O&M Manual
LP Burner series

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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 safety 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:

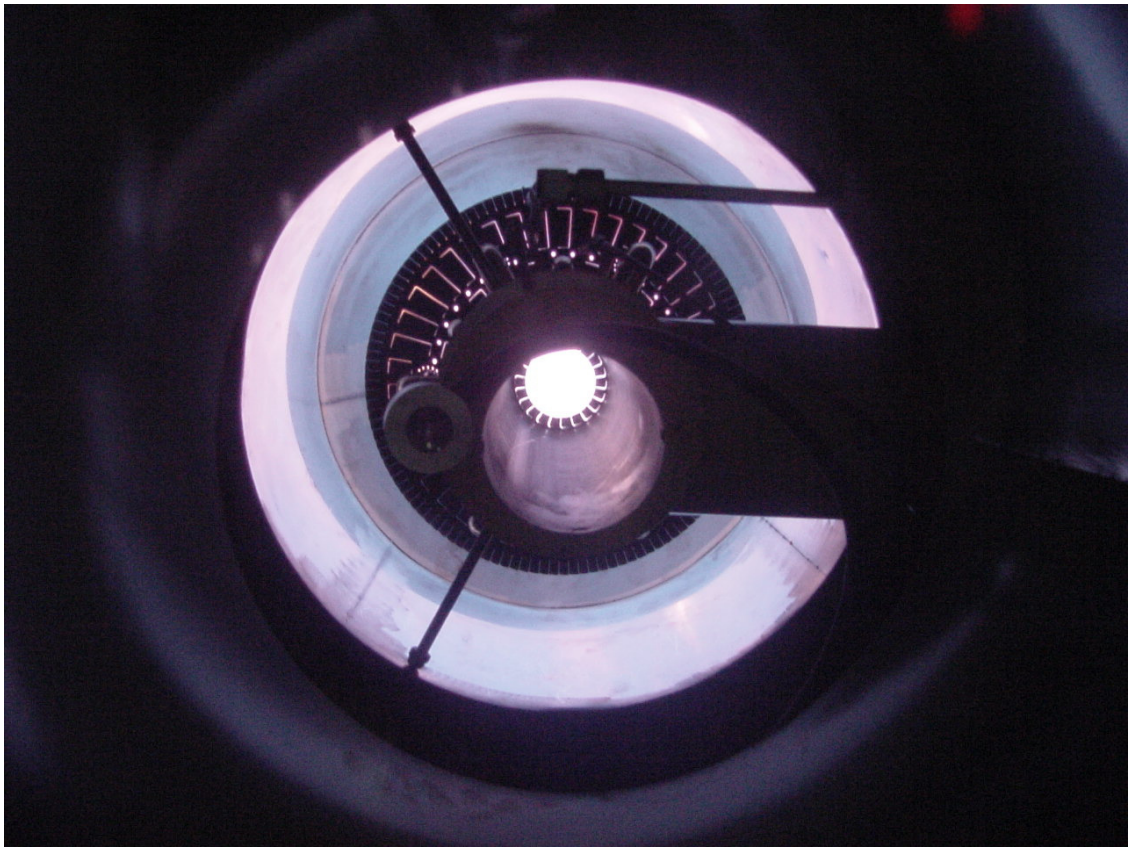
1. Electrical Control Panels
2. Electronic Control Modules
3. Boiler Flue Side Heat Transfer Surfaces
4. Fuel Pumping and Filtering Systems
5. Flue Dampers and Flue Gas Recirculation (FGR) Systems
6. Air Filters, Fans and Silencers
7. Gas Pressure Control Rigs
8. Flues and Exhaust Ducts
9. Level Controls and Blow down 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 10,000,000 btu/hr

Burner Data

Note: Volume of air and flue gases is calculated based around the following criteria. Exhaust gases at 230℃/446℉ ambient air at 20℃/68℉, mix of flue gases and air at 62.9℃/145.22℉ with O_2 at 18.5% dry volume in the wind box.

Burner Type Number		LP1/220	LP1/440	LP2/586	LP2/880	LP3/1465	LP3/2051	LP3/2930
Burner Rating	kW	220	440	586	880	1465	2051	2930
	Mmbtu	0.75	1.5	2	3	5	7	10
Air at 15% Excess	Cuft/hr	8,366	16,733	22,310	33,465	55,775	78,085	111,550
No.2 Oil input rate (137,080 btu/gal)	GPH	5.47	10.94	14.59	21.88	36.47	51.06	72.93
Gas input rate (1000 btu/cuft)	Cuft/hr	750	1,500	2,000	3,000	5,000	7,000	10,000
Minimum Pilot pressure	"WG	4	4	4	4	12	12	12
Delta P Air	"WC	1.6	1.6	2.0	2.0	9	12	12
	mbar	4.0	4.0	5.0	5.0	22.5	29.88	29.88
Blast tube O.D.	MM	116	138	164	182	189	254	270
	Inches	4.57	5.43	6.46	7.17	7.44	10	10.63
Gas inlet (NPT or 150lb)		1" npt	1.5" npt	2" npt	2" npt	2.5" npt	2.5" npt	2.5" npt
Mounting P.C.D.	MM	196	196	280	280	394.25	394.25	394.25
	Inches	7.72	7.72	11.02	11.02	15.52	15.52	15.52
Mounting hole Ø	MM	8.5	8.5	8.5	8.5	10.5	10.5	10.5
	Inches	0.33	0.33	0.33	0.33	0.41	0.41	0.41
Quantity of mounting holes		3	3	3	3	3	3	3

Burner Dimensions

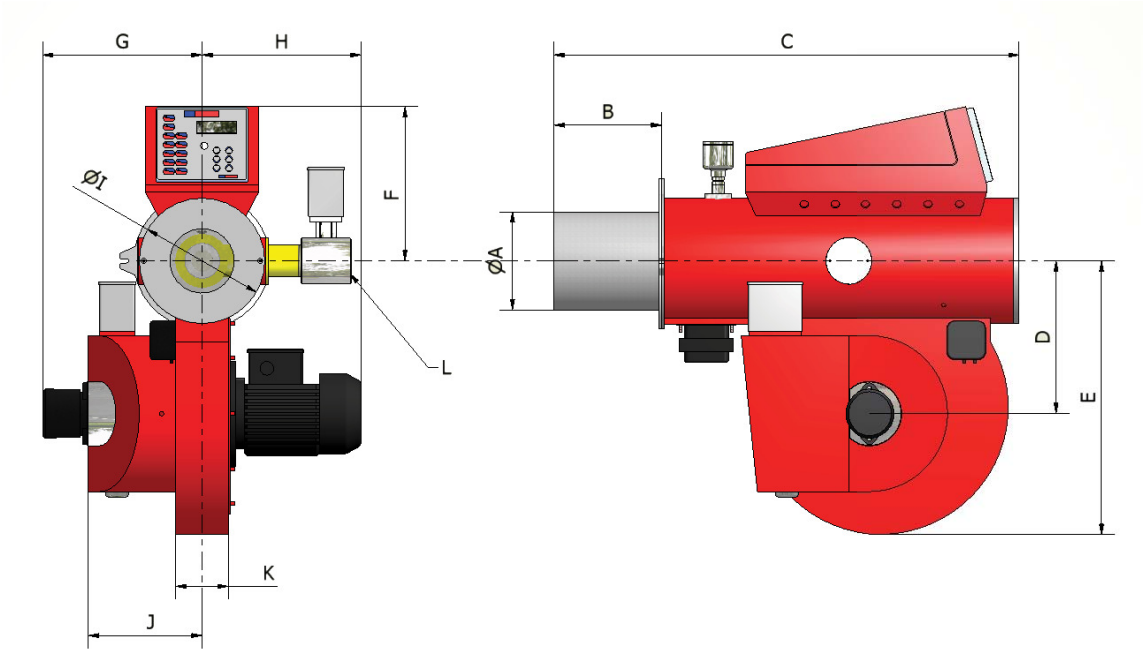
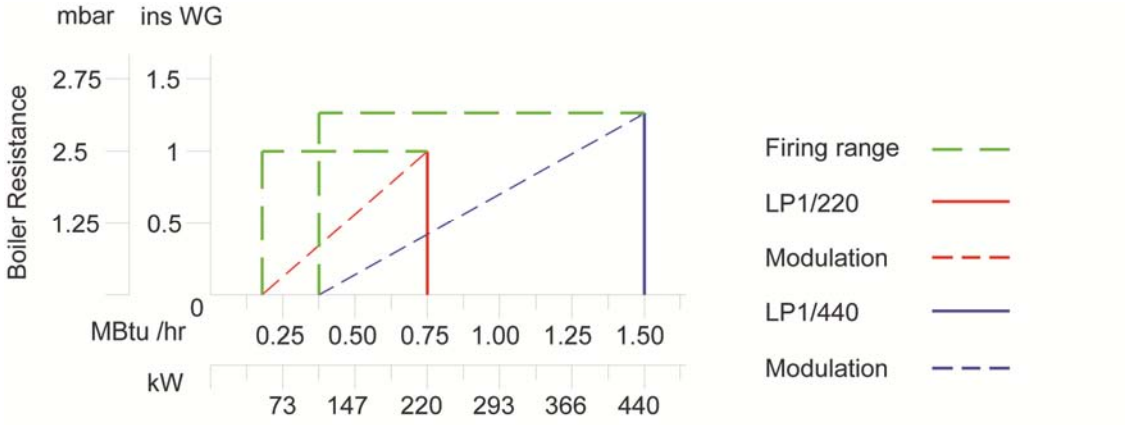


Figure 1: Burner Dimensions

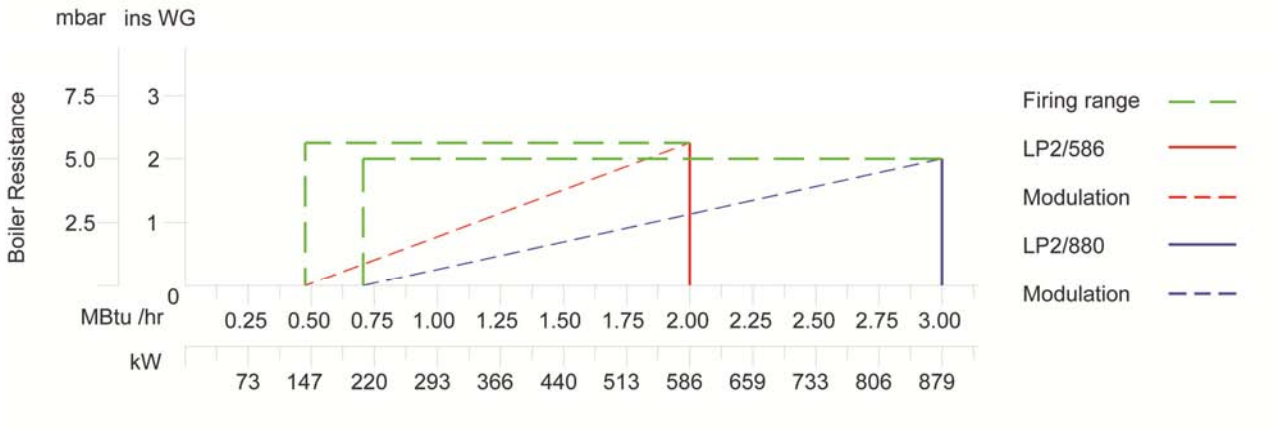
	LP1/220	LP1/440	LP2/586	LP2/880	LP3/1465	LP3/2051	LP3/2930
All dimension in mm and (inches) unless stated otherwise							
Burner Rating (Mbtu)	0.75	1.5	2	3	5	7	10
Burner Rating (kW)	220	440	600	880	1,500	2,050	2,930
A	116 (4.57)	138 (5.43)	164 (6.46)	182 (7.17)	189 (7.44)	254 (10)	270 (10.63)
B	160 (6.3)	160 (6.3)	200 (7.87)	200 (7.87)	348 (13.7)	348 (13.7)	348 (13.7)
C	595 (23.43)	595 (23.43)	865 (34.05)	865 (34.05)	1253 (49.33)	1253 (49.33)	1253 (49.33)
D	172 (6.77)	172 (6.77)	248 (9.76)	248 (9.76)	446 (17.56)	446 (17.56)	446 (17.56)
E	312 (12.28)	312 (12.28)	508 (20)	508 (20)	793 (31.22)	793 (31.22)	793 (31.22)
F Mini Mk7	250 (9.84)	250 (9.84)	287 (11.3)	287 (11.3)	353 (13.90)	353 (13.90)	353 (13.90)
Mk7	n/a	n/a	n/a	n/a	430 (16.93)	430 (16.93)	430 (16.93)
G	n/a	n/a	296 (11.65)	296 (11.65)	440 (17.32)	440 (17.32)	440 (17.32)
H	226 (8.90)	226 (8.90)	296 (11.65)	296 (11.65)	395 (15.55)	395 (15.55)	395 (15.55)
I	175 (6.90)	175 (6.90)	233 (9.17)	233 (9.17)	333 (13.11)	333 (13.11)	333 (13.11)
J	170 (6.69)	170 (6.69)	211 (8.31)	211 (8.31)	331 (13.03)	331 (13.03)	331 (13.03)
K	98 (3.86)	98 (3.86)	98 (3.86)	98 (3.86)	144 (5.67)	144 (5.67)	144 (5.67)
L	25mm (1")	25mm (1")	50mm (2")	50mm (2")	65mm (2.5")	65mm (2.5")	65mm (2.5")

Burner Capabilities

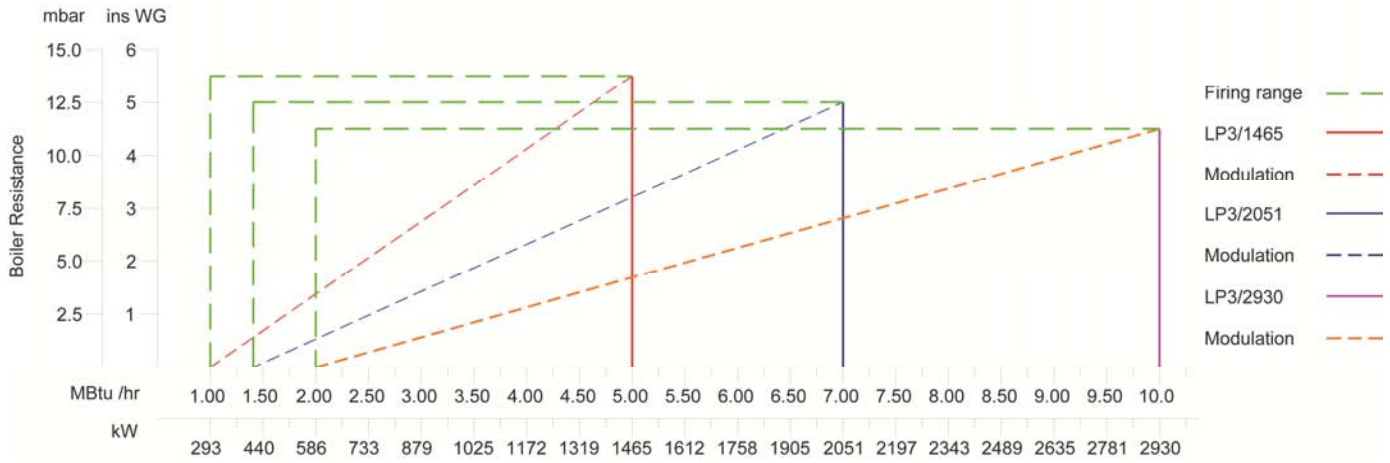
LP1/220, LP1/440



LP2/586, LP2/880



LP3/1465, LP3/2051, LP3/2930



Section 3

Component Information

General assembled burner

Component Information

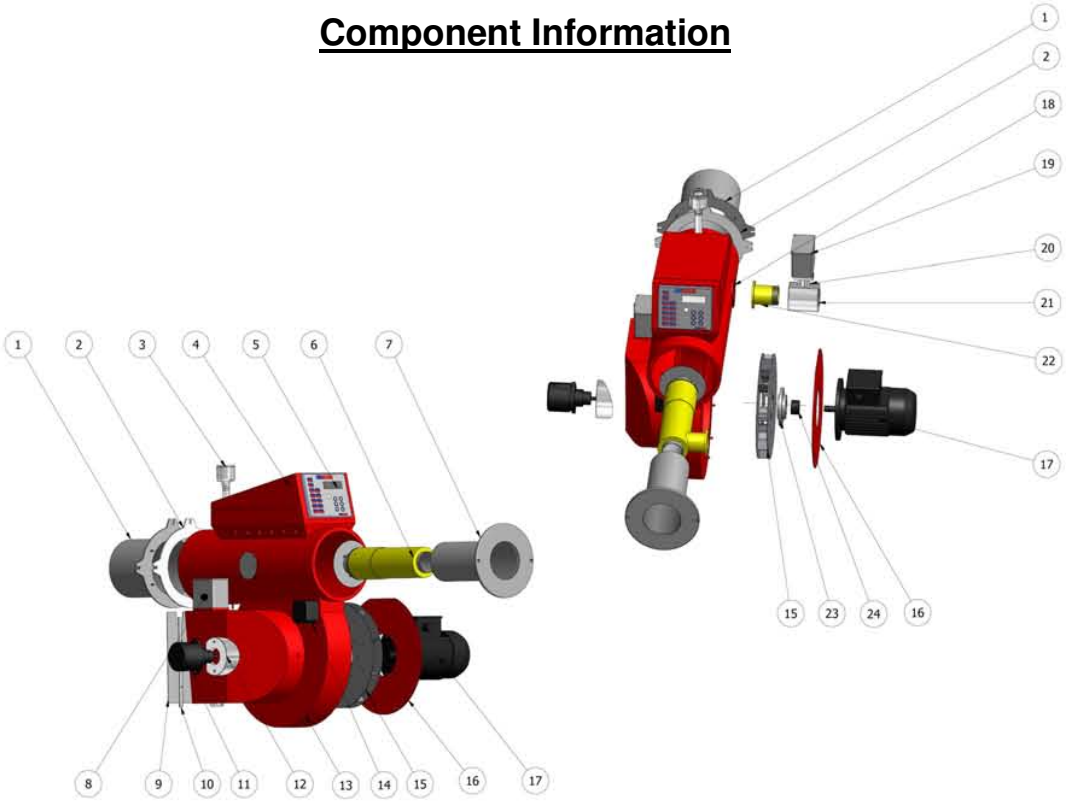


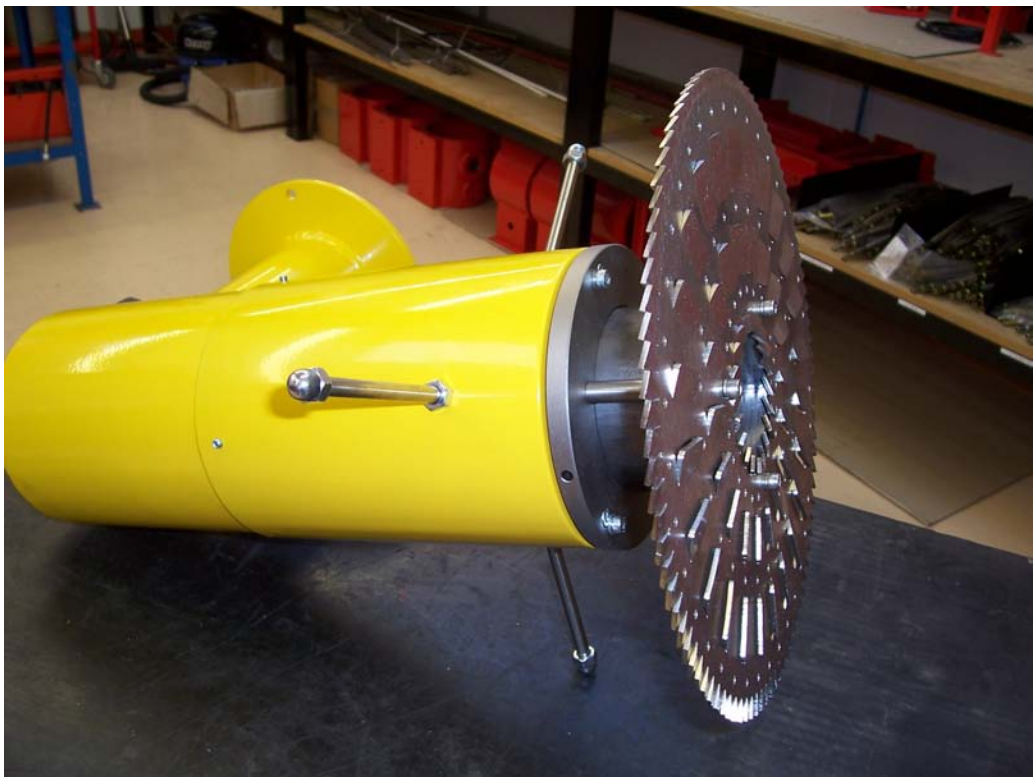
Figure 2: Burner Exploded view

1. Blast tube / mounting flange
2. Mounting gasket
3. UV flame scanner
4. Burner mounted control Pod
5. Autoflame Micro Modulation unit (Mini Mk7 or Mk7 depending on burner model)
6. Combustion gas head assembly
7. Back ring / air director assembly
8. Air damper servo motor
9. Air damper blade
10. Air damper shaft
11. Oil pump (model dependant)
12. Oil pump connection hub
13. Burner outer shell
14. Air pressure switch
15. Combustion air fan impeller
16. Impeller access plate
17. Electric motor
18. Gas and oil billets (one each side of burner)
19. Fuel servo motor
20. Oil valve – not shown (model dependant)
21. Gas butterfly valve
22. Gas valve connection pipe
23. Impeller locking hub
24. Impeller to motor shaft taper lock

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

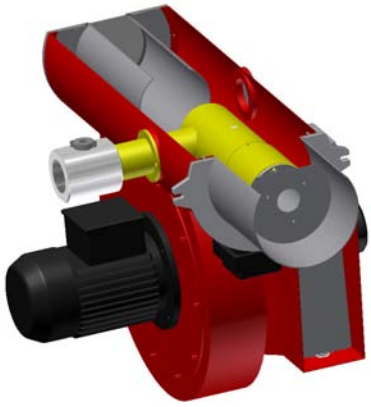


Figure 3: Section view of burner internals

1. Burner back ring assembly
2. Gas manifold assembly
3. Burner housing
4. Gas connection billet

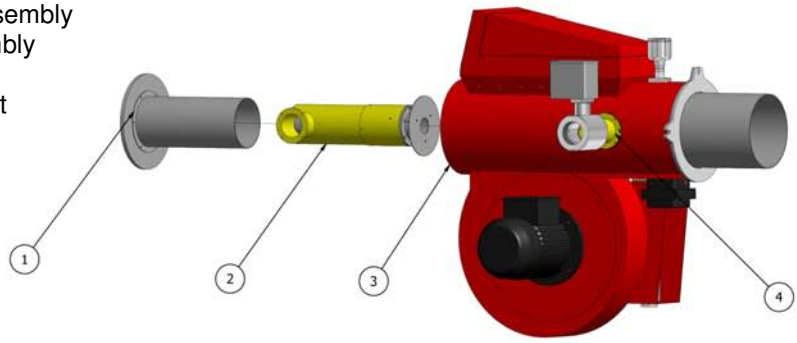


Figure 4: Gas Manifold removal

A unique design feature of the Limpsfield 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 back ring fastening screws and remove the back ring assembly (item 1) from the burner

Step 2: Remove the 4 fixings for the gas manifold from gas manifold mounting plate (item 4). Pull the electrode wires (not shown) and carefully remove manifold assembly (item 3) from the burner blast tube and housing (item 3). Use extreme caution so as not to damage the gas seal o-ring and the internal side of the gas connection billet (item 4) 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)

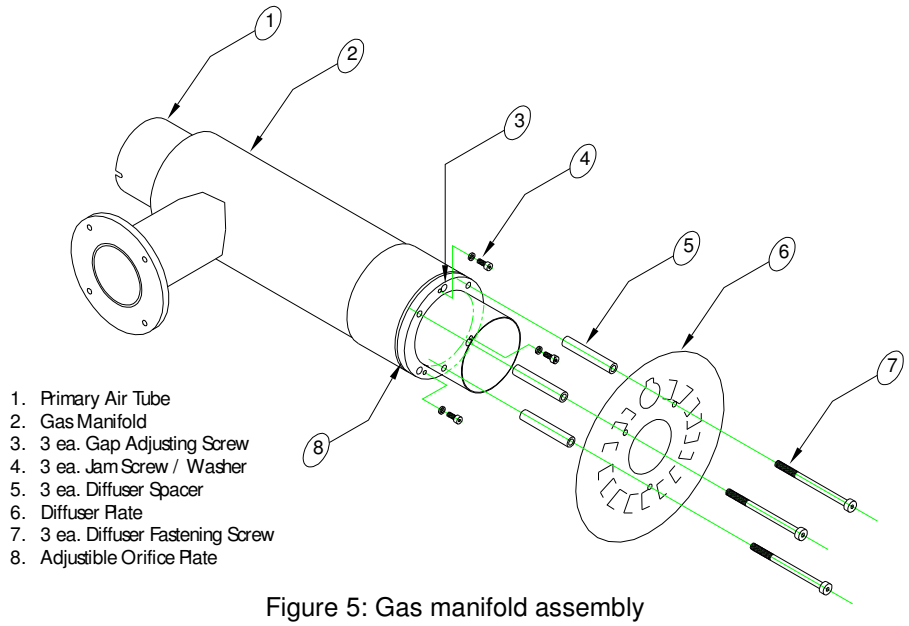


Figure 5: Gas manifold assembly

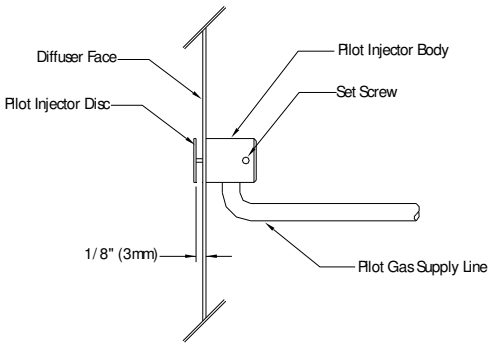


Figure 6: Gas pilot injector

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 (LP3 range), 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 standoff pillars (item5).

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 standoff 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. If 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.

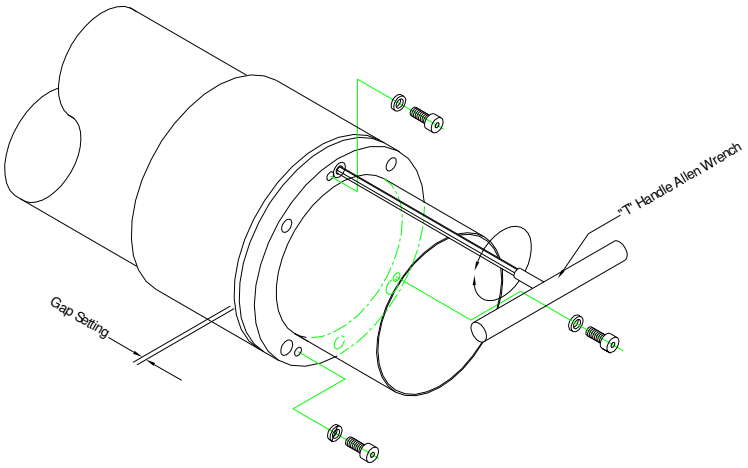


Figure 7: Gas adjustment

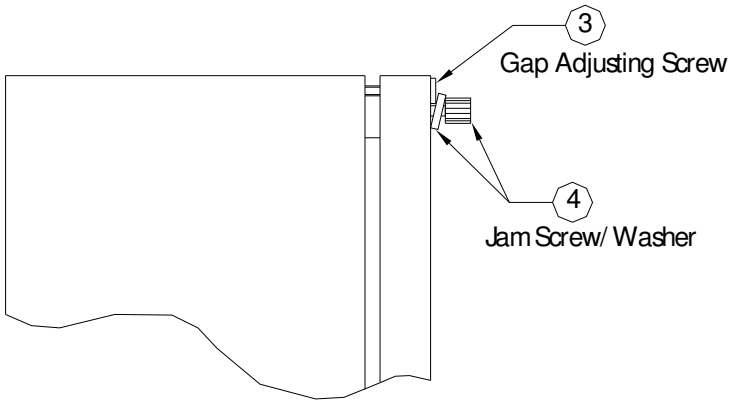
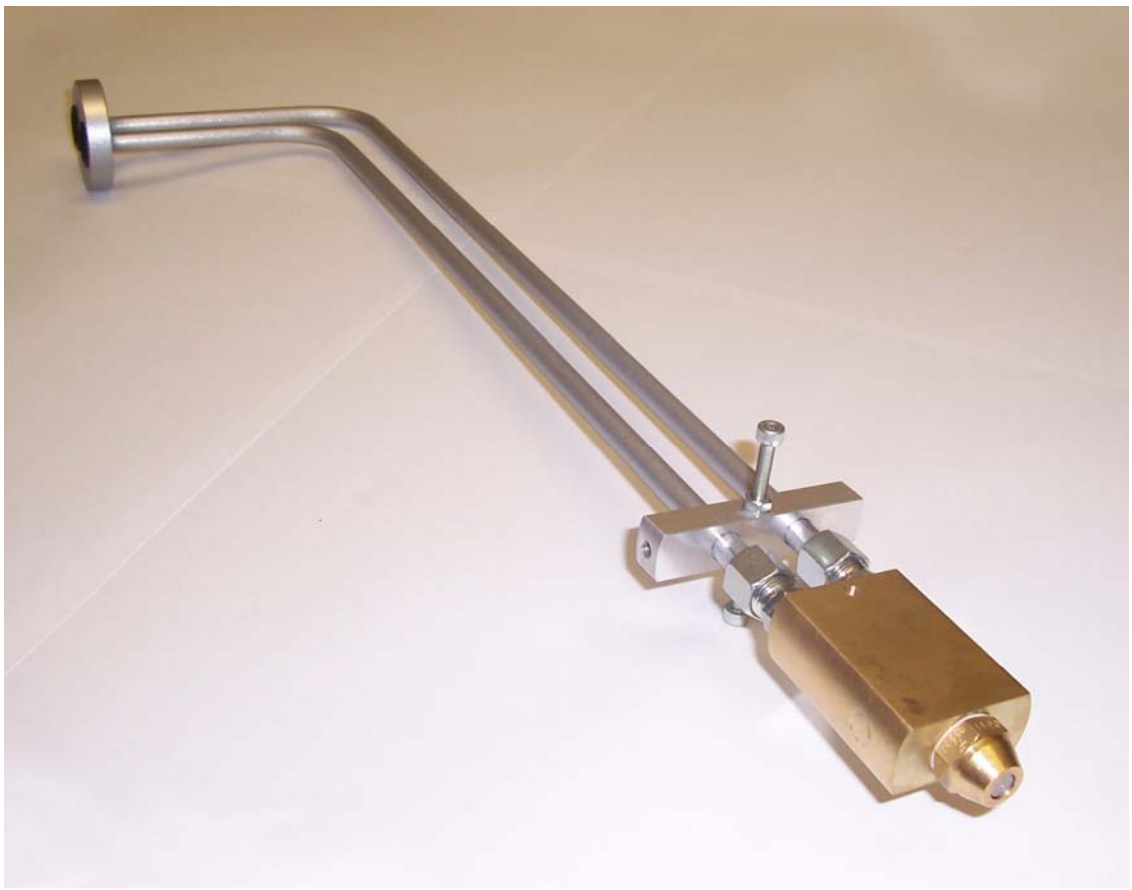


Figure 8: Jam screw/ Washer

Section 5

Oil Gun assembly



Oil nozzle and lance assembly

Oil Gun Assembly

KC2 Oil Gun (LP1 and PL2)

The LP1 and LP2 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 3:1 turndown) are approximately 220 psi (16 bar) and 76.86 psi (5.3 bar) respectively.

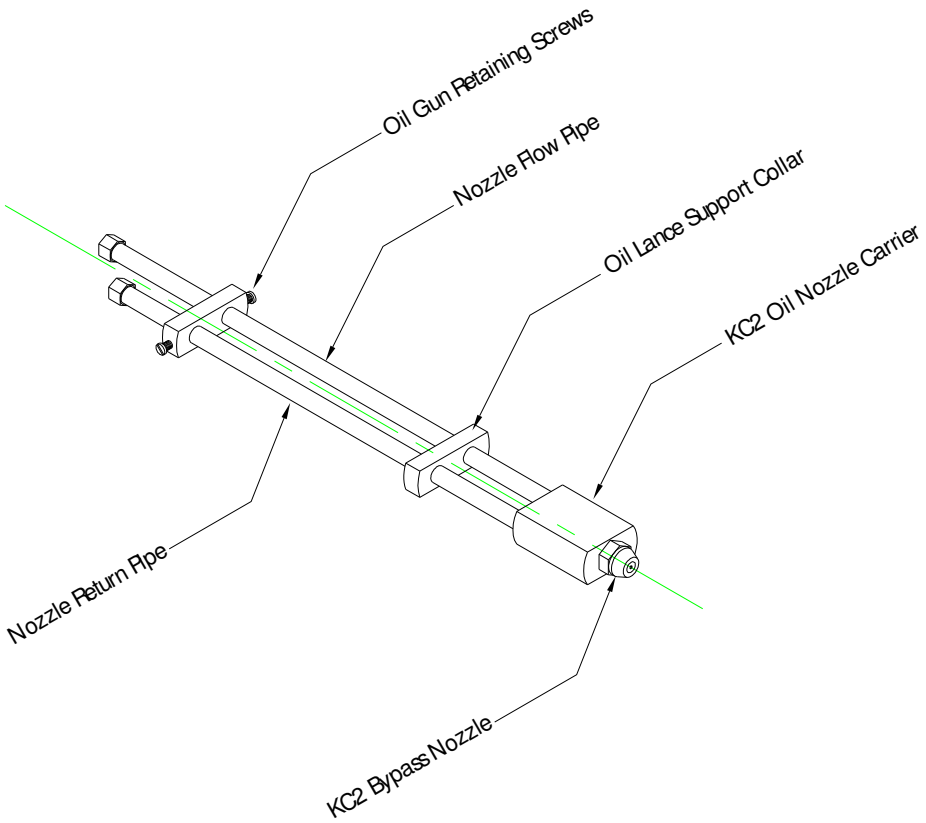


Figure 9: KC2 oil lance

N2 & W2 Oil Gun (LP3)

Burner model upward operate on a high-pressure atomization system. The N2 & 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.

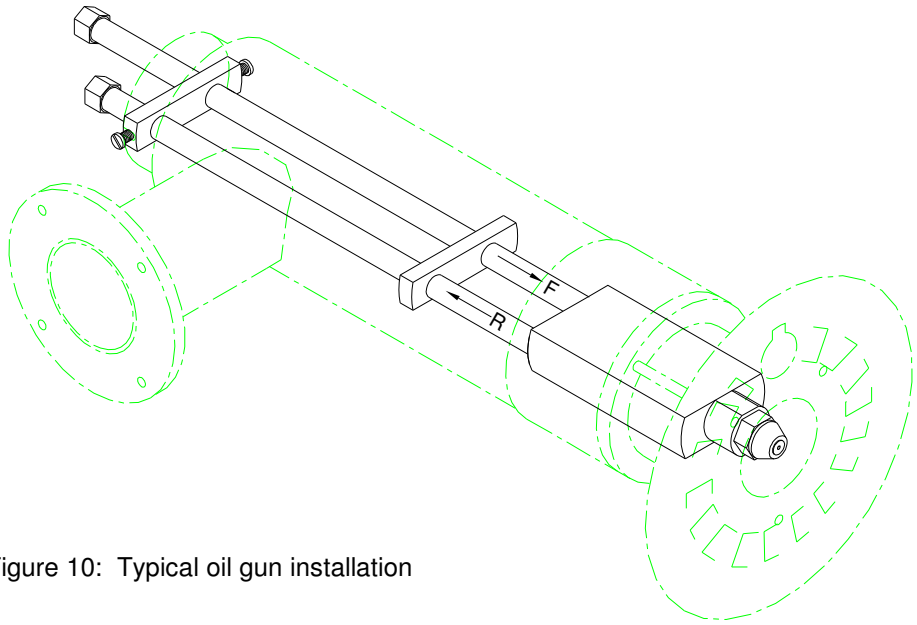


Figure 10: Typical oil gun installation

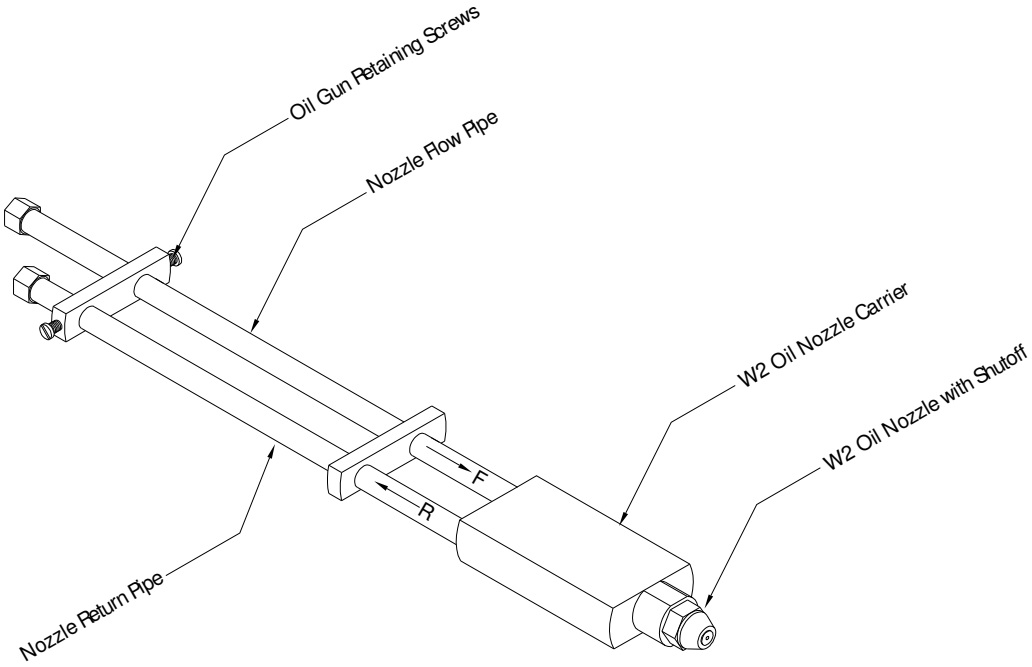
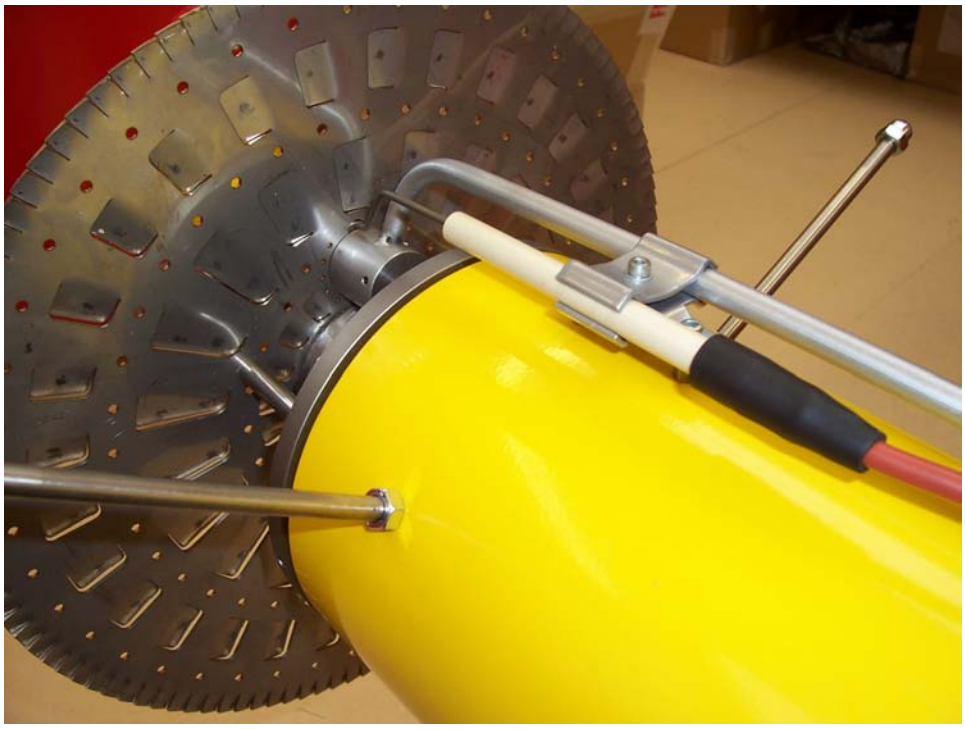


Figure 11: W2 Oil gun with proven gas pilot

Section 6

Electrode settings



Pilot injector and ignition setup

Electrodes

Staged Ignition (LP1, LP2 & LP3/1465 only)

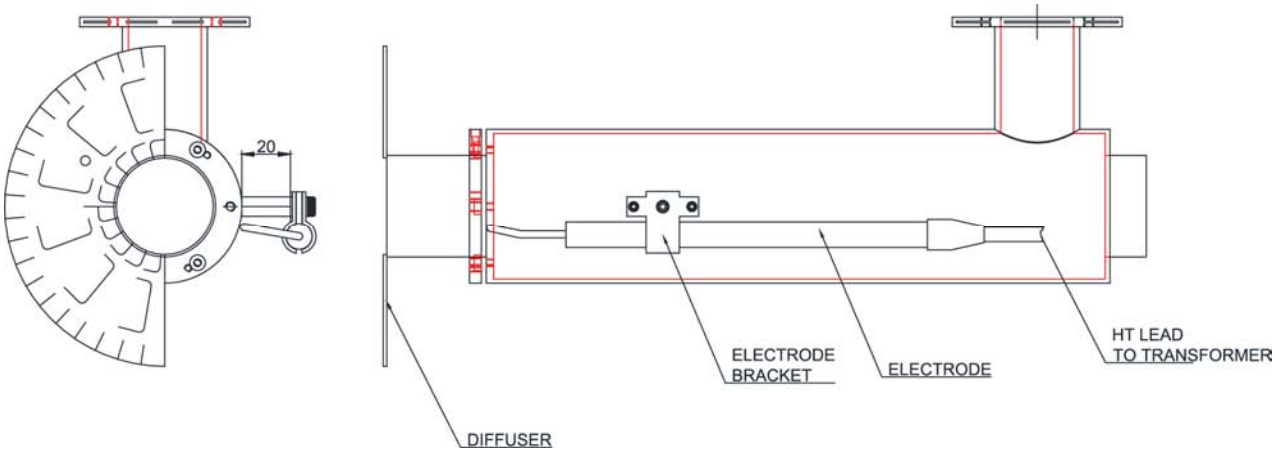


Figure 12: Electrode setting

Staged ignition Electrode Setting:

Limpsfield LP1 & LP2 & LP3/1465 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 tip 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 location. The electrode should be positioned approximately 1/8” or 3mm above the orifice plate.

Pilot Ignition (LP3/2051 & LP3/2930)

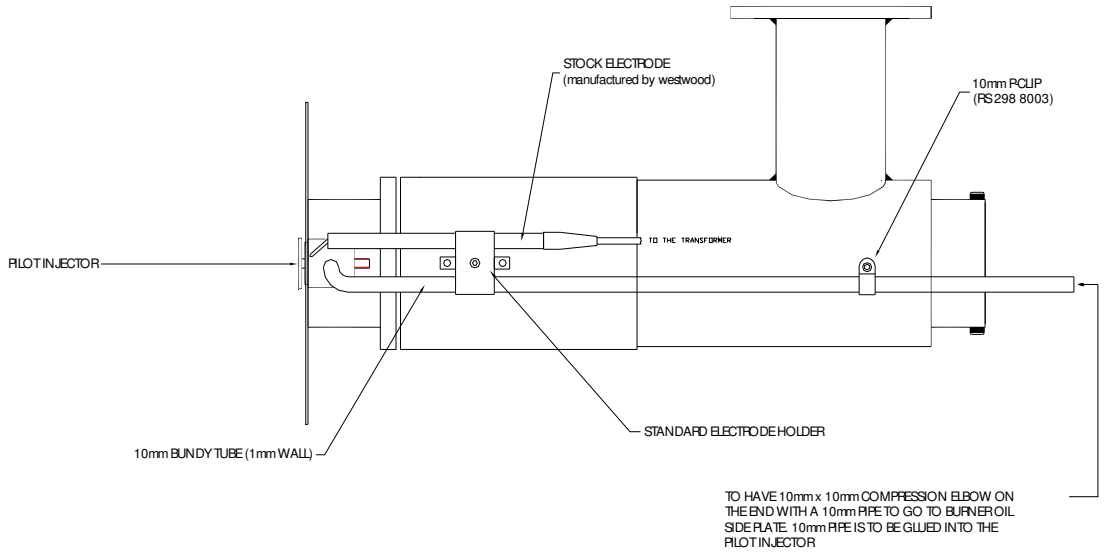


Figure 14: General layout pilot ignition

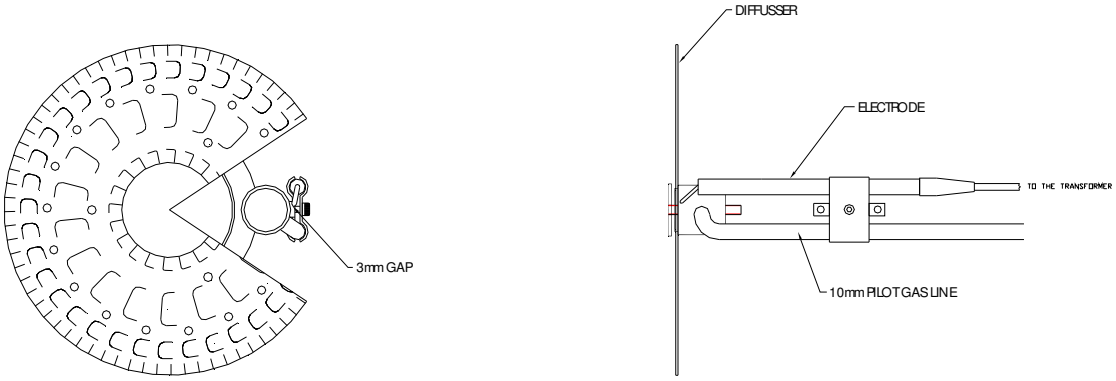


Figure 15: General layout pilot ignition

Pilot Injector Electrode Setting:
LP3/2051 & LP3/2930 models 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 LP2/880 Gas burner

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 installation

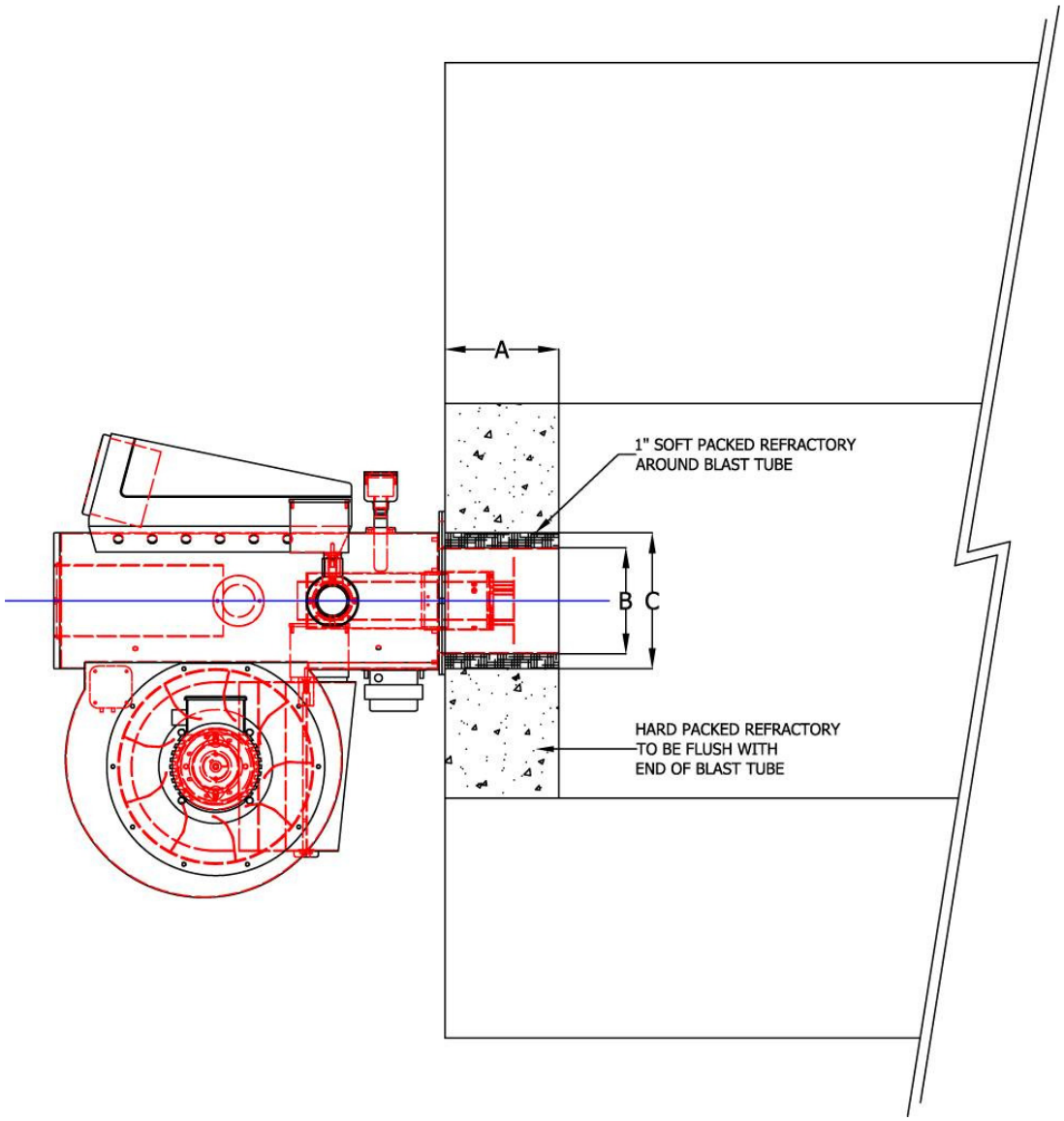


Figure 16: Example installation/ refractory details

Dims mm & (Inches)	**LP1/220**	**LP1/440**	**LP2/586**	**LP2/880**	**LP3/1465**	**LP3/2051**	**LP3/2930**
A – Blast tube length	160 (6.3)	160 (6.3)	200 (7.87)	200 (7.87)	348 (13.7)	348 (13.7)	348 (13.7)
B – Blast tube O.D	116 (4.57)	138 (5.43)	164 (6.46)	182 (7.17)	189 (7.44)	254 (10)	270 (10.63)
C – Refractory O.D	167 (6.57)	189 (7.43)	215 (8.46)	233 (9.17)	240 (9.44)	305 (12)	321 (12.63)

Air Pressure switch

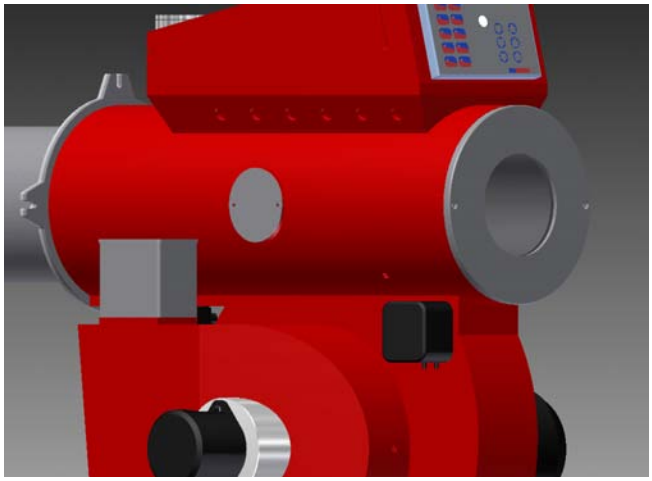


Figure 17: Air pressure switch detail (high pressure connection)

The air pressure switch is pre-set. The switch point must be checked and adjusted during commissioning.

For this a differential pressure measurement between point's ① and ② is required. Pressure behavior is monitored throughout the set range of the burner by the manometer (i.e. U tube). The lowest differential pressure value is used for the determination of switch point. The switch point is set to > 80% of this value. To do this, the protective cap of the LGW is removed and the calculated value is set at the setting wheel.

Example:
Reduced differential 20 mbar
Switch point air pressure switch 20 x 0.8 = 16 mbar
Installation dependant influences, such as flue gas recirculation, heat exchanger, installation or air supply, on the air pressure switch and the settings may result in adjustments having to be made.

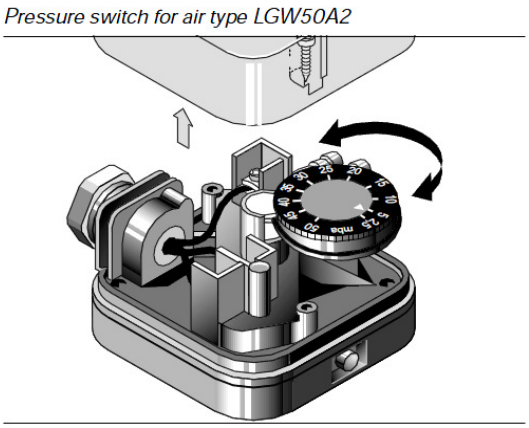


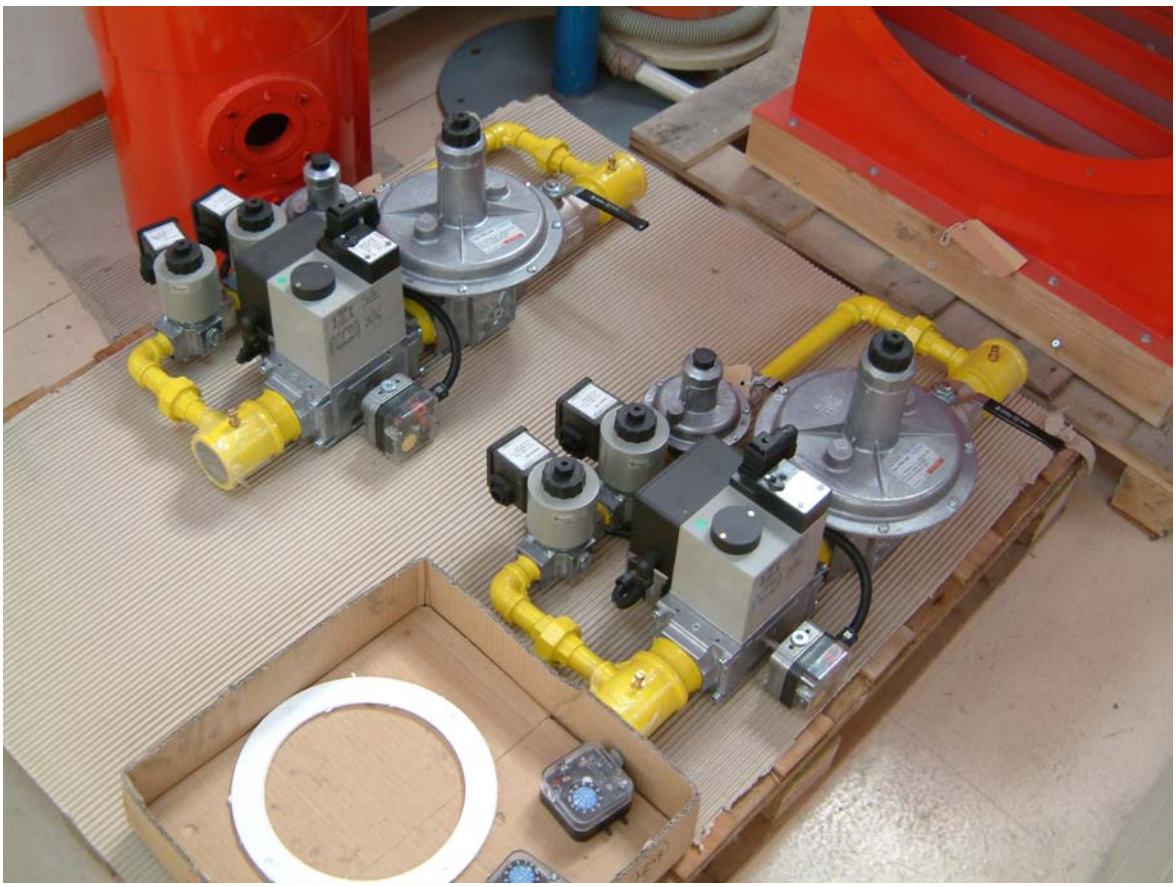
Figure 18: Air pressure switch detail (low pressure connection)

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 ¾" 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.

Section 8

Typical Gas control Train



2” gas control train assembled

Typical Gas Train.

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

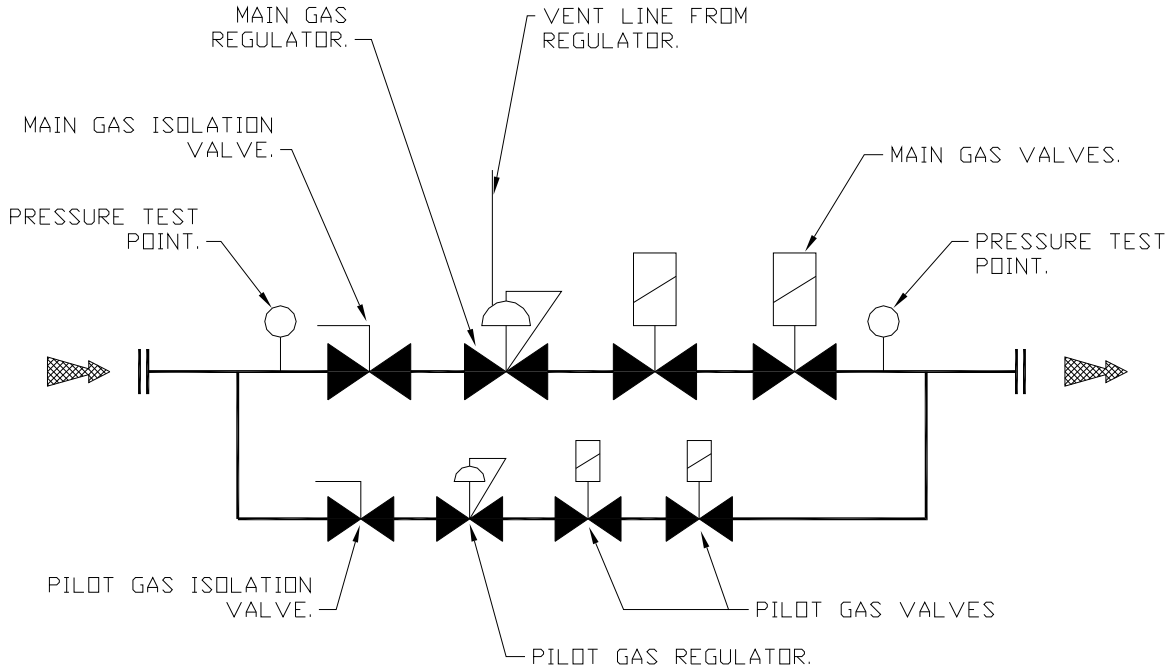


Figure 19: Schematic of a typical gas train (LP1 & LP2)

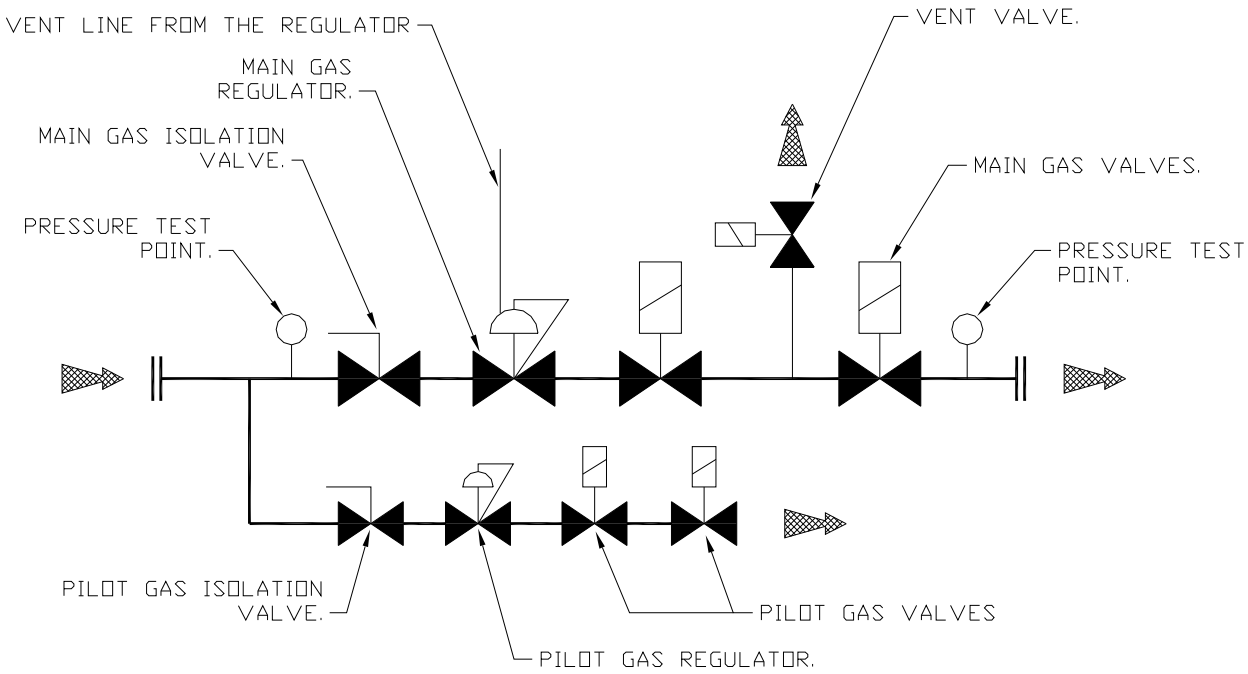
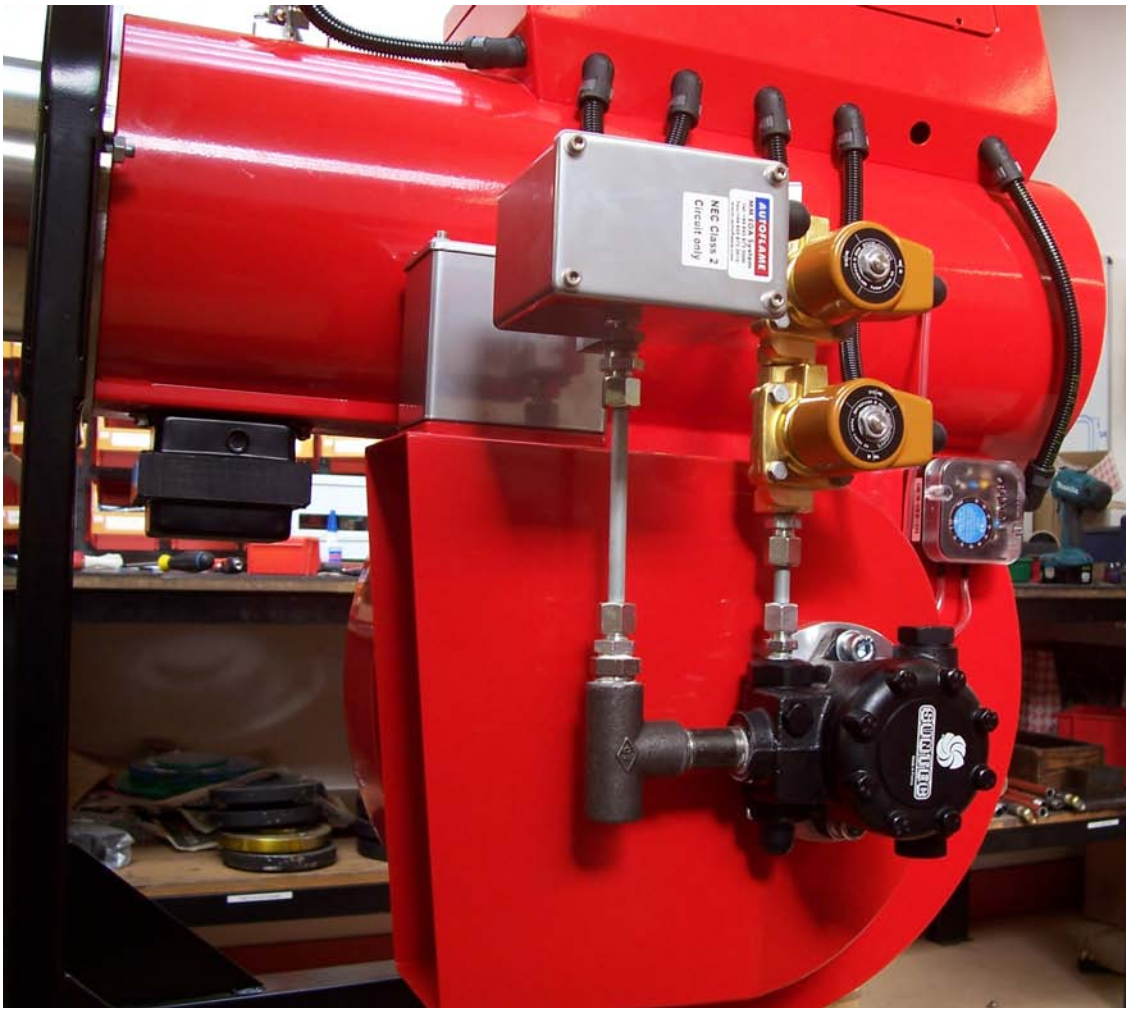


Figure 20: Schematic of a typical gas train (LP3)

Section 9

Typical Oil Train



Assembled burner mounted oil pump

Typical No2 Oil Train (KC2)

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

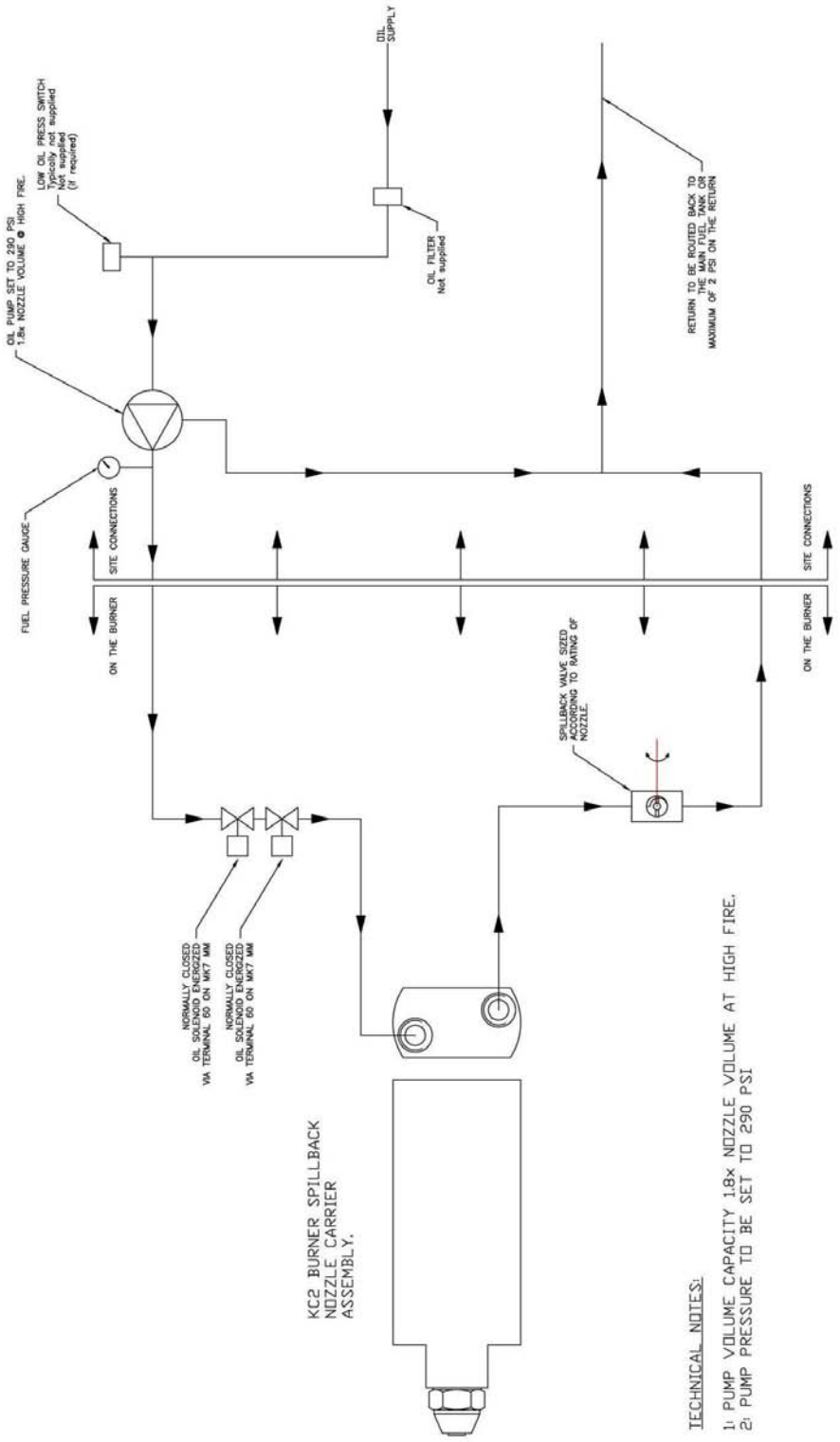


Figure 21: Typical Light Fuel Oil Hydraulic Schematic

Typical No2 Oil Train (N2/ W2)

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

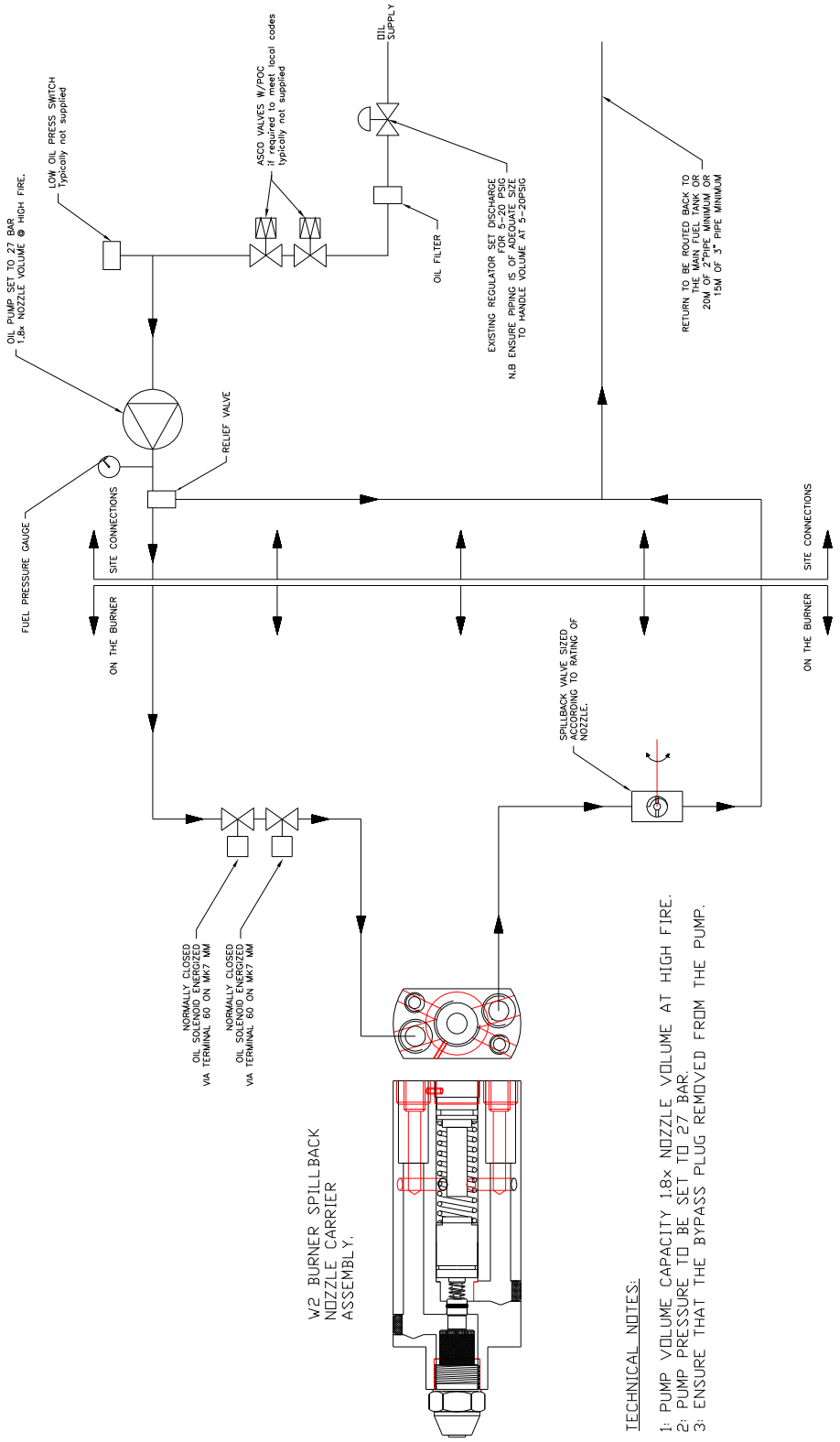


Figure 22: Typical Light Fuel Oil Hydraulic Schematic

Section 10

Electric Motor Information

Electric motor information

The guidelines and safety instructions of the manufacturer must be strictly adhered to.
By nature, fans are machines with relatively high inertia. This is especially the case for large impellers with relatively low speed, i.e. a motor with a relatively low power and small torque. Therefore, the start time should be checked if the fan speed is smaller than the motor speed. Due to customary short relay times, one should not avoid to use relays for extra heavy starts or centrifugal couplings. Special attention is necessary when single phase motors are employed as these motors generally have an extremely unfavorable torque curve.

General

Low-voltage machines have dangerous, live and rotating parts and also possibly, **hot** surfaces. All work regarding transport, connection, commissioning and maintenance must be carried out by **qualified** technical personnel (prEN50110-1/VDE 0105, IEC 364). Improper handling can cause **damages to people and things.**

Intended use

Low voltage machines match with the harmonized standards of the series **EN 60034 (VDE 0530)**. The use in **ex-areas is forbidden**, unless **explicitly** provided for this purpose (Refer to additional instructions). Protection types IP 23 **should not be used** in the open. Air-cooled designs are to be measured for environmental temperatures of **-20°C to +40°C** and also installation heights **1000 m** over NN. Deviating specifications on the rating plate must be adhered to **strictly**. The conditions at site must match **all** specifications on the rating plate. Low voltage machines are **components** for installation in machines as per the machine directive 89/392/EWG. The **commissioning** is not permissible until conformity of end product has been established with this directive (note also EN 60204-1).

Installation/ mounting

Ensure an even supporting surface, good foot- and flange fixture and exact alignment for direct coupling. Avoid structural-conditioned resonances with rotary frequency and doubled power frequency. Turn the rotor **by hand** and listen to unusual grinding noises. **Control** the **direction of rotation** in uncoupled state.
Pulleys and couplings are to be mounted / dismounted **only** with suitable tools (heating up!) and must be covered with a **shock protecting device**. Avoid impermissible belt tensions (technical list). The force status of the low voltage machines is specified on the shaft mirror or rating plate (H = half key, F = full key).
In case the motor has a half key (H), the coupling must be balanced with a half key. **Projecting, visible** key parts are to be removed. Designs with shaft ends are to be provided with a cover upwards **at site** which prevents the foreign bodies from falling into the fan. Condensation can occur in the motor casing for certain environmental conditions. This can be avoided with standstill heating or placing low voltage on the motor winding. The condensate- drainage openings on the motor must be opened regularly or must be checked in the opened state. The operator must protect the drive motor against overload. There are processes such as feeding hot gases or high reduced pressure on the fan for which the motor is not designed for operating at environmental pressure and temperature. For start up and possibly required running, the power consumption must be reduced, say, by partial closure of channel with flaps, operating at lower speeds or checking the inlet vane.
Often used low voltage- asynchronous motors with cage rotors fulfill the requirements of EG-directive with regard to electromagnetic tolerance when operated at electric power supply according to EN 50 160.

When fed with a converter, different, heavy interference emissions occur depending on the design of converter. In order to avoid exceeding the limit values in accordance with EN 50 081-1 for the converter/motor drive system, the EMV-instructions of the converter manufacturer have to be strictly adhered to. For motors with in-built sensors (for e.g. resistors), interferences can occur on the sensor cable conditioned by the converter. The motor needs to fulfill in principle the requirements of interference immunity in accordance with EN 50 082-2. For motors with in-built sensors (for e.g. resistors), the operator himself must ensure sufficient interference immunity by proper selection of sensor- signal cable and of evaluation device.

Electrical connection

All work must be carried out only by **qualified** technical personnel on the **idle** low voltage machine in visibly **activated** state **secured against restart.** This is applicable even for auxiliary circuits (for e.g. standstill heating).**Check whether the system is disconnected!** Adhere to specifications on the rating plate as well as the wiring diagram in junction box. Exceeding the tolerances in EN 60034-1/DIN VDE 0530, Part 1 - Voltage ±5 %, Frequency ±2 %, and also unfavorable curve shape or missing symmetry – increases the heating and influences the electromagnetic tolerance. The connection must be undertaken such that a **permanent, secure** electrical connection is obtained (no dangling wire ends); use dedicated cable ends. Make **ground wire connection**.

The smallest air gaps between blank, live parts and against earthling should not be less than the following values: 8 mm for UN 550 V, 10 mm for UN 725 V, 14mm for UN 1000 V. The junction box must be free from foreign bodies, dirt and humidity. Close cable glands that are not used and the box such that they are **dust-** and **water-proof**. Secure **half keys** for trial run without down thrust elements. **Check** the smooth functioning of **brakes** for low voltage machines with brakes before commissioning.

Operation

Vibration levels veff 3,5 mm/s (PN 15 kW) or 4,5 mm/s (PN > 15 kW) are safe for normal operation. In some cases, higher values are to be expected, refer to ISO 14 694. In case of changes compared to the normal operation – for e.g. **increased temperatures, noises, vibrations** - the cause must be established, if necessary, referring to the manufacturer. Safety devices should not be disconnected even in trial operation. Switch off fan in **case of doubt.** Clean the air passages regularly if dirty. Regrease bearings with regreasing device when motor is **running**. Adhere to type of lubrication! In case the grease outlet bores are closed with stoppers (IP 54 Shaft side: IP 23 Shaft side and cooling side), **remove stoppers** before greasing and then close again thereafter. Bearings must be replaced in case of continuous lubrication (2Z-bearing) after about 10,000 hours (2 pole) or after 20,000 hours (higher-poled) or according to the specifications of the manufacturer. The cooling should **not be obstructed** and the exhaust air also adjacent devices- must not be reused.

Minimum speed/ maximum speed

If a fan has been designed for speed-controlled operation, the **minimum speed** should not be less than **30% of the nominal speed**. If lower speeds are required for the system, special permission (= recalculation of drive motor/ checking the bearing) is required for the same. **Maximum speed.**

Starting/ Stopping/ Reversing

Due to high moment of inertia of fan- impellers, a fan may be started, stopped or reversed maximum 4 times in an hour. At least a time span of 2 minutes must be maintained between two subsequent switching processes. If higher switching cycles are required for the system, special permission (= recalculation of drive motor/ checking the drive motor) is required for the same.

Section 11

Fan Operation

Fan Operation

Caution: Under no circumstances should one dismount the hub from the impeller back plate as this would definitely lead to an imbalance. The bearings must not be canted. Shims already used must be re-used after alignment. The bearing casing and foundation must be carefully bolted. During the remounting of the impeller on the shaft, the use of graphite based grease can be advantageous.
Caution: Taper-lock bushes should not be greased!
Attention must be paid to the following additional instructions:

COMMISSIONING
General safety instructions:
Before commissioning the fan, the casing and the inlet/outlet duct must be checked for contaminants. Loose parts can be carried away by the air flow and can lead to injuries. Care must be taken when installing the protection grills, and other safety features. No one should ever stand in the way of the air flow!
The safety instructions for electrical equipment and of the electricity supply company must be observed at all times.
The rotational direction of the fan is indicated by an arrow on the fan casing or motor. This should be checked by briefly starting the motor and observing the rotating parts. If it is wrong, the electrical leads must be reconnected. The amperage must be measured and compared with the nominal current of the motor.
Centrifugal fans must be throttled appropriately; otherwise the motor can be overloaded. With free outlet they absorb less power than when throttled. Before the rotation direction is reversed, the impeller must come to a complete standstill. The high moment of inertia can otherwise lead to damage.

Mechanical safety
To prevent any contact between moving parts, safety devices must be installed. If they are not supplied as an integral part of the fan, they must be installed on site. This especially is applicable for inlets, outlets and access doors which must be secured on site.

Stall / anti-stall device
The operation of fans at stall condition is forbidden.

Maximum speed, different speeds and speed control
The fan should not be operated at higher speeds than those stated in the data sheet. A speed reduction is permissible only in consultation with Limpsfield.
It must be ensured that the fan is not going to operate at a resonance frequency which can damage the fan or associated components. While controlling the speed it must be taken into account that individual frequencies of different components of fan are achieved **in the range of minimum to the maximum speed. At these corresponding speeds no permanent operation may occur.** While starting the system the variable speed control must be programmed so that these resonance speeds are quickly bypassed. Please refer chapter 10.3.

Motor protection switch
Fans have a relatively high moment of inertia. In most cases for heavy start relays are necessary. While selecting and setting the relays the whole operating range must be considered. For example a fan motor will draw 16% more current when the feed medium going through the fan is at -20° C than at 20° C because of higher atmospheric density.

Maintenance
The frequency of maintenance depends largely on the operating conditions, environmental conditions and the required availability. The frequency must be set by the operator taking into consideration the plant layout and in compliance with the specifications given by us. Sufficient spare parts must be provided. A standard interval is for maximum of 6 months.

All impellers have been carefully balanced at the factory premises itself. Imbalance can occur due to dust, wear, abrasion and accumulation of material on the impeller leading to vibrations and damage of bearings. Therefore an operation free of vibrations must be ensured.

Surface protection
The surface protection of a component too must be regularly checked and if required maintained. Especially mechanical damage to the surface due to rock fall, dust or chemical impact must be looked out for. Even stainless steel can be subject to surface corrosion, e.g. when it is subjected to a very moist salty environment or aggressive gases. Therefore it must be ensured that surface corrosion does not affect the general properties of the fan and does not present a situation where maintenance activities are urgently required, but can be rectified and improved just by carrying out suitable maintenance tasks within the period of warranty. Corrosion can be prevented typically by cleaning the surface and by using a suitable surface conservation technique.

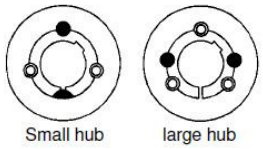
Monitoring vibrations
Increased vibrations are always a danger (ISO 14694 or ISO 10816-3). Changes in the vibration level can be monitored by measuring the mechanical vibrations on the bearings and motors. Variations can be detected by comparing the measured values over a prolonged period of time. If significant changes occur (increase > 30% compared with the values one year before) are observed the cause must be examined, e.g. dirt accumulation on the impeller. The necessary procedures to avoid the problem (e.g. cleaning and/or rebalancing of the impeller) have to be taken.

Impeller inspection / Material fatigue
For likely abrasion, corrosion or dirt deposits on the impeller regular inspections, cleaning and repeated balancing must be carried out at least once a year and in extreme cases it can be done even at intervals of one or two weeks. Wearing plates on the impellers should be installed only in the factory. Provision of a second impeller is recommended for alternate processing. The impeller must be changed not later than 100,000 start/stop procedures or after 200,000 operating hours due to probable material fatigue.

Dismantling of impeller
a) In case of corrosion rust penetrating oil must be used. The use of hammers, crowbars or other objects of force must not be used!
b) If a dual fuel burner is being used, the motor to oil pump coupling must first be disconnected
b1) to do this first remove the burner back ring by unscrewing the connecting Allen bolts
b2) Reach down inside the burner to the coupling and loosen the set screw using an Allen wrench. This only needs to be done on one side of the coupling.
c) Loosen and remove all bolts on the motor mounting plate whilst supporting the weight of the motor
d) Carefully remove the motor, mounting plate and fan impeller away from the burner. Care must be taken not make contact with the burner shell.
e) Detach all fixing screws. Depending on the size of the bush, unscrew one or two screws, oil them and screw them into the set bores.
f) Tighten the screw(s) uniformly until the bush comes out of the hub so that the bush can move freely on the shaft.
g) Remove the impeller with bush from the shaft.

Refitting the impeller

a) Clean and degrease all uncovered surfaces such as the bore and the conical surface of the taper lock bush as well as the conical bore of the hub. Insert the taper lock bush into the hub to coincide with all connection bores (half-thread bores must always have half-plain bores on the opposite side).
b) Mildly lubricate and screw in threaded stud (bush size 1008-3030) and/or cylindrical screws (bush size 3535 - 5050). Do not tighten the screws.
c) Clean and grease the shaft. Push disc with taper lock bush onto the shaft till it sets into the desired position.
d) While using a slot key place it first into the slot of the shaft. There must be a small play between the adjustment key and bore slot.
e) Tighten thread studs and/or cylinder screws uniformly by using a screw driver, DIN 911, with the torques provided in the table.
f) Once the impeller is refitted, reconnect the motor mounting plate onto the burner
g) Replace nuts and washers and tighten
h) Once refitted, ensure the impeller runs smoothly and freely by turning this by hand.
i) If an oil pump coupling need to be reconnected, do this by ensuring the shafts are aligned and tightening the necessary set screws
f) After a short period of operation (1/2 to one hour) check torque of the screws and if necessary, correct it.



○ Fixing bore with fixing screws

● Pull-off bore

Bush	Starting torque of the screws	Fixing screws		Bush	Torque of the screws	Fixing screws		Bush	Starting torque of the screws	Fixing screws	
	[Nm]	No.	Size		[Nm]	No.	Size		[Nm]	No.	Size
1008 1108	5.6	2	1/4" BSW	2012	31	2	7/16" BSW	4040	170	3	5/8" BSW
1310 1315	20	2	3/8" BSW	2517	48	2	1/2" BSW	4545	192	3	3/4" BSW
1210 1215	20	2	3/8" BSW	3020 3030	90	2	5/8" BSW	5050	271	3	7/8" BSW
1610 1615	20	2	3/8" BSW	3535	112	3	1/2" BSW				

Figure 23: Fan taper lock information

Section 12

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 startup 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 startup 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 startup 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/commission 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 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 onsite 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

LP1 and LP2 model burners

The LP1 and LP2 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.

LP3 burners

The LP3 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 (LP1 &LP2)
2. Oil pressure gauge to measure oil supply pressure of 400 psi (LP3)
3. Oil pressure gauge to measure oil spillback return pressure of 77 psi (LP1 & LP2)
4. Oil pressure gauge to measure oil spillback return pressure of 160 psi (LP3)
5. Smoke tester, papers and smoke chart (Shell Bacharach)

Section 13

Service Recommendations

Standard burner routine checks and maintenance

Detailed below are general recommendations for routine checks and maintenance for the Limpsfield 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 manufacturer's 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 manufacturer's instructions
Purge position interlock	Annually	Service Tech	Test purge position interlock in accordance with manufacturer's instructions
Purge air switch	Annually	Service Tech	Test purge air switch interlock in accordance with manufacturer's 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 manufacturer's instructions
Coils and diaphragms	Annually	Service Tech	Check coils and diaphragms in accordance with manufacturer's 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

			manufacturer's 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 dependant)	Service check / operator	Check and clean as required.
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 14

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 startup 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 startup 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 onsite 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

LP1 and LP2 model burners

The LP1 and LP2 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 77 to 100 psi.

LP3 burners

The LP3 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 dependent 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 LP3 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: -

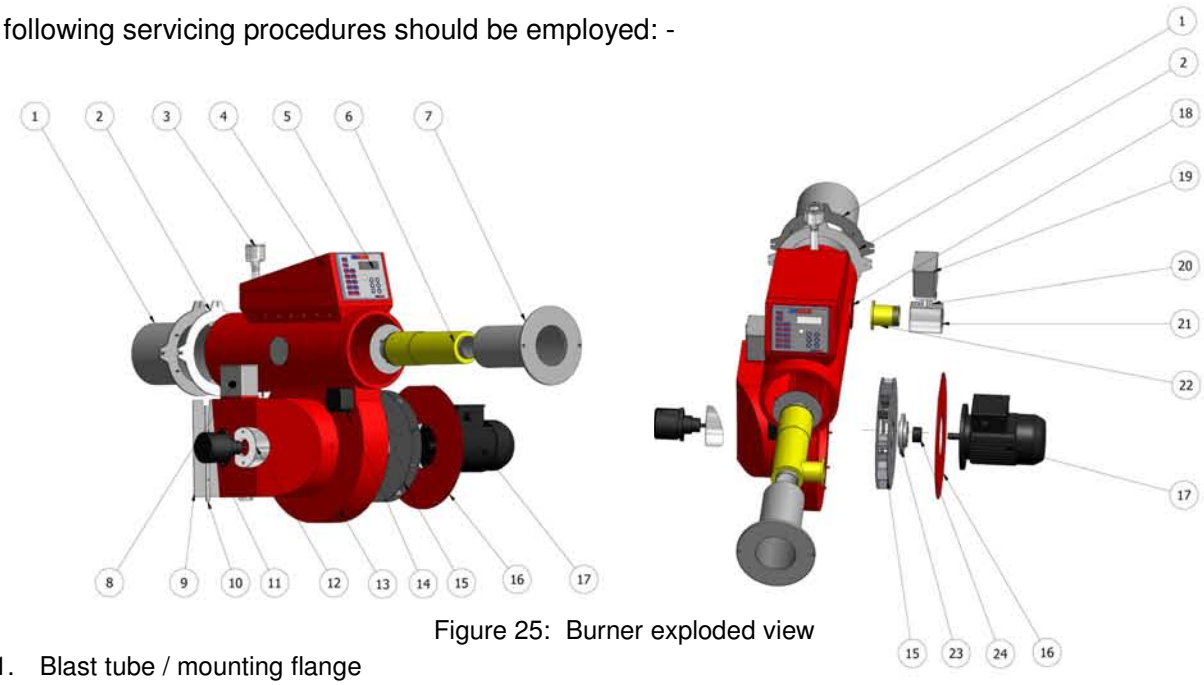


Figure 25: Burner exploded view

1. Blast tube / mounting flange
2. Mounting gasket
3. UV flame scanner
4. Burner mounted control Pod
5. Autoflame Micro Modulation unit (Mini Mk7 or Mk7 depending on burner model)
6. Combustion gas head assembly
7. Back ring / air director assembly
8. Air damper servo motor
9. Air damper blade
10. Air damper shaft
11. Oil pump (model dependant)
12. Oil pump connection hub
13. Burner outer shell
14. Air pressure switch
15. Combustion air fan impeller
16. Impeller access plate
17. Electric motor
18. Gas and oil billets (one each side of burner)
19. Fuel servo motor
20. Oil valve – not shown (model dependant)

21. Gas butterfly valve
22. Gas valve connection pipe
23. Impeller locking hub
24. Impeller to motor shaft taper lock

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 (LP3/2051 & LP3/2930 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
LP1/220	31	290 psi	29 psi
LP1/440	63	290 psi	29 psi
LP2/586	100	290 psi	29 psi
LP2/880	126	290 psi	29 psi
LP3/1465	247	370 psi	6.5 psi
LP3/2051	347	370 psi	6.5 psi
LP3/2930	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.

Figure 26: Typical oil pumps

The pumps are suitable for installation and operation in the two pipe system.
The pumps are fitted with a pressure regulating device and a quick action valve. The pressure regulating valve keeps the pressure constant.

Setting

- The suction line must be filled with fuel oil before commissioning and the pump vented. If this is not done, the pumps will be damaged, due to running dry.
- To test the vacuum or supply pressure on the suction side of the pump, screw in a vacuum or pressure gauge into the connection point (6).
- For pump pressure testing a manometer must be screwed into connection point (5).
- To adjust the pressure, remove nut and set the required pump pressure.

Rotation to right = Pressure increase
Rotation to left = Pressure reduction

- The suction resistance should not exceed 0.4 bar.
- Max supply pressure for pumps

Types AE, AJ, J _____ 2,0 bar
for pumps types E and TA _____ 5,0 bar
(measured at the pump)

Filter for pump types AE, AJ, J and E

The strainer fitted between the filter and the pump in the oil flow keeps foreign particles away from the pump gear. The pumps are fitted with two different strainer sizes.
The mesh of the strainer for E pumps is coarser. This strainer has to be cleaned periodically depending on the degree of soiling. If the mesh is heavily soiled, the vacuum on the suction side increases. The mesh can be reached for cleaning by unscrewing eight screws (12) on the pump cover. *After fitting the strainer, check the pump gear cover for tightness.*

Single pipe operation

In certain cases the pumps J, AE, AJ and TA may be used in single pipe installations.
The following must be observed:
As the pump in a single pipe system does not pull a vacuum, continual oil supply to the pump must be ensured. The bypass plug must be removed and the return line
closed. On single pipe systems the supply line must be vented into a container until all the air is expelled, reconnected to the pump and the pump vented via the pressure gauge port.

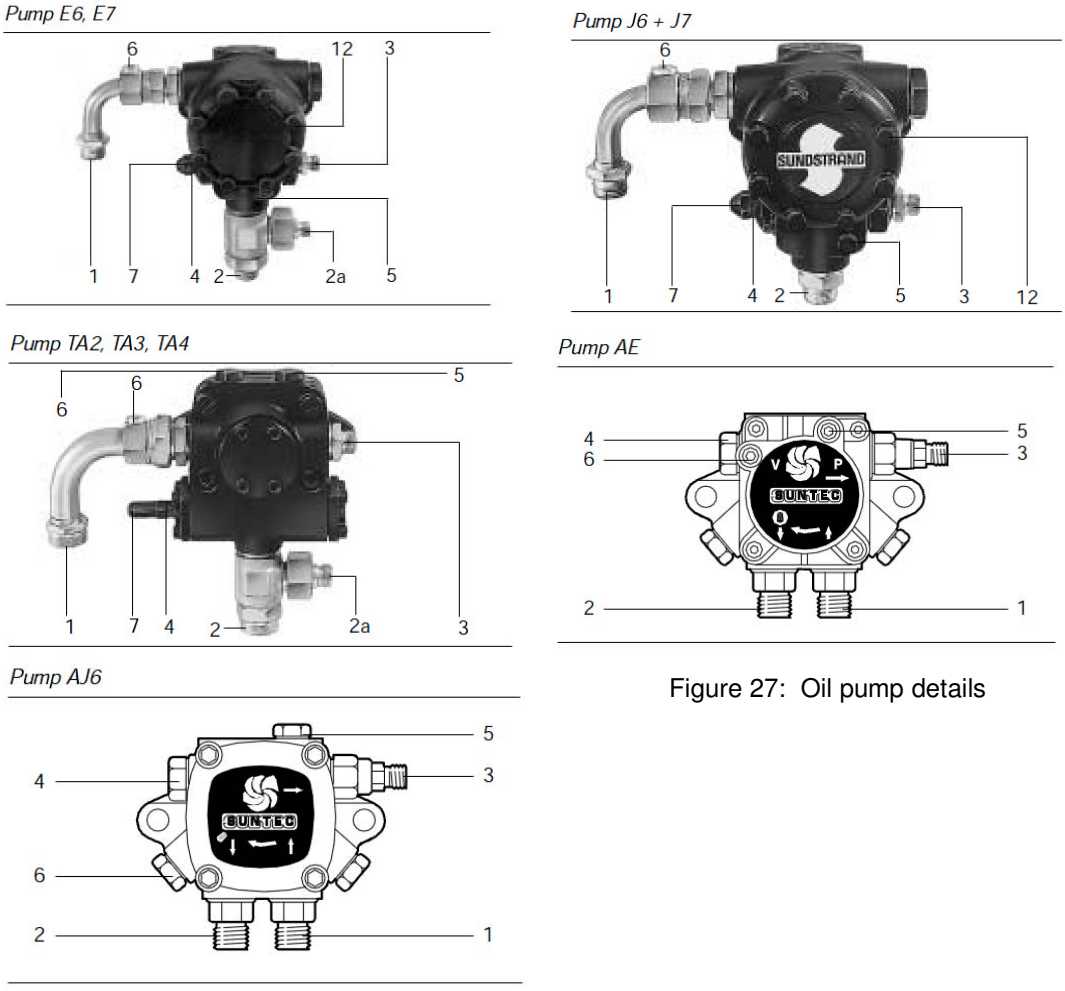


Figure 27: Oil pump details

1. Suction connection
2. Return connection
2a. Return connection oil regulator

3. Nozzle supply line
4. Pressure regulating screw
5. Pressure gauge connection
6. Vacuum gauge connection
7. Dome nut
12. Cover screw

Oil Pump coupling

On oil or duel fuel burners, a flexible coupling is fitted between the Fan motor shaft and the oil pump shaft. The coupling type may vary depending application. When exchanging the pump or coupling please ensure that axial misalignment of the 2 shafts does not exceed 1.5 mm when reconnected.

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, the inlet and outlet pressure should be checked to the commissioned combustion figures to ensure safe operation, a combustion check must also be carried out.

Installation of Gas train

Risk of explosion!
If the valve trains are not installed correctly, their soundness cannot be ensured.
To avoid deadly accidents, the following safety instructions must be observed during installation:
_ Observe the maximum permitted gas pressure in the valve train. Contact your local gas supplier to obtain the connection pressure of the gas mains supply. The connection pressure must not exceed the maximum pressure recorded on the name plate.
_ Valve trains must be installed securely to avoid vibration during operation. Suitable supports should be used. The supports must be fitted to the specific site requirements when mounting the valve trains.
_ Valve trains must be installed tension free. Never compensate for mistakes made during installation by over tightening the flange screws.
_ Flange screws should be tightened diagonally opposite.
_ Ensure flange gaskets are clean and fitted correctly.
_ Only gas board approved sealing material should be used. If a connection needs to be loosened often, flange connections with inlaid gasket should be used.

Section 15

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	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	1. Air pressure switch or air sensor faulty, replace as required 2. Wiring to air pressure switch faulty, check and rewire if required.
Burner fails to light at pilot stage	1. Pilot gas is not turned 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	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	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. 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)**	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	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	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)**	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	1. Oil flame is impinging on the combustion chamber surface, ensure that

black smoke	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	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 16

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																			
4																			
5																			
6																			
7																			
8																			
9																			
10																			
11																			
12																			
13																			
14																			
15																			
Low																			
FGR start																			
Golden start																			

Comments					
Engineer			Customer		