



Webster Combustion Technology LLC  
619 Industrial Road, Winfield, KS 67156

Installation, Startup, Operation and Maintenance Manual

# SC Series Forced Draft Burners



Manual Part No. 950108 - R1  
[www.webster-engineering.com](http://www.webster-engineering.com)  
August, 2017

## 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 THE WINDOWS, 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 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 Model SC burners offered by Webster Combustion Technology 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 SC 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.

**Figure A-1 Nameplate**

<b>MODEL NUMBER</b>				<b>SERIAL NUMBER</b>			
SC12C-15-RM7840L-UL-IRI				U81375A-018-06			
<b>GAS INPUT RATING</b>				<b>OIL INPUT RATING</b>			
	MBTU/HR	IN.WC		GPH	PSI		
MAXIMUM	2940	2.8		21	300		
MINIMUM	1680	1.0		12	100		
FUEL	NATURAL GAS			#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 Combustion.

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. 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 SC burner can fire natural gas as well as #2 oil.

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

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 piping schematics, which show the components and their 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**

# SC BURNER MODEL CONFIGURATION

## FIGURE A-2

### SC12G -50-LMV51-M.25-M-MP-UL/CSD-1

BURNER SERIES	
SC	SC SERIES

HEAD SIZE (INCHES)	
SC	
8	
10	
12	
12.3	
13	
13.8	
14	
15	
15.8	
16	
18	
20	
24	

FUELS	
G	Gas
C	Gas/Oil
O	Oil

BLOWER MOTOR HORSEPOWER	
20	2
25	2 1/2
30	3
50	5
75	7 1/2
100	10
150	15
200	20
250	25
300	30
400	40

CODES AND LISTINGS	
UL	
ULc	
CSD-1	
FM	
IRI	
NFPA-85	

OIL SYSTEMS	
Pressure Atomizing	
MR	Modulation By-Pass
MP	Modulation Simplex
Air or Steam Atomization	
MA	Air Atomization
MS	Steam atomizing

GAS TRAIN VENDOR	
VGD	Siemens
VGG	Siemens
M	Maxon
Blank	All Others (ASCO) - (std)

GAS TRAIN SIZE	
.15	1 1/2 inches
.20	2 inches
.25	2 1/2 inches
.30	3 inches
.40	4 inches

GAS SYSTEMS	
M	Modulation

FLAME SAFEGUARD VENDOR DESIGNATION	
M Mark	AutoFlame - mini mark
Nexus	Fireye
LMV51	Siemens
LMV52	Siemens

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

## Model SC - Specification Data

(1) STANDARD EQUIPMENT AND IMPORTANT OPTIONS		Gas	No. 2 Oil	
			Pressure Atomized	Air Atomized
General	Motor, Fan and Air Inlet Control	X	X	X
	Air Flow Switch	X	X	X
	(2) Burner Mounted Control Panel, Switch and Four Indicator Lights	X	X	X
	Flame Safety Control	X	X	X
	Ultra Violet Scanner	X	X	X
	Motor Starter with Overloads	X	X	X
	Fuel Selector Switch	Dual Fuel Burners Only		
	Linkageless Control	X	X	X
	Ignition	Proven Gas Pilot Ignition	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
	Alternate Control Cabinet Positioning	X	X	X
	Remote Control Panel	X	X	X

STANDARD EQUIPMENT AND IMPORTANT OPTIONS		Gas	No. 2 Oil	
			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
Oil Nozzles			X	X
Remote Oil Pump			X	Opt.
Two Safety Shutoff Valves			X	X
Low Oil Pressure Switch			X	X
Oil Pressure Gauge			X	X
Oil Metering Valve			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".

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

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 5% 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.

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. **Fuel to be Burned** - Type of gas, 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

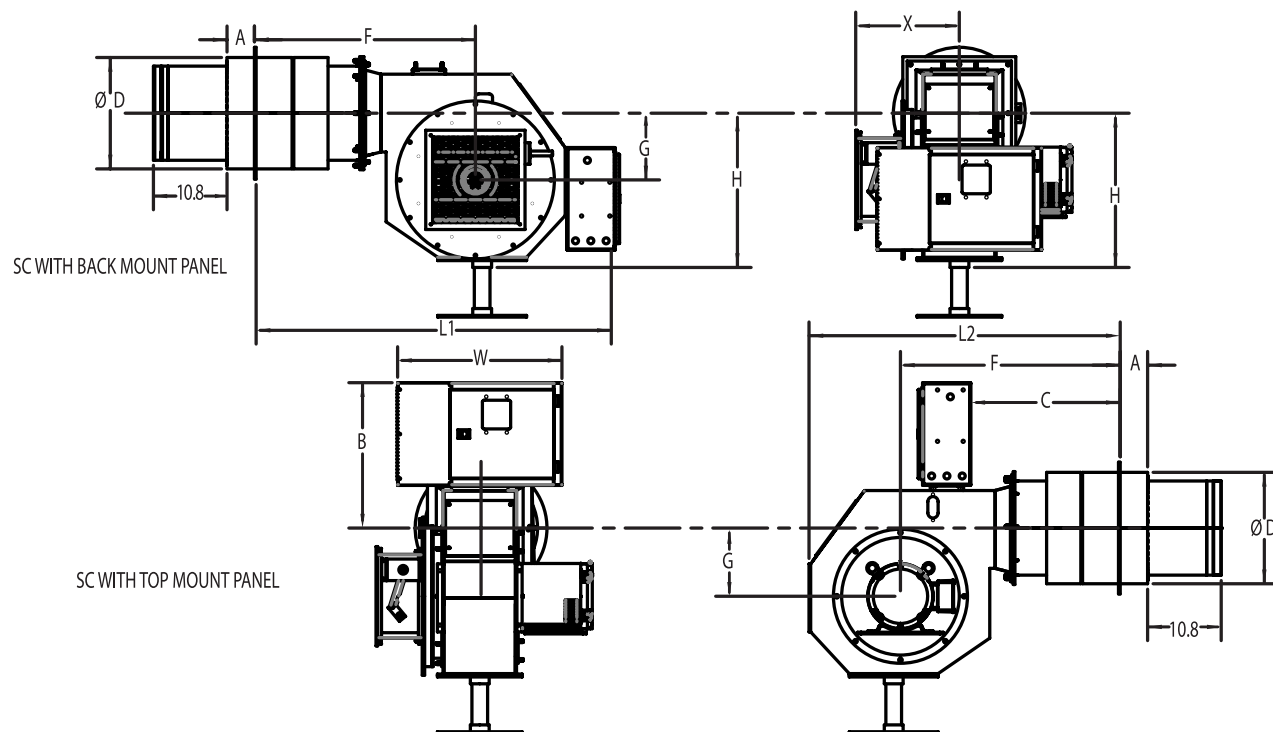
**Control System** - ON-OFF, Low Fire Start, Low-High-Low, Modulation, Posi-Control

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

**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. **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, Fireye or Siemens controls. **Gas Train Components Preferred:** ASCO/ITT, Honeywell or Landis Control System - Modulation, Posi-Control  
**Required Options** - Mounting plate, limiting controls, etc.

## Model SC - Dimensional Data

(Dimensions are +/- 1/4 inch)



MODEL*	Min Req'd Gas Press. (PSIG)	Std Gas Train Size	Max Firing Rate (MBH) STD		Fan Motor  HP	DIMENSIONS (INCHES)											
			<30 PPM	<9 PPM		A**	B	C	D	F**	G	H	K	L1**	L2**	W	
SC8-20	0.75	1.5"	3,300	2,900	2	2	19	15.7	7.9	22.3	6.6	15	10.8	38.4	30.9	24	
SC10-30	0.75	2"	4,100	3,600	3	2	20	19	9.9	26	8.3	18.6	10.8	44.5	36.9	24	
SC12-50	0.75	3"	5,300	4,700	5	2	21.2	16.8	12	27.3	9.7	22.5	10.8	47.9	40.5	24	
SC12.3-75	0.75	3"	7,700	6,800	7.5	2	21.2	16.8	12.3	27.3	9.7	22.5	10.8	47.9	40.5	24	
SC13-100	1	3"	11,700	10,300	10	2	21.2	16.8	13.7	27.3	9.7	22.5	10.8	47.9	40.5	24	
SC13.8-150	1	3"	12,500	11,000	15	2	24.6	26.6	13.8	30.2	17.8	34.2	10.8	56.7	49.1	24	
SC14-150	1	3"	14,300	12,600	15	2	24.6	26.6	14	30.2	17.8	34.2	10.8	56.7	49.1	24	
SC15-150	1	3"	15,700	13,800	15	2	24.6	26.6	15.7	30.2	17.8	34.2	10.8	56.7	49.1	24	
SC15.8-200	1	3"	16,600	14,600	20	2	24.6	26.6	15.8	30.2	17.8	34.2	10.8	56.7	49.1	24	
SC16-200	1	3"	18,800	16,500	20	2	24.6	26.6	16	30.2	17.8	34.2	10.8	56.7	49.1	24	
SC18-300	1.25	3"	21,600	19,000	30	2	27.6	41	18	38	24.2	43.7	10.8	468	60.4	24	
SC20-300	1.25	3"	24,500	21,500	30	2	27.6	41	20	38	24.2	43.7	10.8	68	60.4	24	
SC24-400	1.25	3"	30,400	26,700	40	2	27.6	41	20.4	38	24.2	43.7	10.8	68	60.4	24	

\* Can be "G" (Gas) or "C" (Combination Gas/Oil) \*\* 2" Nose length is standard. May be different depending on vessel insertion depth.

Data shown is for 1" furnace pressure. Contact Webster for data on other furnace pressures.

All dimensions are for reference only. Webster reserves the right to change dimensions without notice.

### Fuels Burned and Control Systems

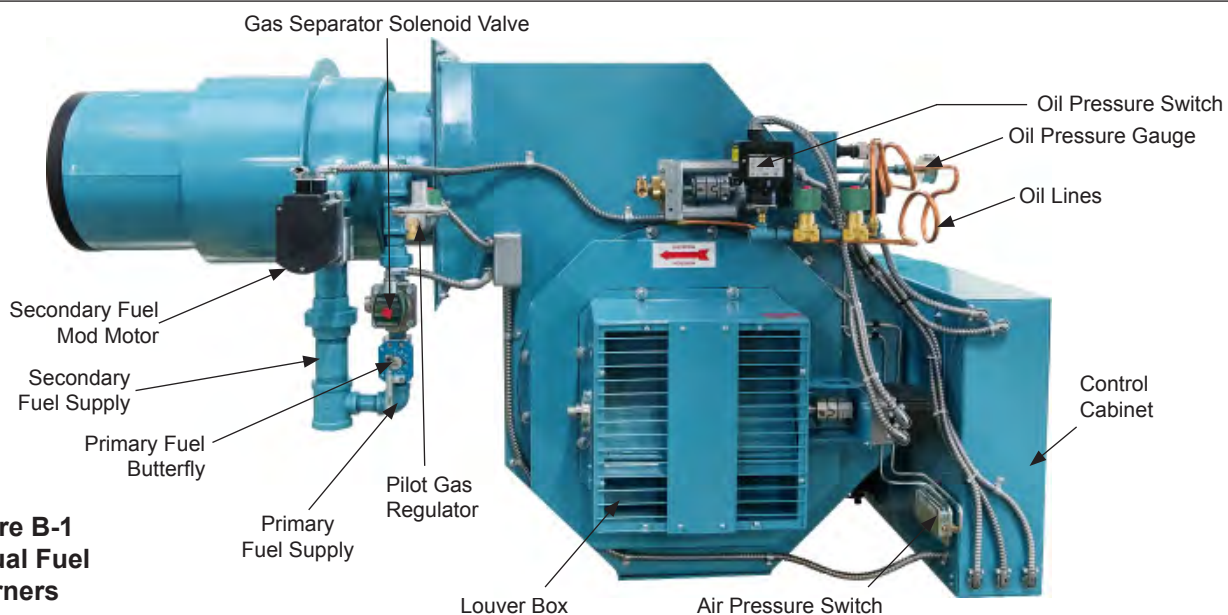
- Natural Gas
- Light #2 Oil, Mechanical Pressure
- Modulating or Micro Modulation
- Control Circuit Requires 120 vac, 60 Hz, Single Phase Voltage Supply

Model SC burners can be packaged to meet specific requirements of IRI, FM, GE GAP, NFPA, MIL spec. or other special insurance or local code requirements.

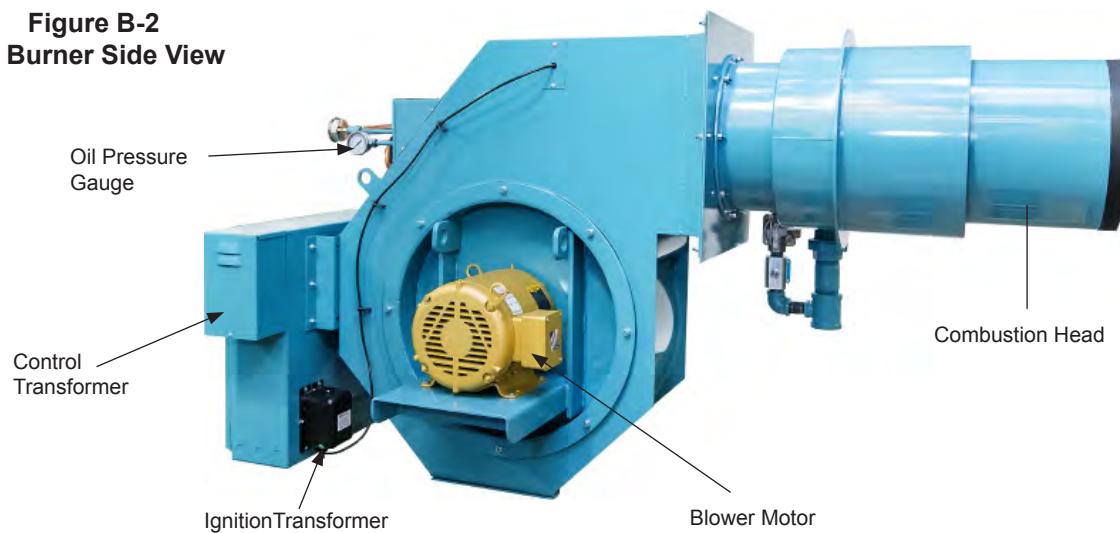


## B. COMPONENT IDENTIFICATION

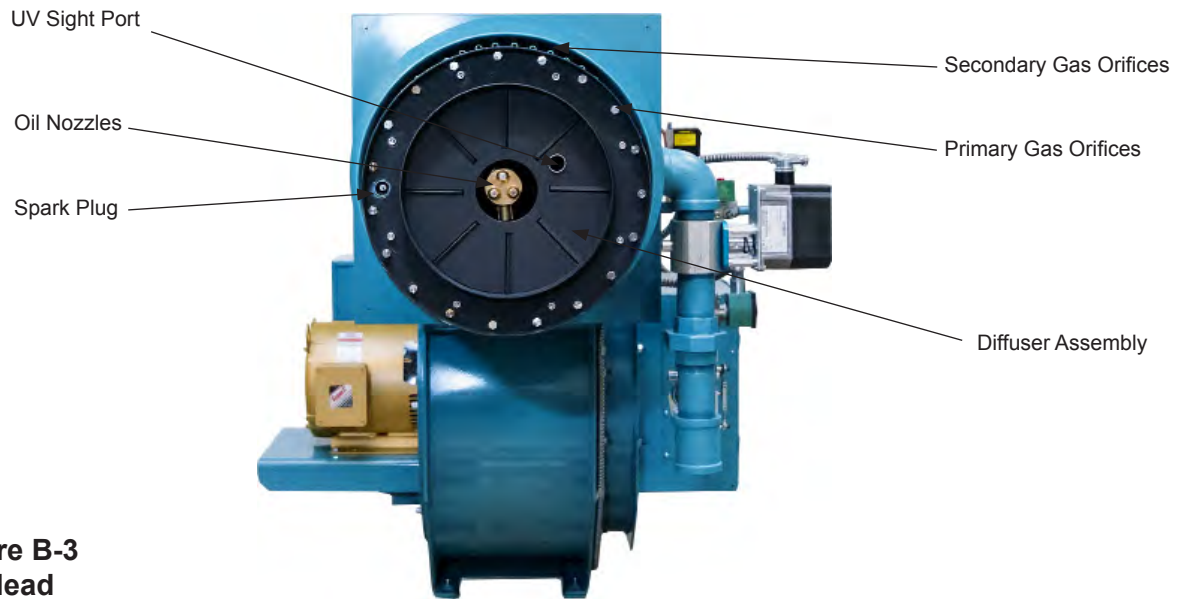
This section shows the different common components used in the SC burner line and should be helpful to identify parts described elsewhere in this manual.



**Figure B-2**  
**SC Burner Side View**

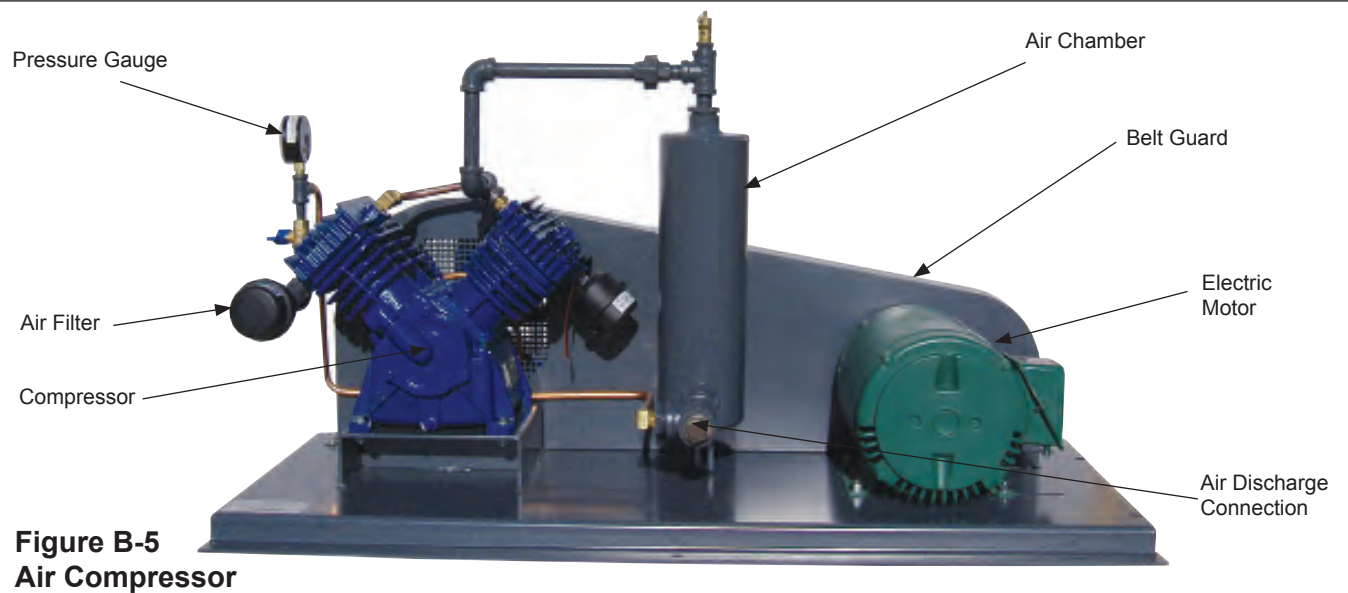
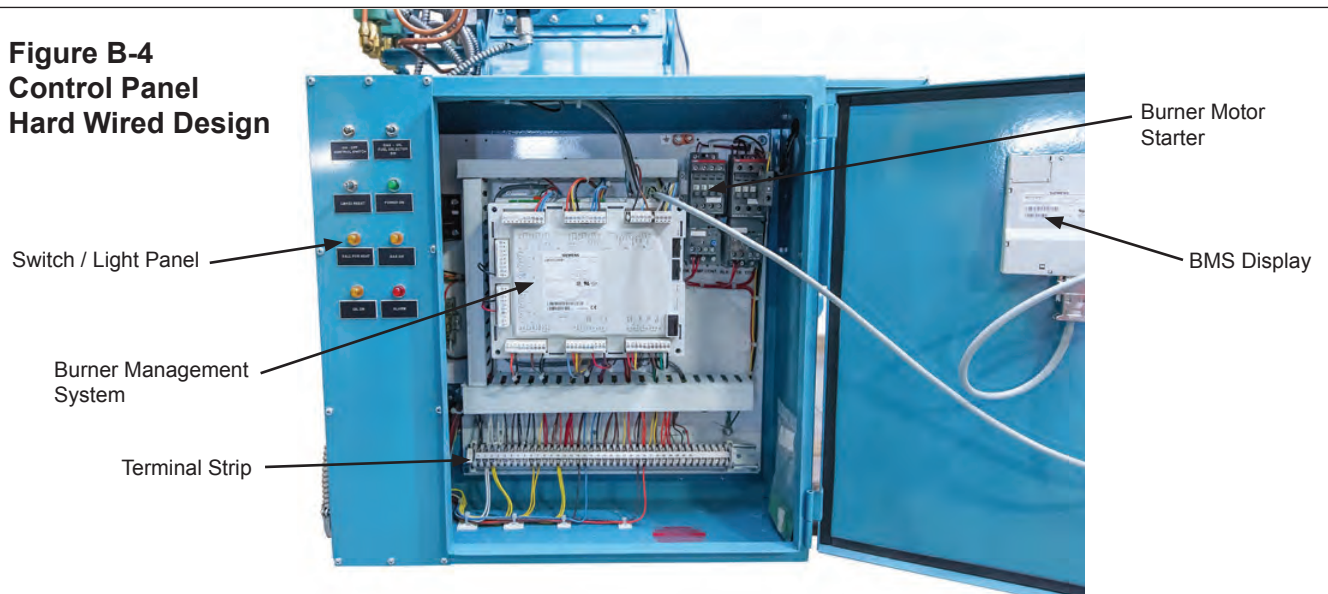




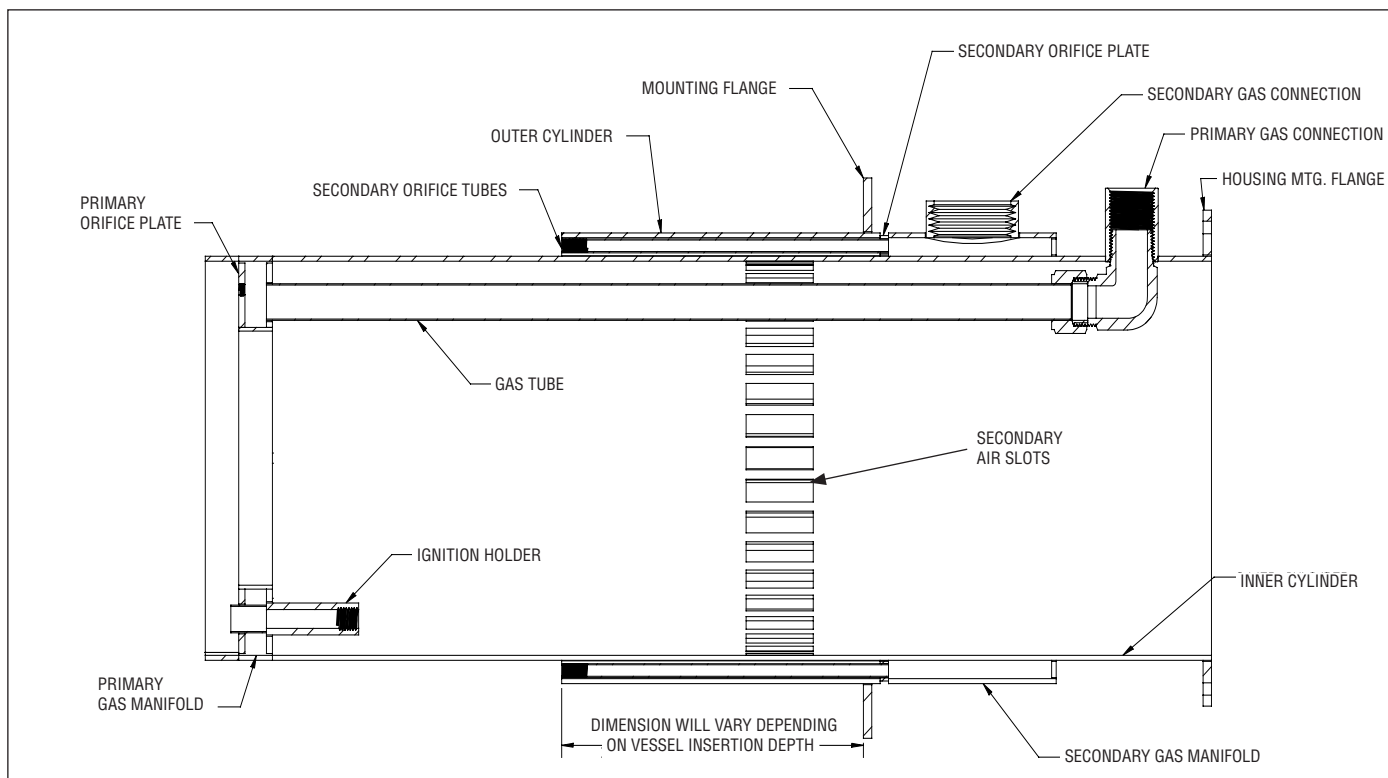


**Figure B-3**  
**SC Head**

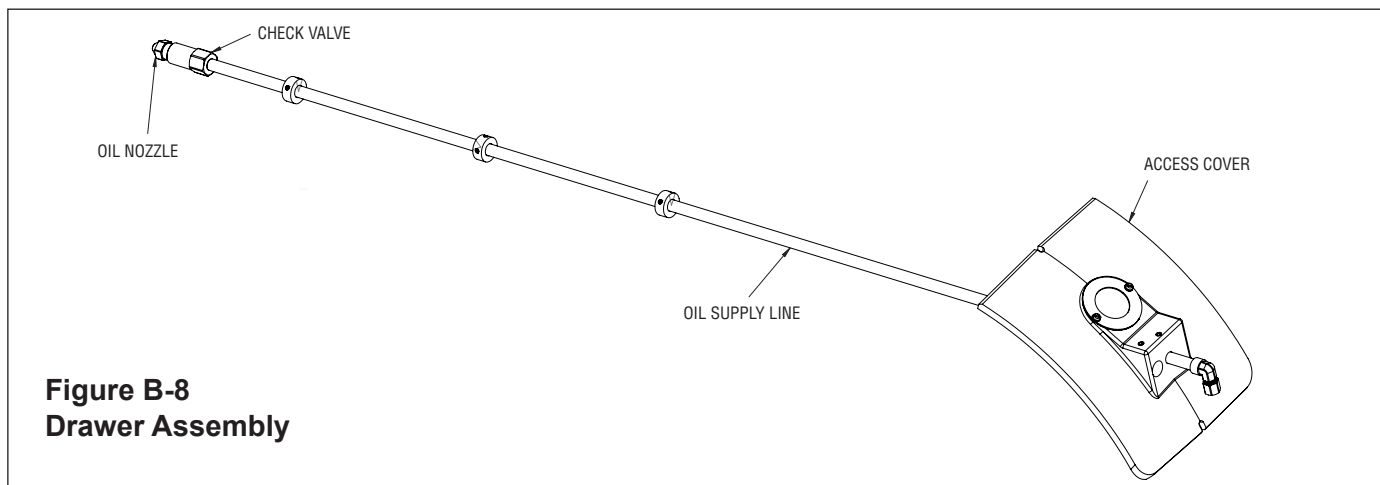
**Figure B-4**  
**Control Panel**  
**Hard Wired Design**



**Figure B-5**  
**Air Compressor**



## Gas Orifice Part Number and Description



## 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. Check 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 the correct 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 combination burner, is gas available at the burner location?
  7. If a combination 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 SC series burners must be operated with a two-pipe system.
8. If a retrofit installation, has the same oil grade always been used? Does it meet the grade specified on the burner's rating plate?

### CAUTION

**THE COMBINATION BURNER SHALL ONLY BURN THAT GRADE OF OIL SHOWN ON THE RATING PLATE. DO NOT USE GASOLINE, CRANKCASE OIL, OR ANY OIL CONTAINING GASOLINE OR TOXIC CONTAMINANTS.**

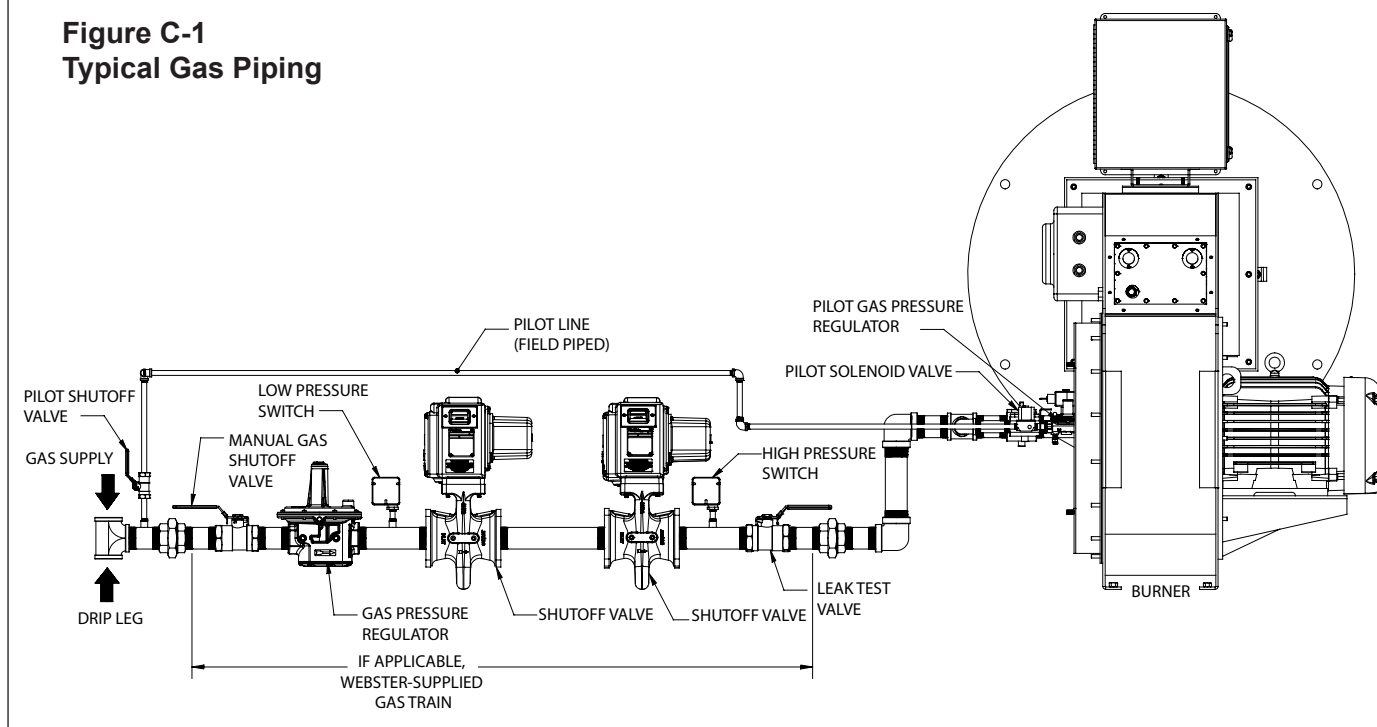
9. Is there adequate flue provisions to assure SAFE and proper venting of the burner?
10. All manuals should be reviewed and understood and stored in a convenient place.
11. Teflon tape should not be used on any field piping.
12. Rope gaskets should be used between vessel and mounting plate, and between mounting plate and burner.
13. Gas piping should be flushed (cleaned) prior to use.
14. Check minimum straight lengths for gas pressure 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 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.
19. 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**

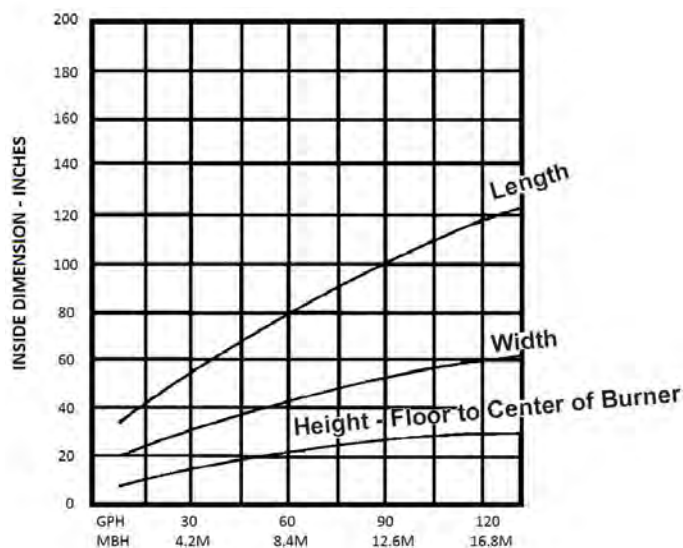
20. Is the burner mounting plate and burner head sealed with rope gasket? (See Figure E-2)
21. Is there a drip leg in the gas supply to capture foreign material? (See Figure C-1)
22. Is the piping between the gas train and burner done in a manner that will minimize the pressure drop?
23. Has all of the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

**Figure C-1**  
**Typical Gas Piping**



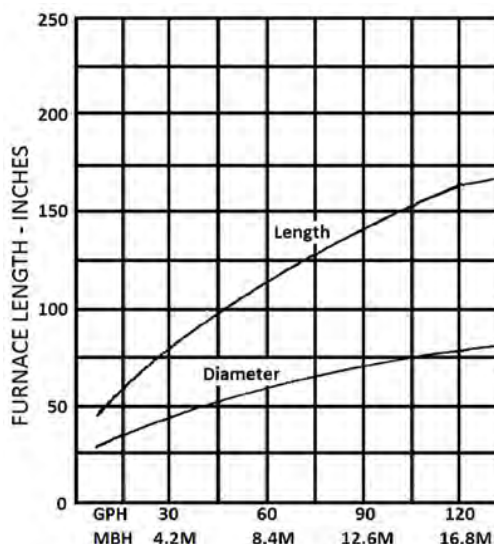
**Chart C-2**

**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

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.

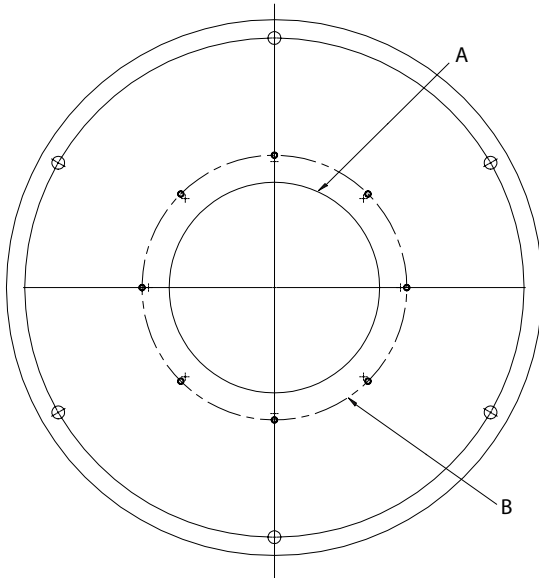
3. The installer shall identify (label) the main electrical power disconnect and the manual shut-off valve on the gas and/or oil supply drop-line to the burner.

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, no more than -0.25 iwc.

## 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.

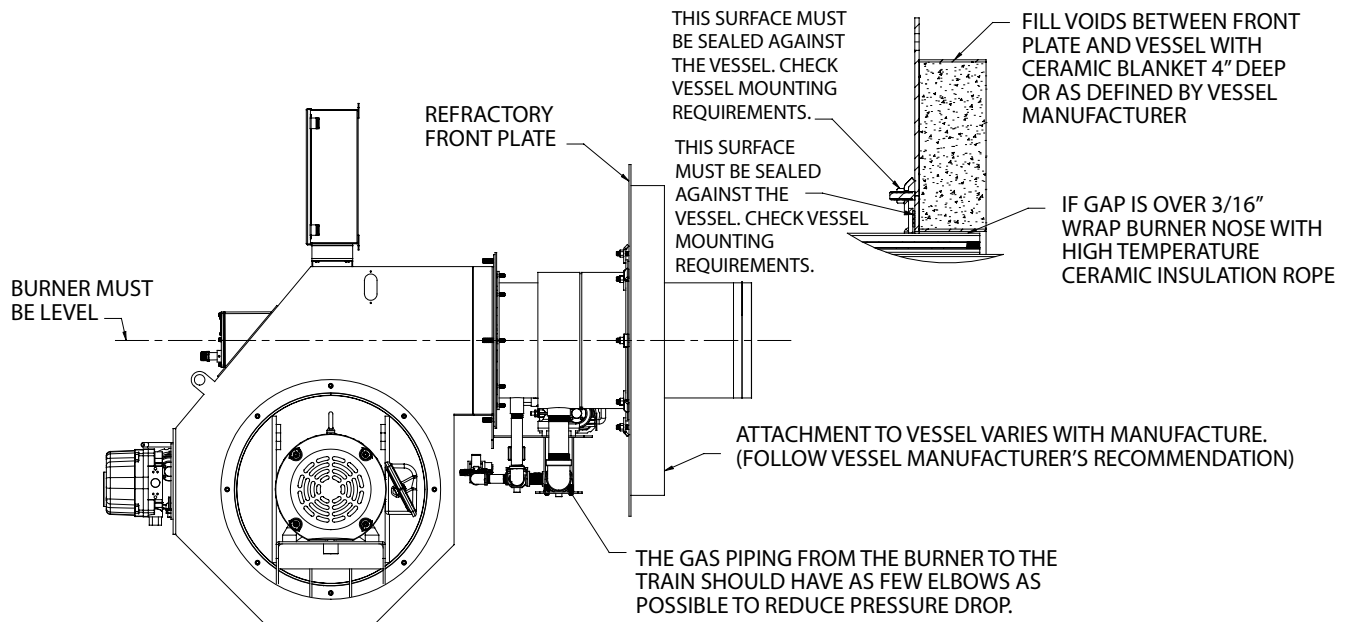
### TYPICAL SC BURNER REFRACTORY FRONTPLATE



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

Dimensions - Inches		
MODEL	DIM. A	DIM. B
SC8	9.25"	14.00"
SC10	11.25"	16.00"
SC12	13.25"	17.00"
SC12.3	13.56"	19.00"
SC13	15.00"	19.00"
SC13.8	15.00"	19.00"
SC14	15.25"	19.00"
SC15	17.00"	20.50"
SC15.8	17.00"	20.50"
SC16	17.25"	20.50"
SC18	19.25"	22.50"
SC20	21.25"	24.50"
SC24	25.25"	28.50"

Contact Webster for more detailed refractory drawings.



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



## F. FUEL SYSTEMS

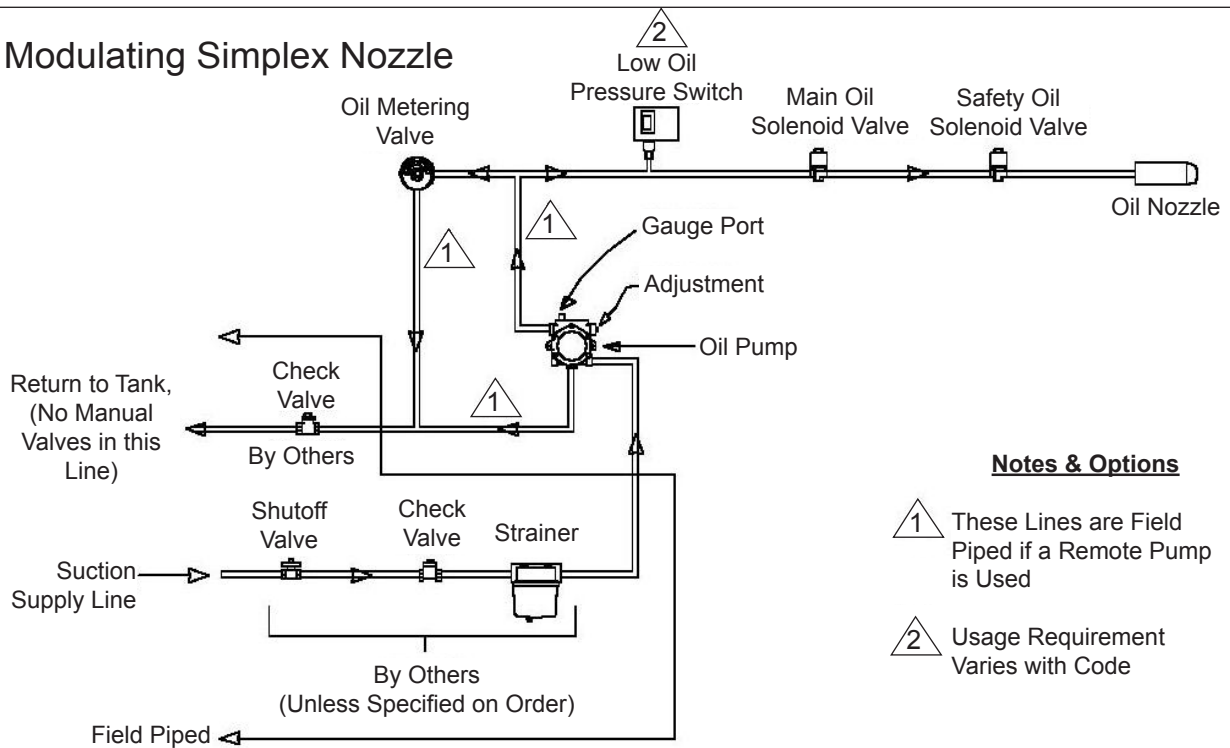
The SC burner can be equipped with a wide range of fuel and operating systems to control the fuel, air, modulation and pilots. This section describes how these systems operate. Burner start-up is expected to be done by service personnel who are qualified in the basics of mechanical know-how. The following 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

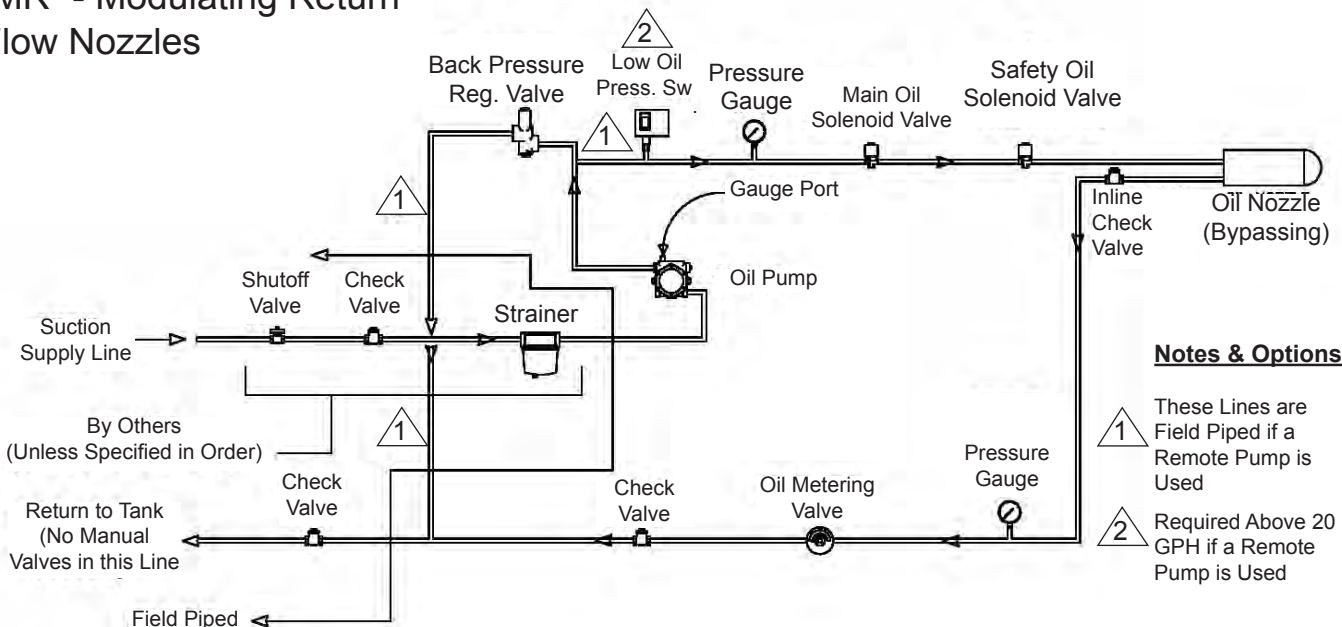
Refer to the bulletins included in the manufacturer's data section of the burner instructions manual for items below.

### 1. Pressure atomized oil systems

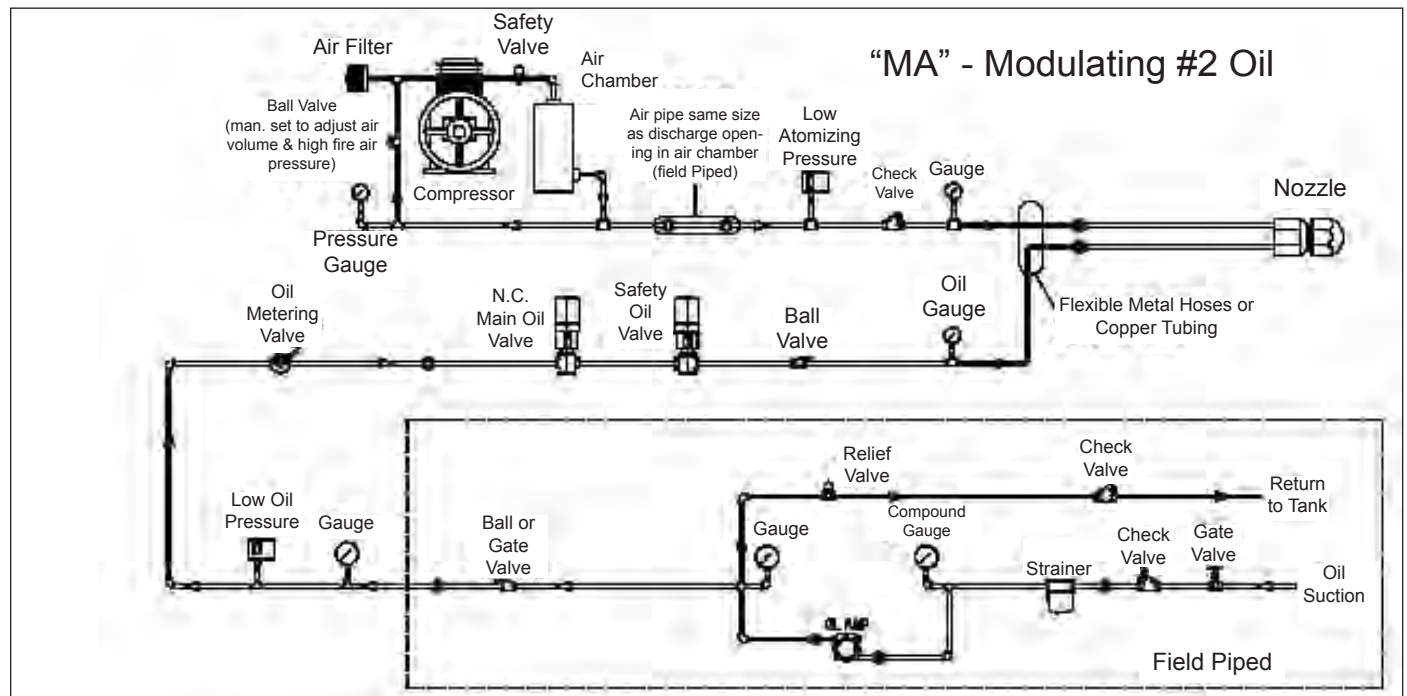
#### "MP" - Modulating Simplex Nozzle



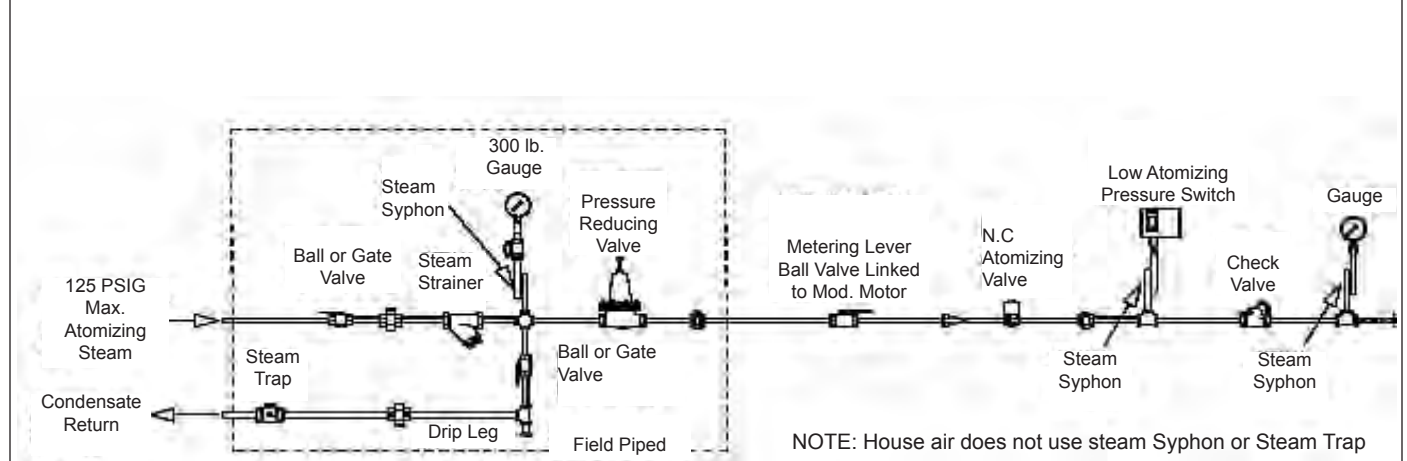
#### "MR" - Modulating Return Flow Nozzles



## 2. Air Atomized Oil Systems



### "MA" or "MS" - Modulating House Air or Steam



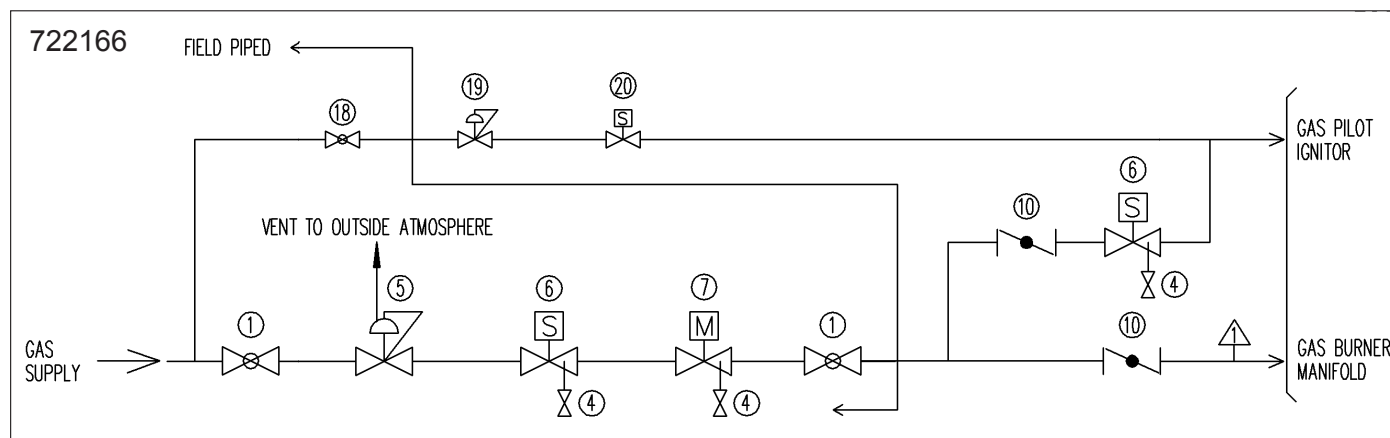


## 2. Gas Systems

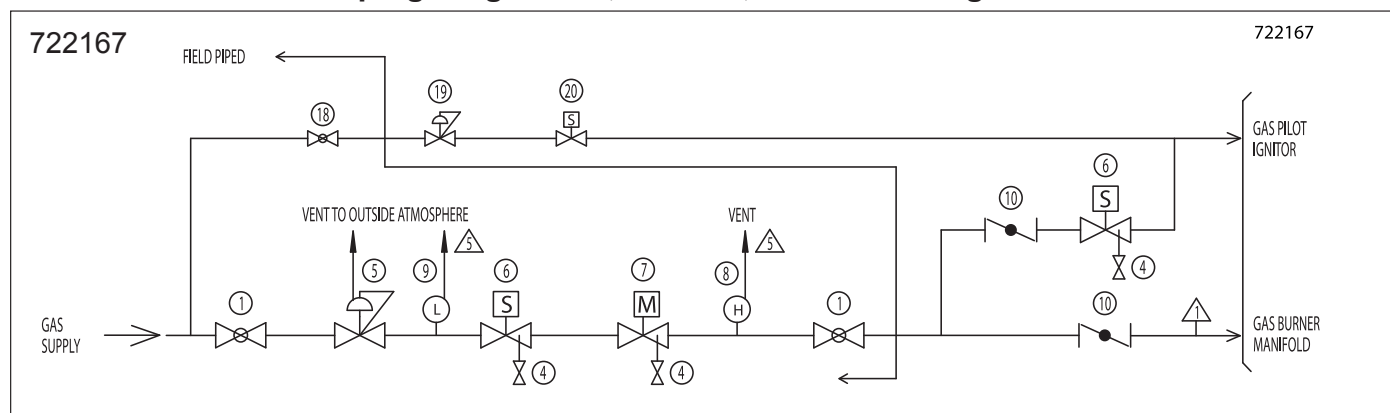
**Illustrated Gas Trains by Capacity and Code:** The following illustrations show the Webster configuration for UL, FM and IRI as grouped by UL capacity ratings. Refer to the legend below for component part identification. These illustrations are not to be used for field erection and/or system design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

UL Capacity Range BTU/Hr.	Operation Mode	Webster Designation	Code		Illustration
			UL	FM	
To 2,500,000	Modulating	M	X	X	722166
2,500,001 to 5,000,000	Modulating	M	X		722167
	Modulating	M		X	722168
5,000,001 to 12,500,000	Modulating	M	X		722169
	Modulating	M		X	722170
12,500,001 and Up	Modulating	M	X		722171
	Modulating	M		X	722172

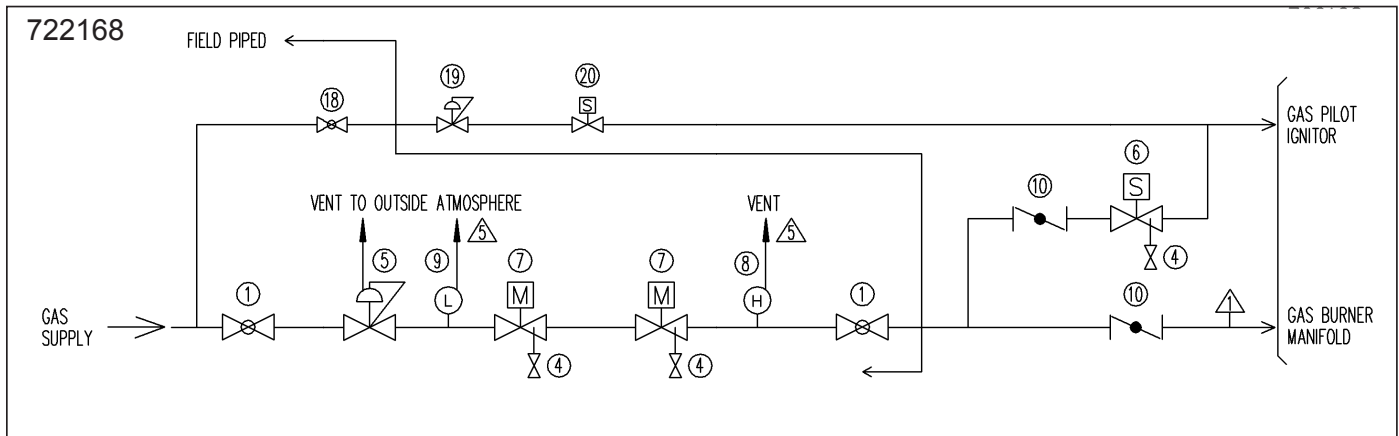
### UL-FM Modulation Gas Piping Diagram - Up To 2,500 MBH Firing Rate



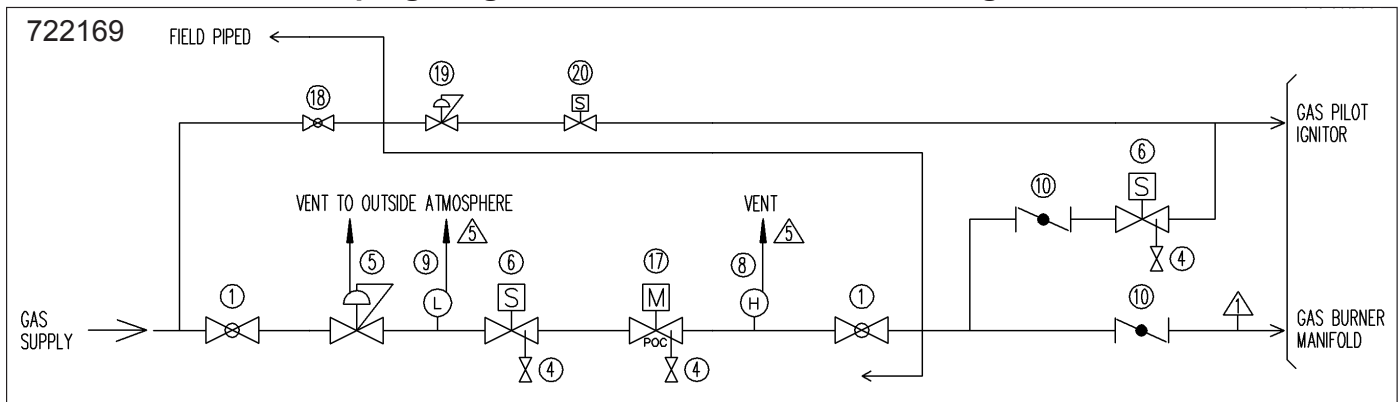
### UL Modulation Gas Piping Diagram - 2,500 To 5,000 MBH Firing Rate



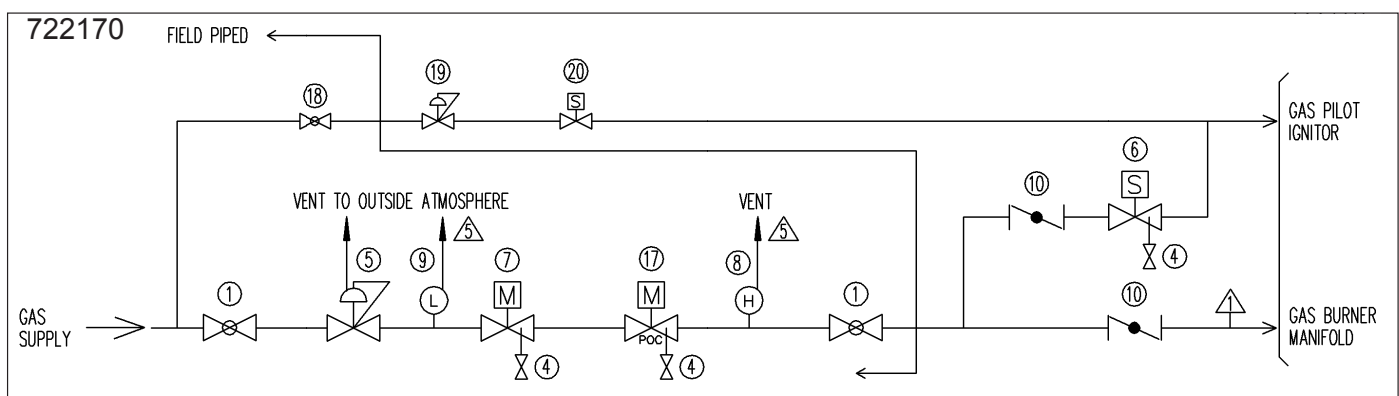
## FM Modulation Gas Piping Diagram - 2,500 To 5,000 MBH Firing Rate



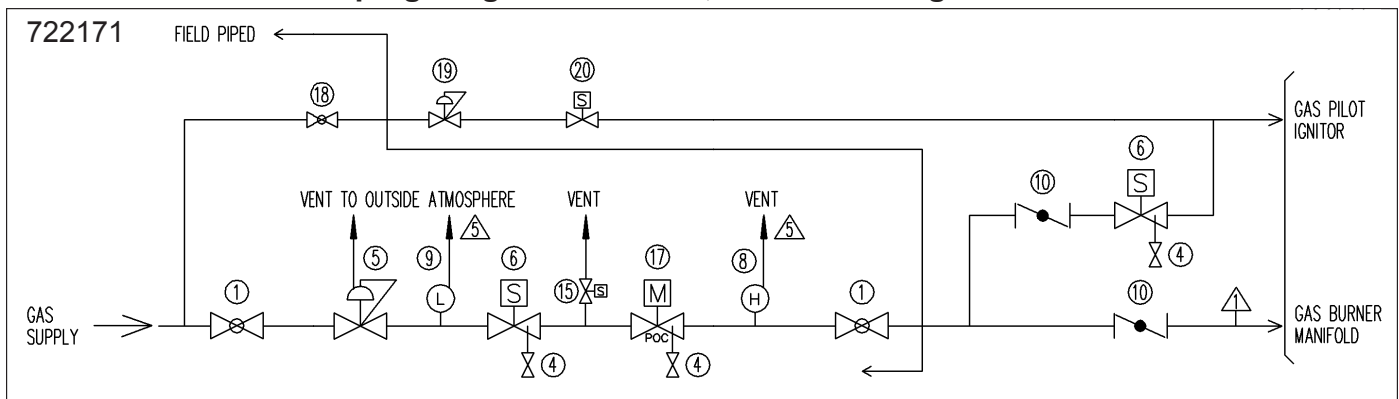
## UL Modulation Gas Piping Diagram - 5,000 To 12,500 MBH Firing Rate



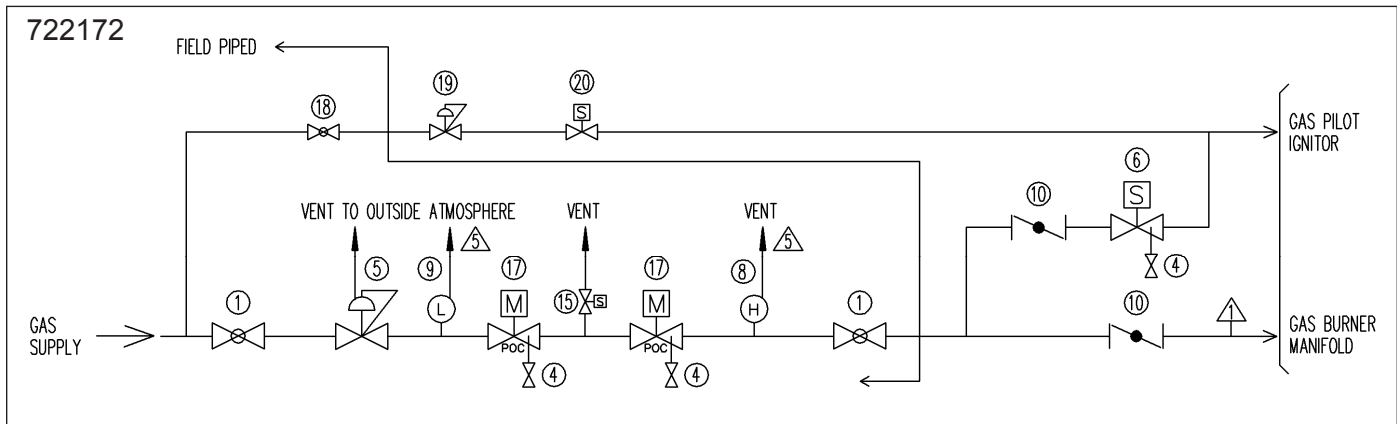
## FM Modulation Gas Piping Diagram - 5,000 To 12,500 MBH Firing Rate



## UL Modulation Gas Piping Diagram - Over 12,500 MBH Firing Rate



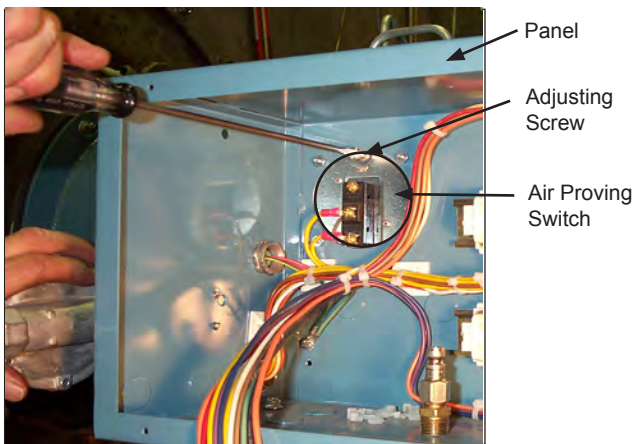
## FM Modulation Gas Piping Diagram - Over 12,500 MBH Firing Rate



## 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 or readjusting the burner if the settings are lost. Presets can change during shipping.

### COMBUSTION AIR CONTROL



Air Flow Interlocking Switch

#### 1. OIL NOZZLE POSITION

The oil nozzle will be adjusted at start-up and may be moved in or out from this initial setting.

#### 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.

#### CAUTION

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 SYSTEM

Every burner set-up is different, therefore the positions below are indications only and tuning must be done by fully trained and qualified personnel.

### 1. Pilot

A crucial part of reliable burner operation is a dependable pilot. The way the SC burner operates is that the primary zone is lit first, thus acting as a pilot, before the secondary fuel valve is opened and the burner can operate the entire operating range.

The spark plug position can be seen in figure H-1.

Pilot gas pressure should be measured at the 1/8" port located downstream of the primary solenoid valve.

### 2. Air Damper Position

The air damper should be near close at low fire and close to full open at high fire.

### 3. Gas Modulating Control Valve Position

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

### 4. 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-1

## I. STARTUP AND OPERATING ADJUSTMENTS

1. Pre-Start Check List
2. Burner Drawer Adjustments
3. Gas Setup
4. Pressure Atomized Oil Setup
5. Air Atomized, #2 Oil Setup
6. Operating Control Adjustments
7. Limit Tests
8. Pilot Test
9. Burner Shutdown
10. Restarting After Extended Shutdown

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

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

Before proceeding with startup and adjustment, be sure that overall installation is complete. Review the boiler

operating and installation manual, as well as all control manuals to verify that equipment is ready for operation. These manuals must be read prior to start of equipment. If you are not qualified to service this equipment, **DO NOT TAMPER WITH THE UNIT OR CONTROLS - CALL YOUR SERVICEMAN.**

**A block diagram of the startup sequence for the SC burner can be found on page 25, Figure I-3.**

When finished with startup, document valve and linkage positions, pressures, and settings for future reference.

### **READ AND SAVE THESE INSTRUCTIONS.**

During purge, all solenoids, including the gas separator solenoid valve, are closed and are to remain closed until called upon. After purging the system for at least 30 seconds, the spark plug is activated. Waiting for one second for the spark to initiate, the pilot solenoid valve is opened which will ignite the primary zone. When the flame safeguard system detects a strong signal, it will open the main fuel valve to start the ignition of the secondary zone. Following a 4-second delay, the gas separator solenoid valve will open and the pilot solenoid can be closed. From this point on, the burner can be driven to low fire.

## 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. Gently pull on all the wires to make sure that they are connected properly.
- \_\_\_\_\_ All fuel lines are connected and tight.
- \_\_\_\_\_ Pilot gas is connected.
- \_\_\_\_\_ Burner is mounted to vessel and floor, with all bolts secured.
- \_\_\_\_\_ 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 and the load must be able to use 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. A NOx 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. 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.

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

- a. Loosen and remove the screws on the burner drawer.

- b. 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.
- c. Pull the drawer out, holding it centered in the opening to prevent it from hanging up while being pulled.
- d. Set the drawer down horizontally.

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

## 3. Gas Setup

- a. Place the burner switch in the "OFF" position
- b. Place the burner management system in manual mode". If this is a combination fuel burner, make sure the fuel selector switch is on "GAS".
- c. Place the burner management system in the low fire position.
- 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. Turn the burner switch on. This will start the blower motor and initiate the prepurge cycle.
- h. When the prepurge sequence is complete and the low fire start switch is made, the flame safeguard should indicate the presence of a flame.
- i. 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.
- j. 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.
- k. 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.
- l. After a few seconds, the combustion analyzer should have an accurate reading of the O<sub>2</sub> in the stack. Fig. I-1 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.



- m. Operate the burner until the boiler is warmed up and near the operating pressure or temperature. Increase the firing rate. Put the 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.
- n. 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:

#### 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/H 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 pressures are 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.**

- o. Adjust the air damper to obtain the correct NOx and CO levels.
- p. Modulate the burner to low fire, adjusting the O<sub>2</sub> level as the burner modulates to match the desired emission level.
- q. Adjust the low fire input and air damper adjustments. If the NOx is too high, close the primary butterfly valve more. If the CO is too high, close the air damper in small increments.
- r. Re-adjust the midfire points for the correct emission level.
- s. 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 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 gauge or manometer and plug 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%.
- t. 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%.
- u. 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.

#### 4. 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 must be adjusted to match these rates.

- a. Place the burner switch in the "OFF" position.
- b. Place the burner management system in manual mode. If this is a combination fuel burner, make sure the fuel selector switch is on "OIL".
- c. Place the burner management system in the low fire position.
- d. Turn the electrical power for the burner, boiler and related components on.
- e. Verify that the oil metering valve is nearly opened (the valve will be closed at high fire).
- 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 (if used) 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 valves (indicated with the Fuel Valve Light), and the burner should ignite at low fire. This operation of the 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.
- i. The main flame may not light on the first attempt, because it must fill the oil lines before providing oil to the nozzle. Press the reset button on the flame safeguard to restart the burner.
- j. In 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%, and the nozzle oil pressure should be between 50 and 70 PSIG return line pressure. Do not attempt to fine tune combustion until the high fire has been set.

**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.**

- k. Operate the burner until the boiler is warmed up and near the operating pressure or temperature.
  - l. Increase the firing rate, using the potentiometer or put the low fire hold switch in auto position, while monitoring and adjusting the O<sub>2</sub> 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 at the pressure rating indicated on the rating label (return line) for the SC.
- n. Modulate the burner to low fire, adjusting the O<sub>2</sub> level as the burner modulates.
- p. Adjust the low fire input and air damper adjustments.
- q. Re-adjust midfire points for correct emission levels.
- r. 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.

## 5. 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.

- a. Place the burner switch in the "OFF" position.
- b. Place the burner management system in manual mode.
- c. Place the burner management system in the 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 flame should be visible through the 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 O<sub>2</sub> in the stack. The O<sub>2</sub> level should be between 4% and 7% (see Figure I-1 for O<sub>2</sub> rates), and the nozzle oil pressure should be between 5 and 15 PSIG. Do not attempt to fine tune combustion until the high fire input has been set.
  - 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 O<sub>2</sub> level. Adjust the oil pressure and atomizing air pressure as needed to reach high fire position.



**Figure I-1  
Typical  
O<sub>2</sub> levels**

	Natural Gas				#2 Oil	
	< 9 ppm NOx		< 30 ppm NOx			
% Power Rate	Min O <sub>2</sub>	Max O <sub>2</sub>	Min O <sub>2</sub>	Max %O <sub>2</sub>	Min O <sub>2</sub>	Max %O <sub>2</sub>
30%	8.0	13.0	5.0	10.0	3.5	7.5
40%	7.5	11.0	4.0	10.0	3.0	7.0
50%	7.0	10.0	3.0	10.0	3.0	5.0
100%	6.0	8.0	3.0	8.0	3.0	5.0

- I. 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

**FIGURE I-2 Typical Atomizing Air Pressure**

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

- m. Adjust the NOx level to be about 10% below any guaranteed NOx performance.
- n. Modulate the burner to low fire, adjusting the O<sub>2</sub> level as the burner modulates.
- o. Adjust the low fire input, using the fuel and air damper adjustments.
- p. Re-adjust the midfire points for the correct O<sub>2</sub> levels. See Figure I-2 for Atomizing Air Pressure.
- q. 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.

## 6. 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.

## 7. 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 safe shutdown.

The limit switches include the air proving interlock 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 regularly to ensure they are operating properly. See the maintenance section.

## 8. Pilot Test

Once the burner has been set for the firing rates intended, 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. 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.**

- h. If the pilot does not light the main flame under these test conditions, adjust the fuel pressure to the primary (pilot) zone
- i. 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.

- j. 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.
- k. 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.
- l. 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).
- m. If the flame signal does not drop out as required, this may indicate a faulty scanner or amplifier.

## 9. 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.**

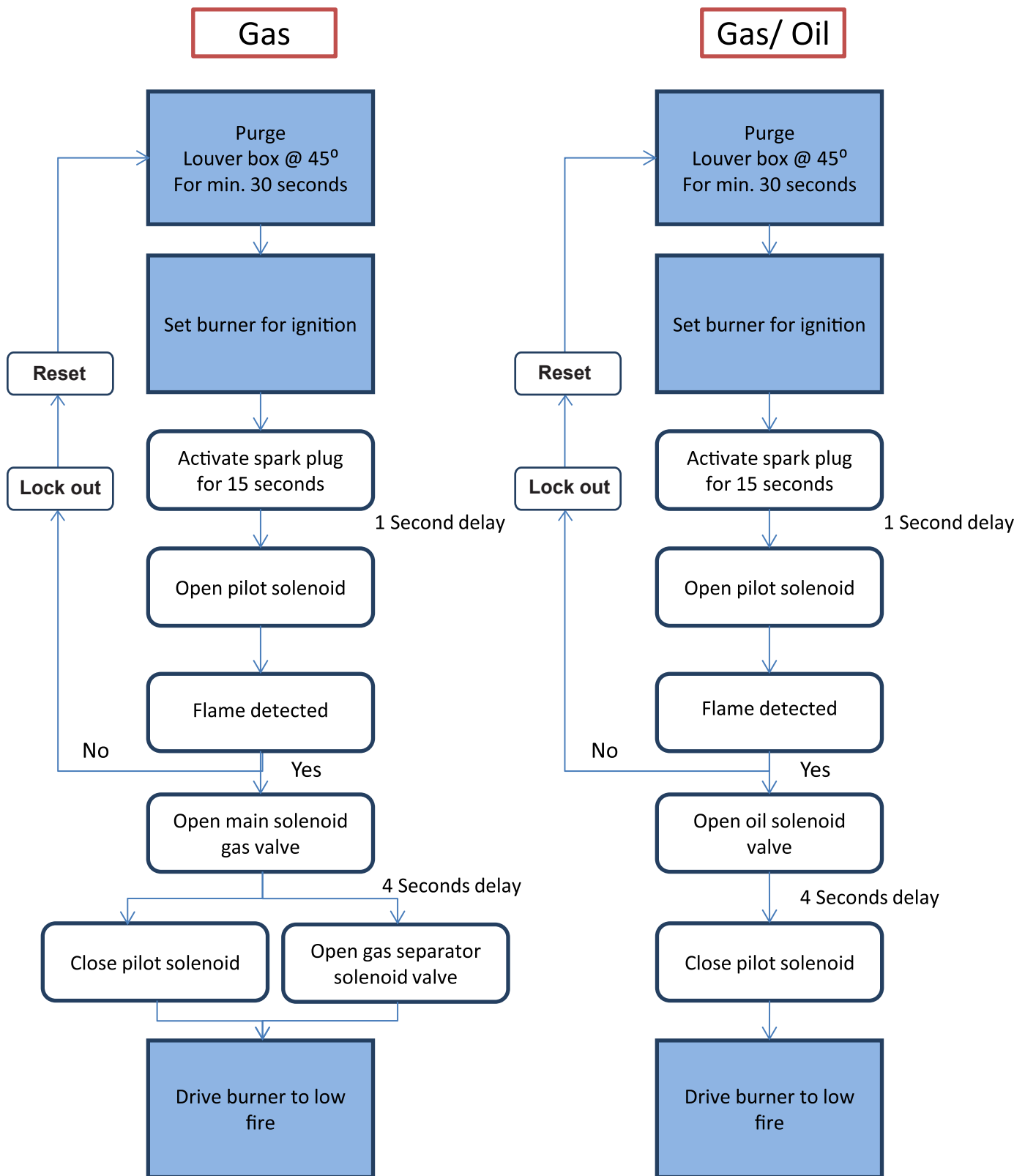
## 10. Restarting After Extended Shutdown

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.**

**FIGURE I-3**  
**Start-Up Sequence For An SC Burner**



## J. TROUBLESHOOTING

No.	System	Cause	Correction
1	No Ignition	Electrode is grounded. Porcelain is cracked.	Replace
		Loose ignition wire connection	Reconnect or tighten
		Defective ignition transformer	Check transformer, replace
		Ignition wire burned	Replace ignition wire - increase air
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
		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
		Incorrect gas pressure to pilot	Readjust pressure
		Combustion air flow rate too high	Readjust damper
		Pressure drops when opening primary zone	Increase separator pilot delay
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	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 nozzles 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	Check wiring 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
		Fluctuating gas pressure (regulator not holding pressure)	Check regulator pressure, sensing line and supply pressure: sized properly
9	Gas combustion noise	Input too low for burner components	Check input, compare to rating label
	(rumbling)	Improper excess air	Readjust excess air
		Fluctuating gas pressure (regulator not holding pressure)	Check regulator pressure and supply
		High stack draft (especially at low fire)	Stabilize draft
		Flame instability	Add primary fuel
10	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
		Fluctuating oil pressures (regulator not holding)	Check regulator pressure and oil supply
		Poor air flow distribution (off center flame)	Adjust air straightener blade
11	Fuel-Air-Ratios are	Fuel line plugged	Check and clean lines, strainers & filter
	not consistent	Fuel supply pressure changing	Check and/or replace pressure regulator
		Combustion air temperature changed	Retune burner
		Draft condition changed	Check draft and outlet damper
		Gas control valve - low fire stop not set (if used)	Adjust low fire stop
		No back pressure	Decrease the stack exhaust area (close the stack)
12	Fuel-Air-Ratios have changed	Air damper seal worn	Replace air damper seals
	over time	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
12	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
13	Cannot obtain rated input on	Oil nozzles plugged	Replace nozzles
	oil firing (pressure atomized)	By-pass seal on nozzle leaking	Replace nozzles
14	Cannot obtain NOx levels on	Operating on propane, not natural gas	
	gas		
15	High NOx during normal oper.	Loose diffuser plate	Tighten diffuser plate
		Gasket burned up	Replace gasket

## K. GENERAL MAINTENANCE AND CARE

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

### 1. General

This burner has been designed to provide many years of trouble free operation. 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 be detected early on by simply watching the movement and detecting uneven changes. The 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 is a must.

### 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 6) 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 system type.

- 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 should be 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. 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 need for cleaning. Extended operation at very low rates (less then 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 part number is given on the material list of the unit.
- 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 not to cut or nick 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 must be replaced, use the burner parts list to determine the Webster part number.



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

## 6. Combustion Air Fan

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

- There should be 1/16" overlap of inlet cone and fan.
- 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.
- 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.
- The motor shaft and fan hub must be clean and free of burrs.

## 7. Ignitor Replacement

To remove the ignitor on the SC series from the combustion head start by removing the housing cover plate. Then use a 7/16" crowfoot wrench on a 24" (or longer) extension to remove the ignition shoe from the ignitor. Change the crowfoot out for a 9/16" socket and unscrew the ignitor. Use a 3/8" baby crowfoot wrench to guide the spark plug from the ignitor collar.

In order to put the spark plug back in place, place the ignitor in the 7/16" socket and then put the ignitor in place by pushing it all the way in. Secure the position of the spark plug by tightening the compression fitting with the 7/16" socket. Use the crowfoot wrench to put the ignition shoe back onto the spark plug.

6 - 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						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	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 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 performed 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

As a minimum, the following replacement parts should be stocked to support uninterrupted burner operation.

Pilot Electrode  
Blower Wheel  
Oil Pump (if oil burner)  
Oil Pump Coupling (if oil burner)  
Ignition Transformer  
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 Combustion 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 COMBUSTION, 619 Industrial Road,  
Winfield, KS 67156.

WEBSTER Series SC Burners 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						
Primary Gas Pressure						
Secondary Gas Pressure						
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 Combustion, Winfield, KS 67156, to validate equipment warranty.**

## NOTES

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