Power Flame Incorporated

HAC INSTALLATION
AND
OPERATION MANUAL

THE POWER TO MANAGE ENERGY
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HACOM 985
Rev. 0498

FOR YOUR SAFETY

If you smell gas:

1. Open windows.
2. Do not touch electrical switches/
3. Extinguish any open flame.
4. Call your gas supplier immediately.

Do not store or use gasoline or other flammable liquids and vapors in the vicinity of this or any other appliance.

WARNING

Improper installation, adjustment, alteration, service or maintenance can cause injury or property damage. Refer to this manual. For assistance or additional information consult a qualified installer, service agency or gas supplier.

TABLE OF CONTENTS

INSTALLATION AND OPERATION HAC MANUAL

PAGE

PAGE

GENERAL PRODUCT INFORMATION

Power Flame Model HAC and HACR (inverted) burners incorporate the principles of air atomization for all fuel oils, and multiple-orifice, high velocity vortex mix operation for gas. The total package utilizes the forced-draft, flame-retention concept. All air for combustion is completely furnished by the burner fan. The burner can be operated under positive or negative furnace pressures with clean efficient combustion of fuels. Forced draft pressurized operation permits stacks of smaller diameter and height. The oil pressure required for air atomization varies from 20 to 70 psig. Oil flow is controlled by a metering valve in the nozzle supply line.

The Power Flame air-atomizing burner consists of a totally packaged and tested system (with unit responsibility) capable of delivering to the combustion area properly atomized fuel with a spray pattern to match the air pattern. Accurate control of atomized fuel and air results in proper flame patterns and clean combustion for maximum efficiency throughout the firing range. A proven gas pilot ignites the main fuel.

An electric trim heater is supplied as an integral part of the burner assembly when supplied for #4 or heavier grades of fuel oil. On burners for #4, #5 and #6 grade fuel oil, oil from a continuously operating oil pump is pumped through an auxiliary heater (steam of hot water may be the auxiliary heating medium) under accurate temperature control then through a thermostatically controlled electric heater. These auxiliary heaters are not a part of the standard HAC burner package.

The electric trim heater is primarily for trim heating and may be used for cold starting. The thermostat is set at a value slightly higher than that of the steam or hot water heater. The auxiliary heater takes over after the steam or hot water is generated and maintains constant temperature of the oil to the burner, to provide viscosity control, which is essential to good atomization.

The oil pump supplies oil to the system in excess of burner requirements. An oil-regulating valve maintains relatively constant oil supply pressure. The oil in excess of burner firing requirements is returned to the storage tank. Frequently, on multiple burner installations a single, separate, remote pump and heater set is used to preheat and transfer the fuel to the burner assemblies. These pump and heater sets are not a part of the standard HAC burner package.

A matched and pretested air compressor, driven by a separate motor, supplies the air for atomization and purging of the oil line and nozzle at the end of each firing cycle (#4, #5 and #6 oil only). The compressor is equipped with a pressure relief valve, intake filter and air receiver tank. An orifice bleed valve permits selection of the proper air pressure to suit various grade of fuel oil.

On a normal limit shutdown, the safety oil valve is de-energized and oil flow to the nozzle is interrupted. On #4, #5 and #6 oil the air purge valve is energized to permit compressor air to flow through the burner piping and nozzle, leaving it clean for next firing cycle.

Combustion air is provided by a forward curved blade fan, driven by an integral motor, and controlled by a dual blade inlet damper operated by a modulating motor actuator.

The modulating motor provides modulated positioning of the oil metering valve, the gas metering valve (on gas-oil burners only) and the dual blade inlet air damper throughout the firing range. It is controlled by a pressure or temperature activated potentiometric control that matches firing rate with load demand. The fuel-air ratio is established at the time of start up by linkage adjustment and set with combustion test equipment to provide the highest practical CO_2 with a clean flame.

A flame safeguard programmer, available in numerous control sequences, programs the firing cycles from prepurge through post purge. The cycle is sequenced to provide normal and safe conditions before fuel can be introduced into the combustion area. The complete firing cycle is supervised. Ignition and main flame failure protection is fast and reliable to render the burner inoperable in the event of pilot for main flame failure and to provide an alarm signal.

The limit circuit must include, as a minimum, an operating control, to maintain set boiler pressure or temperature; high limit control, to guard against excessive pressure or temperature; and low water control, to guard against operation with inadequate water level in the boiler. Devices as recommended by the heat exchanger manufacturer should be used.

Interlock switches protect against an attempt to fire by holding the limit circuit open if the oil temperature is too low for proper atomization, if combustion air pressure is inadequate, if atomizing air is below a preset value, or if the modulating motor is not in the low fire position.

The control circuit is 120 volts A.C.. The power supply for motors and heaters is polyphase 208 volts or higher. An auxiliary contact on the combustion air fan motor starter is interlocked with the control circuit to shut down the burner if this fan starter is not pulled in.

Power Flame HAC burners are offered in models to meet oil or gas/oil dual fuel requirements. Fuel changeover is accomplished by manual operation of a single fuel transfer switch. Automatic fuel changeover is available at extra cost. In some instances manual starting of the circulating pumps may also be required.

The prewired control panel, mounted and wired as an integral part of the burner, is in accordance with the requirements of Underwriters Laboratories, Inc. and the National Electrical Code. Components are wired to numbered terminal strips. Panels and burners are fire tested before shipment. Comprehensive wiring diagrams are furnished with each burner. Special panels for wall mounting or free standing applications are available at extra cost.

The fuel oil pump is remote on all burners for #4, #5 and #6 fuel oil and for HAC5 and HAC6 burners on #2 fuel oil. The integral pump systems employ two stage fuel units and are designed and tested for two pipe system operation. When remote pumps are used on #2 fuel oil, the pumping system is totally packaged and generally consists of pump, motor, direct coupling, bell housing and system base. Remote pumps for #4, #5 and #6 fuel oil are generally single stage, low rpm, belt driven pumps.

AIR COMPRESSOR

The air compressor should be located as close as possible to the burner with minimum pipe and fittings, to ensure minimum pressure drop. Excess pipe length and too many fittings will cause excessive line pressure drop resulting in poor atomization, higher oil temperature requirements, and high maintenance. Consult table 3, page 27, for line sizing information.

Atomizing air from the air receiver on the remote compressor is routed through a check valve on the burner then to the nozzle. A normally closed air purge valve, with an adjustable orifice, provides purge of the oil remaining in the nozzle line after the safety oil valve is closed, (Standard on #4, #5 and #6 fuel oil units, extra cost option on #2 fuel oil units).

MODEL HAC RECEIVING INSTRUCTIONS

Upon receipt, the burner and accessory equipment should be carefully unpacked and checked against the packing slip. Claims for shortage or damage must be immediately filed with the carrier.

Care should be taken to prevent damage to burner, control panel and accessory equipment. Use the furnished lifting lugs when lifting the burner for ease of handling and mounting and to prevent damage to the burner or burner mounted components.

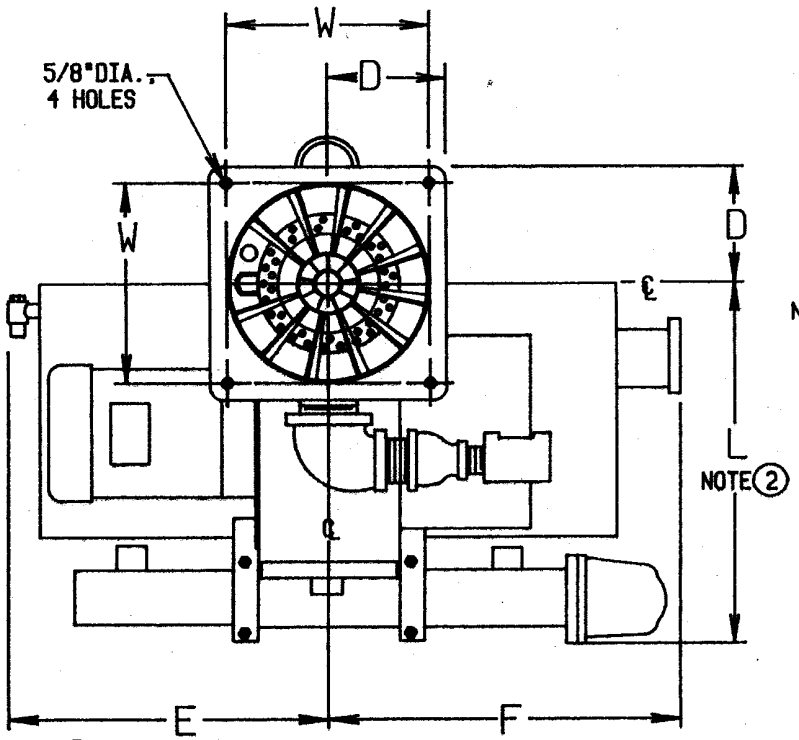
POWER FLAME MODEL HAC & HACR BURNERS
STANDARD BURNER RATINGS & COMPONENT DATA

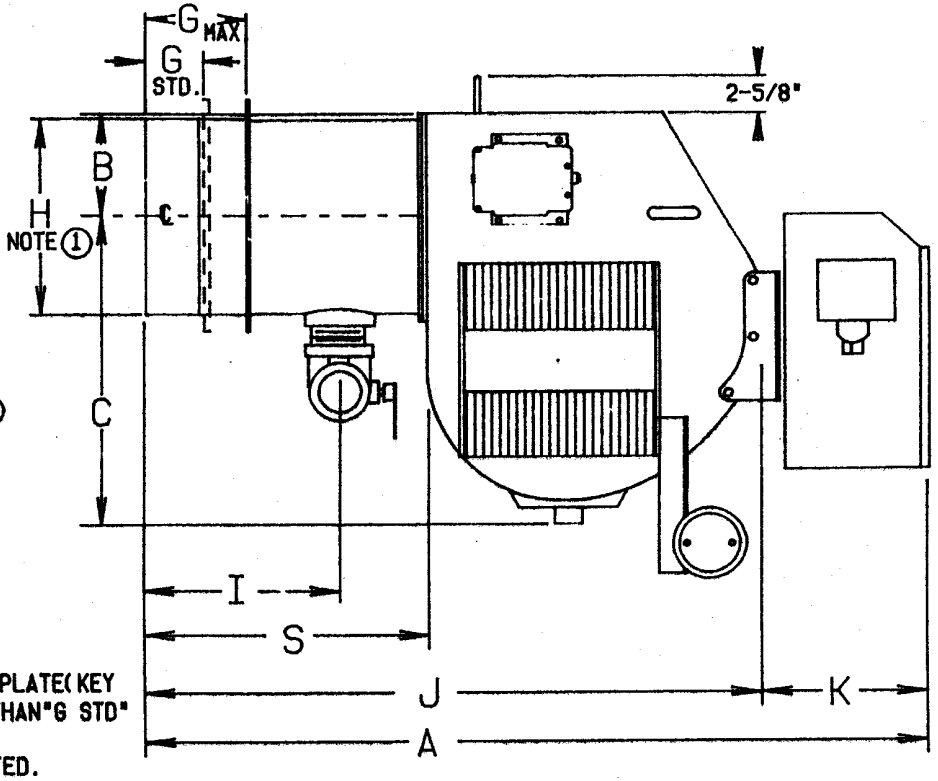
Table 1

BURNER MODEL (1)	MAXIMUM POWER FLAME CERTIFIED CAPACITY (2) -0.5" W.C. GPH	-0.5" W.C. MBTU	+0.5" W.C. GPH	+0.5" W.C. MBTU	BLOWER MOTOR HP 3450 RPM 3 PHASE	AIR COMPRESSOR MOTOR HP 3 PHASE	CFM FREE AIR @ 40 PSIG	REMOTE PUMP MOTOR HP 3 PHASE	OIL PUMP RATE GPH	ELECTRIC HEATER KW 3 PHASE	GAS TRAIN SIZE	GAS PRESSURE REQUIRED "w.c. (3)
HAC3-GO2	30.0	4200	28.5	3990	3	1-1/2-7LDE	4.5	INTEGRAL	45	N/A	2"	7
HAC4A-GO2	39.0	5460	37.5	5250	3	1-1/2-7LDE	4.5	INTEGRAL	55	N/A	2-1/2"	5.5
HAC4B-GO2	45.0	6300	43.5	6090	5	1-1/2-7LDE	4.5	INTEGRAL	75	N/A	2-1/2"	7
HAC4C-GO2	52.5	7350	51.0	7140	5	1-1/2-7LDE	8.2	INTEGRAL	75	N/A	3"	8
HAC5-GO2	60.0	8400	58.5	8190	5	2-C50	8.2	1/2-V056C	130	N/A	3"	15
HAC6-GO2	82.5	11600	81.0	11340	7.5	2-C50	12.0	1/2-V056C	130	N/A	3"	17
HAC3-GO4	29.0	4200	27.5	3990	3	1-1/2-7LDE	8.2	1/3-H4PA	45	3	2"	7
HAC4A-GO4	37.7	5460	36.2	5250	3	1-1/2-7LDE	8.2	1/3-H5PB	55	3	2-1/2"	5.5
HAC4B-GO4	43.4	6300	42.0	6090	5	1-1/2-7LDE	8.2	1/3-H6PA	75	4	2-1/2"	7
HAC4C-GO4	50.7	7350	49.2	7140	5	1-1/2-7LDE	8.2	1/3-H6PA	75	4	3"	8
HAC5-GO4	57.9	8400	56.5	8190	5	3-D80	20.9	1/2-V056C	130	5	3"	15
HAC6-GO4	79.7	11550	78.2	11340	7.5	3-D80	20.9	1/2-V056C	130	6	3"	17
HAC3-GO5(6)	28.0	4200	26.6	3990	3	2-C50	12.0	1/3-18B1	78	2	2"	7
HAC4A-GO5(6)	36.4	5460	35.0	5250	3	2-C50	12.0	1/3-18B1	78	3	2-1/2"	5.5
HAC4B-GO5(6)	42.0	6300	40.6	6090	5	3-D80	20.9	1/3-18B1	78	3	2-1/2"	7
HAC4C-GO5(6)	49.0	7350	47.6	7140	5	3-D80	20.9	1/3-18B1	95	4	3"	8
HAC5-GO5(6)	56.0	8400	54.6	8190	5	3-D80	20.9	1/3-37B1	120	4	3"	15
HAC6-GO5(6)	77.0	11550	75.6	11340	7.5	3-D80	20.9	1/3-37B1	120	5	3"	17
HAC3-O2	30.0	N/A	28.5	N/A	3	1-1/2-7LDE	4.5	INTEGRAL	45	N/A	N/A	N/A
HAC4A-O2	39.0	N/A	37.5	N/A	3	1-1/2-7LDE	4.5	INTEGRAL	55	N/A	N/A	N/A
HAC4B-O2	45.0	N/A	43.5	N/A	5	1-1/2-7LDE	4.5	INTEGRAL	75	N/A	N/A	N/A
HAC4C-O2	52.5	N/A	51.0	N/A	5	1-1/2-7LDE	8.2	INTEGRAL	75	N/A	N/A	N/A
HAC5-O2	60.0	N/A	58.5	N/A	5	2-C50	8.2	1/2-V056C	130	N/A	N/A	N/A
HAC6-O2	82.5	N/A	81.0	N/A	7.5	2-C50	12.0	1/2-V056C	130	N/A	N/A	N/A
HAC3-O4	29.0	N/A	27.5	N/A	3	1-1/2-7LDE	8.2	1/3-H4PA	45	3	N/A	N/A
HAC4A-O4	37.7	N/A	36.2	N/A	3	1-1/2-7LDE	8.2	1/3-H5PB	55	3	N/A	N/A
HAC4B-O4	43.4	N/A	42.0	N/A	5	1-1/2-7LDE	8.2	1/3-H6PA	75	4	N/A	N/A
HAC4C-O4	50.7	N/A	49.2	N/A	5	1-1/2-7LDE	8.2	1/3-H6PA	75	4	N/A	N/A
HAC5-O4	57.9	N/A	56.5	N/A	5	3-D80	20.9	1/2-V056C	130	5	N/A	N/A
HAC6-O4	79.7	N/A	78.2	N/A	7.5	3-D80	20.9	1/2-V056C	130	6	N/A	N/A
HAC3-O5(6)	28.0	N/A	26.6	N/A	3	2-C50	12.0	1/3-18B1	78	2	N/A	N/A
HAC4A-O5(6)	36.4	N/A	35.0	N/A	3	2-C50	12.0	1/3-18B1	78	3	N/A	N/A
HAC4B-O5(6)	42.0	N/A	40.6	N/A	5	3-D80	20.9	1/3-18B1	78	3	N/A	N/A
HAC4C-O5(6)	49.0	N/A	47.6	N/A	5	3-D80	20.9	1/3-18B1	95	4	N/A	N/A
HAC5-O5(6)	56.0	N/A	54.6	N/A	5	3-D80	20.9	1/3-37B1	120	4	N/A	N/A
HAC6-O5(6)	77.0	N/A	75.6	N/A	7.5	3-D80	20.9	1/3-37B1	120	5	N/A	N/A

(1) Model HACR (inverted configuration) carries the same firing rates and other data as the Model HAC.
(2) Burner capacities are based on using 1000 BTU/CU Ft., 0.6 specific gravity natural gas, 150,000 BTU/GAL #6 fuel oil, 145,000 BTU/GAL #4 fuel oil, and 140,000 BTU/GAL #2 fuel oil at 2,000ft. elevation.
(3) At inlet to main (manual) shutoff cock to obtain PFI certified rating at +0.5" w.c.

HAC DIMENSIONAL DETAIL





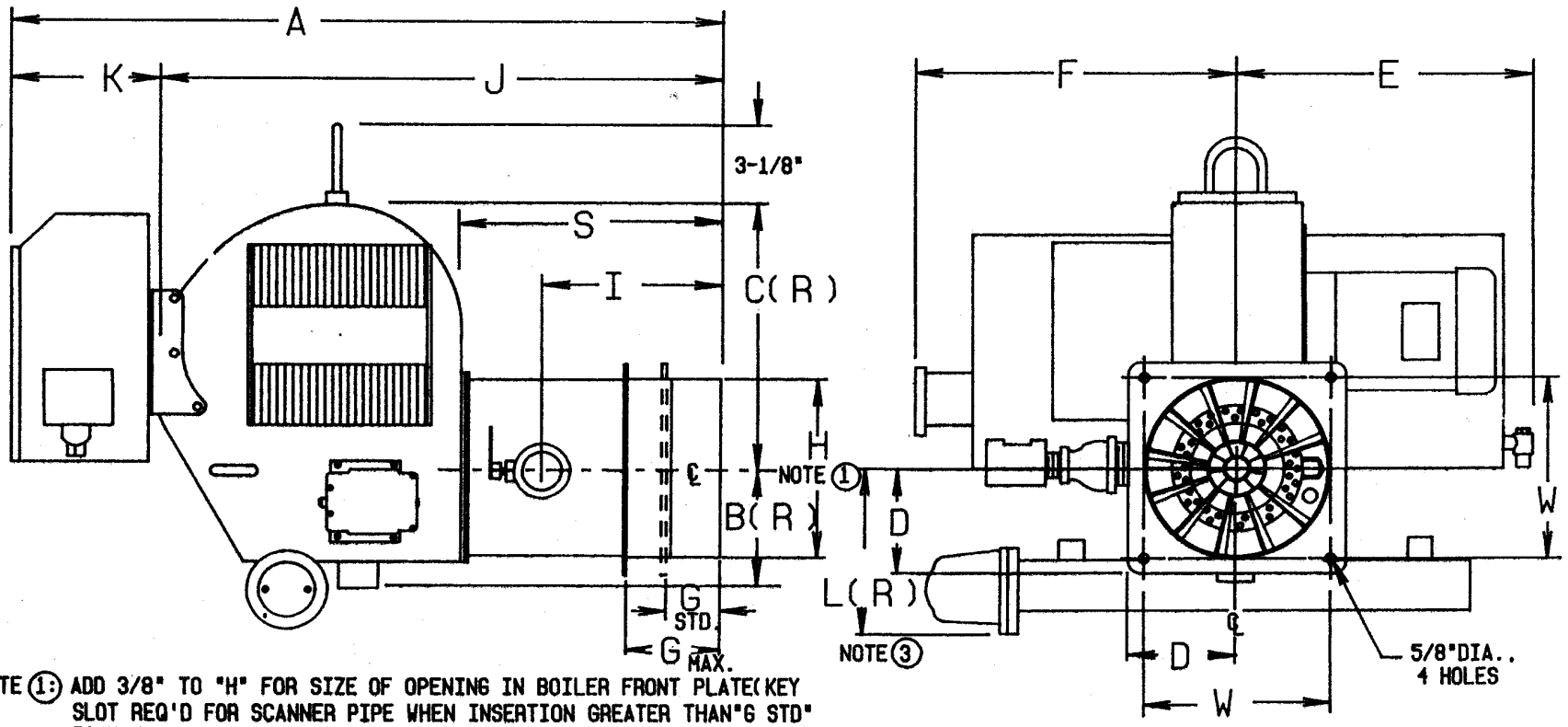
NOTE ①: ADD 3/8" TO "H" FOR SIZE OF OPENING IN BOILER FRONT PLATE(KEY SLOT REQ'D FOR SCANNER PIPE WHEN INSERTION GREATER THAN"G STD" IS USED)

②: IF CLEARANCE PROBLEMS EXIST PREHEATER CAN BE RELOCATED.

BURNER MODEL	DIMENSIONS (INCHES) STANDARD														
	A	B	C	D	E	F	G STD	G MAX	H ①	I	J	K	L	S	W
HAC3	42-3/8	5-1/4	16-3/4	6	20	21	3	4-5/8	9-5/8	10-1/4	32-3/8	10	17-3/8	14-3/8	10
HAC4	46	6-1/4	18-3/4	7	20	21	3-1/2	6	11-5/8	11-5/16	36-1/2	9-1/2	21-1/8	16-3/8	12
HAC5	46	6-1/4	18-3/4	7	20	21	3-1/2	6	11-5/8	11-5/16	36-1/2	9-1/2	21-1/8	16-3/8	12
HAC6	46	6-1/4	18-3/4	7-3/4	20	21	5-5/16	6	13-5/8	11-5/16	36-1/2	9-1/2	21-1/8	16-3/8	13-1/2

FIG.1

HACR DIMENSIONAL DETAIL



NOTE ①: ADD 3/8" TO "H" FOR SIZE OF OPENING IN BOILER FRONT PLATE(KEY SLOT REQ'D FOR SCANNER PIPE WHEN INSERTION GREATER THAN"G STD" IS USED)

②: (R) IS FOR REVERSED (HACR)MODELS ONLY.

③: IF CLEARANCE PROBLEMS EXIST PREHEATER CAN BE RELOCATED.

BURNER MODEL	DIMENSIONS (INCHES) STANDARD														
	A	B(R) ②	C(R) ②	D	E	F	G STD	G MAX	H ①	I	J	K	L(R) ②	S	W
HACR3	42-3/8	6-1/2	15-1/8	6	20	21	3	4-5/8	9-5/8	10-1/4	32-3/8	10	10-1/8	14-3/8	10
HACR4	46	7-1/2	17-1/4	7	20	21	3-1/2	6	11-5/8	11-5/16	36-1/2	9-1/2	10-1/4	16-3/8	12
HACR5	46	7-1/2	17-1/4	7	20	21	3-1/2	6	11-5/8	11-5/16	36-1/2	9-1/2	10-1/4	16-3/8	12
HACR6	46	7-1/2	17-1/4	7-3/4	20	21	5-5/16	6	13-5/8	11-5/16	36-1/2	9-1/2	10-1/4	16-3/8	13-1/2

FIG.2

INSTALLATION INFORMATION
GENERAL

Existing boilers must be thoroughly cleaned to obtain maximum operating efficiency. All fireside surfaces must be free of soot, carbon deposits and scale. Water side surfaces and mud legs must be free of scale and deposits of any kind.

Provisions should be made for adequate space around the burner and associated equipment to allow ease of inspection, maintenance and service. Observe all applicable codes for minimum clearances to combustible materials.

Install the burner using as a guide, a typical installation drawing selected from those provided as a part of this manual. See Figure 3, 4 and 5, pages 17, 18 and 19 respectively.

Provide a suitable burner steel front plate of ample thickness to support the weight of the burner, and to hold it firmly in alignment with the boiler. The front plate shall be protected by heat insulation, and high temperature refractory on the firebox side.

To install the burner, a circular opening sized in accordance with Figure 1, page 4 and Figure 2, page 5 must be cut in the steel front plate and surrounded by suitable bolts or studs. The burner mounting flange must be securely attached to the front plate using these bolts or studs and gas tight sealed with a suitable gasket or fiber rope packing. The burner assembly should be further supported at the base of the housing to prevent undue strain on the front plate, the burner housing and blast tube. A mounting pedestal is furnished for this purpose.

Combustion chambers shall be provided as recommended in “chamber dimension charts”, Table 2, page 16. They should be constructed of high temperature refractories in the form of firebrick or rammed plastic refractory and backed by suitable heat insulating material.

Note: It is the installers responsibility to supply and properly install refractory materials suitable for the application and temperature duty, provide expansion joints, refractory supports, wall ties, etc. as may be required for a proper installation. Consult your refractory supplier for construction details and requirements for these items.

Where boilers are of the mud-ring type, refractory should extend 6” to 8” above the bottom of mud-ring.

All possible points of combustion chamber air infiltration or air loss must be sealed. If the unit is to be fired under positive combustion chamber conditions, extreme care must be taken to ensure that a 100% seal is developed and maintained as high temperature gas leakage will occur at any leakage point possibly allowing flame and/or products of combustion into the boiler room. The model HAC burner is designed to provide all the air required for complete and efficient combustion. Entry of air into the heat exchanger from sources other than the burner will decrease its overall combustion and operational efficiency.

Gas train components and gas piping must be installed and sized in strict accordance with the piping schematic drawing supplied with the burner, Gas Company and/or local codes and regulations and applicable portions of the current revision of National Fuel Gas Code ANSI Z223.1. Also see Tables 4A, B, and C, page 28 and Figure 12, page 26. After installation the gas piping must be tested and purged in accordance with part 4 of the current revision of the “National Gas Fuel Gas Code” ANSI Z223.1.

Oil train components and oil piping must be installed, sized and tested in strict accordance with the piping schematic drawings supplied with the burner, local codes and regulations and applicable portions of the current revisions of “Installation of Oil Burning Equipment” NFPA No. 31.

COMBUSTION AIR SUPPLY

Fresh air required to support combustion as well as to provide adequate equipment ventilation must be supplied. It is generally accepted that ½ square inch of free air opening per 1000 BTU/hr firing rate (for each combustion device in the room) will be adequate. Under no circumstances should the boiler room be under a negative pressure. Jurisdictional authority relating to combustion air and boiler room ventilation requirements vary widely. Check with the controlling authorities to make certain of compliance.

COMBUSTION ADJUSTMENTS ON OIL AND GAS - GENERAL

Efficient combustion cannot be properly judged by flame appearance, although it may help in making preliminary settings.

The proper settings of air-fuel ratios must be determined by flue gas analysis. Combustion gas analysis indicates the air to fuel ratio and the degree of complete combustion. Instruments are available to measure carbon dioxide (CO_2), oxygen (O_2), carbon monoxide (CO), and smoke levels.

STACK TEMPERATURE

Net stack temperature is obtained by subtracting the ambient temperature from the flue gas temperature. A high stack temperature indicates wasted heat. Stack temperature should be as low as possible without causing flue gas condensation.

Stack heat loss can be reduced by decreasing either the temperature or the volume of the flue gas, or both. Flue gas temperature is reduced by improving heat transfer or by reducing excess combustion air. A certain amount of excess air is necessary to complete combustion. More efficient burners require minimum excess air.

SMOKE MEASUREMENTS

Smoke measurements can be made using a variety of different methods. The standards will vary somewhat according to the equipment used, and instructions accompanying the instrument should be followed.

Smokey combustion can result from: Improper air delivery, insufficient draft, improper fuel viscosity, improper fuel-air ratio, excessive air leaks in the combustion chamber, or improper fuel oil temperature.

GAS ADJUSTMENTS

Low fire combustion analysis typically is 7 to 9 percent CO_2 and less than .04 percent CO (400ppm). High fire reading typically is 9 to 10.5 percent CO_2 and less than .04 percent CO. See Figure 18, page 37.

FUEL OIL ADJUSTMENTS

Adjust for a “clean fire”. Typically for No. 2 through 4 oil, CO_2 is 8 to 11 percent at low fire and 10 to 13 percent at high fire. No. 5 and 6 oil, CO_2 is 8 to 13 percent at low fire and 11 to 14 percent at high fire. See Figure 18, page 37.

GENERAL START-UP PROCEDURES ALL FUELS

A representative of the owner and/or the persons responsible for operating and maintaining the unit should be present during the initial start-up. Instructions on the proper care and maintenance of the unit can be covered at this time.

Consult your local utility to determine if they require their service representative's presence at the initial start-up of a gas-fired boiler.

Before beginning start-up, the start-up technician should thoroughly study and become completely familiar with the exact sequence of operation and all other details of the specific flame safeguard control system being used. This information will be found in bulletins printed and supplied by Honeywell or Fireye, Inc.. A copy of this bulletin was supplied with the burner.

After the burner is mounted on the boiler and all the field piping and wiring have been completed and tested, it is recommended that the following procedure be followed.

1. Make a general inspection tour around the boiler or furnace to ensure that the installation is complete. Check piping, controls, wiring, etc.

2. Check control transformer (if supplied) connections and motor wiring to confirm that proper connections are made for the supply voltage to be used.

3. Check fuses in the main panel and in the burner control cabinet. Check wiring to the burner control cabinet for compliance with the wiring diagram and local codes.

4. Tighten all screws on the terminal blocks in the control cabinet in case some may have loosened in shipment.

5. Close all main fuel valves.

6. Check boiler breeching and stack to be sure they are open and unobstructed.

7. Check operating controls, limit controls, low water cutoff, flame safeguard reset, high gas pressure switch and low fire interlock switch. All contacts should be closed.

8. With the control switch "off", all manual gas valves closed, oil suction line manual valve closed and oil return line open, close the fused disconnect switches supplying power to the blower motor, air compressor, and oil pump (if applicable) motor. Check rotation of these motors by momentarily making contact of the motor starters. Proper rotation is imprinted on the burner blower housing, remote pump and compressor assembly.

9. If the burner is supplied with a burner mounted oil pump, driven by direct coupling to the blower motor wheel, oil for circulation must be provided and pump must be primed before operation of the fan motor which drives the oil pump. Operation of the pump without priming and oil circulation may result in pump damage or seizure not covered by guarantee if run "dry".

10. For the reasons given in the proceeding paragraph the procedure for start-up on oil should be followed first, followed by the procedure given for gas fuel.

11. On dual fuel units where the pump is driven by a blower wheel coupling the pump blower wheel coupling must be disconnected if the burner is to operate on gas fuel without full oil circulation in the oil pumping system.

FUEL OIL START-UP PROCEDURES

Power Flame model HAC oil burners are of the air atomizing, forced draft type. The input is controlled by a modulating metering valve connected with appropriate linkage to a modulating motor.

1. Determine that the oil and gas piping has been installed, pressure tested for leakage and gas lines purged in accordance with the instructions previously given in section entitled “Installation”.

2. Check all controls for compliance with codes and insurance requirements.

3. Check all fuel/air drive linkage. The linkage has been roughly adjusted when factory fire tested; but it should be checked to make sure it was not damaged or loosened in shipment. The linkage will have to be reset to suit the job conditions. See Figures 14 and 15, pages 33 and 34.

4. Install oil pressure and vacuum gauges. Check the suction lines to be sure the check valve is installed so that it will open in the proper direction. Check oil filter for tightness. Check return lines to be sure they are free of obstructions and will allow free circulation to the tank system.

   NOTE: There should be no shutoff valve installed in the return line.

5. Keep the fused disconnect switch to the electric oil preheater (if supplied) in the “off” position until the heater elements are completely immersed in oil.

6. Check the pilot burner for proper setting of the ignition electrode spark gap. See Figure 16 , page 35 and Figure 17, page 36. Open the gas pilot cock.

7. Set the air damper approximately ¼” open.

8. Disconnect the wire to the safety oil valve to prevent opening during the following procedure. (Do not allow to ground or short to other power sources).

9. Appropriate steps must be taken to transfer the oil from the tank to the burner. It is imperative that the system be primed prior to pump operation. The system priming may be achieved by closing the manual valve in the suction line and priming the oil pump through the fitting in which the oil pressure gauge was installed. Priming can also be accomplished through the oil filter on the suction line, if it is the removable top type. When replacing the oil strainer cap, be careful to assure a vacuum tight seal. Close the manual oil valve in the suction line and start the oil pump or the burner if the oil pump is driven by the blower motor.

To start burner-

   A. If heavy oil - temporarily set the cold oil lockout switch in the burner mounted trim preheater to the “made” position.

   B. Reset the flame safeguard control.

   C. Place manual-auto switch in the manual position and the potentiometer in the closed position.

   D. With the control switch off, close the main disconnect switch supplying control cabinet power.

   E. On gas/oil units place the transfer switch in the oil position.

   F. Turn the control switch on. Burner fan and pump motor will start to prime pump and oil lines.

10. Let the burner run (for 30 seconds at a time – then reprime as necessary) until the vacuum gauge indicates a 15"Hg vacuum, then quickly open the manual oil valve in the suction line. This combination of priming and high suction should pull the oil from the tank to the burner provided there are no air leaks and the line is properly sized. (See figures 6, 7 and 8, pages 20, 21 and 22 respectively for sizing oil lines.) Continue pump operation until lines are full and oil is flowing freely. Examine the burner mounted electric oil trim heater to assure that the procedure filled the oil heater with oil. If not, continue circulation of the oil until the heater is filled.

11. When it has been determined that oil is flowing freely through the trim oil heater (when supplied), close the fused disconnect switch supplying power to the trim heater. Reset the cold oil lockout switch to the desired temperature settings.

12. The next step is to light the pilot and adjust it for proper ignition and signal. The procedure is accomplished with the safety oil valve still disconnected.

    A. Install a manometer or 0-10" w.c. gas pressure gauge on the pilot test tee.

    B. On flame safeguard controls having a cam timer arrangement and/or controls having a test switch, means is provided to hold a pilot at the "on" position for as long as necessary (once pilot is proven) to adjust gas pressure and/or primary air setting for the best signal strength. Set this switch to hold pilot at the "on" position. Refer to the flame safeguard manual for complete procedure and operation.

    C. Open pilot manual gas valve leaving main gas cock closed.

    D. Close control switch. Burner should start and after pre-purge the pilot should light and flame safeguard programmer should stop and hold at the "trial for ignition" point. (See 12.B above)

    E. See page 29 for specific pilot adjustments. Measure pilot gas pressure and re-adjust pilot gas pressure regulator as required.

    F. Using appropriate meter measure the flame safeguard control signal with the pilot operating. Refer to the flame safeguard instruction manual for type of meter and proper level of signal. Follow procedure listed in the flame safeguard manual and/or pages 29 and 30 in this manual if the proper signal is not obtained.

    G. When pilot adjustments are finished and correct pilot signal level obtained, switch the test switch (or its equivalent) back to the run position. The flame safeguard will advance to the "trial for main flame ignition" point as indicated by the "main fuel" light. Since the safety oil valve is still disconnected, after a short delay the flame safeguard should "lock out" and go into the post purge cycle.

13. After the fan motor stops, disconnect cabinet power, and reconnect the safety oil valve.

14. For heavy oil systems set the oil trim heater thermostat at the oil temperature required to provide oil viscosity equal to 100-150 SSU viscosity with the fuel being used. See viscosity chart, Figure 19, page 38.

15. For heavy oil systems set the cold oil lockout switch approximately 20 degrees F. below the trim heater thermostat setting.

16. Set the high oil temperature switch (if supplied) approximately 20 degrees F. above the trim heater thermostat setting.

17. The next procedure will light the main oil flame.

    A. Throw all fused disconnect switches to the "on" position.

    B. Open all manual oil valves required for normal oil flow to and from the tank.

    C. Place in operation any manual start pump required to supply oil to the burner and circulating system.

D. Turn the control switch on. Provided the cold oil lockout switch (heavy oil only) is made, the burner fan motor should start. After prepurge the pilot should be ignited and proven, and after "pilot trial for ignition" period, the safety oil valve should open to ignite the oil burner at low fire. Low fire flame should now be established. If not, shut the system down and correct failure cause.

18. Test the operation of the oil temperature switches, all oil pressure switches, atomizing air switch, fan air flow switch, all limit switches and low water cutoffs to assure these switch actions close the safety oil valve and properly shut down the burner. Refer to the respective control specification sheets, the burner wiring diagram and oil piping schematics for the correct procedures and the resultant shutdown sequence that should occur.

CAUTION: Do not proceed with further start-up procedure for either fuel if the proper shutdown sequence for each of these safety devices cannot be demonstrated at this time.

19. Measure and adjust as required the oil gun pressure and atomizing air gun pressure for the desired low fire rate using data supplied on the factory fire test sheet supplied with the burner as a guide. Also, refer to Table 5, page 37. Fuel and air pressures will require job site readjustment to assure the desired firing rates for the fuel to be used. Set the burner air damper to obtain 9-10% CO_2 for warm up purposes.

20. Set the low oil pressure switch (if supplied) to trip at 20% below the sensed oil pressure for the low fire rate.

21. Set the low atomizing air pressure switch to trip at 20% below the sensed air pressure required for the low fire rate.

22. Set the high oil pressure switch (if supplied) to trip at 20% above the sensed oil pressure required for the full firing rate.

23. Proceed to warm up the boiler following the recommended procedure as provided by the boiler manufacturer. In the absence of these boiler manufacturers instructions, warm up the boiler at low fire only following a cycle of 5 minutes on and 5 minutes off for 5 cycles then continuous low fire until the boiler reaches the desired operating pressure or temperature.

Note: It may be necessary to limit the boiler load in order obtain operation pressure or temperature at the low fire rate.

24. For Heavy Oil Systems - When boiler operating temperature or pressure is achieved the auxiliary oil system steam or hot water oil heaters may be brought into operation. When these heaters are fully operational and the complete oil circulating system up to desired operating temperature, the system is ready to fire the burner above the low fire rate.

25. All HAC burners are designed for modulation. The modulating motor is connected by linkage to the air inlet dampers and fuel metering devices. Each control point has its own multi-position arm so that the proper air-fuel ratio can be obtained throughout the modulating range. After preliminary safety checks and start-up procedures have been accomplished, proceed to the modulating operation adjustments. See Figure 14, page 33 for linkage operation.

Note: If the burner has been supplied with the "Varicam®" characterized fuel metering system, refer to Figure 15, page 34 this manual and Bulletin No. VA1588 "Varicam®" Adjustment Instructions" included in the information shipped with the burner.

A. In order for you to determine that the metering valve is in the low fire position, observe the metering valve pointer. The "deep end" of the slot must be pointing toward the number 3 position or less. This position is located toward the closed position on the metering valve dial and will be determined by the low fire required at start-up.

B. Settings must be noted and marked on the linkage prior to proceeding with your final adjustment.

C. Mark the linkage setting previously arrived at for low fire warm up prior to proceeding with modulation linkage adjustments at higher firing rates.

D. Using the manual potentiometer manually increase the firing rate to the midway point by small increments, watching linkage to assure free movement at each position. Set the air/fuel ratios to obtain a clean appearing flame. Lock the settings and record CO_2 and smoke readings. 12-1/2 to 13-1/2% CO_2 with #2 Bacharach smoke spot or less on 140,000 Btu/gas oil or 13.2 to 14.1% CO_2 on 150,000 Btu/gal oil with #4 Bachrach smoke spot or less should be obtainable by fuel/air ratio adjustments from 50% full firing rate to 100% full firing rate. Readjust the settings, if necessary to obtain optimum firing conditions. Mark and note the settings for the midpoint firing position.

E. Again by small increments, use the manual potentiometer to manually move the rate to the high fire position and repeat the tests done for the midpoint adjustments. The oil metering valve setting and air damper openings being used to obtain your high fire reference points should be marked and noted.

F. Move the modulating lever arm on the modulating motor through the three previously determined reference points. Check to determine that the same fuel/air ratio % CO_2) are obtained. Minor setting modifications may be required to ensure that your reference points are acquired. Reset fuel/air linkage at low fire to obtain the highest possible CO_2 (but not exceeding high fire CO_2 recommendations) at acceptable smoke levels.

G. Tighten all the linkages and permanently mark settings.

26. By adjustment of the needle valve located in the purge valve body (not supplied on #2 oil burners), set the gun purge oil flow rate so that there is no appreciable change in fire size when the purge valve opens to purge the oil gun.

27. Final checks: After the burner has been adjusted properly, proceed with the checkout of the low fire start switch, purge position switch, starting interlocks, running interlocks, limit controls, outside air dampers interlocks and any other interlocks and limits that are used.

28. The “Owner’s Operating Instructions,” page 48 of this manual, should be posted in a clearly visible location close to the burner.

29. The oil burner start-up is now complete. Proceed to the Gas Fuel Start-up Procedure.

GAS FUEL START-UP PROCEDURE

Power Flame model HAC gas burners are of the multiple orifice, high velocity vortex mix, forced draft type. The input is controlled by a modulating butterfly gas valve connected with appropriate linkage to a modulating motor.

This procedure is written as if the oil fuel start-up has not been completed. If all phases of the oil fuel start-up have been satisfactorily completed then references to procedures and tests in the gas start-up already accomplished in the oil start-up need not be duplicated.

As a safety precaution: If the oil start-up procedure has not been completed, the oil pump coupling must be disconnected for the gas start-up on those units supplied with burner mounted oil pumps direct driven by coupling to the blower motor. Similarly separate motor driven oil pumps must be prevented from operating during gas start-up if the oil start up procedure has not been completed.

1. Close all manual gas valves.

2. Determine that all gas piping has been installed, pressure tested for leakage, gas lines purged in accordance with the instructions previously given in the section entitled “Installation”.

3. Check all gas piping, safety and automatic gas valves, and controls for compliance with codes and insurance requirements.

4. Check all safety gas valves, normally open vent valves and automatic gas valves for leakage. Refer to the valve manufacturers installation instructions for the proper procedure.

5. Check all linkage. The linkage has been roughly adjusted when factory fire tested; but it should be checked to make sure it was not damaged or loosened in shipment. The linkage will have to be reset to suit the job conditions.

6. Install gas pressure gauges. One gauge upstream of the main gas pressure regulator to monitor gas supply pressure, one gauge immediately downstream of the main gas pressure regulator to read the regulator outlet pressure and determine the proper set point for the low gas pressure switch, and one gauge to read the burner manifold or orifice pressure. A manometer or 0-10” w.c. gauge should be installed in the pilot test tee.

7. Keep the fused disconnect switch to the electric oil preheater (if supplied) in the “off” position during gas fuel start-up.

8. Check the pilot burner for proper setting of the ignition electrode spark gap. See page 29, also Figure 16, page 35 and Figure 17, page 36.

9. Set the air damper approximately ¼” open or leave as adjusted during oil start-up.

10. The next step is to light the pilot and adjust it for proper ignition and signal.

    A. On combustion safety controls having a test switch, a means is provided to hold a pilot at the “on” position for as long as necessary (once the pilot is proven) to adjust gas pressure and/or primary air setting for the best signal strength. Set the switch to hold the pilot at the “on” position. Refer to the flame safeguard manual for complete procedure and operation.

    B. With the burner control switch off throw the fused disconnect switches for the fan motor and the control circuit to the “on” position. Leave the oil heater fused disconnect and all pump fused disconnect switches off.

C. Reset the flame safeguard.

D. Place the manual-auto switch in the manual position and the potentiometer in the closed position.

E. Place the fuel transfer switch in the gas position.

F. Open the main manual gas valve leaving the checking cock closed.

G. Open the pilot gas cock.

H. Reset the high and low gas pressure switches. It may be necessary to adjust the low gas pressure switch operating point to assure the switch is made with the available gas pressure.

I. Close the control switch. The burner should start and after a prepurge the pilot should light and flame safeguard programmer should stop and hold at the "trial for ignition" point. (See 10.A above).

J. See pages 29 and 30 for specific pilot adjustments. Measure pilot gas pressure and re-adjust pilot gas pressure regulator as required.

K. Using the appropriate meter, measure the flame safeguard control signal with the pilot operating. Refer to the flame safeguard instruction manual for type of meter and proper level of signal. Follow procedure listed in the flame safeguard manual and/or pages 29 and 30 in this manual if the proper level or type of signal is not obtained.

L. When pilot adjustments are finished and correct pilot signal level obtained, switch the test switch (or its equivalent) back to the run position. The flame safeguard will advance to the "trial for main flame ignition" point as indicated by the "main fuel" light. Since the checking gas cock is still closed, after a short delay the flame safeguard should "lock out" and go into the post purge cycle.

11. Turn the control switch off and reset the flame safeguard.

12. Turn the control switch on to restart the burner using a meter to monitor the flame signal during pilot and main flame operation. After prepurge and trial for pilot ignition, when the safety gas valve is energized to open, slowly open the main checking gas cock to light off the main burner at low fire rate. Low fire gas flame should now be established. If not shut the system down and correct failure cause.

13. Recycle the burner on and off several times at low fire rate to determine that safety gas valves and normally open gas valves (if used) are closing properly and that flame signal is adequate and steady.

14. Test the operation of all limit controls, low water cutoffs, operating controls, fan air flow switch, gas pressure switches, outside combustion air damper interlocks (if used) or any other existing limit or safety controls to demonstrate closure of the safety gas valve(s) and proper shut down of the burner. Refer to the respective manufacturers control specification and installation sheets, the burner wiring diagram and gas piping schematics for the correct procedures and the resultant shut down sequence that should occur.

15. Test the operation of all linkage position switches, valve position switches, airflow and all other limit and control devices. Refer to the respective manufacturers control specification and installation sheets and the burner-wiring diagram to determine the proper procedure and the expected results from operation of these devices.

16. Read the gas meter to determine the low fire rate and re-adjust gas flow rate as required. Contact the local gas utility to determine applicable correction factors.

17. Adjust the low fire fuel/air ratio to 6-8% CO_2 with less than 0.4% CO. See Figure 18, page 37.

18. Set the low gas pressure switch to trip at 20% less than the sensed gas pressure with the burner firing at the high fire rate.

19. Proceed to warm up the boiler following the recommended procedure as provided by the boiler manufacturer. In the absence of these boiler manufacturers instructions, warm up the boiler at low fire only following a cycle of 5 minutes on and 5 minutes off for 5 cycles then continuous low fire until the boiler reaches the desired operating pressure or temperature. Note: It may be necessary to limit the boiler load in order to obtain operating pressure or temperature at the low fire rate. Only after reaching the boiler operating pressure or temperature should the boiler be fired at full firing rate.

20. All HAC burners are designed for modulation. The modulating motor is connected by linkage to the air inlet dampers and fuel metering devices. Each control point has its own multi-position arm so that proper air to fuel ratio can be obtained throughout the modulating range. After preliminary safety checks and start-up procedures have been accomplished, then proceed to the modulating operation adjustments. See Figure 14, page 33 for linkage operation.

NOTE: If the burner has been supplied with the Varicam® characterized fuel metering system, refer to Figure 15, page 34 of this manual and bulletin No. VA1588 “Varicam® Adjustment Instructions” included in the information supplied with the burner.

A. In order for you to determine that the butterfly gas valve is in the low fire position, observe the slot in the end of the butterfly valve shaft. The slot position is parallel to the valve butterfly and thus indicates butterfly position.

B. Settings must be noted and marked on the linkage prior to proceeding with your final adjustment.

C. Mark the linkage setting previously arrived at for low fire warm up prior to proceeding with modulation linkage adjustments at higher firing rates.

D. Using the manual potentiometer manually increase the firing rate to the midway point by small increments, watching linkage to assure free movement at each position. When midpoint is reached take flue gas readings and adjust the fuel/air ratio. 9.5 to 10.5% CO_2 with CO less than 0.04$ CO should be obtainable from 50% to 100% full firing rate. The metering device settings and air damper opening should be noted and marked on linkages before proceeding to full firing rate.

E. Again by small increments, use the manual potentiometer to manually move the firing rate to the high fire position. The high fire rate is set approximately to the manifold gas pressure given on the burner specification sheet. Read the gas meter to determine exact firing rate. Check with the local gas utility to determine meter correction factor applicable. Repeat the tests and adjust fuel/air ratio the same as done for the midpoint adjustment. If desired high fire input rate cannot be achieved with the butterfly valve wide open (do not go beyond full open) increase the gas pressure at the burner main gas pressure regulator, as required. The metering device setting and air damper openings used to obtain your high fire reference points should be marked and noted.

F. Move the modulating lever arm on the modulating motor through the three previously determined reference points. Check to determine that the same fuel/air ratios (%CO_2) are obtained. Minor setting modifications may be required to ensure that your reference points are acquired. Reset fuel/air linkage at low fire to obtain the highest possible CO_2 recommendations) with less than 0.04% CO.

G. Adjust the high gas pressure switch to trip at 20% above the sensed gas pressure present at full burner firing rate.

H. Tighten all linkages and permanently mark settings.

21. The “Owner” Operating Instructions,” page 48 of this manual, should be posted in a clearly visible location close to the burner.

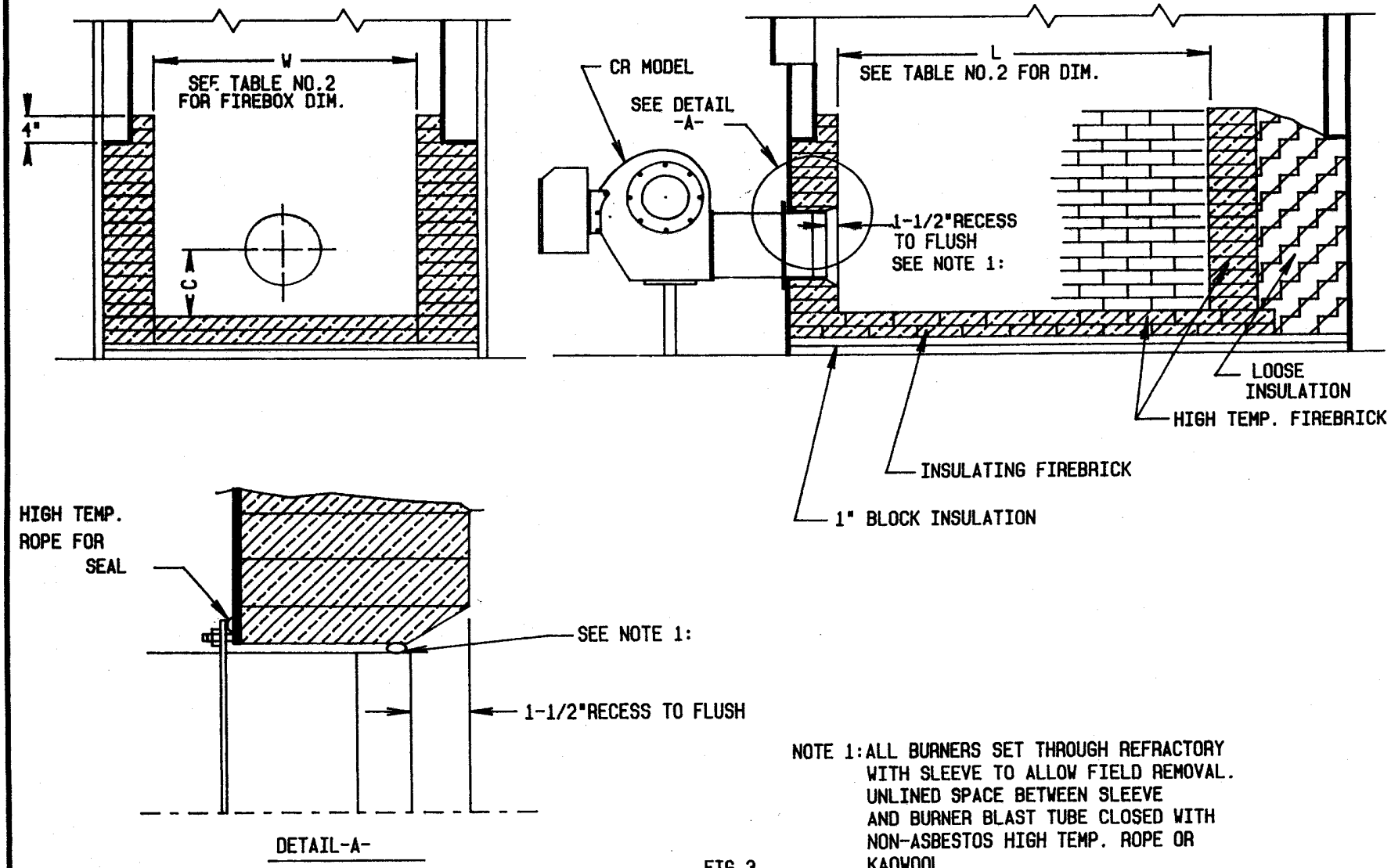
22. The gas burner start-up procedure is now complete.

Table 2

COMBUSTION CHAMBER DIMENSION CHART FOR
FIGURE 3, PAGE 17 AND FIGURE 4, PAGE 18
(ALL DIMENSIONS IN INCHES)

FIRING RATE	FIREBOX TYPE BOILERS RECOMMENDED CHAMBER DIMENSIONS			SCOTCH MARINE TYPE BOILERS RECOMMENDED CHAMBER DIMENSIONS	
GPH	C	L	W	DIAMETER	LENGTH
18	14	50	28	18	90
23	14	54	31	20	95
28	15	59	34	20	100
33	17	64	37	22	110
37	17	68	39	22	120
42	18	73	43	24	130
47	19	77	45	26	130
51	20	81	47	26	140
56	20	86	49	28	145
60	21	90	51	28	150
65	21	94	53	30	150
70	22	96	55	32	160
77	23	98	57	32	160

TYPICAL HACR APPLICATION FOR BRICK SET FIREBOX BOILER

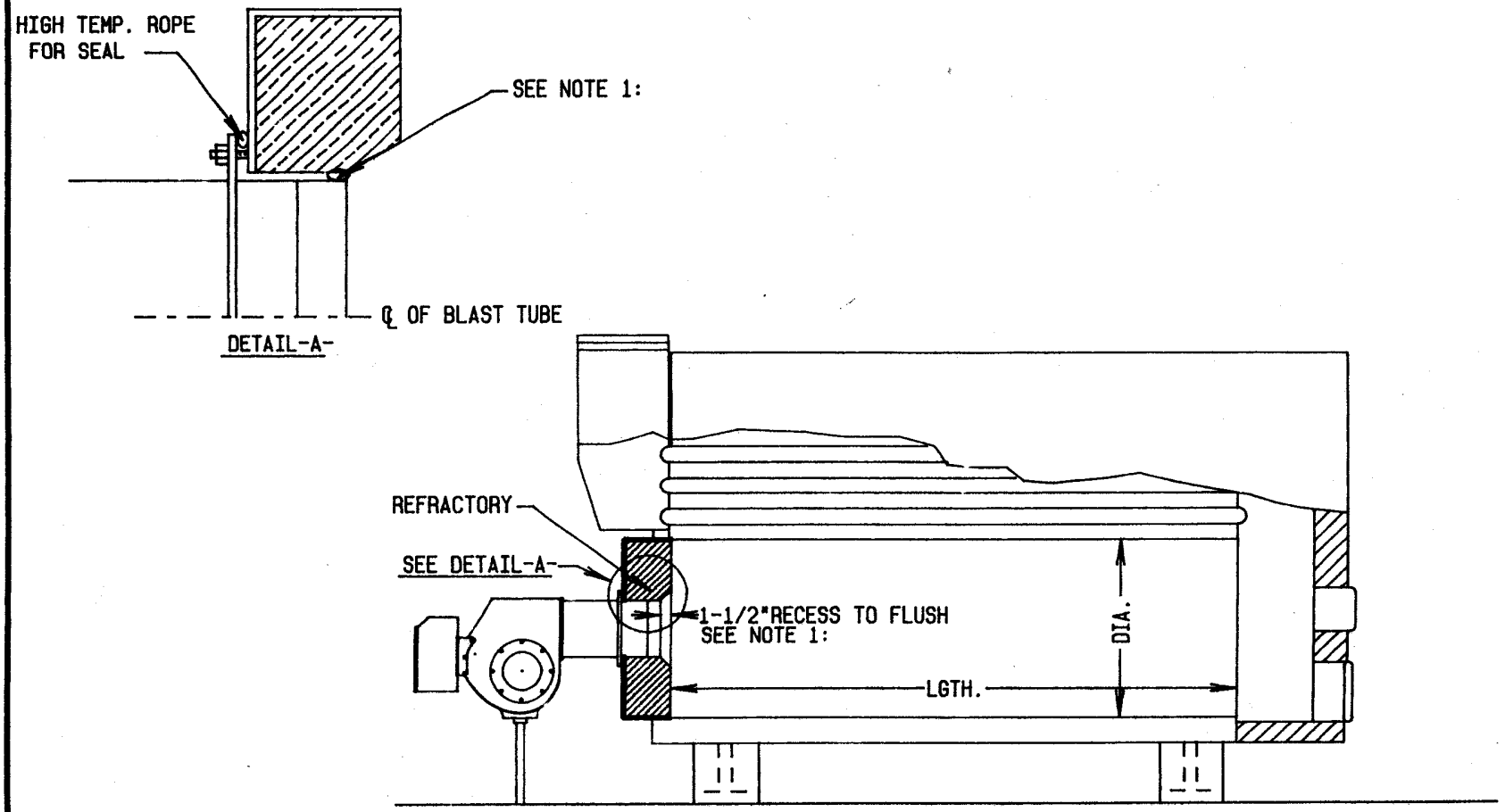


DETAIL-A-

NOTE 1: ALL BURNERS SET THROUGH REFRACTORY WITH SLEEVE TO ALLOW FIELD REMOVAL. UNLINED SPACE BETWEEN SLEEVE AND BURNER BLAST TUBE CLOSED WITH NON-ASBESTOS HIGH TEMP. ROPE OR KAOWOOL

FIG.3

TYPICAL HAC APPLICATION FOR SCOTCH MARINE BOILER

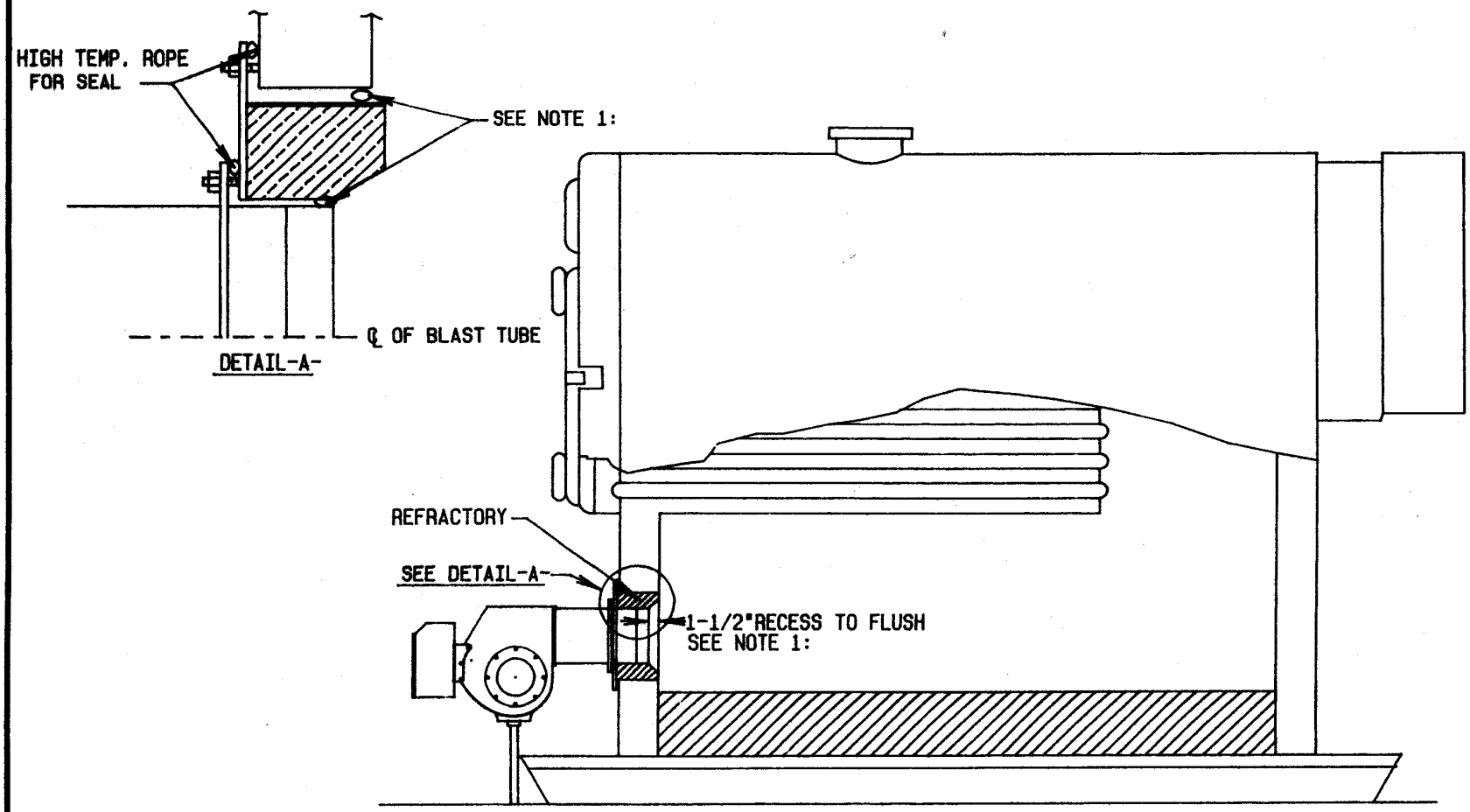


SEE TABLE NO.2 FOR FURNACE TUBE DIAMETER AND LENGTH

NOTE 1: ALL BURNERS SET THROUGH REFRACTORY WITH SLEEVE TO ALLOW FIELD REMOVAL.UNLINED SPACE BETWEEN SLEEVE AND BURNER BLAST TUBE CLOSED WITH NON-ASBESTOS HIGH TEMP. ROPE OR KAOWOOL

FIG. 4

TYPICAL HAC APPLICATION FOR PACKAGED FIREBOX BOILER



NOTE 1: ALL BURNERS SET THROUGH REFRACTORY WITH SLEEVE TO ALLOW FIELD REMOVAL. UNLINED SPACE BETWEEN SLEEVE AND BURNER BLAST TUBE CLOSED WITH NON-ASBESTOS HIGH TEMP. ROPE OR KAOWOOL

FIG. 5

Pump Suction Curve for No. 2 Oil

(Curve is Based on Pumping Temperature of 40 degrees F., or 68 SSU)

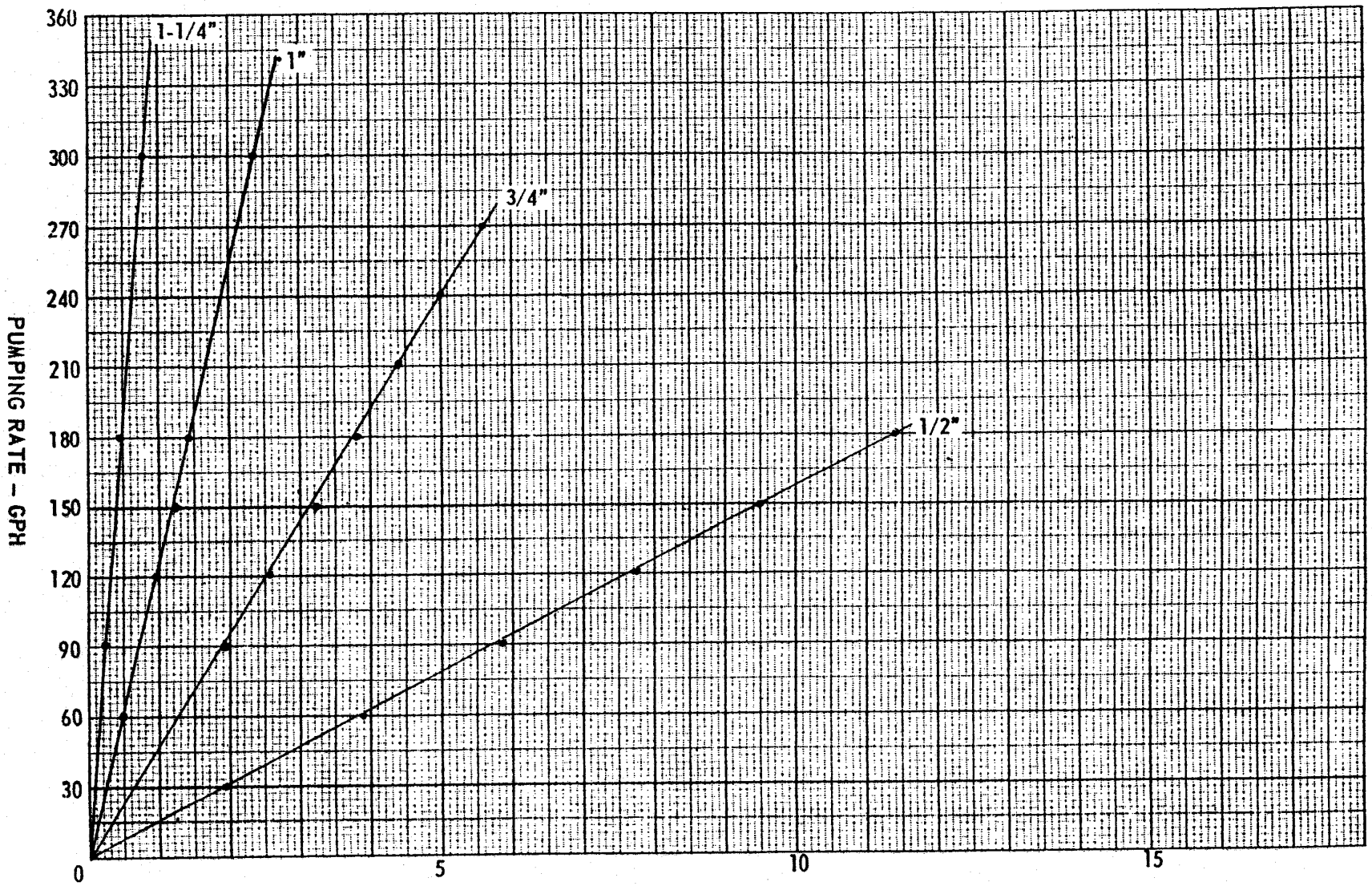


FIG. 6

Pump Suction Curve for No. 4 Oil

(Curve is Based on Pumping Temperature of 40 degrees F., or 1000 SSU)

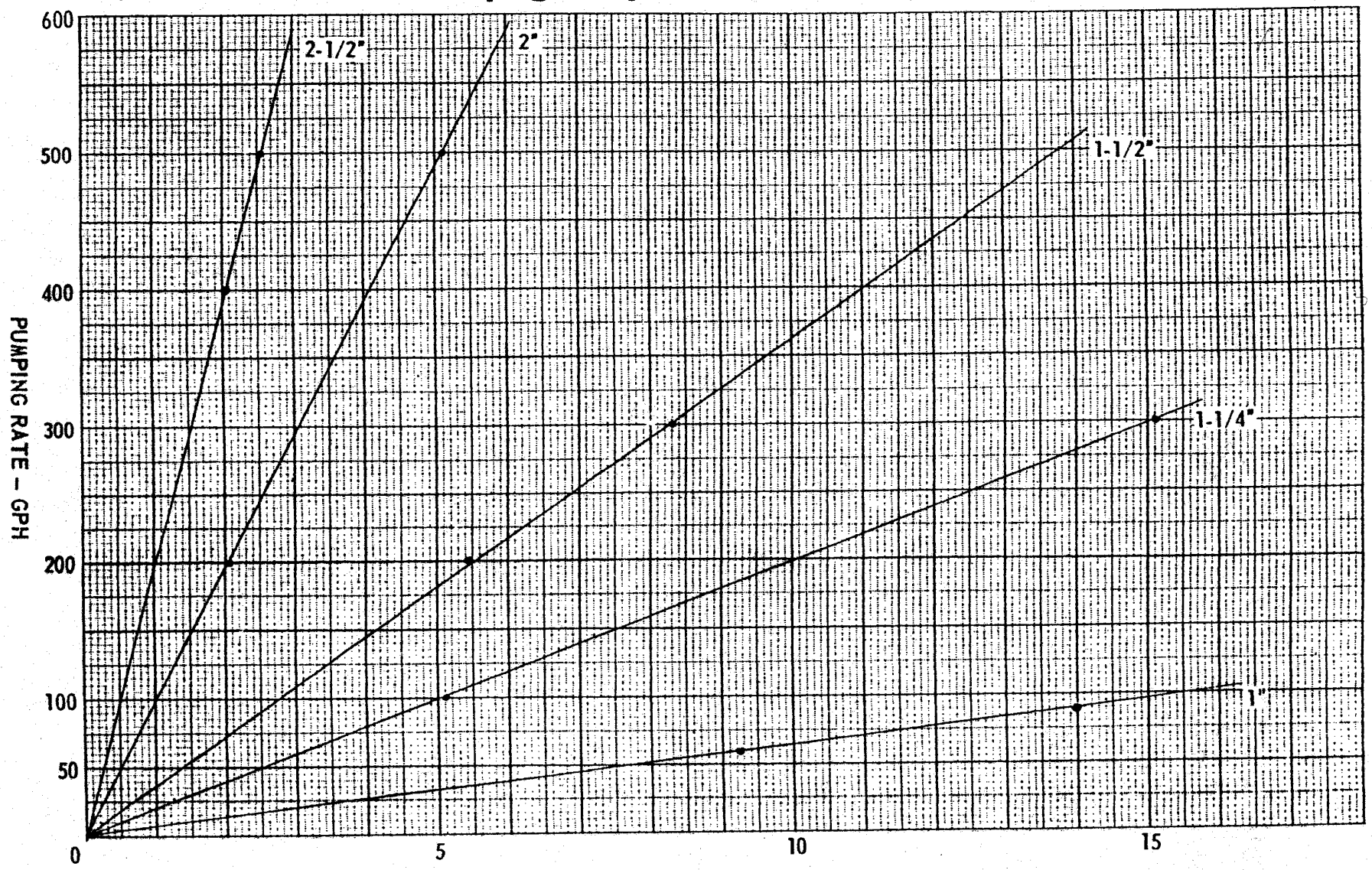


FIG. 7

Pump Suction Curve for No. 5 and No. 6 Oil

(Curve is Based on Pumping Limit of 4000 SSU)

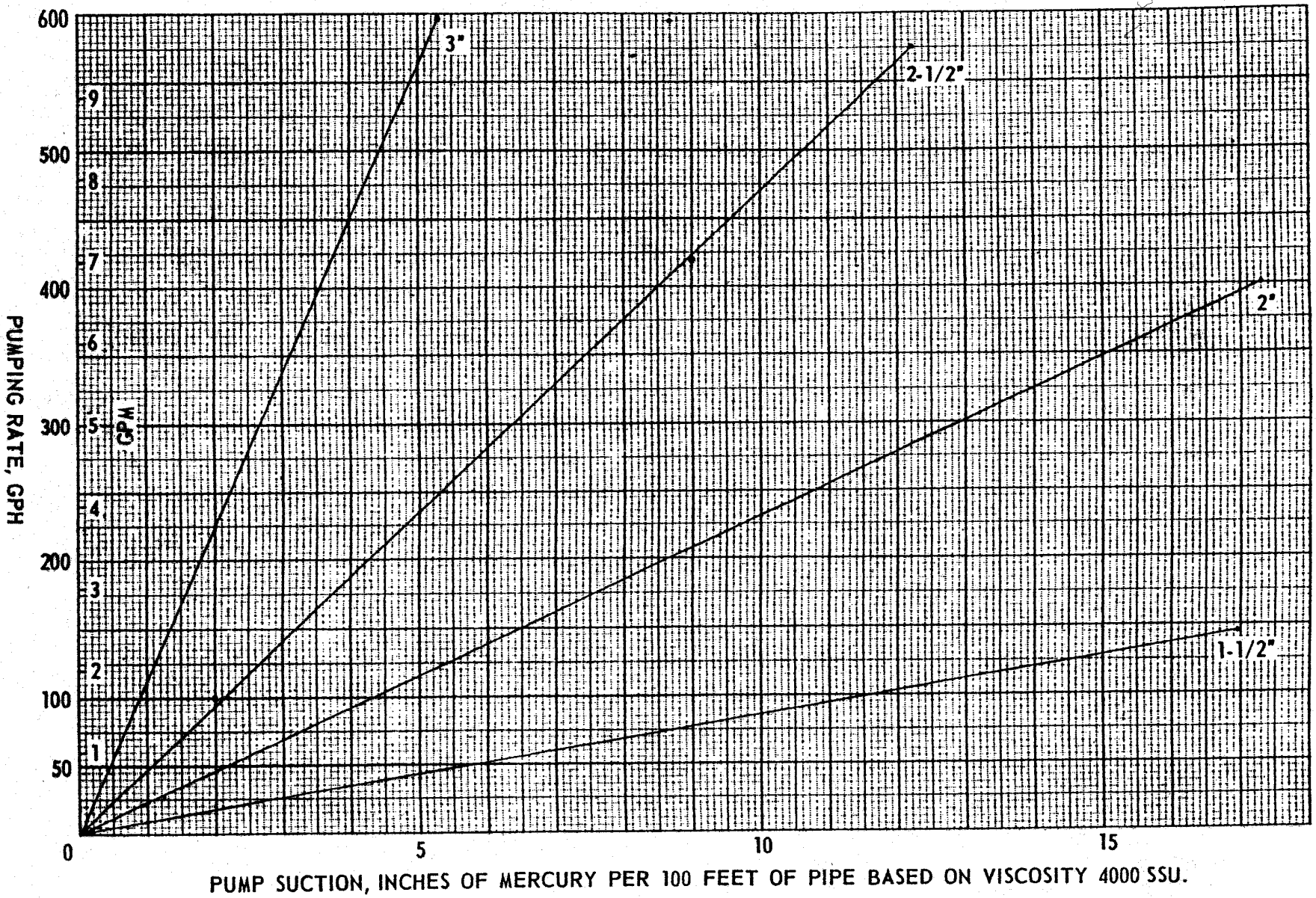
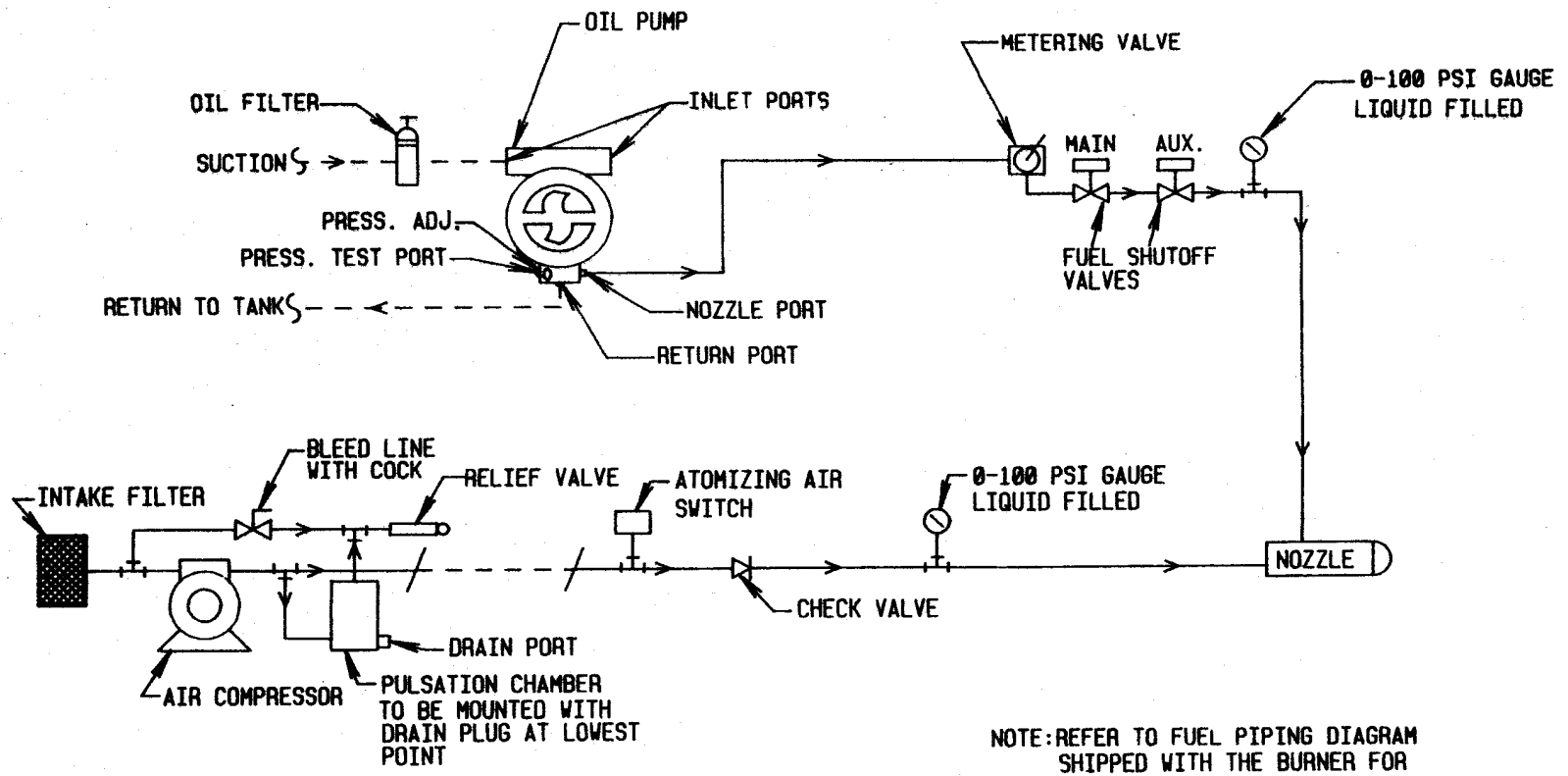


FIG. 8

TYPICAL OIL/AIR PIPING FOR #2 OIL HAC WITH INTEGRAL PUMP



NOTE: REFER TO FUEL PIPING DIAGRAM SHIPPED WITH THE BURNER FOR YOUR SPECIFIC SYSTEM.

———— FACTORY PIPING

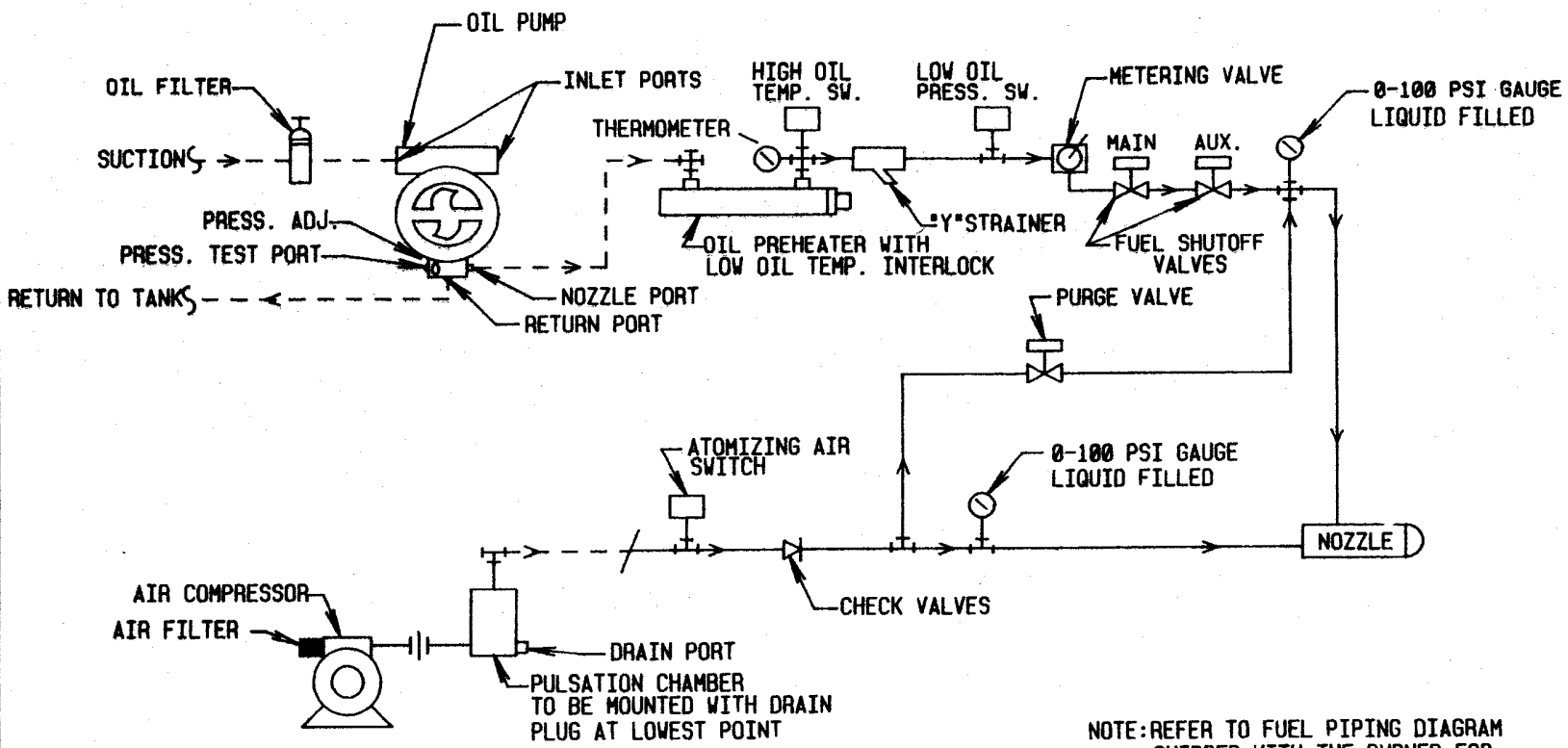
– – – – – FIELD PIPING

DO NOT USE TEFLON TAPE

EQUIPMENT SHOWN ON DIAGRAM IS ONLY PROVIDED AND MOUNTED BY POWER FLAME IF SPECIFICALLY CALLED FOR ON BURNER SPEC. SHEET.

FIG. 9

TYPICAL OIL/AIR PIPING FOR #4 OIL HAC WITH REMOTE PUMP AND GAST COMPRESSOR



NOTE: REFER TO FUEL PIPING DIAGRAM SHIPPED WITH THE BURNER FOR YOUR SPECIFIC SYSTEM.

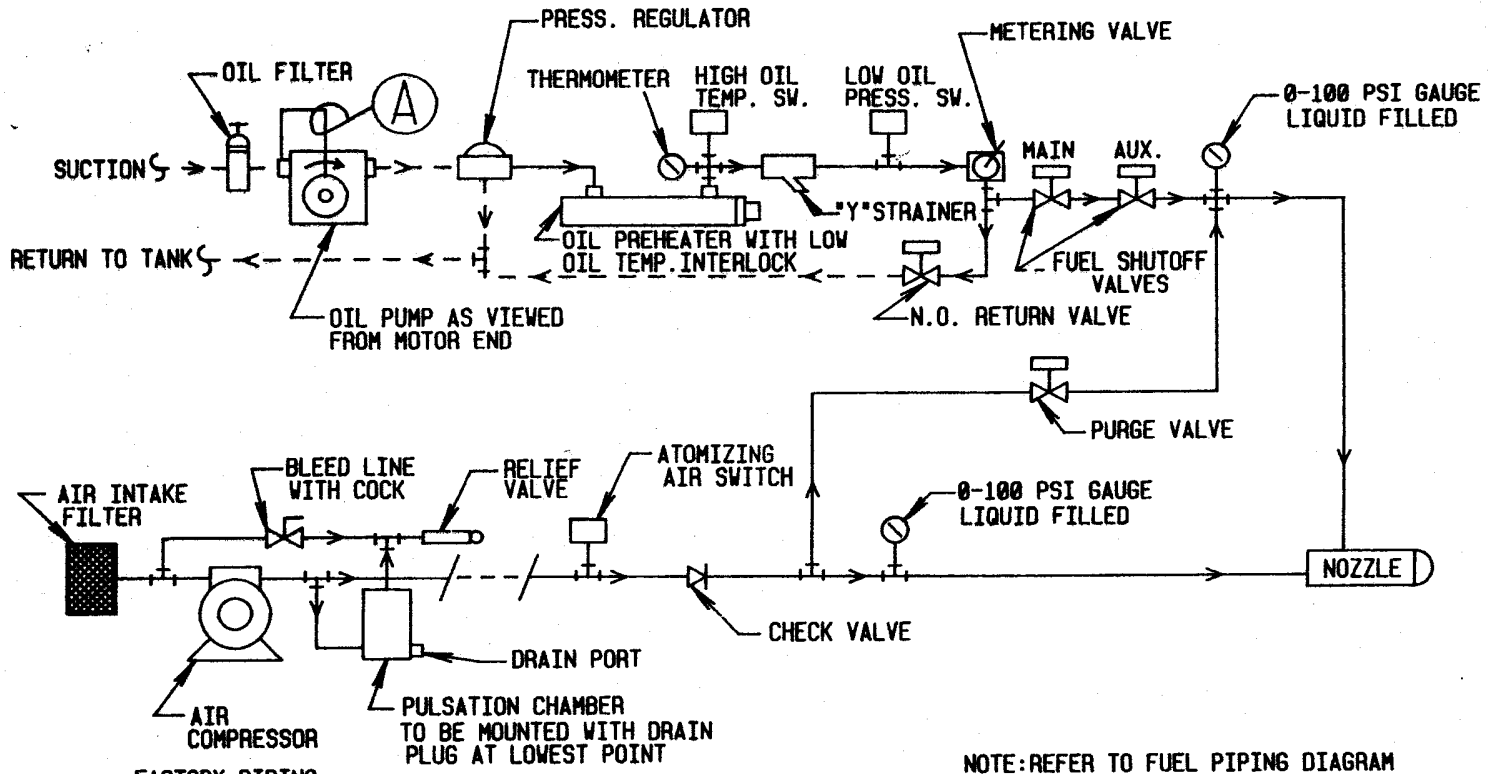
———— FACTORY PIPING
- - - - - FIELD PIPING

DO NOT USE TEFLON TAPE

EQUIPMENT SHOWN ON DIAGRAM IS ONLY PROVIDED AND MOUNTED BY POWER FLAME IF SPECIFICALLY CALLED FOR ON BURNER SPEC. SHEET.

FIG. 10

TYPICAL OIL/AIR PIPING FOR #5 OR #6 OIL HAC WITH REMOTE PUMP



——— FACTORY PIPING
- - - - - FIELD PIPING

DO NOT USE TEFLON TAPE

EQUIPMENT SHOWN ON DIAGRAM IS ONLY PROVIDED AND MOUNTED BY POWER FLAME IF SPECIFICALLY CALLED FOR ON BURNER SPEC. SHEET.

NOTE: REFER TO FUEL PIPING DIAGRAM SHIPPED WITH THE BURNER FOR YOUR SPECIFIC SYSTEM

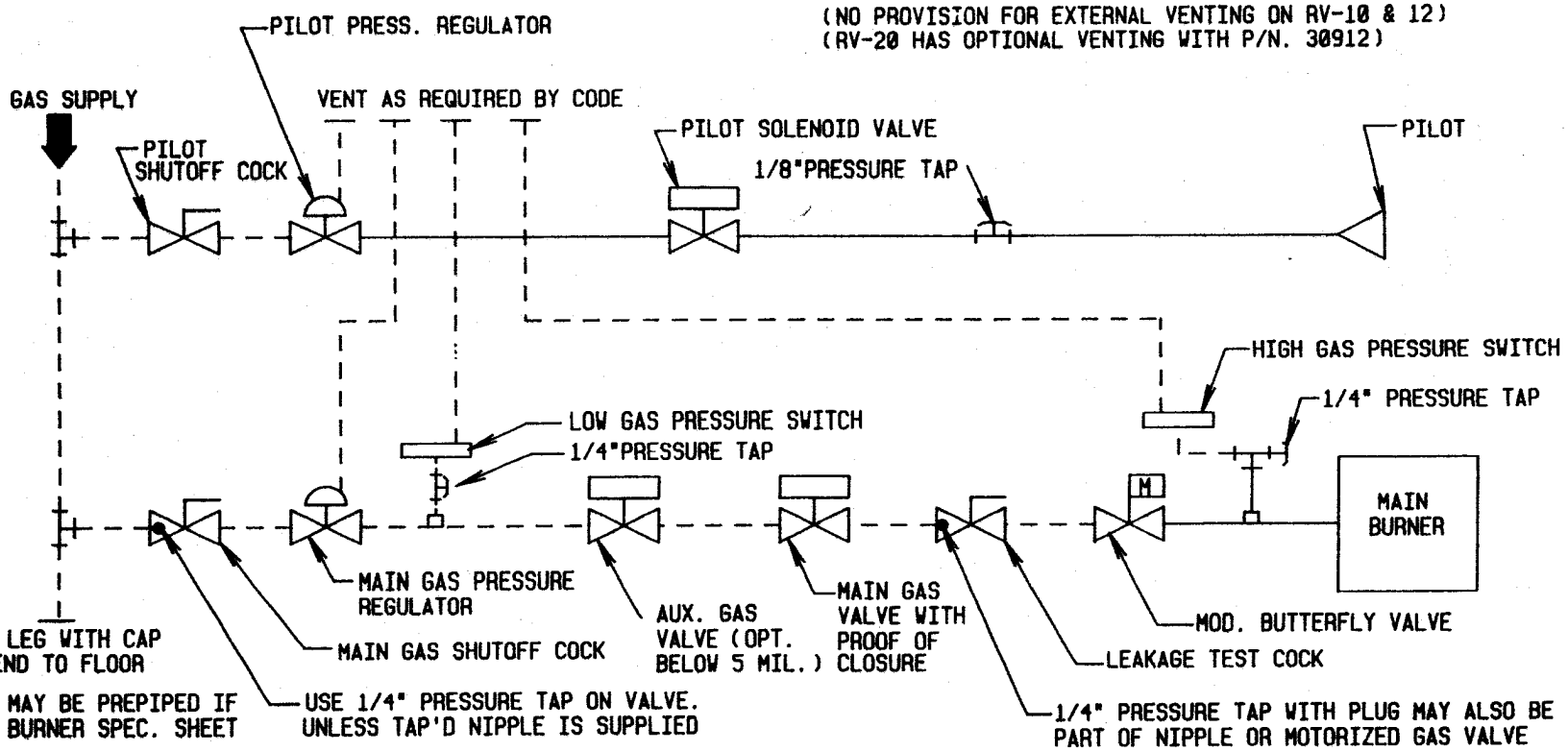
A -ON HBMF PUMPS THE DRAIN PORT MAY BE CONNECTED TO SUCTION LINE, OR TO TANK SIDE OF EXTERNAL REGULATING VALVE, IF USED. DO NOT OPERATE PUMP WITH DRAIN BLOCKED.

FIG. 11

TYPICAL UL MODULATING GAS PIPING FOR HAC GAS/OIL BURNER

NOTE: REFER TO FUEL PIPING DIAGRAM SHIPPED WITH THE BURNER FOR YOUR SPECIFIC SYSTEM.

NOTE: WHEN PILOT GAS PRESS. REG. IS AGA CERTIFIED DEVICE WITH INTEGRAL LEAK LIMITING ORIFICE; SUCH AS RV-20, RV-10 AND RV-12, VENT LINE FOR PILOT GAS PRESS. REG. MAY NOT BE REQ'D. UNLESS SPEC'D. BY OTHER CODES.
(NO PROVISION FOR EXTERNAL VENTING ON RV-10 & 12)
(RV-20 HAS OPTIONAL VENTING WITH P/N. 30912)



——— FACTORY PIPING
- - - - - FIELD PIPED

CAUTION: ALL FIELD PIPED COMPONENTS MUST BE MOUNTED IN THE PROPER LOCATION AND PROPER DIRECTION OF GAS FLOW.

EQUIPMENT SHOWN ON DIAGRAM IS ONLY PROVIDED AND MOUNTED BY POWER FLAME IF SPECIFICALLY CALLED FOR ON BURNER SPEC. SHEET.

FIG. 12

COMPRESSED ATOMIZING AIR PIPING INFORMATION

SUGGESTED AIR PIPE SIZES FOR VARIOUS PIPE RUNS -

COMPRESSOR TO HAC BURNERS

PREFERRED MOUNTING

Set compressor as close as practical to the burner and use shortest run possible with minimum number of fittings.

NOTE:
Steel flexible hose (where provided) must be fitted directly to compressor.

Pipe runs include length of tubing next to burner. Equivalent footage should be added for each fitting used, i.e.: elbows, tees and etc.. Use Table 4.C for equivalent length of fittings in feet.

When it is necessary to mount compressor remote from the burner, use the following pipe sizes.

Compressed Air Pipe Sizing

If Pipe Run is	Use (I.P.S.) Pipe Size
3 ft. to 10 ft.	**1 inch**
10 ft. to 20 ft.	**1-1/4 inch**
20 ft. to 30 ft.	**1-1/2 inch**
30 ft. to 40 ft.	**2 inch**

Table 3

GAS SUPPLY PIPING

Gas piping should be sized to provide required pressure at the burner main manual shutoff cock, when operating at the maximum desired fuel input.

All gas piping should be appropriately pressure tested to ensure leak free operation. It is recommended that a dirt pocket or trap be piped into the gas supply system just ahead of the burner main manual shutoff cock.

When testing with pressures higher than the maximum pressure ratings of the gas train components, be sure to isolate these components and test their piping for gas leaks with correct pressures only. On some burners, the maximum main gas train and/or pilot gas train components pressure is ½ psig. (14: W.C.)

Refer to Tables 4A, 4B and 4C on page 28 for information relating to the sizing of gas supply piping. These charts are based on the general flow characteristics of commercially produced black wrought iron pipe. If in doubt regarding flow capabilities of a chosen line size, the next largest size is recommended.

Refer to page 26, Figure 12 for typical gas piping schematics to meet U.L. requirements in the HAC burner firing ranges.

CAPACITY OF PIPE - NATURAL GAS (CFH)
With Pressure Drop of 0.3" W.C. and Specific Gravity of 0.60

Table 4A

Pipe Length In Feet	Pipe Size -Inches (IPS)						
	1	1-1/4	1-1/2	2	2-1/2	3	4
10	520	1050	1600	3050	4800	8500	17500
20	350	730	1100	2100	3300	5900	12000
30	285	590	890	1650	2700	4700	9700
40	245	500	760	1450	2300	4100	8300
50	215	440	670	1270	2000	3600	7400
60	195	400	610	1150	1850	3250	6800
70	180	370	560	1050	1850	3000	6200
80	170	350	530	990	1600	2800	5800
90	160	320	490	870	1400	2600	5400
100	150	305	460	870	1400	2500	5100
125	130	275	410	780	1250	2200	4500
150	120	250	380	710	1130	2000	4100
175	110	225	350	650	1050	1850	3800
200	100	210	320	610	980	1700	3500

NOTE: Use multiplier in Table 4B for other specific gravities and pressure drops.

CORRECTION FACTORS

Table 4B

Specific Gravity Other Than 0.60		Pressure Drop Other Than 0.3	
Specific Gravity	Multiplier	Pressure Drop	Multiplier
0.50	1.10	0.1	0.577
0.60	1.00	0.2	0.815
0.70	0.926	0.3	1.00
0.80	0.867	0.4	1.16
0.90	0.817	0.6	1.42
1.00	0.775	0.8	1.64
Propane - Air		1.0	1.83
1.10	0.740	2.0	2.58
Propane		3.0	3.16
1.55	0.622	4.0	3.65
Butane		6.0	4.47
2.00	0.547	8.0	5.15

Table 4C

Equivalent Length of Fittings in Feet							
Pipe Size (PS)	1	1.25	1.5	2	2.5	3	4
Std. Tee through Side	5.5	7.5	9.0	12.0	14.0	17.0	22.0
Std. Ell	2.7	3.7	4.3	5.5	6.5	8.0	12.0
450 Ell	1.2	1.6	2.0	2.5	3.0	3.7	5.0
Plug Cock	3.0	4.0	5.5	7.5	9.0	12.0	16.0

ADJUSTING AND SERVICING - GENERAL

This section is intended as a guide in making certain repairs and adjustments, which may be necessary during the operating life of your burner. Many of the repairs can be made by the operator. Others should be made by a skilled burner service man. Call your authorized service representative for dependable service assistance. Service instructions on controls and components not manufactured by Power Flame are included as part of the burner shipping literature. Copies of these manufacturers bulletins are available on request.

GAS PILOT IGNITION

There are two types of pilots that are used on HAC burners. One is referred to as the “Case Type” (standard on HAC4, 5 and 6) and the other the “Round Type” (standard on HAC3).

Excessive gas pressure or insufficient air may be the most common cause of pilot ignition failure. Burner pilot gas pressure is 1.5” to 2.5” w.c. for the case type and 4” to 6” for the round type.

Gas pressure should be read at the test tee on the pilot gas supply pipe with a manometer or 0-10” w.c. gauge. Look for stability of gas pressure at all times. Air shutter opening should be at least ¼” on each shutter or ½” on one with the other nearly closed.

The following steps should be taken:

1. Remove pilot assembly and check for proper orifice size (see schedule) and spark gap. (There is no orifice in the “Round Type” pilot).

   A. Case type spark gap is 1/8 to 3/32” and arcing against the outside radius (not the pilot head nozzle).

   B. For round type spark gap see Figure 17, page 36.

   NATURAL GAS PILOT ORIFICE SCHEDULE - CASE TYPE PILOT

HAC3	#30	HAC4C	#10
HAC4A	#30	HAC5	#10
HAC4B	#10	HAC6	#6

2. Close checking cock (test cock). Start up the burner and stop combustion control timer with “check” switch during pilot ignition. Be sure air shutters are open at least ¼” on each one or ½” on one with the other one nearly closed.

3. Observe pilot signal with dc voltmeter or microammeter and reduce pilot gas pressure to a point where the signal is erratic or reduced substantially from initial reading.

4. Raise the pilot gas pressure to the point where the signal is again stable. Remove scanner and use a mirror to view the pilot flame through the scanner pipe. You may need a live flame from a cigarette lighter or butane torch to keep the scanner actuated. Be sure that you are getting full coverage of the scanner pipe by the pilot flame. Replace scanner.

5. Release the “check switch” and observe the meter as the main fuel valve opens and ignites the main flame. If you get a drop in signal as this happens, increase pilot pressure slightly until signal is steady at all times.

ACCEPTABLE STABLE FLAME CURRENT READINGS

CONTROL	ULTRAVIOLET	LEAD SULPHIDE
7800 series	1.25 - 5.0 volts dc	1.25 – 5.0 volts dc
R4140M(G)(L) OR BC7000	3-1/2 to 7-1/2 microamps	2-5 microamps R7248A red amp 3-1/2 microamps R7248B red amp
D series	15-25 volts dc	15-25 volts dc
E series	Display readout 10 min., 20 or above is normal.	

OIL PUMPS AND PIPING

The following oil service problems may occur and many of the possible causes are listed below:

No oil delivered

1. reverse pump rotation
2. suction lift too high
3. air leak in suction line
4. pump not primed or has lost prime
5. pump coupling not installed properly
6. pump defective
7. line plugged
8. valve closed

Pump is noisy

1. air leak in suction line
2. pump not securely mounted
3. vibration caused by bent shaft or misalignment
4. pump overloaded
5. suction line vacuum so high that vapor forms within the liquid

Capacity too low

1. suction lift too high
2. air leak in suction line
3. suction line too small
4. check valve or strainer is obstructed or dirty
5. mechanical defects:
    a. pump badly worn
    b. seal defective

Pump leaks

1. cover bolts need tightening or gasket broken or defective
2. mechanical seal (used on certain models) may be scratched due to dirt
3. inlet head pressure too high (install a pressure reducing valve set at 3 psig or less)
4. oil line fittings not tight

OIL NOZZLES

1. Oil atomizing nozzles should be removed and cleaned regularly.

2. The nozzle should be removed from the oil gun by used of the proper wrench. The nozzles should be disassembled and thoroughly cleaned with a liquid solvent (non-flammable preferred) and a brush.

3. Do not use a screwdriver, wire brush or similar metallic objects to clean nozzles. Damage to orifices or spray slots results in off-center or “sparky” fires.

4. The nozzle should be seated firmly on the oil gun to prevent leaks.

5. If nozzle is damaged or burned, replace it.

6. The air-atomizing nozzle is designed to handle No. 2, 4, 5 and 6 fuels. Air is supplied from the air compressor at relatively low pressure to provide the energy for atomization. Oil supply to the nozzle is controlled by the oil-metering valve.

7. The air-atomizing nozzle is of the internal mixing type. Air and fuel are piped separately to the nozzle and are mixed in the swirl chamber so that a uniform emulsion is discharged through the orifice in a semi-solid spray pattern.

8. Since the fuel and air passages in this type of nozzle are quite large, clogging is not a serious problem. However, both air and fuel are filtered to remove lint and large particles of foreign matter. Clogging of air passages or fuel passages will result in off-center fires.

9. Damage to the orifice may result in a streaky fire, an off-center fire, or drooling.

10. The entire oil tube and nozzle assembly may be removed for ease of service.

11. Excessive accumulation of carbon within the nozzle may be caused by failure to purge the nozzle with air after each firing cycle. Check air purge relay and air purge valve. (Purge not standard on #2 oil burners).

12. When cleaning and taking nozzle apart, do not force or damage. Soak in light oil or solvent.

ELECTRIC OIL HEATER

1. Do not turn on power to heater unless elements are fully immersed in oil.

2. Thermostat setting should be as low as is consistent with satisfactory operation.

3. To set the oil heater thermostat, remove cover on the thermostat end of the heater. The knurled adjustment knob should be turned counterclockwise to raise oil temperature (clockwise to lower oil temperature). Do not change position of the safety stop nut.

4. The cold oil interlock operated independently of the thermostat and prevents burner operation of the oil is too cold for proper burning.

5. To set the cold oil interlock, remove the end cover from the heater mechanism. The knurled adjustment nut should be turned counter clockwise to close the switch at a higher oil temperature.

6. The cold oil interlock should close to permit burner operation when the temperature of the oil is approximately 20 degrees F below the average operating temperature of the oil.

7. Allow the oil to flow through the heater for several minutes (preferably at high firing rate) before changing adjustments to ensure accurate temperature readings.

AIR COMPRESSOR

1. Use only high grade lubricating oil as recommended by the air compressor manufacturer. If this is not adhered to, all warranties are voided.

2. Air inlet filter felts should be cleaned regularly.

3. Field replacement of internal parts of the compressor should be done only by an experienced service mechanic. Factory overhaul or repair is normally recommended.

4. Correct air compressor rotation is counter clockwise when viewed from the pulley side of the compressor.

TYPICAL HAC BLAST TUBE SHOWING GAS, OIL AND AIR FLOWS

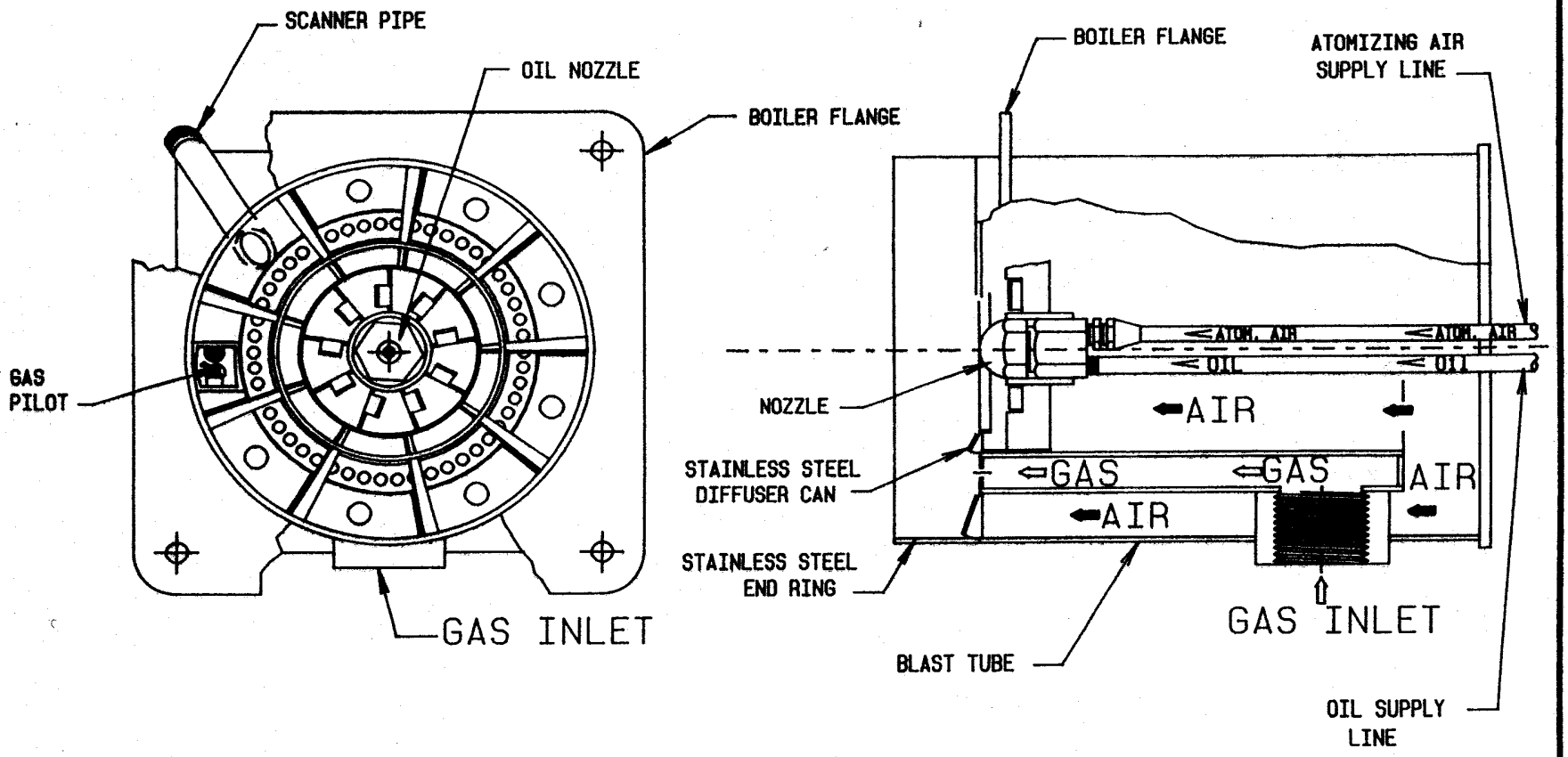
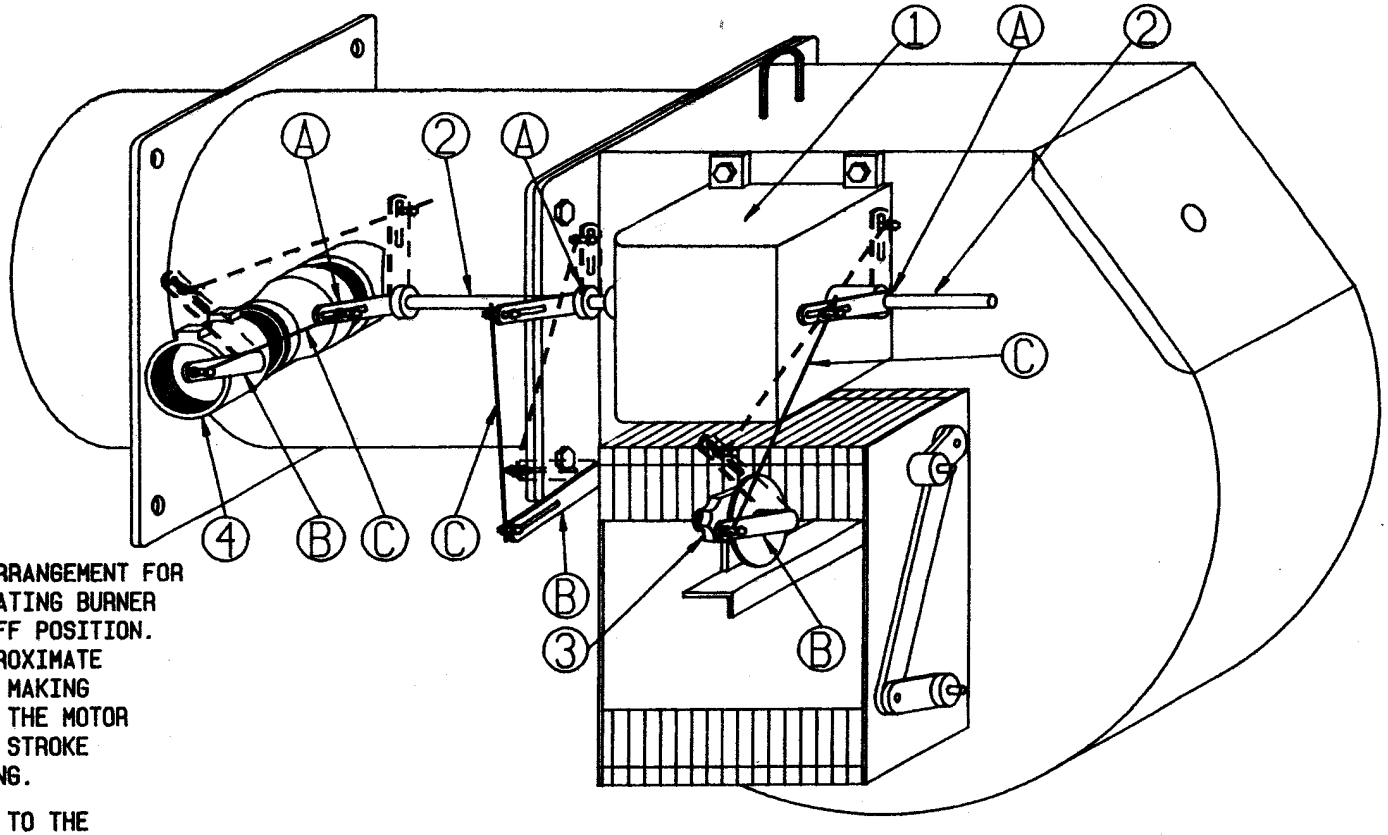


FIG. 13

TYPICAL LINKAGE ARRANGEMENT FOR GAS/OIL MODULATING HAC BURNER



TYPICAL GENERAL LINKAGE ARRANGEMENT FOR COMBINATION GAS/OIL MODULATING BURNER SHOWN IN LOW FIRE LIGHT OFF POSITION. DOTTED LINES INDICATE APPROXIMATE HIGH FIRE POSITION. WHEN MAKING ADJUSTMENTS, MAKE CERTAIN THE MOTOR CAN MAKE ITS FULL 90 DEG. STROKE WITHOUT ANY LINKAGE BINDING.

DRIVER ARMS (A) CONNECTED TO THE MODULATING MOTOR (1) JACK SHAFT (2), WILL INCREASE THE TRAVEL OF THE DRIVEN ARMS (B) AS THE LINKAGE ROD (C) BALL JOINT IS MOVED AWAY FROM THE JACK SHAFT. THE TRAVEL OF THE DRIVEN ARMS WILL BE INCREASED AS THE LINKAGE ROD BALL JOINTS ARE MOVED TOWARD THE SHAFT OF THE DRIVEN DEVICE.

1. MODULATING MOTOR
2. JACK SHAFT
3. MODULATING V PORT OIL VALVE
4. MODULATING BUTTERFLY VALVE
A. DRIVER ARMS
B. DRIVEN ARMS
C. LINKAGE RODS

FIG. 14

TYPICAL DUAL FUEL VARICAM® FOR HAC BURNER

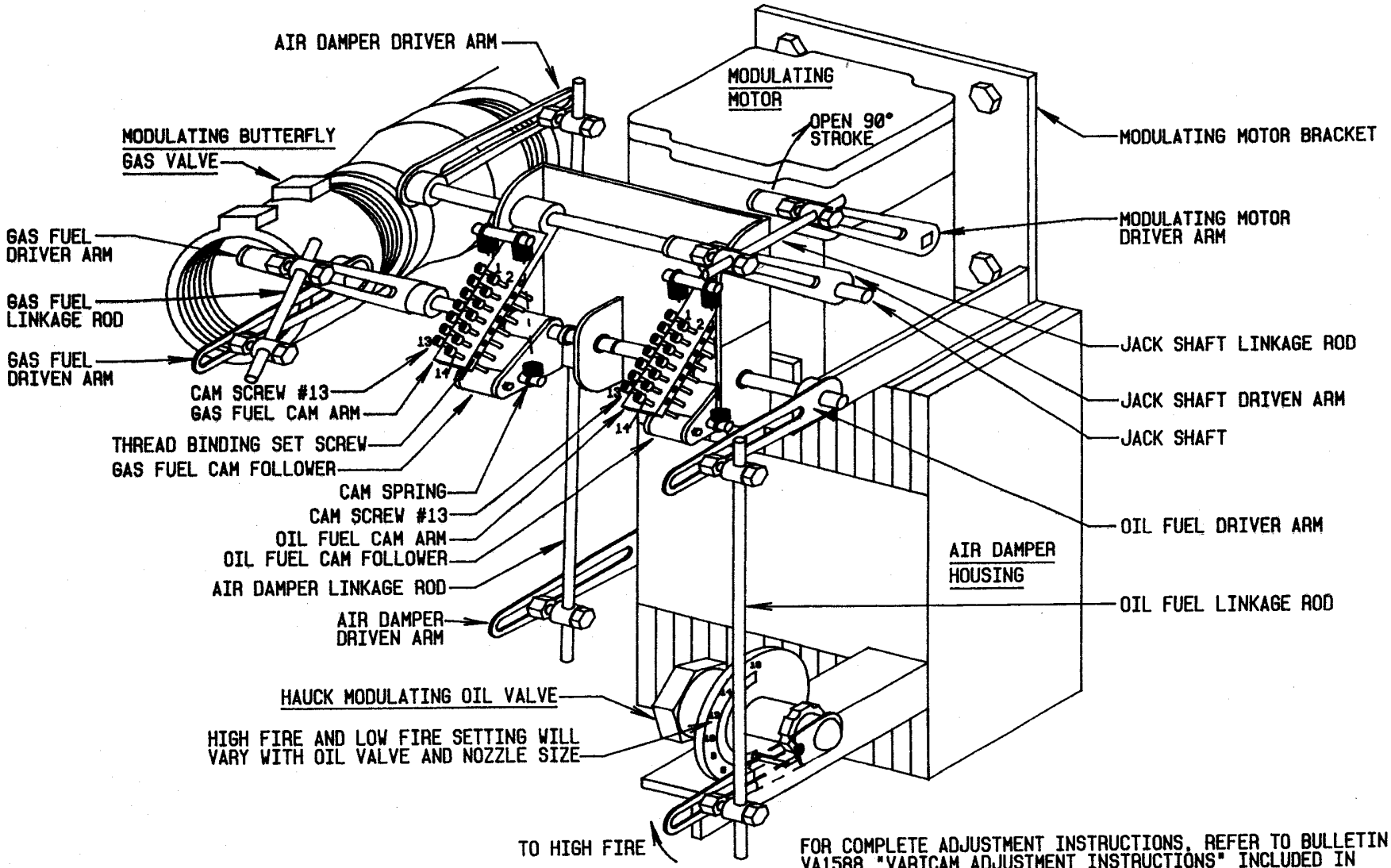


FIG. 15

FOR COMPLETE ADJUSTMENT INSTRUCTIONS, REFER TO BULLETIN VA1588 "VARICAM ADJUSTMENT INSTRUCTIONS" INCLUDED IN THE INFORMATION SHIPPED WITH THE BURNER.

HAC "CASE" PILOT SETTINGS

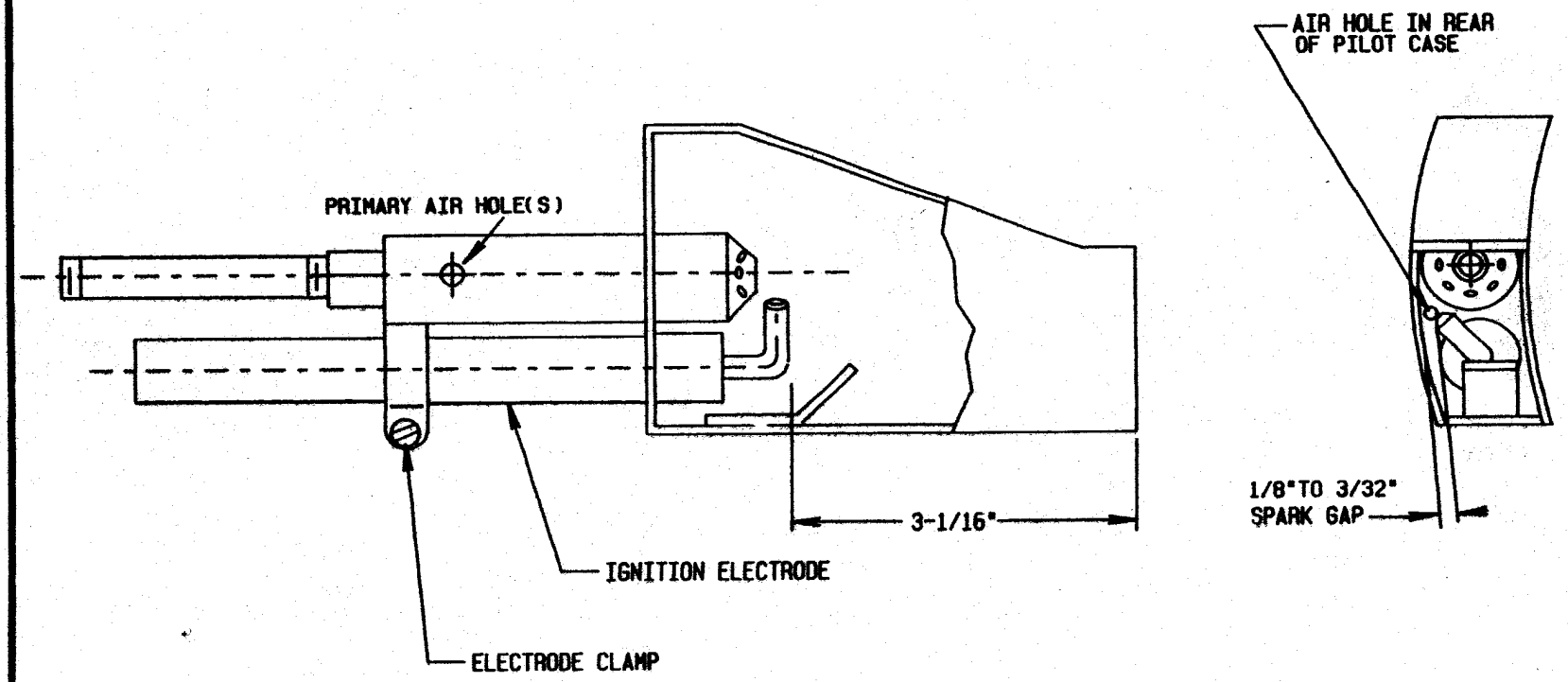


FIG.16

HAC "ROUND" PILOT SETTINGS

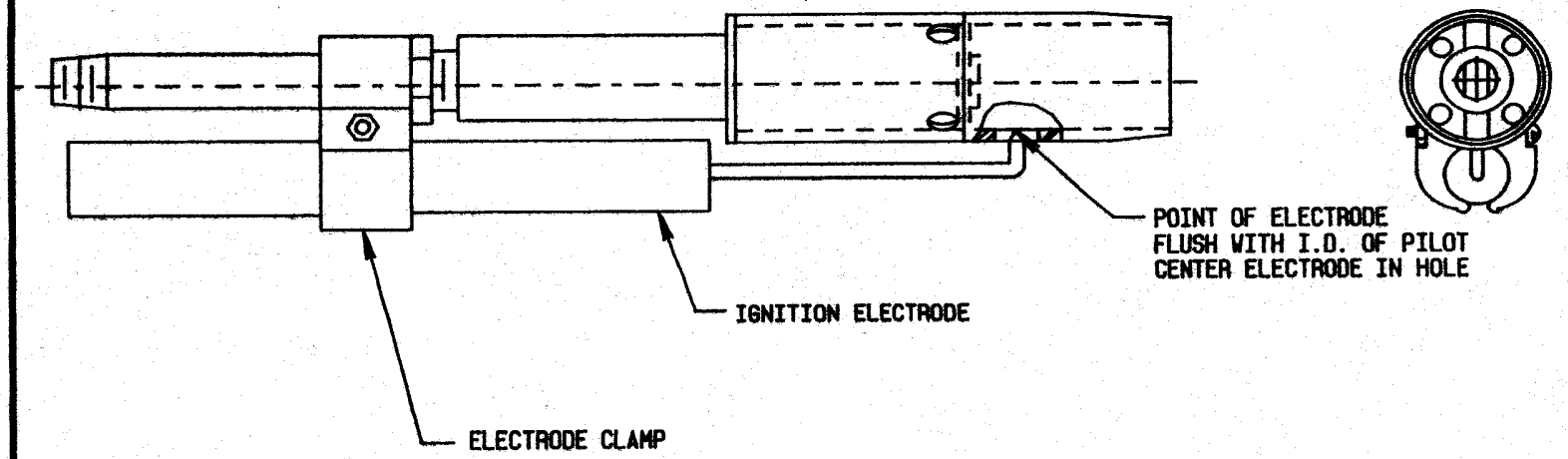


FIG.17

TYPICAL OIL AND AIR PRESSURE FOR VARIOUS INPUTS USING #2 OIL IN MODEL HAC BURNERS (1)

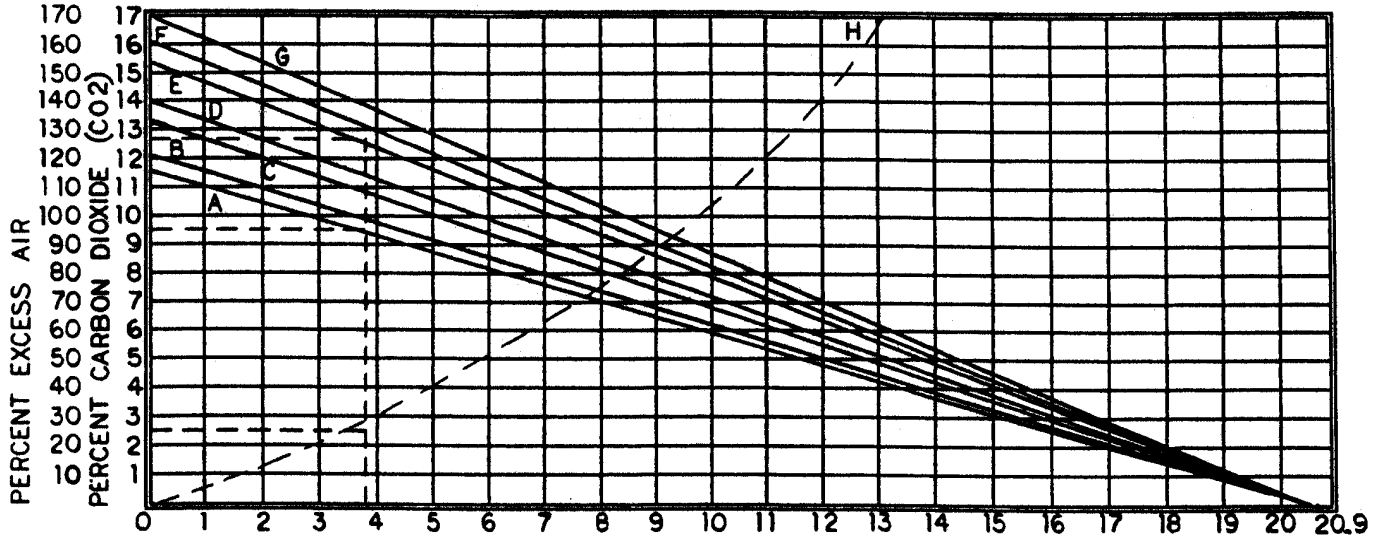
Table 5

BURNER MODEL	LOW FIRE			HIGH FIRE		
	GPH	OIL PSIG AT GUN	AIR PSIG AT GUN	GPH	OIL PSIG AT GUN	AIR PSIG AT GUN
HAC3-O2	10	15	14	30	33	20
HAC4A-O2	13	21	20	39	38	26
HAC4B-O2	15	9	12	45	16	15
HAC4C-O2	17	8	10	52.5	22	15
HAC5-O2	20	11	14	60	28	24
HAC6-O2	27	8	22	82	21	26

(1) Refer to test data sheet for actual firing rate and fuel/air pressures for your specific burner. This data sheet is part of the documentation supplied with the burner. All factory fire testing is done with No. 2 fuel oil. Heavy fuel oil values will vary somewhat from those shown above.

Figure 18

CO_2-O_2 Ratio Curves for fuel Oils and Gases



These curves correlate the relative values of O_2 and CO_2 for the fuels listed, as well as the percentage of excess air at given O_2 and CO_2 values. They can be used to determine required CO_2 or O_2 values (and therefore equivalent BTU input values) for the secondary fuel when the burner has been properly adjusted for the primary fuel inputs.

CURVE	FUEL	MAXIMUM CO_2 %
A	NATURAL GAS	11.7
B	NATURAL GAS	12.1
C	PROPANE	13.7
D	BUTANE	14.0
E	#2 FUEL OIL	15.2
F	$5 FUEL OIL	16.0
G	#6 FUEL OIL	16.9
H	EXCESS AIR vs. O_2	

Example: Following the dotted line on the vertical axis from 4% O_2 to curve "H" and the dotted line on the horizontal axis to the left, the % excess air column shows that 4% O_2 equals 25% excess air. Following the vertical dotted line axis again from curve "H" to fuel A (Natural Gas) and the horizontal axis to the left, the % CO_2 column shows that 4% O_2 and 25% excess air correlate to 9-12% CO_2 for Natural Gas. Again following the 4% O_2 vertical axis to fuel line "E" (#2 Fuel Oil) and to the left to the CO_2 column shows that 4% O_2 and 25% excess air correlate to 12-1/2% CO_2 on #2 Fuel Oil.

FUEL OIL VISCOSITY-TEMPERATURE CHART

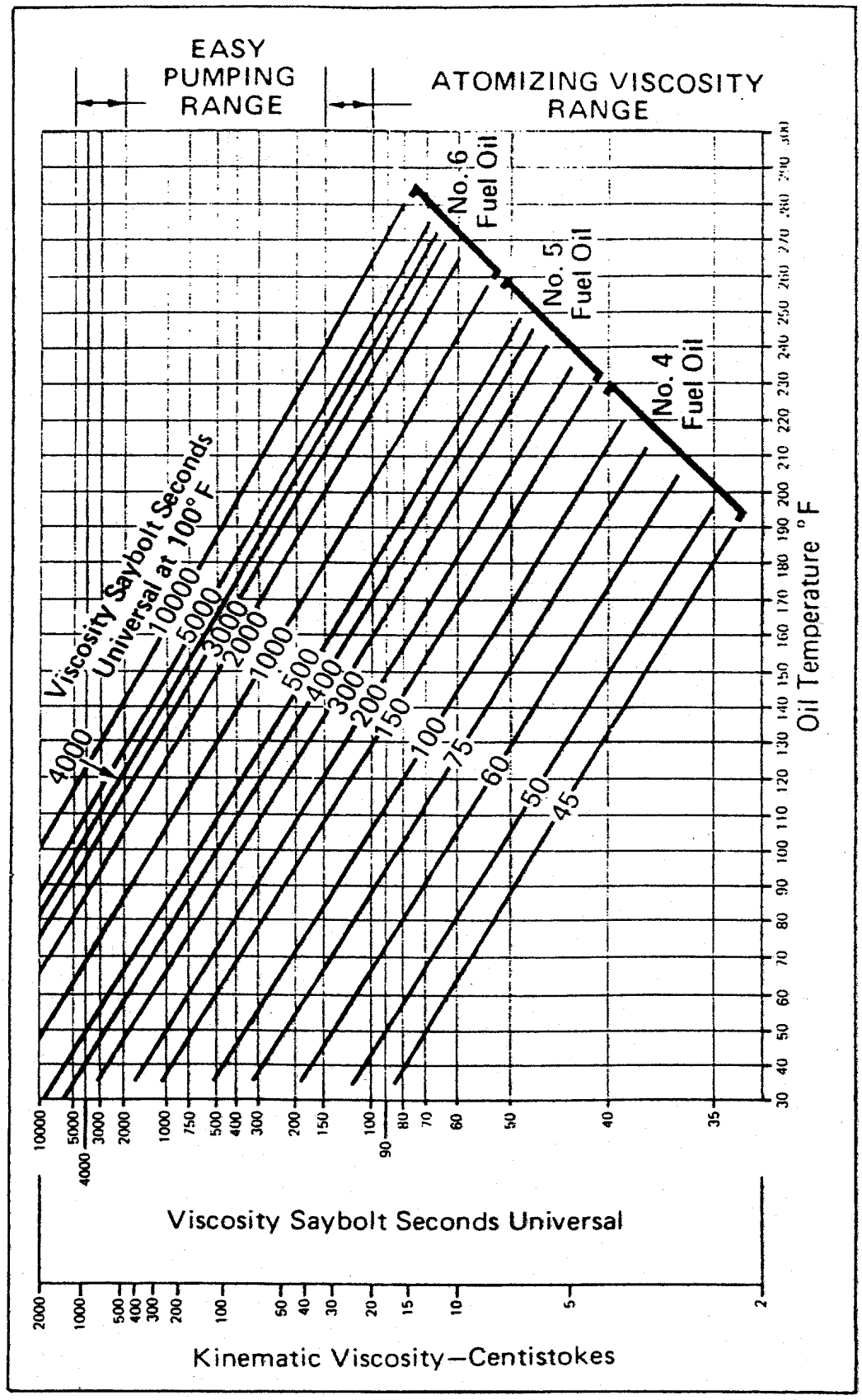


FIG. 19

MAINTENANCE

General

Only qualified service technicians should make mechanical or electrical adjustments to the burner and/or associated control equipment.

Preventative maintenance can usually be performed by building maintenance personnel.

Always follow the information provided in the "Owner Operating Instructions" on page 47. These should be conspicuously posted in the boiler room at the time of the initial burner installation and start-up.

Always turn the power supply off to the burner and close manual fuel valves as appropriate for routine maintenance.

Make sure that combustion and ventilation fresh air sources to the burner room remain clean and open.

Periodically check all electrical connections and make sure the flame safeguard control chassis is firmly connected to its wiring base.

Refer to manufacturer's product bulletins supplied with the burner for maintenance on the flame safeguard control and other components.

Weekly Checklist

1. Blow down the low water cutoff to remove rust and dirt. Be sure that the burner cuts off with low water still showing in the gauge glass.
2. Check boiler temperature or pressure readings.
3. Check any burner pressure gauge readings.
4. Check all burner linkage. Tighten as required.
5. Check condition of remote oil pump belts (if used). Replace as required. Excessive noise and side wear on the belt indicates the sheaves need realignment.
6. Visually observe the flame through the heat exchanger sight port (if provided) for normal appearance
7. Maintain air compressor oil levels and air filters as recommended by the compressor manufacturer.
8. Drain air receiver tank when burning oil.

Monthly Checklist

1. Lubricate electric motors in accordance with the motor manufacturer's instructions. (Most burners have sealed bearings).
2. Check the flame scanner cell and scanner mounting pipe for cleanliness.

Yearly Checklist (To be performed by a qualified service technician)

It is suggested that the burner be checked by a qualified service technician twice a year, but on an annual basis at minimum. The technician should use, but is not limited to, the following procedures.

1. Remove oil drawer assembly. Clean and check oil nozzle, ignition electrode and air diffuser assembly. Check blast tube and fan housing and clean as required.
2. Check blower motor and blower wheel for cleanliness. Remove and clean as necessary.
3. Remove, inspect and clean gas pilot assembly.
4. Inspect combustion chamber and make repairs as necessary.
5. Run burner through complete operational sequence and check for correct operation of all interlocks, operating and limit controls, fuel shutoff valves and other components as appropriate.
6. Conduct maintenance and service procedures as directed by the flame safeguard manufacturer's product bulletin that was shipped with the burner.
7. Conduct complete combustion analysis tests on burner and heat exchanger. Clean as necessary and adjust for efficient operation at all fuel inputs.

TROUBLE SHOOTING SUGGESTIONS HAC OIL OR GAS/OIL BURNER

GENERAL

1. Burner Fails to Start

A. Defective On/Off or fuel transfer switch. Replace switch.

B. Control circuit has an open control contact. Check limits, low water cutoff, proof of closure switch and others as applicable.

C. Bad fuse or switch open on in-coming power source. Correct as required.

D. Motor overloads tripped. Reset and correct cause for trip out.

E. Flame safeguard control safety switch tripped out. Reset and determine cause for apparent flame failure.

F. Loose connections or faulty wiring. Tighten all terminal screws and consult wiring diagram furnished with the burner.

G. Frozen oil pump shaft preventing blower motor operation. Replace oil pump.

H. Flame safeguard control starting circuit blocked due to flame relay being energized. Possible defective scanner - replace. Possible defective amplifier - replace. Scanner actually sighting flame due to leaking fuel valve - correct unwanted flame cause. Defective flame safeguard control - replace.

I. Defective blower motor. Repair or replace.

2. Occasional Lockouts for No Apparent Reason

A. Gas pilot ignition failure. Refer to pilot adjustment section and readjust to make certain that ignition is instant and that flame signal readings are stable and above minimum values. Use a manometer or O to 10" W.C. gas pressure gauge on pilot test tee to make certain that pressure is as recommended.

B. Gas pilot ignition assembly - Verify that there are no cracks in the porcelain and that transformer end and electrode end plug in connections are tight.

C. Loose or broken wires. Check all wire nut connections and tighten all terminal screw connections in panel and elsewhere as appropriate.

D. With flame safeguard controls that incorporate the air flow switch in the non-recycling circuit, ensure that when main flame lights, the air flow switch is not so critically set as to allow occasional momentary opening of the air switch contacts.

E. Occasional low voltage supply. Have local utility correct. Make certain that the burner control circuit transformer is correct for the voltage being supplied.

F. Occasional low gas supply pressure. Have local utility correct.

G. Air leak in oil suction line or check valve not holding. Correct as required.

GAS OPERATION

1. Burner Motor Runs, but Pilot Does Not Light

A. Gas supply to burner shutoff - make sure all manual gas supply valves are open. Automatic high pressure valve at meter such as “Sentry” type tripped shut due to high gas pressure - reset valve and correct cause for trip out.

B. Pilot solenoid valve not opening - listen and feel for valve actuation. Solenoid valve not being powered - check electrical circuitry. Replace coil or entire valve if coil burned out.

C. Defective gas pilot regulator - replace.

D. Gas pressure too high or too low at pilot orifice. Check orifice size in gas pilot assembly. Replace if incorrect. Refer to gas pilot adjustments for correct settings. Readjust as required.

E. Defective ignition transformer - replace. Incorrect ignition electrode settings - refer to gas pilot adjustments for correct settings.

F. Defective flame safeguard control - replace as required.

G. Air flow switch not making circuit - check out electrically and correct pressure adjustment on switch if required. Defective air flow switch - replace. Air switch negative pressure sensing tube out of position - reposition as necessary.

2. Burner Motor Runs & Pilot Lights, but Main Gas Flame Is Not Established.

A. Main shutoff or test cock closed. Check to make certain fully open.

B. Pilot flame signal reading too low to pull in flame safeguard relay. Refer to gas pilot setting section and readjust as required.

C. Defective automatic main or auxiliary gas shutoff valves. Check electrical circuitry to valves. Replace valves or correct circuitry as required.

D. Defective flame safeguard control or plug in amplifier. Check and replace as required.

E. Butterfly valve set incorrectly - readjust as required.

F. Main gas pressure regulator atmospheric vent line obstructed - correct.

G. Defective main gas pressure regulator - replace. Misadjusted main gas pressure regulator -readjust to meet required operation values.

3. Carbon Monoxide Readings on Gas Firing

A. Flame impingement on “cold” heat transfer surfaces caused by excessive firing rate. Reduce firing rate to correct input volume.

B. Flame impingement on cold combustion chamber surfaces due to undersized combustion chamber. Refer to chamber size charts Table 2, page 16, and/or contact factory for additional information.

C. Incorrect gas/air ratios. Readjust burner to correct CO_2/O_2 levels eliminating all CO formation. See Figure 18, page 37 for additional information.

4. Gas High Fire Input Rate Cannot Be Achieved

A. Gas company pressure regulator or meter operating incorrectly, not allowing required gas pressure at burner train inlet. Have gas company correct.

B. Gas cock upstream of train inlet not fully open. Check and correct

C. Gas line obstructed. Check and correct.

D. Gas train main and/or leak test cocks not fully open. Check and correct.

E. Gas supply line between gas company regulator and burner inlet too small. Check supply pressure at meter, determine pressure drop and increase line size as required, or raise supply pressure to compensate for small line. Do not raise pressure so high that under static (no flow) conditions the pressure exceeds the maximum allowable pressure to the gas train components on the burner.

F. Modulating operation - controls set incorrectly. Readjust as required.

G. Linkage mechanically binding. Readjust.

H. Burner gas train components sized too small for supply pressure. Increase component size as appropriate.

I. Automatic gas valve not opening fully due to defective operation. Replace gas valve.

J. Defective modulating motor. Replace.

K. Butterfly valve not fully open. Readjust.

L. Defective main gas pressure regulator. Replace.

M. Incorrect spring in main gas pressure regulator. Replace as required.

N. Main gas pressure regulator vent line obstructed. Check and correct.

O. Normally open vent valve (if supplied) not closing when automatic gas valves open. Check to see if valve is fully closed when automatic valves are open. Replace vent valve, if not closing fully.

P. Manual limiting potentiometer set incorrectly or defective. Check and correct.

OIL OPERATION

1. Burner motor runs - but Pilot Does Not Light. See Gas Operation, page 41, items 1.A through G.

2. Pilot Lights and Proves but Main Oil Flame Is Not Established.

A. Low oil pressure. Check gauges for correct air/oil “light off” pressures. Adjust as required.

B. Defective oil pump. Replace.

C. Defective oil solenoid valve. Replace.

D. Oil pump coupling loose or defective. Replace or tighten as required.

E. On #5 and #6 the N.O. bypass valve not closing. Check and correct.

F. Modulating oil metering valve set incorrectly. Readjust as required.

3. Oil Flame Ignites, but then Flame Safeguard Control Locks Out on Safety.

A. Dirty oil nozzle causing unstable flame and scanning problems. Clean oil nozzle.

B. Fuel/air ratios incorrect, resulting in unstable or smoky flame causing scanner flame sighting problem. Readjust ratios for clean stable flame.

C. Defective flame safeguard amplifier or control. Replace as appropriate.

4. Oil Flame Extremely Smoky at Light Off or in Low Fire Position.

A. Defective or dirty oil nozzle. Clean.

B. Fuel/air ratio incorrect. Readjust. Check PSIG outputs of oil pump and air compressor. Clean air and oil filters as required.

C. On #4, #5 or #6 oil - oil temperature too low. Reset as required.

5. Light Off Oil Flame Is Established and Proven, but Burner will Not Attempt to Go to the High Fire Position.

A. Modulating high fire temperature or pressure control could be defective or not set to call for high fire. Readjust or replace control.

B. Loose wires or incorrectly wired. Verify wiring and tighten all connections.

C. Flame safeguard control or high fire panel switching relay (if supplied) defective. Verify and correct as required.

D. Manual limiting potentiometer set incorrectly or defective. Check and correct.

E. Linkage mechanically binding. Readjust linkage.

F. Defective modulating motor. Replace.

6. Low Oil Flame is established and proven, but flame out occurs in modulating from low fire to high fire.

A. Dirty oil nozzle. Clean.

B. High fire oil pressure too low. Readjust.

C. Air dampers set too far open at low fire, which causes flame to blow out in starting to high fire. Readjust dampers.

D. Oil pump coupling loose or defective. Tighten or replace.

E. Defective oil pump. Replace.

F. Linkage mechanically binding. Readjust.

G. Fuel/air ratios set incorrectly, causing flame to blow out when going to high fire. Readjust linkage.

7. White Smoke Formation on Oil Firing.

A. Oil/air ratios incorrect due to excess air, or oil flow is too low. Readjust for proper fuel input, CO_2 and smoke reading.

8. Gray or Black Smoke Formation on Oil Firing.

A. Impingement on cold combustion chamber surfaces due to undersized chamber, or incorrect oil nozzle spray angle for application. This could also result in carbon formation on chamber surfaces. Refer to chamber sizing, Table 2, page 16, for additional information. If chamber is the correct size, change nozzle spray angle in order to shorten or narrow the flame as required.

B. Defective or dirty oil nozzle. Replace or clean nozzle.

C. Incorrect oil/air ratios. Readjust burner to correct CO_2 and smoke levels.

D. Air pressure too low resulting in poor atomization. Readjust. Check compressor air filter as required.

E. Impingement of raw oil spray on the blast tube. Position the oil gun assembly fore or aft in the blast tube to correct.

F. On #4, #5 and #6 oil - oil temperature too low. Readjust as required.

9. Oil High Fire Input Rate Cannot Be Achieved.

A. Oil nozzle size too small. Remove nozzle and check markings. Replace with correct size nozzle.

B. Nozzle dirty or defective. Clean or replace.

C. Oil supply pressure to nozzle too low. Readjust.

D. Oil pump defective. Replace.

E. Oil pump coupling loose (slipping) or defective. Replace.

F. Linkage mechanically binding. Readjust.

G. Modulating oil fuel metering valve set incorrectly. Reset as required.

H. Oil suction line too small or partially blocked. Make vacuum test while at high fire. If the vacuum is in excess of 10" HG, clear any line obstructions. Increase line size if necessary. (See Figures 6, 7 & 8, pages 20, 21 and 22).

I. Blocked or dirty suction line oil filter or compressor air filter. Clean or replace.

J. Manual valves in suction line not fully open. Check and correct.

K. Suction line check valve or foot valve operating incorrectly. Check and correct.

L. Vent system on oil tank blocked creating vacuum on tank, with high vacuum and lowered oil flow to burner. Check and correct.

Additional trouble shooting information can be found in the Flame Safeguard Control bulletin supplied with the burner.

BURNER START UP INFORMATION & TEST DATA

The following information shall be recorded for each burner start up:

Power Flame Model _____ Invoice No. _____ Serial No. _____

Installation Name _____ Start Up Date _____

Start Up Contractors Name _____ Phone _____

Name of Technician doing Start Up _____

Type of Gas: Nat. ☐ LP ☐ Other ☐ Fuel Oil Grad No. _____

Gas Firing

Gas Pressure at Train Inlet

Burner in Off Position _____ "W.C.

Low Fire _____ "W.C.

High Fire _____ "W.C.

Gas Pressure at Firing Head

Low Fire _____ "W.C.

High Fire _____ "W.C.

Gas Pressure at Pilot Test

Tee _____ "W.C.

Flame Signal Readings D.C. Volts ☐ Micro Amps ☐

Pilot _____

Low Fire _____

High Fire _____

CO_2 or O_2 (Specify)

Low Fire _____ %

High Fire _____ %

CO

Low Fire _____ PPM

High Fire _____ PPM

Input Rate

Low Fire _____ BTU/HR

High Fire _____ BTU/HR

Overfire Draft

Low Fire _____ "W.C.

High Fire _____ "W.C.

NOx (Corrected to 3% O_2)

Low Fire _____ PPM

High Fire _____ PPM

Stack Outlet Test Point Draft

Low Fire _____ "W.C.

High Fire _____ "W.C.

Net Stack Temperature

Low Fire _____ ° F

High Fire _____ ° F

Oil Firing

High Fire Vacuum Reading on Oil

Pump Inlet _____ "H.G.

Gas pressure at Pilot Train

Inlet (if applicable) _____ "W.C.

Gas Pressure at Pilot Test

Tee (if applicable) _____ "W.C.

Oil Nozzle Supply Pressure

Low Fire _____ PSIG

High Fire _____ PSIG

Oil Nozzle Atomizing Medium Pressure

Low Fire _____ PSIG

High Fire _____ PSIG

Flame Signal Readings

Pilot (if applicable) _____ D.C. Volts

Low Fire _____

High Fire _____

GPH Firing Rate

Low Fire _____ GPH

High Fire _____ GPH

CO_2 or O_2 (Specify)

Low Fire _____ %

High Fire _____ %

Bachrach Scale Smoke Number

Low Fire _____

High Fire _____

NOx (Corrected to 3% O_2)

Low Fire _____ PPM

High Fire _____ PPM

Over Fire Draft

Low Fire _____ "W.C.

High Fire _____ "W.C.

Stack Outlet Test Point Draft

Low Fire _____ "W.C.

High Fire _____ "W.C.

Gas Firing (Continued)

Combustion Efficiency

Low Fire _____ %

High Fire _____ %

Windbox O_2

Low Fire _____ %

High Fire _____ %

Oil Firing (Continued)

Net Stack Temperature

Low Fire _____

High Fire _____

Combustion Efficiency

Low Fire _____ %

High Fire _____ %

Control Settings

Operating control cut out setting _____

Operating control cut in setting _____

Limit control cut out setting _____

Limit control cut in setting _____

Power supply: Volts _____ Ph _____ Hz _____

Control circuit: Volts _____

Blower motor amps at high fire _____

Other _____

Gas

Low gas pressure switch _____ "W.C.

High gas pressure switch _____ "W.C.

Other _____

Oil

Low oil pressure switch _____ lbs.

High oil pressure switch _____ lbs.

Atomizing low pressure switch _____ lbs.

Oil pump motor amps at high fire _____

Other _____

Operation Checklist

Checked For Proper Operation Of:	Yes	No		Yes	No
Low water cut off			Barometric damper		
High water cut off			Boiler room combustion air & ventilation provision correct		
Flame safeguard control ignition failure			Oil tank vent system correct		
Flame safeguard control main flame failure			All oil lines checked for leaks		
Burner air flow switch			All gas lines checked for leaks		
Induced draft fan controls			Gas lines & controls properly vented		
Over fire draft controls			Other system components (specify)		
Fresh air damper end switch					

Notified _____ of the following system deficiencies: _____

2001 South 21st St., Parsons, KS 67357, 620-421-0480, Fax 620-421-0948

POWER FLAME INCORPORATED

OWNER OPERATION INSTRUCTIONS

FOR YOUR SAFETY

If you smell gas:
1. Open windows
2. Do not touch electrical switches
3. Extinguish any open flame
4. Call your gas supplier immediately

WARNING

Improper installation, adjustment, alteration, service or maintenance can cause injury or property damage. Refer to the Burner manual. For assistance or additional information consult a qualified installer, service agency or the gas supplier.

Do not store or use gasoline or other flammable liquids and vapors in the vicinity of this or any other appliance.

IMPORTANT PRECAUTIONS

1. Never attempt to light burner with paper or other materials.
2. Never experiment with the burner.
3. Never change the fuel or air adjustments without consulting with the burner service company.
4. Never attempt to light the burner if combustion chamber contains any unburned fuel or gases.
5. Never throw waste paper, rags, garbage or other waste materials into the combustion chamber.
6. Never wash out heating equipment room without first covering the burner with waterproof material.

START-UP

Preparation for Start-up - All Fuels

1. Ensure that the system is in working order. If heat exchanger is a boiler, ensure that proper water level is available. Oil burner - make sure that the oil tank has an adequate fuel level and that the fuel is the proper grade.
2. Set the burner control panel switch to the "OFF" position.
   Combination Gas/Oil burner - set the fuel selector switch to the fuel to be burned.
3. Turn the thermostat or operation control down to its lowest rating.
4. Check fuses and replace as necessary.
5. Depress the flame safeguard programming control reset button.

Start-up - Gas Burner

1. Manually open and close the main gas shutoff cock, leak test cock and pilot cock to determine that they operate freely. Open all three cocks. Reset low gas pressure switch.
2. Set the main power switch and burner panel control switch to the "ON" position. Wait 30 seconds and turn up thermostat or operating control to the desired setting.
3. The burner blower motor will start and after a suitable prepurge period (this will vary with the type of flame safeguard control supplied - but will usually be a minimum of 30 seconds to maximum of 90 seconds) the burner pilot will light, after which the main flame will be established.
4. If the system does not respond properly, contact your qualified burner service company.
5. When burning gas on a Combination Gas/Oil unit that has a blower motor driven oil pump, open all oil line valves. Oil must circulate through the oil pump, even when burning gas.

Start-up - Oil Burner

1. Open all valves in oil lines. If heavy oil is used, establish correct oil temperatures and pressure before starting the burner.
2. Open and close the pilot gas cock to determine that it is operation freely. Open the pilot gas cock.
3. Set the main power switch and burner panel control switch to the "ON" position. Wait 30 seconds and turn up thermostat or operating control to the desired setting.
4. The burner blower and air compressor motor will start and after a suitable prepurge period (this will vary with the type of flame safeguard control supplied – but will usually be a minimum of 30 seconds to a maximum of 90 seconds) the burner pilot will light, after which the maim flame will be established.
5. If the system does not respond properly, contact your qualified burner service company.

EXTENDED SHUTDOWN

1. Place main power switch and burner control panel switch to the "OFF position.
2. Close all valves in gas & oil lines.
3. Cover burner to protect it from dust and dampness.

MAINTENANCE

1. See "Maintenance" section in burner manual for suggestions on periodic maintenance and service.

Burner Service Company Date of Installation

Address Telephone

POWER FLAME INCORPORATED LIMITED WARRANTY

Power Flame Incorporated, hereinafter called the Seller, of 2001 South 21st Street, Parsons, Kansas, hereby warrants its equipment manufactured by it and bearing its nameplate (hereinafter called Warranted Equipment) in the respects and exclusively for the benefit of those users, described herein. THIS LIMITED WARRANTY SHALL EXTEND SOLELY TO THOSE PERSONS WHO ARE OWNERS OF THE WARRANTED EQUIPMENT DURING THE WARRANTY PERIOD HEREINAFTER DEFINED AND WHO USE SUCH WARRANTED EQUIPMENT IN THE PROJECT AND FOR THE PURPOSES FOR WHICH SUCH WARRANTED EQUIPMENT WAS ACQUIRED FROM THE SELLER. The Seller warrants its equipment to be free from defects in the material and workmanship under normal use and service for fifteen (15) months from date of shipment. EXCLUDED FROM ANY COVERAGE UNDER THIS WARRANTY ARE DEFECTS IN WARRANTED EQUIPMENT FROM DAMAGE IN SHIPMENT, FAULTY INSTALLATION, MISUSE OR NEGLIGENCE. If any person becomes entitled to a claim under this warranty, such person shall, as a condition precedent to securing warranty performance, return the Warranted Equipment to the Seller's plant, 2001 South 21st Street, Parsons, Kansas, transportation prepaid. If the Warranted Equipment thus returned is found by the Seller to be defective for a cause and within a time covered by this Warranty, such equipment shall be repaired or replaced without charge; and returned to its owner or job site at the Seller's cost for transportation and handling. If inspection of the Warranted Equipment discloses defects not covered by this Warranty, the Seller shall notify the owner. Said equipment, at the owner's option (to be determined thirty (30) days from the date of notification), may be repaired or replaced at the expense of the owner and Seller's regular charges shall apply. Owner shall assume the cost for transportation and handling. Equipment, which is repaired or replaced, shall carry a warranty equal to the unexpired portion of the original warranty. The Seller will commence inspection of any Warranted Equipment returned to it for warranty claim within seven (7) working days after the arrival of such Warranty Equipment at Seller's plant, and shall complete any repairs required under this warranty within sixty (60) days after such arrival, unless Seller shall sooner notify said owner of reasonable cause for delay beyond control of Seller. Warranty obligations hereunder will be performed only between the hours of 9:00 a.m. and 4:00 p.m. Monday through Friday and excluding holidays. Any person believing himself entitled to warranty performance hereunder is required to notify the Quality Assurance or Service Department of Power Flame Incorporated, 2001 South 21st Street, Parsons, Kansas, prior to return of any Warranted Equipment for repair hereunder. IN ALL EVENTS, SELLER WILL NOT BE LIABLE FOR AND WILL NOT REIMBURSE ANY LABOR, MATERIAL, OR OTHER REPAIR CHARGES INCURRED BY ANYONE OTHER THAN SELLER ON ANY WARRANTY EQUIPMENT, UNLESS SUCH CHARGES HAVE BEEN SPECIFICALLY AUTHORIZED IN ADVANCE IN WRITING BY SELLER. ANY WARRANTY IMPLIED BY LAW WITH RESPECT TO THE MERCHANTABILITY OR FITNESS OF THE WARRANTED EQUIPMENT IS HEREBY LIMITED TO THE DURATION OF THE WARRANTY PERIOD HEREUNDER. THE SELLER WILL NOT IN ANY EVENT BE LIABLE FOR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGES ATTRIBUTABLE TO THE WARRANTED EQUIPMENT.

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