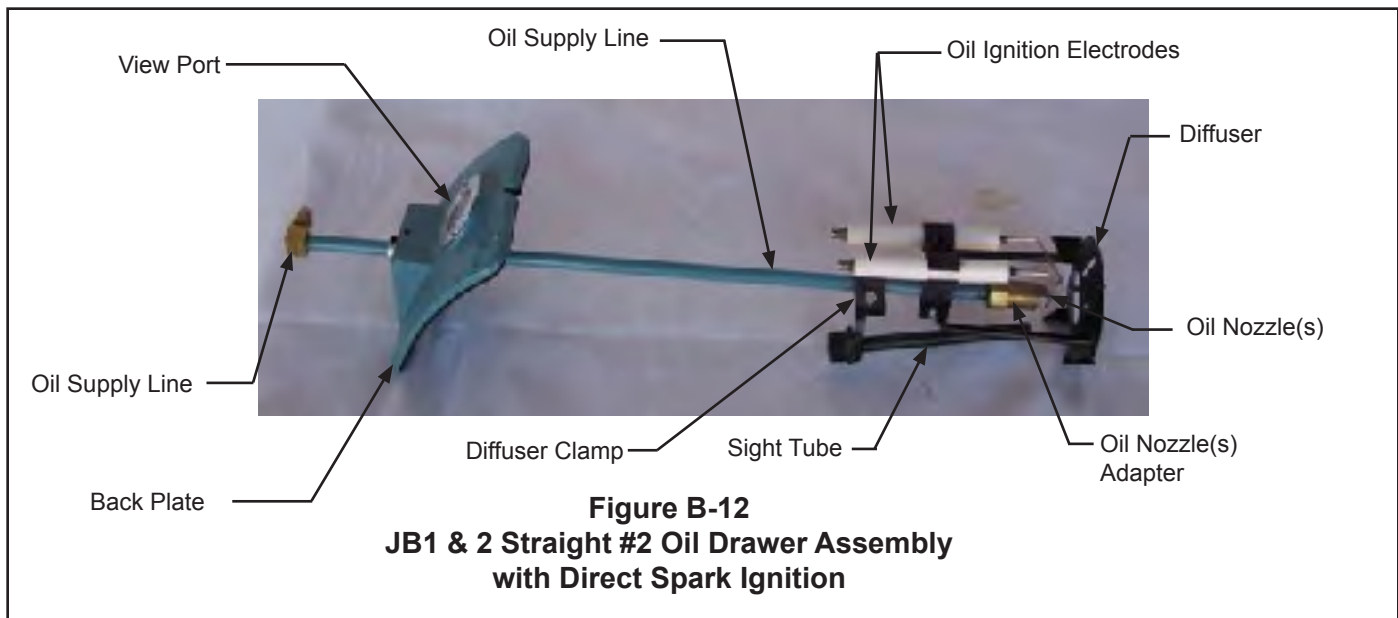


**Figure B-10**  
**JB3 Combination or Straight Oil Drawer Assembly**  
**with Proven Gas Pilot**



**Figure B-11**  
**JB1 & 2 Combination Drawer Assembly**  
**with Proven Gas Pilot Ignition**



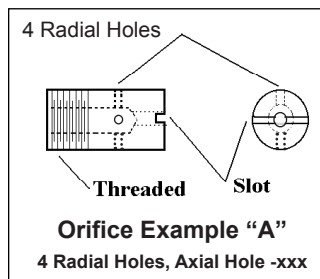


## Gas Orifice Part Number and Description

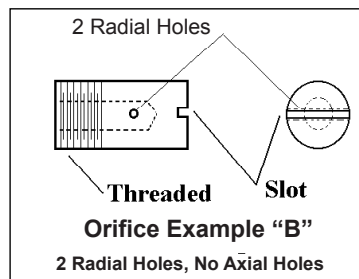
Part No.	Description	Sketch Example	Vessel
090002	Gas orifice, 5/16" brass blank, no holes		
090002-076	Gas orifice, 5/16" brass, (2) radial #48 holes, no axial hole (48 x 2)	B	FB
090002-098	Gas orifice, 5/16" brass, (2) radial #40 holes, no axial hole (40 x 2)	B	FB
090054-xxx	Gas orifice, 5/16" brass, no radial holes, (1) axial hole (xxx = hole dia.)	E	FB, SF
090055-xxx	Gas orifice, 5/16" steel, no radial holes, (1) axial hole (xxx = hole dia.)	E	
090069-xxx	Gas orifice, 5/16" brass, (4) #40 radial holes, (1) axial hole (xxx = hole dia.) (40 x 4 x __)	A	FB, SF
090184-xxx	Gas orifice, 5/16" steel, (4) #40 radial holes, (1) axial hole (xxx = hole dia.) (40 x 4 x __)	A	
090185-000	Gas orifice, 5/16" steel blank, no radial or axial holes		
090185-098	Gas orifice, 5/16" steel, (2) radial #40 holes, no axial hole (40 x 2)	B	
090227-xxx	Gas orifice, 5/16" brass, (4) #48 radial holes, (1) axial hole (xxx = hole dia.) (48 x 4 x __)	A	
090284-xxx	Gas orifice, 1/4" steel, no radial holes, (1) axial hole (xxx = hole dia.)	E	
090287	Orifice extension, 5/16" OD steel tube, 1.188" long	D	
090288	Orifice extension, 5/16" OD steel tube, 2.75" long	D	
090318	Orifice extension, 5/16" OD brass tube, 1.188" long	D	SF
090319	Orifice extension, 5/16" OD brass tube, 2.75" long	D	
OT (open tube)	No orifice used (If no orifice part number given in BOM, assume OP)		

- Note:** 1. Part numbers ending in "-xxx" use the drilled hole diameter as the last three digits, or the "-xxx". A number 40 drill would be "-098".  
 2. Part numbers ending in "000" indicate no drilled hole.  
 3. Sketches show general appearance only, not number or type of holes.  
 4. Secondary orifices are closest to the burner center. primary orifices are on the outside.

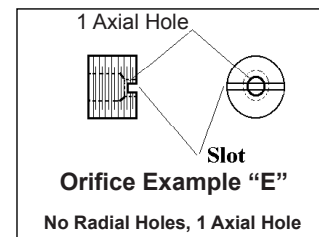
FB = Firebox  
SF = Scotch Firetube



If the radial drill size is a # 40 drill, this would be called a "40 by 4" orifice, which is common in the JB burner line.



If the radial drill size is a # 40 drill, this would be called a "40 by 2" orifice, which is common in the JB burner line.



The threads run the full length of the orifice. This orifice cannot have radial holes.

## C. INSTALLATION

Prior to installing the burner, the site conditions and utilities need to be evaluated. This section provides some general questions that can help the review process. Inspect the burner for any undetected damage that may have occurred during shipment or by job-site handling. Special attention should be given to the control panel and protruding parts such as linkages. Check linkages, air louver stops, wiring connections and fasteners for tightness.

Verify that all ship loose (or separately shipped) items are on hand. This normally will be: gas train components, mounting lugs and insulating rope. Also, front mounting plate and remote oil pump set, if supplied. The burner material list included with the instruction manual serves as a good checklist for this purpose.

1. Is there adequate outside ventilation to supply the needed air for safe combustion as required by your local regulatory agency?
2. If a burner mounting plate is required, is it available and does it meet specifications? (See Section E)
3. Is 120-60-1 voltage available for the control circuit and is the correct voltage available for the blower motor as well for the remote oil pump set and air compressor, if used?
4. Will the burner properly fit the boiler or heater with ample clearance on top, bottom and sides?
5. If a gas burner, will there be adequate gas pressure to assure the specified firing rate?
6. If a straight oil burner with gas pilot, is gas available at the burner location?
7. If an oil burner, what is the age and condition of the oil tank(s) and will there be special piping arrangements needed to deliver the oil to the burner?

**Important Note:** The JB series burners must be operated with a two-pipe system.

8. If an oil burner, what grade of fuel oil is in the tank(s) or on order? If a retrofit installation, has the same oil grade always been used? Does it meet the grade specified on the burner's UL rating plate?

### CAUTION

The oil burner shall only burn that grade of oil shown on the UL rating plate. **DO NOT USE GASOLINE, CRANKCASE OIL, OR ANY OIL CONTAINING GASOLINE OR TOXIC CONTAMINANTS.**

regulator and/or sensing line.

15. Oil piping to be flushed (cleaned) prior to use.
16. Check pump suction pressure (max 10" Hg) or max press (3 psig) if transfer pump is used or tank elevation is higher than the pump.
17. Strainer before oil pump, sized for max pump suction capacity.
18. If FGR is used, does it follow Webster guidelines. (see addendum 950064)
19. If multiple vessels connect to a single stack, are they sized and designed to maintain +/- 0.1" wc draft at the vessel outlet under all operating conditions.
20. Is stack designed to maintain +/- 0.1" wc at outlet during all operating conditions.

### WARNING

**DO NOT USE TEFLON TAPE OR COMPOUNDS CONTAINING TEFLON. THIS COULD DAMAGE THE VALVES CREATING AN UNSAFE OPERATION**

21. Is the burner mounting plate and burner head sealed with rope gasket? (See Figure E-2)
22. Has the new gas and oil piping been purged to remove debris?
23. Is there a drop leg in the gas supply to capture foreign material? (See Figure C-1)
24. Is the piping between the gas train and burner done in a manner that will minimize the pressure drop?
25. Has all of the piping been pressure checked for leaks?
26. Is the combustion chamber of proper size and is the center-line height of the burner head adequate? (See charts C-2 & C-3.)

9. Is there adequate flue provisions to assure SAFE and proper venting of the burner?
10. All manuals should be reviewed and understood and stored in a convenient place.
11. Teflon tape should not be used on any field piping.
12. Rope gaskets should be used between vessel and mounting plate, and between mounting plate and burner.
13. Gas piping should be flushed (cleaned) prior to use.
14. Check minimum straight lengths for gas pressure

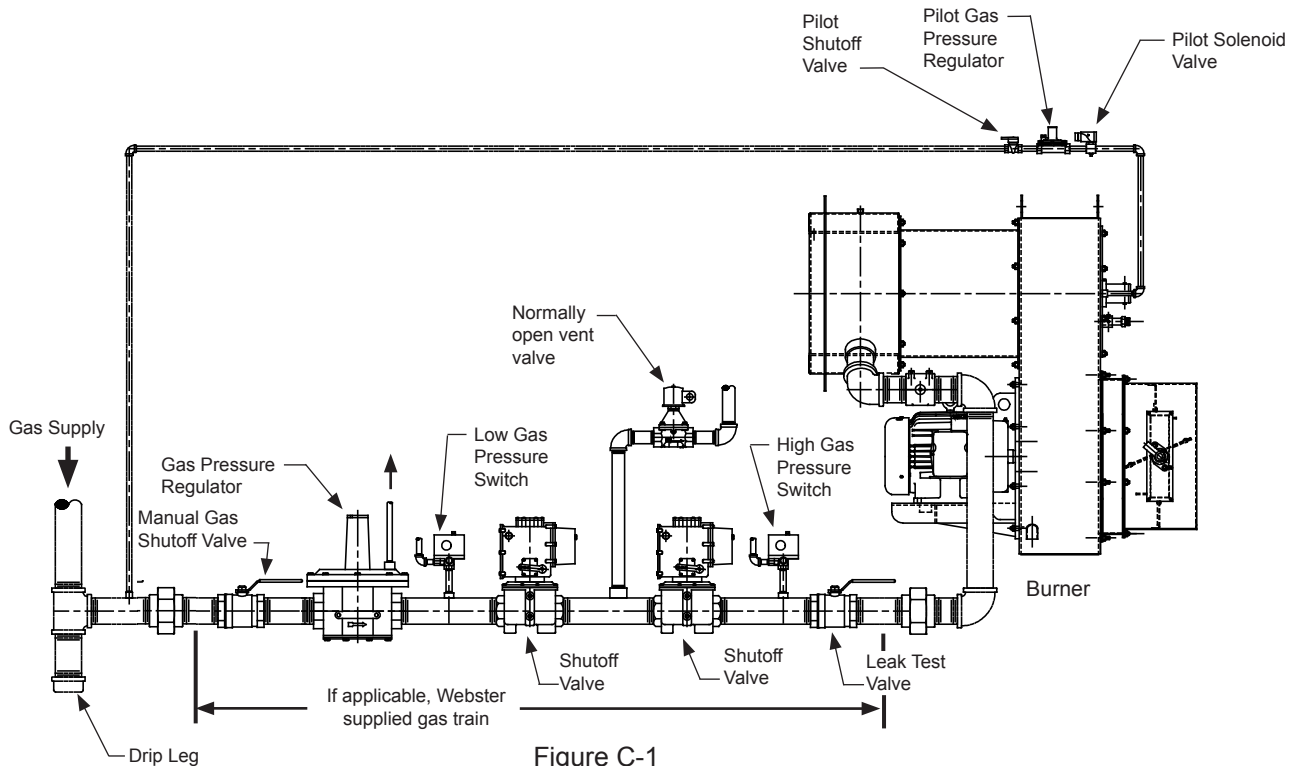


Figure C-1  
Typical Gas Piping

Chart C-2

TYPICAL COMBUSTION CHAMBER SIZE  
FOR FIREBOX BOILERS, WATERTUBE &  
CAST IRON SECTIONAL TYPES

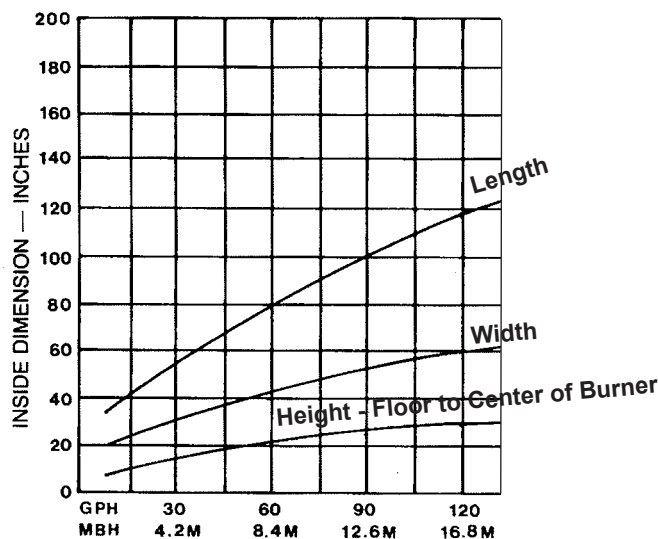
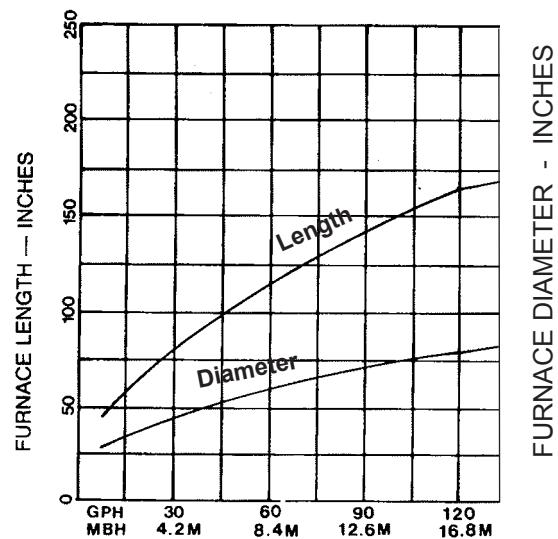


Chart C-3

TYPICAL COMBUSTION CHAMBER SIZE  
FOR SCOTCH MARINE FIRETUBE BOILERS



## D. SPECIAL INSTRUCTIONS FOR CANADIAN INSTALLATIONS

1. The installation of a burner shall be in accordance with the regulations of the provincial installation requirements, or in their absence, the following shall govern:

Gas Burners--CGAB149.1 and CGAB149.2

Oil Burners--CSA Standard B139

Authorities having jurisdiction should be consulted before installations are made.

2. All electrical wiring shall be done in accordance with

the Canadian Electrical Code, Part I.

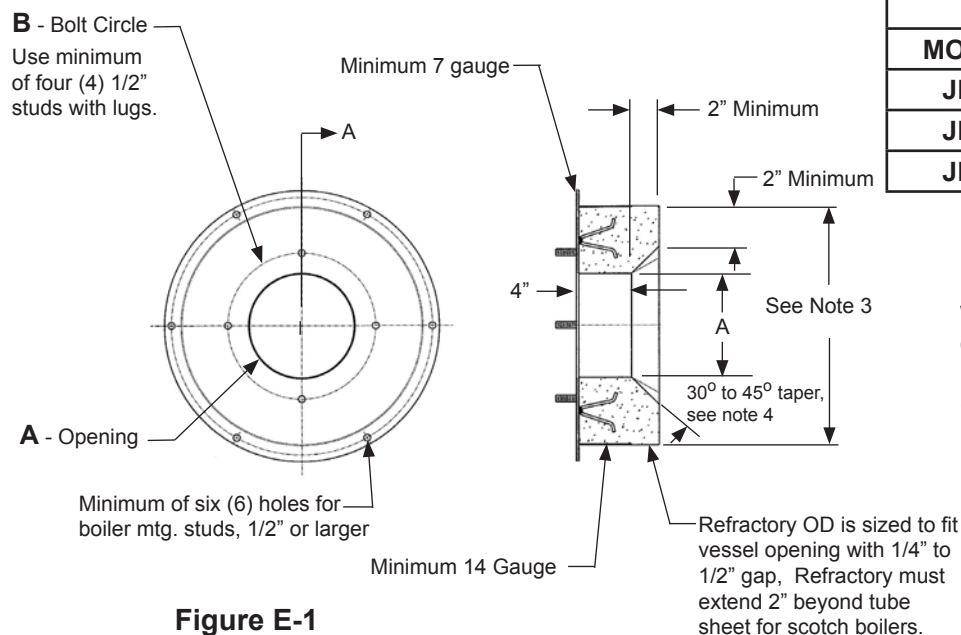
3. The installer shall identify (label) the main electrical power disconnect and the manual shut-off valve on the gas and/or oil supply drop-line to the burner.

4. Oil and gas burning equipment shall be connected to flues having sufficient draft at all times, to assure safe and proper operation of the burner.

## E. BURNER MOUNTING CRITERIA

It is of vital importance that the burner be properly mounted to the boiler or appliance being fired. Improper mounting can cause leakage of the hot gases back around the burner head resulting in warpage and deterioration. The following illustrations show the proper way the burner must be installed to validate warranty conditions.

### TYPICAL JB1, 2, 3 BURNER REFRACTORY FRONTPLATE

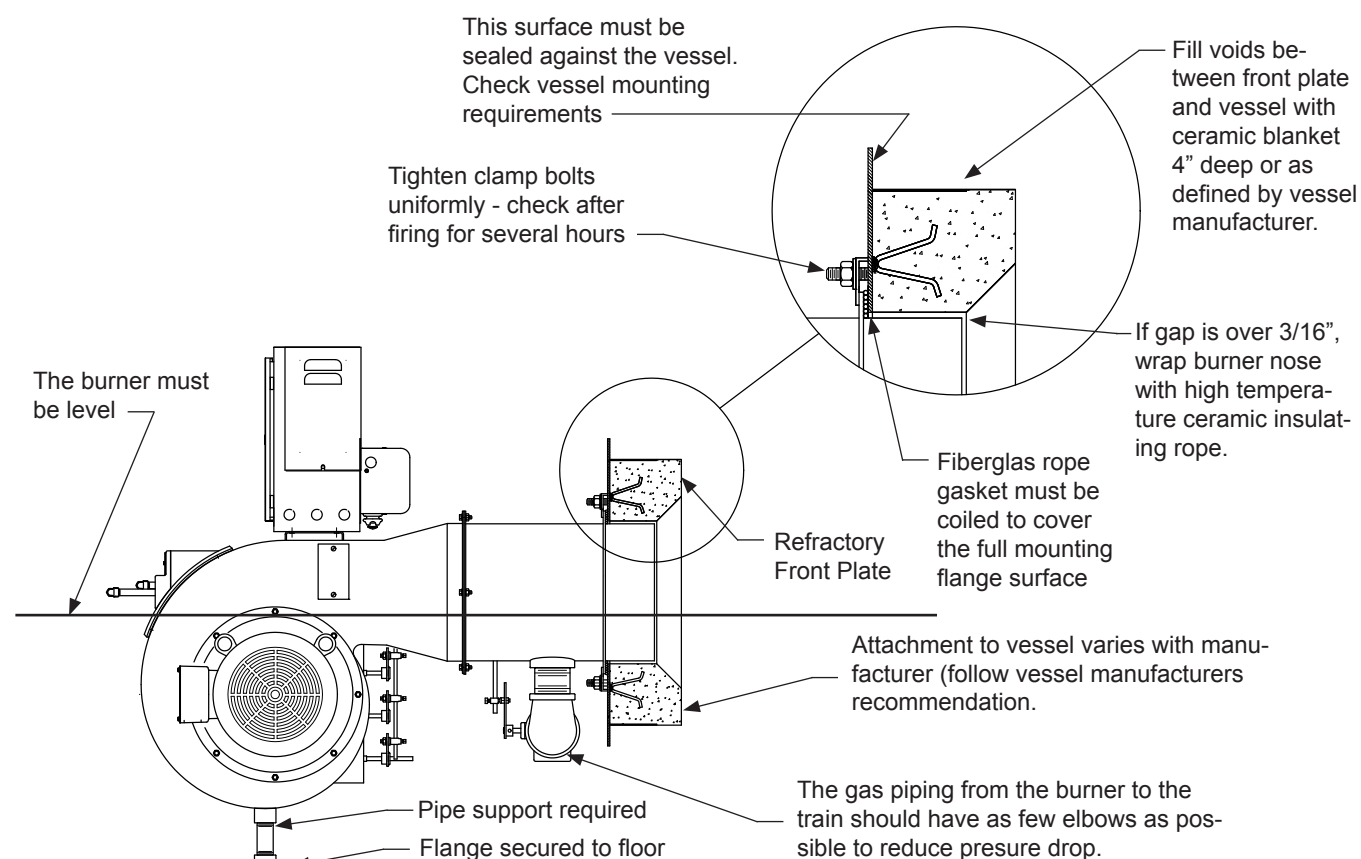


Dimensions - Inches		
MODEL	DIM. A	DIM. B
JB1	7 5/8	10 3/4
JB2	9 5/8	12 3/4
JB3	11 5/8	14 3/4

**Note:** For JB burners equipped with a low NOx cone, refer to addendum number 950064

Contact Webster for more detailed refractory drawings

**Figure E-1**  
**Refractory Dimension**



**Figure E-2**  
**Burner Mounting Instruction**

## F. FUEL SYSTEMS

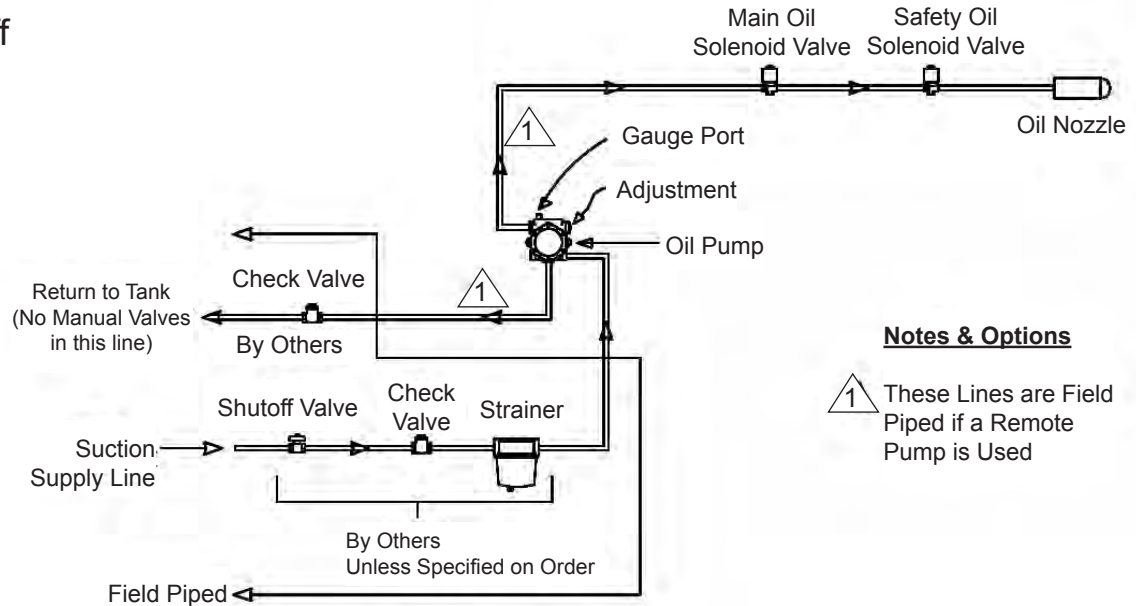
The JB burner can be equipped with a wide range of fuel and operating systems to control the fuel, air, modulation and pilots. This section describes how these systems operate. Burner start-up is expected to be done by service personnel who are qualified in the basics of mechanical know-how. The following illustrations and information is supplied to identify the various fuel; air and ignition devices that have **Adjustment Features**. All adjustments can be done with common place tools normally carried by burner and boiler service personnel.

### NOTE

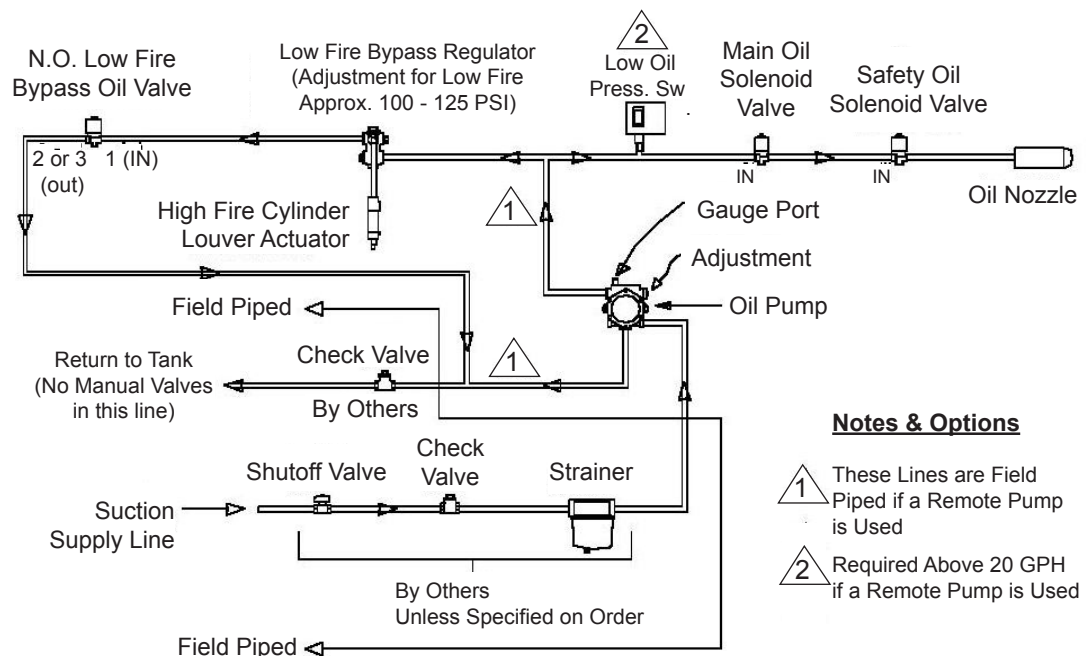
Refer to the bulletins included in the manufacturer's data section of the burner instructions manual for items shown below.

### 1. Pressure atomized oil systems

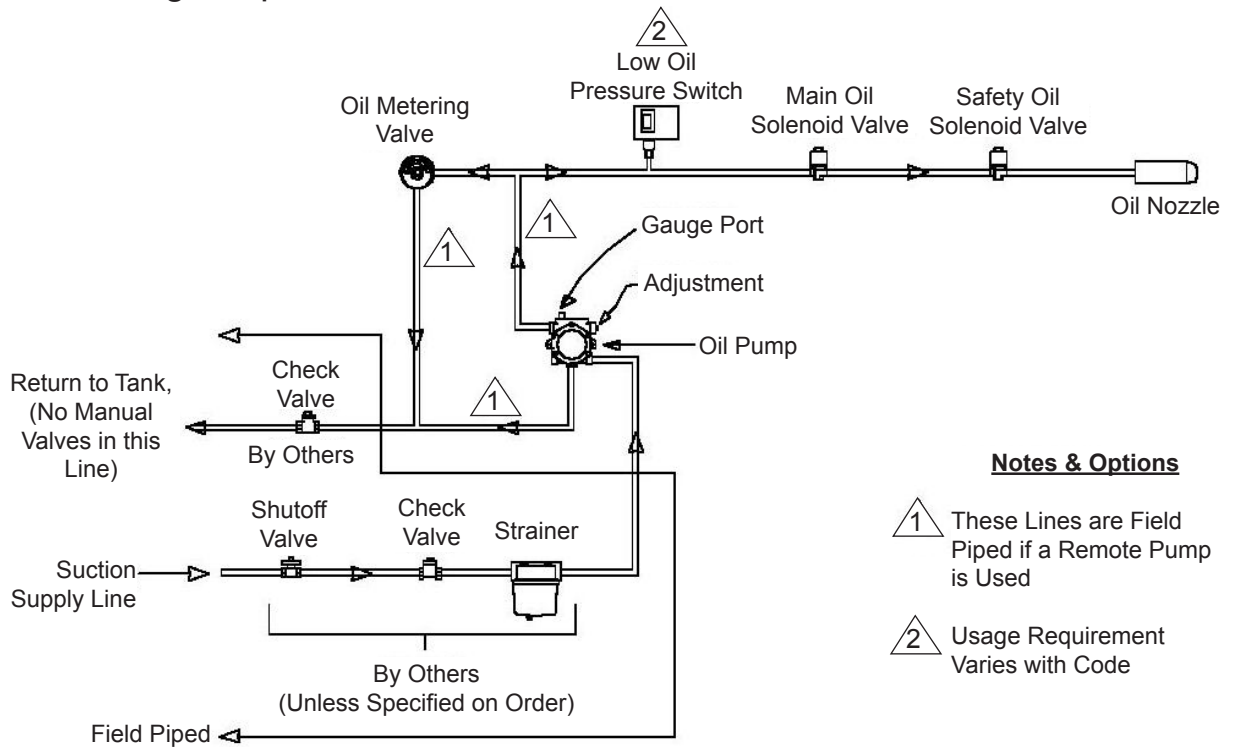
#### "A" - On - Off



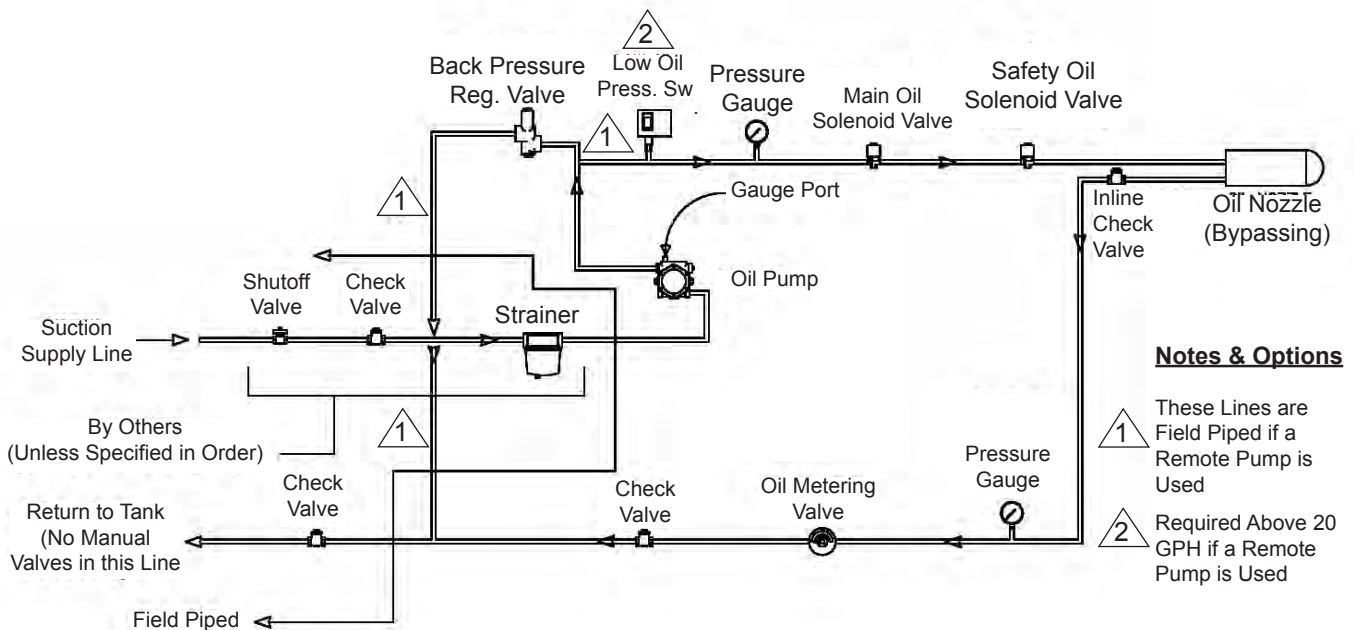
#### "L" - Low Fire Start or "H" - Low - Hi - Low



## "MP" - Modulating Simplex Nozzle



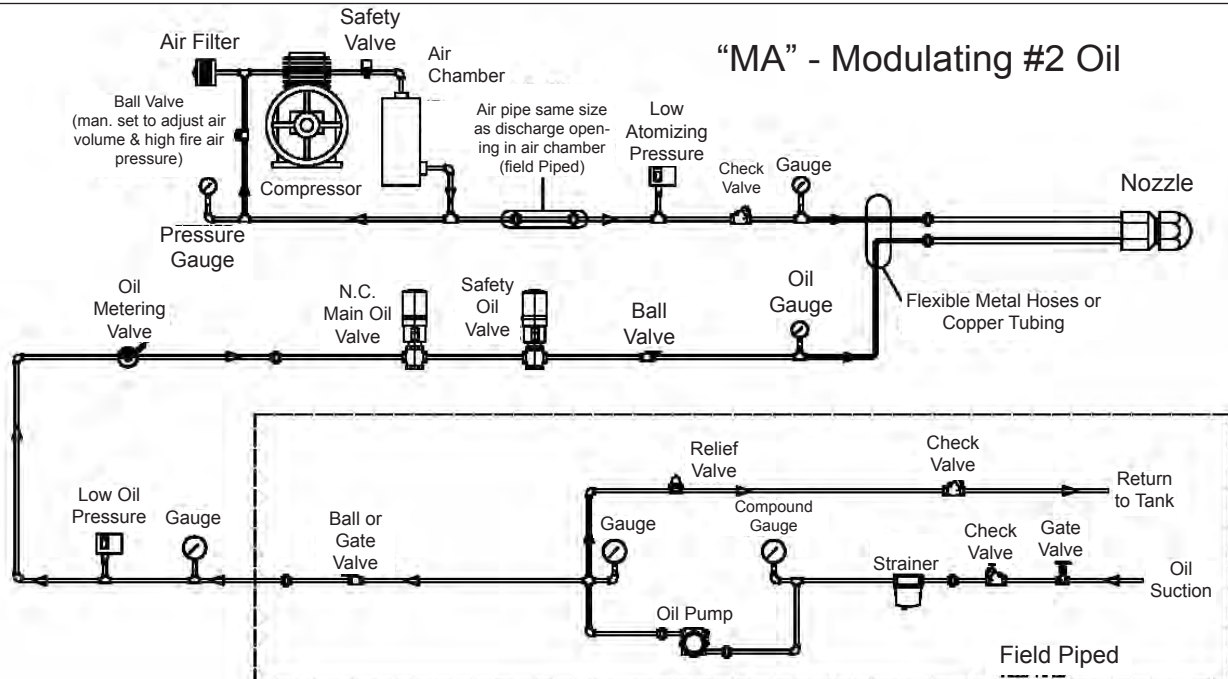
## "MR" - Modulating Return Flow Nozzles



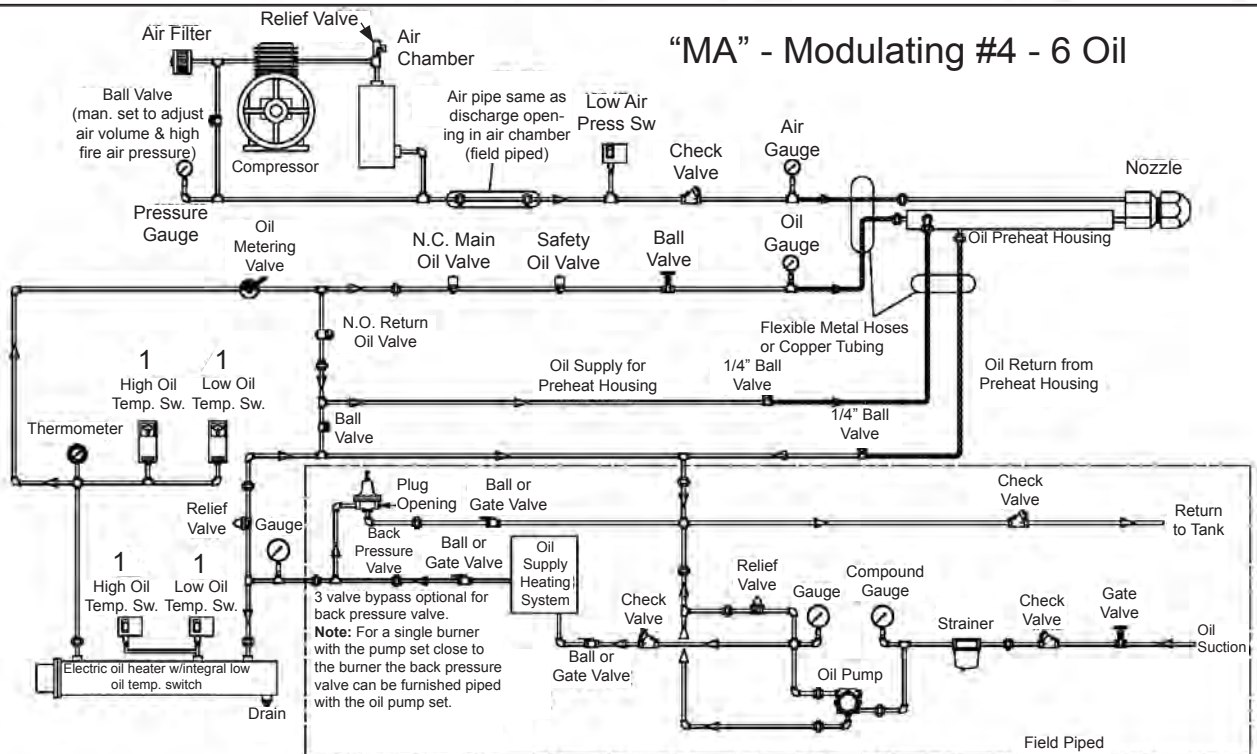


## 2. Air Atomized Oil Systems

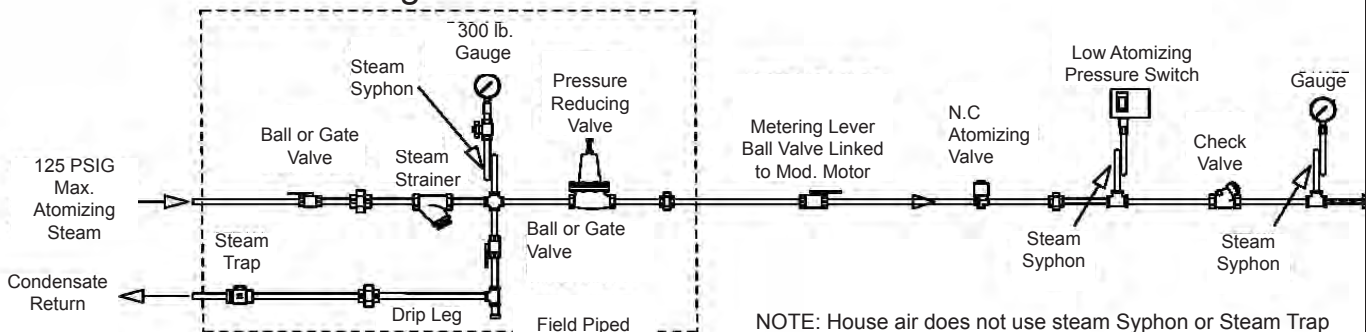
“MA” - Modulating #2 Oil



“MA” - Modulating #4 - 6 Oil



“MA” or “MS” - Modulating House Air or Steam



NOTE: House air does not use steam Syphon or Steam Trap

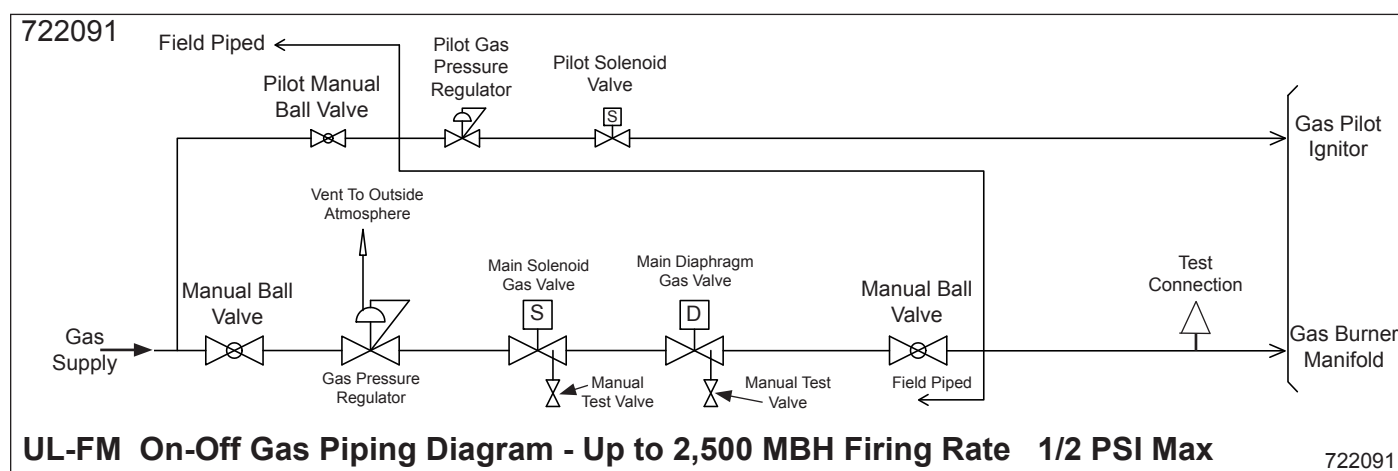


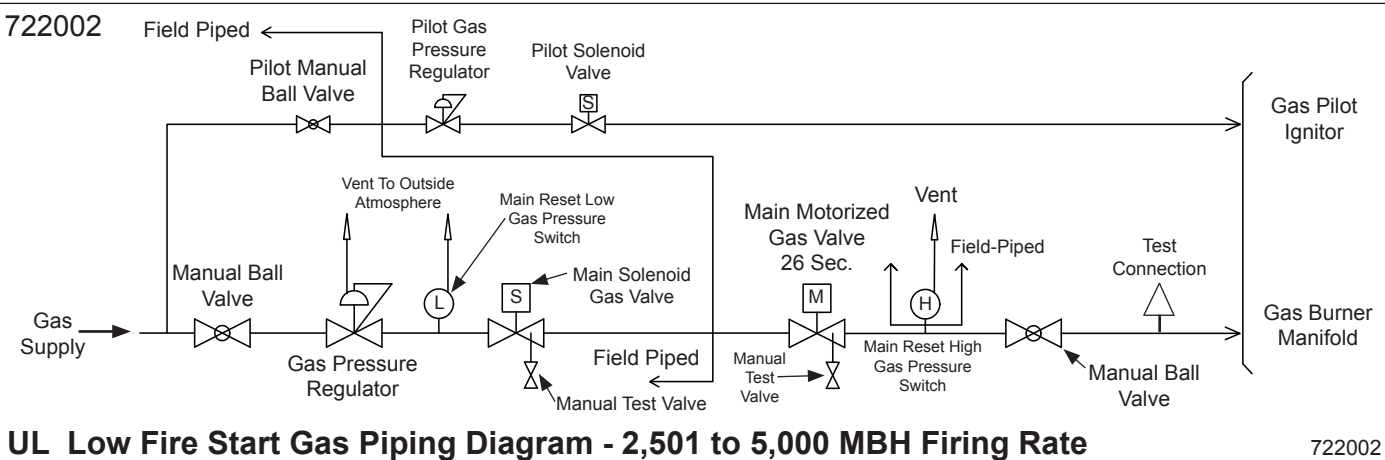
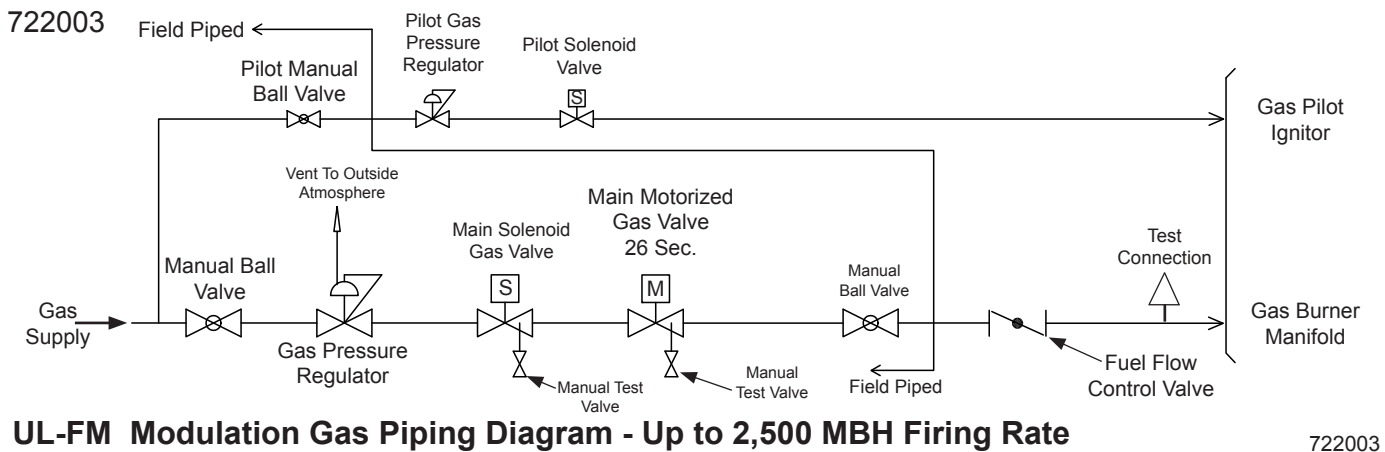
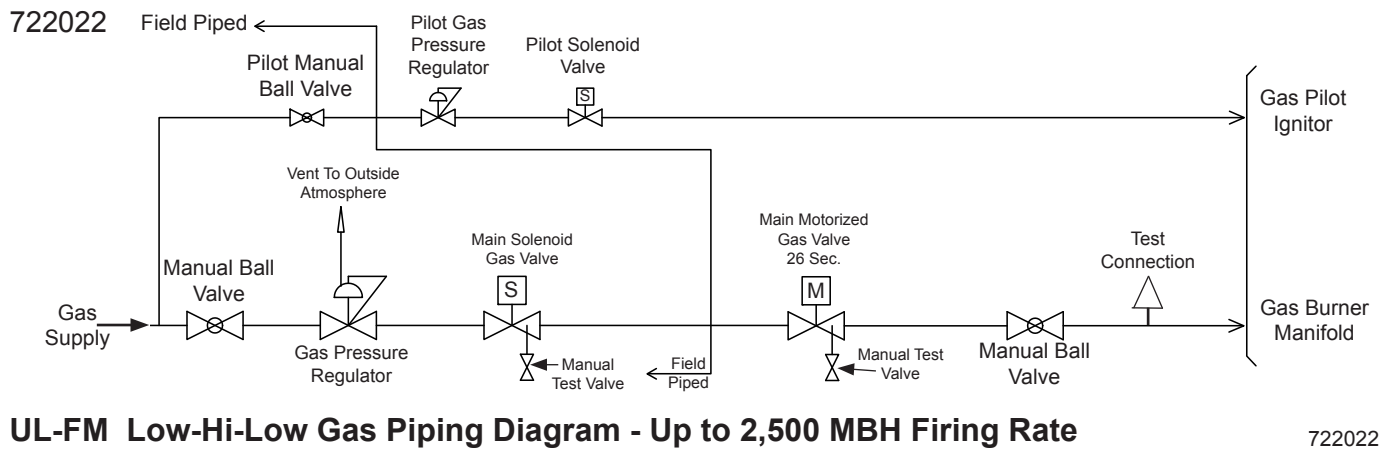
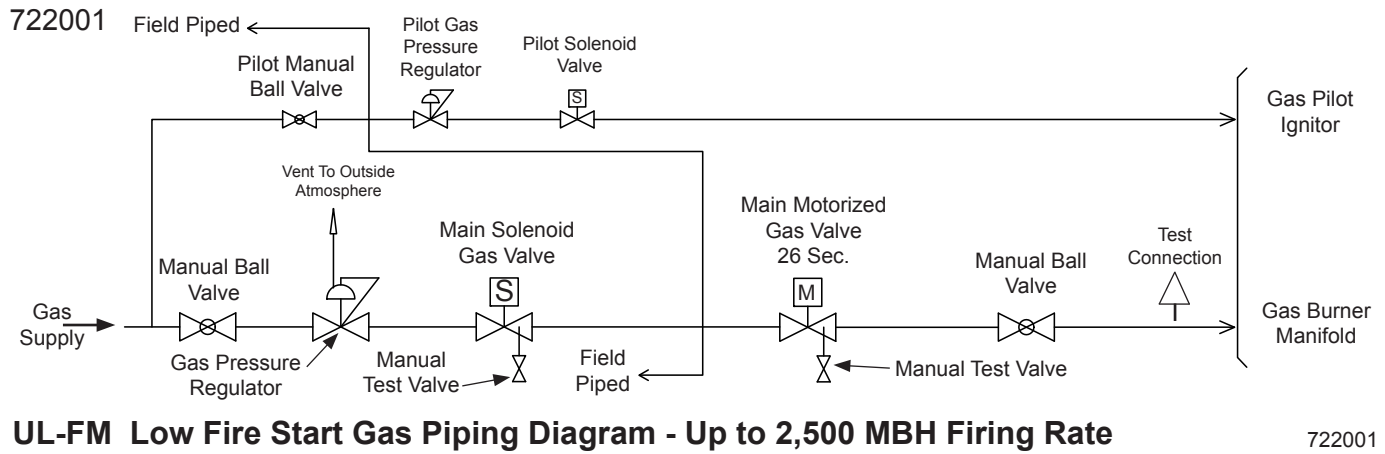
### 3. Gas Systems

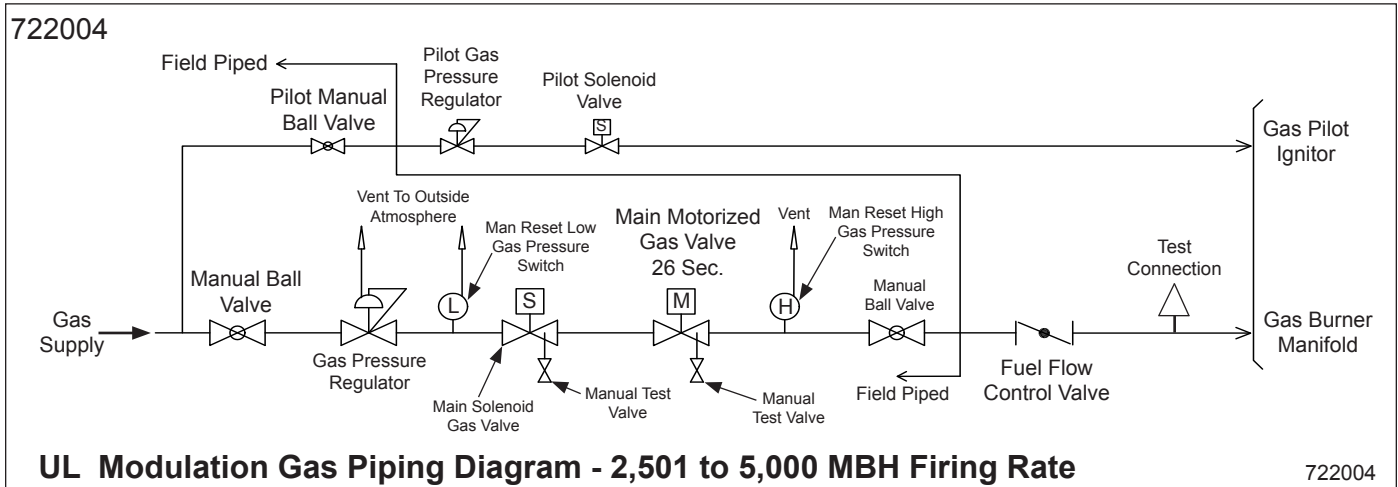
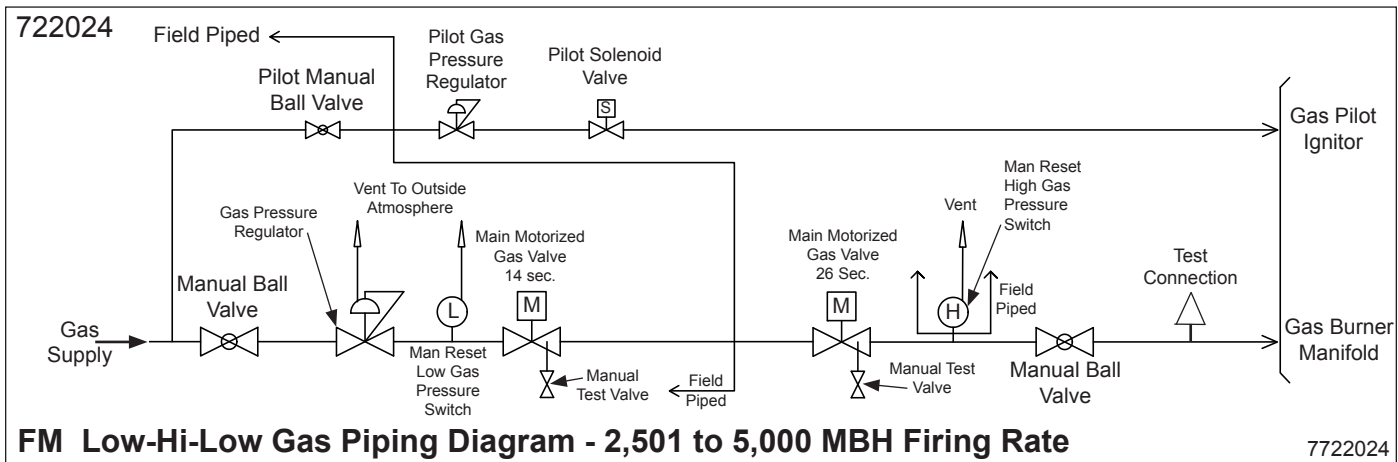
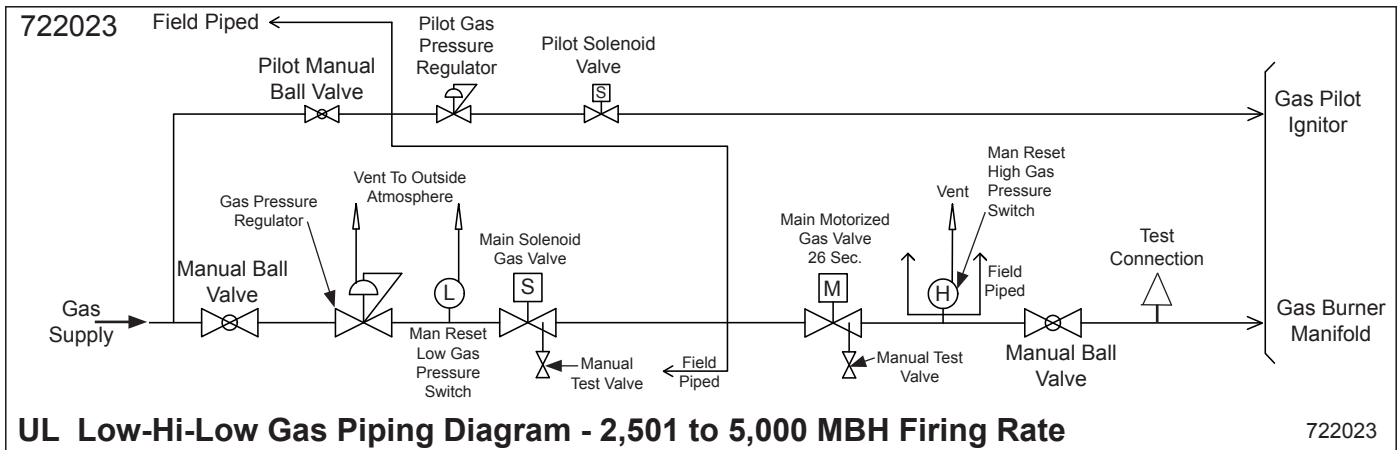
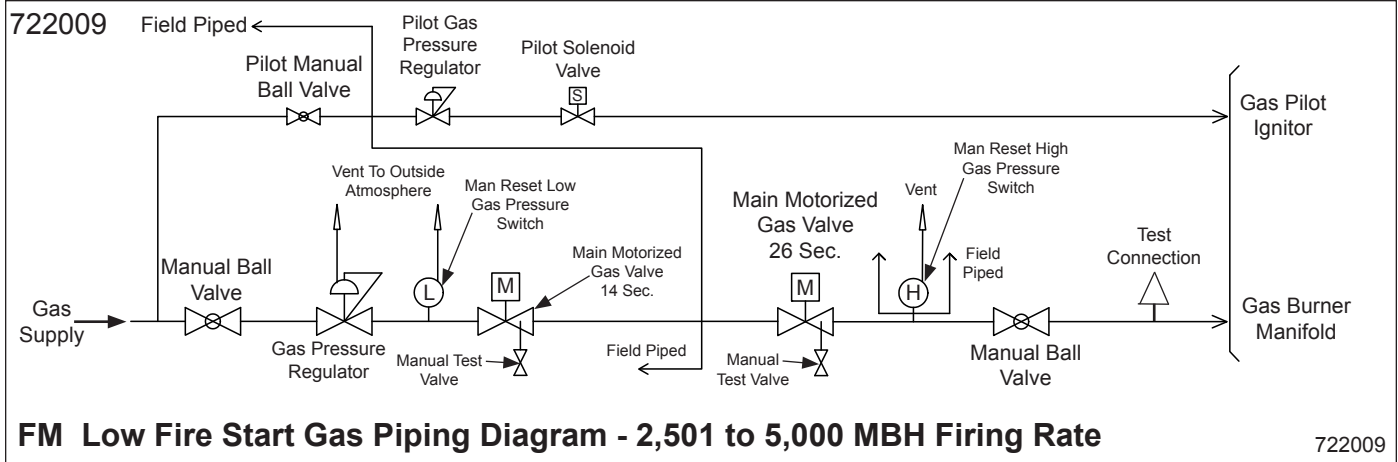
**Illustrated Gas Trains by Capacity and Code:** The following illustrations show the Webster configuration for UL, FM and IRI as grouped by UL capacity ratings. Refer to the legend below for component part identification. These illustrations are not to be used for field erection and/or system design purposes.

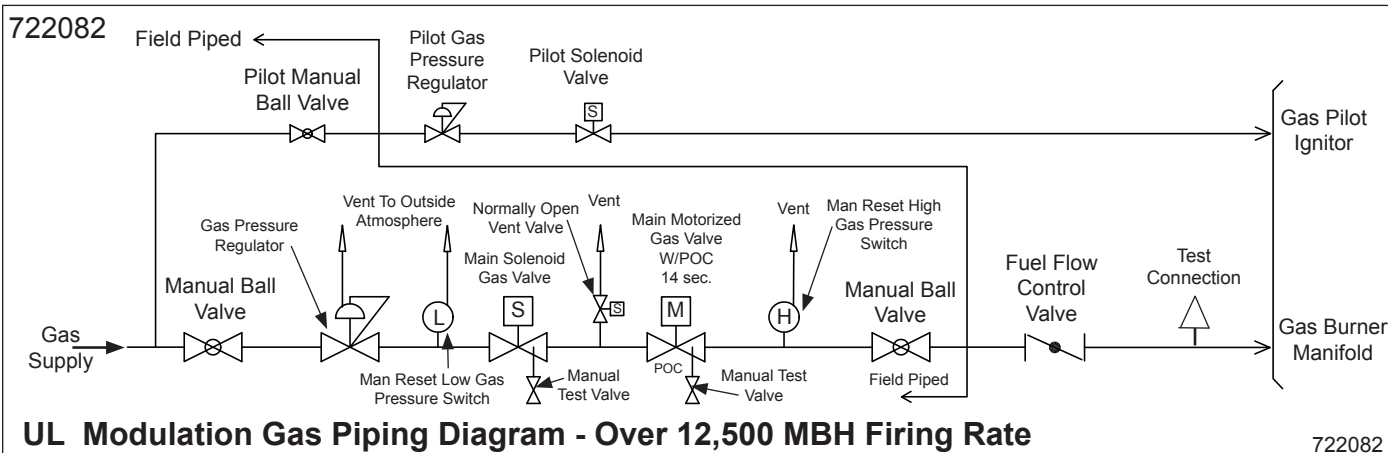
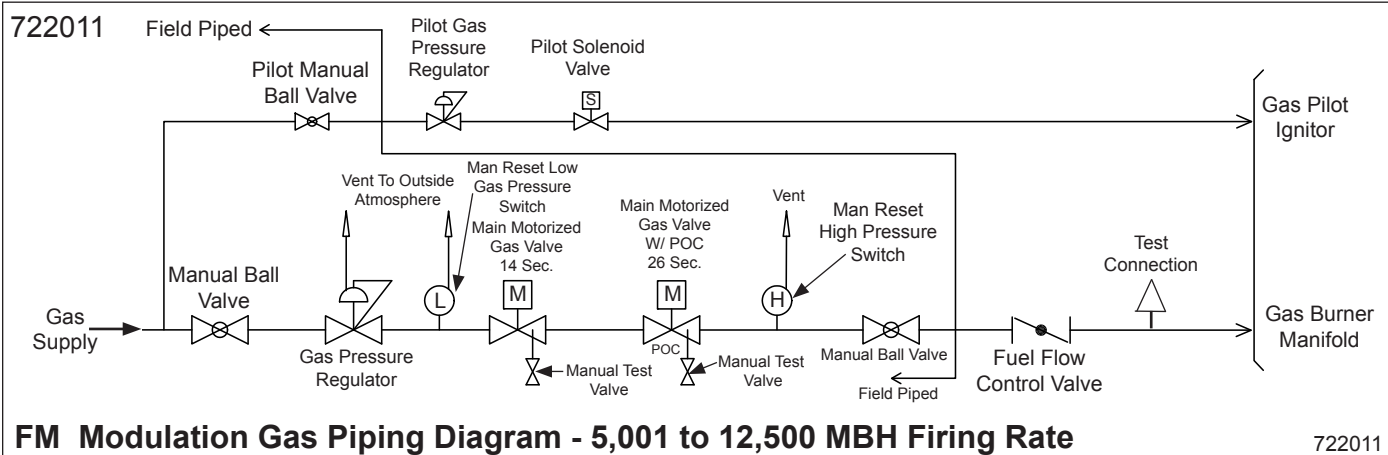
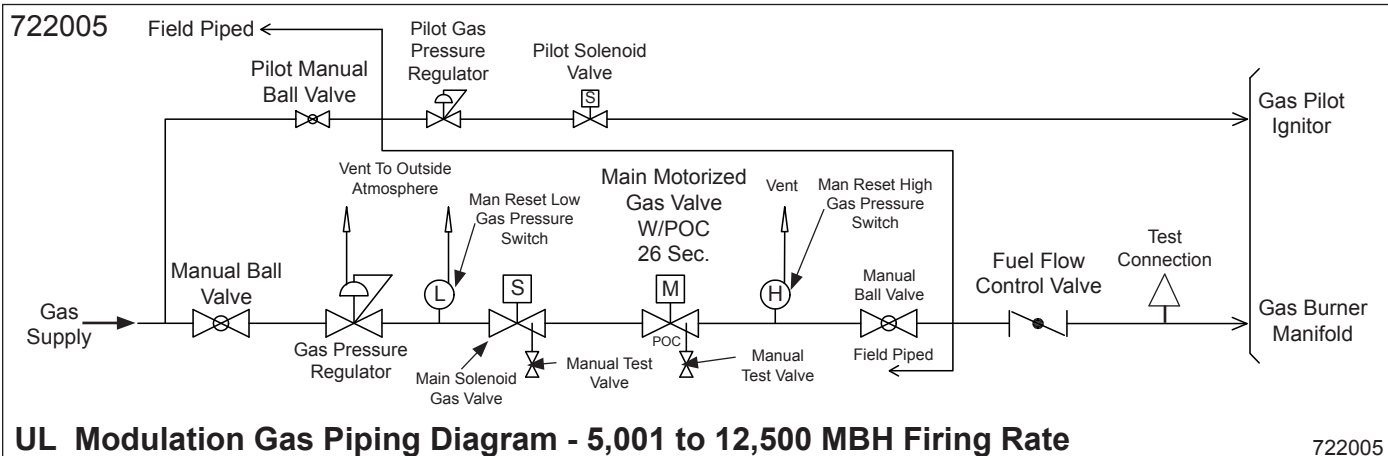
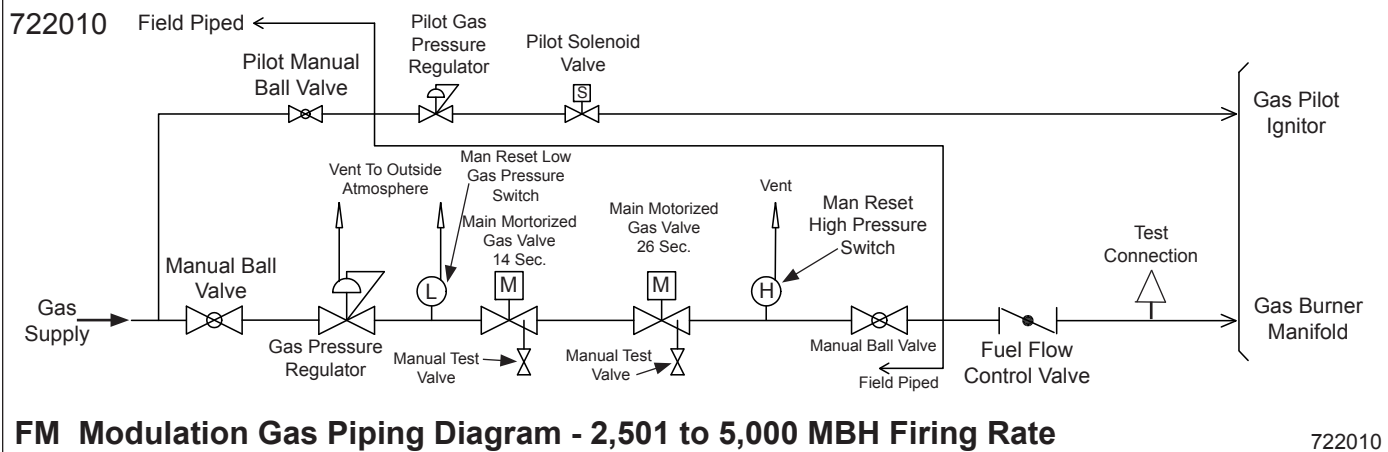
UL Capacity Range BTU/Hr.	Operation Mode	Webster Designation	Code		Illustration
			UL / GE GAP	FM	
To 2,500,000	On-Off	A	X	X	722091
	Low Fire Start	L	X	X	722001
	Low Hi Low	H	X	X	722022
	Modulating	M	X	X	722003
2,500,001 to 5,000,000	Low Fire Start	L	X		722002
	Low Fire Start	L		X	722009
	Low Hi Low	H	X		722023
	Low Hi Low	H		X	722024
	Modulating	M	X		722004
	Modulation	M		X	722010
5,000,001 to 12,500,000	Modulating	M	X		722005
	Modulating	M		X	722011
12,500,001 and Up	Modulating	M	X		722082
	Modulating	M		X	722084

**NOTE:** Pressure Drops; Pressure drop through a given gas train will vary somewhat in relation to the individual items used, the specific gravity of the gas to be burned and the overall length.

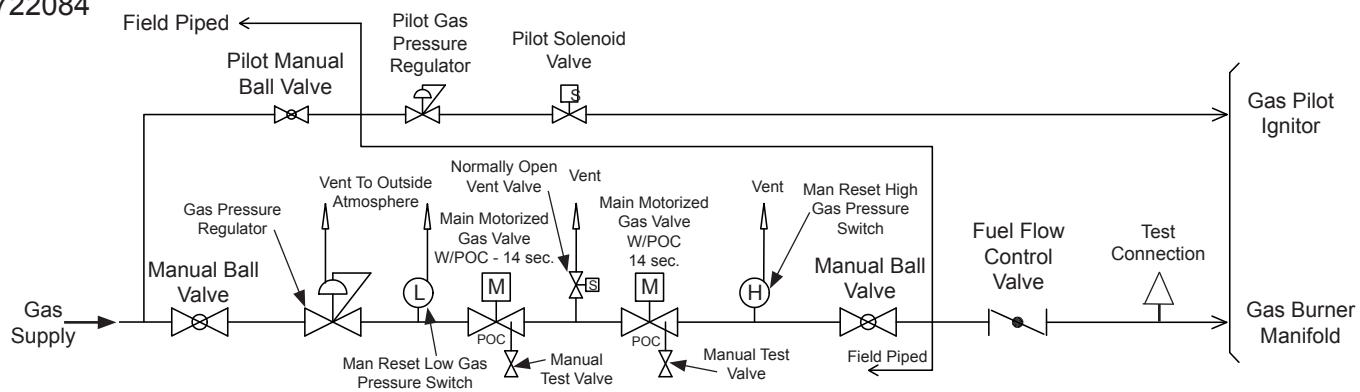








722084

**FM Modulation Gas Piping Diagram - Over 12,500 MBH Firing Rate**

722084

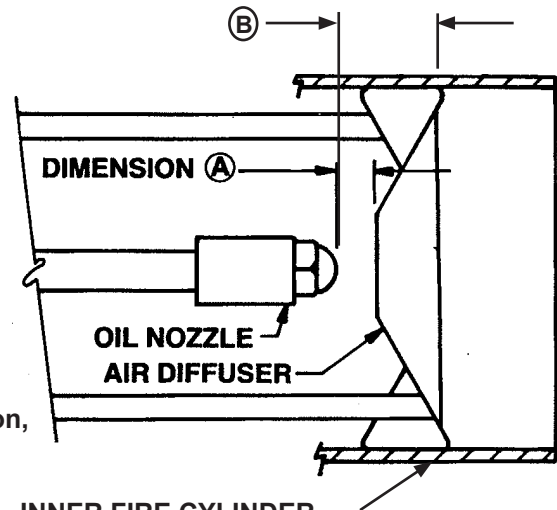
## G. INITIAL SETTINGS

The burner will be set at the factory for normal initial settings. These are only rough settings that must be adjusted at startup to match the furnace, fuel pressure and environment of the specific application. These general settings are covered in this chapter as a means of checking the burner (linkage and settings can move in shipment) or readjusting the burner if the settings are lost.

### 1. Oil nozzle position

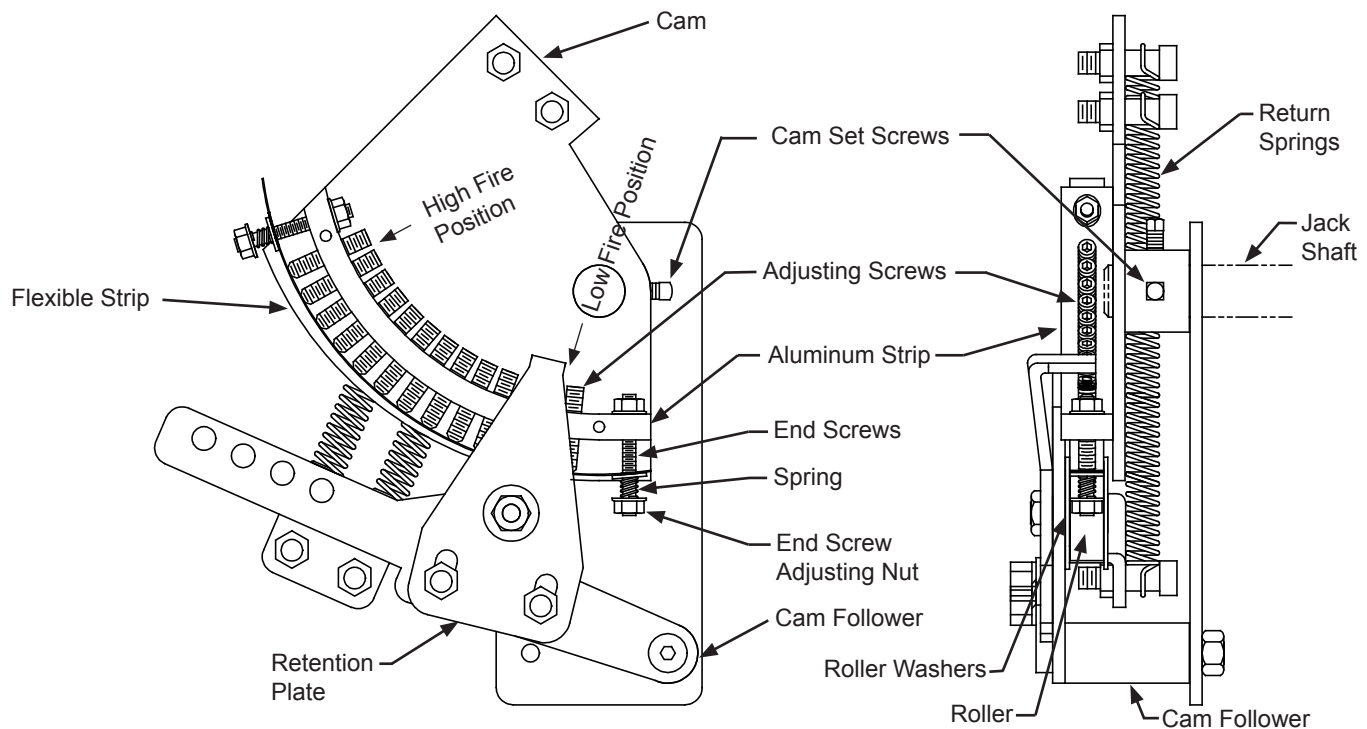
The oil nozzle initial position is shown in Figure G-2. The oil nozzle will be adjusted at start-up and may be moved in or out from this initial setting. In some cases, the oil nozzle may be inside the diffuser

**Figure G-1**  
Oil Nozzle Position,  
Gas Pilot



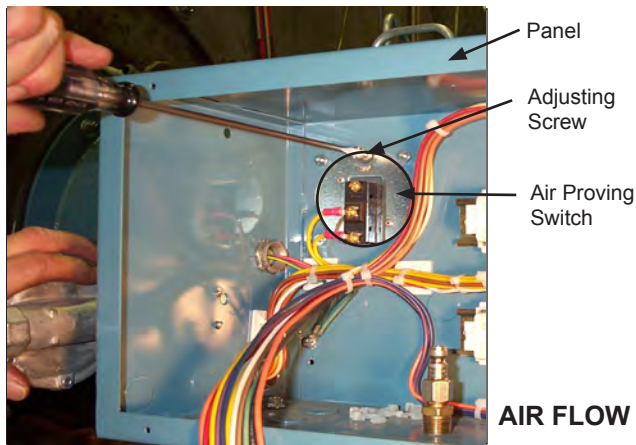
**Chart G-2**

Model	PRESSURE ATOMIZED NOZZLE				AIR ATOMIZED NOZZLE				
	Diffuser I.D.	Qty.	Spray Angle	Dimension Inches	Diffuser I.D.	Nozzle Type	Spray Angle	Dim. A	Dim. B
JB1	1 1/2"	2	30	3/8	NA	NA	NA	NA	NA
			45	1/4					
		1	30	7/8					
			45	3/4					
JB2	1 3/4"	2	30	3/4	2"	Single Port	60°	1/4"	NA
			45	5/8					
			60	1/2					
JB3	2 1/2"	3	60	5/8	2 1/2	Multi Port	80°	NA	3/8
	2 7/8"	3	60	5/8	2 7/8				



**Figure G-3**  
Fuel Cam Adjustment

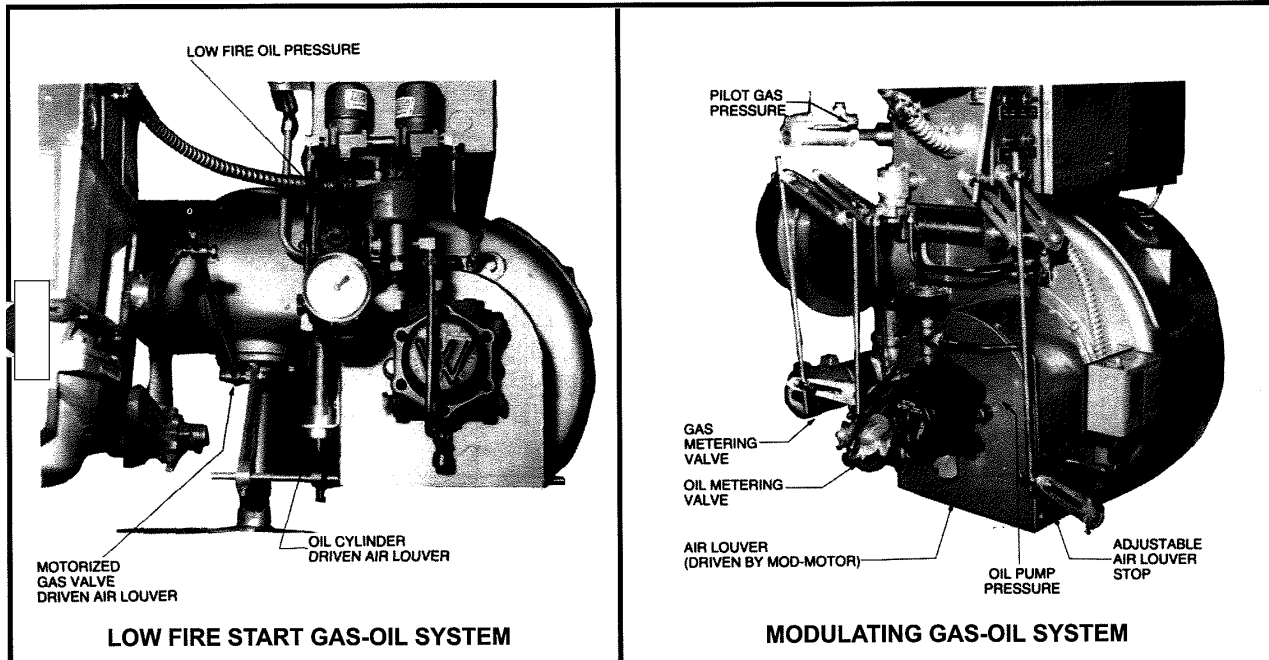
## COMBUSTION AIR CONTROL



### 2. AIR PROVING SWITCH

The air proving switch has been adjusted at the factory for an initial setting. If the switch trips during initial start-up, turn the adjustment screw ccw two full turns to reduce the trip pressure setting.

### 3. TYPICAL AIR AND FUEL ADJUSTMENT LOCATIONS



#### 4. Fuel Cam Adjustments (if applicable)

The fuel cam needs to be checked for correct travel and alignment. Positions can change during shipment and installation and they must be reviewed prior to startup. The fuel cams are mounted to the ends of the jackshaft assembly. A cam follower link follows the profile established by the adjusting screws and drives the fuel valve. A thin metal band is used between the screw and cam follower to provide a smooth profile. The adjusting screws are backed by compressed nylon inserts, which provide a resistance to turning.

The cam (Figure G-3) should be checked for the following conditions:

- At the low fire position, the roller should be between the first two adjusting screws. If not, adjust the position of the cam accordingly, making sure to maintain the same low fire fuel valve position.
- When the linkage is modulated from low to high fire, the roller must stay in the center of the adjusting screws within 1/8". If needed, the two cam set screws can be loosened and the cam moved to center it on the roller.

- At high fire, the roller should be between the last two adjusting screws.

- The adjusting screws should form a smooth contour with no jumps between the screws.

- In preparation of startup, the retention plate can be removed temporarily to make it easier to adjust the screws.

#### THE RETENTION PLATE MUST BE REPLACED WHEN SETUP IS COMPLETE.

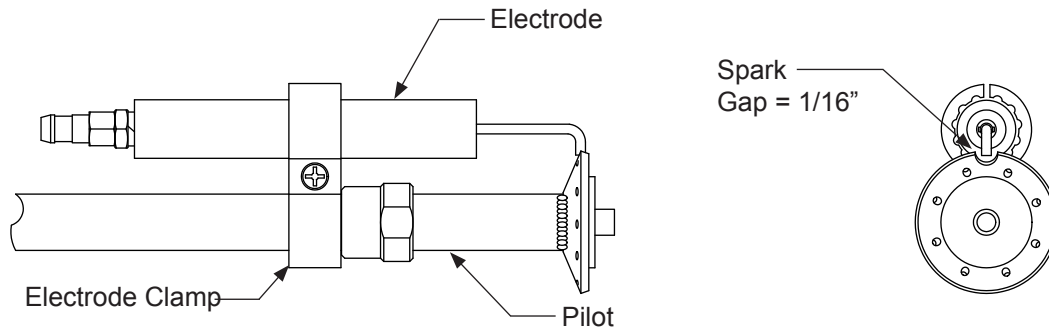
If the unit is equipped with a parallel positioning system (linkageless), the control valves can be positioned and operated in a similar manner, but accomplished through the controller. Refer to the instruction manual for details.

#### CAUTION

LINKAGE AND ACTUATOR MOUNTINGS CAN BE BENT OR MOVED DURING SHIPMENT AND INSTALLATION. THEY MUST BE CHECKED PRIOR TO OPERATION AND ANY FAULTS CORRECTED. FAILURE TO CORRECT A MISALIGNED CONTROL WILL RESULT IN PREMATURE FAILURE.



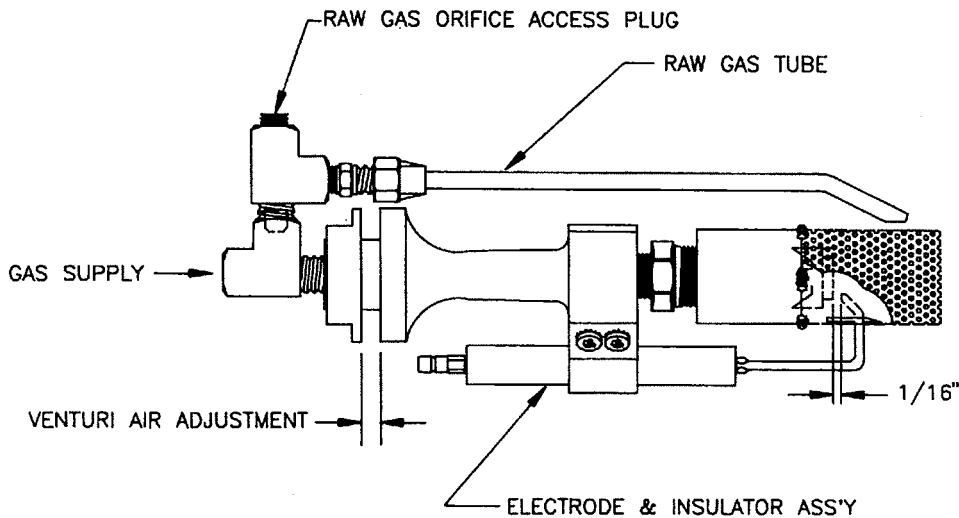
## H. IGNITION SYSTEMS



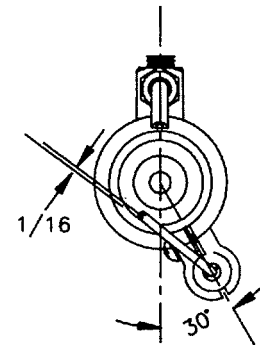
**Figure H-1  
JB1 & JB2 Gas Pilot**

Note: Required 2 1/2" - 3" wc pressure for natural gas and 1/2" - 2" for LP, as measured at the last solenoid in the pilot train.

**Figure H-2 JB3 PILOT ASSEMBLY  
(SUPPORT TUBE MOUNTED PILOT)**



Natural Gas Pressure;  
4 - 6" wc  
LP Gas Pressure;  
1.5 - 2.5" wc



### 1. Gas Pilot Assembly

A crucial part of reliable burner operation is a dependable pilot, which must be properly adjusted and kept clean. A gas pilot is standard for all models except JB1 through JB2-20 straight oil pressure atomizing burners which have direct spark ignition as standard. The following illustrations show the typical configuration and nominal adjustment parameters of each pilot.

Figure H-1 shows the JB1 & JB2 gas pilot. Figure H-2 shows the JB3 gas pilot. Figure H-3 shows how the pilots are positioned in the burner drawer.

Pilot gas pressure should be measured at the 1/8" port located on the downstream side of the last pilot solenoid valve.

### 2. Oil Nozzle Position, Direct Spark Oil.

Figures H-5 and H-6 show the position of direct spark ignition and nozzle positions. These are initial settings and will be adjusted at start-up.

### 3. Air Damper Position

On a straight gas burner, the air damper should be open about 1/4" at low fire and close to full open at high fire. In

some applications, the pilot requires an orifice in the pilot gas supply line. With the exception of the JB3, this orifice is located external of the blower housing.

The pilot to diffuser dimension is the distance of the face of the pilot to the outer diameter of the diffuser.

For an oil or combination burner, the air damper should be open about 3/8" at low fire and close to full open at high fire.

### 4. Gas Modulating Control Valve Position

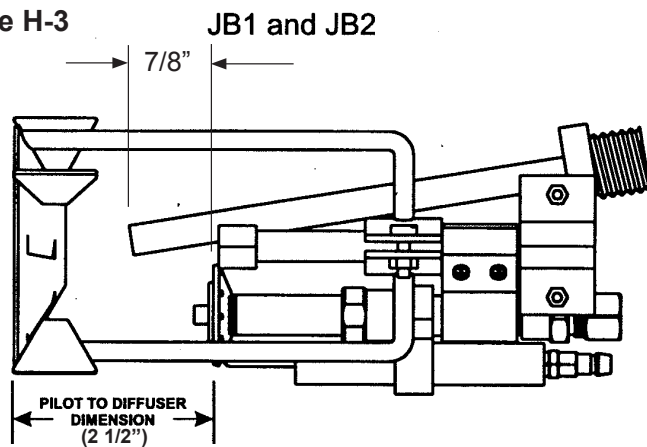
The gas valve should be open about 10% at low fire and stroked to about 60% open at high fire.

### 5. Oil Modulating Control Valve Position.

For pressure atomizing, the low fire position should be adjusted to get the correct low fire pressure, as stated on the rating label. Typically, this would be 100 psi for simplex systems and 65 psi for return flow nozzles. The high fire position should be about 45° to 60° travel from low fire.

For air atomizing, the low fire should be on about #2 position and the high fire should be about the #8 position.

Figure H-3



JB3

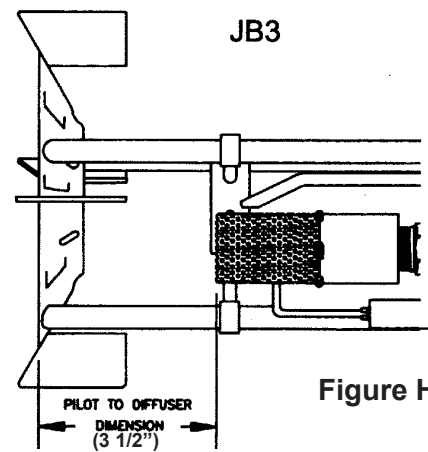
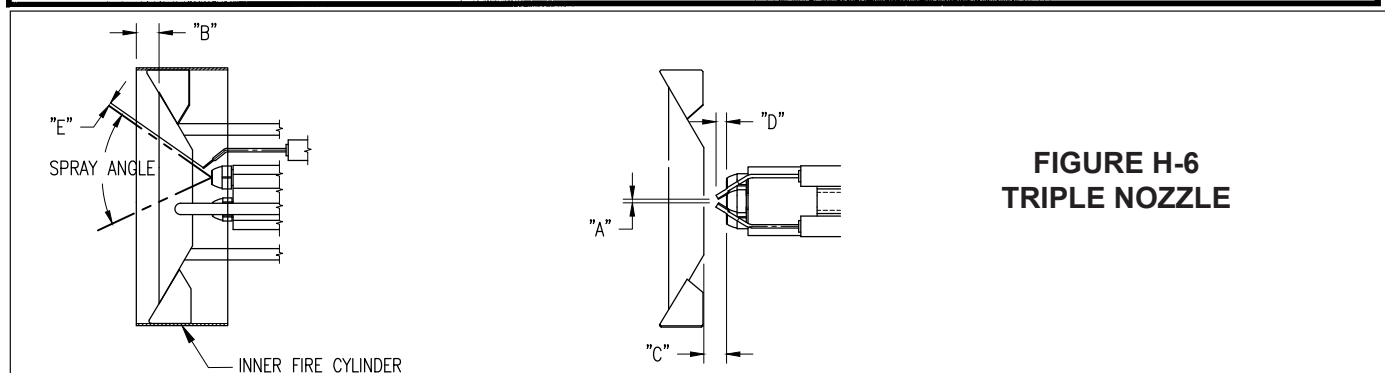
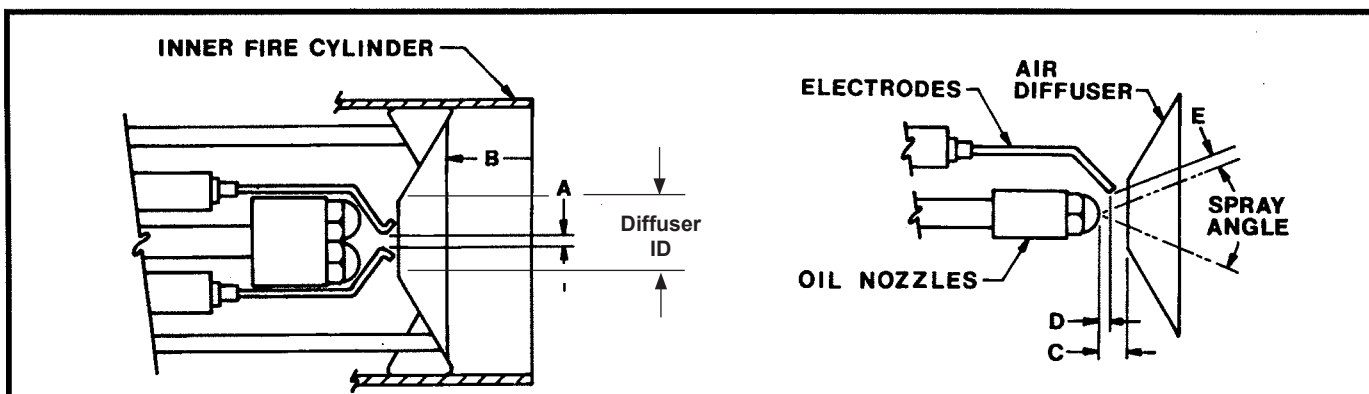


Figure H-4

FIGURE H-5 DIRECT SPARK PRESSURE ATOMIZING OIL IGNITION (See Table Below)

FIGURE H-6  
TRIPLE NOZZLE**DIRECT SPARK OIL IGNITION (See Table Below)**

**Note:** These represent initial nozzle settings. The final position will be determined in the start-up process.

FIGURE H-7 DIMENSION TABLE FOR DIRECT SPARK OIL IGNITION (Pressure Atomizing)								
BURNER DATA		NOZZLE DATA		ADJUSTMENT SETTINGS (Inches)				
Model	Diffuser I.D.	Qty.	Spray Angle <sup>o</sup>	A	B	C	D	E
JB1	1	1	30	1/8	1/2	1/2	5/16	1/4
		1	45		3/8	3/8		
	1 1/2"	1	30	1/8	1 1/2	7/8	5/16	1/4
		1	45			3/4		
		2	30			1/4		
		2	45			1.4		
JB2	1 3/4"	2	30	1/8	1 1/2	3/4	5/16	1/4
			45			5/8		
			60			1/2		
JB3	2 7/8	3	60	1/8	1 1/2	5/8	3/8	1/8
			80			7/16		

## I. STARTUP AND OPERATING ADJUSTMENTS

1. Pre-start Checkout
2. Linkage Adjustments
3. Fuel Cam Adjustments
4. FGR Adjustment
5. Burner Drawer Adjustments
6. Single Fuel Setups
7. Combination Gas and Pressure Atomized Oil
8. Combination Gas and Air Atomized #2 Oil
9. Combination Gas and Heavy Oil
10. Gas Setup
11. Pressure Atomized Oil Setup
12. Air Atomized #2 Oil Setup
13. Heavy Oil Setup
14. Operating Control Adjustments
15. Limit Tests
16. Pilot Test
17. Burner Shutdown
18. Restart After Extended Shutdown

This section covers the startup and operating adjustments of the Webster Models JB and JBX burners.

### WARNING

**BURNER STARTUP, COMBUSTION ADJUSTMENTS AND LIMIT CONTROLS ADJUSTMENTS SHOULD ONLY BE PERFORMED BY TRAINED AND EXPERIENCED SERVICE TECHNICIANS. ATTEMPTING TO PERFORM THESE FUNCTIONS WITHOUT THE PROPER TRAINING AND EXPERIENCE CAN RESULT IN EQUIPMENT DAMAGE, PERSONAL INJURY OR DEATH.**

Before proceeding with the startup and adjustment, be sure that the overall installation is complete. Review the boiler operating and installation manual, as well as all control manuals to verify that all equipment is ready for operation. These manuals must be read and understood prior to starting the equipment.

If you are not qualified to service this equipment, DO NOT TAMPER WITH THE UNIT OR CONTROLS - CALL YOUR SERVICEMAN.

At the conclusion of the startup, document valve and linkage positions, pressures and settings for future reference.

### READ AND SAVE THESE INSTRUCTIONS FOR FUTURE REFERENCE.

#### 1. Pre-Start Check List

Before starting the burner, a complete review of the installation, wiring and piping of the burner, boiler and all supporting equipment must be complete and all of these items must be ready for operation prior to starting. The following is a general review:

\_\_\_\_\_ All wiring is connected. Test pulls on wire show them to be tight.

\_\_\_\_\_ All fuel lines are connected and tight.

\_\_\_\_\_ Pilot gas is connected.

\_\_\_\_\_ Burner is mounted to vessel and floor, with all bolts secured.

\_\_\_\_\_ The linkage is correct (in low fire position) and tight.

\_\_\_\_\_ The stack is connected and routed to the outside. Draft controls are installed and operational, if needed.

\_\_\_\_\_ Gas vent lines are connected and routed to the outside, if required per code.

\_\_\_\_\_ Do not start the unit unless all cleanout doors are in place and secured.

\_\_\_\_\_ The vessel is completely installed, filled with water and operating controls checked.

\_\_\_\_\_ Support equipment is in place and ready (feed pumps, draft controls, steam/hot water systems, boiler limits and controls and feedwater systems).

\_\_\_\_\_ A load must be available for the burner startup and adjustment process. The burner must be operated at high rates for extended periods of time and the load must be capable of using this energy.

\_\_\_\_\_ A combustion analyzer with O<sub>2</sub> and CO (for gas) must be available to tune combustion. A smoke spot tester must be available for oil firing. If this is a low NO<sub>x</sub> burner, a NO<sub>x</sub> analyzer must be available. All of these analyzers must be recently calibrated and able to provide accurate readings.

\_\_\_\_\_ Other test equipment, including manometers, gauges and volt meter shall be available.

\_\_\_\_\_ Manometer or gauge on the gas manifold.

\_\_\_\_\_ Manometer or gauge before and after gas pressure regulator.

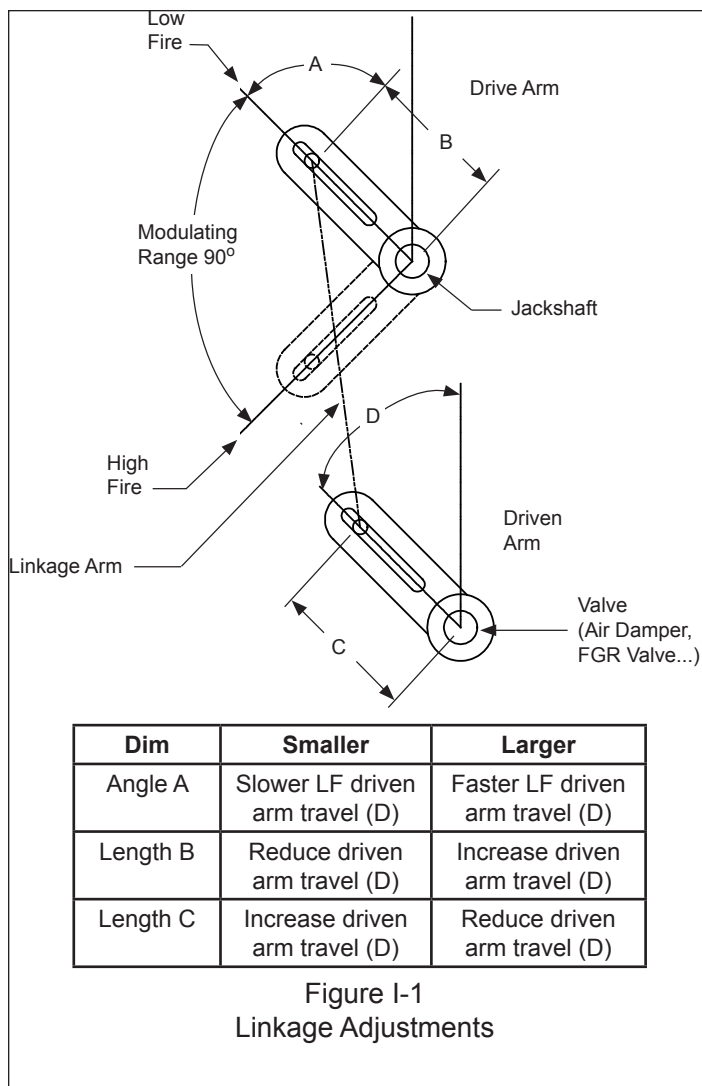
\_\_\_\_\_ Draft gauge or manometer (at stack outlet).

\_\_\_\_\_ Draft gauge or manometer for furnace pressure.

#### 2. Linkage Adjustments

Adjusting the air damper and FGR control valve on a linkage system requires an understanding of linkage setups. The rate of change for the fuel valve, air damper and FGR valve must be matched by how the linkage is setup. If the air damper or FGR valve opens too quickly, the flame may become unstable or the NO<sub>x</sub> levels may not meet the requirements. There are a few general guidelines that should be followed in setting up the linkage of a burner,

a. The linkage must provide the correct stroke of the valve, from low to high fire. Increasing the length of the drive crank arm (B) or decreasing the length of the driven crank arm (C) will increase the valve travel. To reduce valve travel, decrease B or increase C (Figure I-1).



**b.** Decreasing the angle of the drive arm will slow the initial valve travel (and speed up the travel at high fire). This would be done to get the air damper to match the fuel valve action.

### 3. Fuel Cam Adjustments

The cam is used to adjust the intermediate fuel rate with the low and high fire settings done by the linkage connections. The intermediate rates can be adjusted by turning the adjusting screws in the clockwise direction to increase fuel input and decrease the % O<sub>2</sub> level in the flue gases. Turning the adjustment screws counterclockwise will decrease fuel input and increase % O<sub>2</sub> in the flue gases.

The following guidelines should be used for adjusting the cam:

- When adjusting the screws, the adjacent screws must also be adjusted to provide a smooth contour from screw to screw. When complete, the flexible strip between the adjusting screws and the roller must come in contact with each screw, providing a smooth transition from low fire to high fire.
- The end screws (or nuts) can be adjusted to hold the strip against the screws, but should not deform the strip.
- There should be no upsets in the profile, where the flex-

ible strip is required to move to a screw position where it is initially not in contact with the screw. Also, the movement from one screw to the next cannot be too large (more than 1/8"). This will cause the strip to flex and will lead to premature failure of the strip.

**d.** The adjusting screws have a limited range of adjustment. They can be turned in until they are flush with the aluminum bar and adjusted out until the side washers of the roller contact the aluminum bar.

**e.** If any adjusting screw does not turn with some resistance, the cam must be replaced.

**f.** When the cam adjustment is complete, the retention plate must be installed. The retention plate will help insure that the fuel valve position will not get far from its ideal position, even with interference or sticky valve operation.

#### WARNING

**IF THE CAM ADJUSTING SCREWS DO NOT HAVE RESISTANCE TO TURNING, THE CAM SHOULD BE REPLACED, AS THE SCREWS MAY CHANGE POSITION. FAILURE TO CHANGE A DEFECTIVE CAM MAY RESULT IN INJURY OR DEATH.**

#### CAUTION

**LARGE CHANGES FROM ONE ADJUSTING SCREW TO ANOTHER WILL RESULT IN PREMATURE FAILURE OF THE CAM AND MAY PREVENT THE BURNER FROM OPERATING PROPERLY.**

**g.** If the contour has a sharp rise in the cam screw profile, trying to open the valve very quickly in the first few screws, the linkage should be readjusted to cause the air damper to open slower (make the jackshaft drive arm more parallel to the linkage rod). Likewise, the opposite contour can be corrected by speeding up the air damper drive (Figure I-1). The final cam screw profile should be close to the profile of the cam with no abrupt changes.

### 4. FGR Adjustments

Flue gas is recirculated back into the burner to reduce the flame temperature, which reduces the NO<sub>x</sub> level. High quantities of flue gas result in lower NO<sub>x</sub> levels, but can also result in flame instability if there is too much FGR. Natural gas fuel can handle larger quantities of flue gas than oil and can have much lower NO<sub>x</sub> levels as a result. Generally, the NO<sub>x</sub> levels only apply to gas firing and oil firing is not adjusted for NO<sub>x</sub> levels. There may be exceptions to this, and the orders details should be reviewed to identify any special combustion requirements.

Dual fuel units may need additional adjustments and compensation to handle the different FGR rates between natural gas and #2 fuel oil. Units that require gas NO<sub>x</sub> levels above about 45 ppm can operate with the same quantity of FGR on both fuels and no additional controls or adjustments are needed. Burners

equipped with Posi-Control can be adjusted for individual air and FGR settings on both fuels and can easily handle these variations, even with lower NOx levels. Linkage burners operating at 30 ppm NOx (natural gas) are equipped with a potentiometer in the control panel that will allow the shut-off valve to partially open and allows a small amount of FGR to flow when firing oil. This keeps the oil inputs close to the gas input (lower FGR rates increases the combustion air rate). The oil combustion is generally better when FGR is used at low rates resulting in a lower NOx level. Linkage levels with NOx levels under 30 ppm will also use a multiple modulation motor to provide separate gas and oil low fire and high fire positions.

Linkage dual fuel units may also be equipped with the optional multiple set point (Landis) modulation motor in addition to the above potentiometer. This motor allows for different low and high fire settings on gas vs oil to obtain the correct airflow for each fuel and optimize the turndown on gas.

On a dual fuel unit, the natural gas should be done first to properly set the FGR inlet tube. Once gas is setup, oil can be set.

For dual fuel linkage systems, the following guidelines should be used:

- A 60 ppm system can be adjusted with the same FGR rate on both fuels. The FGR control valve is set on gas and oil follows that setting.
- A 30 ppm system uses the FGR limiting potentiometer (located in the control panel) to obtain a partial flow of FGR when firing oil. The FGR control valve is set when firing gas. The FGR limiting potentiometer is adjusted to improve combustion but not cause instability. The combustion needs to be checked at several firing rates.
- Under 30 ppm, separate gas and oil operating points are established in the modulating motor. Parallel positioning (linkageless) systems allow all of the valves to be positioned independently for each fuel. For this reason, the setup sequence can be more flexible.

## 5. Burner Drawer Adjustments

The burner drawer has several adjustments built into the design that allow the combustion to be tuned. While this can simplify the combustion tuning process, care must be used to retain the relative position of other components during this sequence. If these adjustments are required, follow the sequence listed to perform the adjustments.

Before any adjustments are made, the position of each component must be marked. A felt tip pen or a combination of masking tape and another type of pen can be used.

- Mark the distance of the oil gun tube from the backplate.
- Mark the distance of the gas pilot line to the backplate.
- a.** To adjust the diffuser to inner fire cylinder dimension:
  - Measure the dimension from the backplate to the end of the oil gun tube. This dimension, along with the initial position will determine the limit of the adjustment. For example, if the diffuser is 1 inch behind the fire end of the inner fire cylinder, then it can be adjusted in 3/4 inch or out 1/2 inch to stay within the limits of 1/4 inch to 1 1/2 inch diffuser to fire

end of the inner fire cylinder dimension.

- Loosen the two setscrews locking the pilot gas line and gun tube to the backplate.
- Adjust the diffuser by moving the oil gun tube in and out the amount determined above. When the best position is found, lock into place with the two setscrews on the oil and pilot tubes.
- b.** To adjust the oil nozzle to diffuser position:
  - Adjust the oil nozzle to obtain the best combustion.
  - Watch for spray back on the diffuser when the oil nozzle is pulled too far back. The flame may appear good but carbon will quickly develop on the diffuser.
  - The drawer assembly must be removed to adjust the oil nozzle to diffuser position.

The burner drawer must be removed for access to components, follow the following steps:

- a.** Disconnect the gas pilot line. Move the pilot line so the drawer can be pulled out without interference.
- b.** If equipped with oil, disconnect the oil line(s), and move the oil line out of the way to allow the drawer to be pulled.
- c.** Loosen and remove the screws on the burner drawer.
- d.** Disconnect the ignition cable from the drawer assembly. It is attached with a snap-on fitting.
- e.** Pull the drawer out, holding the drawer centered in the opening to prevent it from hanging up while being pulled out.
- f.** Disconnect the scanner by screwing it off of the scanner tube. In some cases, the scanner simply pulls out, with a spring tension. Secure the scanner so that it is protected from shock.
- g.** Set the drawer down horizontally, do not set it on the diffuser as it may flatten some fins or change positions.

To re-install the burner drawer, simply work the procedure in reverse.

## 6. Single Fuel Setups

Single fuel burners can be adjusted following the procedures outlined in Section 10 for gas firing; Section 11 for pressure atomized oil, Section 12 for Air atomized #2 oil and Section 13 for heavy oil firing.

The procedures for each of the systems (linkage, cams, FGR) must be completely understood and followed as part of the setup process.

## 7. Combination Gas and Pressure Atomized Oil

Combination burners, firing both gas and oil, require some compromises in the setup because they share common controls for both fuels. In this case, linkage units must have the gas input adjusted to match the oil inputs because there is little flexibility in adjusting the oil rates. Oil will be setup first and will set the air damper positions to support the low and high fire oil inputs. Follow the procedure outlined in section 11 to complete the oil setup. Then setup the gas input as defined in section



10, using the air damper positions defined by oil, and adjusting the gas input to match the air damper settings.

If the burner is equipped with an optional multiple set-point modulating motor or parallel positioning, the low and high fire rates, as well as lightoff rates, can be set independently for each fuel. In this case, the gas is adjusted first, to set the air damper locations for gas firing, as defined in Section 10. Once gas is set, oil is setup as defined in Section 11, except that the multipoint modulating damper motor is adjusted to bring the low fire air setting to match the oil needs.

There are several different options available that can alter the exact setup details, and these must be evaluated prior to startup so that the procedures can be adjusted accordingly. The procedures given are for linkage systems. Parallel positioning (linkageless) systems allow for much more flexibility in the fuel, air and FGR settings on each fuel, and can be tuned to better match each fuels needs. The setup details for linkageless controls will follow the same general sequence, but differ in specifics for setting the valve positions.

## **8. Combination Gas and Air Atomized #2 Oil**

Combination burners, firing both gas and oil, require some compromises in the setup because they share common controls for both fuels. Air atomized #2 oil firing can have turn-downs and air damper positions very similar to gas firing, simplifying the setup. If the burner is equipped with FGR, gas must be started first to set the FGR control valve positions to obtain the correct NO<sub>x</sub> performance. If there is no FGR, either fuel can be started first, however the setup cannot be finalized until both fuels have been reviewed to determine the air damper positions. Follow the setup procedures defined in Section 10 for gas setup and Section 12 for air atomized oil setup.

If the burner is equipped with an optional multiple set-point modulating motor, the low and high fire rates, as well as lightoff rates, can be set independently for each fuel. In this case, the gas is adjusted first, to set the air damper locations for gas firing, as defined in Section 10. Once gas is set, oil is setup as defined in Section 12, except that the multipoint modulating damper motor is adjusted to bring the low fire air setting to match the oil needs.

There are several different options available that can alter the exact setup details, and these must be evaluated prior to startup so that the procedures can be adjusted accordingly. The procedures given are for linkage systems. Parallel positioning (linkageless) systems allow for much more flexibility in the fuel, air and FGR settings on each fuel, and can be tuned to better match each fuels needs. The setup details for linkageless controls will follow the same general sequence, but differ in specifics for setting the valve positions.

## **9. Combination Gas and Heavy Oil**

Combination burners, firing both gas and oil, require some compromises in the setup because they share common controls for both fuels. Heavy oil burners cannot operate with

FGR and do not have this adjustment. If the burner does not have a multiple setpoint modulating motor or linkageless control, oil must be set first, as the air damper positions will be determined by this setup. With the multiple setpoint modulating motor, gas must be set first, as it will dictate the damper positions. In either case, setup cannot be finalized until both fuels have been reviewed to determine the air damper positions. Follow the setup procedures defined in Section 10 for gas setup and Section 13 for air atomized heavy oil setup.

There are several different options available that can alter the exact setup details, and these must be evaluated prior to startup so that the procedures can be adjusted accordingly. The procedures given are for linkage systems. Parallel positioning (linkageless) systems allow for much more flexibility in the fuel, air and FGR settings on each fuel, and can be tuned to better match each fuels needs. The setup details for linkageless controls will follow the same general sequence, but differ in specifics for setting the valve positions.

## **10. Gas Setup**

- a. Place the burner switch in the "OFF" position
- b. Place the "Auto-Manual" switch in the manual position, for modulation or low fire hold, switch in low fire position for Lo-Hi-Lo operation. If this is a combination fuel burner, make sure the fuel selector switch is on "GAS".
- c. Place the manual flame control potentiometer in the MIN (low fire) position on modulating units.
- d. Close the downstream manual shutoff valve (closest to the burner head) on the gas train.
- e. Turn the electrical power on for the burner, boiler and related components.
- f. Verify that the gas metering valve is nearly closed, the vent valve (if equipped) is operating and the gas pilot valve is not open (the solenoid will hum and feel warm).
- g. If equipped with FGR, verify that the FGR control valve is in the near closed position. A linkage system should have the shutoff FGR valve in the closed position.
- h. Turn the burner switch on. This will start the blower motor and initiate the prepurge cycle.
- i. When the prepurge sequence is complete and the low fire start switch (if used) is made, the pilot valve will open and the pilot flame should be visible through the sight port.
- j. When the pilot flame is established, the flame safeguard will energize the main gas valve (indicated with the Fuel Valve Light). This operation of the main fuel valves must be visually checked by observing the valve stem operation.
- k. After the timer has completed the trial for main flame, the burner will go out on alarm (the closed manual gas valve prevented the burner from lighting). At this time, the gas valves must be visually checked to verify that they have closed. This test sequence proves the proper operation of the primary control.
- l. Press the reset button and restart the burner. When the pilot has started, open the manual gas valve to allow

the main flame to start.

**m.** If equipped with FGR, the shutoff FGR valve should open on a linkage system, after the main flame has been proven. The timing can be adjusted with the time delay inside the control panel, so that the FGR shutoff valve opens 5 to 10 seconds after the main flame is established. The control valve of the linkageless system should move from closed to a low flow position after light off timing has expired.

**NOTE:** If the burner is not operating as indicated, follow the troubleshooting guide steps to determine the problem and corrections required.

**n.** After a few seconds, the combustion analyzer should have an accurate reading of the O<sub>2</sub> in the stack. Figure I-3 shows the typical range of O<sub>2</sub> at different firing rates, and the burner should be adjusted to be within this range. Rough settings for low and mid fire combustion settings are adequate at this time. Once the high fire is set, the other settings can be fine tuned.

- Turning the cam screw in will add fuel, making it richer and reducing the O<sub>2</sub> level.
- Turning the cam screw out will reduce the fuel input, increasing the O<sub>2</sub> level.

If equipped with FGR, the NO<sub>x</sub> level should be close to the desired NO<sub>x</sub>, as required by the specific order. The FGR valve can be opened to decrease the NO<sub>x</sub> level, or closed to increase the NO<sub>x</sub> level.

**o.** Operate the burner until the boiler is warmed up, and near the operating pressure or temperature. Increase the firing rate, using the manual potentiometer, or put low fire hold switch in auto mode, while monitoring and adjusting the O<sub>2</sub> level. Adjust the gas pressure regulator as needed to reach the high fire input.

**p.** If equipped with FGR, adjust the FGR valve as needed to obtain the approximate NO<sub>x</sub> level.

**q.** Adjust the high fire input to match the maximum input listed on the rating label. At high fire, the gas butterfly valve should be at least 75 degrees open (more if available gas pressure is low), and the gas pressure regulator adjusted to obtain the rating. The input should be measured using the following equation:

#### Calculating Natural Gas Input

Gas MBH =

$$\text{HHV} \times [(\text{Patm} + \text{Pgas})/29.92] \times [520/(\text{Tgas} + 460)] \times [\text{measured ft}^3/\text{sec}] \times [3600 \text{ sec/hr}]$$

Where:

MBH = 1000's of BTU/M input

HHV = Higher heating value of gas, BTU/cubic feet

Patm = Atmospheric pressure in inches Hg

Pgas = Gas pressure before gas meter in inches Hg  
(inches HG = PSIG x 2.04)

Tgas = Gas temperature at the flow meter, in degrees F

Measured ft<sup>3</sup> = volume of gas measured by meter  
sec = Time for measured ft<sup>3</sup> to flow through meter

**Note:** Some gas meters require a 6 inch wc correction to Pgas. Consult your meter calibration data.

**NOTE: The listed manifold pressure is only an approximate value and can vary with operating conditions and normal tolerances. The fuel flow rate must be measured to obtain an accurate input value.**

- r.** Adjust the air damper to obtain the correct O<sub>2</sub> level.
- s.** If equipped with FGR, adjust the NO<sub>x</sub> level to be about 10% below any guaranteed NO<sub>x</sub> performance. A balance of the FGR control valve and air damper are required to obtain the final result, as each can impact the other.
- t.** Modulate the burner to low fire, adjusting the O<sub>2</sub> level as the burner modulates.
- u.** Adjust the low fire input, using the fuel cam and air damper adjustments. The linkage may need to be readjusted to obtain the correct relationship between the fuel valve and air damper. (Figure I-1)
- v.** Re-adjust the midfire points for the correct O<sub>2</sub> level.
- w.** If equipped with FGR, adjust the NO<sub>x</sub> levels at low and midfire rates to be about 10% under the guaranteed levels.
- x.** Adjust the low gas pressure switch to be 10% below the lowest expected gas pressure.
  - With a gauge or manometer at the same location as the low gas pressure switch, modulate the burner to determine the firing rate with the lowest gas pressure.
  - At the lowest gas pressure, adjust the low gas pressure setting up until the switch breaks and causes the burner to shutdown.
  - From the scale reading of the switch, adjust the setting to a pressure that is 10% lower than the shutdown pressure. For example, if the switch opened at 10 inches as indicated on the low gas pressure switch, the switch should be adjusted to a reading of 9 inches.
  - Remove the gauge or manometer and plug the opening.
  - Cycle the burner on and off to determine if the limit works properly.
  - If the limit causes nuisance shutdowns because of small pressure drops during startup, reduce the pressure setting an additional 5%.
- y.** Adjust the high gas pressure switch to be 10% above the highest expected gas pressure.
  - With a gauge or manometer at the same location as the high gas pressure switch, modulate the burner to determine the firing rate with the highest gas pressure.
  - At the highest gas pressure, adjust the high gas pressure setting down until the switch opens and causes the burner to shutdown.
  - From the scale reading of the switch, adjust the setting to a pressure that is 10% higher than the shutdown pressure. For example, if the switch opened at 10 inches as indicated on the high gas pressure switch, the switch should be adjusted to a reading of 11 inches.
  - Remove the gauge or manometer and plug the opening.
  - Cycle the burner on and off to determine if the limit works properly.
  - If the limit causes nuisance shutdowns because of small pressure changes during startup, increase the pressure setting an additional 5%.



**Figure I-3  
O2 levels**

	Natural Gas With FGR		Natural Gas No FGR		Oil	
% Rate	Min % O2	Max % O2	Min %O2	Max %O2	Min %O2	Max %O2
30	5.0	7.0	5.0	7.0	3.5	7.5
40	4.0	7.0	4.0	7.0	3.0	7.0
50	3.0	5.0	3.0	5.0	3.0	5.0
100	3.0	5.0	3.0	5.0	3.0	5.0

z. The burner should be operating at low fire to adjust the air proving switch. Turn the adjusting screw cw (in) until the burner trips out (shutdown caused by the air flow switch). Turn the adjustment screw ccw (out) 1 1/2 turns from the point of shutdown. Check the operation at higher rates.

### 11. Pressure Atomized Oil Setup

The pressure atomized oil system has a limited range of adjustment for low and high fire, dictated by the operation of the oil nozzle. The combustion air and FGR must be adjusted to match these rates.

If the burner is equipped with FGR, and is a linkage system, the type of FGR control must be determined prior to starting. If this is a dual fuel burner, the FGR rate is determined by the NOx performance on gas. A 60 ppm burner will operate with the same FGR rate on gas and oil. A 30 ppm unit will use the limiting potentiometer to slightly reduce the FGR rate on oil firing. For Oil only combustion, the NOx level will be given on the burner detail sheet, and should be used to set the FGR control valve.

- Place the burner switch in the "OFF" position.
- Place the "Auto-Manual" switch in the manual position or low fire hold switch in the low fire position for LO-HI-LO operation. If this is a combination fuel burner, make sure the fuel selector switch is on "OIL".
- Place the manual flame control potentiometer in the min (low fire) position on modulation units.
- Turn the electrical power for the burner, boiler and related components on.
- Verify that the oil metering valve is nearly opened (the valve will be closed at high fire).
- Turn the burner switch on. This will start the blower motor and initiate the purge cycle.
- When the prepurge sequence is complete and the low fire start switch (if used) is made, the pilot valve will open and the pilot flame should be visible through the burner sight port.
- When the pilot flame is established, the flame safeguard will energize the main oil valves (indicated with the Fuel Valve Light), and the burner should ignite at low fire. This operation of the main fuel valves must be visually checked by observing the valve stem moving up with a motorized valve or hearing the clicking noise from a solenoid valve.

**NOTE:** If the burner is not operating as indicated, follow the troubleshooting steps to determine the problem and corrective action.

- The main flame may not light on the first attempt, be-

cause it must fill the oil lines before providing oil to the nozzle. Press the reset button on the flame safeguard to restart the burner.

#### **WARNING**

**DO NOT ATTEMPT TO START THE BURNER WHEN EXCESS OIL HAS ACCUMULATED, WHEN THE UNIT IS FULL OF VAPOR, OR WHEN THE COMBUSTION CHAMBER IS HOT.**

j. After a few seconds, the combustion analyzer should have an accurate reading of the O2 in the stack. The O2 level should be between 4% and 7%, and the nozzle oil pressure should be between 50 and 70 PSIG return line pressure for the JB3. JB1 and JB2 burner low fire oil pressure should be 100 psig. Do not attempt to fine tune combustion until the high fire has been set.

If the burner is equipped with FGR, the FGR control valve should be set for the approximate NOx level required.

- Turning the cam screw in will add fuel, making it richer and reducing the O2 level.
- Turning the cam screw out will reduce the fuel input, increasing the O2 level.
- The air damper should be positioned for the correct low fire settings.

k. Operate the burner until the boiler is warmed up, and near the operating pressure or temperature.

l. Increase the firing rate, using the manual potentiometer or put the low fire hold switch in auto position, while monitoring and adjusting the O2 level. Adjust the cam as needed to reach the high fire input.

If the burner is equipped with FGR, adjust the FGR control valve as required to maintain the NOx level.

m. At high fire (end of the modulating motor travel), adjust the high fire input (open or close the fuel valve) to match the maximum input and/or pressure listed on the rating label. The fuel metering valve should be nearly closed (or closed) at this point and the nozzle pressure should be about 150 PSIG (return line) for JB3. For JB1 and JB2 250 to 300 psig.

n. If equipped with FGR, adjust the NOx level to be about 10% below any guaranteed NOx performance or if performance guarantee exists adjust the FGR to provide some added turbulence but not high enough to impact flame stability. A balance of the FGR control valve and air damper are required to obtain the final result, as each can impact the other. If this is a 30 ppm system, the FGR limiting pot should be adjusted to reduce the FGR rate for stable combustion, with the FGR control valve set when firing gas. If this is a 60 ppm system, no adjustment is necessary.

- Modulate the burner to low fire, adjusting the O2 level as the burner modulates.

p. Adjust the low fire input, using the fuel cam or low fire regulator on LO-HI-LO systems and air damper adjustments. If the burner is equipped with FGR, adjust the NOx level according to the type of system (limiting potentiometer or matching gas).

q. Re-adjust the midfire points for the correct O2 levels. The linkage may need to be readjusted to obtain the correct relationship between the fuel valve and air damper. (Figure I-1)

r. If equipped with FGR, adjust the NOx levels at low and midfire rates to be about 10% under the guaranteed levels or as required for the gas firing.

s. The burner should be operating at low fire to adjust the air proving switch. Turn the adjusting screw cw (in) until the burner trips out (shutdown caused by the air flow switch). Turn the adjustment screw ccw (out) 1 ½ turns from the point of shutdown. Check the operation at higher rates.

t. Adjust the oil pressure switch to trip and shutdown the burner at a pressure that is 10% lower than the supply oil pressure.

## 12. Air Atomized, #2 oil Setup

The air atomized oil system has the potential for a large turndown range similar to gas and has the potential to be adjusted to different low fire rates. See the burner nameplate for details on actual rates for this burner.

If the burner is equipped with FGR and is a linkage system, the type of FGR control must be determined prior to starting. If this is a dual fuel burner, the FGR rate is determined by the NOx performance on gas. A 60 ppm burner will operate with the same FGR rate on gas and oil. A 30 ppm unit will use the limiting potentiometer to slightly reduce the FGR rate on oil firing. For Oil only combustion, the NOx level will be given on the burner detail sheet, and should be used to set the FGR control valve.

a. Place the burner switch in the "OFF" position.

b. Place the "Auto-Manual" switch in the manual position. If this is a combination fuel burner, make sure the fuel selector switch is on "OIL".

c. Place the manual flame control potentiometer in the min (low fire) position.

d. Turn the electrical power for the burner, boiler and related components on.

e. Verify that the oil metering valve is at the nearly closed position.

f. Turn the burner switch on. This will start the blower motor and initiate the purge cycle.

g. When the prepurge sequence is complete and the low fire start switch is made, the pilot valve will open and the pilot flame should be visible through the burner sight port.

h. When the pilot flame is established, the flame safeguard will energize the main oil valves (indicated with the Fuel Valve Light), and the burner should ignite at low fire. This operation of the main fuel valves must be visually checked by observing the valve stem moving up with a motorized valve or hearing the clicking noise from a solenoid valve.

**NOTE:** If the burner is not operating as indicated, follow the troubleshooting steps to determine the problem and

corrective action.

### WARNING

**DO NOT ATTEMPT TO START THE BURNER WHEN EXCESS OIL HAS ACCUMULATED, WHEN THE UNIT IS FULL OF VAPOR, OR WHEN THE COMBUSTION CHAMBER IS HOT.**

i. After a few seconds, the combustion analyzer should have an accurate reading of the O2 in the stack. The O2 level should be between 4% and 7% (see Figure I-3 for O2 rates), and the nozzle oil press should be between 5 and 15 PSIG (see Figure I-4). Do not attempt to fine tune combustion until the high fire input has been set.

If the burner is equipped with FGR, the FGR control valve or limiting potentiometer should be set for the approximate NOx level required.

- Turning the cam screw in will add fuel, making it richer and reducing the O2 level.

- Turning the cam screw out will reduce the fuel input, increasing the O2 level.

- The air damper should be positioned for the correct low fire settings.

- The atomizing air pressure can be adjusted using the air bleed valve.

j. Operate the burner until the boiler is warmed up, and near the operating pressure or temperature.

k. Increase the firing rate, using the manual potentiometer, while monitoring and adjusting the O2 level. Adjust the cam, oil pressure and atomizing air pressure as needed to reach the high fire input.

l. If the burner is equipped with FGR, adjust the FGR control valve or potentiometer as required to maintain the NOx level.

m. At high fire (end of the modulating motor travel), adjust the high fire input to match the maximum input listed on the rating label. Using a flow meter, the fuel input may be measured using the following equation,

$$\text{Oil GPH} = \frac{[\text{Gal end} - \text{Gal start}] \times [3600 \text{ sec/hr}]}{[\text{measured sec}]}$$

Where Gal end = meter gallons at end of test

Gal start = gallons at start of the test

Measured sec = measured time of test

GPH = Gallons of oil per hour

n. If equipped with FGR, adjust the NOx level to be about 10% below any guaranteed NOx performance or if no performance guarantee exists adjust the FGR to provide some added turbulence but not high enough to impact flame stability. A balance of the FGR control valve and air damper are required to obtain the final result, as each can impact the other. If this is a 30 ppm system, the FGR limiting pot should be adjusted to reduce the FGR rate for stable combustion, with the FGR control valve set when firing gas. If this is a 60 ppm system, no adjustment is necessary.

o. Modulate the burner to low fire, adjusting the O2 level as the burner modulates.

p. Adjust the low fire input, using the fuel cam and air damper adjustments.

q. If the burner is equipped with FGR, adjust the NOx level

according to the type of system (limiting potentiometer or matching gas).

r. Re-adjust the midfire points for the correct O<sub>2</sub> levels. The linkage may need to be readjusted to obtain the correct relationship between the fuel valve and air damper. See Figure I-1.

s. If equipped with FGR, adjust the NO<sub>x</sub> levels at low and midfire rates to be about 10% under the guaranteed levels or as required for the gas firing.

t. The burner should be operating at low fire to adjust the air proving switch. Turn the adjusting screw cw (in) until the burner trips out (shutdown caused by the air flow switch). Turn the adjustment screw ccw (out) 1 ½ turns from the point of shutdown. Check the operation at higher rates.

**FIGURE I-4**  
**Typical Atomizing Air Pressure**

% Rate	Minimum
20	10 - 25
30	12 - 30
40	15 - 35
50	20 - 40
100	25 - 60

### 13. Heavy Oil Setup

#### **CAUTION**

**WHEN WORKING WITH HEATED OIL, PROTECTIVE CLOTHING, INCLUDING GLOVES, SHOULD BE WORN TO PROTECT FROM BURNS.**

The air atomized heavy oil system requires the additional adjustment of oil temperature in the burner setup. The temperature is adjusted to improve the viscosity for good atomization. Typically, this will be about 150°F for #4 oil, 180°F for #5 oil and 200°F for # 6 oil.

a. Prior to startup, the oil system must be operating with the oil temperature to the burner (before the trim heater) within 20°F of the final temperature.

b. Place the burner switch in the "OFF" position. If this is a combination fuel burner, make sure the fuel selector switch is on "OIL" and that the oil pump is running.

c. Place the "Auto-Manual" switch in the manual position.

d. Place the manual flame control potentiometer in the MIN (low fire) position.

e. Turn the electrical power on for the burner, boiler and related components.

f. The oil may take some time to get up to temperature. If the oil is cool, the ball valve downstream of the N.O. oil return valve (Figure B-7) can be opened to make it easier for the oil to circulate and reach operating temperature.

g. Verify that the oil metering valve is at the nearly closed position.

h. Turn the burner switch to "ON". This will start the blower motor and initiate the prepurge cycle.

#### **WARNING**

**DO NOT ATTEMPT TO START THE BURNER WHEN EXCESS OIL HAS ACCUMULATED, WHEN THE UNIT IS FULL OF VAPOR, OR WHEN THE COMBUSTION CHAMBER IS HOT.**

i. When the prepurge sequence is complete and the low fire start switch is made, the pilot valve will open and the pilot flame should be visible through the burner sight port.

j. When the pilot flame is established, the flame safeguard will energize the main oil valves (indicated with the Fuel Valve Light), and the burner should ignite at low fire. This operation of the main fuel valves must be visually checked by observing the valve stem moving up with a motorized valve or hearing the clicking noise from a solenoid valve.

k. After a few seconds, the combustion analyzer should have an accurate reading of the O<sub>2</sub> in the stack. The O<sub>2</sub> level should be between 4% and 7% (See Figure I-3 for O<sub>2</sub> rates) and the nozzle oil press should be between 10 and 20 PSIG. Do not attempt to fine tune combustion until the high fire input has been set.

- Turning the cam screw in will add fuel, making it richer and reducing the O<sub>2</sub> level.

- Turning the cam screw out will reduce the fuel input, increasing the O<sub>2</sub> level.

- The air damper should be positioned for the correct low fire settings.

- The atomizing air pressure can be adjusted using the air bleed valve (Figure I-4).

- The oil temperature can be adjusted to obtain the best atomization.

l. Operate the burner until the boiler is warmed up and near the operating pressure or temperature.

m. Increase the firing rate, using the manual potentiometer, while monitoring and adjusting the O<sub>2</sub> level. Adjust the cam, oil and atomizing air pressure and oil temperature as needed to reach the high fire input.

n. At high fire (end of the modulating motor travel), adjust the high fire input to match the maximum input listed on the rating label. Using a flow meter, the fuel input may be measured using the following equation,

$$\text{Oil GPH} = \frac{[\text{Gal end} - \text{Gal start}] \times [3600 \text{ sec/hr}]}{[\text{measured sec}]}$$

Where Gal end = meter gallons at end of test

Gal start = gallons at start of the test

Measured sec = measured time of test

GPH = Gallons per hour

o. Modulate the burner to low fire, adjusting the O<sub>2</sub> level as the burner modulates.

p. Readjust the low fire input, using the fuel cam and air damper adjustments.

q. Re-adjust the midfire points for the correct O<sub>2</sub> levels. The linkage may need to be readjusted to obtain the correct relationship between the fuel valve and air damper. (Figure I-1)

r. The burner should be operating at low fire to adjust



the air proving switch. Turn the adjusting screw cw(in) until the burner trips out (shutdown caused by the air flow switch). Turn the adjustment screw ccw (out) 1 ½ turns from the point of shutdown. Check the operation at higher rates.

#### 14. Operating Control Adjustments

The operating controls must be adjusted to properly cycle the burner "ON and OFF" and provide modulation. The controls should not force the burner into rapid "ON-OFF" cycles, as this will cause premature failure of the motor and operating equipment.

The operating control must be adjusted to provide the "ON" pressure or temperature desired. It must allow the burner to come on and start before the temperature or pressure drops into the modulating range. The "OFF" pressure or temperature must be sufficiently above the "ON" point to allow a reasonable run time.

The modulating control must be adjusted to start modulation at some reasonable point below the "ON" temperature or pressure and provide modulation to high fire at the lowest temperature or pressure.

#### 15. Limit Tests

Once the burner has been started and the operating pressures and temperatures have been set, the limit switches need to be adjusted so that they will trip if the pressure or temperature exceeds the operating value, but will not trip with normal variations. The switch should be checked for proper operation by allowing the temperature or pressure to vary below (or above) the recommended level to insure that they provide safe shutdown before the burner operation is affected. In some high pressure or temperature switches, where the temperature or pressure cannot be set high enough to trip the switch, the switch can be checked by lowering the set point to prove that the switch will provide a safe shutdown.

The limit switches would include the air proving switch on the burner. Limits for gas operation could include the high and low gas pressure switches and for oil firing, the high and low oil pressure switches, high and low oil temperature switches and the atomizing air pressure switch. If in doubt about which limits are on a burner, refer to the wiring diagram that will show each item.

Limit switches need to be checked at regular intervals to ensure they are operating properly. See the maintenance section for details.

#### 16. Pilot Test

Once the burner has been set for the firing rates intended for the burner, the pilot must be checked for proper operation and safety.

The minimum pilot test is done to insure that a pilot which can be seen by the scanner will light the main flame.

**a.** During a startup sequence, measure the time required to light the main flame after the fuel valves have been energized. This will be used to monitor the test with reduced pilot.

**b.** Lock the flame safeguard into the pilot position (refer to

the manual for the flame safeguard for this setting)

**c.** Adjust the gas pressure regulator to the pilot for a minimum value while still holding the minimum signal strength for the scanner.

**d.** Release the flame safeguard from the pilot position and allow it to cycle through the main flame proving sequence.

**e.** This reduced pilot must reliably light the main flame. Monitor the time from the main fuel valve opening and do not allow the burner to continue if the time is more than an additional two to three seconds from the initial time measured above.

**f.** Run through two or three cycles.

**g.** If this is a combination fuel burner, repeat the test on the other fuel.

**h.** Failures due to reduced scanner signal are also acceptable.

#### WARNING

**THE MINIMUM PILOT TEST REQUIRES CLOSE SUPERVISION OF THE COMBUSTION PROCESS. FAILURE TO CLOSELY MONITOR THE MAIN FLAME TEST TIME COULD RESULT IN DAMAGE, INJURY OR DEATH.**

**i.** If the pilot does not light the main flame under these test conditions, check and adjust the pilot as shown in section "H".

**j.** The infrared detector must be tested for hot refractory pickup. This test is performed to make sure that the scanner does not see hot refractory that could be mistaken for a flame.

**k.** After the burner has been operating for some time at high input levels and the refractory in the vessel is hot, the burner should be cycled off while monitoring the scanner signal.

**h.** The flame signal should drop off quickly as the flame goes out and should be well below the minimum level (indicating a flame) at the end of the post purge cycle.

**i.** The UV detector must be tested for spark pick-up. Turn the burner on, with the pilot shut off, during the ignition cycle the flame signal should be well below the minimum level (indicating a flame).

**j.** If the flame signal does not drop out as required, check the location of the pilot and scanner, as shown in section "H". This may also indicate a faulty scanner or amplifier.

#### 17. Burner Shutdown

Normal operation of the burner will allow the operating controls to shut the burner down when the load demand is satisfied. If the burner needs to be shut down for any reason, the "ON-OFF" switch can be used to quickly turn the burner off. This will instantly cause the fuel valves to close and start a post purge cycle to remove any unburned fuel from the vessel.

In an emergency shutdown, all fuel and electrical power should be de-energized or turned off to secure the burner. This would include the main power disconnect, the manual gas shutoff valve at the drop down line and if equipped, the manual oil valve to the nozzle.

It is recommended that the burner be manually driven to low fire before turning the burner off, as this reduces the dynamic and thermal stress. If the burner will remain off for some time, the manual fuel valves, fuel pumps and power supply should be turned off.

**CAUTION**

**ALWAYS KEEP THE FUEL SUPPLY VALVE SHUT OFF WHEN THE BURNER IS SHUT DOWN FOR AN EXTENDED PERIOD OF TIME.**

## **18. Restarting after Extended Shutdown**

Extended shutdowns require the same startup process as those outlined above. In addition, the following advanced cleaning must be done,

- a.** The air atomized oil nozzle should be removed and cleaned, if pressure atomized they should be replaced. Use care in cleaning to preserve the sharp edges of the nozzle, which are required to maintain good atomization.
- b.** The oil filter and strainer must be removed and cleaned prior to starting.

**CAUTION**

**DO NOT START THE BURNER UNLESS ALL CLEANOUT DOORS ARE SECURED IN PLACE.**

## J. TROUBLESHOOTING

No.	System	Cause	Correction
1	No Ignition (lack of spark)	Electrode is grounded. Porcelain is cracked.	Replace
		Improperly positioned electrode	Recheck dimensions
		Loose ignition wire connection	Reconnect or tighten
		Defective ignition transformer	Check transformer, replace
2	No Ignition (spark, no flame)	Lack of fuel, no gas pressure, closed fuel valve	Check fuel supply and valves
		No voltage to pilot solenoid	Check electrical connections
		Defective pilot solenoid valve	Replace
		Incorrect location of pilot	Check location of pilot
		Improper raw gas tube position	Check location of raw gas tube
		Improperly positioned electrodes	Recheck dimensions
		Too much combustion air flow	Check air damper position
3	Pilot not detected (flame present)	Scanner tube not positioned correctly	Check location of scanner tube
		Scanner tube dirty or wet (oil film)	Clean scanner tube / scanner
		Scanner or amplifier faulty	Replace
		Pilot improperly positioned	Check pilot position
		Incorrect gas pressure to pilot	Readjust pressure
		Combustion air flow rate too high	Readjust damper
4	No main gas flame (pilot OK)	Weak scanner signal	Clean scanner lens and tube
		Damper or fuel control valve setting incorrect	Readjust
		Fuel valve(s) not opening	Check wiring to valves
5	No main oil flame (pilot OK)	Weak scanner signal	Clean scanner lens and tube
		Damper or fuel control valve setting incorrect	Readjust
		Fuel valve(s) not opening	Check wiring to valves
		Oil nozzle or line obstructed	Check nozzle and lines, clean
		No atomizing air pressure	Check compressor wiring
		Compressor pressure too low or high	Readjust
		Burner not level, oil is draining into vessel	Check level, adjust as required.
6	Burner stays at low fire	Manual pot in low fire position (low fire hold)	Readjust to high fire position
		Manual-auto switch or low fire hold switch in wrong position	Change position of switch
		Modulating Control or Lo-Hi-Lo Control	Check wiring or replace
		Loose linkage	Readjust and tighten
		Binding linkage or valve	Readjust or replace
7	Burner shuts down during operation	Loose electrical connection	Check and tighten connections
		Loss of fuel supply	Replenish fuel supply
		Limit switch breaks (opens)	Readjust limit switch
8	Burner does not start	Main disconnect switch is open	Close switch
		Loose electrical connection	Check electrical connections
		Operating controls are tripped	Check and reset operating limits
		High or low fuel pressure	Check fuel supply - reset switches
9	High CO at low fire (firing gas)	Improper excess air level	Readjust excess air
		Input too low for burner components	Check input, compare to rating label



No.	System	Cause	Correction
	High CO at low fire (con't)	High stack draft (especially at low fire)	Stabilize draft
	(firing gas)	Poor air flow distribution (off center flame)	Adjust air straightener blade
		Diffuser not in optimum position	Adjust diffuser position in or out
		Fluxuating gas pressure (regulator not holding pressure)	Check regulator pressure, sensing line and supply pressure: sized properly
10	Gas combustion noise	Input too low for burner components	Check input, compare to rating label
	(rumbling)	Improper excess air	Readjust excess air
		Fluxuating gas pressure (regulator not holding pressure)	Check regulator pressure and supply
		High stack draft (especially at low fire)	Stabilize draft
		Diffuser not in optimum position	Adjust diffuser position in or out
		Poor air flow distribution (off center flame)	Adjust air straightener blade
11	Oil combustion smoking	Oil nozzle dirty or plugged	Clean oil nozzle
		Improper excess air	Readjust excess air
		Input too low for burner components	Check input, compare to rating label
		High stack draft (especially at low fire)	Stabilize draft
		Incorrect nozzle position	Adjust the nozzle to diffuser position
		Fluxuating oil pressures (regulator not holding)	Check regulator pressure and oil supply
		Poor air flow distribution (off center flame)	Adjust air straightener blade
		Too much FGR (if equipped)	Reduce FGR rate
12	Fuel-Air-Ratios are	Linkage flexing	Realign linkage, straighten rods
	not consistent	Linkage slip	Check linkage and tighten all joints
		Fuel cam screws have moved	Replace fuel cam
		Fuel line plugged	Check and clean lines, strainers & filters
		Fuel supply pressure changing	Check and/or replace pressure regulator
		Combustion air temperature changed	Retune burner
		Draft condition changed	Check draft and outlet damper
		Plugged or leaky FGR line	Clean / repair
		Gas control valve - low fire stop not set (if used)	Adjust low fire stop
13	Fuel-Air-Ratios have changed	Linkage wear	Check linkage and tighten all joints
	over time	Fuel cam screws have moved	Replace fuel cam
		Air damper seal worn	Replace air damper seals
		Fuel lines plugged	Check and clean lines, strainers & filters
		Fuel control valve worn	Replace fuel control valve
		Gas orifices or gas manifold plugged	Clean and/or replace
		Combustion air temperature changed	Retune burner
		Draft condition changed	Check draft and outlet damper
		Vessel plugged	Clean vessel
		Plugged or leaky FGR valve	Clean / repair
14	Cannot obtain capacity on	Wrong spring range in regulator	Install higher spring range
	gas	Too many elbows before control valve	Rework piping to reduce elbows
		Gas line too small, high pressure drop	Use larger pipe size
		Supply pressure lower than stated	Increase supply pressure
		Supply pressure drops too low at high fire	Use larger gas line sizes / orifice in service regulator
		Regulator too small for flow and pressure	Change regulator
15	Cannot obtain rated input on	Oil nozzles plugged	Replace nozzles
	oil firing (pressure atomized)	By-pass seal on nozzle leaking	Replace nozzles

No.	System	Cause	Correction
	Cannot obtain rated input on	Oil pressure too low	Increase oil pressure
	oil firing (pres. atom.) (con't)	Flow valve set too low (should be closed at high fire)	Adjust oil control valve
16	Cannot obtain rated input on	Oil nozzles plugged	Clean nozzle
	oil firing (air atomized)	Air pressure too low	Replace nozzle
		Oil pressure too low	Increase oil pressure
		Flow valve set too low	Adjust oil control valve
17	Cannot obtain NOx levels on	FGR valve not full open	Adjust FGR valve to full open
	gas	FGR valve full of condensate	Clean duct and add drains
		FGR duct not directed to flue stream	Add angle cut in center of stack
		FGR line too small	Check sizing, use fittings with less drop
		Operating on propane, not natural gas	Resize FGR for propane operation
		Shutoff valve is not full open	Check FGR shutoff valve position

## K. GENERAL MAINTENANCE AND CARE

1. General
2. Physical Inspection
3. Fuel-Air-Ratio
4. Gas Fuel Systems
5. Oil Fuel Systems
6. FGR System
7. Combustion Air Fan

### 1. General

This burner has been designed to provide many years of trouble free operation. The reliability can be greatly improved with some simple inspection and maintenance programs.

One of the best tools for a good maintenance program is to keep a log on the key parameters of the burner and boiler. These would include operating temperatures, pressures, inspections and preventative maintenance activities. This document can be used to detect any changes in the operating characteristics of the burner, which can be used for preventative maintenance.

The maintenance schedule can be used to help generate this log. There are also many other good references that can be use to help develop your log. Adding check points for other equipment into a common log can help. It is common to integrate the boiler and burner log, so that all components are checked at the same time.

The frequency of inspection given in the following charts is only a guideline. Initial results should be used to adjust the time intervals to be more frequent when problems or potential problems are observed.

### 2. Physical Inspection

Listening and looking at the burner can detect many problems. For example, leakage can usually be seen early with a small buildup of oil. Valve and linkage problems can usually be detected early on by simply watching the movement and detecting rough uneven changes. The jackshaft, linkage and valve movement should occur smoothly with no rough jerks.

The flame condition can often be a good indicator of the firing head. If the flame does not look correct, there may be a problem with the hardware. The firing head is exposed to the high temperatures of combustion and can have reduced life due to the thermal stress. In particular, the diffuser, oil nozzle, gas orifices, gas manifold, refractory and burner mounting plate should all be inspected.

### 3. Fuel-Air-Ratio Controls

The fuel-air-ratio controls must be maintained in good operating condition. Over time, these items will wear and may not operate smoothly. Corrective action must be taken.

There are several different types of controls and the corrective action of each could be different. The following general guidelines can be used for initial steps.

Linkage based controls should be inspected for wear. If there is any noticeable play in the linkage rod ends or shaft bearing, they should be replaced. Likewise, any control valves that exhibit sloppy or hard to turn movement should also be replaced.

Fuel cams should have adjusting screws that are held firmly in position and can not move due to normal vibrations. The moving parts must be in good condition with no noticeable wear or play. Worn connections will result in hysteresis and reduced combustion efficiency.

The cam and jackshaft should be visually checked on a frequent or daily basis for obvious problems, including free movement, no loose parts and correct position of components.

On a monthly basis, the linkage and cams should be inspected for wear and loose parts. Annually, the cam and linkage should be operated manually to check the movement of all components and valves. Any worn parts should be replaced immediately.

### 4. Gas Fuel System

The safety interlocks must be checked at regular intervals to ensure that they provide the proper safety. See the Inspection and Maintenance Schedule Chart (Figure 8) for frequencies.

The drip leg should be cleaned annually.

Monitoring the outlet gas pressure from the regulator will verify this control is working properly.

### 5. Oil Fuel System

The oil system has additional components that require regular maintenance, depending on the type of system used.

a. Oil added to air compressor. The air compressor has a visual sight glass showing the oil level. This must be inspected every shift (while operating).

b. Air compressor belt tight and in good condition

c. The oil strainer should be checked and cleaned periodically. A high vacuum reading on the suction side of the pump (over 10") is a good indication that the strainer needs to be cleaned. Strainers provided by Webster will use a wire mesh basket inside a canister. After turning the pump off (and making sure there is no pressure on the strainer), unscrew the yoke to gain access to the basket. The canister does not need to be drained. Be careful with the gasket when removing or replacing the cover to insure

a good seal. The basket can be lifted out and cleaned with a soft brush and cleaning solution.

**d.** Vacuum higher than the 10" limit on suction side of pump (indicates need to clean strainer, as described above). If cleaning the strainer does not resolve this, check the other valves between the tank and gauge for plugged or closed position.

**e.** Air atomized oil nozzles should be cleaned periodically, depending on the type of operation and the observed need for cleaning. Extended operation at very low rates (less than 15% of capacity) can cause carbon buildup on the outside of the nozzle. This can be cleaned with a rag and cleaning solution. If the fire is showing some deterioration, and the external surfaces are clean, then the nozzle should be removed, disassembled and cleaned using a soft brush and cleaning solution.

**f.** If the edges of the air atomizing nozzle are not sharp, or the nozzle shows sign of wear and the combustion is deteriorated, the nozzle should be replaced. The nozzle part number is given on the material list of the unit. In general, a single port (center hole) uses a 80° nozzle or multiport (multiple hole at the spray angle) nozzle with a spray angle of 70 degrees will work well for light oil. Heavy oil should use a spray angle of about 60 degrees.

**g.** Pressure atomized oil nozzles have a filter feeding the nozzle that can be plugged over time. The filter can be unscrewed from the back and cleaned, using a soft brush and cleaning solution. When the nozzle(s) are removed from the nozzle body (BPS nozzles), the plastic seals at the end of the nozzle must be replaced, or the nozzle may not seal correctly. The seal can be slid off of the nozzle and a new one installed. Use extreme care to not put any cuts or nicks in the seal. Once the seal is on, the nozzle can be inserted and screwed into the nozzle body.

**h.** If a pressure atomized oil nozzle needs to be replaced, it should be a Delevan Veriflow type, using a 60 degree spray angle (JB3 BPS nozzle(s)).

**i.** Check safety limits, including pressure and temperature switches

## 6. FGR Systems

The flue gas is corrosive and requires regular inspection of the equipment to ensure proper and safe operation. The potential for corrosion and frequency of the inspection can vary greatly based on the application. Applications with condensation will have more corrosion and will need more maintenance. Frequent cycling, cold startups, cool operating temperatures, cool air temperatures and outdoor installations are good examples of where high levels of condensation can occur.

Areas to inspect for corrosion:

- FGR control valves(s)
- FGR Duct
- Air inlet louver box
- Fan and fan housing
- Burner housing
- Firing head and blast tube

Other checks:

**a.** The condensation traps must work properly and be installed to capture all of the condensation. If condensation passes through to the burner windbox, a condensate drain should be added to the bottom of the windbox.

**b.** Linkage and valve movement must operate freely and smoothly.

**c.** If the FGR valve is modulated partly open (oil firing on dual fuel burner) check position of FGR valve.

**d.** NOx emission levels.

**e.** Other general items like the refractory.

**f.** Stack temperature of boiler - high temperatures will increase NOx levels.

**g.** Operation of safety equipment.

**h.** Time delay on FGR on-off valve (if equipped).

## 7. Combustion Air Fan

If the fan and motor are ever removed, the following should be observed in re-assembly.

**a.** There should be about 1/16" overlap of inlet cone and fan.

**b.** Never re-use the fan to motor shaft set screws, always use new screws of the same type and style to maintain balance and fan retention.

**c.** When tightening the fan hub set screws, rotate the fan to place the screws on the bottom. This way the screw is not lifting the fan.

**d.** The motor shaft and fan hub must be clean and free of burrs.

As a minimum, the following replacement parts should

## 8 - Inspection and Maintenance Schedule

Frequency							Component / Item	Recommended Action or Test	Performed By	
Daily	Weekly	Monthly	Seasonal	Annual	Annual As Required				Boiler Operator	Trained Burner Technician
X							Burner Flame	Visual inspection of burner flame.	X	
X							Jackshaft and Linkage	Visual inspection for smooth and free travel.	X	
X							Air Damper	Visual inspection for smooth and free travel.	X	
X							Fuel Metering Valves	Visual inspection for smooth and free travel.	X	
X							Draft Controls (Stack)	Visual inspection for smooth and free travel.	X	
X							Gas Fuel Pressure	Record in log book, compare trends.	X	
X							Oil Pressure	Record in log book, compare trends.	X	
X							Atomizing Air Pressure	Record in log book, compare trends.	X	
X							Pilot	Visually inspect pilot flame, check and record flame signal strength if metered.	X	
	X						Flame SafeGuard - Pilot Test	Close manual fuel valve on pilot during cycle and check for safety shutdown, recording time.	X	
	X						Flame SafeGuard - Main Flame	Close manual fuel valve on pilot during cycle and check for safety shutdown, recording time.	X	
		X					Flame SafeGuard	Check flame safeguard components, including scanner.		X
				X			Flame SafeGuard	Replace flame safeguard components in accordance with manufacturers instructions.		X
				X	X		Pilot Turndown Test	Conduct pilot turndown test annually or after any component change.		X
				X	X		Hot Refractory Test	Conduct hot refractory hold in test. This test is required annually or after any component change.		X
		X					Oil Pressure and Temperature Interlocks	Check oil pressure and temperature switch for smooth operation and correct action.		X
		X					Atomizing Air Pressure	Check air atomizing pressure interlock switch for smooth operation and correct action.	X	
		X					Interlock Controls	Check other interlocks that may be used on the burner for smooth operation and correct action.		X
			X				Firing Rate Control	Check firing rate control and verify settings.		X
			X				Combustion Tuning	Conduct a combustion test, verify setting and NOx emission levels.		X
	X						Pilot and Main Fuel Valves	Make visual and manual check for proper sequencing of valves.		X
				X			Pilot and Main Fuel Valves	Check all coils, diaphragms, interlock switch & other parts of all safety shutoff valves.		X
				X			Pilot and Main Fuel Valves	Perform leak tests on all safety shutdown control valves.		X
				X			Low Pressure Air Switch	Test low air pressure switch for proper operation and adjustment.		X
				X			Mod Damper Switch	Check damper low fire proving switch per manufacturers instructions.		X
				X			Linkage and Fuel Cams	Check linkage and cams for wear and replace any items with wear indication or stress cracks.		X
X							FGR Control Valve	Visual inspection for smooth and free travel.	X	
			X				FGR Control Valve	Clean and lubricate FGR control valve.	X	
	X						FGR Shutoff Valve	Visually inspect for smooth and complete travel.	X	
			X				FGR Shutoff Valve	Clean and lubricate FGR shutoff valve	X	
X							FGR Condensate Drain	Open FGR condensate drains, remove all condensate.	X	
					X		FGR Shutoff Valve Switch	Check operation of shutoff FGR valve for full rotation and position proving switch.		X
					X		FGR Duct	Inspect and clean FGR duct.	X	
					X		Combustion Air Fan	Clean combustion air fan and housing		X
X	X						Burner Components	Visually check the burner components for signs of cracks, deformation, slip-page or other unusual indication.	X	
		X					Burner Mounting	Check burner mounting clamps and brackets for tightness.	X	
		X					Refractory and Seals	Check burner refractory for cracks or signs of leakage.	X	
		X					Oil Nozzle	Check and clean oil nozzle.	X	
X							Air Compressor	Check air compressor for lubrication oil and air filter.	X	
				X			Air Compressor	Check air compressor relief valve operation.		X

## L. CARE OF THE BURNER DURING EXTENDED SHUTDOWN

Heating equipment is oftentimes located in an environment conducive to corrosion and general deterioration if not properly protected and periodically checked, especially during an extended period of shut down. The following procedures should be followed if the burner is going to be placed out of service even for a short period of time.

1. Turn the main manual fuel valve OFF.

### CAUTION

Always keep the main fuel valve(s) **OFF** if the burner is shut down for an extended period of time.

2. Turn off the main electrical disconnect to the burner OFF. Follow tagout / lockout procedures.

3. Place a notification tag or label at the main manual fuel valve giving reason for shutdown. Follow tagout / lockout procedures.

4. If the burner is in an area subject to sweating and condensation, cover the control cabinet and electrical devices with plastic and secure with twine or tape.

5. Should the burner be out of service for more than thirty (30) days, a complete operational safety check must be made at the time of restart. The restart must be treated as a new burner start-up (see burner start-up section in this manual).

6. The oil nozzle(s), if pressure atomized should be replaced. If air atomized, clean the nozzle with cleaning fluid and a soft brush.

## M. REPLACEMENT PARTS

be stocked to support uninterrupted burner operation.

Pilot Electrode  
Blower Wheel  
Oil Pump (if oil burner)  
Oil Pump Coupling (if oil burner)  
Pilot Ignition Transformer  
Oil Ignition Transformer (if used)  
Gas Pilot Solenoid Valve  
Flame Scanner

Items with greater life expectancy and/or greater dollar value, such as flame safety controls, main gas or oil valves and blower motors should be obtained from your local Webster representative when a need arises.

An illustrated parts drawing is included within the Burner Instructions Manual to aid in parts identification. The noun name of the part needed should be established from the drawing, then the part number can be obtained from the burner material list contained in the Burner Instructions and Service Manual.

### NOTE

**Always give Webster Engineering Serial Number and/or UL Serial Number when ordering parts.**

## N. WARRANTY VALIDATION & FIELD START-UP REPORT

As a final step, forward the top copy of the Warranty Validation and Field Startup Report, Form 113, to:  
WEBSTER ENGINEERING & MFG. CO., LLC, 619 Industrial Road, Winfield, KS 67156.

WEBSTER Series JB Burners are listed by Underwriters Laboratories, Inc. (U.L.). Also by the State of Massachusetts Fire Marshall, City of New York Board of Standards and Appeals, State of Minnesota, and can be packaged to meet specific requirements of CSD-1, GE GAP, IRI, FM, NFPA, MIL or other special insurance or local code requirements.



# WARRANTY VALIDATION FIELD START-UP REPORT

CUSTOMER: \_\_\_\_\_ W.O. \_\_\_\_\_

BURNER MODEL: \_\_\_\_\_ BOILER MODEL: \_\_\_\_\_

CONTROL CIRCUIT COMPONENT OPERATIONAL TESTING (Check if Okay)

Primary LWCO \_\_\_\_\_ High Limit \_\_\_\_\_ Firing Rate Control \_\_\_\_\_  
 Secondary LWCO \_\_\_\_\_ Operational Control \_\_\_\_\_ Low Fire Start Switch \_\_\_\_\_  
 High Gas Press. Switch \_\_\_\_\_ Oil Press. Switch \_\_\_\_\_ High Fire Purge Switch \_\_\_\_\_  
 Low Gas Press. Switch \_\_\_\_\_ Air Flow Switch \_\_\_\_\_ Other \_\_\_\_\_

FIELD COMBUSTION SETTINGS	OIL FIRED			GAS FIRED		
	Low	Med.	High	Low	Med.	High
Firing Rate						
CO <sub>2</sub>						
O <sub>2</sub>						
Smoke or CO (ppm)						
NOx (ppm)						
Stack Temp. Net °F						
Room Temperature °F						
Overfire Draft " WC						
Breeching Draft " WC						
Water Temp. °F/Steam Press.						
Air Inlet Shutter (" Open)						
Flame Signal Pilot						
Flame Signal Main						
Oil Noz. Press/Man. Gas Pres.						
By-Pass Oil Pressure						
Atomizing Air Pressure						
Combustion Efficiency						
Running Motor Amps & Volts	L1		L2		L3	

**Comments:**

Having read the Manufacturer's service manual as to the proper installation, start-up and service of the unit above, I verify that the burner has been put into operation as specified, and that the above information and checks are complete and correct.

START-UP BY \_\_\_\_\_ Date \_\_\_\_\_

Company \_\_\_\_\_ Phone No. \_\_\_\_\_

Address \_\_\_\_\_

**NOTE:** Warranty Validation - Field Start-up report must be completed, signed, dated and the top copy sent to Webster Engineering & Manufacturing Co., Winfield, KS 67156, to validate equipment warranty.

**NOTES**

**NOTES**

**WEBSTER COMBUSTION TECHNOLOGY**  
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www.webster-engineering.com