WEBSTER COMBUSTION
A Selas Heat Technology Company

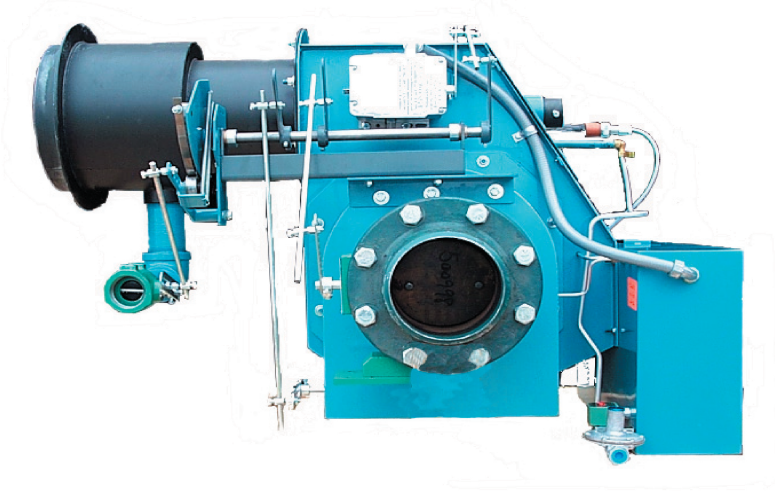
Webster Combustion Technology
619 Industrial Road, Winfield, KS 67156

Installation Manual Addendum

Model JBS(X)2 and JBS(X)3 Burner

High Swirl Combustion Head

This addendum should be used in conjunction with the HDS-HDSX manual, part No. 950058, due to the use of the high swirl combustion head.



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Manual Part No. 950061
www.webster-engineering.com
October, 2014

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 potentially hazardous situation, which if not avoided, could result in personal injury or death.

CAUTION

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

The following general safety precautions apply to all equipment work.

WARNING

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

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

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

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

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

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

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

Service Organization Information:

Company Name _____

Address _____

_____

Phone Number _____

Date of Startup

_____

Lead Technician

_____

A. GENERAL

1. Nameplate Information
2. Ratings
3. Product Offering
4. Your Complete Manual
5. Service and Parts

This manual covers the Models JBS and JBSX burners offered by Webster Engineering & Manufacturing Co., LLC. These burners are intended for commercial and industrial applications for Scotch Marine Firetube boilers. They can fire gas, oil or combinations of gas and oil.

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 JBS and JBSX burner requires the skills of an experienced and properly trained burner technician. Inexperienced individuals should not attempt to start or adjust this burner.

THE INSTALLATION OF THE EQUIPMENT SHALL BE IN ACCORDANCE WITH THE REGULATION OF AUTHORITIES HAVING JURISDICTION, INCLUDING THE NATIONAL ELECTRICAL CODE, CSA STANDARDS 139 AND 140, THE CANADIAN NATIONAL ELECTRIC CODE, PART I AND ALL LOCAL CODES.

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.

Figure A-1 Nameplate

MODEL NUMBER			SERIAL NUMBER	
HDSXC-400B-5V 150 RM7800L-M.25 VGD			U73586A-02	
JOB LOCATION			**DATE MFG**	
Georgia			30 - Nov - 04	
	GAS INPUT RATING		OIL INPUT RATING	
	MBTU/HR	IN.WC	GPH	PSI
MAXIMUM	16738	8.4	119.6	28/31
MINIMUM	2790	0.15	23	12/21
FUEL	NATURAL GAS		#2 OIL / AIR	

	VOLTS	AMPS	HERTZ	PHASE	HP
CONTROL CIRCUIT	115	5	60	1	
BURNER MOTOR	460	20.1	60	3	15
OIL PUMP MOTOR	460	2.9	60	3	1.5

These special components will be described in the information provided with the burner and should be used as the controlling document.

NOTE: This manual and manual #950088 (Model HDS and HDSX burners) 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 . The "X" in the JBSX refers to a low NOx burner, where FGR is used to reduce the NOx in the combustion gases. If the burner is not a low NOx burner, there is no X in the model.

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

The input rates define the maximum and minimum inputs for that burner, given in MBH for gas and GPH for oil. Air atomized burners (Figure A-1) 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 (Figure A-1). The maximun and minimum 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 limit the turndown.

Turndown is defined as the ratio of the maximum input to the minimum input. For example, a burner with a maximum input of 120 GPH and a minimum input of 12 GPH has a 10:1 turndown. Burners equipped for high turndown (greater than 6:1) can have different equipment to improve fuel, air and FGR flow control.

3. Product Offering

The JBS burner is intended for Scotch Marine Firetube boiler applications. The round furnace is required to contain the flame and make the best use of the high swirl action. The burner can fire natural gas, propane and digester gas as well as all grades of light and heavy oil (#2, #4, #5 and #6 oils as defined by ASTM D396).

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

This burner is also available as a low emission burner, and will have model designation JBSX. Several low NOx rates are available for all gas and light oil burners, with the stan-

dard offering of 60 ppm, 30 ppm and 20 ppm when firing natural gas. Heavy oil is not allowed in combination with low NOx, as the high sulfur content can recirculate from the vessel through the burner when switched from heavy oil to gas. Low sulfur heavy oil can be used with gas FGR, when the sulfur is under ½% (the FGR is closed during oil firing).

4. Your Complete Manual

In addition to this manual and manual 950058 (model HDS and HDSX burners), 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 interconnection of the burner and vessel controls.
b. The gas and oil piping schematics, which show the components and their relative positions in the piping train.
c. The unit material list which provides an overview of the burner requirements and a complete bill of material, including the part numbers and description for each item.
d. The flame safeguard manual provides the operating sequence for the burner management system. This will be a critical document for troubleshooting any future problems.
e. Catalog cuts of the major components. These provide details on the installation, adjustment and maintenance of the components used on the burner.

5. Service, Parts and other Information

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

www.webster-engineering.com or call 620-221-7464.

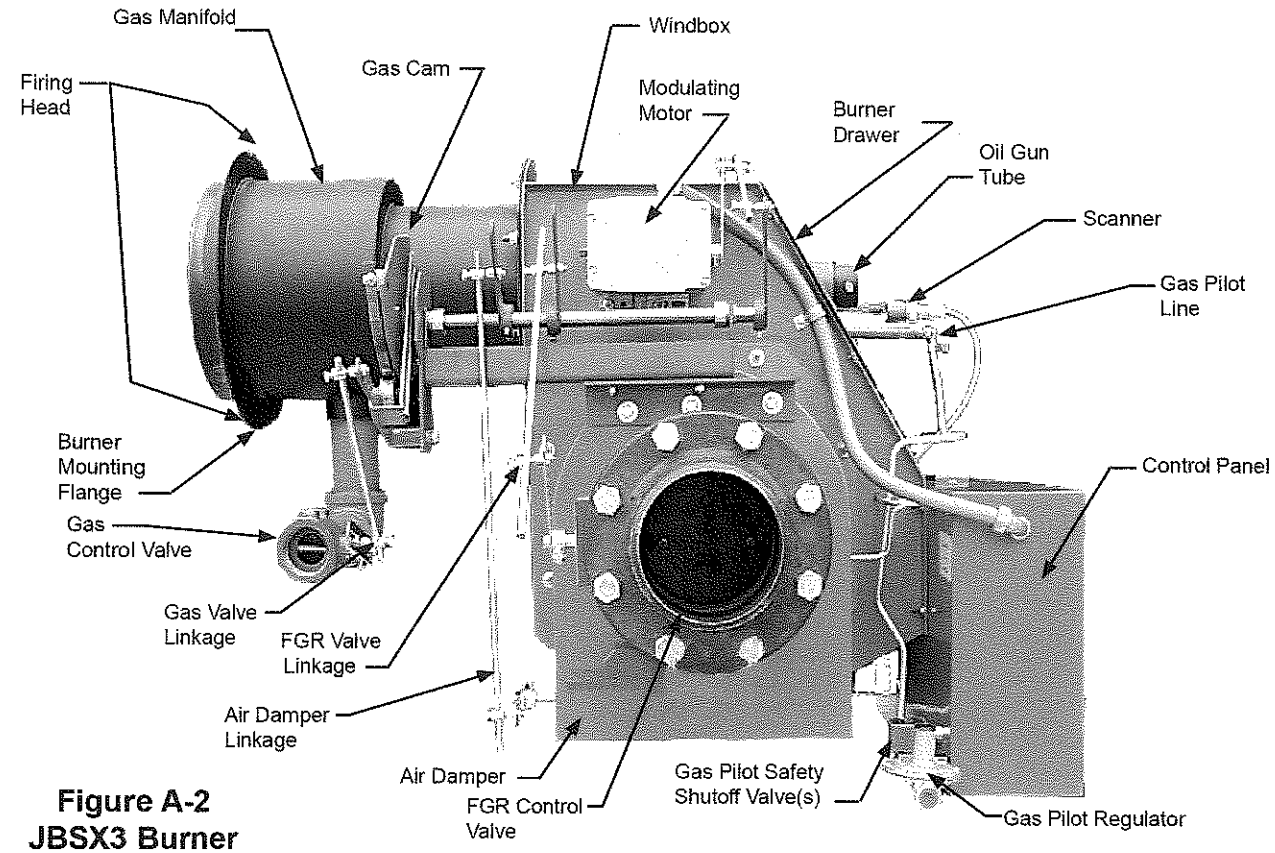


Figure A-2
JBSX3 Burner

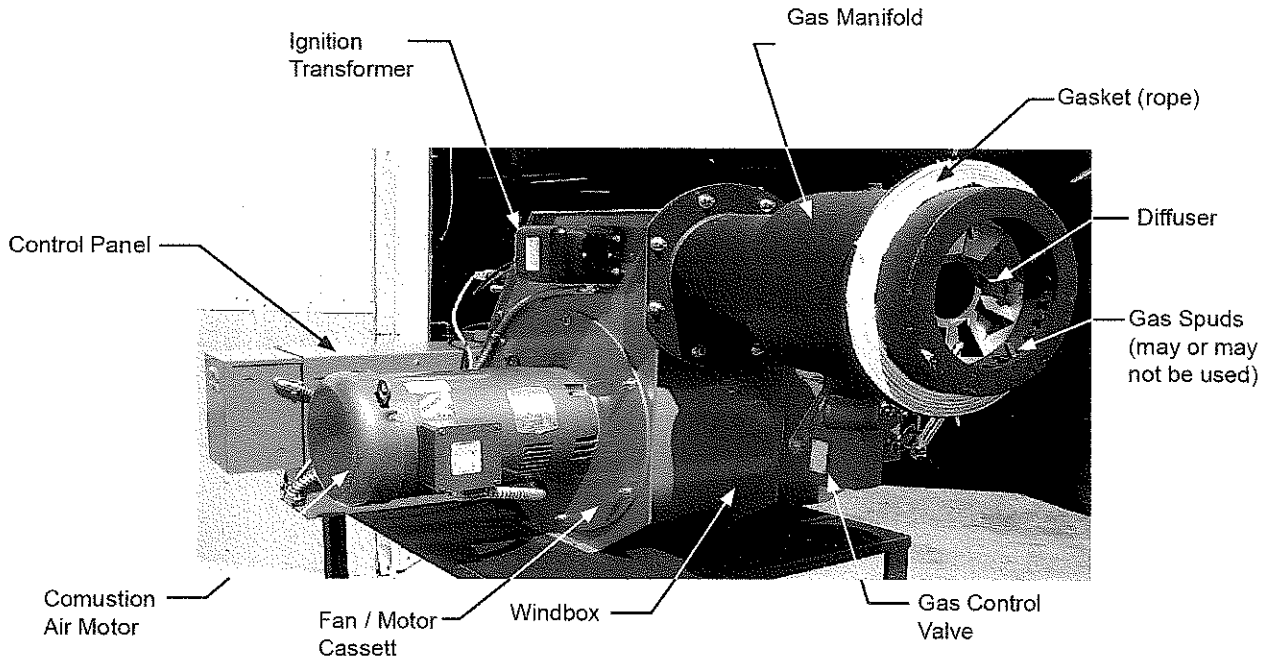


Figure A-3
General Burner Description
JBSX2

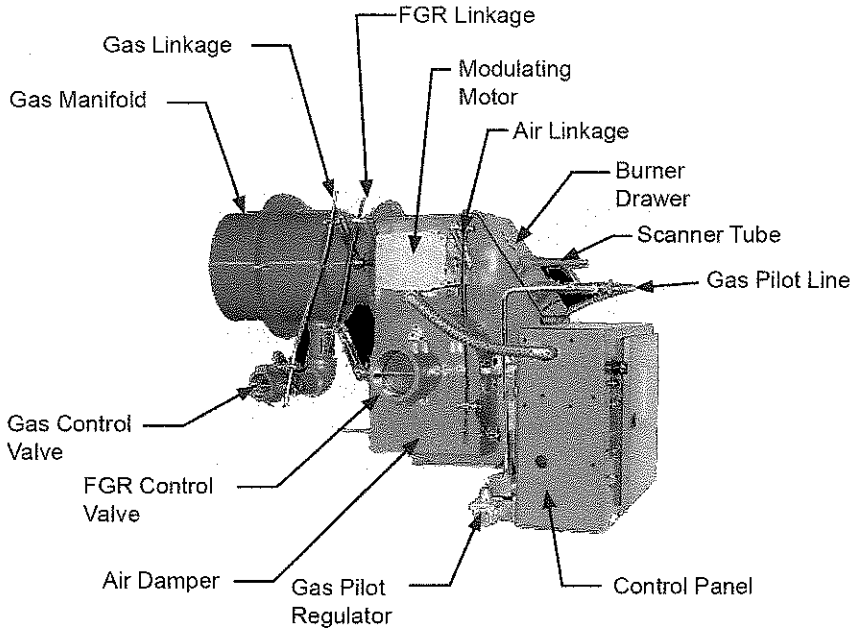


Figure A - 4
General Burner Description
JBSX2

B. Reference Documents

Refer to the following drawings for additional information:

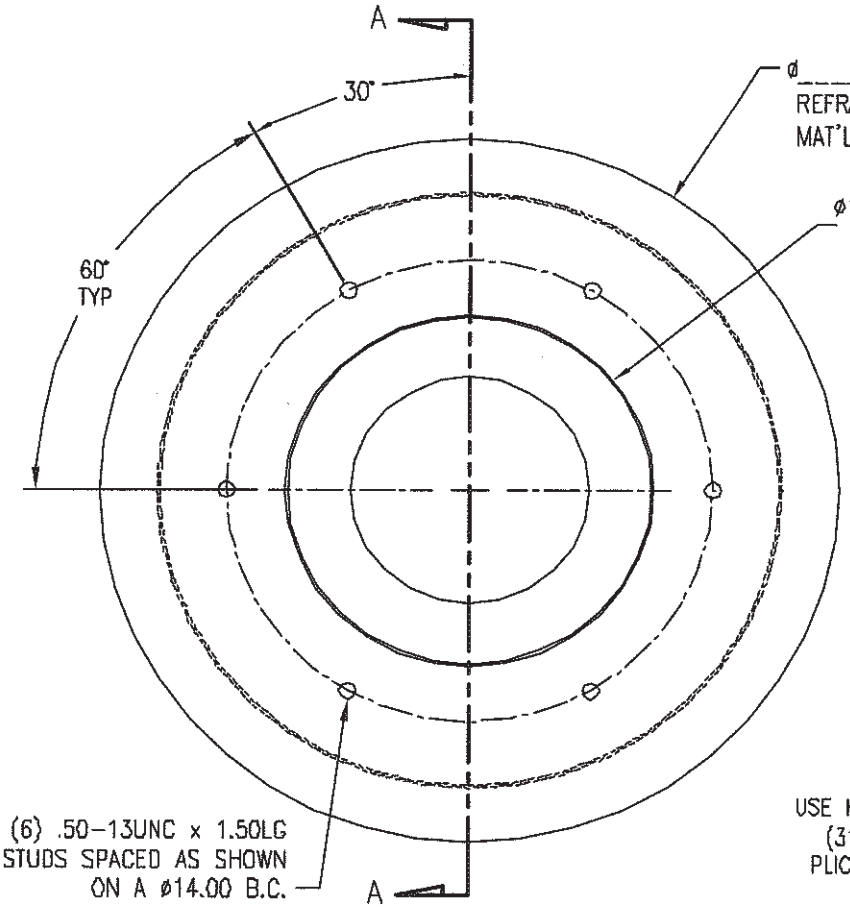
1. Drawing 970277
   Frontplate, refractory, general arrangement
   For JBS2 & JBSX2 burners

2. Drawing 970276
   Frontplate, refractory, general arrangement
   For JBS3 & JBSX3 burners

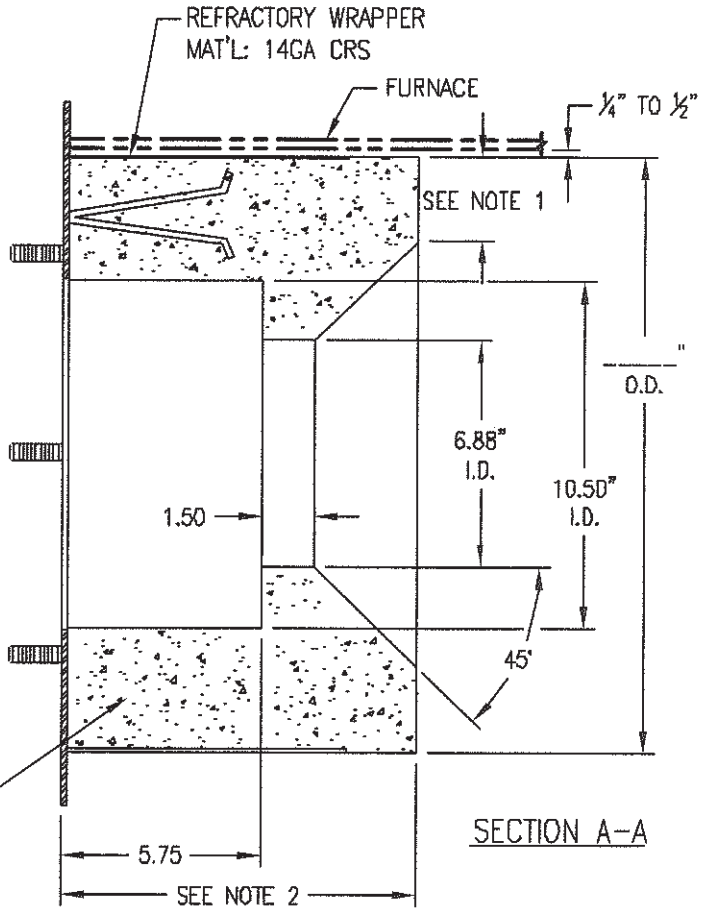
3. Drawing 740016
   Oil piping diagram
   For Pressure atomized oil firing
   For low fire start or LO-HI-LO systems
   For JBS2 & JBSX2 burners

4. Drawing 740005
   Oil piping diagram
   For pressure atomized oil firing burner
   For oil metering valve and simplex nozzles
   For JBS2 & JBSX2 burners

   For JBS3 & JBSX3 burners, use the oil piping diagrams in the HDS manual, #950058.



970277



SECTION A-A

NOTES:

1. THE DIMENSION FROM THE FURNACE WALL TO THE 60° ANGLE IN THE REFRACTORY CAN BE 2" TO 4", INCLUDING THE SPACE BETWEEN THE FURNACE AND REFRACTORY.
2. REFRACTORY LENGTH IS DETERMINED FROM THE LAYOUT, BASED PROVIDING THE 60° ANGLE. THE LARGER THE FURNACE DIAMETER, THE LONGER THE LENGTH.

REV.	DATE	ECN. NO.	CHK.
F			
E			
D			
C			
B			
A			

UNLESS OTHERWISE SPECIFIED
1. TOLERANCES
.X = ± .08
.XX = ± .03
.XXX = ± .010
FRACTIONS ± 1/32
ANGLES ± 1/2°
2. REMOVE ALL BURRS & SHARP EDGES
3. CORNER RAD. .03
4. ALL DIMS. IN INCHES
5. MACHINE ✓

DR.	CS
CK.	
APP.	

FRONTPLATE, REFRACTORY
GENERAL ARRANGEMENT
F/ JBS2 & JBSX2 BURNERS

SCALE 3/16"=1" | DATE 10-04-05 | DWG. NO. 970277

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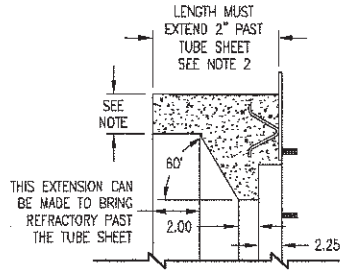
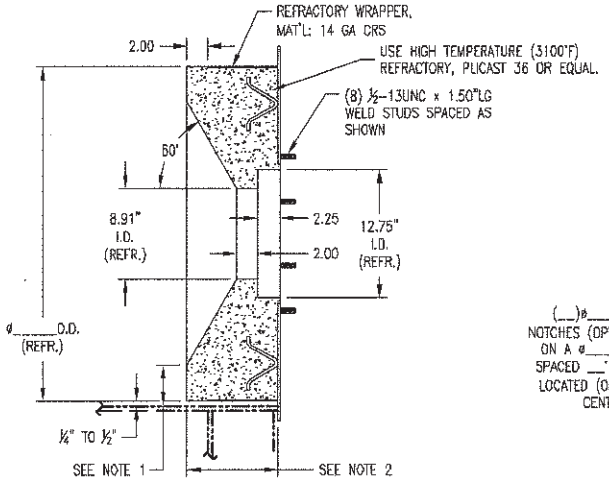
970276

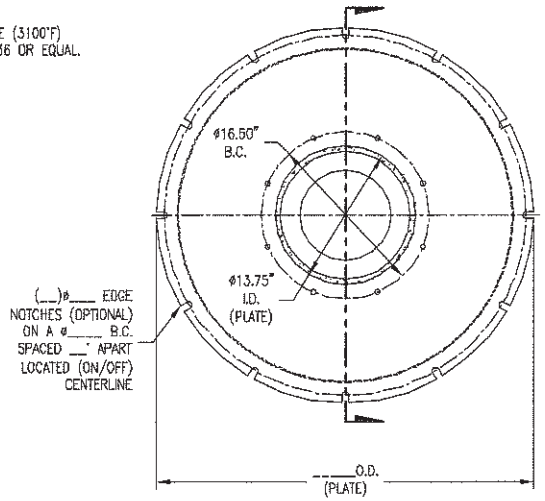


ARRANGEMENT "C"

** USED FOR EXTENDED REFRACTORY LENGTH **



ARRANGEMENT "A"



NOTES:

1. THE DIMENSION FROM THE FURNACE WALL TO THE 60° ANGLE IN THE REFRACTORY CAN BE 2" TO 4", INCLUDING THE SPACE BETWEEN THE FURNACE AND REFRACTORY.
2. REFRACTORY LENGTH IS DETERMINED FROM THE LAYOUT, BASED PROVIDING THE 60° ANGLE. THE LARGER THE FURNACE DIAMETER, THE LONGER THE LENGTH.

DIMENSIONS SHOWN MUST BE HELD.
DIMENSIONS SHOWN AS "BLANKS" (____) ARE TO BE PROVIDED BY CUSTOMER.

REV.	DATE	ECN. NO.	CHK.
F			
E			
D			
C			
B			
A			

UNLESS OTHERWISE SPECIFIED
1. TOLERANCES
.X = ± .06
.XX = ± .03
.XXX = ± .010
FRACTIONS ± 1/32
ANGLES ± 1/2°
2. REMOVE ALL BURRS & SHARP EDGES
3. CORNER RADII .03
4. ALL DIMS. IN INCHES
5. MACHINE ✓

DR.	CS	FRONTPLATE, REFRACTORY GENERAL ARRANGEMENT F/ JBS3 & JBS/X3 BURNERS
CK.		
APP.		
SCALE	3/32" = 1"	DATE 10-04-05
		DWG. NO. 970276

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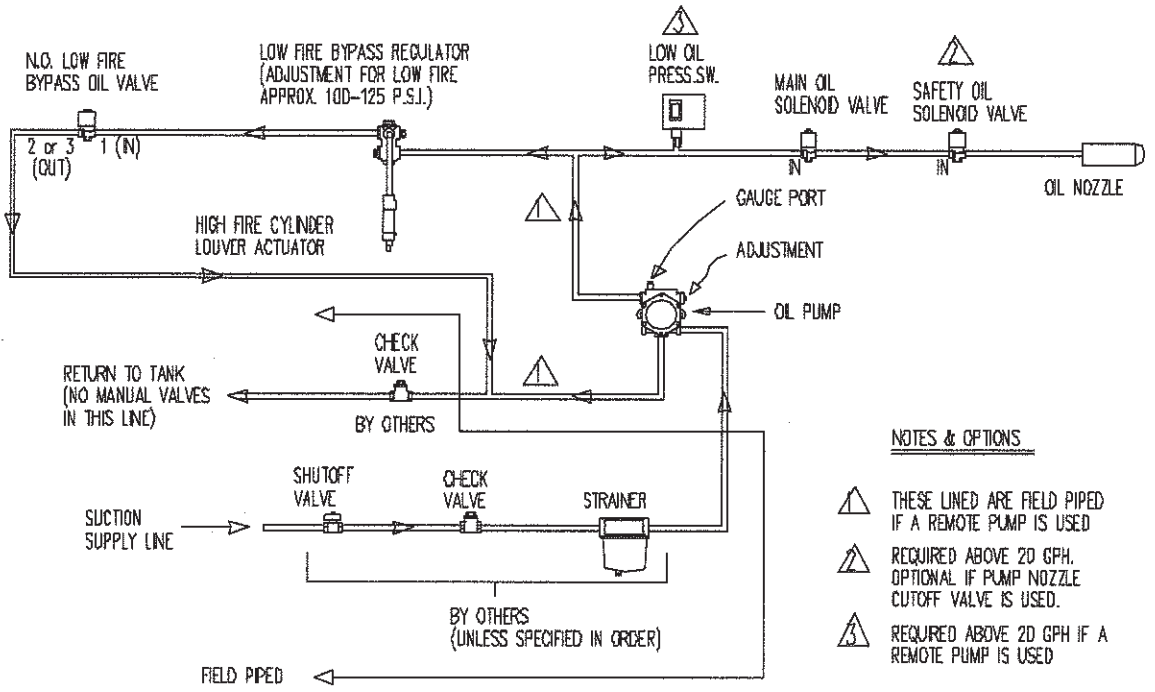
740016



NOTES & OPTIONS

1. THESE LINED ARE FIELD PIPED IF A REMOTE PUMP IS USED
2. REQUIRED ABOVE 20 GPH. OPTIONAL IF PUMP NOZZLE CUTOFF VALVE IS USED.
3. REQUIRED ABOVE 20 GPH IF A REMOTE PUMP IS USED

REV.	DATE	ECN. NO.	CHK.
F			
E			
D	8/8/1	2567	
C	4/4/94	1859	MMW
B	1/14/94	1836	MMW
A		0978	MMW

DR.	[illegible]
CK.	TG
APP.	MW

OIL PIPING DIAGRAM
FOR PRESSURE ATOMIZED OIL FIRING
FOR LOW FIRE START OR LO-HI-LO SYSTEM

SCALE	DATE	DWG. NO.
NONE	03/22/89	740016

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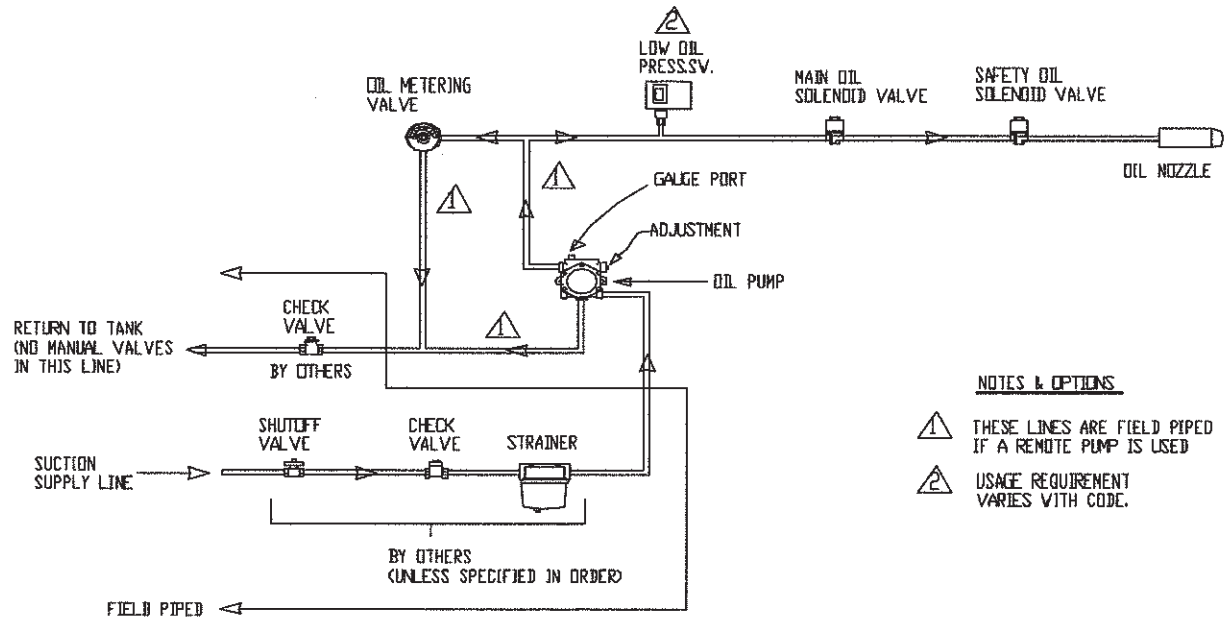
Webster Combustion Technology
619 Industrial Road, Winfield, KS 67156, (620) 221-7464

740005



NOTES & OPTIONS

1. THESE LINES ARE FIELD PIPED IF A REMOTE PUMP IS USED
2. USAGE REQUIREMENT VARIES WITH CODE.

REV.	DATE	ECN. NO.	CHK.
F			
E			
D			
C			
B			
A			

DR. [illegible]
CK.
APP.

OIL PIPING DIAGRAM
FOR PRESSURE ATOMIZED OIL FIRING BURNER
F/OIL METERING VALVE AND SIMPLEX NOZZLES

SCALE NONE | DATE 03/22/89 | DWG. NO. 740005

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C. Installation

1. General Considerations
2. Refractory Frontplate
3. Burner Mounting
4. Gas Piping
5. General Oil Piping
6. Pressure Atomized Oil
7. Air Atomized #2 oil
8. Heavy Oil
9. Gas Pilot
10. FGR System
11. Draft and Stacks
12. Electrical

This section covers the installation procedures for the JBS burner line. Your specific burner will not have each of the systems discused and may be supplied to you as an installed system. If you receive the burner as part of a new boiler for example, the burner will be installed in the vessel with much of the piping already done. For this reason, a complete review of the installation is required to determine which tasks are complete and which need to be done.

THE INSTALLATION OF THE EQUIPMENT SHALL BE IN ACCORDANCE WITH THE REGULATION OF AUTHORITIES HAVING JURISDICTION, INCLUDING THE NATIONAL ELECTRICAL CODE, INSURANCE REGULATIONS AND ALL LOCAL CODES.

The equipment shall be installed in accordance with the state and local requirements and in Canada, in accordance with Provincial Installation Requirements, or in their absence, the CGA B149.1 and B149.2 codes shall prevail. Authorities having jurisdiction should be consulted before installations are made.

NOTE TO INSTALLER: The main power disconnect for this equipment must be conspicuously labeled and placed within sight of the operating system and equipped with lockout provisions.

1. General Considerations

In the initial planning of the installation, several items must be covered:

a. Prior to starting the installation, all the techinical literature should be collected and reviewed to identify requirements. As a minimum, these should include the Installation and Operating Manuals for the burner and the vessel, the wiring diagram, the fuel schematics and technical literature on supplied controls.

b. A general overview of the equipment should be made prior to installation. Check the location of access doors and insure that they will be able to function properly when all equipment is installed. The burner and control panel should have sufficient clearance for the operator to monitor, inspect and perform maintenance. A minimum clearance of 24 inches all around the burner should be provided for maintenance. The burner drawer and oil gun is pulled out from the front of the burner and there needs to be sufficient space for this activity.

c. A source of combustion air must be provided for the burner. Local codes often determine minimum requirements, and these must be followed. In absence of other codes, the following can be used.

Webster recommends two air sources be provided, one located high and one low. Each air source must be at least 1 ft^2. If there are multiple burners, the area must consider all burner requirements. Exhaust fans are not recommended as they create additional air flow requirements that must be included in the area calculation.

The quantity of air required for combustion and ventilation is 10 cfm/BHP. The maximum air velocity is 250 ft/min from the floor to 7 feet high, and 500 ft/min above 7 feet high. Outdoor louvers may restrict the open area, and if the exact restriction is unknown, a restriction of 20% can be used. Add 3.5% to the area for each 1000 ft above sea level. The calculations are,

Total air required (cfm) = BHP x 10
Open area = cfm / velocity
Louvered area = open area x 1.2 (or actual)
Area of opening = louvered area / 2

For example, with duct located under 6' high for a 500 HP boiler, what would their area need to be? The total air is (500 BHP x 10 cfm/BHP) = 5000 cfm. The maximum velocity is 250 ft/min, so the open area must be = (5000 cfm / 250 ft/min) = 20 ft^2. Since these opening will have louvers, the actual openings must be = (20 ft^2 x 1.2) = 24 ft^2. There will be two opening, so each will be = (24 ft^2 / 2) = 12 ft^2.

The location of the combustion air source must not create a condition where the burner or vessel comes in contact with very cold air (under 40°F) or causes large fluctuations in combustion air temperature. Cold air can cause condensation below 40°F in a standard burner and below 50°F when equipped with FGR.

There should be no large variations in combustion air temperature supplied to the burner. The burner can be adjusted to handle temperature variations of 30°F, but may not be able to handle temperature swings of 50°F without combustion deterioration. In conditions where this can occur, some conditioning of the combustion air must be done by location, baffling or pre-heating of the air. Seasonal tune-ups can also help cover the larger temperature swings.

d. There are several people that should be notified before starting, including the owners representative, the mechanical contractor, the electrical contractor, the service organization and the boiler manufacturer.

e. **DO NOT USE TEFLON TAPE** or compounds with Teflon content as an oil or gas pipe sealant. Teflon can cause valves to fail creating a safety hazard. Warranties are nullified and liability rests solely with installer when evidence of Teflon is found.

f. Installer must clearly identify the main electrical power

disconnect and the manual shutoff valve on the gas supply drop line to the burner.

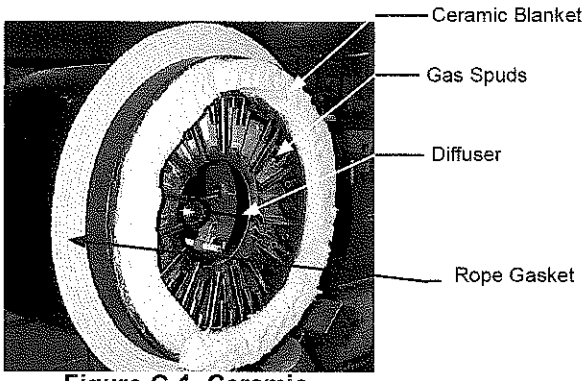

Figure C-1 Ceramic Blanket and Rope Gasket

2. Refractory Frontplate

The refractory front plate is used to adapt the burner to the vessel. While the specific dimensions will vary with different vessel and burner configurations, all will be similar in shape to that shown on the drawings at the end of this section. A mounting flange on the frontplate is used to clamp the frontplate to the vessel. Bolts on the frontplate are used to clamp the burner to the frontplate. High temperature fiberglass rope gaskets are used to seal each connection.

A rope gasket is applied to full surface of the frontplate mounting flange (it must cover the full face of the flange) to seal the refractory front plate to the vessel (a spray adhesive can be used to hold the gasket in place temporarily). The refractory frontplate is inserted into the furnace and clamped to the end of the furnace. The refractory must be centered in the furnace, so that the gap between the refractory and furnace is uniform. Clamp the frontplate to the furnace with uniform tension on the bolts, starting with a low torque for all bolts and then repeating with higher torque levels until tight.

Pack the gap between the refractory and furnace with ceramic blanket insulation (or ceramic rope) for at least 4 inches from the end of the refractory. This can be accomplished by reaching in from the center hole, and placing the insulation between the refractory and furnace, then pushing it in with a block.

3. Burner Mounting

A rope gasket is applied to the burner mounting flange, completely covering the flange (the 3/8" fiberglass gasket is provided with the burner). A ceramic insulation is placed on the end of the burner, as shown in Figure C-1. A spray adhesive can be used to hold these in place prior to installation.

The burner is then inserted into the frontplate, centered evenly (the 2 inch recess will center the burner) and clamped into position. Clamp the burner to the frontplate with uniform tension on the bolts, starting with a low torque for all bolts and then repeating with higher torque levels until tight.

The burner should be checked for level and must be perpendicular to the vessel. If the burner is not level or perpendicular, loosen the mounting clamps, reposition the burner and retighten. This will properly align the burner flame with the furnace and allow the proper flow of liquid. Oil combustion will not work properly if not level.

The burner is equipped with a mounting support to secure it to the floor. This is a pipe coupling attached to the burner. To secure the burner to the floor, pipe sections are installed to these couplings and a flange mount is secured to the floor.

4. Gas Piping

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

NOTE TO INSTALLER: The manual shutoff valve on the gas supply drop line to the burner must be conspicuously labeled.

Figure C-2 shows a typical gas piping schematic, although some components can vary based on size, insurance and other requirements. Consult the job specific gas train piping schematic (provided with the burner if train is supplied by Webster), along with a detailed list of components for specific details. This must be followed to properly locate the components in the gas train.

The gas piping must comply with all local and state codes and must be in accordance with the local gas company and insurance requirements.

If the gas train has not been factory assembled, the components should be assembled as indicated on the gas piping schematic furnished with the burner. The section between the two manual shutoff valves is mounted securely to the base rail on the side of the vessel. A drip leg should be provided upstream of the first manual valve to collect any moisture or contaminates.

Some general considerations for this installation are:

a. The piping to the burner must be sized to provide gas at the pressure and volume indicated on the order.

b. The gas piping should be installed according to local regulations and any applicable insurance requirements.

c. The gas pressure regulator usually requires a minimum straight length of pipe leading into and from the valve for proper operation. Also some regulating valves require a downstream pressure tap that must also be located at a certain dimension from the valve. These details are provided in the job specific details provided with the burner.

d. The piping between the train and burner must be done in a manner that will minimize the pressure drop. The pipe size should be the larger of the two connection points (on the train or the burner connection) and must use a minimum amount of elbows.

e. The gas piping should be cleaned to remove filings and

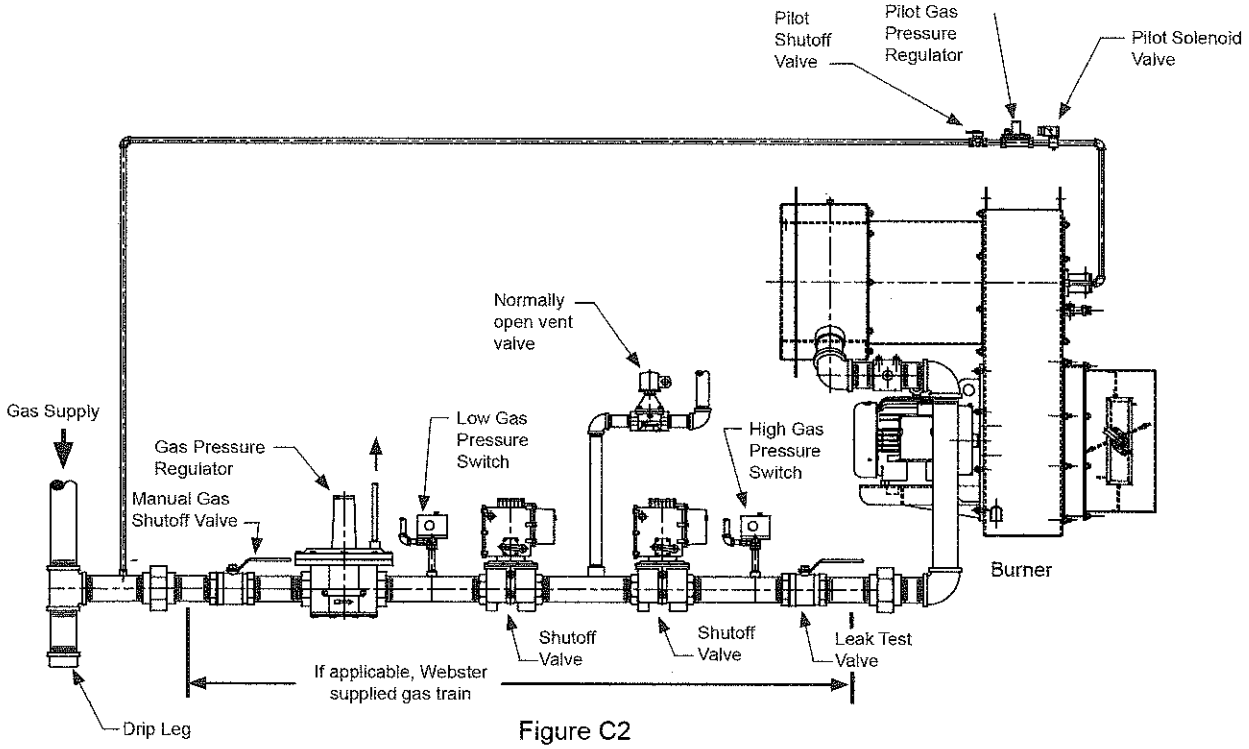

Figure C2
Typical Gas Piping

other debris common in the construction process.

f. The piping should be pressure tested with inert gas at two times normal operating pressure before use.

5. General Oil Piping

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

The amount of oil piping required in the field will depend on the type of system and how the burner was purchased. If the burner was factory mounted to the boiler, much of the installation work may already be complete. Units with heavy oil have more complexity built into them and will require more installation effort. The items identified in this manual assume that none of the installation work has been done by others.

The oil piping must be constructed to provide the flow and maintain the pressure required for proper system operation. Refer to the previous section for details on each of the different types of oil systems and how they operate.

Some of the actions required for successful piping systems are:

a. Oil storage tanks and piping must conform to The National Fire Protection Association "Standard for the Installation of Oil Burning Equipment NFPA-31", local ordinances and EPA underground storage tank requirements.

b. Oil lines shall be substantially supported and protected against physical damage. Buried lines shall also be protected against corrosion.

c. After installation and before covering, buried lines should be pressure tested for leakage.

d. Cast iron fittings should not be used.

e. Aluminum tubing should not be used.

f. Proper allowance should be made for expansion and contraction, jarring, vibration and tank settling.

g. Always run full size lines.

h. Suction and return lines shall be as short as possible.

i. The oil lines must be cleaned to remove water, rust and foreign matter. A common method of cleaning the oil piping is to temporarily install a short copper tube to the pump inlet, feeding the pump oil from a bucket. The gauge must be removed and the tapping plugged. The pump is run for a short time by manually engaging the motor starter by pushing it with a piece of wood. If flow does not establish within 2 minutes of engaging the pump, shut the pump off and run through the priming procedure again.

j. The standard oil pumps can provide suction (vacuum) of 10 inch of Hg when used to pull from a tank. If a transfer pump is used, the maximum inlet pressure that the pump can tolerate is 3 PSIG.

k. A strainer is required to protect the pump, valves and oil nozzle. This strainer is not part of the standard equipment supplied by Webster, but is intended to be supplied and installed by others. The strainer should have a maximum filter opening of 0.027" for #2 oil and 0.056" for #4-6 oil and sized to handle the full flow rate of the pump. The strainer must also handle the temperature and pressure. Retain and follow the strainer instructions supplied by the manufacturer. It is essential that these instructions be followed to insure proper filtration to protect the pump, valves and nozzle.

l. In Canada, refer to CSA Standard B139, "Installation Code for Oil Burning Equipment" for recommended instal-

lation procedures.

m. The oil lines and most valves are sized to handle the full pump capacity. The pumps are selected for a capacity of at least 1.5 times the maximum nozzle rate. If pumps are used with substantially higher flow rates, these selections may not function correctly. This is especially critical for the pressure atomized system where the metering valve is sized for the pump flow.

The selection of the oil pipe line size is critical for proper operation of the system.

CAUTION
PUMP FAILURES CAUSED BY FOREIGN MATTER IN THE OIL LINES WILL NOT BE COVERED BY WARRANTEE

6. Pressure Atomized Oil System

A pump is provided as standard with this system. There are several components that are required to complete the oil system as indicated on the schematic. The burner supplied oil pump suction should not exceed 10" hg. If a transfer pump is used to supply oil to the burner pump, the supply pressure should not exceed 3 PSIG.

The oil pump should be mounted close to the burner, so that the pressure and flow can be properly controlled.

The oil supply and return lines must be piped to the burner, with the components installed as shown in the schematic. The motor base of the oil pump should be bolted securely to the floor or some rigid base.

7. Air Atomized #2 Oil

The standard air atomized burner equipped for light oil may not include the optional oil pump. Oil is to be delivered to the burner at a constant 125 PSIG and with a flow capacity that is at least 50% higher than the rated nozzle capacity. For pump selections, the capacity should be 50% over the nozzle capacity. A supply and return line connection are required, along with the components indicated. The lines must be sized correctly to provide the required flow with minimal pressure drop. The pressure in the return line should not exceed 3 PSIG.

	Equivalent Lengths of Pipe Fittings (Schedule 20/40 - use for calculating total lengths)							
Pipe diameter (in)	4"	5"	6"	8"	10"	12"	14"	16"
Mitered 90° elb or "T" side flow	21	26	32	42	52	61	71	81
Standard 90° elbow	8.7	10.8	13	17	22	26	30	35
Long rad 90° elb (rad = 8 x dia)	7.1	8.7	10	14	17	20	23	27
Mitered 45° elbow	3	6	8	10	12	14	16	18

FIGURE C-3
Eqivalent Lengths of Fittings for FGR Duct

The oil supply and return lines must be piped to the burner, with the components installed as shown in the schematic. The oil pressure regulator must be located close to the burner to provide a constant oil supply pressure.

8. Heavy Oil

The standard burner equipped for heavy oil will include a trim heater and controls, but not the pump or primary heater. Oil is to be delivered to the burner at 125 PSIG and at a temperature that is within 20°F of the final oil temperature.

The primary oil heater (provided by others) may be required to reach the temperatures needed for good atomization. This can be accomplished with a heat exchanger that uses steam, hot water or electrical energy, or it could be done by simply heating the oil tank. In either case, the oil must be provided to the burner at a temperature that is within 20°F of the required atomization temperature.

A supply and return line connection are required, along with the components indicated. The lines must be sized correctly to provide the required flow with minimal pressure drop. The pressure in the return line should not exceed 3 PSIG.

The oil supply and return lines must be piped to the burner, with the components installed as shown in the schematic. The motor base of the oil pump and air compressor should be bolted securely to the floor or some rigid base.

9. Gas Pilot

The typical piping arrangement for the gas pilot is shown in Figure C-2. The supply is connected upstream of the first manual gas valve.

10. FGR Duct System

If the burner is equipped with Induced Flue Gas Recirculation (IFGR), it will require a duct connection between the stack outlet of the boiler and the air inlet of the burner. FGR is used to reduce NOx emissions. There can be different levels of NOx emissions that require different quantities of flue gas and different FGR duct and valve sizes. Proper sizing and installation of the FGR duct must be done to provide the required emission control and burner performance.

The FGR control valve is already installed on the burner and the duct will connect to this point. Depending on the duct size required, a pipe reducer may be required to match the control valve to the duct. The control valve is usually a smaller pipe size. The FGR shutoff valve may also require a pipe reducer, depending on the duct size.

If the FGR duct is to be installed in the field, the following procedures should be used to determine the best arrangement. The process uses a "Trial and Error" sequence to evaluate different possible duct arrangements.

a. Put together a duct arrangement based on a estimated duct size.
b. Determine the equivalent total pipe length based on the arrangement and fittings used.

FIGURE C-4		Pressure Drop per 100 feet of Duct (in wc)								
BHP	Max Inlet Press	2.5"	3"	4"	5"	6"	8"	10"	12"	14"
Pressure drop for 60ppm NOx - Natural Gas Firing										
30	0.50	0.3								
40	0.50	0.6	0.2							
50	0.75	1.0	0.4							
60	0.75	1.4	0.5	0.1						
70	0.75	1.9	0.7	0.2						
80	0.75	2.5	0.9	0.2						
100	0.75	3.8	1.5	0.3						
125	0.75	6.0	2.3	0.5	0.2					
150	1.00	8.7	3.3	0.8	0.2					
175	1.00		4.4	1.1	0.3					
200	1.00		5.8	1.4	0.4	0.1				
250	1.00			2.1	0.6	0.2				
300	1.25			3.1	0.9	0.3				
350	1.25			4.2	1.2	0.5				
400	1.25			5.5	1.6	0.6				
450	1.25			7.0	2.0	0.8	0.2			
500	1.50				2.5	0.9	0.2			
600	1.50				3.6	1.3	0.3			
Pressure drop for 30ppm NOx - Natural Gas Firing										
30	0.75	4.4	1.7	0.4	0.1					
40	0.75	7.8	2.9	0.7	0.2					
50	0.75		4.6	1.1	0.3	0.1				
60	1.00		6.6	1.6	0.5	0.2				
70	1.00			2.1	0.6	0.2				
80	1.00			2.8	0.8	0.3				
100	1.25			4.4	1.3	0.5	0.1			
125	1.25			6.8	2.0	0.7	0.2			
150	1.50				2.8	1.1	0.2			
175	1.50				3.9	1.4	0.3			
200	1.50				5.1	1.9	0.4	0.1		
250	2.00				7.9	2.9	0.6	0.2		
300	2.00					4.2	0.9	0.3		
350	2.00					5.8	1.3	0.4		
400	2.00					7.5	1.7	0.5	0.2	
450	2.00						2.1	0.6	0.3	0.1
500	2.00						2.6	0.8	0.3	0.2
600	2.00						3.7	1.1	0.5	0.2
Pressure drop for 20ppm NOx - Natural Gas Firing										
30	0.75	10.7	4.0	1.0	0.3	0.1				
40	0.75		7.2	1.7	0.5	0.2				
50	0.75			2.7	0.8	0.3				
60	1.00			3.8	1.1	0.4				
70	1.00			5.2	1.5	0.6	0.1			
80	1.00				2.0	0.7	0.2			
100	1.25				3.1	1.1	0.3			
125	1.25				4.8	1.8	0.4	0.1		
150	1.50				6.9	2.6	0.6	0.2		
175	1.50					3.5	0.8	.02		
200	1.50					4.6	1.0	0.3		
250	2.00					7.2	1.6	0.5	0.2	
300	2.00						2.3	0.7	0.3	
350	2.00						3.1	0.9	0.4	
400	2.00						4.0	1.2	0.5	0.2
450	2.00						5.1	1.5	0.7	0.3
500	2.00						6.3	1.9	0.8	0.4
600	2.00							2.7	1.2	0.5

c. Calculate the actual pressure drop in the duct using the value in Figure C-4 for the drop per 100' of pipe.
d. If this pressure drop is higher than the allowed drop (in Figure C-4), select a larger duct size or fittings that have a lower equivalent length and repeat the above steps.
e. If the calculated pressure drop is less than the maximum drop, that arrangement can be used.

Figure C-3 can be used to determine the equivalent duct length. Each fitting used in the duct has an equivalent straight pipe length, which is given in the chart. By adding up all of the equivalent lengths (including the length when multiple fitting are used) and all of the straight pipe lengths, the total equivalent length can be determined. This number is used to determine the pressure drop.

Figure C-4 provides pressure drop information used in sizing the FGR duct. The maximum FGR duct pressure drop is given for different inputs and NOx levels. The duct must be sized to be under this pressure. For a specific duct design, the equivalent length is used with the pressure drop per 100 feet of duct (selected from the chart, for the burner input and NOx level). The total pressure drop is:

Pressure drop = (drop per 100 feet)*(equivalent length)/100

This is the pressure drop expected from the duct that was selected. If the pressure drop is higher than the maximum allowed drop, the duct must be modified to reduce the pressure drop. This can be done by reducing the total length, using fittings with lower pressure drops or using larger pipe sizes. The pressure drop from the FGR control valve and shutoff valve (if required) do not need to be included in this evaluation.

For example, consider the arrangement shown in Figure C-5. There will be three 90 degree elbows (close radius) and 22 feet of straight pipe. If 8" pipe is used, then the total length will be:

Length = (3 x 13) + 22 = 61 ft.

If this is a 600 BHP 30 ppm system, then the maximum duct pressure drop is 2". The calculated drop is:

Pressure drop = 61 ft. x (3.8"/100 ft) = 2.3"

which is higher than allowed. Adjusting the pipe to 10" gives a new length of:

Length = (3 x 17) + 22 = 73 ft.

New pressure drop = 73 x (1.2"/100 ft.) = 0.9"

This pressure drop is good.
Changing to a 90 degree "T" as shown in the alternate:

Length = (2 x 17) + 52 + 22 = 108 ft.

New pressure drop is = 108 x (1.2"/100 ft)
= 1.3"

This pressure drop is still good. Note the increase pressure with the side outlet "T". The type of fittings used often has a bigger impact on pressure drop than pipe size.

The design of the FGR duct must include the following

considerations,

a. Normally the duct would connect to the stack as shown in Figure C-5, with a 45 degree cut facing the flue gas flow and with the center of the cut centered in the stack. The duct could be made to the smoke box, but must still be located with the same 45 degree cut facing the flue gas flow stream and with the center of the cut in the center of the stream.

b. The duct should be routed in a manner that has the minimum number of elbows and provides for the normal expansion and contraction of the piping. Long duct runs can change length by over 1" and can put an extreme load on the connecting points that could cause component failures. The design must include offsets that will allow for the required movement of the piping without undue force on the burner or stack.

c. Duct expansion and contraction can be managed by using two relatively long duct runs that are 90 degrees apposed to each other, similar to that shown in Figure C12. A small movement in the angle between these two legs will provide the space needed to absorb the expansion and contraction. The ends of the FGR duct must be securely attached to allow this to work properly, and prevent high loads from being applied to the burner or stack.

d. A condensation drip leg must be provided upstream of the FGR control valve and the FGR shutoff valve (if used). There must be sufficient condensate drip legs and catch space (volume of drip legs) to prevent the condensation from flowing through the control valves and into the fan. In cases of heavy condensation, a condensate drip leg may be required on the bottom of the housing, to remove condensate.

e. Determine the duct size, as indicated above. Remember that changing the fitting type and number of elbows can have a large impact on the pressure drop. If the pressure drop is too high, the unit will not make the required NOx or input due to the increased pressure drop. The burner capacity is reduced about 6% for each 1" of pressure drop.

f. Determine the location of the FGR shutoff valve (linkage systems only). It can be mounted in either the vertical or horizontal run, but it must be near the top of a vertical run to reduce the potential for condensation collection. If the valve is mounted in a horizontal run, the valve shaft must be horizontal (so condensation does not collect in the bearing) and the actuator motor must be on top of the valve (with insulation between the line and drive motor). Also, there must be a condensation drip leg in the horizontal run before the shutoff valve to remove any condensation.

g. Determine if pipe reducers are needed for the connection to the FGR control valve and the FGR shutoff valve.

h. The duct must be properly supported, handling both the weight of the duct and to control the thermal expansion and contraction. The supports may need to be anchored to provide this stability in the FGR duct.

CAUTION

UNCONTROLLED CONDENSATION CAN CAUSE PREMATURE FAILURE OF THE CONTROL VALVES, FAN AND MOTOR. ADEQUATE MEANS MUST BE PROVIDED TO REMOVE CONDENSATION FROM THE SYSTEM. COLD STARTUP WILL GENERATE SIGNIFICANT AMOUNTS OF CONDENSATION.

i. The FGR duct is normally made from schedule 40 pipe because it is easily obtainable and inexpensive. Schedule 20 pipe can also be used for this application.

j. The duct components must be seal welded, flanged or screwed together to provide an air tight duct. Air leakage into the duct will prevent the system from working properly. It is sufficient to only inspect the welds for a proper seal, they do not need to be leak tested.

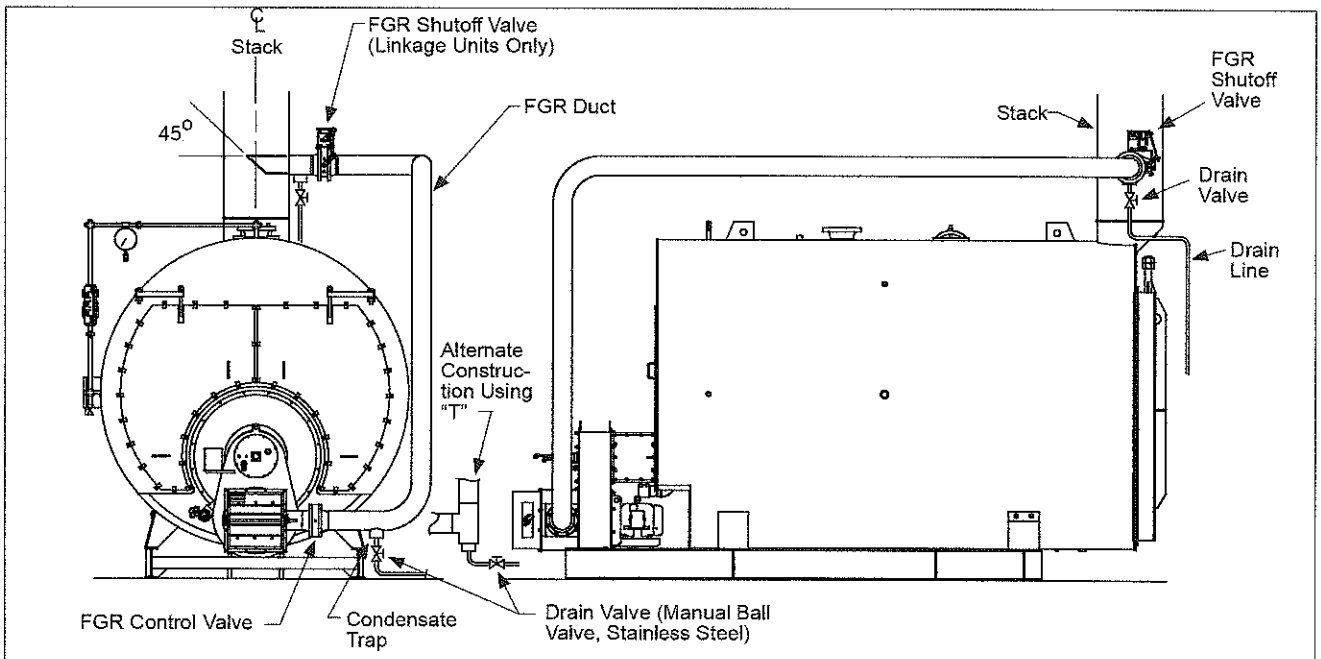

Figure C-5
FGR Duct Installation

11. Draft and Stacks

Stacks and breechings must be designed to maintain a relatively constant draft at the boiler outlet without large variations. The draft at the boiler outlet should be maintained within +/- 0.1" wc. at low fire and up to +/- 0.2" at high fire, with intermediate draft proportional to firing rate. More important than the actual draft is the variation in draft at any given firing rate. For example, a tall stack or multiple units in a single stack may have different draft conditions depending on the outside temperature and the number of units running. The draft variation at any given firing rate should be controlled to within +/- 0.1" wc.

The stack should be designed to avoid wind influences from adjacent structures as well as preventing the flue products from entering inlet ducts, windows or other occupied areas. It should be of sufficient height to extend above the roof of the building or adjoining buildings to avoid down drafts in the stack or the possibility of carrying combustion gases to undesirable locations. Local codes should be checked for criteria on heights and exit velocities.

The breeching should be designed to be as straight and short as practical, to minimize pressure fluctuations. Smooth bends, gradual transitions, low velocities and tight construction are all important. Round breechings are preferred to square or rectangular ducts because they are more efficient and less likely to generate noise on the flat side due to resonance. The size should be based on a maximum velocity of 30 ft/sec. Changes in direction must be as slow as possible. Circular elbows should be of at least a four piece construction with a centerline radius that is at least double the duct diameter (use three times the duct width for square ducts). The breeching should have a slight upward elevation (about 1" per foot) towards the stack to help induce a draft. Figure A shows the total BHP that can be fired within different breeching diameters. These can be multiple boilers of different size.

CAUTION

OIL BURNING EQUIPMENT SHALL BE CONNECTED TO FLUES HAVING SUFFICIENT DRAFT AT ALL TIMES, TO ASSURE SAFE AND PROPER OPERATION OF THE BURNER.

The connection of the breeching to the stack or multiple boilers to a common breeching or stack must be done with care. The ducts should never be connected at a 90 degree angle, but rather a 45 degree angle where the flows will easily join each other. When connecting multiple boilers into a single breeching, the breeching size must be increased to accommodate the larger flow rates before the introduction of the added flow. These breeching size changes must be gradual, with no more then a 10 degree slope change in the duct. When multiple breechings are connected into a common stack, their locations must be staggered to prevent the flow of one breeching interfering with another.

Tall stacks can generate large drafts, and in fact the amount of the draft is related to the stack height. Also, systems with multiple boilers can have draft variations that are well beyond the desired level. These conditions must be corrected to allow the burner to work properly, or the draft variations will cause combustion problems. Controls can be added to compensate for this draft, and bring it back into the desired level. The barometric damper is the most common and least expensive control. Several barometric dampers can be added to provide the total correction to the system draft.

Draft controls are also available to regulate the draft by controlling an outlet damper. The speed of response is critical to allow these units to work correctly. If the draft control does not operate much quicker than the burner changes rate, the result may be large swings in draft as the control attempts to catch up with the burner. A feed forward control is the best means of performing this control. If there are large drafts due to tall buildings, special consideration must be given to the type of damper needed to regulate this draft, and the response of the control to maintain the proper draft.

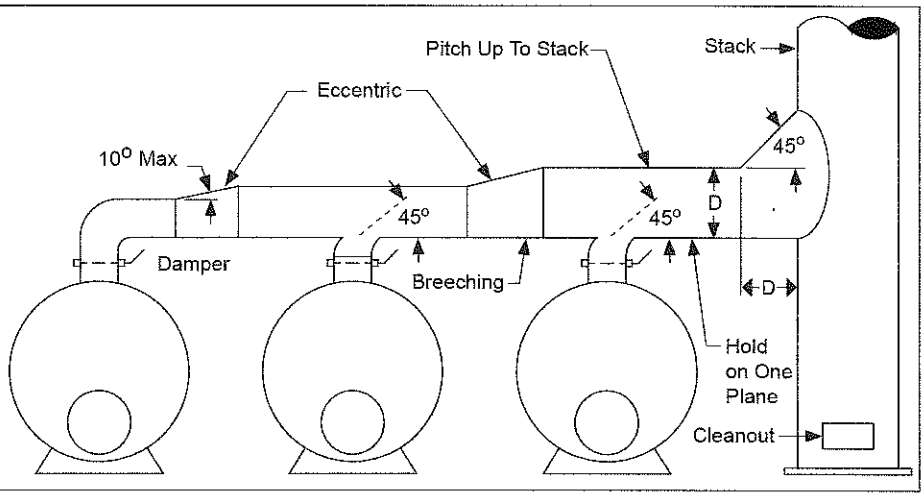

Figure C5
Method of Connecting Breechings and Stacks

12. Electrical System

The burner is supplied as standard, with a remote control panel. The panel is either intended for floor or wall mounting. The proper location will allow the operator to see the burner operate while manning the controls. In some areas, there are local regulations that define where the control panel must be mounted in relation to the vessel.

The control panel must be securely attached to either the floor or the wall. This should include lag bolts into the floor or wall.

The wiring diagram for the specific job should be followed for the connections to the panels and external equipment. The National Electric Code, Canadian Electrical Code, Part 1 or similar code for other jurisdictions should be followed.

The following list covers the standard acronyms used on wiring diagrams:

AUX.	– Auxiliary
CB	– Circuit Breaker
C.C.W.	– Counter Clock-Wise
C.W.	– Clock-Wise
CR( )	– Control Relay
FGR	– Flue Gas Recirculation
FTS	– Fuel Transfer Switch
GND	– Ground terminal
H.W.C.O.	– High Water Cut Off
INT	– Interlock
L	– 120V line
L.F.H.	– Low Fire Hold switch
L.W.C.O.	– Low Water Cut Off
MR	– Manual Reset
N.	– 120 V Nuetral
N.C.	– Normally Closed
N.O.	– Normally Open
P.L.F.S.	– Proven Low Fire Start
P.O.C.S.	– Proof Of Closure Switch
SW.	– Switch
TDR	– Time Delay Relay