

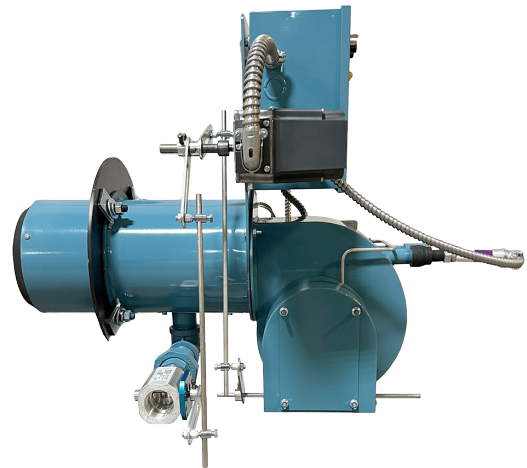


Webster Combustion Technology
619 Industrial Road, Winfield, KS 67156

Installation, Startup, Operation and Maintenance Manual

Cyclonetic SG Series Forced Draft Burners

SG Gas Burner



Manual Part No. 950212

www.webstercombustion.com

February, 2022

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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.**
- **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 SG Model CYCLONETIC burners offered by Webster Combustion. These burners can be used in a wide variety of Cast Iron, Firebox, Firetube, Flextube and other applications. They fire gas 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 KNOWLEDGE-ABLE TECHNICIANS CAN RESULT IN EQUIPMENT DAMAGE, PERSONAL INJURY OR DEATH.

The startup and maintenance of the SG 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 nameplate shown in Figure A-1.

Figure A-1 Nameplate

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/minimum inputs for that burner, given in MBH for gas. The gas manifold pressure is given in "in wc" which is inches of water column.

Cyclonetic		DATE MFG.			
MODEL NUMBER		SERIAL NUMBER			
GAS INPUT RATING					
	MBTU/HR	IN.WC			
MAXIMUM					
MINIMUM					
FUEL					
MAX OVERFIRE DRAFT		GAS BTU/CUFT			
BURNER MOTOR					
	VOLTS	AMPS	HERTZ	PHASE	HP
CONTROL CIRCUIT					
BURNER MOTOR					

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. Other conditions, like the supply gas pressure and control systems, may prevent the burner from reaching the lowest firing rate.

3. Product Offering

The burner can fire natural gas.

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:

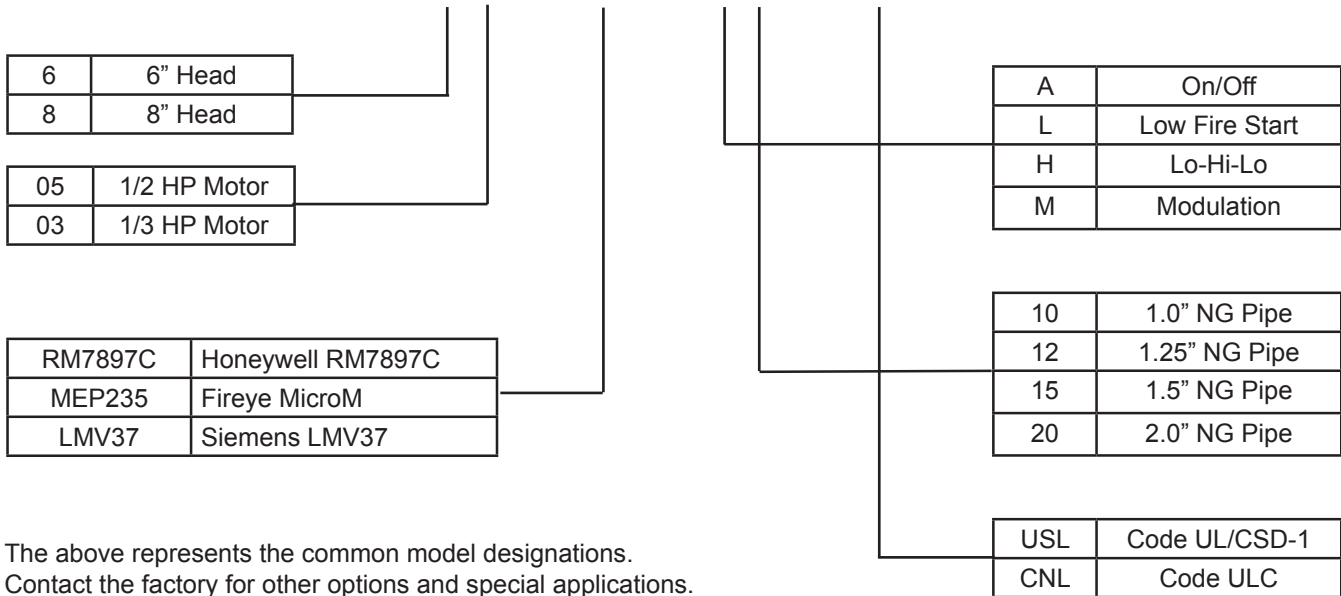
- a. The wiring diagram, which shows the limits and inter-connection of the burner and vessel controls.
- b. The gas schematic, which shows the components and their relative positions in the piping train.
- c. The unit material list which provides an overview of the burner requirements and a complete 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.webstercombustion.com or call 1-620-221-7464.

SG8-05 - RM7897C - A.20 - USL/CSD-1



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

Model SG - Specification Data (400 - 2500 MBH Input)

(1) STANDARD UL EQUIPMENT AND IMPORTANT OPTIONS		Fuel	STANDARD UL EQUIPMENT AND IMPORTANT OPTIONS		Fuel
		Gas			Gas
General	Motor, Fan and Air Inlet Control	X	Gas Fuel	Main Manual Shutoff Valve	X
	Air Flow Switch	X		Main Safety Shutoff Valve	X
	Burner Mounted Control Panel, Switch and Indicator Lights	X		Second Safety Shutoff Valve	X
	Flame Safety Control	X		Main Gas Regulator	X
	Ultra Violet Scanner	X		Gas Checking Valve	X
	Motor Controller (single phase voltage)	X		High and Low Gas Pressure Switches	Opt.
Ignition	Direct Spark Gas Ignition	X			
	Direct Spark Gas Ignition Transformer	X			

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

Model SG – Sizing & Application Data (contact Webster for complete information)

Model Number	Maximum Furnace Pressure	Burner Firing Capability Range Gas scfh	Burner Motor HP Gas Only HP	Gas Train			Capacity Ratings			
				Pipe Size	(4) Inlet Pressure		Min. Gas Press. Req	Stand Gas Train Sz	Max Firing Rate, MBH	Fan Motor HP
					On-Off, LFS	Modulation				
SG6-03	.25	400 / 1000	1/3	1"	6 / 14"	7 / 14"	6" wc	1"	1,000	1/3
SG8-03	.25	600 / 1500	1/3	1 1/4"	8 / 14"	9 / 14"	8" wc	1-1/4"	1,500	1/3
SG8-05	.25	800 / 2100	1/2	1 1/2"	7 / 14"	8 / 14"	8" wc	1-1/2"	2,500	1/2

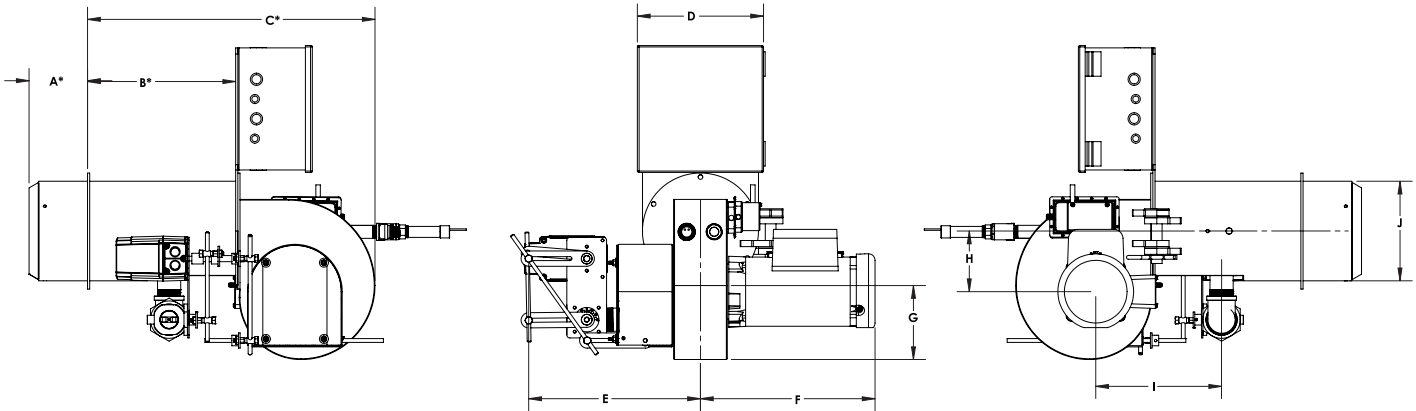
3. Larger motors may be required for single phase or 208 volts. 4. Contact Webster for complete details
 The above maximum ratings are based on 0 furnace pressure, an altitude of 1000 feet, 90°F air temperature and 60 HZ electrical supply. Use the following corrections for higher temperatures and altitude. 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.

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.
 Flame Safety Control Preferred - Honeywell or Fireye controls.
 Gas Train Components Preferred - ASCO or Honeywell
 Control System - ON-OFF, Low Fire Start, Low-High-Low, Modulation

Model SG - Dimensional Data (250 - 2500 MBH Input)

(Dimensions are +/- 1/4 inch)



MODEL	A*	B*	C*	D	E	F	G	H	I	J
SG6	4	12.1	23.5	10.3	14.1	14.3	6.1	5.0	10.3	6.1
SG8	4	12.1	23.5	10.3	14.1	14.3	6.1	5.0	10.3	8.1

* Based off standard burner insertion. For insertion different from 4", contact Webster for dimensions. All dimensions are for reference only. Webster reserves the right to change dimensions without notice.

Model SG burners are listed by Underwriters Laboratories, Inc. (UL / ULC).

B. 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, 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?
4. Will the burner properly fit the boiler or heater with ample clearance on top, bottom and sides?
5. Will there be adequate gas pressure to assure the specified firing rate?
6. Are there adequate flue provisions to assure SAFE and proper venting of the burner?

7. All manuals should be reviewed, understood and stored in a convenient place.

8. Teflon tape should not be used on any field piping.
9. Rope gaskets should be used between vessel and mounting plate, and between mounting plate and burner.
10. Gas piping should be flushed (cleaned) prior to use.
11. Check minimum straight lengths for gas pressure regulator and/or sensing line.
12. 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.
13. 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

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

C. 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.

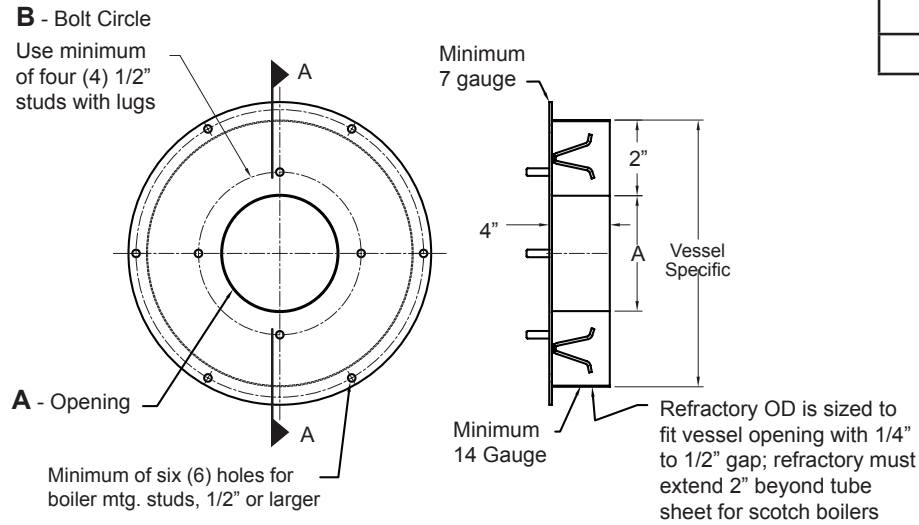
3. The installer shall identify (label) the main electrical power disconnect and the manual shut-off valve on the gas drop-line to the burner.

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

D. 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 SG BURNER REFRACTORY FRONTPLATE

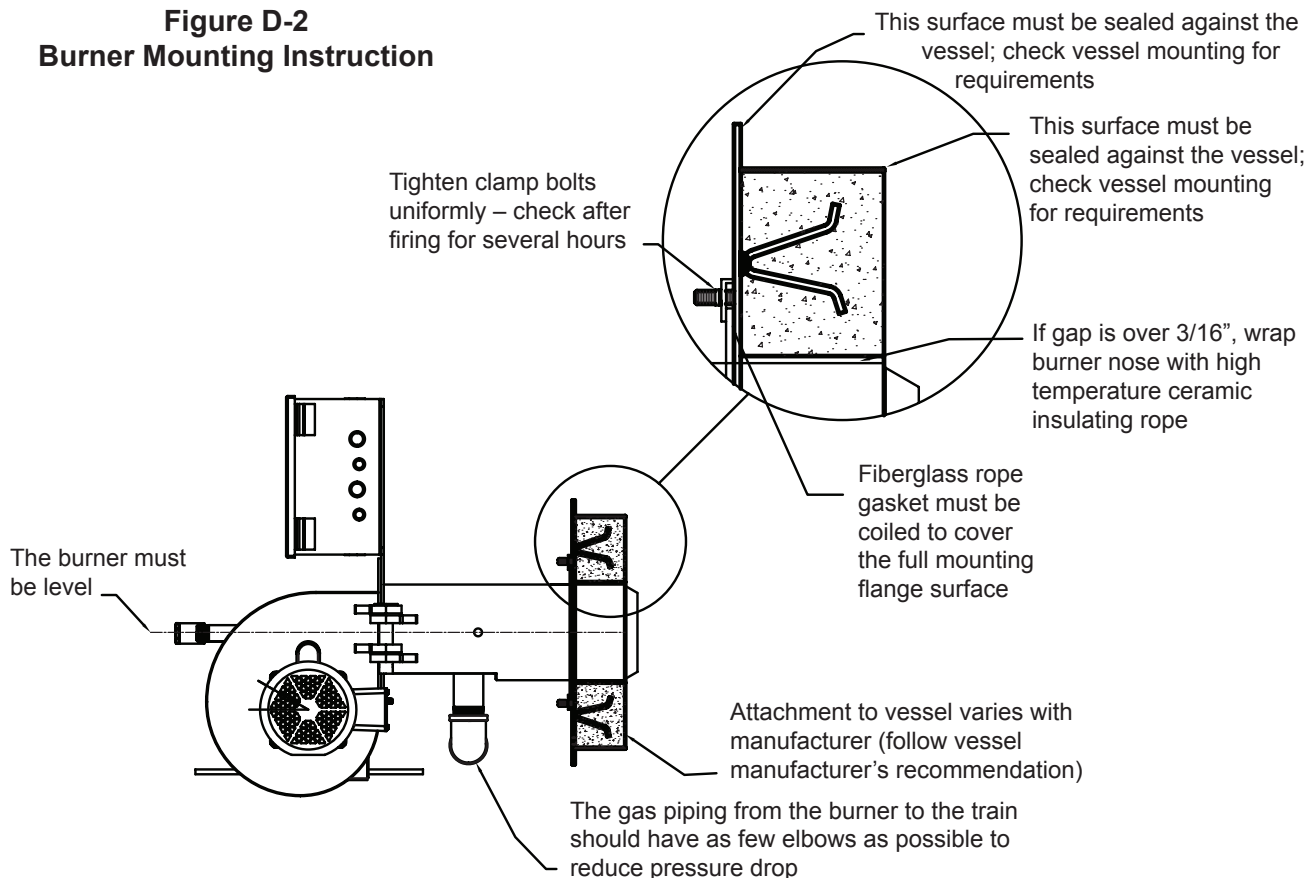


Dimensions - Inches		
MODEL	DIM. A	DIM. B
SG6	6 5/8	10 1/8
SG8	8 5/8	12 1/8

Contact Webster for more detailed refractory drawings.

Figure E-1
Refractory Dimension

Figure D-2 Burner Mounting Instruction

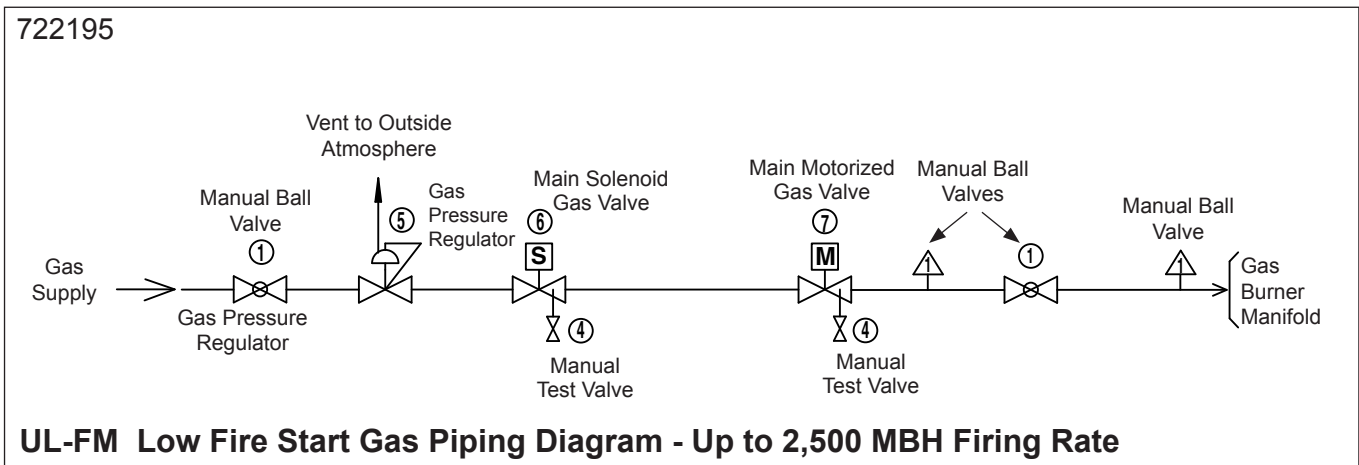
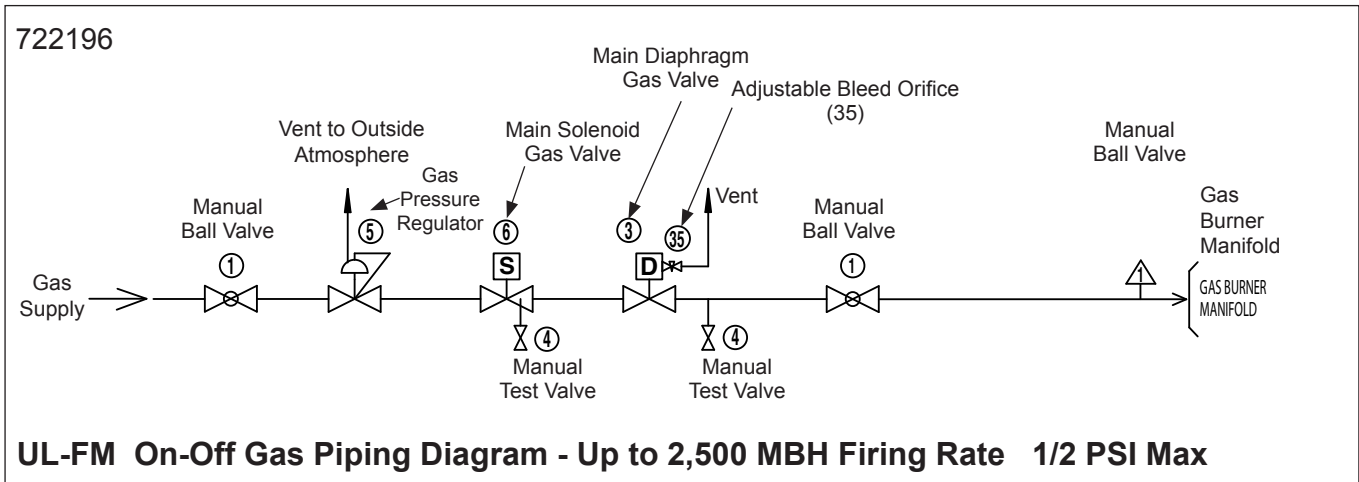


E. FUEL SYSTEMS

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.

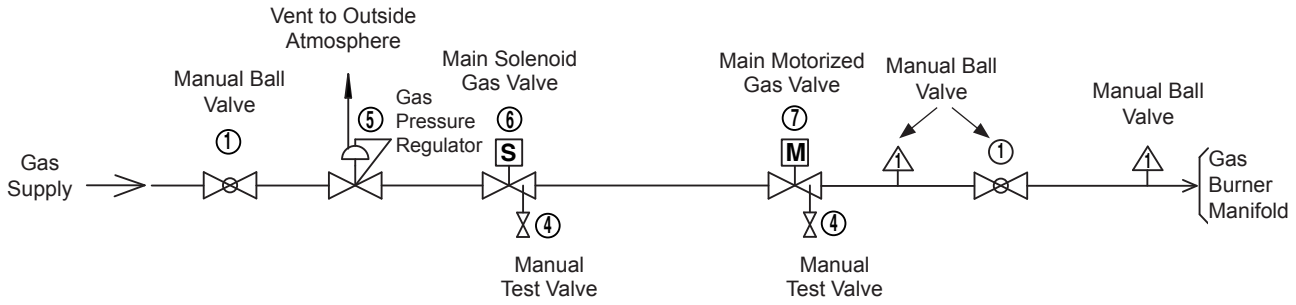
UL Capacity Range BTU/Hr.	Operation Mode	Webster Designation	Code		Illustration
			UL / GE GAP	FM	
To 2,500,000	On-Off	A	X	X	722196
	Low Fire Start	L	X	X	722195
	Low Hi Low	H	X	X	722197
	Modulating	M	X	X	722198

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.



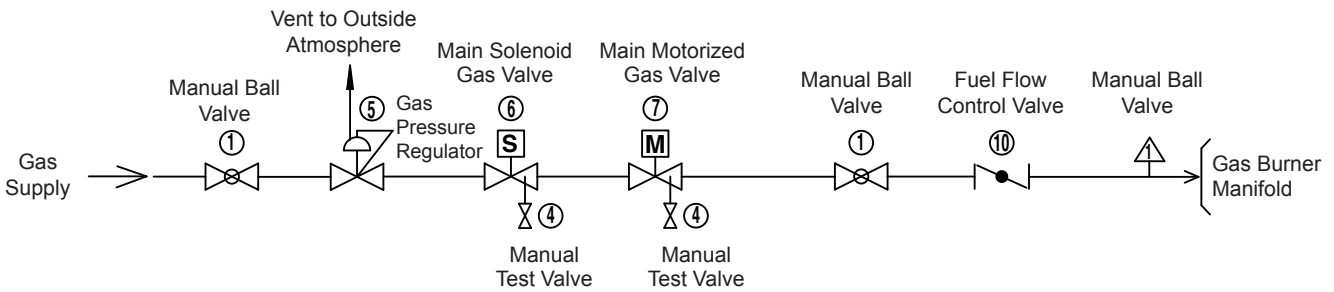
E. FUEL SYSTEMS (continued)

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UL-FM Low-Hi-Low Gas Piping Diagram - Up to 2,500 MBH Firing Rate

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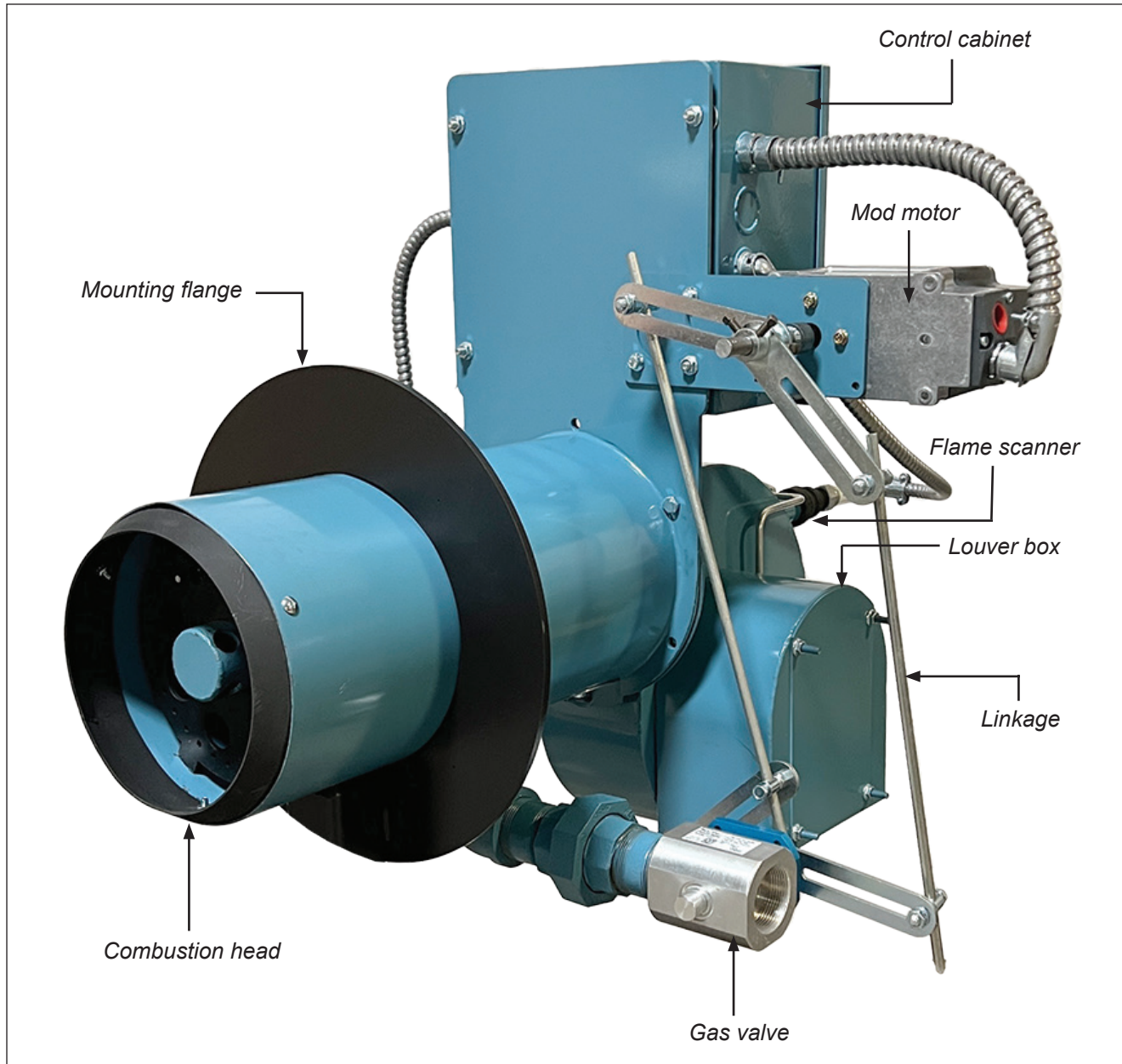


UL-FM Modulation Gas Piping Diagram - Up to 2,500 MBH Firing Rate

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.

TYPICAL AIR AND FUEL ADJUSTMENT LOCATIONS



F. STARTUP AND OPERATING ADJUSTMENTS

1. Pre-Start Check List
2. Linkage Adjustments
3. Gas Setup
4. Operating Control Adjustments
5. Limit Tests
6. Burner Shutdown
7. Restart After Extended Shutdown

This section covers the startup and operating adjustments of the Webster Model SG 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.

_____ 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 O₂ and CO (for gas) must be available to tune combustion. 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.

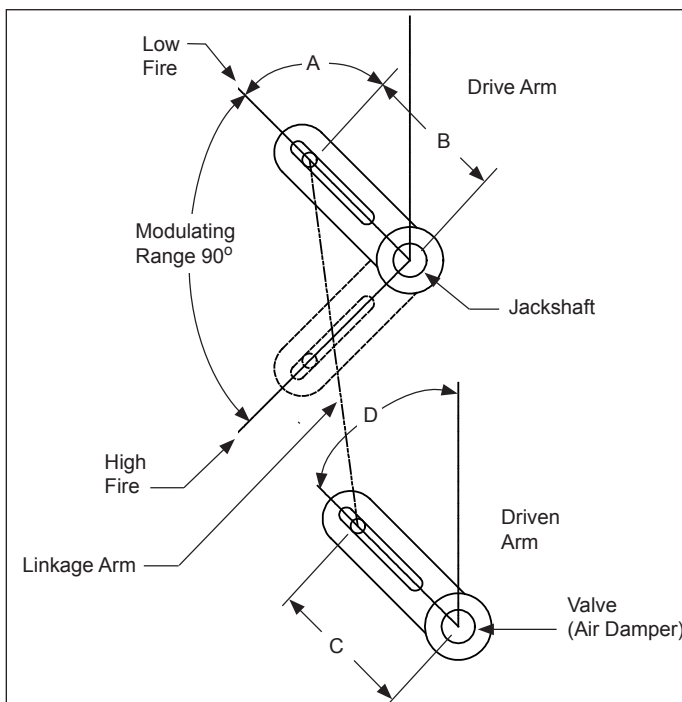
_____ Draft gauge or manometer (at stack outlet).

_____ Draft gauge or manometer for furnace pressure.

2. Linkage Adjustments

Adjusting the air damper on a linkage system requires an understanding of linkage setups. The rate of change for the fuel valve and air damper must be matched by how the linkage is set up. If the air damper opens too quickly, the flame may become unstable. 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.



Dim	Smaller	Larger
Angle A	Slower LF driven arm travel (D)	Faster LF driven arm travel (D)
Length B	Reduce driven arm travel (D)	Increase driven arm travel (D)
Length C	Increase driven arm travel (D)	Reduce driven arm travel (D)

Figure I-1
Linkage Adjustments

3. 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 and the vent valve (if equipped) is operating.
- g. Turn the burner switch on. This will start the blower motor and initiate the prepurge cycle.
- h. When the pre-purge sequence is complete and the low fire start switch (if used) is made, the gas valve will open and the flame should be visible through the sight port.
- i. 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.
- j. 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.
- k. After a few seconds, the combustion analyzer should have an accurate reading of the O_2 in the stack. Figure 1-3 shows the typical range of O_{2v} 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_2 level.
 - Turning the cam screw out will reduce the fuel input, increasing the O_2 level.
- l. 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_2 level. Adjust the gas pressure regulator as needed to reach the high fire input.

m. 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 ft³ = volume of gas measured by meter

sec = Time for measured ft³ 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.

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

s. 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 drops during startup, reduce the pressure setting an additional 5%.

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)

- 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.

Figure I-3: O₂ levels

% Rate	Natural Gas	
	Min % O ₂	Max %O ₂
30	5.0	7.0
40	4.0	7.0
50	3.0	5.0
100	3.0	5.0

4. 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.

5. 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.

6. 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.

7. 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.

G. 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 gas valve	Check electrical connections
		Defective gas valve	Replace
		Improperly positioned electrodes	Recheck dimensions
		Too much combustion air flow	Check air damper position
3	Flame not detected (Flame present)	Scanner tube dirty or wet	Clean scanner tube / scanner
		Scanner or amplifier faulty	Replace
		Incorrect gas pressure	Readjust pressure
		Combustion air flow rate too high	Readjust damper
4	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
5	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
6	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
7	High CO at low fire	Improper excess air level	Readjust excess air
		Input too low for burner components	Check input, compare to rating label

G. TROUBLESHOOTING (continued)

No.	System	Cause	Correction
	High CO at low fire (con't)	High stack draft (especially at low fire)	Stabilize draft
		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
8	Gas combustion noise (rumbling)	Input too low for burner components	Check input, compare to rating label
		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
9	Fuel-Air-Ratios are not consistent	Linkage flexing	Realign linkage, straighten rods
		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
		Gas control valve - low fire stop not set (if used)	Adjust low fire stop
10	Fuel-Air-Ratios have changed over time	Linkage wear	Check linkage and tighten all joints
		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
11	Cannot obtain capacity	Wrong spring range in regulator	Install higher spring range
		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

H. GENERAL MAINTENANCE AND CARE

1. General
2. Physical Inspection
3. Fuel-Air-Ratio
4. Gas Fuel Systems
5. 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 used 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. 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, 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. 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.

H. GENERAL MAINTENANCE AND CARE (continued)

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

Electrode
Blower Wheel
Ignition Transformer
Gas Solenoid Valve
Flame Scanner

Items with greater life expectancy and/or greater dollar value, such as flame safety controls, main gas 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.

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					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	Hot Refractory Test	Conduct hot refractory hold in test. This test is required annually or after any component change.		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					Main Fuel Valves	Make visual and manual check for proper sequencing of valves.		X
				X		Main Fuel Valves	Check all coils, diaphragms, interlock switch & other parts of all safety shutoff valves.		X
				X		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	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	

I. 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).

J. REPLACEMENT PARTS

The following replacement parts should be stocked to support uninterrupted burner operation.

Electrode
Blower Wheel
Ignition Transformer
Flame Scanner

Items with greater life expectancy and/or greater dollar value, such as flame safety controls, main gas 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 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 and/or UL Serial Number when ordering parts.

K. 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 TECHNOLOGY, LLC
619 Industrial Road, Winfield, KS 67156.

WEBSTER Series SG 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.

K. WARRANTY VALIDATION FIELD START-UP REPORT (continued)

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 _____ High Fire Purge Switch _____
 Low Gas Press. Switch _____ Other _____

FIELD COMBUSTION SETTINGS	GAS FIRED		
	Low	Med.	High
Firing Rate			
CO ₂			
O ₂			
Smoke or CO (ppm)			
NO _x (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 Main			
Manual Gas 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 Technology, Winfield, KS 67156, to validate equipment warranty.

NOTES

NOTES

WARRANTY MATTERS AND EXCLUSION OF IMPLIED WARRANTIES

The following warranty applies: All Products manufactured by the Company are warranted to be free from defects in material and workmanship under normal use and service for a period of eighteen months from the date of shipment or twelve months from the date of start-up; whichever should occur first. Products which are purchased by the Company and resold without further processing by the Company are not covered by the Company's warranty. The Company shall pass to the Buyer whatever warranty the Company receives on such products. The Company will repair or replace, at its option, its products which prove to be defective within the warranty period, F.O.B. the factory. The Company's warranty shall be voided by any abuse, misuse, or neglect of the products by use not in accordance with the Company's published instructions. The remedies for any failure of the Company's product to meet warranty specified herein shall be those remedies herein and no others; these remedies being exclusive remedies as a condition of sale irrespective of the theory upon which any claim might be based, including negligence, breach of contract or strict liability.

IN ALL EVENTS, THE COMPANY WILL NOT BE LIABLE FOR AND WILL NOT REIMBURSE ANY LABOR, MATERIAL, OR OTHER REPAIR CHARGES INCURRED BY ANYONE OTHER THAN THE COMPANY ON ANY WARRANTY EQUIPMENT, UNLESS SUCH CHARGES HAVE BEEN SPECIFICALLY AUTHORIZED IN ADVANCE IN WRITING, BY THE COMPANY. THIS PARAGRAPH CONTAINS THE COMPANY'S SOLE WARRANTY. THE COMPANY MAKES NO IMPLIED WARRANTY, AND THERE IS NO IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE.

DAMAGE LIMITATION

Under no circumstances shall the Company be liable for any loss of profits, down time, or any incidental, consequential, special, punitive, exemplary, enhanced, or indirect damages of any kind with respect to its products or the transaction by which its products are sold.

IN NO EVENT SHALL THE COMPANY'S AGGREGATE LIABILITY ARISING OUT OF OR RELATED TO THE EQUIPMENT OR THE TRANSACTION BY WHICH THE EQUIPMENT IS SOLD, WHETHER ARISING OUT OF OR RELATED TO BREACH OF CONTRACT, TORT (INCLUDING NEGLIGENCE), OR OTHERWISE, EXCEED THE TOTAL OF THE AMOUNTS PAID TO THE COMPANY WITH RESPECT TO SUCH EQUIPMENT.

EXCUSE

In no event shall the Company be liable for any loss or damage resulting from any delay or failure in shipment or other failure, loss or damage that is the proximate result of any act of government authority, revolution, riot, civil disorder or disturbance, act of enemies, delay or default in transportation, inability to obtain materials or facilities from normal sources of fire, flood, act of God, or any cause not within the reasonable control of the Company, whether of the class of causes enumerated or otherwise. Without limiting the generality of the foregoing, the Company may, without causing a breach or incurring liability, allocate goods which are in short supply irrespective of the reasons therefore among customers in any manner which the Company in its sole discretion deems advisable. If an event occurs that is beyond the control of the Company's performance and causes its cost of production to increase because of the delay, the Company may pass such increase on to the Buyer.



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