TYPE AC ADDENDUM

(TO BE USED IN CONJUNCTION WITH THE TYPE C MANUAL)

POWER FLAME INCORPORATED

Manual AC0402Prelim

1. GENERAL PRODUCT INFORMATION

Principal of Operation

Power Flame Type AC Burners incorporate the principals of air atomization for oil and multiple orifice, venturi operation for gas. The total package utilizes the forced draft, flame retention concept. The Type AC burner is listed and labeled by Underwriters Laboratories, Inc. for the U.S. and Canada. Capacities, when fired at 0.2" w.c. positive combustion chamber pressure, range from 2.5 to 136.4 GPH of commercial grade #2 fuel oil and/or 428 to 19,100 CFH of natural gas. Air for combustion is furnished by an integrally mounted combustion air fan. The Power Flame packaged combustion system can be operated under positive or negative furnace pressures with clean, efficient combustion in a wide range of combustion chamber conditions. (Consult page 4 for appropriate ratings.)

Power Flame Type AC Burners are designed to produce greater flame turbulence and reduce flame size. As a result, they require less combustion volume for complete combustion and can be easily fired under positive furnace pressure. Forced draft pressurized operation requires stacks of smaller diameter and height.

The Power Flame AC Burner is a totally packaged and factory tested combustion system offering single unit responsibility. The package incorporates accurate control of the fuel-air ratio throughout the firing range with the resultant controlled flame patterns and clean combustion for maximum efficiency.

Combustion air flow is controlled by a multi-louvered damper assembly. The combustion air is supplied by an integral motor-driven blower, which discharges into the burner blast tube assembly. High turbulence flow is controlled by means of an adjustable fan diffuser system.

The air/fuel ratio is established at the time of start-up and proven with combustion test equipment to provide the lowest practical oxygen with clean flame.

A Flame-Safeguard Programmer, available in various control sequences, programs the firing cycle. The operating cycle is sequenced to ensure normal and safe conditions before fuel can be introduced into the combustion area. The complete firing cycle is supervised to ensure that ignition of main flame is properly established and maintained. All burners utilize a gas pilot ignition system. Flame monitoring is provided by optical scanner of the lead sulfide or ultraviolet types.

The limit circuit includes the operating limit control to maintain set operating pressure or temperature, as well as a high limit control to guard against excessive pressure or temperature. Low water and other similar safety controls can be interlocked into the burner control system to fit specific job and/or code requirements.

The control circuit is normally 120 volts. A control circuit transformer may be furnished to provide the 120 volt control circuit for polyphase motor applications. The control circuit is frequently interlocked with the polyphase motor circuit to shut down the burner in the event of an interruption of the motor current.

Power Flame Type AC burners are capable of firing single or multi-fuel applications. (See model selection, page 4).

For multi-fuel burners, fuel changeover may be provided by automatic control, influenced by outside temperature or manual switching. Interlocking relays and timers ensure safe changeover of fuels by means of a timed interruption of firing, long enough to cause a complete recycle of the programmer.

The prewired Control Panel is mounted and wired as an integral part of the burner in accordance with recommendations of Underwriters Laboratories, Inc. and National Electrical Code. Components are wired to numbered terminal strips. Panels and burners are factory fire tested before shipment. Comprehensive wiring and gas and/or oil piping diagrams are furnished with each burner in accordance with individual job or application requirements. Wall mounted or free-standing control panels are also available.

Power Flame AC Burners are available with control systems to comply with the requirements of Factory Mutual, Industrial Risk Insurers and any special state, municipal, local and utility company codes, including New York City Department of Buildings (MEA), NYC Department of Environmental Protection, Commonwealth of Massachusetts, State of Connecticut Fire Marshall, Illinois School Code and others.

2. MODEL IDENTIFICATION

The numerical suffix after the letters AC denotes the burner frame size. The letter R inserted immediately after the letters AC denotes an inverted blower configuration.

The alphabetical designation immediately following the frame size indicates the fuels to be used: O, oil only; and GO, combination gas/oil. Frame size (see capacity ratings)

Any alphabetical suffix (such as A, B, S or V, etc.) to the fuel designation denotes special product coding (consult factory).

The two numbers following the fuel designation, in all gas/oil listings, denote the standard gas train size. (Selected components may be different pipe sizes than the normal train size coded.)

10	1" gas train	20	2" gas train
12	1 ¼" gas train	25	2 ½" gas train
15	1 ½" gas train	30	3" gas train

See page 4, Standard Burner Ratings and Component Data for further information.

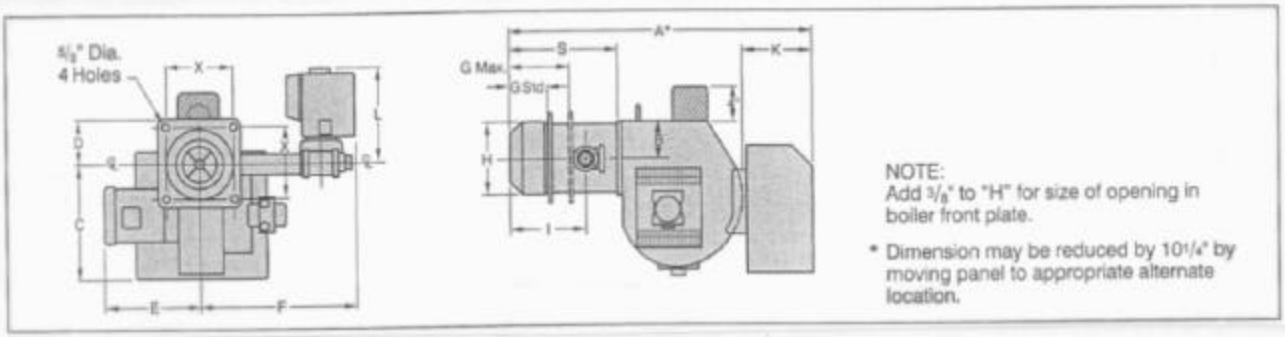
3. UNPACKING AND HANDLING

Type AC Power Flame burners are usually shipped as a unit with an integrally mounted, prewired control panel. A remote fuel oil pumpset is shipped separately on the larger size oil and gas/oil units. Gas train components may be mounted on the burner or shipped loose for field mounting.

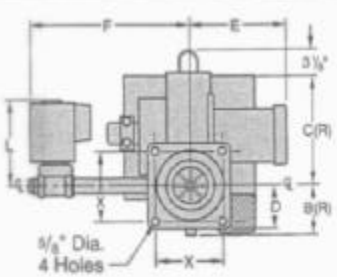
Uncrate the burner carefully and check all parts received against the computer generated Burner Specification Sheets supplied by Power Flame. Components not mounted on the burner (shipped loose) are designated with an L on the sheets. Claims of shortage or damage must be immediately filed with the carrier.

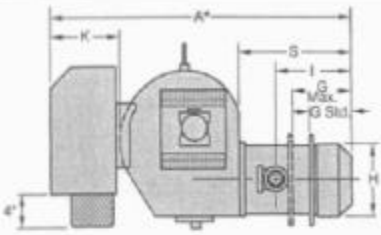
4. BURNER SPECIFICATIONS

Model AC Configuration – Figure 1



Model ACR Configuration – Figure 2





NOTE:
Add ⅜" to "H" for size of opening in boiler front plate.

* Dimension may be reduced by 10¼" by moving panel to appropriate alternate location.

Table 1
Standard Dimensions (Inches)

Model	A	B	B®	C	C ®	D	E	F** Gas/ Oil
AC3	44	5 ¼	7	16 5/8	15 ¼	6	16	22 3/8
AC4	50	6 ¼	7 5/16	18 7/8	17 11/16	7	18 ½	28
AC5	50	6 ¼	7 5/16	18 7/8	17 11/16	7	18 ½	26 ½
AC6	49 7/8	6 ¼	7 5/16	18 7/8	17 11/16	7 ¾	19 7/8	26 ½
AC7	51 11/16	8 1/8	10 1/8	24 5/16	22 3/8	8 ¾	18	21 13/16
AC8	56 9/16	8 1/8	10 1/8	271/8	27 5/8	8 ¾	20	24 3/8

Model	G Std Oil	Std	Max*	H	I	K	L	S	X
AC3	14 ¼	4 ½	8	10 1/8	11 ½	10 ¼	22	15 ½	10
AC4	18	6	9	12 1/8	14 ¼	10 ¼	26 5/8	19 1/8	12
AC5	18	6	9	12 1/8	14 ¼	10 ¼	26 5/8	19 1/8	12
AC6	18	5	11 ¾	13 5/8	14 1/8	10 ¼	26 ½	19	13 ½
AC7	14 7/8	4 7/8	11 ¼	15 5/8	13 7/8	9 1/8	26 ½	19	13 ½
AC8	3 ¼	3 ¼	9 5/8	15 5/8	12 ¼	9 1/8	24 7/8	17 5/16	13 ½

* This dimension may be increased. Consult factory.

Note: Dimensions shown are standard, but may vary due to component changes, etc.

** This dimension depicts space required to accommodate a standard gas train, standard oil valves and standard burner mounted pump.

Table 2
Standard Burner Ratings and Component Data Power Flame Certified Capacity 0.2" W.C. Positive Pressure (D)

Burner Model (A)	Std Flame Sensor (B)	3450RPM Blower Motor H.P.©	GPH Max	MBTU/HR Natural Gas Maximum	Nominal Boiler H.P.	Gas Pressure Required Inches W.C. (E) Min-Max	Std Gas Train Size (F)	Burner Mounted Oil Press Pump Suction Capacity In GPH (G)	Separate Driven Oil Pressure Pump If Supplied (H)		Comp Motor H.P.
									Motor H.P.	Suction Capacity In GPH	
Model ACGO (Combination Gas/Oil)											
AC3-GO-20	UV	2	23.5	3285	80	5.3-14	2"	69	1/3	69	¾ (I)
AC3-GO-25	UV	2	30.3	4240	100	7.5-14	2½"	79	1/3	79	¾ (I)
AC3-GO-25B	UV	3	33.8	4725	110	6.0-14	2½"	79	1/3	79	¾ (I)
AC4-GO-25	UV	5	40.5	5670	135	9.5-14	2½"	93	1/3	93	1½
AC4-GO-30	UV	5	50.4	7055	170	10-14	3"	93	1/3	93	1½
AC5-GO-30	UV	7½	67.5	9450	225	11.3-28	3"	N/A	½	190	2
AC5-GO-30B	UV	7½	72.1	10100	240	14.3-28	3"	N/A	½	190	2
AC6-GO-30	UV	10	90.0	12600	300	20.9-28	3"	N/A	½	190	2
AC7-GO-30	UV	15	121.4	17000	404	33.9-28	3"	N/A	½	220	3
AC7-GO-30B	UV	20	127.8	17900	425	37.5-280	3"	N/A	½	220	3
AC8-GO-30	UV	15	136.4	19100	454	40.3-280	3"	N/A	½	220	3
Model ACO (Oil)											
AC3-O	UV	2	30.3	---	100	---	---	79	1/3	79	¾ (I)
AC3-OB	UV	3	33.8	---	110	---	---	79	1/3	79	¾ (I)
AC4-OA	UV	5	40.5	---	135	---	---	93	1/3	93	1½
AC4-OB	UV	5	50.4	---	170	---	---	93	1/3	93	1½
AC5-O	UV	7½	67.5	---	225	---	---	N/A	½	190	2
AC5-OB	UV	7½	72.1	---	240	---	---	N/A	½	190	2
AC6-O	UV	10	90.0	---	300	---	---	N/A	½	190	2
AC7-O	UV	15	121.4	---	404	---	---	N/A	½	220	3
AC7-OB	UV	20	127.8	---	425	---	---	N/A	½	220	3
AC8-0	UV	15	136.4	---	454	---	---	N/A	½	220	3

A. See page 2 for further model number information.

B. The flame sensor shown – UV (Ultra Violet). Other flame sensors such as Lead Sulfide are available to comply with specifications or codes.

C. If separate pump is supplied, HP may be reduced.

D. Capacities listed are based on 0.20" W.C. positive pressure. For derate capacities see the enclosed capacity curves. All capacities based on 2000' elevation. Derate capacity by 4% for each additional 1000' elevation.

E. At inlet to main shutoff cock with burner operating at maximum input rate. If auxiliary gas valves are used AC3-G(O)-20 thru AC4-G(O)-30 inlet pressure of 28" (1#) are permitted when using optional 325-3 pilot regulator.

F. Model numbers will always reflect the standard U.L. listed gas train sizes to correlate with U.L. input listings. The actual train size may vary, depending on local gas supply pressures available.

G.&H. Suction line and oil filter must be sized to provide these suction capacities. **Do not size suction lines or filter capacities based on burner firing rates. See page for further information.**

I. Standard with ¾ HP, 3 phase motor. Single phase motor is ½ HP.

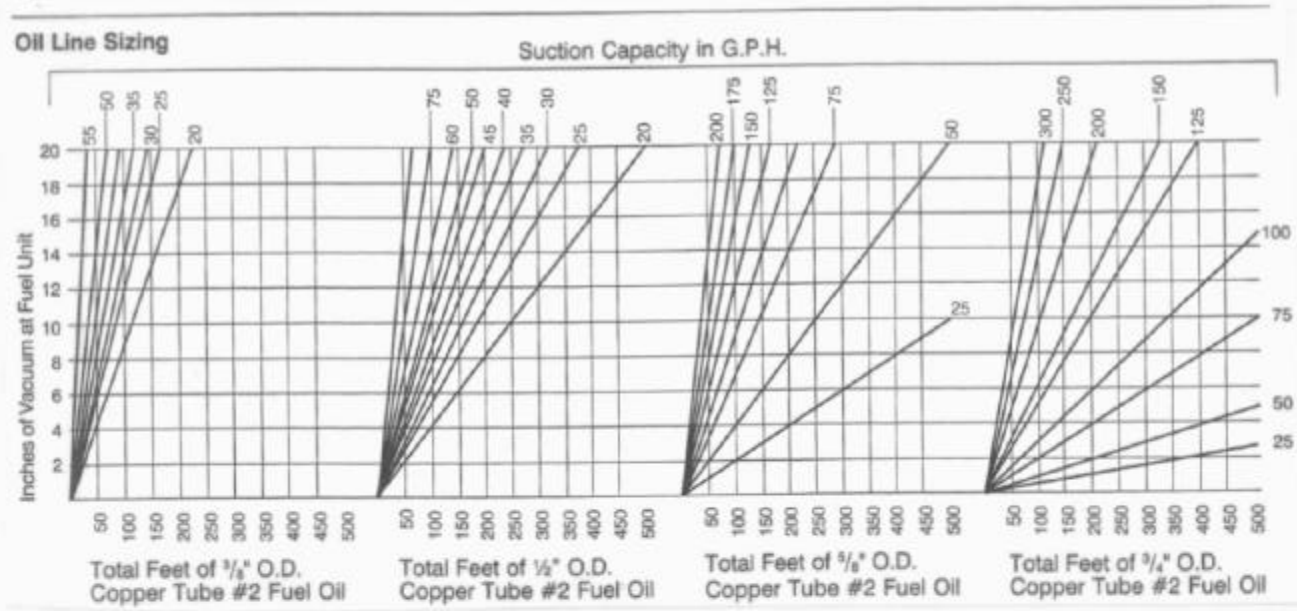
Table 3

Oil Pump Suction Capacity and Filter Selection Chart				
Gas/Oil Model	Oil Model	GPH Suction Capacity	Power Flame Oil Filter Model	Alternate Oil Filter
AC3-GO-20	AC3-O	69	70101-100	73410 (Fulflo FB-10)
AC3-GO-25	AC3-O	79	70101-100	73420 (Fulflo FB-10)
AC3-GO-25B	AC3-OB	79	70101-100	73420 (Fulflo FB-10)
AC4-GO-25	AC4-OA	93	70101-100	73420 (Fulflo FB-10)
AC4-GO-30	AC4-OB	93	70101-100	73420 (Fulflo FB-10)
AC5-GO-30 & 30B	AC5-O & OB	190	70101-100	73290 (#72 1" Hayward With 100 mesh basket)
AC6-GO-30	AC6-O	190	70101-100	
AC7-GO-30 & 30B	AC7-O & OB	220	70101-100	
AC8-GO-30	AC8-O	220	70101-100	

It is very important to properly size the oil suction line and oil filter, to provide fuel flow to the burner without exceeding 10" suction pressure (vacuum) at the oil pump suction port.

The method to properly size copper tubing is outlined below (Figure 4). Consult Power Flame Customer Services Department for sizing assistance regarding iron pipe.

Figure 4



1. Check oil pump GPH Suction Capacity shown in Table 6.
2. Measure total tube length (horizontal and vertical) from the end of the line in the tank, to the connection at the oil pump.
3. Choose the appropriate graph above based on the tubing size. Read up from horizontal line Total Feet of Copper Tube to Suction Capacity in GPH.
4. Read left to the vertical line Inches of Vacuum at Fuel-Unit. (This is the vacuum required to draw oil through the length of tube selected.)
5. If installation has lift (Lift is defined as the vertical distance the fuel unit is above the top of the tank,) add 1" of vacuum for every foot of lift.
6. Add the vacuum determined from items 4 and 5 together to determine total inches of vacuum.
7. If total is over 10", move to next larger tube size chart and re-calculate total inches of vacuum.

8. The instructions above do not allow for any added restrictions, such as line filter, elbows, sharp bends, check valves, etc. Suction line vacuum values for such components vary from one manufacturer to another.

   A Rule of Thumb to determine total vacuum for suction line sizing is to add 10% to vacuum determined from Figure 10 calculations.

9. It is always safe to size the return line from pump to tank at the same size as the selected suction line..

5. OIL START UP

General Information

Power Flame Type AC oil burners are of the air atomizing forced draft type. The burners have movable air dampers and use an air atomized nozzle with proportioning metering valve in the nozzle supply line to allow modulated fuel inputs from low to high fire.

Some applications may require the burner to function at the low end of its rated capacity. As a result, the two combustion air inlets may supply more air than is required for efficient combustion. It may therefore be desirable to operate the system using only one combustion air inlet and one combustion air inlet damper.

This may be accomplished by removing cross connecting linkage between dampers and locking the unused damper in a fixed position.

One way of locking the damper is to use a 10-24 machine screw through the hole in the linkage arm, and drill and tap the air inlet housing or use two nuts on the screw and let the screw bear against the air inlet housing.

Air diffuser movement (fore and aft) may be necessary to produce the best flame pattern or smoothest operation. See page 20 of the C Manual, Gas, Oil or Gas/Oil Burners Diffuser Adjustment, for further information.

Gas/Oil burners for Scotch marine and other selected applications incorporate a gas/air premix adjustment. This adjustment is identified by diametrically opposed adjustment knobs on the blast tube. See page 20, of the C Manual, Gas or Gas/Oil Burner and Fuel/Air Premix Adjustment for further information.

Burner Start Up Sequence

1. Check oil and gas piping (if applicable) for leaks, and check all controls for compliance with codes and insurance requirements.

2. Check all linkages. If the system is a packaged burner/heat exchanger system, the linkage was probably set when the system was fire tested at the heat exchanger manufacturing factory. It should, however, be checked to ensure that it was not damaged in shipment. If the system is a conversion unit (burner and heat exchanger are mated in the field), the linkage will have to be set to suit the particular operating conditions.

3. Do not power the flame safeguard control into its wiring base until it has been determined that there are no shorts or grounds in the system.

4. Install oil pressure and vacuum gauges. Check suction line to be sure manual valve is open and that check valves are opening in the proper direction of oil flow. Check oil filter for tightness. There should be no manual valve in the return line from pump to tank.

5. Gas Pilot Oil Ignition. Remove the pilot assembly and check for proper setting of the ignition electrode spark gap. Install a manometer or 0-10" W.C. gas pressure gauge in the pilot gas pressure test port. See pages 37 and 38 of the C Manual for details on gas pilot adjustments. Disconnect the pilot gas line at the inlet to the pilot gas pressure regulator and bleed air out of the pilot line. Make certain that the gas pressure to the pilot regulator does not exceed the regulator or pilot solenoid valve rating. When bleeding air from the pilot line system, do not allow the venting of gas into the room.

6. Install required systems measuring devices:

   A) appropriate flame signal meter to the flame safeguard control

B) stack thermometer, CO_2 and Smoke Test sample line in the breaching

C) draft gauge to the combustion chamber test point

7. With the burner panel control switch in the Off position, apply power to the burner through the main burner disconnect switch. Switch the burner panel On/Off switch to the On position momentarily to determine that the blower motor (and separate oil pump set motor, if supplied) is running in the right rotation.

8. 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 operation. The system priming may be achieved by closing the manual valve in the oil suction line and priming the oil pump through the pump gauge pressure port. Priming can also be accomplished through the oil filter on the suction line, if it is of the removable top type. When replacing the oil filter cap, be sure to attain a vacuum tight seal. Start the burner with the suction line manual valve closed. Let the burner run until the vacuum gauge indicates a high vacuum, then quickly open the manual valve in the suction line. This combination of priming and high suction should pull the oil from the tank to the burner, provided that there are no leaks and the line is properly sized. See page 5, Figure 4 for proper line size.

9. Refer to the burner wiring diagram and flame safeguard control information supplied with the burner to determine the specific firing sequence relating to limit and interlock circuits.

10. Set the air damper approximately 1/8" open and start the burner. The ignition circuit will be energized after the blower prepurge period (if supplied) has been completed and all limit and other interlock circuits have been closed. Allow the gas pilot to come on and adjust it for proper ignition and flame signal. For flame safeguard controls having a Test/Run test switch, place the switch in the Test position, causing the ignition timing sequence to stop while air and gas pressure adjustments **are** being made. See pages 37 and 38 of the C Manual for details on gas pilot ignition adjustments.

Cycle the burner several times to make certain the pilot is operating reliably. Shut the pilot gas cock and cycle the burner through prepurge. With the gas shut off, the pilot valve and ignition transformer will energize, but there will be no pilot and the unit will shut down on safety lockout.

There should be no evidence of flame signal reading, nor should the main oil solenoid valve attempt to open.

11. When a Gas Pilot is used to ignite the main oil, there will be a period of time when only the pilot will be on. The flame scanner must first detect the pilot and then, in a given number of seconds, the main oil solenoid valve will be energized. As soon as the oil flame is detected by the flame scanner, the ignition spark will be de-energized (interrupted ignition),

12. Restart the burner and allow normal sequencing to bring on gas pilot ignition. Once the main solenoid oil valve is energized, the oil flame should be established immediately. If not, shut the system down and make corrections as required. Do not repeatedly recycle the burner, such as to allow any accumulation of unburned fuel in the combustion chamber.

13. The modulating motor is connected by linkage to the air inlet dampers and a fuel metering valve located in the oil nozzle supply line controls a modulated fuel input from low to high fire. Each control point has its own multi position arm, so that proper air/fuel ratios can be achieved throughout the entire firing range. Initial adjustments should be made at the low fire position (low fuel/air flow). All Power Flame burners are factory tested and adjusted. However, to determine that the metering valve is, in fact, in the low fire position, observe the pointer on the metering valve shaft. The pointer must be pointing toward the 1 or 2 position on the dial on the Hauck metering valve. As the burner runs from low to high fire, it will proceed from the low fire setting towards the 6 position on the dial (i.e., the valve will be open at high fire). Refer to page 20, Figure 27 of the C Manual, for linkage adjustment information and page 21, Figure 28 of the C Manual, for adjustment information on the Varicam ™ characterized fuel metering system.

14. Turn the burner on and let it advance to the main flame light off position, taking action as necessary to hold the linkage at the low fire position by using a manual potentiometer or electrically disconnecting the modulating motor. Power Flame burners are test fired at the factory, and linkage adjustments for modulation are made at the time. Note that the factory settings relate to good operation while firing into open test pits, and will therefore not normally relate directly to the absolute fuel/air ratios while firing under specific field conditions. It is suggested that the factory settings be noted and marked on the linkage prior to proceeding with final adjustment. This will allow a return to those settings as initial reference points, if need be.

15. On air atomized nozzle systems, oil pressure at the pump nozzle port will generally be between 75 and 100 psig. Nozzle pressure will be approximately 40 psig when in the high fire position and 15 psig in the low fire position.

16. On air atomized nozzle systems, typical low fire atomizing air pressures will generally be in the area of 15 psig. High fire atomizing air pressures will generally be in the range of 30 to 40 psig, but these pressures can vary, depending upon the nozzle selected for a particular firing application. The atomizing air pressure is adjusted by opening or closing the bleed valve in the atomizing air line. The air pressure increases as the valve is closed and decreases as the valve is opened. Refer to the attached table for specific pressures.

17. With the burner in the factory set low fire position, adjust air and fuel linkage to good fuel/air ratio low fire settings (8 —10% CO_2 and #0 - #2 smoke reading). Mark the linkage at the new settings.

18. Increase the firing rate to the midway point. Set the fuel/air ratios to achieve good combustion values (9 – 11% CO_2 and #0 - #2 smoke reading). Mark the linkage as a reference point for this new mid-fire position.

19. Increase the rate to the high fire position and repeat the tests done for the mid-point adjustment. Results should be in the area of 12-½% CO_2 and no more than #2 smoke. The metering device setting and air damper openings should be marked and noted to obtain the high fire reference points.

20. Operate the modulating lever arm on the modulating motor through the three previously determined reference points. Minor setting modifications may be required to ensure that the reference points are acquired.

21. Tighten (finger tight) the hex bolt to the linkage rod at the swivel on the modulating motor driver arms, and run the motor through its full travel to ensure that linkage is free and that the limits on the metering device and air dampers are not exceeded.

22. Intermittently operate the burner until the water is warm in the boiler, or follow specific initial firing recommendations provided by the heat exchanger manufacturer.

23. Tighten all linkages and permanently mark settings.

24. Limit control check should be made as follows:

    A) Permit the burner to run until the limit control settings have been reached.

    B) The burner should turn off when the set temperature or pressure has been reached. Set the controls so that the burner will go to the low fire position before the operating limit control turns the burner off.

    C) After the differential pressure or temperature drop, the burner should start automatically.

    D) With the unit running normally, open the blowdown valve and remove water to the point below the low water cutoff setting. The burner should turn off and restart automatically when the proper water level is re-established. (If manual reset type low water cutoff is used, it will have to be reset.)

    E) Set and check operation of:

        (1) Low Oil Pressure Switch (if supplied). Set at 80% of low fire oil pressure. Check visually, or test electrically to confirm that circuit opens at the proper oil pressure.

(2) Low Atomizing Air Pressure Switch. Set at 80% of low fire air pressure. Check visually, or test electrically to confirm that circuit opens at the proper oil pressure.

(3) Blower Combustion Air Flow Switch (if supplied).

(a) Shut burner power off.

(b) Disconnect both wires at the air flow switch and temporarily clip them together. Make sure that they cannot ground against anything, since they will be powered with 110 volts during the test.

(c) Put a continuity meter across the two terminals.

(d) Disconnect the wire to the main automatic oil valve.

(e) Start the blower motor. The meter should read electrical continuity as soon as the blower starts.

(f) Disconnect the blower motor lead wire, or open the main power disconnect switch to the burner. Within 4 to 5 seconds after the blower motor is de-energized, the meter should indicate an open air flow switch circuit (no continuity).

(g) If the switch does not open in 4 to 5 seconds, readjust accordingly. Turn the air flow switch adjustment screw clockwise to shorten cut-off response time, and counter-clockwise to lengthen cut-off response time.

(h) Turn the burner power off. Remove the shorting clip from the two disconnected wires and let them hang loose. (They will be powered with 110 volts, so do not let them ground out.)

(i) Reconnect the wire to the main automatic oil valve. Turn the burner on. With the air flow switch wires disconnected, the burner should go into a purge cycle, but neither the ignition nor the main fuel valve circuits will be energized. If they do energize, there is a wiring problem. Correct as required.

(j) Turn power off. Reconnect the air flow switch wires to the air flow switch terminals. Place burner back into normal operation.

(4) All burner and heat exchanger controls and operating devices.

25. The Owner's Operating Instructions, page 47 of the C Manual, should be posted in a clearly visible location close to the burner.

26. If the burner operation is abnormal, refer to Section 8 Trouble Shooting Suggestions, as well as trouble shooting information in the flame safeguard manufacturer's bulletin shipped with the burner. It is also strongly suggested that all test procedures outlined in the flame safeguard control manufacturer's bulletin be conducted.

27. Complete the Burner Start Up Information and Test Data sheets on pages

6. SERVICING AND COMPONENT ADJUSTMENTS

General Information on Air Atomized Oil Nozzle Systems

1. The system is designed to use 40 PSI oil pressure and 30 PSI air pressure at the nozzle inlet at high fire and 15 PSI oil and air pressure at low fire. The firing rate is changed by adjustable metering arrangement that allows more or less oil to the nozzle.

2. Smoky fires with apparent large droplet size in the spray pattern are generally caused by low atomizing air pressures. To properly check the system, it is necessary to verify both nozzle oil and air pressures. Also check to make certain that the nozzle adapter and strainer are not partially plugged.

3. Careless cleaning or handling of the nozzle may damage the orifice, causing heavy streaks in the oil spray. This will also show up as large droplets or sparks in the flame.

4. Off center fires, low atomizing air pressures and safety lockouts (due to poor spray pattern and ignition failure) may result from plugged slots in the nozzle distributor head. When such situations are observed, the nozzle should be removed, disassembled and cleaned.

5. Excessive after squirt of oil is caused by air in the oil line system. Be sure air is not trapped in pressure gauges, overhead oil lines or fittings.

6. High turn down ratios are a distinct advantage of air atomized systems. It is possible, however, to adjust for a low fire so small that the flame is being chilled. The fire will look excellent and appear bright and uniform, but a combustion efficiency test will reveal high smoke content and low CO_2. To correct this situation, increase the oil flow or decrease the air, or both. Be sure to test with proper instruments to ensure good, clean efficient combustion throughout the firing range.

Table 4 - Oil Nozzle Pressure Chart *

				Reduced Firing Rates					
Nozzle	High Fire Rate (GPH)	Approx. High Fire Oil Press. (PSIG)	Approx. High Fire Air Press. (PSIG)	Firing Rate	Oil Press	Atom Air Press	Firing Rate	Oil Press.	Air Press
Delavan	16.0	26	22	4.0	15	15	2.0	13	14
25 GPH	20.0	32	25	5.0	16	15	3.0	14	15
30615	24.0	36	27	6.0	18	15	3.0	14	15
Delavan	24.0	35	25	6.0	20	20	3.0	13	15
30 GPH	27.0	38	27	6.5	21	22	3.5	14	15
30615	30.0	41	32	7.0	22	22	4.0	15	18
Delavan	32.0	35	20	8.0	20	19	4.0	18	15
40 GPH	36.0	37	22	9.0	22	20	4.5	19	15
30615	40.0	43	25	10.0	23	22	5.0	20	16
Delavan	45.0	30	24	11.0	20	18	5.5	13	15
50 GPH	52.5	35	29	13.0	22	19	6.5	14	15
30615	60.0	39	31	15.0	25	21	7.5	16	16
	67.5	44	33	17.0	26	23	8.5	18	17
Monarch	74.0	29	25	18.5	16	20	9.5	13	15
80 GPH	82.0	35	28	20.5	17	22	10.5	14	15
C-169	90.0	44	33	22.5	18	23	11.5	16	16
Monarch	95.0	36	25	24.0	17	20	12.0	15	16
100 GPH	100.0	41	28	25.0	18	20	12.5	16	16
C-169	105.0	45	32	26.0	20	21	13.5	18	17
Monarch	108.0	33	22	27.0	19	29	14.0	15	16
125 GHP	115.0	38	24	29.0	20	20	15.0	16	17
C-169	122.0	43	28	31.0	23	21	16.0	17	18

* Oil and air pressures are approximate, actual pressures will vary.

7. COMPRESSED ATOMIZING AIR PIPING INFORMATION

SUGGESTED AIR PIPE SIZES FOR VARIOUS PIPE RUNS –

COMPRESSOR TO AC 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 tube next to burner. Equivalent footage should be added for each fitting used, i.e., elbows, tees and etc. Use Table 6 for equivalent length of fittings in feet.

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

Table 5
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 6

	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

8. OIL TROUBLESHOOTING

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

   A. Flame scanner lens dirty. Remove and clean.

   B. Scanner sight tube blocked or dirty. Check and clean.

   C. Flame scanner defective. Replace.

   D. Defective oil nozzle causing unstable flame and scanning problems. Replace oil nozzle.

   E. Fuel/air ratios incorrect, resulting in unstable or smoky flame causing scanner flame sighting problem. Re-adjust ratios for clean stable flame.

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

2. Oil Flame Extremely Smoky at Light Of or in Low Fire Position.

   A. Defective or incorrect size oil nozzle. Replace

B. Fuel/air ratio incorrect. Readjust.

C. Atomizing air pressure too low. Readjust.

3. Light Off Oil Flame is Established and Proven, but Burner Will Not Attempt to Go to the High Fire Position.
   A. Modulating burner high fire temperature or pressure control could be defective or not set to call for high fire. Readjust or replace control.

   B. Loose wire 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. Linkage mechanically binding. Readjust linkage.

   E. Defective modulating motor. Replace.

4. Low Oil Flame is Established and proven, but Flame Out Occurs in Transition from Low Fire to High Fire.

   A. Defective or incorrect size oil nozzle. Replace.

   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. On modulating systems – fuel/air ratios set incorrectly, causing flame to blow out when going to high fire. Readjust linkage.

   H. Atomizing air pressure too high. Readjust.

5. 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, CO2 and smoke reading.

6. 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, page 12, Figure 16 and page 13, Table 7 of the C Manual for additional information. If chamber is 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 CO2 and smoke levels.

   D. Air pressure too low resulting in poor atomization. Readjust.

   E. Impingement of raw oil spray on blast tube choke ring or oil nozzle air diffuser. Position the oil gun assembly for or at in the blast tube to assist in elimination of oil spray on the blast tube choke ring.

7. 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 defective – replace. Nozzle mesh filter dirty – clean or replace.

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

   D. Oil pump defective. Replace.

   E. Atomizing air pressure too high. Readjust.

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

   G. Linkage mechanically binding. Readjust.

   H. Metering valve set incorrectly. Readjust to attain required nozzle pressure.

   I. Oil suction line too small or partially blocked. Make vacuum test while at high fire. If the vacuum is in excess of 10" HG, consult line sizing chart on page 10. Make line size changes, if required.

   J. Blocked or dirty suction line oil filter. Replace or clean.

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

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

M. 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.

9. MAINTENANCE

General Information

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 of the C Manual. These should be conspicuously posted in the burner room at the time of the initial burner installation and start up.

Always turn the power supply off to the burner and close main 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.

PERIODIC CHECK LIST

Item	Frequency	Checked By	Remarks
Gages, monitors and indicators	Daily	Operator	Make visual inspection and record readings in log
Instrument and equipment settings	Daily	Operator	Make visual check against heat exchanger manufacturer's recommended specifications
Firing rate control	Weekly	Operator	Verify heat exchanger manufacturer's settings
	Semiannually	Service Technician	Verify heat exchanger manufacturer's settings
	Annually	Service Technician	Check with combustion test
Flue, vent, stack, or outlet damper	Monthly	Operator	Make visual inspection of linkage, Check for proper operation
Combustion air	Monthly	Operator	All resources remain clean and open
Ignition System	Weekly	Operator	Make visual inspection, check flame Signal strength if meter-fitted (see Combustion safety controls)
Fuel Valves			
Pilot and main	Weekly	Operator	Open limit switch-make aural and visual check-check valve position indicators and check fuel meters if so fitted
Pilot and main gas or main oil	Annually	Service Technician	Perform leakage tests-refer to valve manufacturer's instructions
Combustion safety controls			
Flame failure	Weekly	Operator	Close manual fuel supply for (1) pilot, (2) main fuel cock, and/or valve(s): check safety shutdown timing; log
Flame signal strength	Weekly	Operator	If flame signal meter installed, read and log; for both pilot and main flames, notify service organization if readings are very high, very low, or fluctuating; refer to flame safeguard manufacturer's instructions
Pilot turndown tests	As required/ Annually	Service Technician	Required after any adjustments to flame scanner mount or pilot burner; verify annually-refer to flame safeguard manufacturer's instructions
Refractory hold in	As required/ Annually	Service Technician	See Pilot turndown tests
High limit safety control	Annually	Service Technician	Refer to heat exchanger Manufacturer's instructions

PERIODIC CHECK LIST

Item	Frequency	Checked By	Remarks
Operating control	Annually	Service Technician	Refer to heat exchanger Manufacturer's instructions
Low draft, fan, air pressure, and damper	Monthly	Operator	Refer to this manual and control manufacturer's instructions
High and low gas pressure Interlocks	Monthly	Operator	Refer to instructions in this manual
Low oil pressure interlocks	Monthly	Operator	Refer to instructions in this manual
Low atomizing air pressure	Monthly	Operator	Refer to instructions in this manual
Fuel valve interlock switch	Annually	Service Technician	Refer to valve manufacturer's Instructions
Purge switch	Annually	Service Technician	Refer to fuel/air control motor Manufacturer's instructions
Low fire start interlock	Annually	Service Technician	Refer to fuel/air control motor Manufacturer's instructions
Automatic changeover control (dual fuel)	At least annually	Service Technician	Under supervision of gas utility
Inspect burner components		Service Technician	Refer to this manual and control Component manufacturer's Instructions
Remove oil drawer assembly	Annually	Service Technician	Remove and clean
Check blower motor and blower Wheel for cleanliness. Remove And clean as necessary	Annually	Service Technician	Remove and clean
Remove, inspect and clean gas Pilot assembly	Annually	Service Technician	Remove and clean

Refer to heat exchanger manufacturer's instructions for general inspection procedures and for specific testing and inspection of all liquid level controls, pressure/temperature relief and other applicable items.

If you have any questions about the procedures listed above, or questions relating to components or devices on your unit not specifically covered in the above, contact our Service Department at (620) 421-0480 for assistance.

10. 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 Grade 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

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.

Low Fire _____ °F
High Fire _____ °F

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			Yes	
Low water cut off	____	____	Barometric damper	____	____
High water cut off	____	____	Boiler room combustion air &	____	____
Flame safeguard control ignition failure	____	____	ventilation provision correct	____	____
Flame safeguard control main flame failure	____	____	Oil tank vent system correct	____	____
Burner air flow switch	____	____	All oil lines checked for leaks	____	____
Induced draft fan controls	____	____	All gas lines checked for leaks	____	____
Over fire draft controls	____	____	Gas lines & controls properly vented	____	____
Fresh air damper end switch	____	____	Other system components (specify)	____	____

Notified _____ of the following system deficiencies: _____