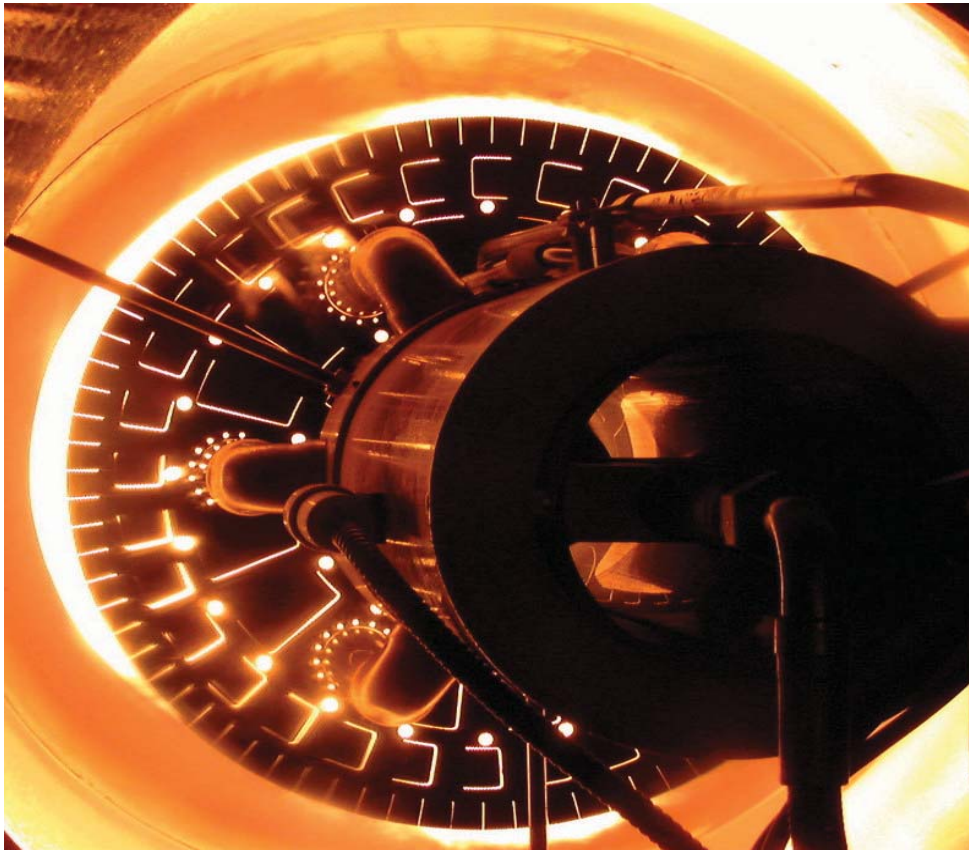




O&M Manual LC burner series



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Limpsfield Combustion Operating and Maintenance Manual

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Section 1

Legal statements and Disclaimers



Burner assembly area

Legal Notice

Operation instruction for Limpsfield Combustion Equipment to guarantee safety, reliability and efficiency.

The end user should carry out only operational adjustments & routine maintenance. Operational adjustments would include adjusting temperature or pressure settings on the burner management system. Maintenance by the end user should be limited to checking peripheral equipment such as fuel filters, fuel flow meters and fuel supply pressures. Any malfunction of the control system or burner must be attended to by a qualified technician who has been trained by the manufacturer of the equipment or his accredited representative. Commissioning, fault finding or any system equipment modification must absolutely only be implemented by manufacturer trained and approved technicians/engineers.

Various training schemes can be arranged at or our works or on site with suitably qualified personnel by prior arrangement with our service support department.

All personnel working on boilers/combustion system should hold suitable qualifications in an appropriate discipline. All personnel should have received training from the relevant manufacturer. All personnel should have or be supplied with appropriate clothing i.e. boiler suit, hard hat, safety glasses and suitably robust foot ware. Any technician/operative must ensure he has access to the appropriate technical documentation, the correct tools and test equipment to safely and efficiently deal with the scope of work set out in the job instruction.

If the end user and installer follow the recommendations and instructions set out above the safe, reliable and efficient operation of the combustion system will be guaranteed and many years of trouble free operation will be assured.

Important Notice to the end user and operator.

To ensure:

1. Safety
2. Efficiency
3. Reliability

of the system. It is vital that all of the component parts in a combustion system installation are serviced and inspected for soundness/correct operation at 12 monthly intervals. The particular installation and the way in which it is used may require more frequent servicing and inspections. Always contact the manufacturer for advice if in any doubt of your particular requirements.

It is, therefore, vitally important that any of the following works:

1. Servicing
2. Inspections
3. Remedial Breakdown Works
4. System Modification and Enhancements

be carried out by qualified and experienced technicians who have received training from the manufacturer. If in any doubt as to the technical proficiency of any person or organisation offering field service and support, always contact the manufacturer for their recommendations.

Always remember:

Expert Servicing = Safety, Efficiency and Reliability

Hints and General Advice to the End-User/Operator

Please be aware that many components and systems in a modern installation are 'service free' or 'lubricated and sealed for life'. This means that although no servicing is required it is still of the highest importance that these items of equipment are inspected regularly to ensure that they are sound and still meeting their originally specified performance. Components in a system can become degraded or damaged by the installation being operated in an inappropriate manner. Regular inspection by an experienced technician will identify any of these situations before they become troublesome.

'The more care taken with the system and component maintenance the greater the reliability and reduced down-time'

Inspection must be made on a regular basis of the following systems/components:

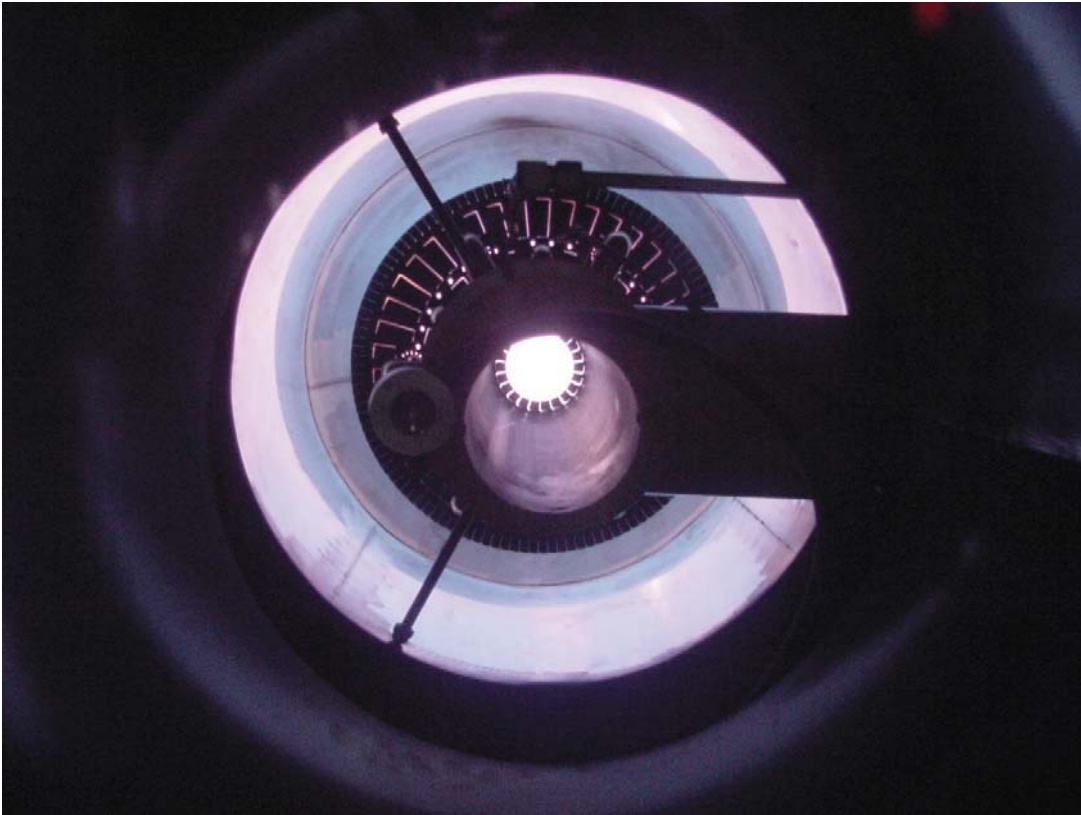
1. Electrical Control Panels
2. Electronic Control Modules
3. Boiler Flue Side Heat Transfer Surfaces
4. Fuel Pumping and Filtering Systems
5. Flue Dampers and Flue Gas Recirculation (FGR) Systems
6. Air Filters, Fans and Silencers
7. Gas Pressure Control Rigs
8. Flues and Exhaust Ducts
9. Level Controls and Blowdown Systems
10. Refractory Insulation
11. Burner Ignition and Flame Safeguard Systems

Any abnormal occurrence or condition on the system must be investigated by a trained and technically competent person who has been trained by the manufacturer of the relevant equipment. A malfunction or abnormal condition would include, Flame Failure, Lockout, High Limit Temperature/Pressure, Low Gas Pressure, Low Oil Pressure, e.t.c. Any abnormal condition will be indicated by warning lights or alphanumeric electronics displays, e.t.c. In the interest of safety and reliability a clear reason must be established for any abnormal condition, system malfunction or failure before the system can be put back into normal operation. The reason for malfunction and the recovery procedure must be made and logged by a well trained and technically proficient engineer, who has received training by the relevant manufacturer.

FAILURE OR IMPROPER SELECTION OR IMPROPER USE OF THE PRODUCTS AND/OR SYSTEMS DESCRIBED HEREIN OR RELATED ITEMS CAN CAUSE DEATH, PERSONAL INJURY AND PROPERTY DAMAGE.

Section 2

Burner Technical Data



Gas flame firing at 12,300,000 btu/hr

Burner Data

Note: Volume of air and flue gases is calculated based around the following criteria. Exhaust gases at 230°C/446°F ambient air at 20°C/68°F, mix of flue gases and air at 62.9°C/145.22°F with O₂ at 18.5% dry volume in the wind box.

Burner Type Number		9	15	21	36	44	53	62	73
Burner Rating	Mw	0.9	1.5	2.1	3.6	4.4	5.3	6.2	7.3
	Mmbtu	3	5	7	12.3	15	18	21	25
Air at 15% Excess	Cuft/hr	33,465	55,775	78,085	137,206	167,325	200,790	234,255	278,875
Air + FGR @62.9°C/145.22°F	Cuft/hr	41,831	69,718	97,606	171,507	209,156	250,987	292,818	348,593
No.2 Oil input rate (137,080 btu/gal)	GPH	21.88	36.47	51.06	89.72	109.43	131.31	153.19	183.38
Gas input rate (1000 btu/cuft)	Cuft/hr	3000	5,000	7,000	12,300	15,000	18,000	21,000	25,000
Minimum Pilot pressure	"WG	12	12	12	12	12	12	12	12
Delta P Air	"WC	7	10	11	12	12	12	12	12
	mbar	17.4	24.9	27.4	29.88	29.88	29.88	29.88	29.88
Delta P Air + FGR	"WC	N/A	N/A	16.5	18	18	18	18	18
	mbar	N/A	N/A	41	44.8	44.8	44.8	44.8	44.8
Blast tube O.D.	MM	176	189	202	299	314	361	386	417
	Inches	6.92	7.44	7.95	11.77	12.36	14.21	15.19	16.41
Gas inlet (NPT or 150lb)		2" npt	2" npt	2" npt	2.5" 150lb	2.5" 150lb	3" 150lb	3" 150lb	4" 150lb
Mounting P.C.D.	MM	240	240	240	355	355	440	440	570
	Inches	9.45	9.45	9.45	13.97	13.97	17.32	17.32	22.44
Mounting hole Ø	MM	8.5	8.5	8.5	10.5	10.5	10.5	10.5	17
	Inches	0.33	0.33	0.33	0.41	0.41	0.41	0.41	0.67
Quantity of mounting holes		4	4	4	8	8	8	8	8
Burner Type Number		88	100	123	150	175	200	263	310
Burner Rating	Mw	8.8	10	12.3	15	17.5	20	26.3	31
	Mmbtu	30	35	42	50	60	70	90	110
Air at 15% Excess	Cuft/hr	334,650	390,425	468,510	557,750	669,300	780,850	1,003,950	1,227,050
Air + FGR @62.9°C/145.22°F	Cuft/hr	418,312	488,031	585,637	697,187	836,625	976,062	1,254,937	1,533,812
No.2 Oil input rate (137,080 btu/gal)	GPH	218.85	255.33	306.39	364.75	437.70	510.65	656.55	802.45
Gas input rate (1000 btu/cuft)	Cuft/hr	30,000	35,000	42,000	50,000	60,000	70,000	90,000	110,000
Minimum Pilot pressure	"WG	12	12	12	12	12	12	12	12
Delta P Air	"WC	12	12	12	12	12	12	12	12
	mbar	29.88	29.88	29.88	29.88	29.88	29.88	29.88	29.88
Delta P Air + FGR	"WC	18	18	18	18	18	18	18	18
	mbar	44.8	44.8	44.8	44.8	44.8	44.8	44.8	44.8
Blast tube O.D.	MM	456	490	540	582	638	687	775.5	852
	Inches	17.95	19.29	21.25	22.91	25.11	27.04	30.53	33.54
Gas inlet (NPT or 150lb)		4" 150lb	4" 150lb	6" 150lb	6" 150lb	6" 150lb	6" 150lb	8" 150lb	8" 150lb
Mounting P.C.D.	MM	570	570	785	785	785	785	998.5	998.5
	Inches	22.44	22.44	30.9	30.9	30.9	30.9	39.31	39.31
Mounting hole Ø	MM	17	17	14	14	14	14	21	21
	Inches	0.67	0.67	0.55	0.55	0.55	0.55	0.82	0.82
Quantity of mounting holes		8	8	12	12	12	12	8	8

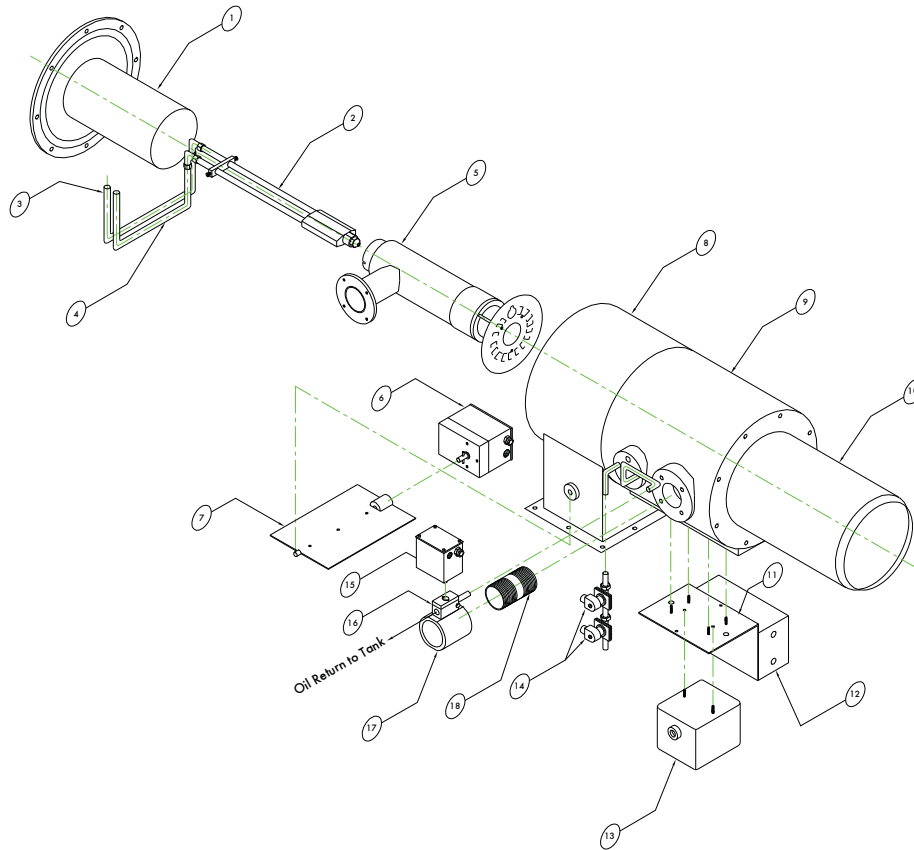
Section 3

Component Information



General assembled burner

Component Information

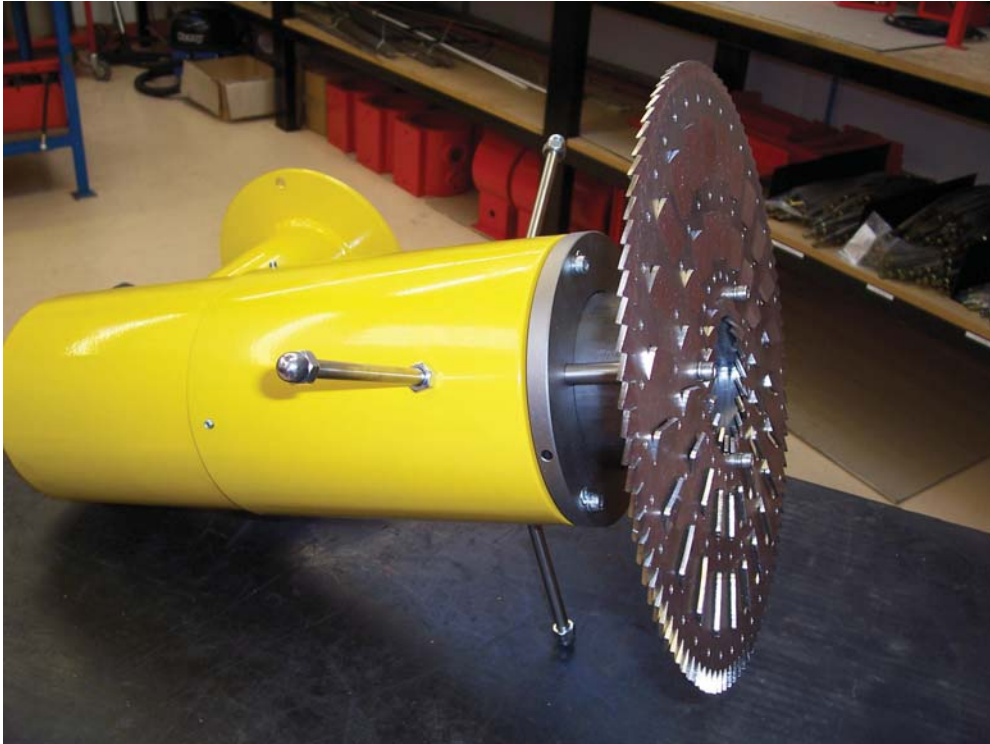


1. Sight Glass Assembly/Access Door
2. Oil Gun Assembly
3. Oil Flow to Lance Hose
4. Oil Return from Lance Hose
5. Gas Manifold
6. Combustion Air Servo Motor
7. Combustion Air Damper
8. Rear Burner Wind box
9. Front Burner Wind box
10. Blast Tube Assembly
11. Terminal Box Assembly/Transformer Mounting Bracket
12. Terminal Box
13. Ignition Transformer
14. Normally Closed Oil Solenoid Valves
15. Fuel Servo Motor
16. Oil Metering Valve
17. Gas Control valve (Lc9-15 screwed type / Lc21-310 flanged type)
18. Gas Nipple (Lc9-15 only)

Note: The above diagram is a general arrangement for illustrational purposes only. Some burners may differ slightly.

Section 4

Gas Manifold assembly



Split gas head assembly

Gas Manifold

Gas Manifold Removal

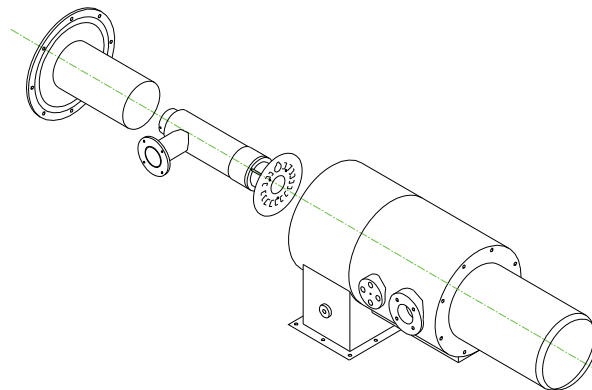
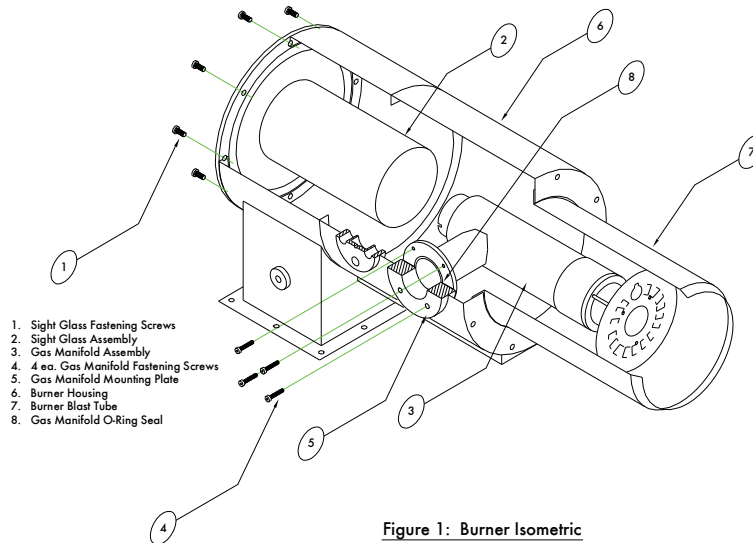


Figure 2: Gas Manifold Removal

A unique design feature of the Limpfield burner is the accessibility to all internal parts without removing the burner from the boiler. This allows for ease in set-up, maintenance and servicing.

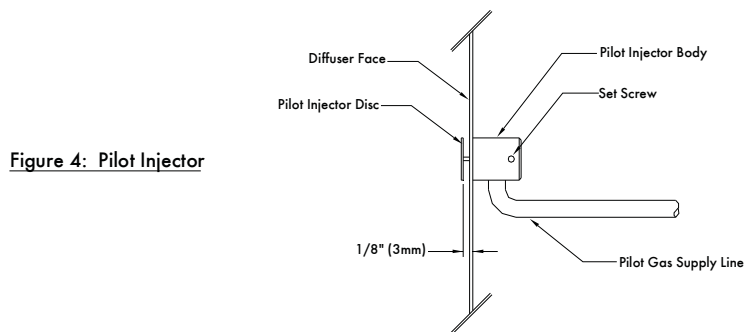
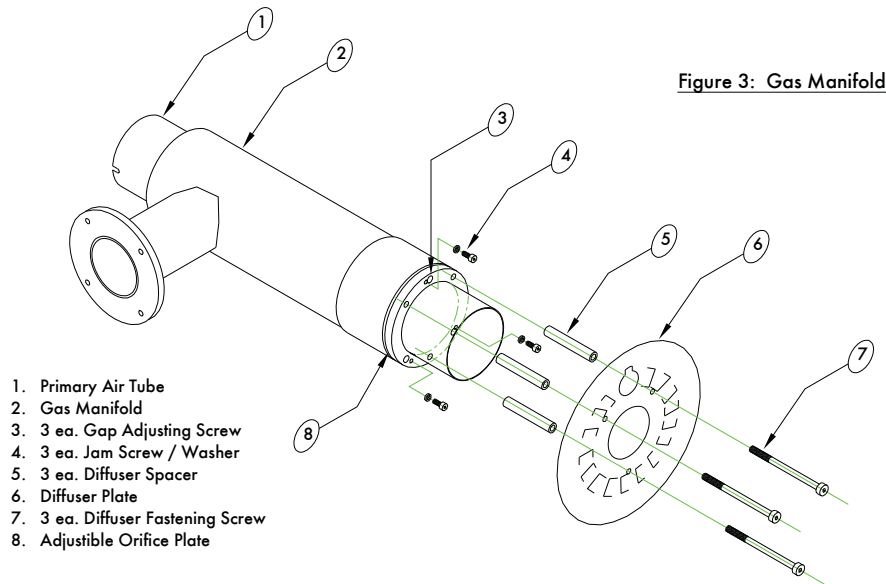
Warning: Ensure all electrical power is removed prior to servicing equipment

Step 1: Remove all sight glass fastening screws (item 1 on the diagrams above) and remove the sight glass assembly (item 2) from the burner

Step 2: Remove the 4 fixings for the gas manifold from gas manifold mounting plate (item 5). Pull the electrode wires (not shown) and carefully remove manifold assembly (item 3) from the burner blast tube (item 7) and housing (item 6). Use extreme caution so as not to damage the gas seal o-ring (item 8) and the ignition electrodes during the removal procedure.

Once adjustments to the gas manifold have been made, replace the gas manifold and sight glass assembly in the reverse order of the above method.

Adjusting the Orifices Plate Gap Setting (Split Head Design)



To alter the orifice plate gap setting, the gas manifold (item 2) must first be removed from the burner. To do this, follow the procedure outlined on the previous page. Once the gas manifold has been removed, the diffuser (item 6) must be removed. Once removed, the service person has access to the adjustable orifice plate (item 8).

Step 1: If the burner is equipped with a proven gas pilot (Lc21-310), the pilot injector disc must be removed. Loosen set screw to allow for removal of the pilot injector disc assembly (figure 4).

Step 2: Remove 3 ea. Diffuser fastening screws (item 7) and diffuser stand off pillars (item 5).

Step 3: Loosen 3 ea. Jam screw/washer (item 4) on the orifice plate.

Step 4: To DECREASE the gap setting, rotate the gap adjusting screw (item 3) clockwise as illustrated in Figure 5 on the next page. To INCREASE the gap, rotate counter-clockwise. Using a measuring scale or gap gauge, adjust all three screws so that the gap setting is equally maintained around the circumference of the assembly. The orifice plate is free to slide along the primary air tube (item 1).

(Instructions continue on next page.)

Step 5: Once the desired gap has been obtained, tighten jam screws/washers as illustrated in Figure 6. The washer, once tight, should compress against the head of the gap adjusting screw (item 3). Ensure that this is the case. Replace washer as needed if compression does not take place.

Step 6: After jam screws/washers have been installed, re-assemble diffuser and diffuser stand off pillars to their original position. Install pilot injector disc, setting the gap to its original position (1/8" or 3mm). DO NOT FORGET TO TIGHTEN SET SCREW, located in the pilot injector body.

IMPORTANT NOTE:

Adjustments in the orifice plate gap setting will change the gas flow rate (hence, gas pressure) from their original values. DECREASING the gap will allow less gas flow per the same pressure. Likewise, INCREASING the gap will allow more gas flow per the same pressure. Thus, the burner fuel/air ratio may change and require alterations to be made from the original commissioned values. Refer to the Autoflame Technical Manual and the "Single Point Change Facility" for assistance. In doubt, a re-commission should be carried out.

Only trained service personnel should make adjustments in the orifice plate gap setting. Call your local service company for assistance in making any adjustments to any piece of combustion equipment.

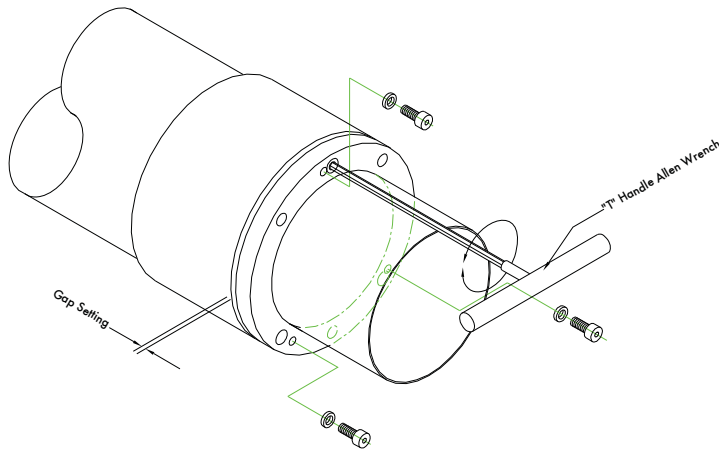


Figure 5: Gas Adjustment

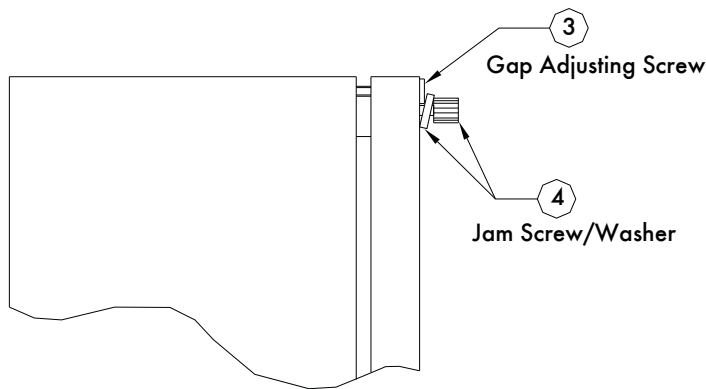
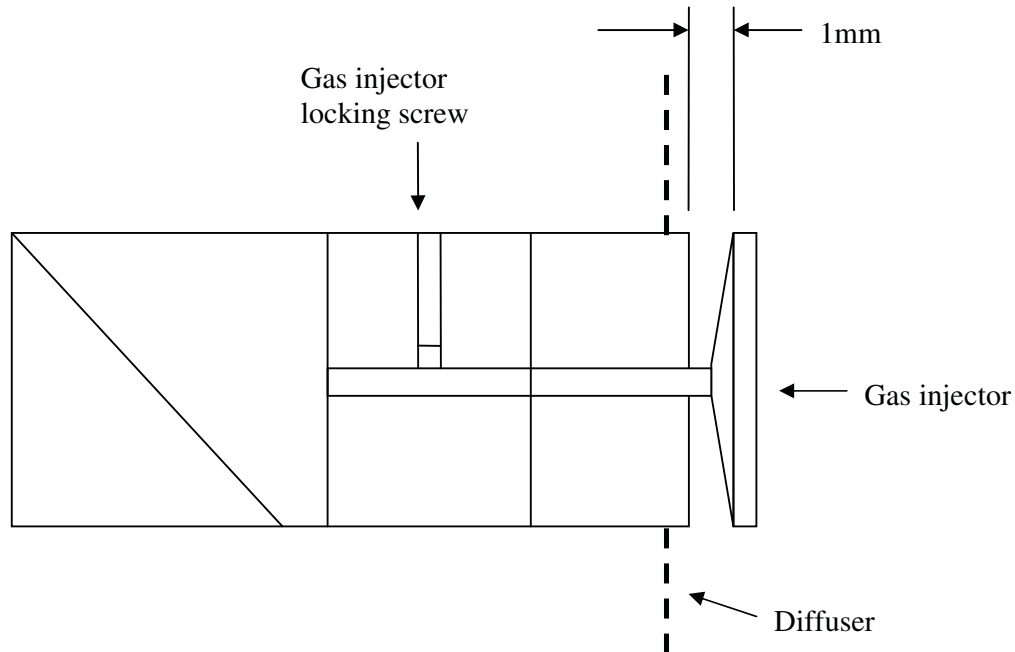


Figure 6: Jam Screw/Washer

Adjusting the Orifices injector Setting (Spider Head Design)

Spider heads are factory set for an inlet pressure of 5 psi to produce the required injection to enable correct fuel to air ratio. These settings can be adjusted to suit on site conditions. Below is the recommended procedure to adjust the gas injectors. It is important that the injectors are set to the same gap setting.



Setting the injectors is ideally achieved using a feeler gauge like used to set the gaps on spark plugs in an internal combustion engine. This should be carried out as follows:-

- Remove the gas head assembly from burner.
- Feeler gauges should first be selected for the correct injector setting. In this case 1mm.
- The injector should be loosened off and the feeler gauge inserted between the injector and pipe.
- The injector should then be pushed up against the feeler gauge, and locked in position. It is important that care is taken to ensure that the injector is securely locked in position by the gas injector locking screw.
- The feeler gauge should then be slid out from between the injector and pipe.
- Gas head is now ready to re-install.

Section 5

Oil Gun assembly

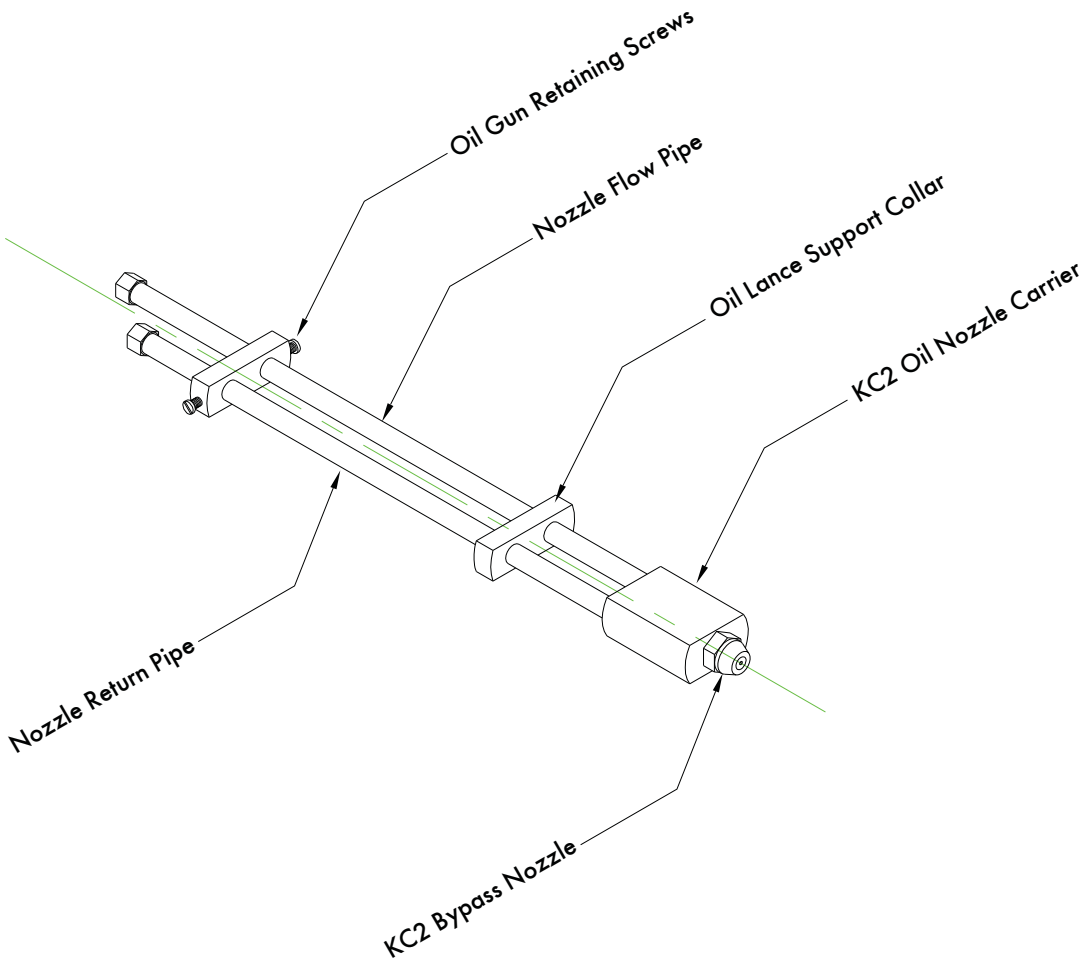


Oil nozzle and lance assembly

Oil Gun Assembly

KC2 Oil Gun (LC 9/15)

The LC9 and 15 burner models operate on a bypass pressure atomization system. The KC2 series bypass nozzle requires approximately 300 psi (20 bar) of oil supply to the nozzle. Bypass pressures at high and low fire (for a 4:1 turndown) are approximately 220 psi (16 bar) and 60 psi (4 bar) respectively.



W2 Oil Gun (LC 21-310)

Burner models from LC 21 upward operate on a high-pressure atomization system. The W2 series bypass nozzle requires approximately 368 psi (25 bar) of oil supply at the nozzle. Bypass pressures at high and low fire (for a 4:1 turndown) are approximately 310 psi (21 bar) and 160 psi (11 bar) respectively. The W2 nozzle incorporates a positive mechanical “Nozzle Shutoff” system that ensures no after drip after burner shutdown. This feature requires approximately 75 psi (5 bar) of oil pressure at the nozzle to open. Upon initial commissioning of oil, the commissioning engineer may have to close the spillback/metering valve an incremental amount if ignition does not take place. The opening pressure can be measured with a 0-600 psi (0-40 bar) oil pressure gauge via the pressure port in the spillback/metering valve.

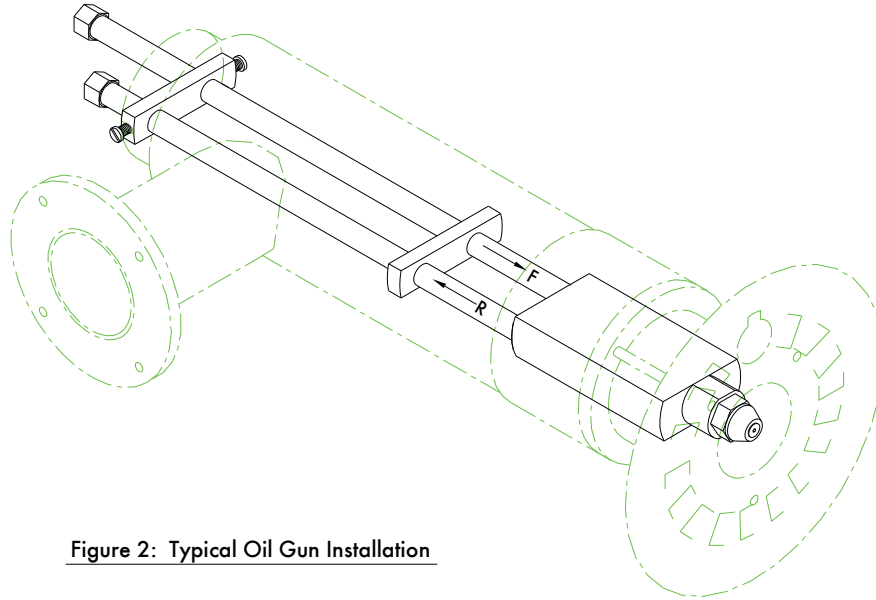


Figure 2: Typical Oil Gun Installation

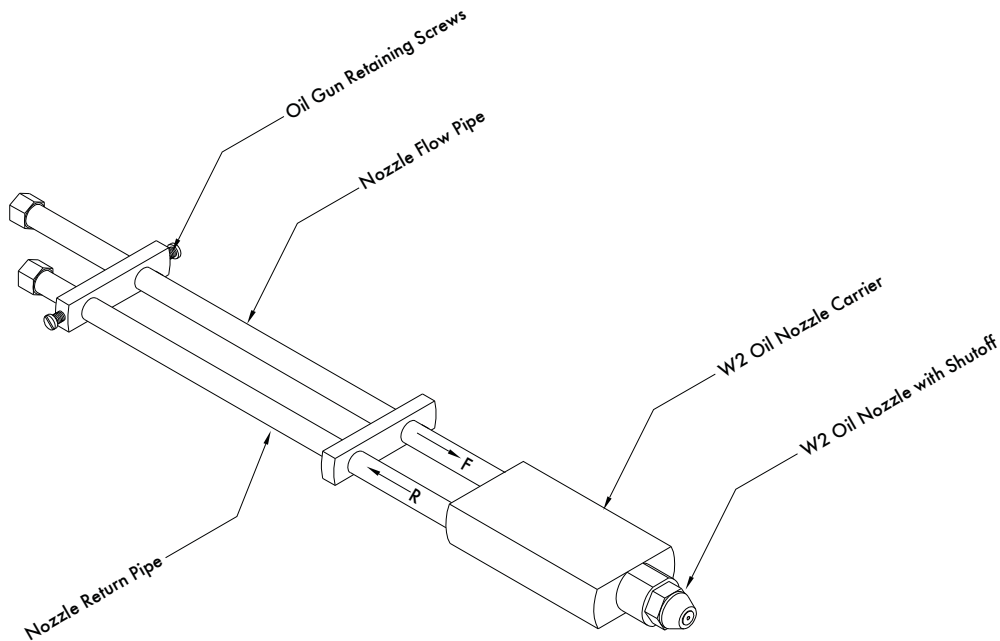
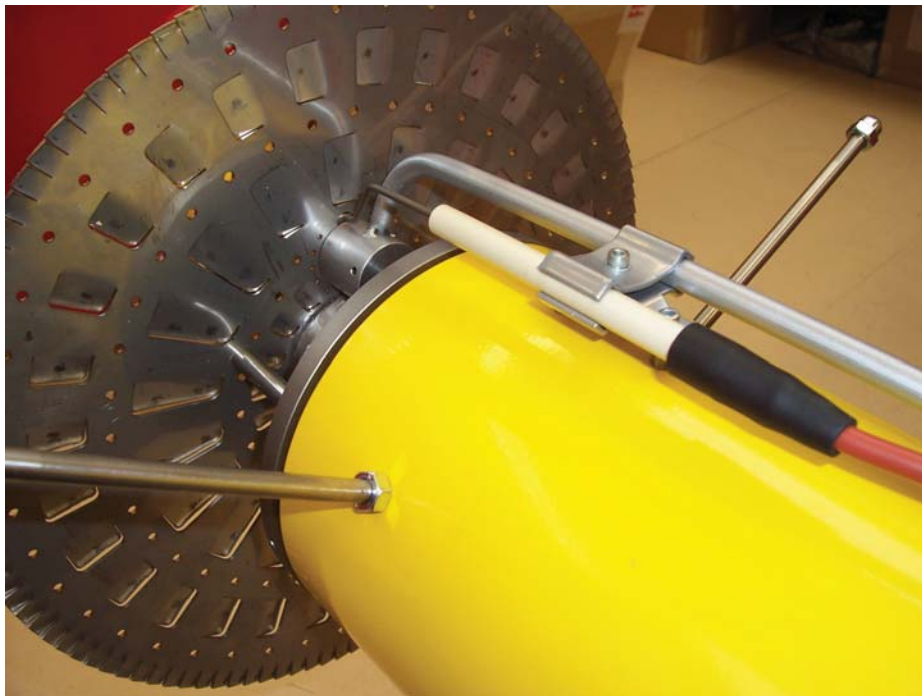


Figure 3: W2 Oil Gun with Proven Gas Pilot

Section 6

Electrode settings



Pilot injector and ignition setup

Electrodes

Staged Ignition (LC 9/15)

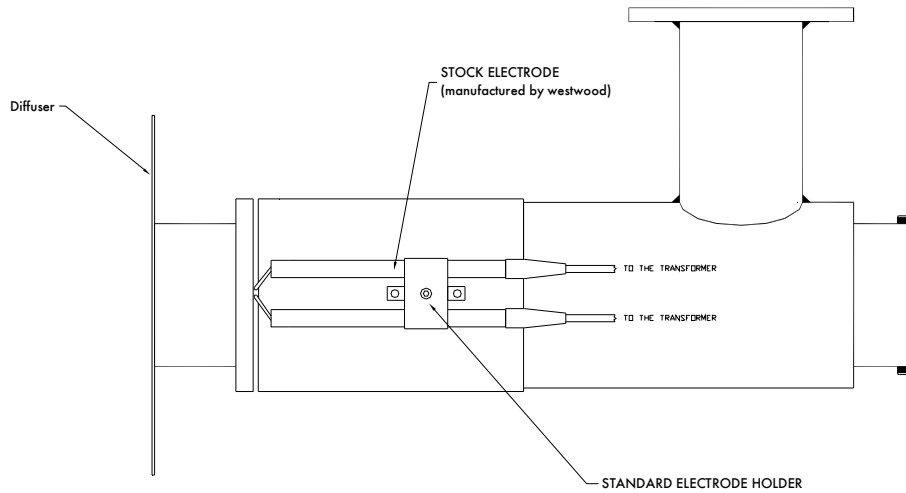


Figure 1: General Layout Electrodes Lc9/15

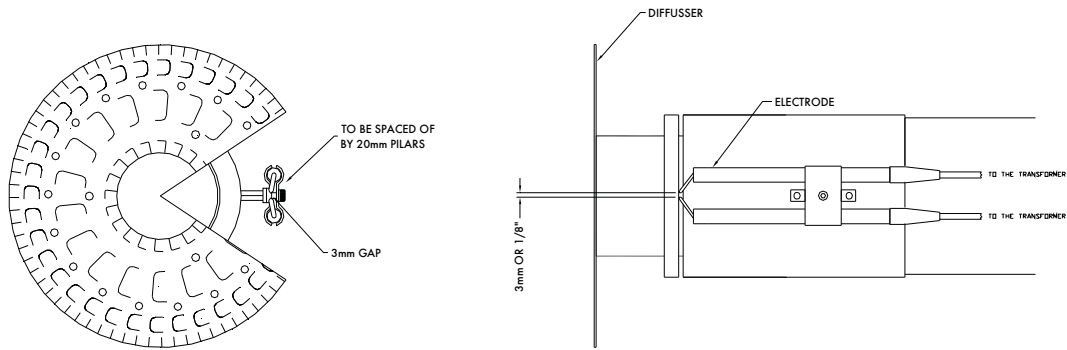


Figure 2: Staged Ignition Electrodes Lc9/15

Staged ignition Electrode Setting:

Limpsfield LC9 and 15 burners utilize a “staged” pilot gas ignition system. The pilot gas is introduced into the main gas manifold, prior to the gas-metering valve. At the proper sequence, the ignition transformer energizes and a spark is generated at the electrode tips located directly above the orifice plate gap. At this time the pilot gas is ignited and may burn behind the diffuser. Once the main gas valves energize, main ignition takes place and the gas should move from behind the diffuser and retain to the diffuser face. The figure above illustrates proper ignition electrode gap setting. Distance between electrodes should be kept to approximately 1/8” or 3mm. The electrodes should be positioned approximately 3/16” or 5mm above the orifice plate.

Pilot Ignition (LC 21-310)

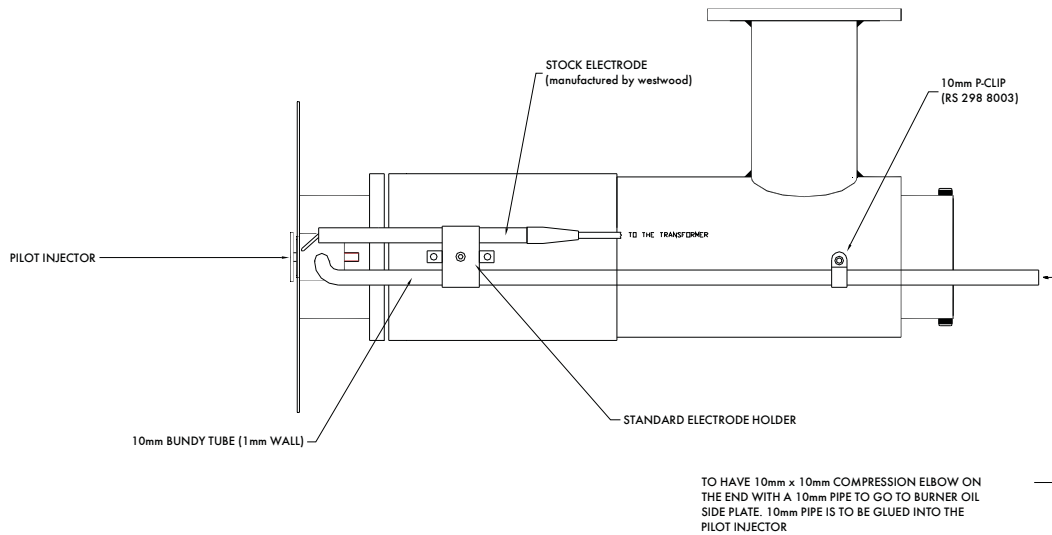


Figure 3: General Layout electrode Lc21-310

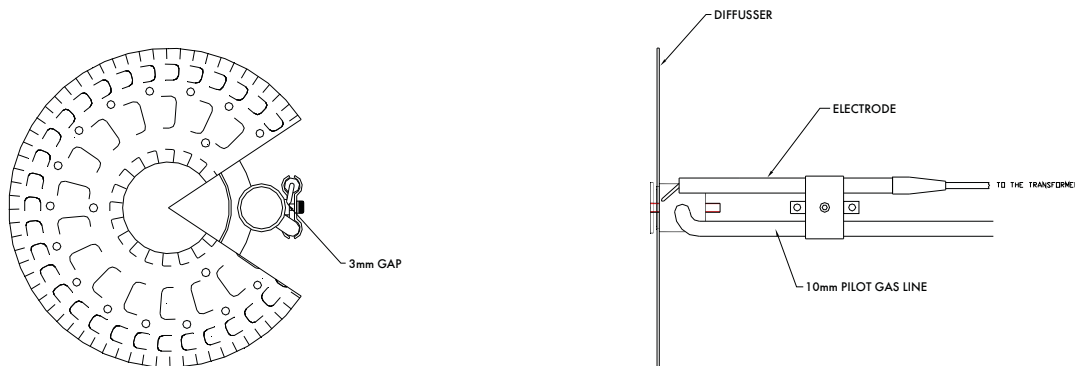


Figure 3: Pilot Injector electrode Lc21-310

Pilot Injector Electrode Setting:

LC21 models and higher utilize a proven gas pilot injector as the source of the main gas ignition. A critical element in proper burner light off not only is related to pilot gas supply pressure but also the position of the ignition electrode. The figure above illustrates proper ignition electrode gap setting. This setting should be kept to approximately 1/8" or 3mm. Electrodes should be kept clean and checked periodically for proper adjustment.

Pilot Injector Disc Setting:

For proper dispersion of pilot gas across the face of the diffuser, the gap between the pilot injector disc and the front face should be set to approximately 0.078" or 2mm (refer to the above figure). This setting may be altered depending on varying factors such as available pilot gas supply pressure and furnace pressure loss.

Section 7

Burner Installation



Limpsfield LC9 dual fuel burners on Hurst boilers

Typical Burner Installation

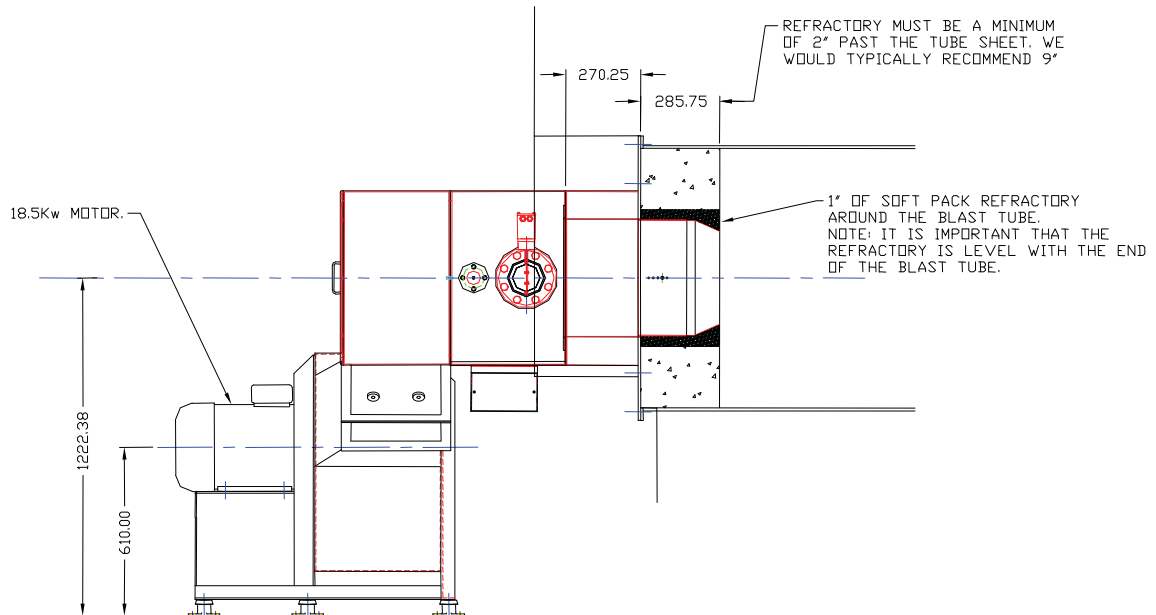
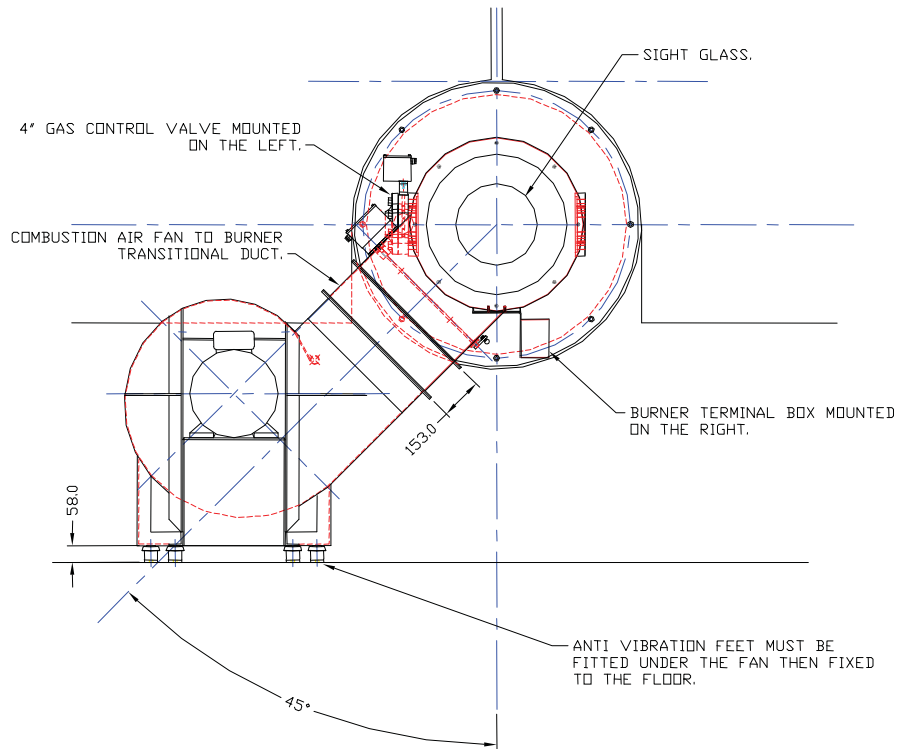
Installation Notes

Any Installation of a Limpsfield burner to a boiler should be carried out to the satisfaction and compliance of all local codes and with reference to ASME CSD-1 (Controls and Safety Devices for Automatically fired Boilers). In the absence of local codes, please see NFPA 85, Boiler and Combustion Systems Hazard Code, NFPA 54/ANSI Z223.1, National Fuel Gas Code, International Fuel Gas Code, NFPA 31, Standard for Installation of Oil-Burning Equipment and NFPA 70, National Electrical Code. Please contact Limpsfield Engineering Technical Help for clarification on any of the above.

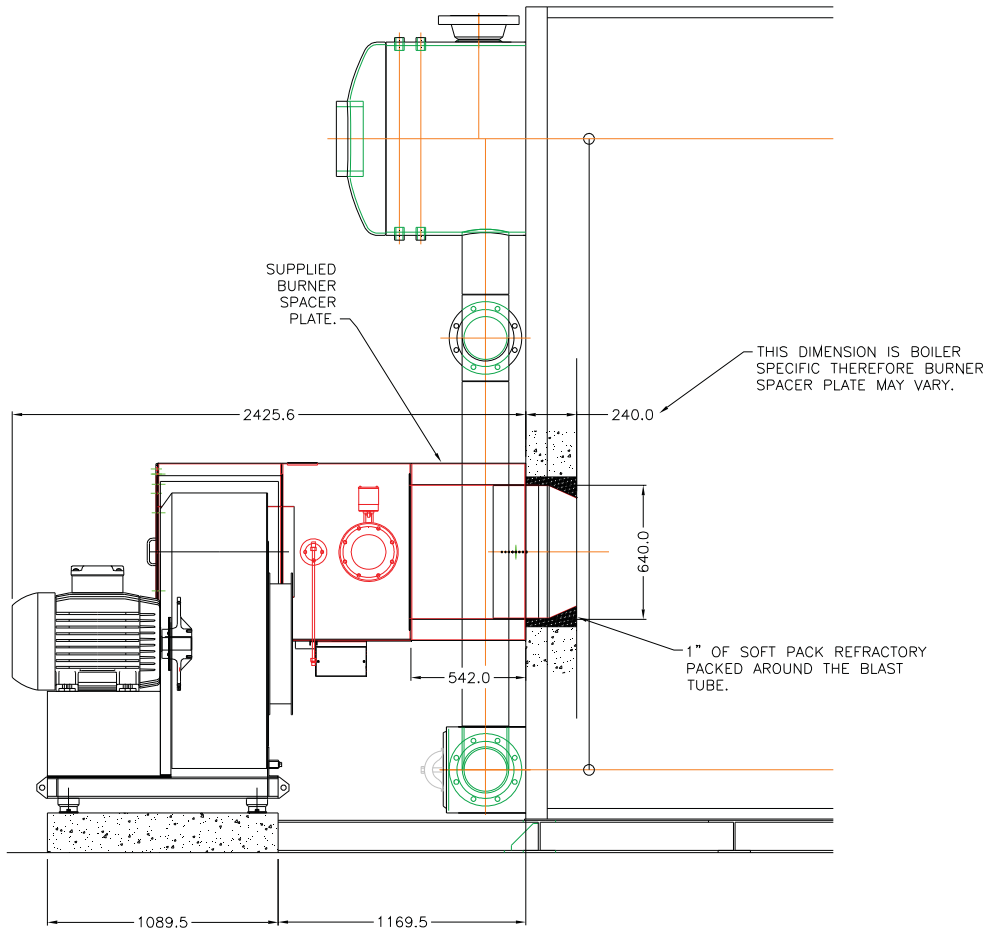
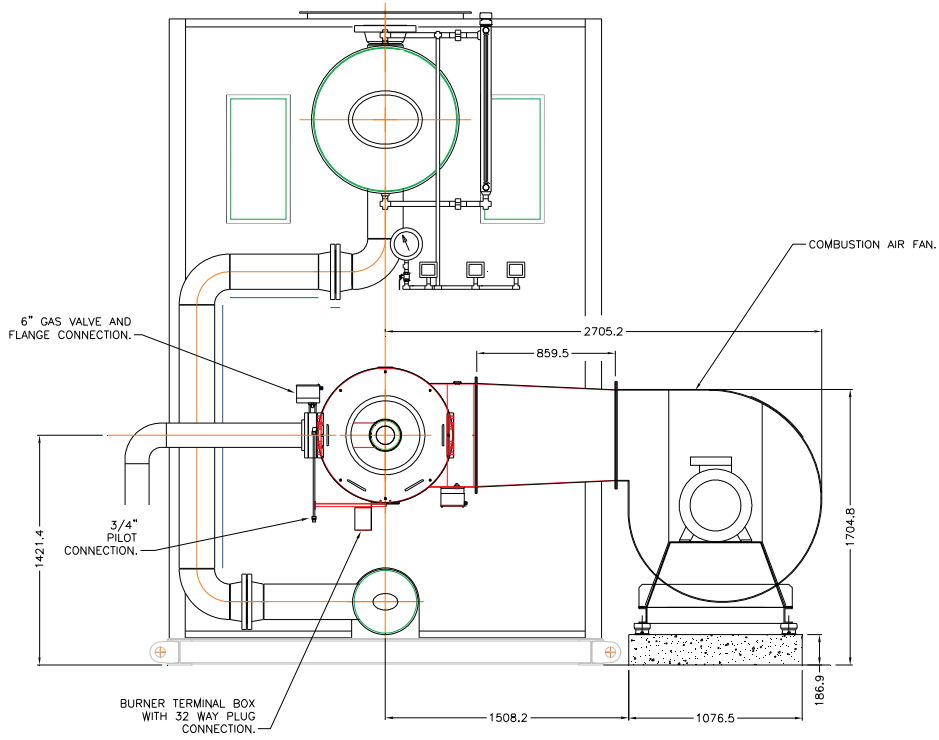
Contact Limpsfield's engineering department for installation technical information as each burner is engineered to suit each site application and a general arrangement drawing is created and submitted to the customer for application approval for height, width, length dimensions and location of burner related components.

Please find the examples following of 'typical' information supplied for the installation of the burner on a fire tube and water tube boilers. The burner can be retro fitted to all types of boiler, for more information contact Limpsfield Combustion Engineering Ltd.

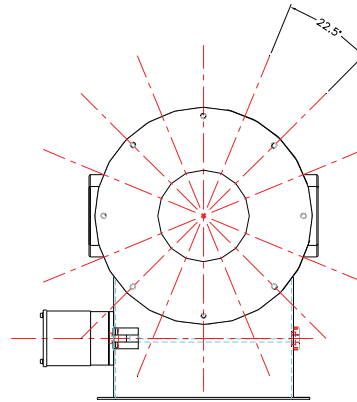
Sample Typical fire tube installation



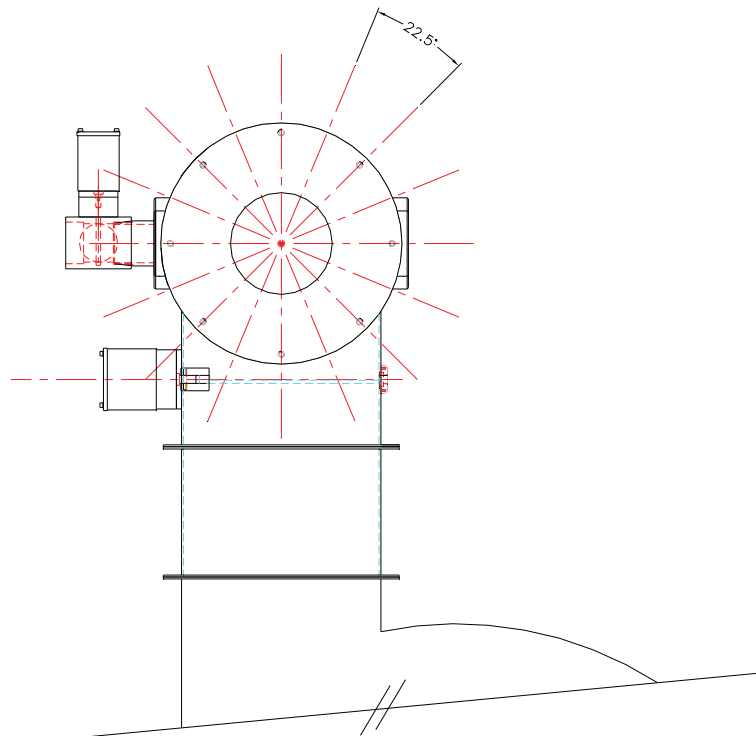
Typical water tube installation



The Limpsfield burner is supplied as standard with a split housing which allows the air inlet duct to be rotated 360 degrees in increments of 22.5 degrees, independent of the gas inlets illustrated in the drawings. This feature allows flexibility as to the position of the blower relative to the burner, which may be governed by specific site constraints. Installation arrangements are limitless. However, for arrangements not shown please contact the factory for consultation in proper air duct design. It is recommended that the pressure drop in the air duct between the outlet of the blower and inlet to the burner be no more than 1/2" WC.



To properly engineer and ensure job performance, Limpsfield combustion utilizes a vast array of fan types/sizes from several manufacturers. This allows for proper air delivery in both volume and pressure for installations of high altitude, elevated furnace pressures and varying ambient conditions which affect fan performance. Thus, blower arrangement is dependant upon jobsite conditions, which must be known at the time of placing the order.



The installation arrangement of the blower is dependant upon many factors such as space limitations, physical size of the blower, boiler type/size, and blower manufacturer. In some instances, it will be necessary to provide an air transition duct for connection between the blower outlet to the burner inlet. It is recommended that a rubber gasket (approximately 1/8" or 3mm thick) of a durometer of 50 be placed between the flanges of the blower and the burner to eliminate the possibility of air leakage. When bolting the blower to the burner, always use lock washers and/or nylon-insert locknuts where possible.

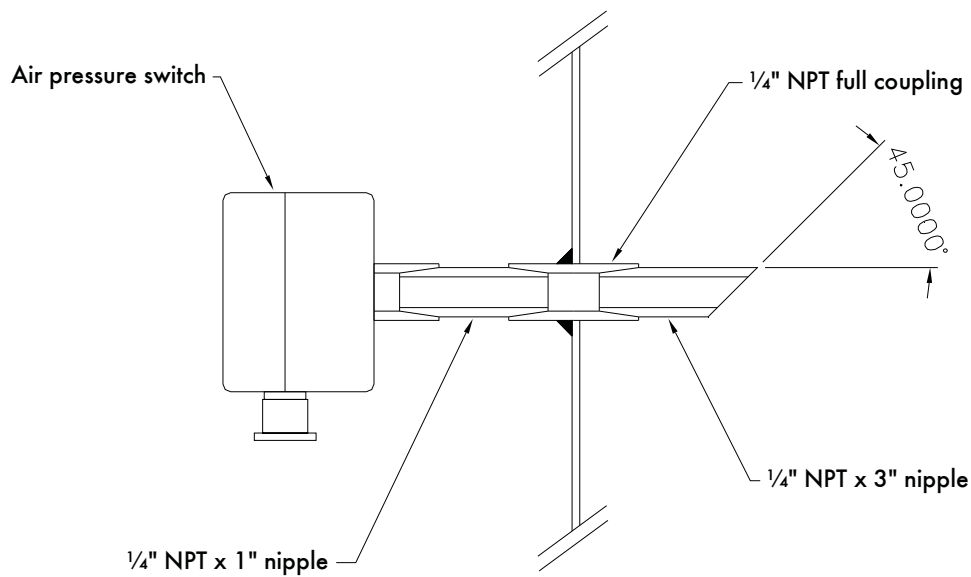


Figure 4: Air pressure switch detail (high pressure connection)

After installing the blower and transition duct to the burner, the air pressure proving switch should be installed as per figure 4 into the 1/4" NPT nipple factory welded into the air transitional duct which is located between the blower and the burner. If the air inlet transition is supplied by those other than Limpfield Combustion, a 1/4" NPT full coupling should be fully welded through the transition wrapper 3" back from the burner connection flange and along the center line on the width of the duct so that 2 off 1/4" NPT pipe nipples (schedule 40) can be fitted to either end one for the air pressure switch to be mounted to and the other 1/4" nipple to be Beveled as shown in figure 4 above to an angle of 45 degree angle and then positioned in-line with the airflow stream. The low pressure sensing line (vacuum connection of a differential pressure switch) should be connected before the high pressure side of the combustion air blower i.e. the vacuum side, this connection will be a 1/4" NPT connection on the inlet spigot to the combustion air blower as shown in figure 5 below with suitable piping to meet local codes.

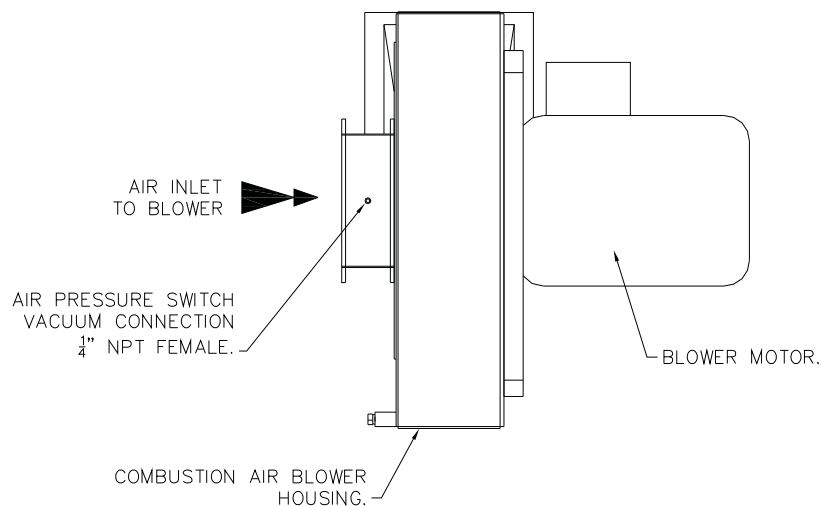


Figure 5: Air pressure switch detail (low pressure connection)

For the electrical connection information refer to factory supplied wiring diagram for the proper wiring of the air proving switch.

Combustion Air Requirements

Fresh air is required to support/maintain combustion as well as to provide adequate location ventilation, must be supplied to the burner/blower assembly as NFPA 31. All types of fuel require approximately 10 cubic feet of fresh air at sea level and 60 °F per 1000 BTUs being fired for theoretical perfect combustion. When actually firing fuel into a boiler/application excess air is required to ensure complete combustion, the less excess air used will mean less fuel is required and therefore more efficient and higher fuel savings, but this can vary substantially with specific job conditions. Additional air can be lost from the boiler room through barometric dampers, draft diverters and other venting devices etc. Under no circumstances should the boiler room be subject to a negative pressure. It is generally accepted that 3/4" square inch of free air opening (for each burner within the boiler room) per 1000 BTU/hr. Authority relating to combustion air and boiler room ventilation requirements vary widely and in order to make certain of compliance the controlling authorities should be consulted and to NFPA 31 to ensure all necessary requirements are met or exceeded for the application.

Burner Dimensions

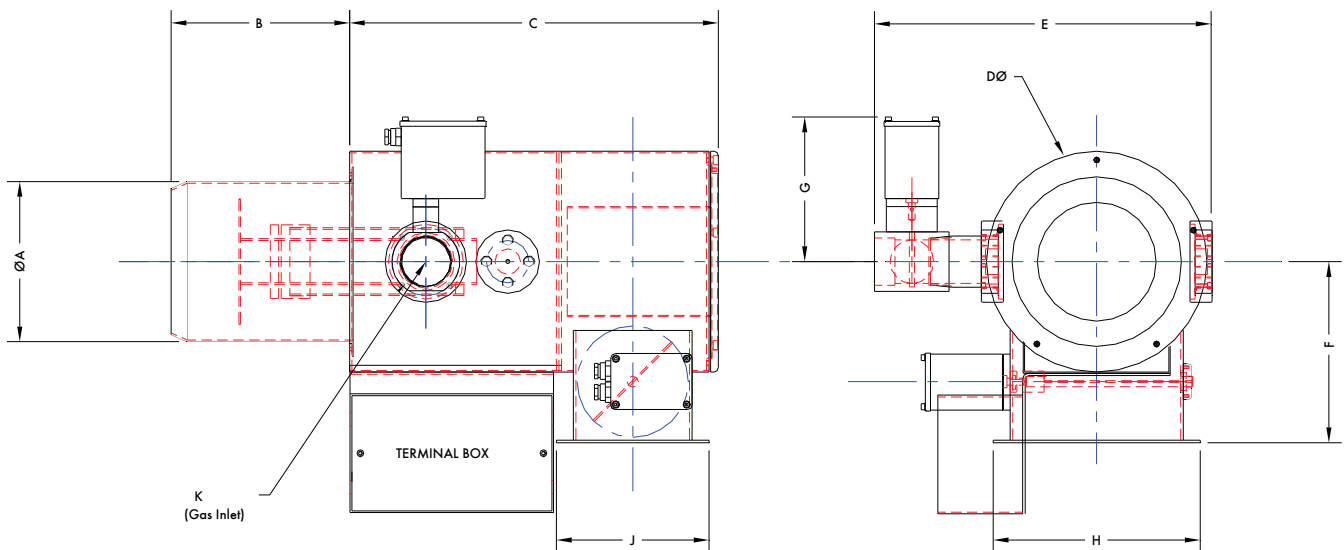
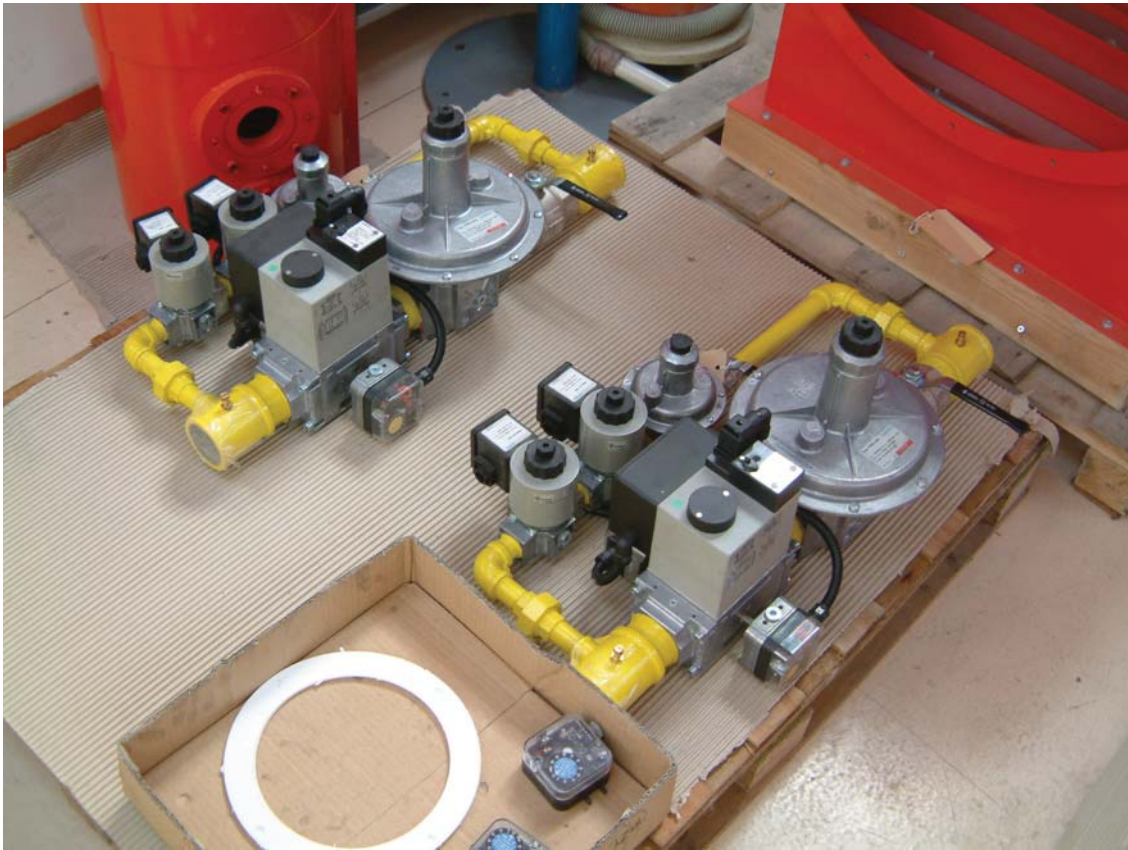


FIGURE 1: BURNER DIMENSIONS

MODEL	AØ	B	C	DØ	E	F	H	J	K
LCNO 9	6.94 (177)	8.24 (210)	17.13 (435)	10.25 (260)	15.50 (394)	8.31 (212)	9.63 (244)	7.00 (180)	2" NPT
LCNO 15	7.41 (189)	8.24 (210)	17.13 (435)	10.25 (260)	15.50 (394)	8.31 (212)	9.63 (244)	7.00 (180)	2" NPT
LCNO 21	10.13 (259)	15.98 (406)	25.25 (642)	15.16 (385)	17.92 (455)	12.20 (311)	14.25 (362)	9.50 (242)	2-1/2" 150lb flanged
LCNO 36	11.77 (299)	16.06 (408)	25.25 (642)	15.16 (385)	17.92 (455)	12.20 (311)	14.25 (362)	9.50 (242)	2-1/2" 150lb flanged

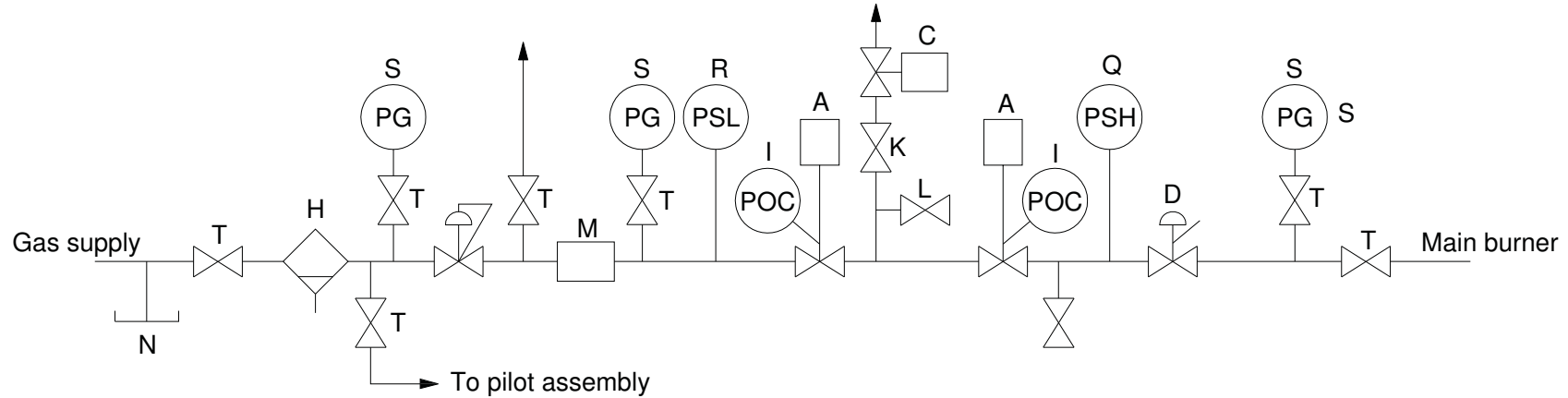
Section 8

Typical Gas control Train



2" gas control train assembled

NFPA 85 – Typical fuels supply system and safety control



- A - Safety shutoff valve, spring closing (NC)
- C - Vent valve, spring opening (NO)
- D - Gas modulating control valve (Autoflame)
- H - Gas strainer
- I - Proof of closure switch
- J - Constant gas pressure regulator valve
- K - Vent line manual shutoff valve for leakage testing (locked or sealed open)

- L - Leakage test connection
- M - Gas Meter (optional)
- N - Drip leg
- Q - High gas pressure switch
- R - Low gas pressure switch
- S - Pressure gauge
- T - Manual shutoff valve
- X - Low fire start switch

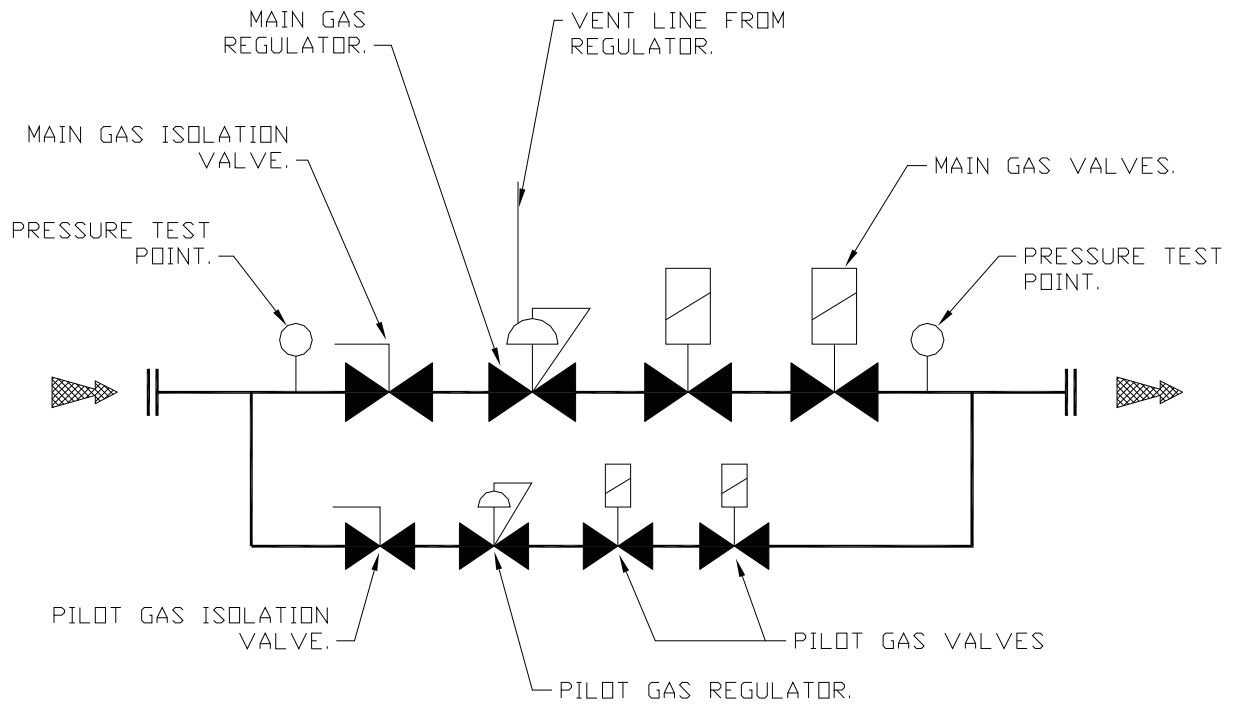
Safety shutdown interlocks (not shown)

- Flame detector (s)
- Excessive steam back pressure interlock (excessive water temperature and pressure interlock for hot water boilers)
- Auxiliary flow water cutoff (one required)
- Combustion air supply interlock

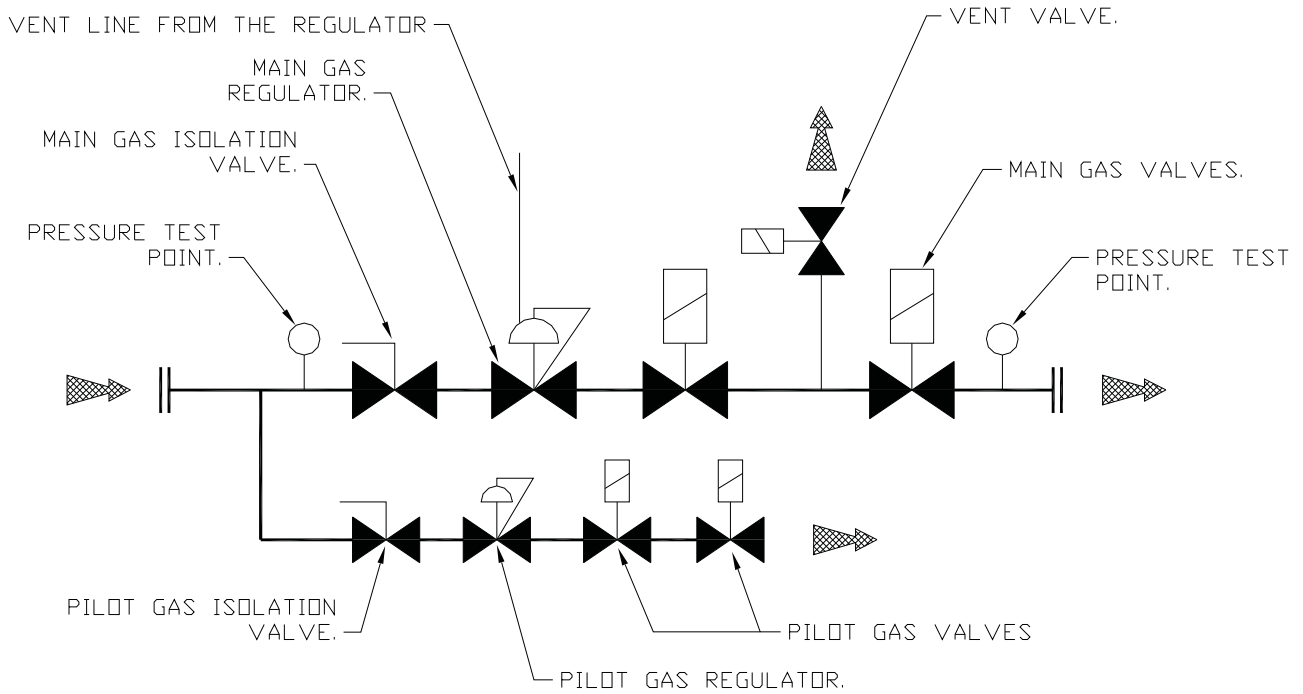
Note: NC = normally closed, de-energized / NO = normally open, de-energized.

Typical Gas Train.

Note: it is important that gas trains adhere to your local codes and requirements



Schematic of a typical gas train (Lc9-15)



Schematic of a typical gas train (Lc21-310)

Section 9

Typical Oil Train



Assembled oil pump with filter

Typical No2 Oil Train

Note: It is important that oil trains adhere to local codes and requirements.

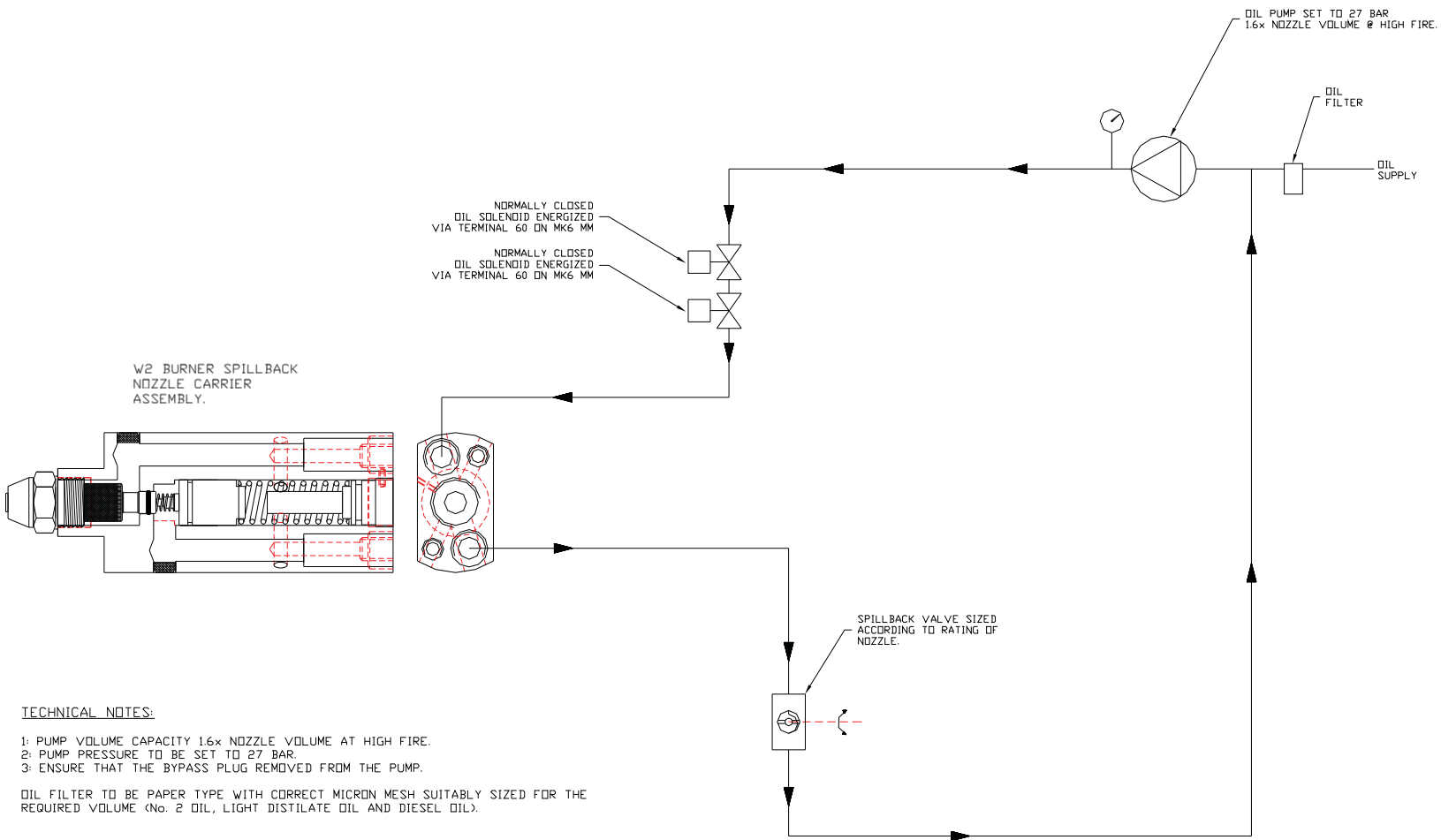


Figure 1: Typical Light Fuel Oil Hydraulic Schematic

Typical No6 Oil Train

Note: It is important that oil trains adhere to local codes and requirements.

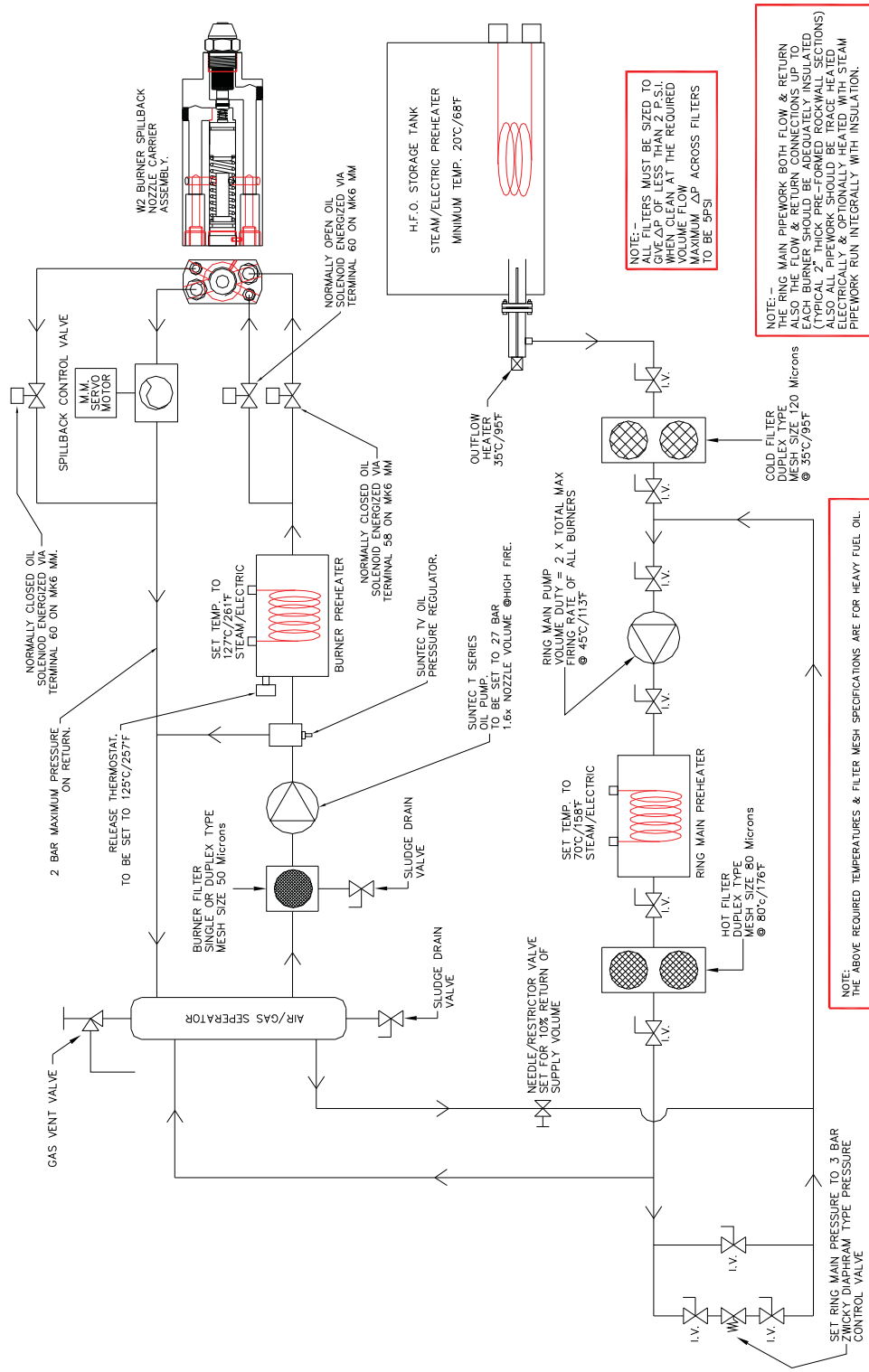


Figure 2: Typical Heavy Fuel Oil Hydraulic Schematic

Section 10

General start up procedure

General Start up Procedure

General Start up Procedure for all Fuels

The start up of the Limpsfield burner on either or all fuels must be carried out by a fully trained and qualified burner technician at all times. Please contact Limpsfield Engineering Technical Help for clarification on any of the above.

The start up should be witnessed by the end user or/and the operator in order that they are aware of the proper care and ongoing maintenance required for the burner package.

The start up technician should be trained and make themselves aware of the exact operation of the burner control safeguard. Limpsfield use the fully approved Autoflame Micro Modulation flame safeguard. The start up technician should be trained and certified in the correct operation of the Autoflame burner control products before attempting a start up of the Limpsfield burner.

Once the burner has been installed correctly in compliance of local codes In the absence of local codes the compliance should be referenced to: - ASME CSD-1 (Controls and Safety Devices for Automatically fired Boilers). In the absence of local codes, please see NFPA 85, Boiler and Combustion Systems Hazard Code, NFPA 54/ANSI Z223.1, National Fuel Gas Code, International Fuel Gas Code, NFPA 31, Standard for Installation of Oil-Burning Equipment and NFPA 70, National Electrical Code.

Before start up of the burner, the gas head, oil lance and ignition should be checked for tightness and that they are set to the correct positions (see Gas Manifold, Oil Gun assembly and Electrode sections in our O & M manual).

For Gas firing burners; the gas throughput should be checked at the gas meter to ensure that the correct amount of gas is being input in to the boiler furnace.

For Oil firing burners; the oil pressure supply from the oil pump must be set up as per the **Oil Gun section in our O & M Manual** to ensure that the correct amount of oil is input in to the boiler furnace. The oil throughput can be measured by an oil meter or the absence of an oil meter the throughput can be checked by supply and spillback oil pressures.

Procedures in general

1. Check and inspect that all burner package equipment has been installed correctly and the installation has been completed, this includes gas and oil pipe, control and general wiring etc.
2. Check electrical power is turned off.
3. Close all fuel isolation cocks as required.
4. Check and tighten all screws on terminal blocks on burner and control panel (some terminals may have become loose during shipping of burner package to site).
5. Check fuses are secure in main supply to the control panel and in the control panel. Check wiring to the burner and control panel for compliance to local codes (or to national codes as detailed above). Check that Voltage supply is correct to panel, motor starter and control circuit line connections.
6. Check that the boiler is ready for operation, that all boiler fireside surfaces are clean and unobstructed. Check breaching and boiler stack is clear, open and unobstructed.
7. Check that the FD Combustion Fan motor and Oil Pump motor rotate in the correct direction. The correct rotation is marked on the fan housing and pump assembly. The oil pump should be started only momentarily by making contact of the pump motor starter. Ensure that the oil pump is not run without being flooded with oil as this will damage the oil pump.
8. Check operation of all controls including but not limited to: - Burner flame safeguard lockout/reset, boiler pressure/temperature limits, low and high water level limits (if required), auxiliary low water cut off, air pressure sensor or air pressure switch, high and low gas pressure switches (if required) low oil pressure switch (if required) and any other switches as required for the particular installation. All contacts should be closed (except any gas and oil low pressure switches which may be closed and opened in failure mode).

9. If the burner fails to start during the normal start up procedure do not repeatedly recycle the burner until the failure to start has been identified and rectified, this is to ensure that any unburned fuel is not deposited into the boiler combustion chamber.
10. The Limpsfield burner cycle/sequence will be controlled by the Autoflame Micro Modulation flame safeguard. The specific instructions for the operation of this flame safeguard are supplied to the trained technician during Autoflame training and can also be supplied from Limpsfield Engineering on request.
11. The correct combustion test equipment such as combustion gas analyzer, manometers, electrical testers etc. should be used to ensure the burner package is set up for reliable operation whilst maximizing end user safety.
12. Any combustion adjustments made to either the fuel or air controls to achieve the required input must be made using a calibrated combustion analyzer, a visual check to ensure that the flame is stable must also be made.
13. On completion of the start up/commissioning of the burner package, the Limpsfield Commissioning Report (found at the rear of the O & M manual in section 17) should be filled in completely, copy's should be sent to the end user, held by the commissioning technician and sent to Limpsfield Engineering.

General Information

The burner air damper and combined oil/gas valves are operated by individual servo motors, these servo motors can be accurately set to any position between 0 and 90 angular degrees. The commissioning process is fully described in the Autoflame Technical Manual section 2. The air damper and fuel valves can be programmed for a minimum of 5 positions or up to a maximum of 17 positions. Each position should be set

up to provide clean and efficient combustion from low to high fire. The air damper and fuel valves are driven to the correct position(s) to provide good combustion and electronically entered and locked into the Autoflame Micro Modulation Flame safeguard in order that when operating and modulating under normal conditions the same safe and efficient combustion is met at all times.

The servo motors controlling the air and fuel (Gas or Oil) should be set to achieve a smooth and reliable light off every time, once this is achieved the burner flame will modulate to meet the boiler load demand based on the settings programmed and entered by the trained commissioning engineer into the Autoflame Micro Modulation and flame safeguard. The high fire position is also locked into the electronic memory of the Autoflame Micro Modulation flame safeguard therefore ensuring that the high input position cannot be increased by the operator.

The gas is introduced via a dual gas shut off valve assembly and gas pressure regulator; this controls the on/off control of the gas as well as ensuring that the gas is supplied at a constant pressure to the burner. The gas volume is controlled using a butterfly gas metering valve and servo motor assembly.

The oil is introduced via a dual oil shut off valve assembly and an oil pump complete with oil pressure regulator; this controls the on/off control of the oil as well as ensuring that the oil is supplied at a constant pressure to the burner. The oil volume is controlled using a V slot oil spillback valve and servo motor assembly. The V slot oil valve is situated in the return oil line from the nozzle, this controls the amount of oil spilling back to the oil pump or oil supply. The spillback pressure controls the amount of oil being passed through the oil nozzle therefore controlling the firing rate.

Note: In the case of dual fuel burners; the oil and gas valve metering devices are direct coupled and controlled by one servo motor for the fuel control and one for the air damper control. When the burner is gas firing the oil V slot valve will also open/close as they are direct coupled but the main oil shut off valves remain closed therefore no oil is allowed to flow to the nozzle. When the burner is oil firing the gas butterfly valve will also open / close as they are direct coupled but the main gas shut off valves remain closed therefore no gas is allowed to flow to the gas head.

Gas start up specifics

Gas Burners

The Limpfield gas burners are designed to have 25 inches WC supplied to the gas head at high fire (this can vary depending on application and boiler furnace pressure, the pressure detailed is based on firing into atmospheric pressure, therefore the boiler furnace pressure needs to be added to this detailed pressure example: boiler furnace pressure at high fire = 4 inches WC, therefore $25 + 4 = 29$ inches WC). This pressure can be adjusted to suit the on site application and on site available gas pressure. The gas head injection gap can be increased or decreased to improve gas to air mixing (please see gas manifold section). The service technician should refer to the commission report if he/she is unsure of the correct gap setting of the burner.

1. Before any start up the technician should check with the local gas supplier for the Btu content of the gas supplied and if any pressure correction factors need to be considered before calculating the correct gas input. Gas heat content is assumed to be nominally 1000 Btu per cubic foot of gas. Ultimate CO₂ content is assumed to be 11.8%.
2. Check that gas components and pipe work are connected as per the relevant Gas Train section in our O & M manual.
3. Check all equipment supplied meets compliance to relative local or national codes.
4. Check all mechanical components are securely fitted to the burner package.
5. Check all wiring is sound and meets compliance to local or national codes. Check all wiring connections terminations for correct and tight termination.
6. Remove gas head and check for tightness and correct gas orifice setting.
7. Remove ignition assembly and check for correct gap setting, tightness of electrode and electrode cap connection.
8. It is recommended to turn off all fuel cocks and turn on only the electrical power, then operate both servo motors checking the correct closed position and that the air damper and fuel valves operate from 0 to 90 angular degrees to the fully open position. It is then recommended to operate the burner to a lockout condition with fuel valves still in the manually off/closed position to check the shut off safety of the burner package.
9. The pilot and main gas lines should be purged of air carried out in accordance with NFPA 54 and then all valves shut off and pipe work reconnected in readiness for firing burners.
10. All gas pipe work should be pressure checked for gas soundness, we advise that a "bubble leak test" is also carried out on all joints.
11. The correct testing equipment should be set up for commissioning purposes. (Please see testing equipment list at the end of this section).
12. Turn on the burner control panel and select the gas on/off selection switch. Using the Autoflame flame safeguard drive the air damper to approx 20 angular degrees and make sure that the low gas proving switches are made (this may require the partial opening of the main gas line cock to allow some gas to make the low gas pressure switch, once the low gas pressure switch is made the gas cock can then be closed). Once this is achieved the FD Combustion Air fan will start.
13. Using the Autoflame flame safeguard enter the high and low air positions (as per the Autoflame technical manual) and prove the air pressure switch operation, providing the air pressure switch is made the burner will go through the pre purge cycle. The burner will go through the purge cycle to the ignition cycle at this point the ignition transformer will be energized and after a pre determined time the pilot valves will open, although no pilot will be established as the pilot gas isolation cock will still be closed. This will result in a lockout from the Autoflame flame safeguard.
14. The technician should wait a minimum of 3 minutes and then reset the Autoflame flame safeguard with the pilot gas cock now opened. This will restart the burner. The Autoflame flame safeguard should be operated as before up to the ignition cycle, this time the pilot valves will open and gas will flow to the ignition assembly and pilot should be established. It is advisable to restart the burner to make sure the pilot is reliable and remains stable at pilot start up.
15. Once the pilot has been adjusted and is reliable the main gas cock should be opened slowly manually, the main gas flame should light immediately. Care must be taken to ensure that the air

damper is driven to meet the gas input at all times it is advisable to ensure that the combustion O₂ levels are in the region of 3 to 4% during this operation. DO NOT open the manual gas cock fully without checking the combustion throughout this process.

16. Once the manual gas cock is opened the Autoflame flame safeguard controller can be used to drive open/close the main gas butterfly valve and air damper to ensure safe combustion.
17. The burner gas valve and air damper should be increased to the full input requirement; the air damper should be adjusted to ensure the combustion sample reads between 2.5 and 3% O₂ and must not exceed the maximum CO concentration by safety standards, which is 400ppm air free. CO concentration in ppm must not exceed the local permitted levels.
18. The burner “electronic cam” “inter” positions should be commissioned from high fire to low fire in accordance to the Autoflame technical manual.
19. Start the burner several times to ensure safe and reliable start up, it is also recommended to modulate the burner from low fire to high fire several times to ensure good flame stability and combustion throughout the firing range.
20. Once the burner has been commissioned the technician should check and adjust as necessary and test all gas pressure switches, air pressure switches for correct operation to the manufacturer’s recommendations. The air pressure switch should be adjusted and set to shut down and cause a “lockout” to the burner if the air pressure is lower than the commission values.
21. The burner should be re-lit and set to the low fire position, the fuel valves should be turned off, flame failure should occur resulting in a lockout, all safety shut off fuel valves should be checked to ensure that they have been de energized and have closed and that the burner package has shut down in a safe manner.
22. The boiler water levels, high temperature/high pressure limits should be checked to make sure they turn off the burner as designed and remain in the off condition until the limit or fault has been rectified.
23. If the burner turns off on pressure/temperature due to the Autoflame flame safeguard internal PID, the burner will turn back on at the pre determined set point (set by the trained technician).
24. If water levels are fitted to the boiler (steam applications) the boiler should be blown down to check the operation of the water level controls. When the water falls below the set water level the burner should turn off and restart automatically when the water level is restored to the correct level. With some applications a low water cut out is employed this will require a manual reset before the burner turns back on and is not an automatic operation.

Oil start up specifics

Oil Burners

LC9 and 15 burners

The LC9 and LC15 Limpsfield oil burners are designed to have the oil pressurized to 300 psi supplied to the oil nozzle throughout the firing range including high and low fire. The firing rate is adjusted by a V slot spillback valve situated in the return oil line after the nozzle. The V slot spillback valve is controlled by a servo motor which in turn is controlled by an Autoflame Micro Modulation Flame safeguard controller. The typical spillback pressure at high fire will be in the region of 220 psi. The typical spillback pressure at low fire will be in the region of 60 to 100 psi.

LC21 and 36 burners

The LC21 and LC36 Limpsfield oil burners are designed to have the oil pressurized to 370 psi supplied to the oil nozzle throughout the firing range including high and low fire. The firing rate is adjusted by a V slot spillback valve situated in the return oil line after the nozzle. The V slot spillback valve is controlled by a servo motor which in turn is controlled by an Autoflame Micro Modulation Flame safeguard controller. The typical spillback pressure at high fire will be in the region of 310 psi. The typical spillback pressure at low fire will be in the region of 160psi.

1. Before any start up the technician should check with the local oil supplier for the Btu content of the oil supplied before calculating the correct oil input. Oil heat content is assumed to be nominally 19,600 Btu/lb. Ultimate CO₂ content is assumed to be 15.2%.
2. Check that oil components and pipe work are connected as per the relevant Oil Train sections in our O & M manual.
3. Check all equipment supplied meets compliance to relative local or national codes.

4. Check all mechanical components are securely fitted to the burner package.
5. Check all wiring is sound and meets compliance to local or national codes. Check all wiring connections terminations for correct and tight termination.
6. Remove oil lance and check for tightness and correct nozzle is fitted and tightened.
7. Remove combustion head and ignition assembly and check for correct gap setting, tightness of electrode and electrode cap connection.
8. It is recommended to turn off all fuel cocks and turn on only the electrical power, then operate both servo motors checking the correct closed position and that the air damper and fuel valves operate from 0 to 90 angular degrees to the fully open position. It is then recommended to operate the burner to a lockout condition with fuel valves still in the off/closed position to check the shut off safety of the burner package.
9. All oil pipe work should be pressure checked for oil soundness, we advise that a visual check for leaks is also carried out on all joints.
10. The correct testing equipment should be set up for commissioning purposes. (Please see testing equipment list at the end of this section).
11. Turn on the burner control panel and select the oil on/off selection switch, using the Autoflame flame safeguard drive the air damper to approx 20 angular degrees and make sure that the low oil switch is made (this may require the opening of the main oil line cock to allow some oil to make the low oil pressure switch, once the low oil pressure switch is made the oil cock can then be closed). Once this is achieved the FD Combustion air fan will start.
12. Using the Autoflame flame safeguard enter the high and low air positions (as per the Autoflame technical manual) and prove the air pressure switch operation, providing the air pressure switch is made the burner will go through the pre purge cycle. The burner will go through the purge cycle to the ignition cycle at this point the ignition transformer will be energized and after a pre determined time the pilot valves will open, although no pilot will be established as the pilot gas isolation cock will still be closed. This will result in a lockout from the Autoflame flame safeguard.
13. The technician should wait a minimum of 3 minutes and then reset the Autoflame flame safeguard with the pilot gas cock now opened. This will restart the burner. The Autoflame flame safeguard should be operated as before up to the ignition cycle, this time the pilot valves will open and gas will flow to the ignition assembly and pilot should be established. It is advisable to restart the burner to make sure the pilot is reliable and remains stable at pilot start up.
14. Once the pilot has been adjusted and is reliable the burner should be turned off and the main oil cock should be opened manually.
15. The burner should be restarted through to the pilot cycle, once the Autoflame flame safe guard has monitored the pilot flame the oil solenoid valves will open, care must be taken to ensure that the air damper is driven to meet the oil input at all times it is advisable to ensure that the combustion O₂ levels are in the region of 3 to 4% during this operation. The Autoflame flame safeguard controller can be used to drive open/close the main oil V slot valve and air damper to ensure safe combustion. A smoke spot test must be carried out and checked against a Shell Bacharach scale and must not exceed a No. 2. Typically the burner should be set for a 0 level with a No. 1 maximum.
16. The burner oil V slot valve and air damper should be increased to the full input requirement; the air damper should be adjusted to ensure the combustion sample reads between 3 and 3.5% O₂ without causing any smoke to form from the combustion. A smoke spot test must be carried out and checked against a Shell Bacharach scale and must not exceed a No. 2 level. Typically the burner should be set for a 0 level with a No. 1 maximum.
17. The burner "electronic cam" "inter" positions should be commissioned from high fire to low fire in accordance to the Autoflame technical manual.
18. Start the burner several times to ensure safe and reliable start up, it is also recommended to modulate the burner from low fire to high fire several times to ensure good flame stability and combustion throughout the firing range.
19. Once the burner has been commissioned the technician should check, adjust as necessary and test the low oil pressure switch, air pressure switches for correct operation to the manufacturer's recommendations. The air pressure switch should be adjusted and set to shut down and cause a "lockout" to the burner if the air pressure is lower than the commission values. Once the low oil pressure switch has been correctly set a test of operation should be carried out, close the isolation valve on the oil supply to the oil pump and start burner, the low oil pressure switch should hold off the burner from firing and the burner panel indicator for low oil pressure should be illuminated, open the oil isolation valve and check the system has re-set and the panel indicator is off. The air pressure

switch should also be tested by isolating the power to the blower motor and trying to start the burner, when the blower fails to start the air pressure switch will cause a lockout on the Autoflame control system, reinstate the power to the blower motor and reset the Autoflame controller, fire the burner and check correct operation.

20. The burner should be re lighted and set to the low fire position, the fuel valves should be turned off, flame failure should occur resulting in a lockout, all safety shut off fuel valves should be checked to ensure that they have been de energized and have closed and that the burner package has shut down in a safe manner.
21. The boiler water levels, high temperature/high pressure limits should be checked to make sure they turn off the burner as designed and remain in the off condition until the limit or fault has been rectified.
22. If the burner turns off on pressure/temperature due to the Autoflame flame safeguard internal PID, the burner will turn back on at the pre determined set point (set by the trained technician).
25. If water levels are fitted to the boiler (steam applications) the boiler should be blown down to check the operation of the water level controls. When the water falls below the set water level the burner should turn off and restart automatically when the water level is restored to the correct level. With some applications a low water cut out is employed this will require a manual reset before the burner turns back on and is not an automatic operation.

The following general test equipment is required during Start up and Servicing works.

1. Exhaust Gas analyzer, measuring O₂ or CO₂ or both
2. CO indicator
3. Exhaust stack temperature thermometer
4. U tube manometer or digital manometer (ideally calibrated from 0 to 35 inches WC)
5. Draft gauge (digital or inclined manometer)
6. Electrical tester measuring Volts and Amps
7. Commissioning reports

Gas only test equipment requirements in addition to general test equipment.

1. Gas Meter (if not fitted to site application)
2. U tube manometer or digital manometer (ideally calibrated from 0 to 35 inches WC)
3. Gas pressure Gauge (if not fitted to site application)

Oil only test equipment requirements in addition to general test equipment.

1. Oil pressure gauge to measure oil supply pressure of 300 psi (LC9/15)
2. Oil pressure gauge to measure oil supply pressure of 400 psi (LC21/36)
3. Oil pressure gauge to measure oil spillback return pressure of 60 psi (LC9/15)
4. Oil pressure gauge to measure oil spillback return pressure of 160 psi (LC21/36)
5. Smoke tester, papers and smoke chart (Shell Bacharach)

Section 11

Service Recommendations

Standard burner routine checks and maintenance

Detailed below are general recommendations for routine checks and maintenance for the Limpfield burner. These should be carried out in a safe and appropriate manner, and in accordance with any related health and safety policies. Additional checks may be required by local codes and end user company policies.

A log should be maintained for each burner/boiler on site. This log should detail checks and maintenance outlined within to ensure safe and correct operation of the burner equipment.

Please see the table below detailing the item to check, frequency, who to carry out the checks and the remarks.

Item	Frequency	Checked By	Remarks
Gauges, monitors and indicators	Daily	Operator	Make visual inspection and record readings in a log
Instrument and equipment setting	Daily	Operator	Make visual check against heat exchanger manufacturer's recommended specifications.
Check burner flame	Daily	Operator	Check combustion to commissioned values
Firing rate control	Weekly	Operator	Check heat exchanger manufacturer's settings
	Semi annually	Service Tech.	Check heat exchanger manufacturer's settings
	Annually	Service Tech.	Check with combustion check
Combustion air	Weekly	Operator	All sources remain clean and open
Ignition system	Weekly	Operator	Open limit switch, carry out aural and visual checks
Check flame signal strength	Weekly	Operator	Monitor UV signal via the MM display and log data
Pilot, fuel valves	Weekly	Operator	Perform leakage tests – refer to the valve manufacturers instructions
UV scanner	Weekly	Operator	Shut burner down via the main gas or oil valves to lockout burner. Check lockout timing and log data
Check flue, vent, stack or outlet dampers	Monthly	Operator	All sources remain clean and open
Test low draft, fan air pressure and damper position interlocks	Monthly	Operator	Check operation of interlock devices and log data
Test high and low oil pressure and temperature interlocks	Monthly	Operator	Check operation of interlock devices and log data
Test high and low gas pressure interlocks	Monthly	Operator	Check operation of interlock devices and log data
Remove oil lance assembly	Semi annually	Service Tech.	Remove, clean and inspect as detailed in section 12
Inspect burner service components	Semi annually / Annually	Service Tech.	As described in section 12
Oil pump assembly	Semi annually	Service Tech.	Check oil pump operation to manufacturer recommendations
Firing rate control	Semi annually	Operator	Check heat exchanger

			manufacturer's settings
Check flame failure detection system	Semi annually	Operator / Service Tech	Shut burner down via the main gas or oil valves to lockout burner. Check lockout timing and log data. Monitor UV signal via the MM display and log data
Gauges and indicators	Semi annually	Operator	Re-calibrate all indicator and gauges
Piping and wiring	Semi annually	Service Tech	Check all piping and wiring of all interlocks and shutoff valves.
High limit safety control	Annually	Service Tech.	Check high limit operation to heat exchanger's instructions
Combustion air fan impeller	Annually	Service Tech.	Inspect and clean as per manufacturer's instructions
Gas head and pilot assembly	Annually	Service Tech.	Remove and clean as described in section 12
Pilot turndown test	Annually	Service Tech.	Required after service or repair works – refer to manufacturer instructions
Refractory hold in	Annually	Service Tech.	See "pilot turndown test"
Low fire interlock	Annually	Service Tech	Test low fire interlock in accordance with manufacturers instructions
Purge position interlock	Annually	Service Tech	Test purge position interlock in accordance with manufacturers instructions
Purge air switch	Annually	Service Tech	Test purge air switch interlock in accordance with manufacturers instructions
Leakage tests	Annually	Service Tech	Perform leakage test on pilot and main gas and/or oil valves
Fuel valve interlock	Annually	Service Tech	Test Fuel valve interlock in accordance with manufacturers instructions
Coils and diaphragms	Annually	Service Tech	Check coils and diaphragms in accordance with manufacturers instructions, test other parts of all safety shutoff and control valves.
Combustion check	Annually	Service Tech	Check Burner combustion with a suitable combustion analyser and adjust as required.
UV scanner	Annually	Service Tech	Replace scanner in accordance with manufacturers instructions
Dual fuel change over	Annually	Service Tech	Check dual fuel changer over for correct operation.
Sediment trap and gas strainers	Semi annually /as required (site	Service check / operator	Check and clean as required.

	dependant)		
Oil filter / Oil atomiser	Semi annually /as required (site dependant)	Service check / operator	Check clean and change as required.
Pilot turndown test	Annually (as required)	Service Tech.	Required after service or repair works – refer to manufacturer instructions
Refractory hold in	Annually (as required)	Service Tech.	See “pilot turndown test”

All routine checks should be carried out along with any local codes or site specific maintenance requirements.

Please refer to heat exchanger manufacturer’s instructions for any further exchanger specific procedures for fluid levels, heat and pressure tests.

All service works should be carried out by a fully trained technician to a safe and competent level. All operators should be trained to a level that is suitable for the operation of the installed equipment.

Section 12

General Burner Servicing Procedure

Burner Servicing Procedure

The servicing of the Limpsfield burner on either gas or oil or both fuels must be carried out by a fully trained and qualified burner technician at all times. Please contact Limpsfield Engineering Technical Help for clarification if unsure.

The completed service should be signed and witnessed by the end user or/and the operator in order that they are aware of the proper care and ongoing maintenance required for the safe operation of the burner package.

The start up technician should be trained and make themselves aware of the exact operation of the burner control safeguard. Limpsfield use the fully approved Autoflame Micro Modulation flame safeguard. The start up technician should be trained and certified in the correct operation of the Autoflame burner control products before attempting a service up of the Limpsfield burner.

The service technician should check that the burner has been installed correctly in compliance of local codes (In the absence of local codes the compliance should be referenced to: - ASME CSD-1 Controls and Safety Devices for Automatically fired boilers, NFPA 85 for Boiler and Combustion Systems Hazard Code, NFPA 54 for gas-fired boilers, NFPA 32 for oil-fired boilers and NFPA 70 for Electrical Codes.

Gas Burners

The Limpsfield gas burners are designed to have 25 inches WC supplied to the gas head at high fire (this can vary depending on application and boiler furnace pressure, the pressure detailed is based on firing into atmospheric pressure, therefore the boiler furnace pressure needs to be added to this detailed pressure example: boiler furnace pressure at high fire = 4 inches WC, therefore $25 + 4 = 29$ inches WC). This pressure can be adjusted to suit the on site application and on site available gas pressure. The gas head injection gap can be increased or decreased to improve gas to air mixing (please see gas manifold section). The service technician should refer to the commission report if he/she is unsure of the correct gap setting of the burner.

Oil Burners

LC9 and 15 burners

The LC9 and LC15 Limpsfield oil burners are designed to have the oil pressurized to 300 psi supplied to the oil nozzle throughout the firing range including high and low fire. The firing rate is adjusted by a V slot spillback valve situated in the return oil line after the nozzle. The V slot spillback valve is controlled by a servo motor which in turn is controlled by an Autoflame Micro Modulation Flame safeguard controller. The typical spillback pressure at high fire will be in the region of 220 psi. The typical spillback pressure at low fire will be in the region of 60 to 100 psi.

LC21 and 36 burners

The LC21 and LC36 Limpsfield oil burners are designed to have the oil pressurized to 370 psi supplied to the oil nozzle throughout the firing range including high and low fire. The firing rate is adjusted by a V slot spillback valve situated in the return oil line after the nozzle. The V slot spillback valve is controlled by a servo motor which in turn is controlled by an Autoflame Micro Modulation Flame safeguard controller. The typical spillback pressure at high fire will be in the region of 310 psi. The typical spillback pressure at low fire will be in the region of 160psi.

The spillback pressures are dependant on upon application and nozzle selection.

Oil nozzles

To prolong the life of the nozzle, correct filtering of oil should be employed at all times. Filtering should be to 40 microns, the oil supplied should be commercially clean and filtered. Dismantling of the nozzle must be carried out carefully to ensure the hardened nozzle orifice does not get damaged. The nozzles are fitted with an 'O' ring seal this must be replaced if it is damaged or scored in any way.

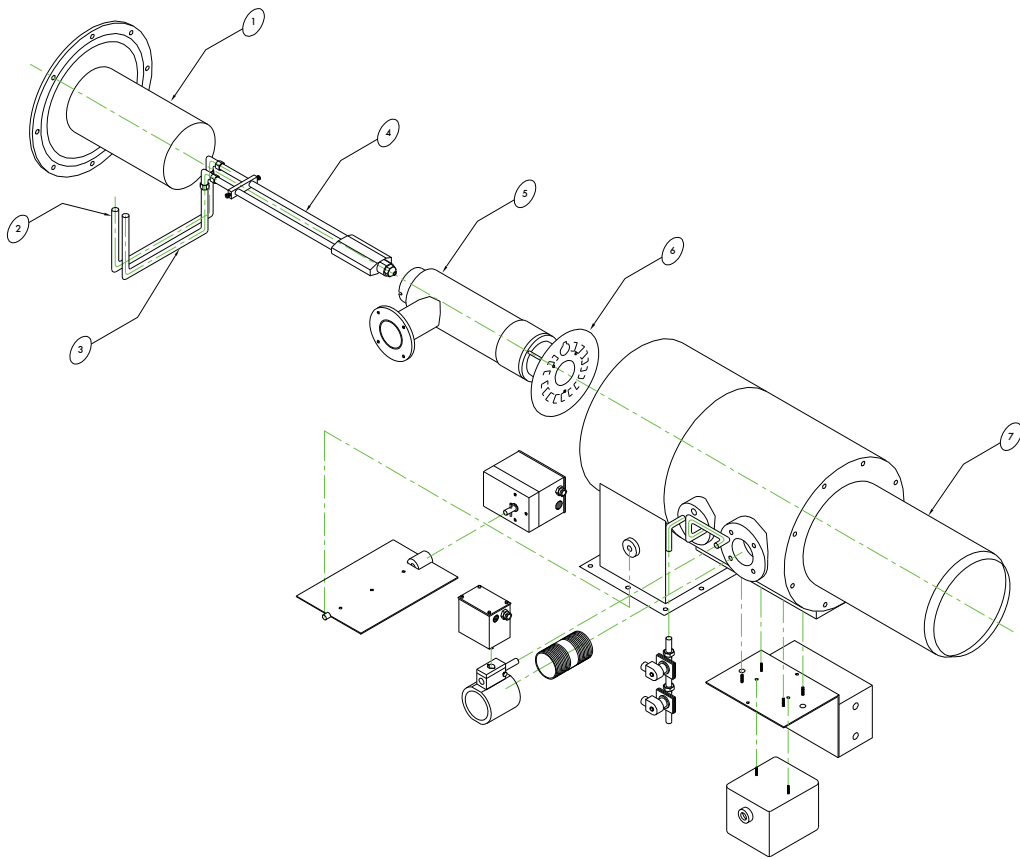
If the flame shape has deteriorated or/and has become smoky this could be due to a worn nozzle or it could be that the oil supply or spillback pressure has been adjusted too low. Check nozzle condition, supply and spillback oil pressures and oil filter cleanliness during every service or if the flame is not burning cleanly.

The nozzles are designed to be “non drip” the LC 21 and LC36 have an inbuilt positive nozzle shut off system to ensure no after drip. Sometimes nozzle drip can be caused by air in the oil pipe work, if this is the case ensure that all of the air is expelled from the oil pipe work before re firing the burner.

The burners are fitted with a check valve in the return pipe work this should be checked for debris and correct operation.

Always use calibrated ‘U’ tubes, pressure gauges when commissioning on gas, you will also require a smoke tester when commissioning on the burner on oil. Oil spillback pressure gauges are fitted to the burner as standard.

The following servicing procedures should be employed: -



1. Sight Glass Assembly/Access Door
2. Oil Flow to Lance connections
3. Oil Return From Lance connections
4. Oil Lance assembly
5. Gas Manifold
6. Diffuser Plate
7. Blast Tube

Please follow the instructions below for burner strip down for servicing.

Ensure all Fuel and Electrical supplies to the burner are isolated before commencing with the procedure listed below. Service work should be carried out by a fully trained service technician.

1. Remove sight glass assembly/access door by undoing the retaining bolts.
2. Disconnect oil flow to lance connections and remove from the burner (only required on oil)
3. Disconnect oil return to lance connections and remove from the burner (only required on oil)
4. Remove oil lance by loosening the retaining bolts on the rear oil lance support, now the lance can be removed (only required on oil).
5. Remove oil nozzle and replace o-ring/nozzle as required (only required on oil)
6. Remove Gas manifold by undoing the 4 fixings where the gas manifold meets the burner housing, remove the manifold ensure care is taken not to damage the ignition lead which has to be removed as the gas manifold is removed.
7. Check the diffuser plate for any distortion or heat damage and replace as required.
8. Clean any deposits from the diffuser.
9. Clean and check the pilot assembly as required (LC21 and 36 only)
10. Check ignition electrode for cracks or damage.
11. Check the blast tube for heat damage especially the combustion chamber end.
12. Reset ignition and pilot as shown in sections 3 & 5.
13. Check air damper for excessive play on connection to servo motor.
14. Ensure gas manifold o-ring seal is not damaged before re-fitting the gas manifold.
15. Re-assemble burner by reversing steps 6 through to 1

Ensure all fixings and equipment are tight before firing the burner after service work has been carried out. Once the burner is fired a combustion check must be carried out on both fuels as appropriate.

Oil Pump maintenance

The oil pump is a crucial part of the oil delivery system to enable the burner to operate correctly. The oil to the pump should be piped from the oil tank to the oil pump via an isolation valve and to a supply oil filter that is selected to suit the supply pressure and to filter the oil to 40 microns (dependant on site and application). The oil filter must be well maintained to avoid damage to the pump see section 11 for oil filter maintenance. Oil supplied should be commercially clean.

The oil pump will need to deliver as follows:

Burner Model	Pump volume (Kg/hr)	Pump outlet pressure	Maximum inlet pressure
LCNO9	118	290 psi	6.5 psi
LCNO15	197	290 psi	6.5 psi
LCNO21	276	370 psi	6.5 psi
LCNO36	496	370 psi	6.5 psi

All information shown in the table above is typical information, if in doubt please contact Limpsfield's technical department.



Gas Control Train Maintenance

All electrical connections on the gas control train should be checked to ensure connections are tight. Any filters before the gas train should be checked and cleaned as needed to ensure correct operation. When burner is firing gas inlet and outlet pressure should be checked to the commissioned combustion figures to ensure safe operation, a combustion check must also be carried out.

Section 13

Fault Finding

Fault Finding

Gas, Oil and Gas/Oil combined burner

Fault finding should only be undertaken by a fully trained qualified burner technician. The burner technician should ensure that he has the correct tools to carry out the required tasks.

The burner technician should be trained and certified in the use of the Autoflame Micro Modulation and Flame Safeguard and associated products. Refer to the manufacturer's technical manual and periodical bulletins.

When checking the burner components it is important to remember that individual components may be energized and de energized automatically by the flame safeguard. Always turn the power supply off and close the fuel valves when carrying out routine maintenance.

The boiler room should be clean of combustible materials and must have sufficient combustion and ventilation air at all times to meet local or national codes.

Fault	Possible solution
Burner fails to start	<ol style="list-style-type: none">1. Power not turned on to control panel.2. Faulty fuses in panel check and replace if required.3. Faulty burner on/off switch.4. Open circuit in control circuit. Check all safety devices, limit switches, water level controls, auxiliary switches, proof of closure switches, etc.5. Air pressure switch (sensor if fitted) failure, (check burner safeguard controller).6. Loose connections or faulty wiring, check and tighten wiring terminals. Use wiring diagram to check for correct connections.7. FD Combustion fan, motor overload trip, reset and determine reason for trip, i.e. motor damage or loose wiring connections.8. FD Combustion fan motor faulty, replace if required.9. Flame Safeguard locked out reset and determine reason for lockout.
Burner starts but locks out after 10 seconds	<ol style="list-style-type: none">1. Air pressure switch or air sensor faulty, replace as required2. Wiring to air pressure switch faulty, check and rewire if required.
Burner fails to light at pilot stage	<ol style="list-style-type: none">1. Pilot gas is not tuned on, turn gas isolation cock on.2. Gas pilot solenoid valves faulty, check pilot valves open when energized.3. Gas pilot valves faulty, check wiring connections.4. Check gas supply to burner is ok. Gas supply can occasionally be low check with local gas supplier if required.5. Check pilot gas pressure regulator is set correctly.6. Ignition fails to provide "ignition spark", check condition of electrode porcelain for cracks or possible visible evidence of arcing, check ignition lead for cracks, check ignition lead to electrode connector for cracks replace any or all parts as necessary.7. Check position and setting of ignition electrode (see electrode section 5)8. Ignition transformer faulty, if above points are ok the transformer may be faulty replace if required.9. Ignition transformer faulty, check wiring connections.
Burner pilot lights but then extinguishes	<ol style="list-style-type: none">1. UV flame scanner is not seeing the flame, check that UV flame scanner is aiming at the flame.2. UV flame scanner is not seeing the flame, check wiring connections.3. UV flame scanner is not seeing the flame UV flame scanner may require changing, replace as required.

Gas Specific

Burner pilot lights but main fuel (gas) does not light	<ol style="list-style-type: none">1. Gas supply is turned off. Turn on main gas isolation cocks.2. Gas solenoid valves faulty, check valves open when energized.3. Gas valves faulty, check wiring connections.
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	<ol style="list-style-type: none"> 4. Check fuel supply to burner is ok. Gas supply can occasionally be low check with local gas supplier if required. 5. Check gas pressure regulator is set correctly. Gas pressure regulator must have the vent to atmosphere free from any obstruction. 6. UV flame scanner is not seeing the main flame, check that UV flame scanner is aiming at the flame. 7. Defective flame safeguard, replace if required.
High fire cannot be achieved (gas)	<ol style="list-style-type: none"> 1. Main gas supply pressure is low, contact gas supplier. 2. Gas isolation cocks partially closed in gas line, open fully. 3. Check gas throughput at gas meter and check with original commissioning report. 4. Make sure gas pipe is sized correctly and is not obstructed. 5. Check that gas pressure regulator is correctly sized and regulator spring is adjusted to the same pressure as originally commissioned. 6. Check gas pressure regulator is set correctly. Gas pressure regulator must have the vent to atmosphere free from any obstruction.
CO being formed	<ol style="list-style-type: none"> 1. Gas flame is impinging on combustion chamber surface, ensure that correct fuel/air ratios and combustion is set correctly, the burner may be over fired, reduce gas flame to the correct input. 2. Check for correct fuel/air ratios and combustion is set correctly, O2 values should read in between 2 to 3% without making CO. Re-adjust gas/air ratios to correct CO condition. 3. Adjust gas injection gap to improve gas/air mixing at the combustion head.

Oil specifics

Burner pilot lights but main fuel (oil) does not light	<ol style="list-style-type: none"> 1. Oil supply is turned off. Turn on main gas isolation cocks. 2. Oil solenoid valves faulty, check valves open when energized. 3. Oil valves faulty, check wiring connections. 4. Check fuel supply to burner is ok. Oil supply from local tank could be isolated or tank could be empty. 5. Check oil pump is rotating correctly in the correct direction. Check motor wiring connections, check motor windings for integrity, check motor to pump coupling. 6. Check oil pressure regulator is set correctly. 7. Check oil filter is clean and unobstructed, replace if required. 8. UV flame scanner is not seeing the main flame, check that UV flame scanner is aiming at the flame. 9. Defective flame safeguard, replace if required.
High fire cannot be achieved (oil)	<ol style="list-style-type: none"> 1. Main oil supply pressure is low, check oil supply line for tank. 2. Oil isolation cocks partially closed in oil line, open fully. 3. Check oil throughput at oil meter and check with original commissioning report. 4. Make sure oil pipe is sized correctly and is not obstructed. 5. Check that oil pressure regulator is correctly sized and regulator spring is adjusted to the same pressure as originally commissioned. 6. Check oil pump is rotating correctly in the correct direction. Check motor to pump coupling is tight.
Oil flame producing black smoke	<ol style="list-style-type: none"> 1. Oil flame is impinging on the combustion chamber surface, ensure that the flame is not over fired, reduce oil flame to the correct input. 2. Check for correct fuel/air ratios and combustion is set correctly, O2 values should read in between 3 to 4% without making any smoke. Re-adjust oil/air ratios to correct smoky condition. 3. Faulty nozzle or blocked nozzle, clean or replace as required. 4. Oil pressure too high, check oil pump and oil pressure regulator for correct adjustment.

	5. Oil lance and nozzle assembly incorrectly position, set up as described in oil gun assembly section of O & M manual.
Oil flame producing white smoke	<ol style="list-style-type: none"> 1. Oil flame is over aired, check for correct fuel/air ratios and combustion is set correctly, O2 values should read in between 3 to 4% without making any smoke. Re-adjust oil/air ratios to correct white smoky condition 2. Oil flame is over aired, check for low oil pressure due to incorrectly adjusted oil pressure regulator, adjust as required. 3. Oil flame is over aired, check for blocked oil filter, clean or replace as required.

All information shown in the table above is typical information, if in doubt please contact Limpsfield Engineering's technical department.

Section 14

Commissioning Report

Commissioning report



Site Name														Engineer						
Burner/ equipment																				
Fuel type																				
	channel 1	channel 2	channel 3	channel 4	channel 5	channel 6	O2 %Vol	CO2 %Vol	CO ppmvd	NO ppmvd	SO2 ppmvd	Smoke number	T exhaust oF	Pwindbox "WG	Pfurnace "WG	Pstack "WG	Pfuel supply	Pfuel return (oil only) (Spillback)		
																	psi	psi		
High																				
1																				
2																				
3																				
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11																				
12																				
13																				
14																				
15																				
Low																				
FGR start																				
Golden start																				
Comments																				
Engineer												Customer								