

Gas Burners



RS 45/M LN

Low-High-Low or Modulating Operation

CONTENTS

TECHNICAL DATA	page 3
Burner models	3
Accessories	3
Burner description	4
Packaging - Weight	4
Max. dimensions	4
Standard equipment	4
Firing rates	5
Minimum furnace dimensions	5
Commercial boilers	5
Gas pressure	6
INSTALLATION	7
Boiler mounting	7
Blast tube length	7
Securing the burner to the boiler	7
Ignition pilot adjustment	7
Combustion head adjustment	8
Gas piping	9
Adjustments before first firing	10
Servomotor	10
Burner starting	10
Burner firing	10
Burner calibration:	11
1 - Firing output	11
2 - Maximum output	11
3 - Minimum output	12
4 - Intermediates outputs	12
5 - Air pressure switch	13
6 - Low gas pressure switch	13
Flame present check	13
Maintenance	14
Appendix	15
Switchboard layout	16
Burner firing rates according to air density	19
Start up report	23

N.B.

Figures mentioned in the text are identified as follows:

- 1)(A) = part 1 of figure A, same page as text;
- 1)(A)p.4 = part 1 of figure A, page number 4.

WARNING

If you smell gas:

- Do not touch any electrical items.
- Open all windows.
- Close all gas supply valves.
- Contact your local gas authority immediately.

Do not store flammable or hazardous materials in the vicinity of fuel burning appliances.

Improper installation, adjustment, alteration, service or maintenance can cause property damage, personal injury or death. Refer to this manual for instructional or additional information. Consult a certified installer, service representative or the gas supplier for further assistance.

Burner shall be installed in accordance with manufacturers requirements as outlined in this manual, local codes and authorities having jurisdiction.

TECHNICAL DATA

MODEL			RS 45/M LN
Output (1)	MAX.	MBtu/hr kW	717 - 2037 (1969 *) 210 - 597 (577 *)
	MIN.	MBtu/hr kW	341 100
Fuel			Natural gas
- Max delivery		SCFH	2037
- Pressure at maximum delivery (2) natural gas		" WC	5.31
Operation			Low - high-low or modulating
Standard application			Boilers: water, steam, thermal oil
Ambient temperature		°F	32 - 104 (0 - 40 °C)
Combustion air temperature		°F max	140 (60 °C)
Main power supply		V/Ph/Hz	120/1/60
Fan motor		rpm	3400
		W - HP	370 - 0.5
		V	120
		A	5.2
Motor capacitor		µF	45
Ignition transformer		V1 - V2	120 V - 1 x 7 kV
		I1 - I2	1.6 A - 23 mA
Electrical power consumption		W max	600
Electrical protection			NEMA 1
Noise levels (3)		dBA	72

(1) Reference conditions: Ambient temperature 68 °F (20 °C) - Barometric pressure 394" WC - Altitude 329 ft.

(2) Pressure at test point 8)(A)p.4, with zero pressure in the combustion chamber, with open gas ring 2)(B)p.8 at maximum burner output

(3) Sound pressure measured in manufacturer's combustion laboratory, with burner operating on test boiler and at maximum rated output.

* Firing rate for C-UL Canadian Listing (CNL)

Burner models designation:

Model	Code	Voltage	Flame safeguard
RS 45/M LN	C9541000 (3897370)	120/1/60	Burner mounted

ACCESSORIES (optional):

• **Modulating control kit:** Under modulating operation, the burner automatically adapts to one of an infinite number of firing rates between the low and high flame output position, thus ensuring stable operating conditions in terms of temperature or pressure.

Two components should be ordered:

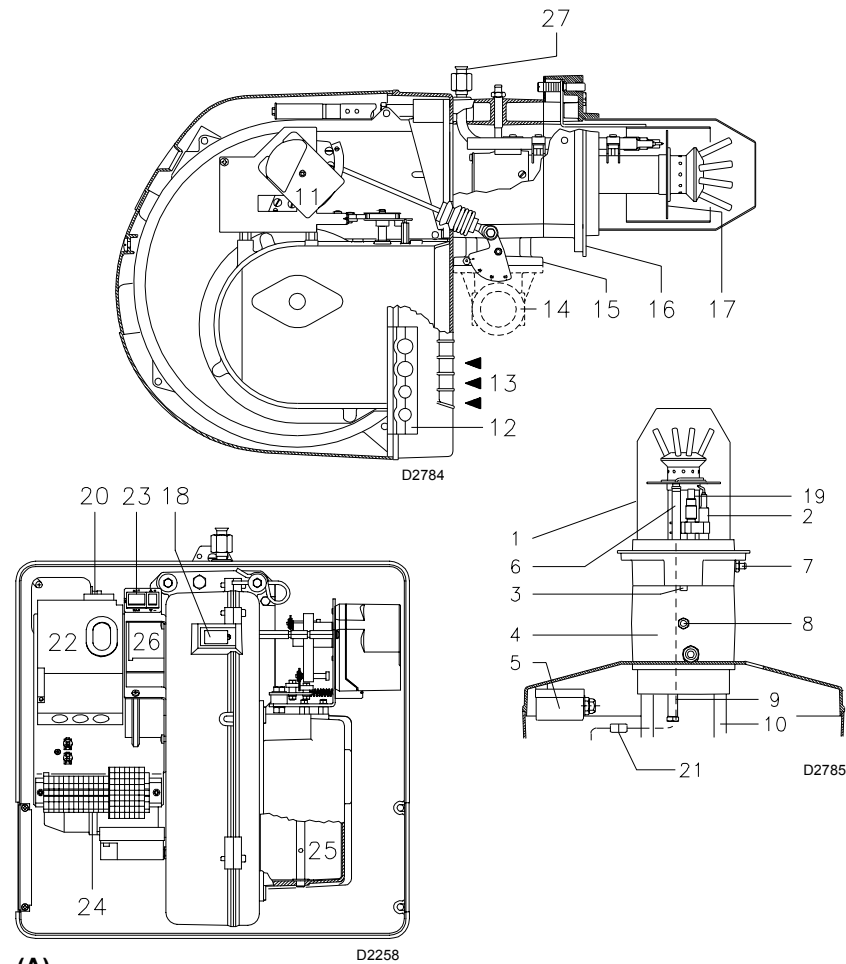
- Modulating control to install to the burner;
- probe to install to the boiler.

Parameter to be checked	Range	Probe		Modulating control	
		Type	Code	Type	Code
Temperature	- 212...+ 932 °F (- 100...+ 500 °C)	PT 100	3010110	RWF40	3010212
Pressure	0...36.3 PSI (0...2.5 bar)	Output probe	3010213		
		0...232 PSI (0...16 bar)	4...20 mA	3010214	

• **GAS TRAIN ACCORDING TO UL STANDARDS:** see page 9.

Important:

The installer is responsible for the supply and installation of any safety device(s) not indicated in this manual.



BURNER DESCRIPTION (A)

- 1 Combustion head
- 2 Ignition electrode
- 3 Screw for combustion head adjustment
- 4 Sleeve
- 5 Low air pressure switch (differential operating type)
- 6 Flame sensor probe (flame rod)
- 7 Air pressure test point
- 8 Gas pressure test point and head fixing screw
- 9 Screws securing fan housing to sleeve
- 10 Slide bars for opening the burner and inspecting the combustion head
- 11 Servomotor controlling the gas butterfly valve and air damper (by means of a variable profile cam mechanism).
When the burner is not operating the air damper is fully closed in order to reduce heat loss.
- 12 Plate with four hole knock-outs for electrical cable routing
- 13 Air inlet to fan
- 14 Gas input connection
- 15 Gas butterfly valve
- 16 Boiler mounting flange
- 17 Flame stability disk
- 18 Flame inspection window
- 19 Ignition pilot
- 20 Motor contactor
- 21 Plug-socket on flame rod probe cable
- 22 Flame safeguard
- 23 Power switch for different operations:
automatic - manual - off
Switch for:
manual modulation of servomotor
- 24 Burner terminal strip
- 25 Air damper
- 26 Bracket for mounting the PID modulating controller RWF40 (optional)
- 27 Pilot burner attachment

Note

If the flame relay 22(A) pushbutton lights up, it indicates that the burner is in lock-out.
To reset, press the pushbutton.

PACKAGING - WEIGHT (B) - Approximate measurements

- The burners are shipped in cardboard boxes with the maximum dimensions shown in Table (B).
- The weight of the burner complete with packaging is indicated in table (B).

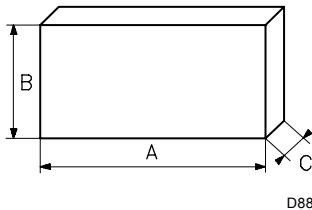
MAX. DIMENSIONS (C)

Approximate measurements
The maximum dimensions of the burners are given in (C).
Note that if you need to examine the combustion head, the burner must be pulled backward on the slide bars and turned upward.
The maximum dimension of the burner, without the cover, when open is give by measurement H.

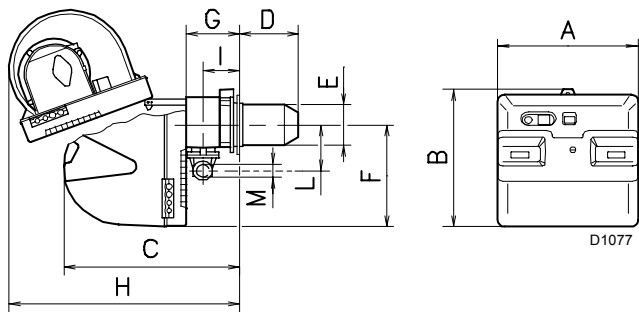
STANDARD EQUIPMENT

- 1 - Gas train flange
- 1 - Flange gasket
- 4 - Flange fixing screws
- 1 - Head gasket
- 4 - Screws to secure the burner flange to the boiler:
3/8 W x 1"
- 1 - Instruction booklet
- 1 - Spare parts list

inch	A	B	C	lbs
RS 45/M LN	39 ^{31/32"}	24 ^{13/16"}	19 ^{11/16"}	90



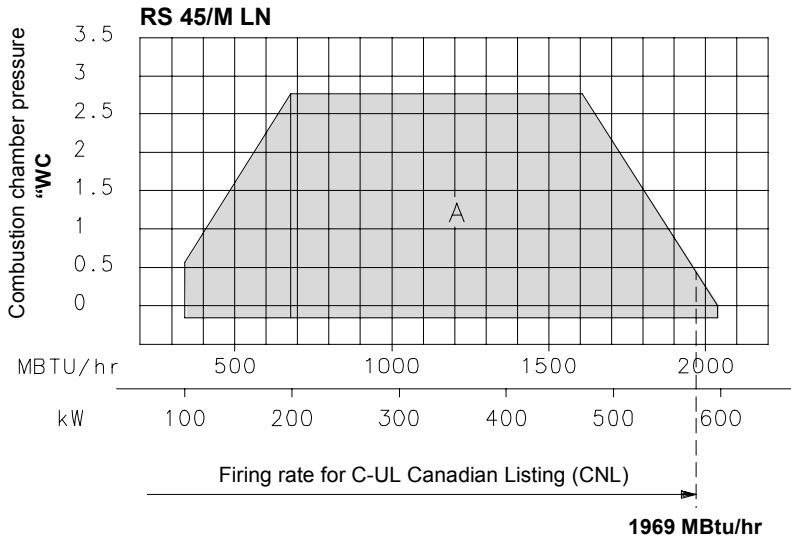
(B)



A	B	C	D (1)	E	F	G	H	I	L	M
18 ^{23/32"}	18 ^{21/32"}	22 ^{13/16"}	9 ^{1/32"} -13 ^{15/16"}	6 ^{9/32"}	13 ^{27/32"}	6 ^{7/16"}	3 ^{17/8"}	4 ^{1/4"}	6 ^{5/8"}	1 ^{1/2"}

(1) Blast tube: short - long (with kit)

(C)



FIRING RATES (A)

During operation, burner output varies between:

- a **MAXIMUM OUTPUT**, selected within area A,
- and a **MINIMUM OUTPUT**, which must not be lower than the minimum limit in the diagram.

Important:

The FIRING RATE value range has been obtained considering an ambient temperature of 68 °F (20 °C), and an atmospheric pressure of 394" WC and with the combustion head adjusted as shown on page 8.

Note:

The FIRING RATE areas given in figure (A) have been reduced by 10% with respect to the maximum range that can be reached.

Consult Appendix on page 18 for operation at different surrounding temperatures and/or altitudes.

MINIMUM FURNACE DIMENSIONS (B)

The firing rates were set in relation to certified test boilers.

Figure (B) indicates the diameter and length of the test combustion chamber.

Example:

output 1388 MBtu/hr:
diameter 19.7 inch - length 4.9 ft.

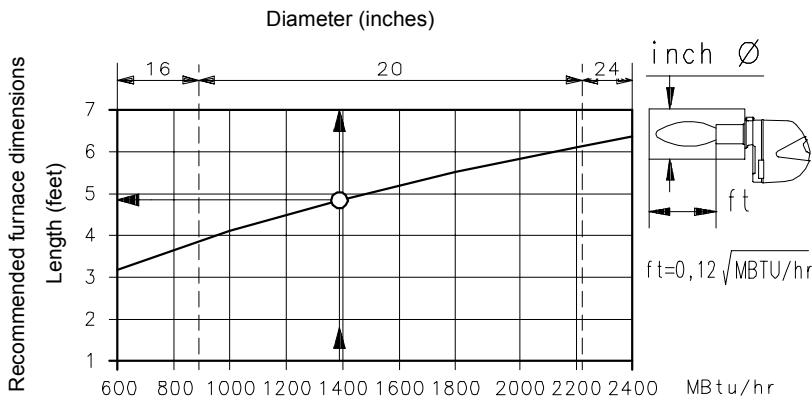
COMMERCIAL BOILERS (C) - IMPORTANT

The RS 45/M LN burner is suitable for operation on either flame-inversion boilers or boilers with combustion chambers featuring flow from the base (three flue passes) on which the best results are obtained in terms of low NOx emissions.

The maximum thickness of the boiler's front door must not exceed 8" (see fig. C).

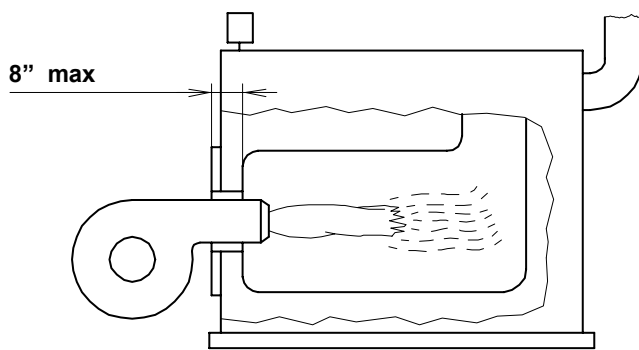
(A)

D2787



(B)

D2417



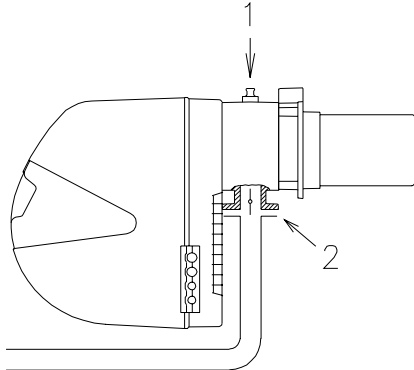
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(C)

RS 45/M LN

MBtu/hr	kW	Δp (" WC)
		1
720	211	1.38
949	278	2.16
1136	333	2.90
1327	389	3.66
1515	444	4.21
1706	500	4.72
1894	555	5.12
2085	611	5.31

(A)



(B)

D2786

GAS PRESSURE

The adjacent tables are used to calculate manifold pressure taking into account combustion chamber pressure.

Column 1

Gas manifold pressure measured at test point 1)(B), with:

- Combustion chamber at 0" WC
- Burner operating at maximum output
- Gas ring 2)(B)p.8 adjusted as indicated in diagram (C)p. 8.

Calculate the approximate maximum output of the burner as follows:

- subtract the combustion chamber pressure from the gas pressure measured at test point 1)(B).
- Find the nearest pressure value to your result in column 1 of the table (A).
- Read off the corresponding output on the left.

Example - RS 45/M LN:

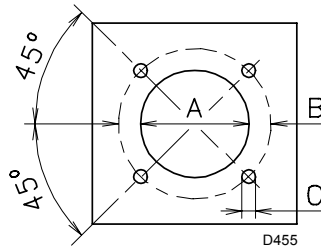
- Maximum output operation
- Natural gas
- Gas ring 2)(B)p.8 adjusted as indicated in diagram (C)p.8.
- Gas pressure at test point 1)(B) = 3.69" WC
- Pressure in combustion chamber = 0.79" WC

$$3.69 - 0.79 = 2.90" \text{ WC}$$

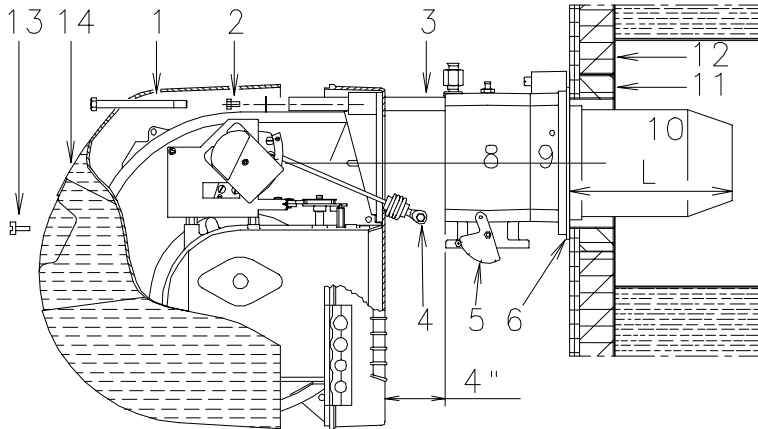
A maximum output of 1023 MBtu/hr shown in table (A) corresponds to 2.90" WC pressure, column 1.

This value serves as a rough guide, the effective delivery must be measured at the gas meter.

inch	A	B	C
RS 45/M LN	6 ⁹ / ₃₂ "	8 ¹³ / ₁₆ "	3 ⁷ / ₈ W

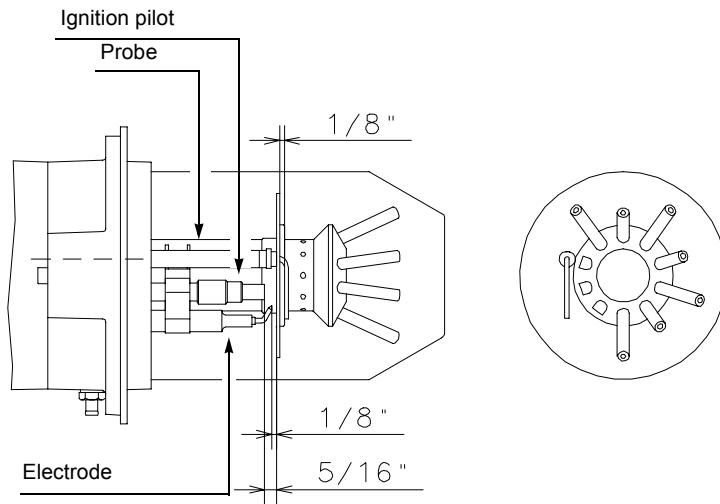


(A)



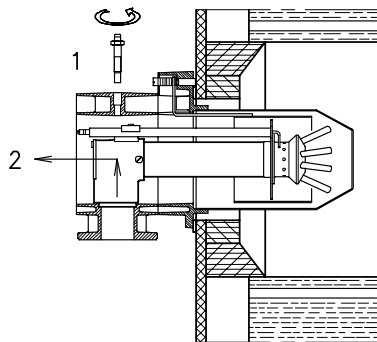
(B)

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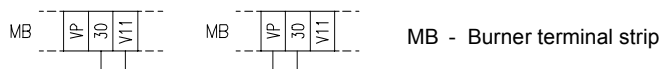
(C)

D2788



(D)

D1082



(E)

D2317

INSTALLATION

BURNER MOUNTING (A)

Drill the combustion chamber mounting plate as shown in (A).

The position of the threaded holes can be marked using the head gasket supplied with the burner.

BLAST TUBE LENGTH (B)

The length of the blast tube must be selected according to the indications provided by the manufacturer of the boiler, and it must be greater than the thickness of the boiler door complete with its insulation. The lengths, L (inches), are:

Blast tube 10):	RS 45/M LN
• short	9 ¹ / ₃₂ "
• long	13 ¹⁵ / ₁₆ "

Protective insulation material 11) must be inserted between the boiler refractory 12) and the blast tube 10). This protective insulation must not compromise the extraction of the blast tube.

For boilers with a water-cooled front, the insulation fitting 11)-12)(B) is not required unless it is required by the boiler manufacturer.

SECURING THE BURNER TO THE BOILER (B)

Before securing the burner to the boiler, check through the blast tube opening to make sure that the flame sensor probe and the ignition electrode are correctly set in position, as shown in (C).

Now detach the combustion head from the burner, fig. (B):

- Remove screw 13) and withdraw the cover 14).
- Disengage the swivel coupling 4) from the graduated sector 5).
- Remove the screws 2) from the slide bars 3).
- Remove screw 1) and pull the burner back on slide bars 3) by about 4".
- Disconnect the wires from the probe and the electrode and then pull the burner completely off the slide bars, after removing the split pin from the slide bar 3).

Secure the flange 9)(B) to the boiler plate, inserting the head gasket 6)(B). Use the 4 screws, also supplied with the unit, after first protecting the thread with an anti-seize product.

The seal between burner and boiler must be airtight.

If you noticed any irregularities in the positions of the probe or ignition electrode during the check mentioned above, remove screw 1)(D), extract the internal part 2)(D) of the head and set up the two components correctly.

IGNITION PILOT ADJUSTMENT

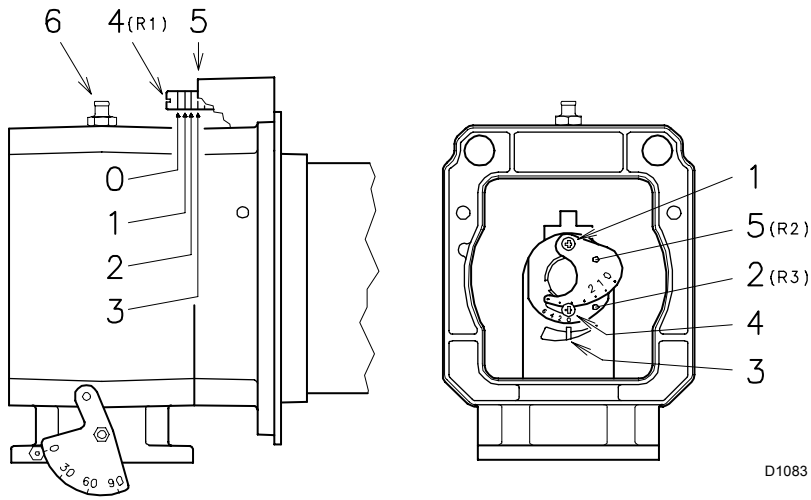
Place the pilot and electrode as shown in fig. (C).

The pilot works correctly at pressures ranging from 5 - 12" WC.

Important

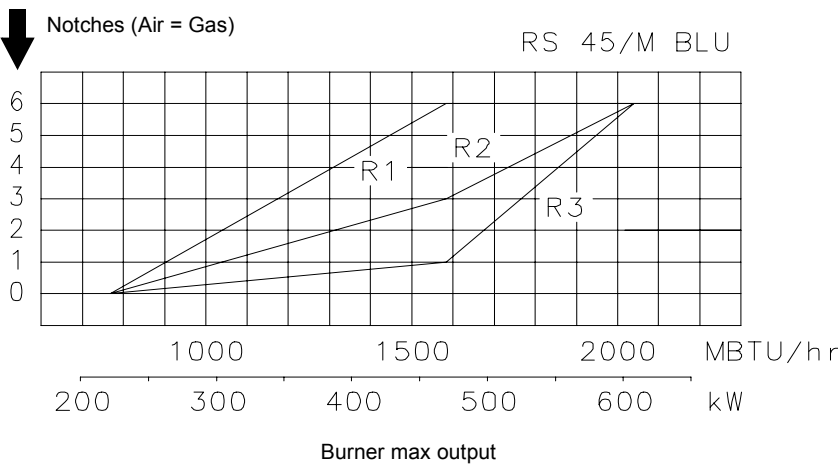
To set the pilot without main burner operation, proceed as follows:

- Move the jumper from terminals "30-V11" to terminals "30-VP", as given in fig. (E), this way the main valve is not energized.
- With the burner in the manual position, hold the air damper in the minimum position and make the setting.
- When the setting is correct, replace the jumper on "30-V11".



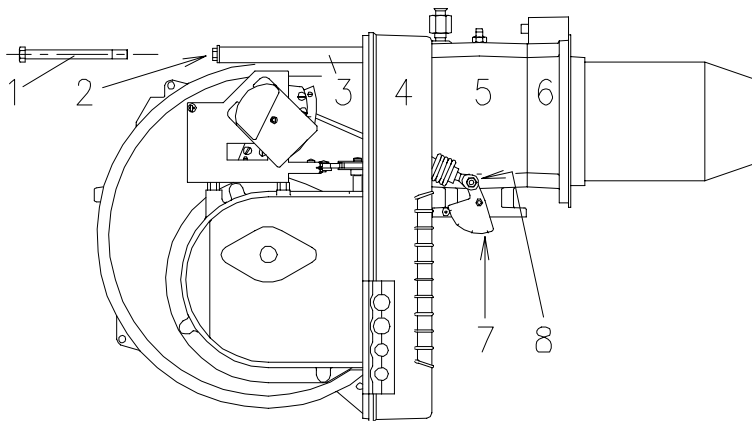
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(A) (B)



D2789

(C)



D2790

(D)

COMBUSTION HEAD ADJUSTMENT

Installation operations are now at the stage where the blast tube and sleeve are secured to the boiler as shown in fig. (A). It is now a very simple matter to set up the combustion head, as this depends solely on the output developed by the burner at maximum power.

It is therefore essential to establish this value before proceeding to set up the combustion head.

There are three adjustments to make on the head:

- outside air R1;
- central air R2;
- gas deliveries R3.

In diagram (C) find the notch to use for adjusting the air and the gas, and then proceed as follows:

Outside air adjustment R1 (A)

Turn screw 4)(A) until the notch identified is aligned with the front surface 5)(A) of the flange.

Gas adjustment R3 (B)

Loosen screws 1)(B) and 4)(B) and turn ring 2) until the notch identified is aligned with index 3).

Central air adjustment R2 (B)

Turn choke 5) until the notch identified is aligned with screw 4). Tighten the screws 1) and 4) fully down.

Example

Burner output = 1515 MBtu/hr.

If we consult diagram (C) we find that for this output, the adjustments are:

- outside air: R1 = 5,3;
- central air: R2 = 2,7;
- gas: R3 = 0,7.

Once you have finished setting up the head, refit the burner 4)(D) to the slide bars 3) at approximately 4" from the sleeve 5) - burner positioned as shown in fig. (B)p. 7 - insert the flame rod cable and the ignition electrode cable and then slide the burner up to the sleeve so that it is positioned as shown in fig. (D).

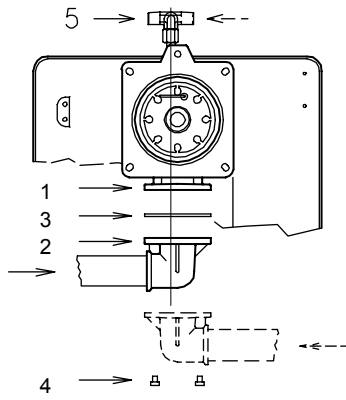
Refit screws 2) on slide bars 3).

Secure the burner to the sleeve by tightening screw 1) and then refit the split pin into one of two slide bars 3). Reconnect the swivel connector 8) to the graduated sector 7).

Connect gas train and pilot train as shown in fig. (A) page 9.

Important

When fitting the burner on the two slide bars, it is advisable to gently draw out the high tension cable and flame detection probe cable until they are slightly stretched.



(A)

D2293

TYPICAL SCHEMATIC GAS PIPING

GAS PIPING

- The main gas train must be connected to the gas attachment 1)(A), using flange 2), gasket 3) and screws 4) supplied with the burner.
- The main gas train can enter the burner from the right or left side, depending on which is the most convenient, see fig.(A).
- Gas safety shut-off valves 5)-6)(B) must be as close as possible to the burner to ensure gas reaches the combustion head within the safety time range.
- The pilot gas train must be connected to the gas attachment 5)(A) and can enter the burner from the right or left side.

GAS TRAIN (B)

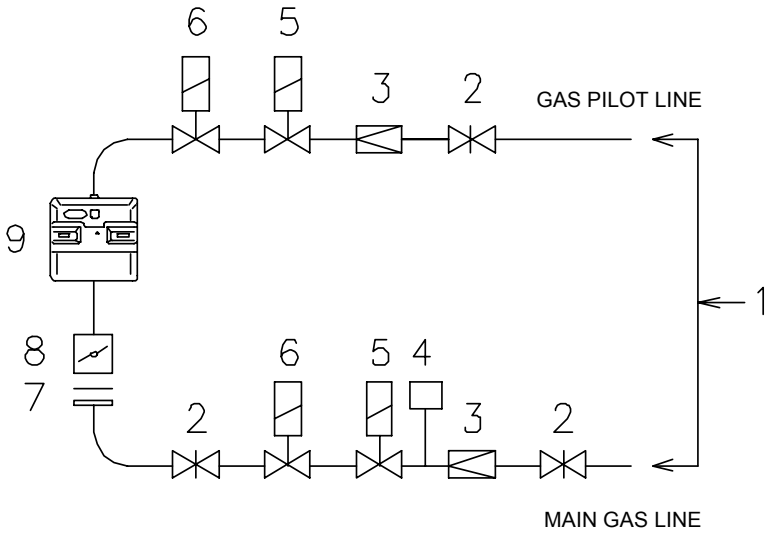
It must be type-approved according to required local standards and is supplied separately from the burner.

Note

See the accompanying instructions for the gas train layout.

KEY (B)

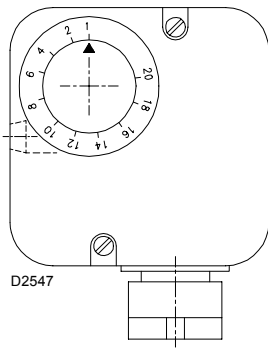
- 1 - Gas input pipe
- 2 - Manual valve
- 3 - Pressure regulator
- 4 - Low gas pressure switch
- 5 - 1st safety shut off valve
- 6 - 2nd safety shut off valve
- 7 - Standard issue burner gasket with flange
- 8 - Gas adjustment butterfly valve
- 9 - Burner



(B)

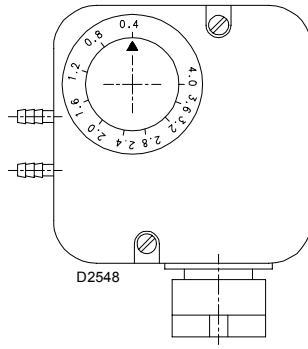
D2294

LOW GAS PRESSURE SWITCH



(A)

AIR PRESSURE SWITCH



(B)

ADJUSTMENTS BEFORE FIRST FIRING

Adjustment of the combustion head, and air and gas deliveries has been illustrated on page 8.

In addition, the following adjustments must also be made:

- Open manual valves on the gas train.
- Adjust the low gas pressure switch to the start of the scale (A).
- Adjust the air pressure switch to the zero position of the scale (B).
- Purge the air from the gas line.
- Fit a U-type manometer (C) to the gas pressure test point on the sleeve.

The manometer readings are used to calculate MAX. burner power using the tables on page 6.

Before starting up the burner it is good practice to adjust the gas train so that ignition takes place in conditions of maximum safety, i.e. with gas delivery at the minimum.

SERVOMOTOR (C)

The servomotor provides simultaneous adjustment of the air damper, by means of the variable profile cam, and the gas butterfly valve.

The angle of rotation of the servomotor is equal to the angle on the graduated sector controlling the gas butterfly valve. The servomotor rotates through 90 degrees in 25 seconds.

Do not alter the factory setting for the cams; simply check that they are set as indicated below:

Red cam : 90°

Limits rotation toward maximum position.

When the burner is at max output the gas butterfly valve must be fully open: 90°.

Blue cam : 0°

Limits rotation toward the minimum position. When the burner is shut down the air damper and the gas butterfly valve must be closed: 0°.

Orange cam : 15°

Adjusts the ignition position and the MIN output.

BURNER STARTING

Close the control circuit and set switch 1)(E) to "MAN".

As soon as the burner starts check the direction of rotation of the fan blade, looking through the flame inspection window 18)(A)p.4.

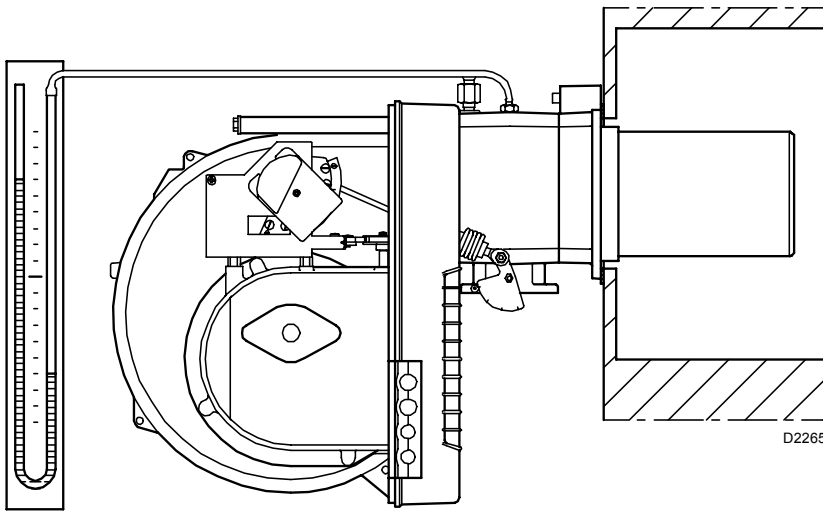
BURNER FIRING

Having completed the checks indicated in the previous heading, the pilot of the burner should fire. If the motor starts but the flame does not appear and the flame safeguard goes into lock-out, reset and wait for a new firing attempt.

Pilot adjustment has been illustrated on page. 7.

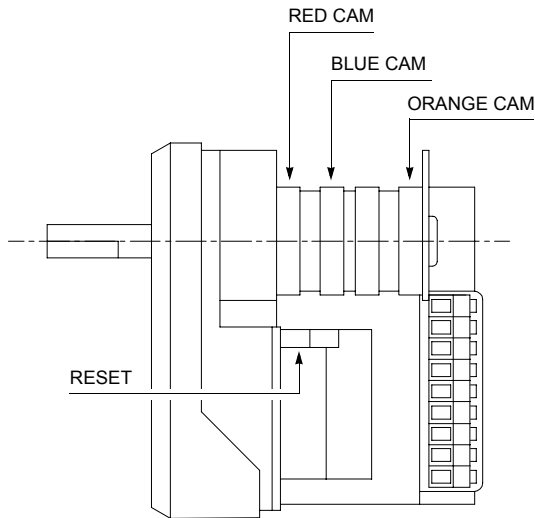
Having adjusted the pilot, reconnect the main valve and ignite the main flame; it might require several attempts to purge the air from the gas lines or to adjust the valve with little gas.

Once the burner has fired, now proceed with calibration operations.



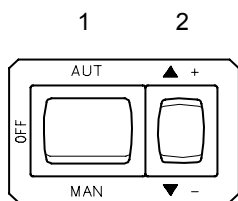
(C)

SERVOMOTOR



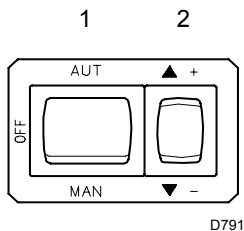
(D)

D2266



(E)

D791



(A)

BURNER CALIBRATION

The optimum calibration of the burner requires an analysis of the flue gases at the boiler outlet.

Adjust successively:

- 1 - First firing output
- 2 - Max. burner output
- 3 - Min. burner output
- 4 - Intermediate outputs between low and high fire
- 5 - Air pressure switch
- 6 - Minimum gas pressure switch

1 - FIRING OUTPUT

Pilot adjustment has been illustrated on page. 7.

2 - MAXIMUM OUTPUT

Maximum output of the burner must be set within the firing rate range shown on page 5.

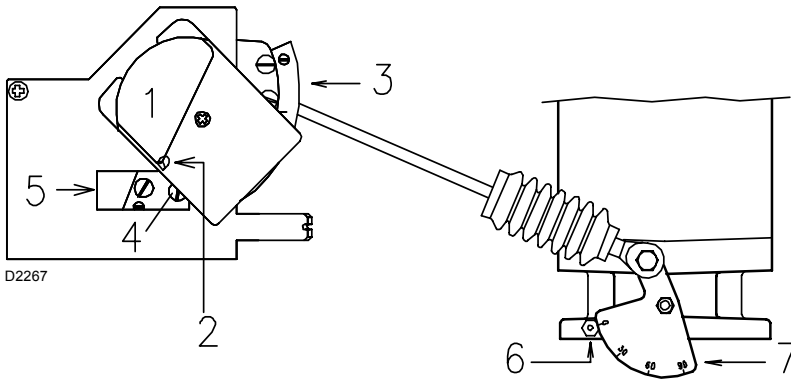
In the above instructions we left the burner running in MIN. output operation. Now press switch 2)(A) "increase output" and keep it pressed until the servomotor has opened the air damper and the gas butterfly valve to 90°.

Gas calibration

Measure the gas delivery at the meter.

A guideline indication can be calculated from the table on page 6, simply read off the gas pressure on the U-type manometer, see fig.(C) on page 10, and follow the instructions on page 6.

- If delivery needs to be reduced, reduce outlet gas pressure and, if it is already very low, slightly close adjustment valve.
- If delivery needs to be increased, increase outlet gas pressure.



D2267

- 1 Servomotor
- 2 Lever, push to engage, push to release
- 3 Adjustable profile cam
- 4 Cam profile adjustment screws
- 5 Opening for access to screws 5
- 6 Index for graduated sector 8
- 7 Graduated sector for gas butterfly valve

(A)

Adjusting air delivery

Progressively adjust the end profile of cam 4)(A) by turning the cam adjustment screws as they appear through the access opening 6)(A).

- Turn the screws clockwise to increase air delivery.
- Turn the screws counter-clockwise to reduce air delivery.

3 - MINIMUM OUTPUT

Minimum output must be selected within the firing rate range shown on page 5.

Press switch 2)(A)p.11 "output reduction" until the servomotor has closed the air damper and the gas butterfly valve to 15° (factory set adjustment).

Adjusting gas delivery

Measure the delivery of gas from the gas meter.

- If this value is to be reduced, decrease the angle of orange cam (B) slightly by proceeding a little at a time until the angle is changed from 15° to 13° or 11°....
- If it has to be increased press the switch "output increase" 2)(A)p.11 (i.e. open the gas butterfly valve by 10-15°), increase the orange cam angle (B) with small successive movements, i.e. take it from angle 15° to 17° - 19°....

Then press the switch "output decrease" until the servomotor is taken to the minimum opening position and measure the gas delivery.

Note

The servomotor follows the adjustment of cam only when the cam angle is reduced. If it is necessary to increase the cam angle, first increase the servomotor angle with the switch "output increase", then increase the orange cam angle, and at the end bring the servomotor back to the MIN output position with the switch "output decrease".

Adjustment of air delivery

Progressively adjust the starting profile of cam 4)(A) by turning the screws working through the access hole 6)(A).

4 - INTERMEDIATE OUTPUTS

Adjustment of gas delivery

No adjustment of gas delivery is required.

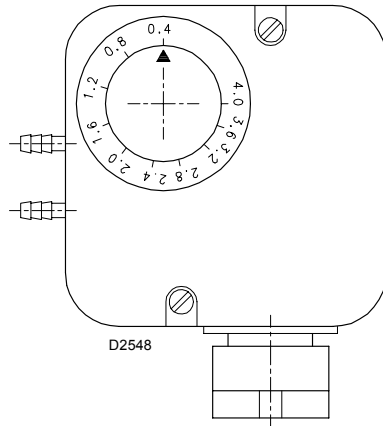
Adjustment of air delivery

With the switch 1)(A) page 11 move in intermediate outputs and set the variable profile cam 4) by turning the screws 5).

- If the burner operation is low-high it is sufficient to set only minimum and maximum firing rates
- If the burner operation is modulating, all the points of modulation should be adjusted.

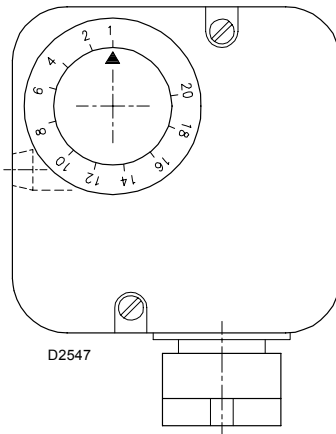
When the adjustment is complete, release the servomotor and manually check there is no binding of the cam.

AIR PRESSURE SWITCH

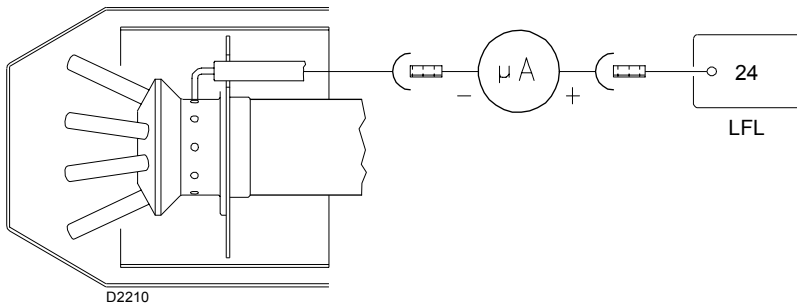


(A)

LOW GAS PRESSURE SWITCH



(B)



(C)

5 - AIR PRESSURE SWITCH (A) - CO CHECK

Adjust the air pressure switch after having performed all other burner adjustments with the air pressure switch set to the start of the scale (A).

With the burner operating at min. output, increase adjustment pressure by slowly turning the relative dial clockwise until the burner locks out.

Then turn the dial anti-clockwise by about 20% of the set point and repeat burner starting to ensure it is correct. If the burner locks out again, turn the dial anti-clockwise a little bit more.

Attention:

As a rule, the air pressure switch must prevent the formation of CO.

To check this, insert a combustion analyser into the chimney, slowly close the fan suction inlet (for example with cardboard) and check that the burner locks out, before the CO in the fumes exceeds 400 ppm.

The air pressure switch may operate in "differential" operation in two pipe system. If a negative pressure in the combustion chamber during pre-purging prevents the air pressure switch from switching, switching may be obtained by fitting a second pipe between the air pressure switch and the suction inlet of the fan. In this way the air pressure switch operates as differential pressure switch.

6 - LOW GAS PRESSURE SWITCH (B)

Adjust the low gas pressure switch after having performed all the other burner adjustments with the pressure switch set at the start of the scale (B).

With the burner operating at MAX output, increase adjustment pressure by slowly turning the relative dial clockwise until the burner locks out.

Then turn the dial anti-clockwise by 0.8" WC and repeat burner starting to ensure it is uniform.

If the burner locks out again, turn the dial anti-clockwise again by 0.4" WC.

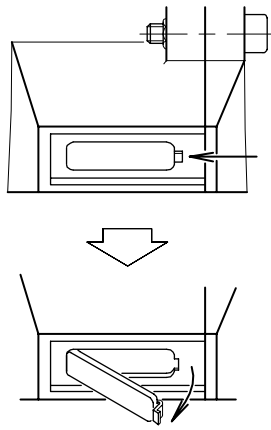
FLAME PRESENT CHECK (C)

The burner is fitted with an ionisation system (flame rod) which ensures that a flame is present. The minimum current for operation is 6 μA. (or see appropriate documentation of flame safeguard manufacturer)

The burner provides a much higher current, so that controls are not normally required. However, if it is necessary to measure the ionisation current, disconnect the plug-socket 21(A)p.4 on the ionisation probe cable and insert a direct current microammperometer with a base scale of 100 μA.

Carefully check polarities!

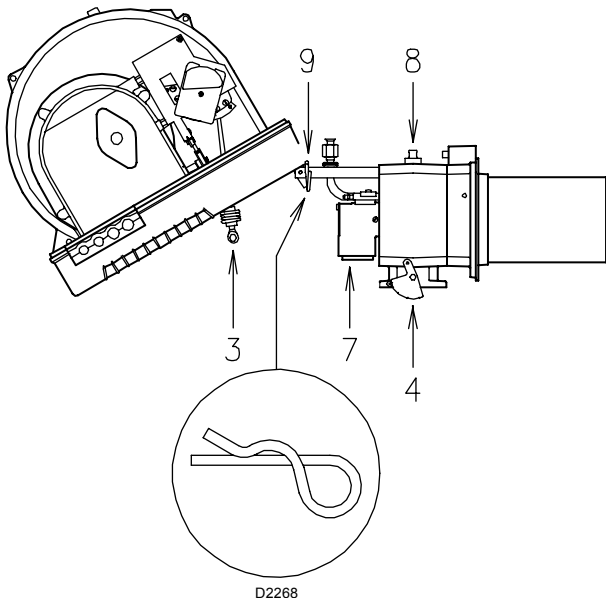
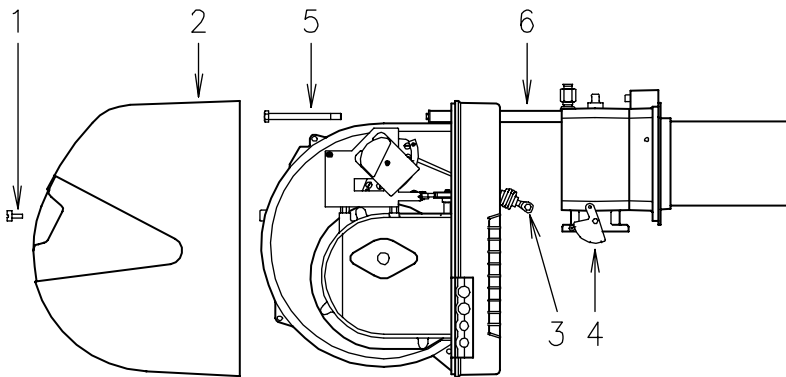
FLAME INSPECTION WINDOW



(A)

D484

OPENING THE BURNER



D2268

(B)

MAINTENANCE

Combustion

The optimum calibration of the burner requires an analysis of the flue gases. Significant differences with respect to the previous measurements indicate the points where more care should be exercised during maintenance.

Gas leaks

Make sure that there are no gas leaks on the pipework between the gas meter and the burner.

Flame inspection window

Clean the flame inspection window (A).

Combustion head

Open the burner and make sure that all components of the combustion head are in good condition, not deformed by the high temperatures, free of impurities from the surroundings and correctly positioned. If in doubt, disassemble the elbow fitting 7)(B).

Servomotor

Disengage the cam from servomotor and turn it backward and forward by hand to make sure it is free moving. Now engage cam again.

Burner

Check for excess wear or loose screws in the mechanisms controlling the air damper and the gas butterfly valve. Also make sure that the screws securing the electrical leads in the burner connections are fully tightened. Clean the outside of the burner, taking special care with the linkages joints and cam.

Combustion

Adjust the burner if the combustion values found at the beginning of the operation do not comply with the regulations in force, or do not correspond to good combustion.

TO OPEN THE BURNER (B):

- Switch off the electrical power.
- Remove screw 1) and withdraw cover 2).
- Disengage the swivel coupling 3) from the graduated sector 4).
- Remove screw 5), the split pin 9) and pull the burner back by about 4" on the slide bars 6).
- Disconnect the probe and electrode leads and then pull the burner fully back.
- Turn the burner as shown in the figure and fit the split pin 9) into one of the slide bar holes so that the burner remains in position.

Now extract the gas distributor 7) after having removed the screw 8) and disconnecting the pilot gas line.

TO CLOSE THE BURNER (B):

- Remove the split pin 9) and push the burner until it is about 4" from the sleeve.
- Re-connect the leads and slide in the burner until it comes to a stop.
- Refit screw 5), the split pin 9) and pull the probe and electrode leads gently out until they are slightly stretched.
- Re-couple the swivel coupling 3) to the graduated sector 4).
- Connect the pilot gas line.

APPENDIX

Electrical connections



NOTES

The electrical wirings must be carried out in conformity with the regulations in force in the countries of destination, and by qualified personnel.

Riello S.p.A. cannot accept any responsibility for modifications or connections other than those shown in these diagrams.

RS 45/M LN		
FU1 (A)	T10	T10
FU2 (A)	T6	

NOTES

Field Wiring Connections

- The RS 45/M LN burners have been type- approved for intermittent operation. This means they should compulsorily be stopped at least once every 24 hours to enable the flame safeguard to check its own efficiency at start-up. Burner halts are normally provided for automatically by the boiler load control system.

If this is not the case, a time switch should be fitted in series to IN to provide for burner shut-down at least once every 24 hours.



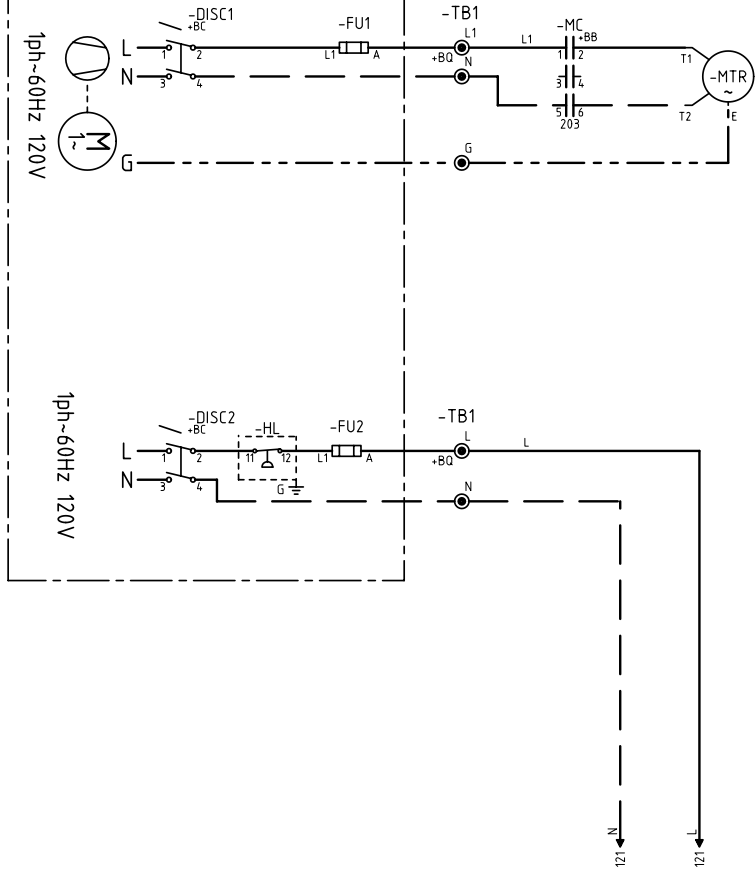
Important note

When installing for the first time and after any maintenance work, make sure the gas valves are connected properly to the orange terminals before proceeding to ignite the burner. Insert auxiliary lamps or check, with the aid of a tester, that power is not being supplied to the valves during standby or pre-purging. Burner ignition with the gas valves open during pre-purging may cause the generator to burst.

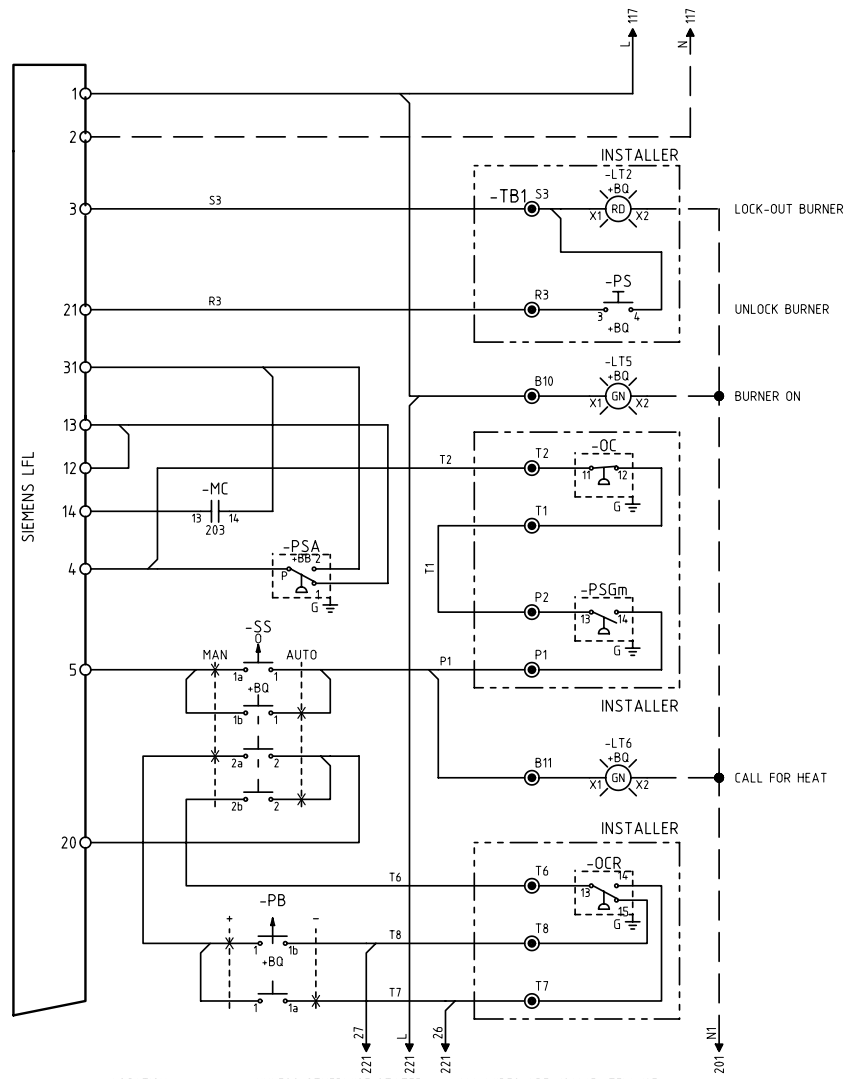
- Do not invert the neutral with the phase wire in the electricity supply line.
- Only use original spare parts to replace the components.

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INSTALLER

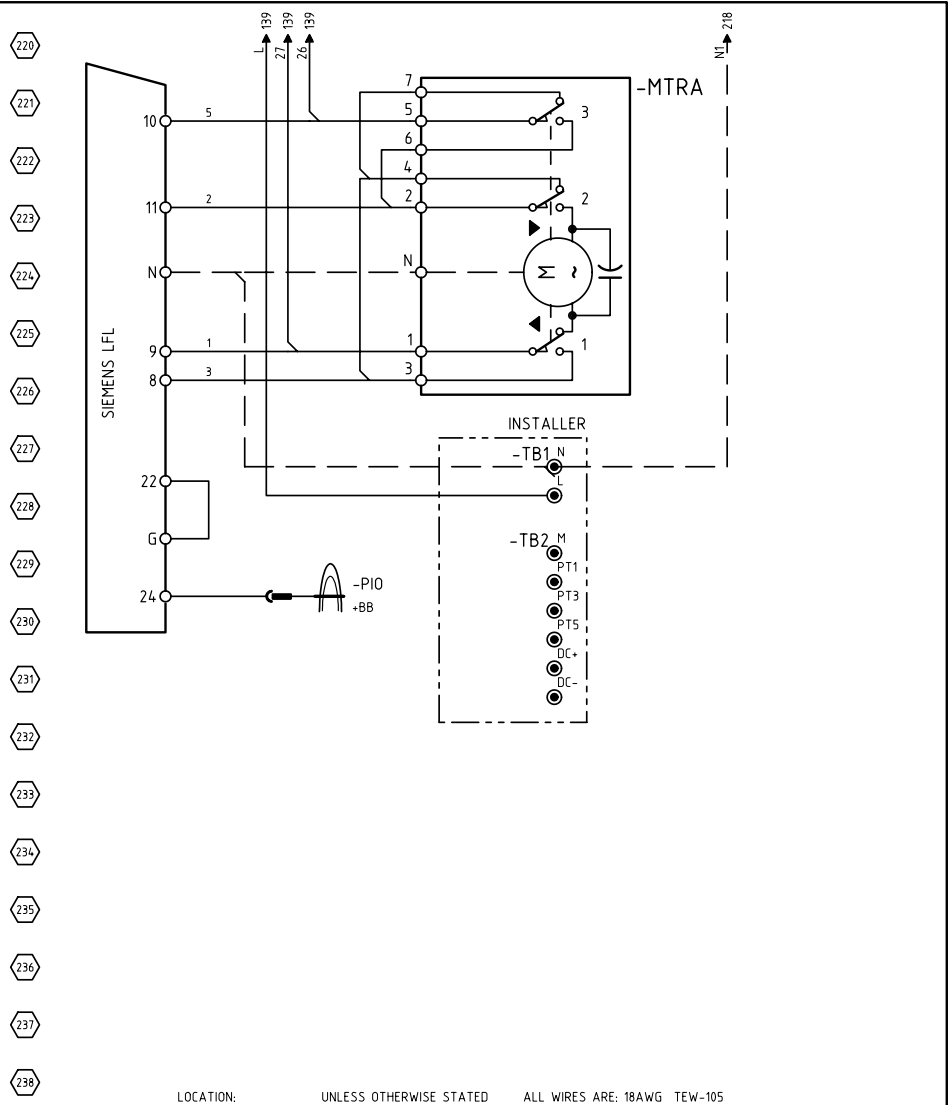
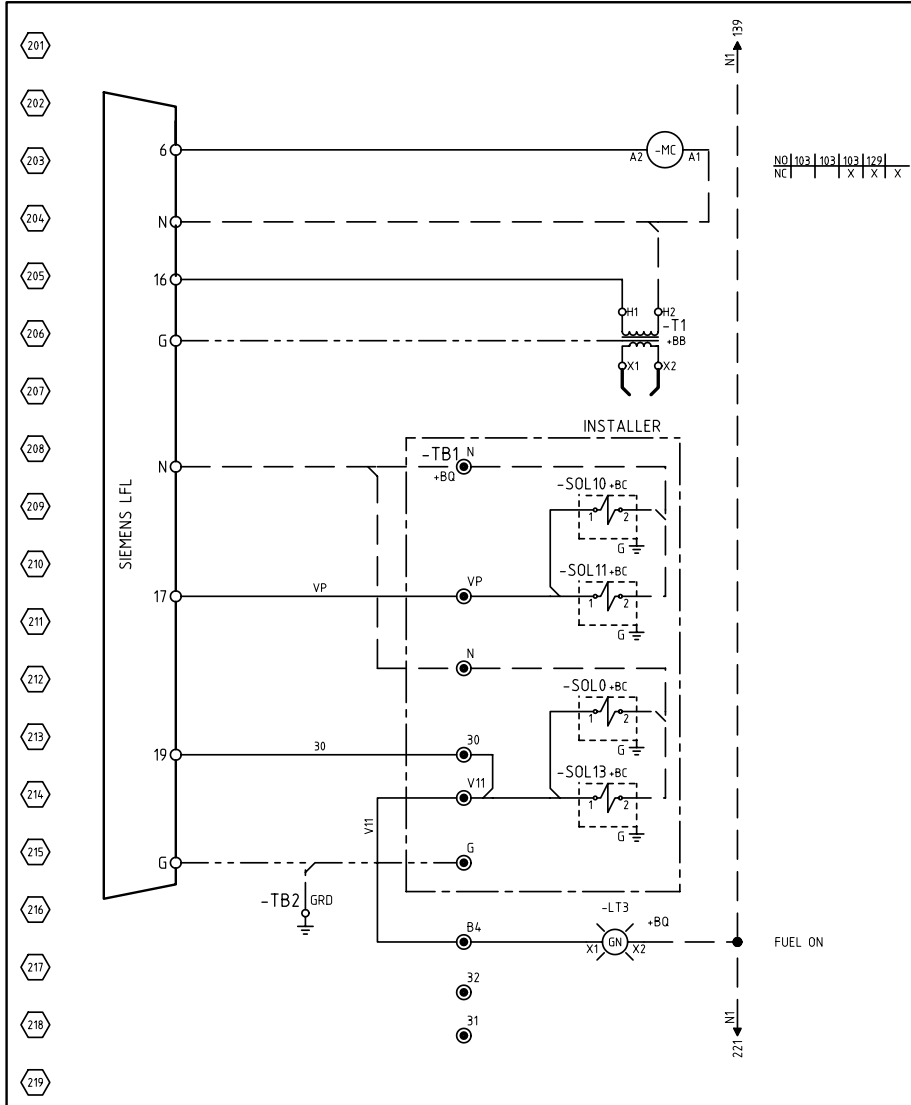


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LOCATION: UNLESS OTHERWISE STATED ALL WIRES ARE: 18AWG TEW-105

BK: Black
 BN: Brown
 BU: Blue
 GN: Green
 GY: Grey
 OR: Orange
 RD: Red
 YE: Yellow
 WH: White



LOCATION: UNLESS OTHERWISE STATED ALL WIRES ARE: 18AWG TEW-105

BK: Black
 BN: Brown
 BU: Blu
 GN: Green
 GY: Grey
 OR: Orange
 RD: Red
 YE: Yellow
 WH: White

APPENDIX - Burner firing rates according to air density

above sea level		average barom. pressure		CORRECTION FACTOR F								
				Air temperature °F (°C)								
ft	m	" W.C.	mbar	0 (0°C)	41 (5°C)	50 (10°C)	59 (15°C)	68 (20°C)	77 (25°C)	86 (30°C)	104 (40°F)	
0	0	399	1013	1,087	1,068	1,049	1,031	1,013	0,996	0,980	0,948	
329	100	394	1000	1,073	1,054	1,035	1,017	1,000	0,983	0,967	0,936	
658	200	389	989	1,061	1,042	1,024	1,006	0,989	0,972	0,956	0,926	
987	300	385	978	1,050	1,031	1,013	0,995	0,978	0,962	0,946	0,916	
1316	400	380	966	1,037	1,018	1,000	0,983	0,966	0,950	0,934	0,904	
1645	500	376	955	1,025	1,007	0,989	0,972	0,955	0,939	0,923	0,894	
1974	600	372	944	1,013	0,995	0,977	0,960	0,944	0,928	0,913	0,884	
2303	700	367	932	1,000	0,982	0,965	0,948	0,932	0,916	0,901	0,872	
2632	800	363	921	0,988	0,971	0,954	0,937	0,921	0,906	0,891	0,862	
2961	900	358	910	0,977	0,959	0,942	0,926	0,910	0,895	0,880	0,852	
3290	1000	354	898	0,964	0,946	0,930	0,914	0,898	0,883	0,868	0,841	
3947	1200	346	878	0,942	0,925	0,909	0,893	0,878	0,863	0,849	0,822	
4605	1400	337	856	0,919	0,902	0,886	0,871	0,856	0,842	0,828	0,801	
5263	1600	329	836	0,897	0,881	0,866	0,851	0,836	0,822	0,808	0,783	
5921	1800	321	815	0,875	0,859	0,844	0,829	0,815	0,801	0,788	0,763	
6579	2000	313	794	0,852	0,837	0,822	0,808	0,794	0,781	0,768	0,743	

(A)

The FIRING RATE area values have been obtained considering a surrounding temperature of 68°F (20°C), and an atmospheric pressure of 398" W.C. and with the combustion head adjusted as shown on page 8.

The burner may be required to operate with combustion air at a higher temperature and/or at higher altitudes.

Heating of air and increase in altitude produce the same effect: the expansion of the air volume, i.e. the reduction of air density.

The burner fan's delivery remains substantially the same, but the oxygen content per cubic meter and the fan's head are reduced.

It is therefore important to know if the maximum output required of the burner at a given combustion chamber pressure remains within the burner's firing rate range even at different temperature and altitude conditions. Proceed as follows to check the above:

- 1 - Find the correction factor F in the Table (A) for the plant's air temperature and altitude.
- 2 - Divide the burner's delivery Q by F in order to obtain the equivalent delivery Q_e:

$$Q_e = Q : F \quad (\text{MBtu/hr})$$

- 3 - In the firing rate range of the burner, Fig. (B), indicate the work point defined by:

Q_e = equivalent delivery

H1 = combustion chamber pressure

The resulting point A must remain within the firing rate range.

- 4 - Plot a vertical line from Point A as shown in Figure (B) and find the maximum pressure H2 of the firing rate.

- 5 - Multiply H2 by F to obtain the maximum reduced pressure H3 of the firing rate.

$$H_3 = H_2 \times F \quad (\text{"W.C.})$$

If H3 is greater than H1, as shown in Fig. (B), the burner delivers the output required.

If H3 is lower than H1, the burner's delivery must be reduced. A reduction in delivery is accompanied by a reduction of the pressure in the combustion chamber:

Q_r = reduced delivery

H1_r = reduced pressure

$$H_{1r} = H_1 \times \left(\frac{Q_r}{Q}\right)^2$$

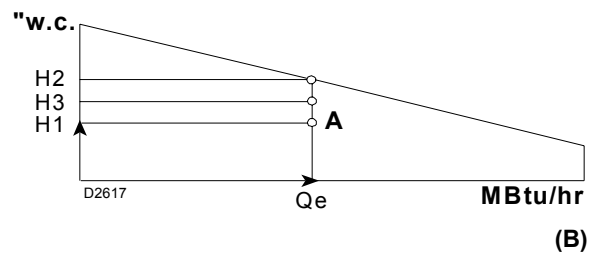
Example, a 5% delivery reduction:

$$Q_r = Q \times 0.95$$

$$H_{1r} = H_1 \times (0.95)^2$$

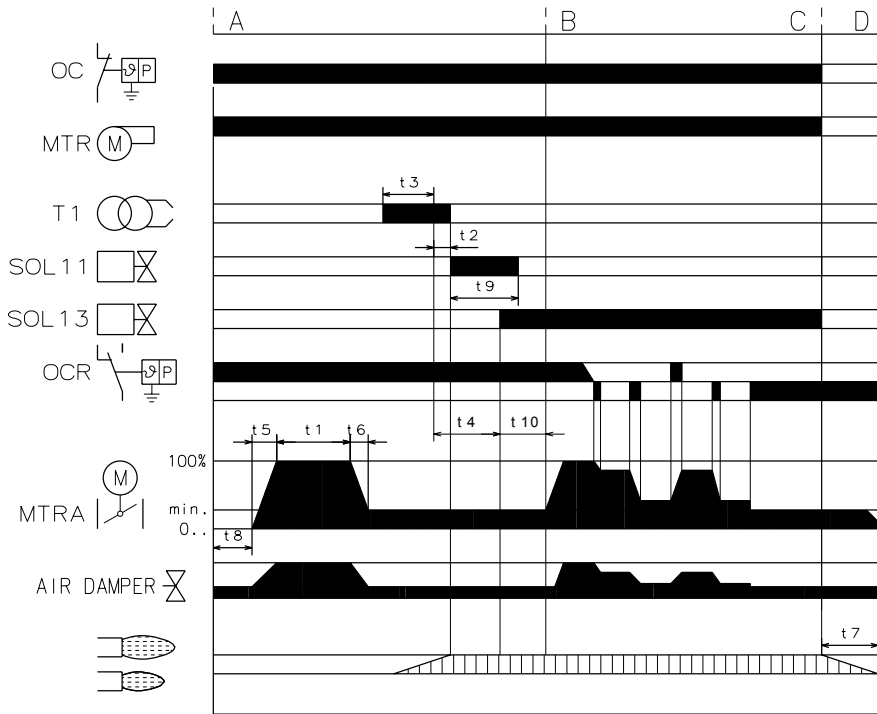
Steps 2 - 5 must now be repeated using the new Q_r and H1_r values.

Important: the combustion head must be adjusted in respect to the equivalent delivery Q_e.



(B)

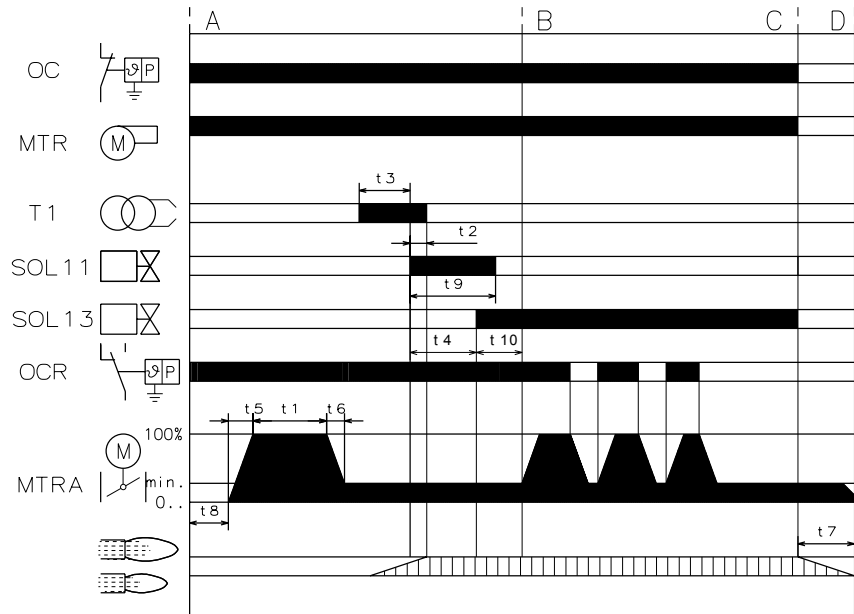
Full Modulation



(A)

D7780

Low - High



(B)

D7781

BURNER OPERATION

BURNER STARTING

- Operating closes.
- Fan motor starts.
- Servomotor starts:
 - 90° rotation to right, until contact is made on red cam. The air damper is positioned to MAX. output.
- Pre-purge stage with air delivery at MAX. output.
- After pre-purge stage, servomotor rotates to left up to the angle set on blu cam for MIN. output.
- The air damper and the gas butterfly are positioned to MIN. output.
- Ignition electrode strikes a spark.
- Pilot valve opens. The pilot flame is ignited.
- After about 12s the main flame ignites and starting cycle ends.

STEADY STATE OPERATION

Burner without modulating control RWF40

At the end of the starting cycle, the servomotor control then passes to the load control for boiler pressure or temperature.

(The flame safeguard continues, however, to check that the flame is present and that the air pressure switch is in the correct position.)

- If the temperature or pressure is low, the burner progressively increases its output to the MAX. value.
- If the temperature or pressure is high, the burner progressively decreases its output to the MIN. value. And so on.
- The burner locks out when demand for heat is less than the heat supplied by the burner at min. output. Load control opens. The servomotor returns to the 0° angle limited by contact with orange cam. The air damper closes completely to reduce thermal dispersion to a minimum.

Every time output is changed, the servomotor automatically modifies gas delivery (gas butterfly valve) and air delivery (fan damper).

Burner with modulating control RWF40

See the handbook enclosed with the modulating control.

Switching times are given in seconds, in the burner start-up sequence.

LFL 1.335 Series 01

t1	30s	t6	*
t2	2s	t7	12s
t3	4s	t8	4s
t4	12.5s	t9	16s
t5	*	t10	10s

* Variable to air damper setting.

Legend for the times

- t1 Pre-purge time with air damper open
- t2 Safety time
- t3 Pre-ignition time, short (ignition transformer on terminal 16)
- t4 Interval between start of t2 and release of valve at terminal 19
- t5 Interval between end of t4 and release of load controller or valve at terminal 20
- t5 Running time of air damper into OPEN position
- t6 Running time of air damper into low-flame position (MIN)
- t7 Permissible after-burn time
- t8 Interval until OPEN command for the air damper is given
- t9 Running time of pilot
- t10 Interval between end of t4 and end start up sequence

FIRING FAILURE

If the burner does not fire, it locks out within 2.5 seconds from opening the pilot valve and then within 5 seconds from opening the main valves.

BURNER FLAME GOES OUT DURING OPERATION

If the flame should accidentally go out during operation, the burner will lock out within 1s.

BURNER FAULTS

Control program under fault conditions and lock-out indication

In case of any disturbance, the sequence mechanism stops and with it the lock-out indicator. The symbol above the reading mark of the indicator gives the type of disturbance:



No start, e.g. because one contact is not closed. Lock-out during or after control program sequence due to extraneous light (e.g. non-extinguished flames, leaking fuel valves, defects in the flame supervision circuit, etc.)



Interruption of startup sequence, because the OPEN signal has not been delivered to terminal 8 by limit switch "a". Terminals 6, 7 and 14 remain under voltage until the fault has been corrected!



Lockout, because there is no air pressure indication at the beginning of air pressure control. **Every air pressure failure after this moment in time leads to lock-out, too!**



Lock-out due to a fault in the flame supervision circuit.



Interruption of startup sequence, because the position signal for the low-flame position has not been delivered to terminal 8 by auxiliary switch "m". Terminals 6, 7 and 14 remain under voltage until the fault has been corrected!



Lock-out, because no flame signal is present after completion of the (1st) safety time.



Lock-out, because no flame signal has been received on completion of the 2nd safety time (flame signal of the main flame with interrupted pilot burners).



Lock-out, because the flame signal has been lost during burner operation.

If lock-out occurs at any other moment in time between the start and the pre-ignition which is not marked by a symbol, this is usually caused by a premature, i.e. faulty flame signal, e.g. caused by a self-igniting UV tube.

Key to Layouts

- BP** - Pressure probe
- BT** - Tree-wire probe Pt100
- BT1** - Temperature probe with two-wire circuit
- + BB** - Components on board burners
- + BQ** - Components on board main panel
- + BC** - Components on board boiler
- DISC1** - Disconnect switch motor
- DISC2** - Disconnect switch auxiliary
- FU1** - Motor fuse
- FU2** - Auxiliary fuse
- HL** - High limit control
- LFL** - Control box
- LT2** - Remote lock-out signal
- LT3** - Fire signal
- LT5** - Power on signal
- LT6** - Limit satisfied
- MC** - Motor contactor
- MTR** - Fan motor
- MTRA** - Servomotor
- OC** - Operating control
- OCR** - High-low control
- PS** - Remote lock-out reset
- PSA** - Air pressure switch
- PB** - Switch: burner off - on;
- Switch: low and high fire operation
- PIO** - Ionisation probe (flame rod)
- PSGm** - Min. gas pressure switch
- SOL0** - Safety valve
- SOL10** - Pilot valve
- SOL11** - Adjustment valve
- SOL13** - Pilot valve (safety)
- SS** - Switch for following operations :
MAN= manual
AUT= automatic
OFF
- T1** - Ignition transformer
- TB1** - Burner terminal strip
- TB2** - Burner ground (earth) connection

BURNER START UP REPORT

Model number: _____	Serial number: _____
Project name: _____	Start-up date: _____
Installing contractor: _____	Phone number: _____

GAS OPERATION					
Gas Supply Pressure: _____	CO ₂ : Low Fire _____	High Fire _____	_____	_____	_____
Main Power Supply: _____	O ₂ : Low Fire _____	High Fire _____	_____	_____	_____
Control Power Supply: _____	CO: Low Fire _____	High Fire _____	_____	_____	_____
Burner Firing Rate: _____	NO _x : Low Fire _____	High Fire _____	_____	_____	_____
Manifold Pressure: _____	Net Stack Temp - Low Fire: _____	High Fire: _____	_____	_____	_____
Pilot Flame Signal: _____	Comb. Efficiency - Low Fire: _____	High Fire: _____	_____	_____	_____
Low Fire Flame Signal: _____	Overfire Draft: _____	_____	_____	_____	_____
High Fire Flame Signal: _____	_____	_____	_____	_____	_____

OIL OPERATION					
Oil supply pressure: _____	CO ₂ : Low Fire _____	High Fire _____	_____	_____	_____
Oil suction pressure: _____	O ₂ : Low Fire _____	High Fire _____	_____	_____	_____
Control Power Supply: _____	CO: Low Fire _____	High Fire _____	_____	_____	_____
Burner Firing Rate: _____	NO _x : Low Fire _____	High Fire _____	_____	_____	_____
Low Fire Flame Signal: _____	Net Stack Temp - Low Fire: _____	High Fire: _____	_____	_____	_____
High Fire Flame Signal: _____	Comb. Efficiency - Low Fire: _____	High Fire: _____	_____	_____	_____
Low Fire Nozzle Size: _____	Overfire Draft: _____	_____	_____	_____	_____
High Fire Nozzle Size: _____	Smoke number: _____	_____	_____	_____	_____

CONTROL SETTINGS					
Operating Setpoint: _____	Low Oil Pressure: _____	_____	_____	_____	_____
High Limit Setpoint: _____	High Oil Pressure: _____	_____	_____	_____	_____
Low Gas Pressure: _____	Flame Safeguard Model Number: _____	_____	_____	_____	_____
High Gas Pressure: _____	Modulating Signal Type: _____	_____	_____	_____	_____

NOTES



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