

## Gas Burners



**RS 190/M**

**Low-High-Low or Modulating Operation**

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### **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 190/M
Output (1)	MAX.	kW MBtu/hr	1420 - 2542 4845 - 8673
	MIN.	kW MBtu/hr	522 1781
Fuel			Natural or Propane gas
- max. delivery			SCFH 8673
- pressure at max. delivery (2)			"WC 5.9
Operation			Low - high or modulating
Standard applications			Boilers: water, steam, thermal oil
Ambient temperature		°F	32 - 104 (0 - 40 °C)
Combustion air temperature		°F max	140 (60 °C)
Main electrical supply (+/- 10%)		V/Ph/Hz	208 - 230/460/575/3/60
Fan motor		rpm W - HP V A	3400 4000 - 5.5 208-230/460/575 15.8 - 9.1 - 7.3
Ignition transformer		V1 - V2 I1 - I2	120 V - 1 x 7 kV 1.6 A - 23 mA
Electrical power consumption		W max	5500
Electrical protection			NEMA 1
Noise levels (3)		dBA	83.1

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

(2) Pressure at test point 17)(A)p.4, with zero pressure in the combustion chamber, with open gas ring 2)(B)p.6 an maximum burner output

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

### Burner models designations:

Model	Code	Voltage	Flame Safeguard
RS 190/M	C9527300 (3787670)	208-230/460/3/60	Burner mounted
	C9527301 (3787670)	575/3/60	Remote panel
	C9627300 (3787672)	208-230/460/3/60	Burner mounted
	C9627301 (3787672)	575/3/60	Remote panel

### ACCESSORIES (optional):

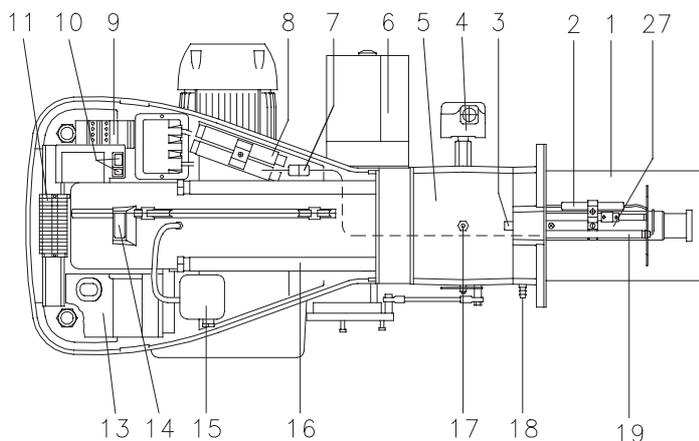
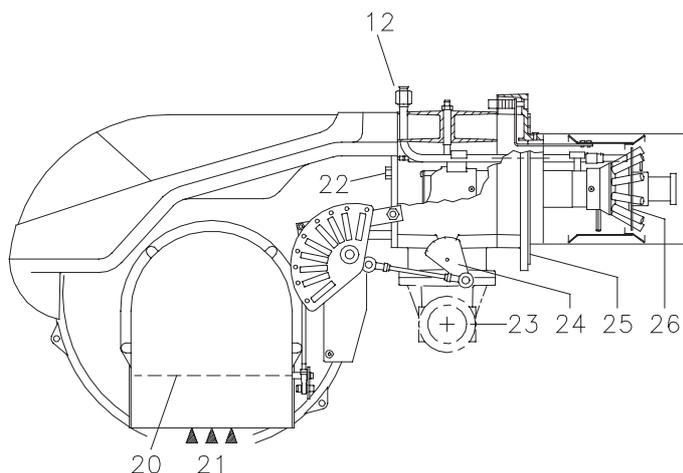
- **Kit for LPG operation:** The kit allows the RS 190/M burners to operate on LPG.

BURNER		RS 190/M
Output	kW	516 - 2542
	MBtu/hr	1761 - 8673
Code		3010276

- **Gas train according to UL regulation:** see page 9.

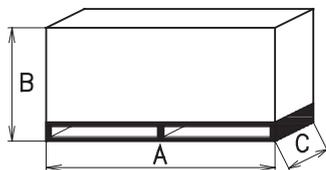
### Important:

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

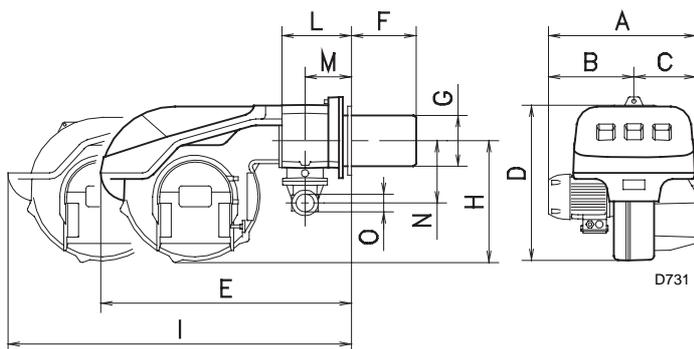


(A) D2430

A	B	C	lbs
49 <sup>31</sup> / <sub>32</sub> "	28 <sup>1</sup> / <sub>2</sub> "	30 <sup>29</sup> / <sub>32</sub> "	181



(B) D36



A	B	C	D	E	F	G	H	I	L	M	N	O
26 <sup>13</sup> / <sub>16</sub> "	14 <sup>13</sup> / <sub>32</sub> "	12 <sup>13</sup> / <sub>32</sub> "	21 <sup>27</sup> / <sub>32</sub> "	33 <sup>11</sup> / <sub>16</sub> "	14 <sup>21</sup> / <sub>32</sub> "	8 <sup>3</sup> / <sub>4</sub> "	16 <sup>15</sup> / <sub>16</sub> "	51 <sup>21</sup> / <sub>32</sub> "	9 <sup>1</sup> / <sub>16</sub> "	5 <sup>29</sup> / <sub>32</sub> "	7 <sup>5</sup> / <sub>16</sub> "	2"

(C)

### BURNER DESCRIPTION (A)

- 1 Combustion head
- 2 Ignition electrode
- 3 Screw for combustion head adjustment
- 4 High gas pressure switch
- 5 Sleeve
- 6 Servomotor controlling the gas butterfly valve and of 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 dispersion from the boiler due to the flue draught which draws air from the fan suction inlet.
- 7 Plug-socket on ionisation probe (flame rod) cable
- 8 Extensions for slide bars 16) (with kit)
- 9 Motor contactor and thermal overload with reset button
- 10 Power switch for different operations:  
automatic - manual - off  
Switch for:  
Power increase - power reduction
- 11 Terminal strip
- 12 Pilot burner attachment
- 13 Flame safeguard (flame relay) with lock-out pilot light and lock-out reset button
- 14 Flame inspection window
- 15 Low air pressure switch (differential operating type)
- 16 Slide bars for opening the burner and inspecting the combustion head
- 17 Gas pressure test point and head fixing screw
- 18 Air pressure test point
- 19 Flame sensor probe (flame rod)
- 20 Air damper
- 21 Air inlet to fan
- 22 Screws securing fan to sleeve
- 23 Gas input pipework
- 24 Gas butterfly valve
- 25 Boiler mounting flange
- 26 Flame stability disk
- 27 Ignition pilot

Two types of burner failure may occur:  
**Flame safeguard lock-out:** if the flame relay 13)(A) push-button lights up, it indicates that the burner is in lock-out. To reset, press the pushbutton.  
**Motor trip:** release by pressing the pushbutton on thermal relay 9)(A).

### PACKAGING - WEIGHT (B) - Approximate measurements

- The burner is shipped skid mounted Outer dimensions of packaging are indicated in (B).
- The weight of the burner complete with packaging is indicated in Table (B).

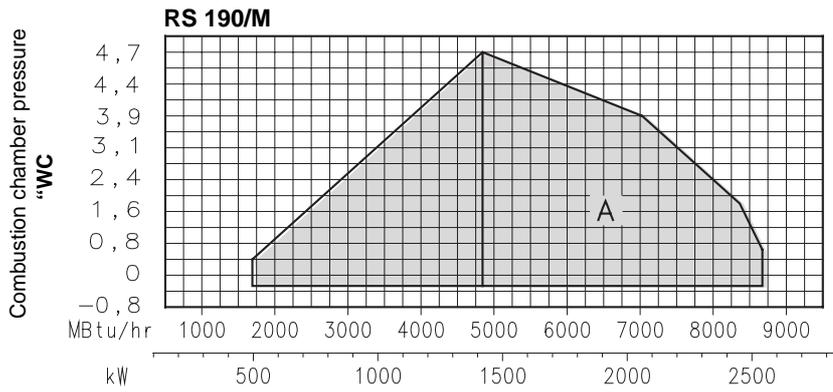
### MAX. DIMENSIONS (C) - Approximate measurements

The maximum dimensions of the burners are given in (C).

Bear in mind that inspection of the combustion head requires the burner to be opened and the rear part withdrawn on the slide bars.  
The maximum dimension of the burner, without casing, when open is give by measurement I.

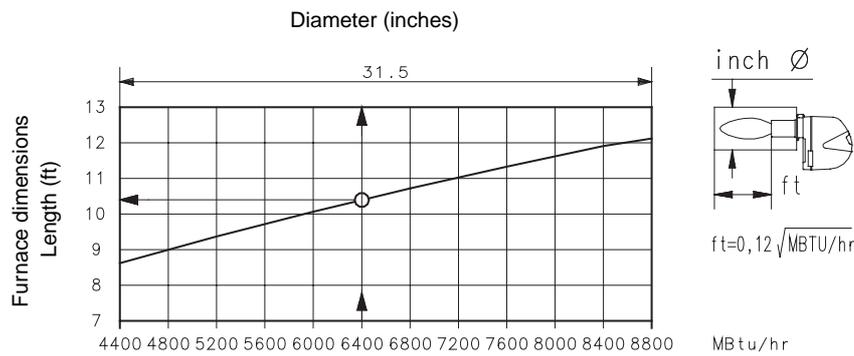
### STANDARD EQUIPMENT

- 1 - Gas train flange
- 1 - Flange gasket
- 4 - Flange fixing screws
- 1 - Burner head gasket
- 4 - Screws to secure the burner flange to the boiler:  
1/2 W x 1<sup>3</sup>/<sub>8</sub>"
- 1 - Cap for combustion head
- 1 - Disc for combustion head
- 1 - Instruction booklet
- 1 - Spare parts list



(A)

D2431



(B)

D2920

### FIRING RATES (A)

During operation, burner output varies between:

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

$$RS\ 190\ /M = 1781\ MBTU/h = 522\ kW$$

#### 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.

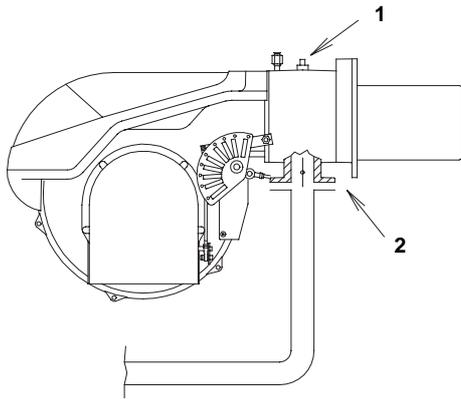
#### Example:

Output 6400 MBtu/hr:  
diameter = 31.5 inch; length 10.4 ft

**RS 190/M**

MBtu/hr	kW	Δp (" WC)	
		1	2
4848	1421	2.76	0.71
5302	1554	2.87	0.79
5681	1665	2.99	0.87
6060	1776	3.15	0.98
6438	1887	3.43	1.10
6817	1998	3.66	1.18
7196	2109	4.02	1.26
7575	2220	4.45	1.34
7953	2331	4.92	1.46
8673	2542	5.91	1.69

**(A)**



**(B)**

D2441

**GAS PRESSURE**

The adjacent table shows minimum pressure losses along the gas supply line depending on the maximum burner output operation with natural gas.

**Column 1**

Pressure loss at combustion head.

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

- Combustion chamber at 0" WC;
- Burner operating at maximum output;
- Combustion head adjusted as indicated in diagram (C)p. 8.

**Column 2**

Pressure loss at gas butterfly valve 2)(B) with maximum opening: 90°.

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**

- Maximum output operation
  - Natural gas
  - Gas pressure at test point 1)(B) = 4.33" WC
  - Pressure in combustion chamber = 1.18" WC
- $$4.33 - 1.18 = 3.15" \text{ WC}$$

An output of 6060 MBtu/hr shown in table (A) corresponds to 3.15" WC pressure, column 1.

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

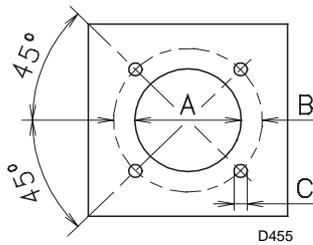
To calculate the required gas pressure at test point 1)(B), set the maximum output required from the burner operation:

- Find the nearest output value in the table (A).
- Read off the pressure at test point 1)(B) on the right in column 1.
- Add this value to the estimated pressure in the combustion chamber.

**Example**

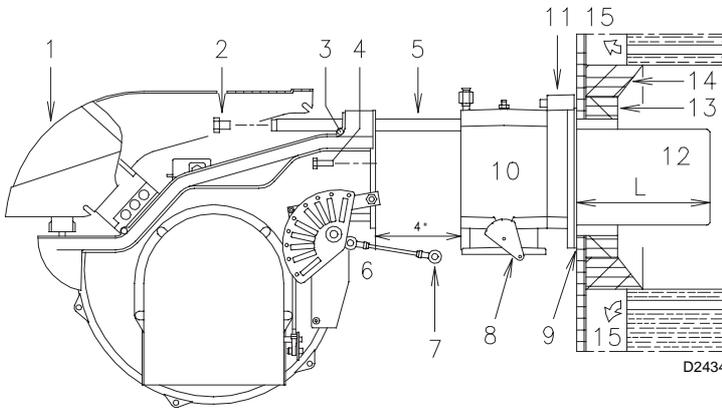
- Required burner maximum output operation: 6060 MBtu/hr
  - Natural gas
  - Gas pressure at burner output of 6060 MBtu/hr, taken from table (A), column 1 = 3.15" WC
  - Pressure in combustion chamber = 1.18" WC
- $$3.15 + 1.18 = 4.33" \text{ WC}$$
- pressure required at test point 1)(B).

inch	A	B	C
RS 190/M	9 <sup>1</sup> / <sub>16</sub> "	12 <sup>25</sup> / <sub>32</sub> " - 14 <sup>1</sup> / <sub>2</sub> "	5 <sup>8</sup> / <sub>8</sub> W



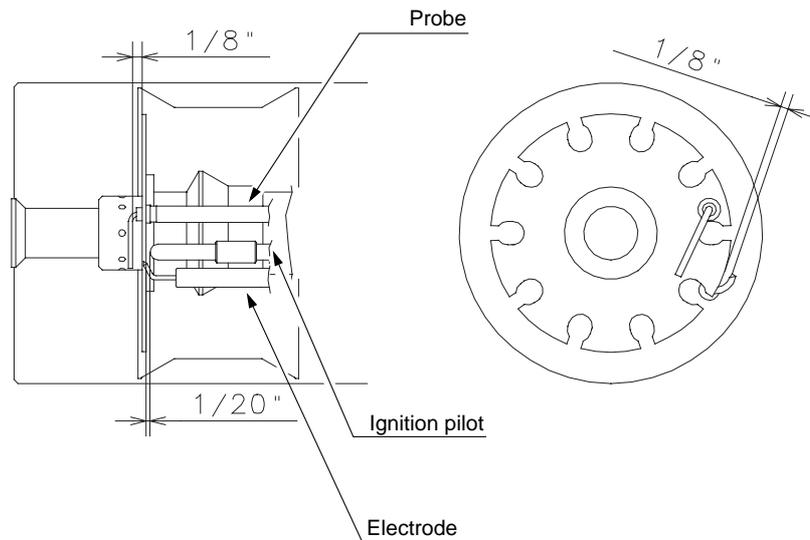
(A)

D455



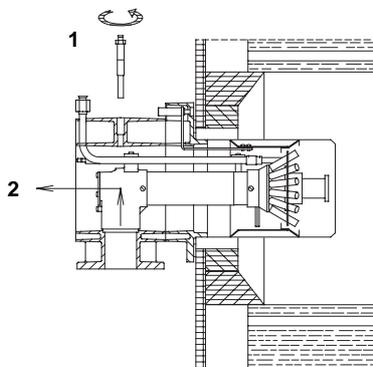
(B)

D2434



(C)

D2435



(D)

D2436



(E)

D2317

## INSTALLATION

### BOILER PLATE (A)

Drill the combustion chamber mounting plate as shown in (A). The position of the threaded holes can be marked using the burner 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 in any case it must be greater than the thickness of the boiler door complete with its insulation. The length available, L (inches), is 14<sup>21</sup>/<sub>32</sub>".

For boilers with front flue passes 15) or flame inversion chambers, protective insulation material 13), must be inserted between the boiler's refractory 14) and the blast tube 12).

This protective insulation must not compromise the extraction of the blast tube.

For boilers having a water-cooled front, the insulation 13)-14)(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 is correctly set in position, as shown in (C).

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

- Loosen the four screws 3) and remove the cover 1).
- Disengage the swivel joint 7) from the graduated sector 8)
- Remove the screws 2) from the two slide bars 5).
- Remove the two screws 4) and pull the burner back on slide bars 5) by about 4".
- Disconnect the wires from the probe and the electrode and then pull the burner completely off the slide bars.

Secure the flange 11)(B) to the boiler plate, inserting the gasket 9)(B). Use the 4 screws, also supplied with the unit, after first protecting the thread with an anti-locking 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 proceed to set up the two components correctly.

### IGNITION PILOT ADJUSTMENT

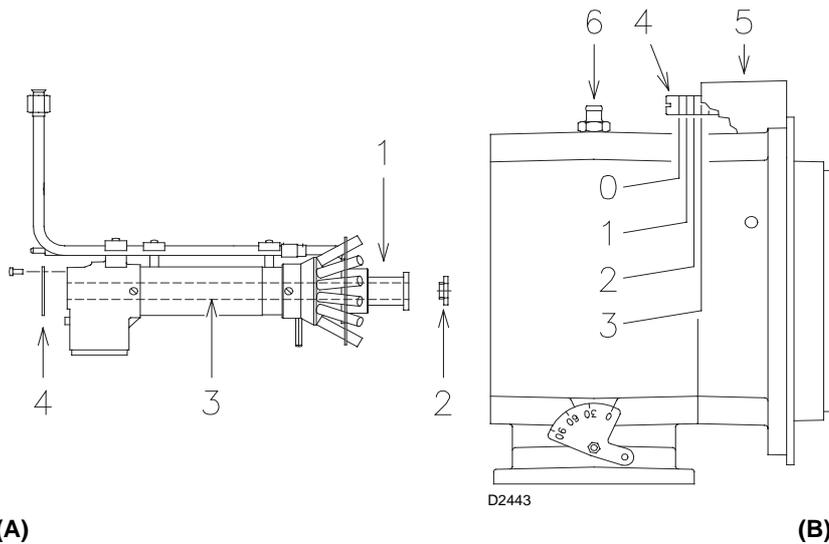
Place the pilot and electrode as shown in fig. (C).

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

#### Important

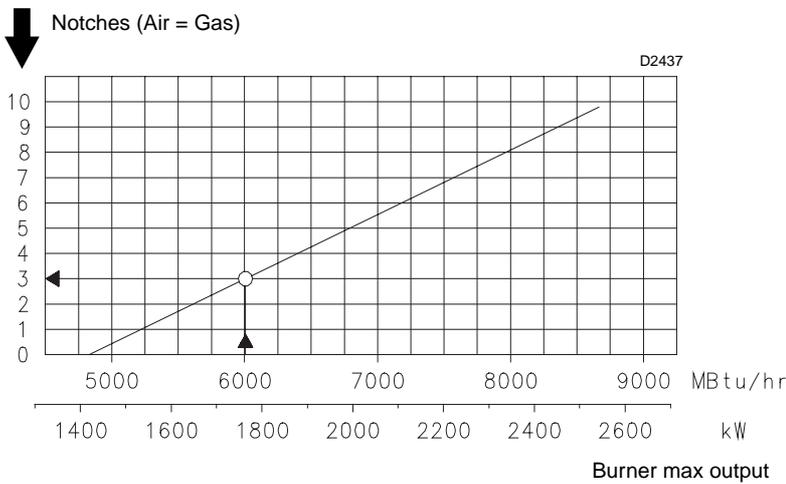
To set the pilot without main burner operation, proceed as follows:

- Move the jumper from terminals "30-V11" to terminals "30-VP", as given in fig. (E), this way the main valve is cut out.
- 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".

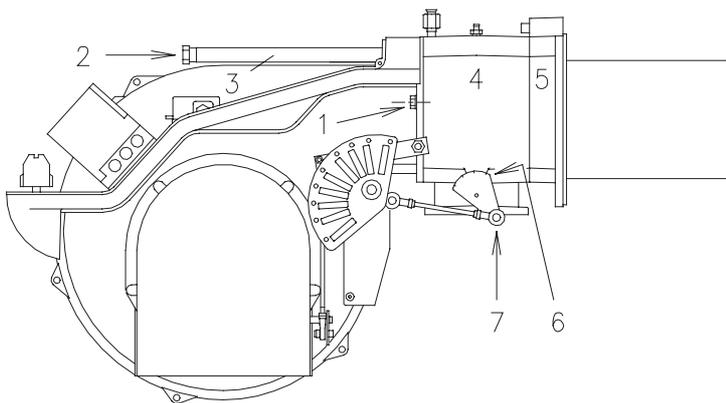


(A)

(B)



(C)



(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. (B). It is now a very simple matter to set up the combustion head, as this depends solely on the MAX output developed by the burner.

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

There are two adjustments to make on the head.

#### Air adjustment (B)

See diagram (C). Turn screw 4(B) until the notch identified is aligned with the front surface 5(B) of the flange.

#### Gas adjustment (A)

When the burner is installed for a maximum output  $\leq 5726$  MBtu/hr unscrew and remove the front part 1(A). Replace it with the supplied cap 2(A), after removing the inner pipe 3(A). Replace the disc 4(A) with the supplied disc without hole. If there is low gas supply pressure, the head may be left in standard configuration, limiting the minimum modulation to 1980 MBtu/hr.

#### Example

Maximum burner output = 6033 MBtu/hr.

If we consult diagram (C) we find that for this output, air must be adjusted using notch 3, as shown in fig. (B).

Continuing with the previous example, page 6 indicates that for burner with output of 6033 MBTU/hr a pressure of approximately 3.15 "WC is necessary at test point 6(B).

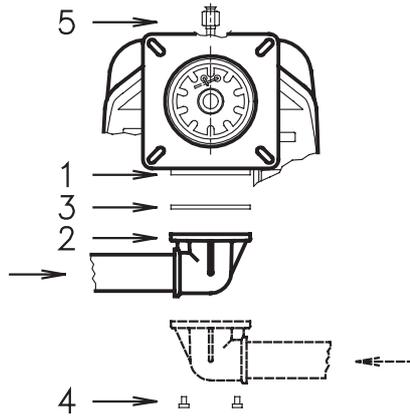
Once you have finished setting up the head, refit the burner to the slide bars 3(D) at approximately 4" from the sleeve 4(D) - burner positioned as shown in fig. (B)p. 7 - insert the flame rod cable and the ignition electrode cable and then slide the burner up to the sleeve so that it is positioned as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

Refit screws 2) on slide bars 3).

Secure the burner to the sleeve by tightening screw 1). Reconnect the swivel joint 7) to the graduated sector 6). 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 rod cable until they are slightly stretched.



(A)

D2393

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 gas train can enter the burner from the right or left side, depending on which is the most convenient, see fig. (A).
- The gas safety shut-off valves 5)-6)(A) 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 standards and is supplied separately from the burner.

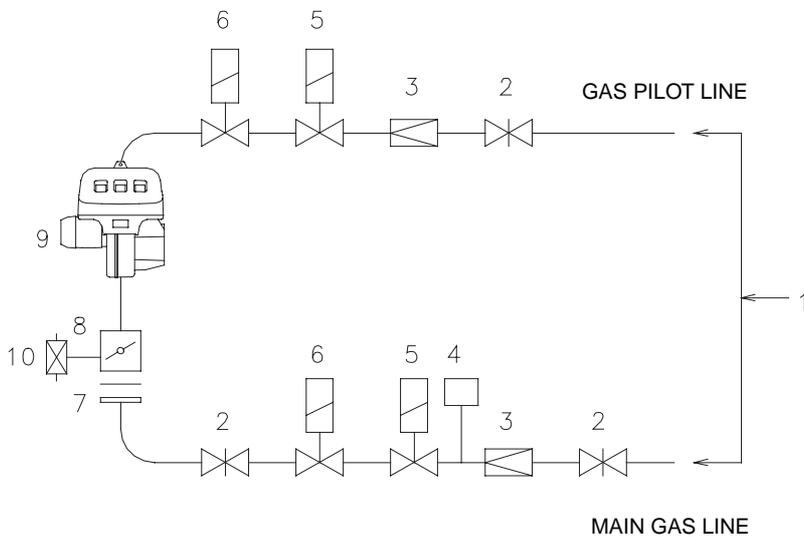
**Note**

See the accompanying instructions for the adjustment of the gas train.

**KEY (A)**

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

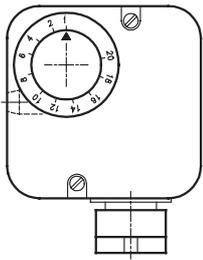
\* On the burner



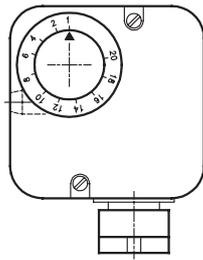
(B)

D2438

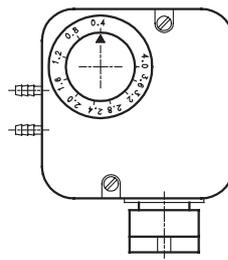
LOW GAS PRESSURE SWITCH    HIGH GAS PRESSURE SWITCH    AIR PRESSURE SWITCH



(A)



(B)



(C)

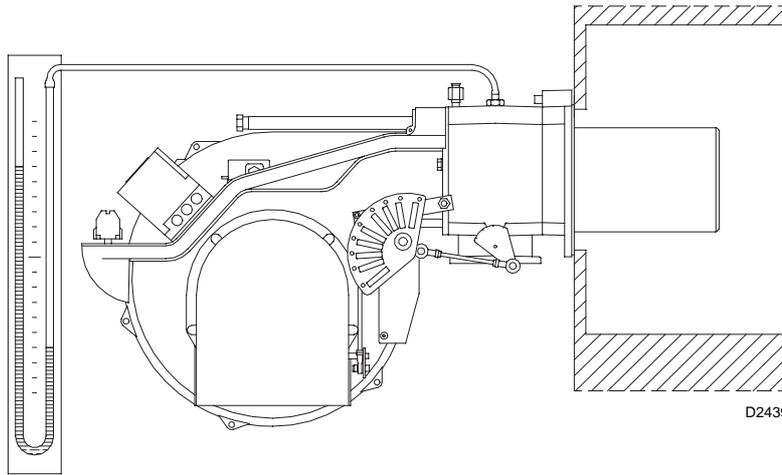
**ADJUSTMENTS BEFORE FIRST FIRING**

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

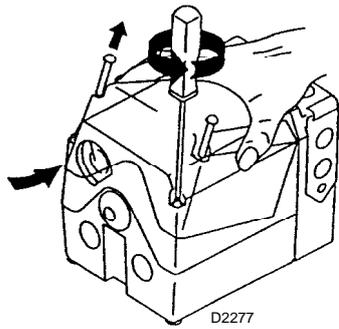
In addition, the following adjustments must also be made:

- Open manual valves up-stream from the gas train.
- Adjust the low gas pressure switch to the start of the scale (A).
- Adjust the high gas pressure switch to the end of the scale (B).
- Adjust the air pressure switch to the zero position of the scale (C).
- Purge the air from the gas line.  
Fit a U-type manometer (D) to the gas pressure test point on the sleeve.  
The manometer readings are used to calculate the MAX. burner power using the table 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.

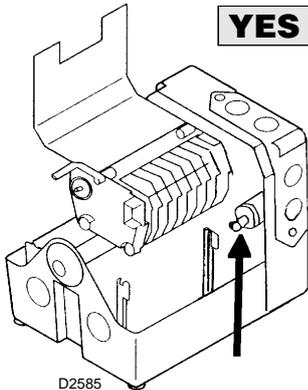


(D)



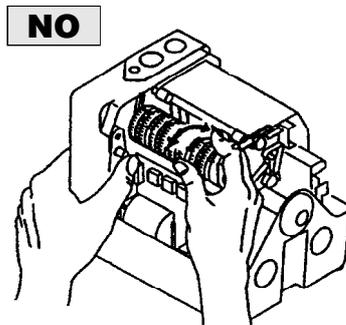
(A)

D2277



**YES**

D2585



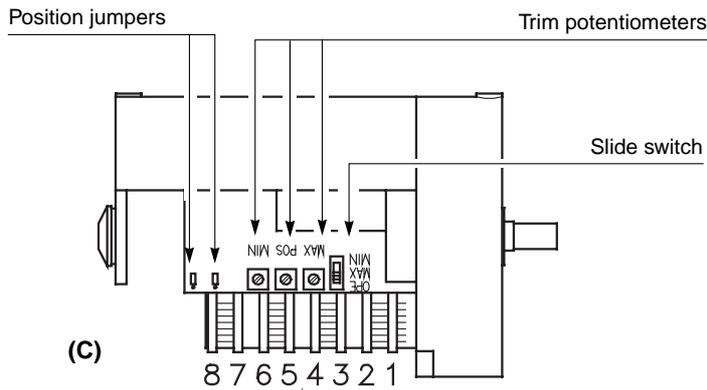
**NO**



Don't release the button indicated in this figure: the synchronization of the cams made in factory would be changed.

Figure above shows how the servomotor is released to manually check there is no binding though its motion.

(B)



(C)



(D)

(E)

D2593

## SERVOMOTOR

The servomotor gives simultaneous regulation of the air damper through the variable cam profile 4)(F) and the gas butterfly valve.

It rotates by 130° in approx. 35 s.

The factory settings must not be changed for the first firing, check that they comply with the details below.

To open the servomotor, remove the screws and pull the cover outward, fig. (A).

## CAMS AND TRIM POTENZIOMETERS FUNCTIONS

**Cam 1: 130°**

Limits rotation towards maximum for gas.

**Cam 2: 0°**

Limits rotation towards minimum, air damper closed on stand by.

**Cam 3: 20°**

Limits gas ignition regulation.

**Cams 4 - 5 - 6 - 7 - 8:** not used

**Trim potentiometer MAX**

Limits maximum modulation.

It must be set near the stroke end (cam 1) to exploit as far as possible the variable profile cam and maximum opening of the gas butterfly valve.

**Trim potentiometer MIN**

Limits minimum modulation.

It must be set near the stroke end (cam 2) to exploit as far as possible the variable profile cam.

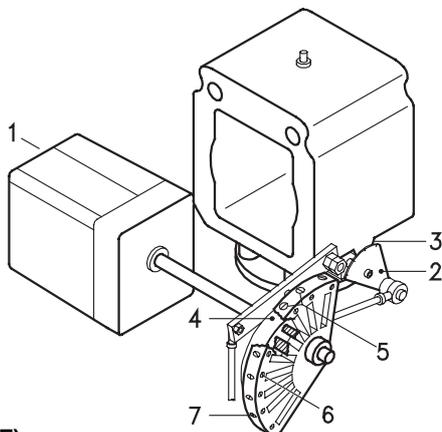
**Trim potentiometer POS**

Limits an intermediate operating position between MAX and MIN, supplying power to the "P" terminal in the servomotor (through an external command). This function cuts out any external signals.

**Note**

Using the slide switch to select MAX or MIN, the servomotor goes into the position for the respective settings of the MAX and MIN TRIM POTENTIOMETERS.

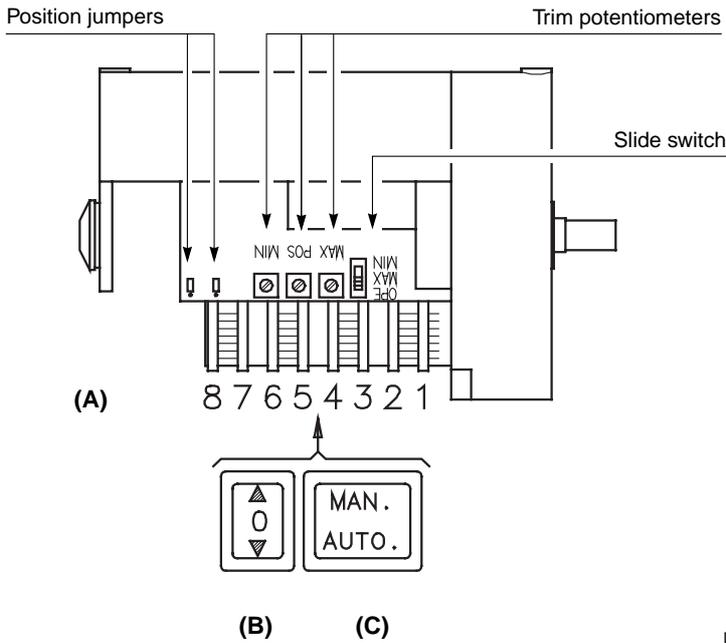
When the settings are complete, place the slide switch on OPE. (Operating position)



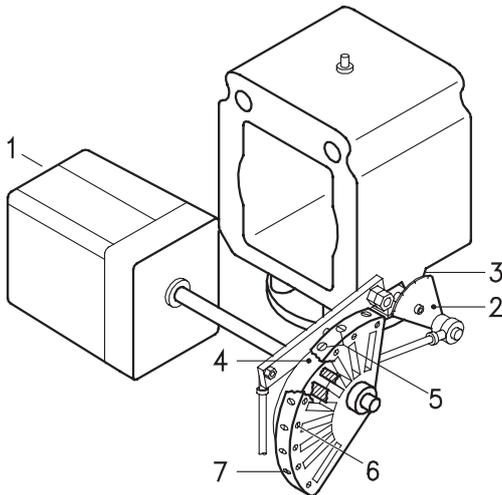
(F)

D2594

- 1 Servomotor
- 2 Graduated sector for gas butterfly valve
- 3 Index for graduated sector 2
- 4 Adjustable profile cam
- 5 Adjustment screws for cam starting profile
- 6 Adjustment fixing screws
- 7 Adjustment screws for cam and profile



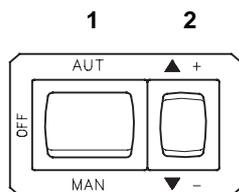
D2593



- 1 Servomotor
- 2 Graduated sector for gas butterfly valve
- 3 Index for graduated sector 2
- 4 Adjustable profile cam
- 5 Adjustment screws for cam starting profile
- 6 Adjustment fixing screws
- 7 Adjustment screws for cam and profile

(D)

D2594



(E)

D791

## BURNER STARTING

Close the control circuit, with the switch in fig. C) in the AUTO position.

On firing (pilot burner and main valve) turn the switch (C) to MAN and the switch 1)(E) in the AUT position.

## MAXIMUM OUTPUT

Using button (B), "increase output" until it locks out, app. 130° (cam 1).

Place the slide switch on MAX and set the relative MAX trim potentiometer (setting must be very near to 130°) to exploit as far as possible the variable profile cam 4)(D) and have the gas butterfly valve on maximum opening, graduated sector 2) on index 3) fig. (D).

The setting of the gas flow must be made on the gas train pressure regulator and, if necessary, on the gas valve.

The air setting must be made on the variable profile cam 4)(D) by turning the screws 5), after loosening the screws 6).

## MINIMUM OUTPUT

With the slide switch on the OPE position, use button (B) "decrease output" until it stops at app. 20° (cam 3).

Put the slide switch in the MIN position and set the modulation minimum using the relative MIN trim potentiometer.

Set the air using the variable profile cam 4)(D).

If a lower modulation minimum is required than the level set on cam 3 of the servomotor (20°), decrease the cam setting.

## INTERMEDIATE OUTPUTS

With the switch (C) in the AUTO position, the slide switch in the OPE position and the switch 1)(E) in the MAN position, move the button 2)(E) in various intermediate levels between maximum and minimum and set the variable profile cam 4)(D) to achieve optimum combustion, by turning the screws 5).

If possible, do not change the previously set maximum and minimum levels.

Check the various setting levels with a combustion analysis.

## Important

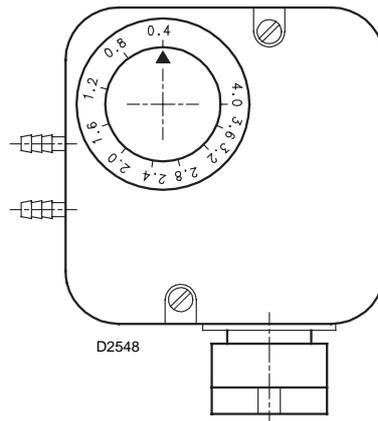
Make a progressive setting of the profile, without sharp changes.

When the setting is complete, lock the cam profile using screws 6)(D).

Turn the burner off, release the servomotor as shown in fig. (B) page 11 and manually turn cam 4)(D) to check for smooth cam operation.

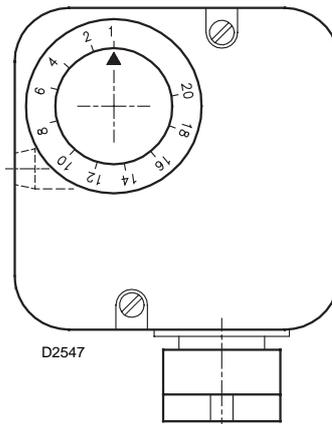
Finally fix the adjustment by turning the screws 6)(D).

AIR PRESSURE SWITCH



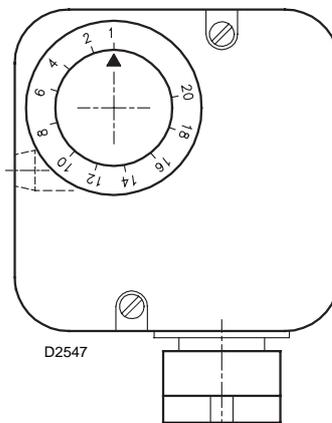
(A)

HIGH GAS PRESSURE SWITCH

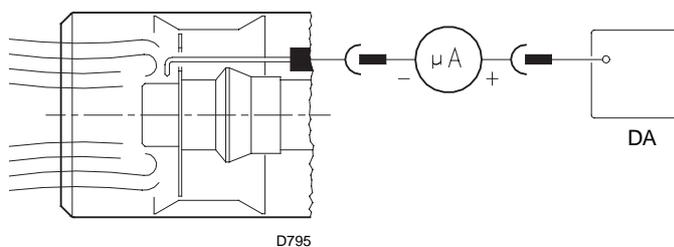


(B)

LOW GAS PRESSURE SWITCH



(C)



(D)

**AIR PRESSURE SWITCH (A)**

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 block 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.

**HIGH GAS PRESSURE SWITCH (B)**

Adjust the high gas pressure switch after having performed all other burner adjustments with the maximum gas pressure switch set to the end of the scale (B).

With the burner operating at MAX output, reduce the adjustment pressure by slowly turning the adjustment dial anticlockwise until the burner locks out.

Then turn the dial clockwise by 0.8" WC and repeat burner firing.

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

**LOW GAS PRESSURE SWITCH (C)**

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 (C).

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

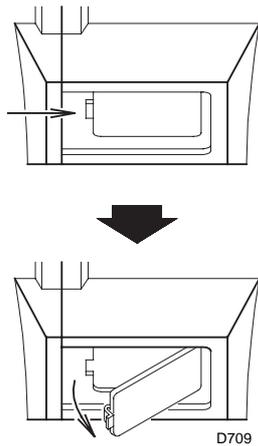
Then turn the dial anti-clockwise by 0.8" WC and repeat burner starting to ensure it is uniform.

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

**FLAME PRESENT CHECK (D)**

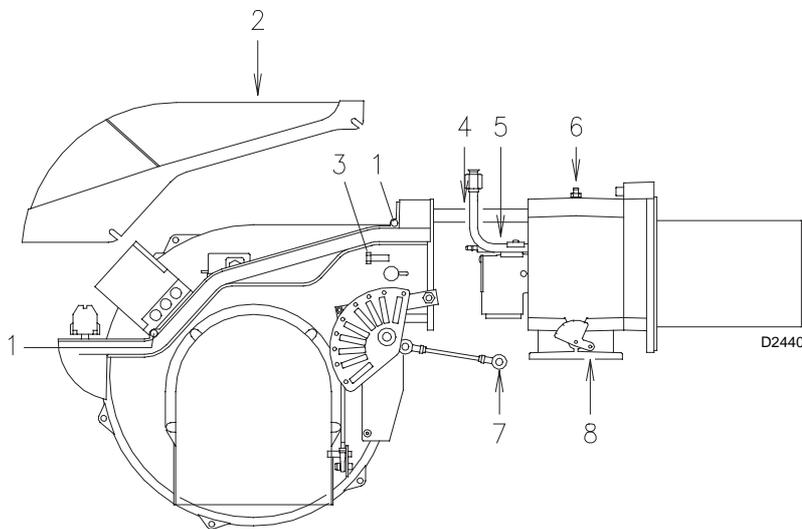
The burner is fitted with an ionisation system (flame rod) which ensures that a flame is present. The minimum current for reliable operation is 6 μA ( see manufacturers documentation). The burner provides a much higher current, so that controls are not normally required. However, if it is necessary to measure the ionisation current, disconnect the plug-socket 7)(A)p.4 on the ionisation probe cable and insert a direct current microammeter with a base scale of 100 μA. Carefully check polarities.

## FLAME INSPECTION WINDOW



(A)

## OPENING THE BURNER



(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 5)(B).

### Servomotor

Disengage the cam 4)(D)p. 12 from the servomotor and turn it backwards and forwards by hand to make sure it moves freely.

### 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 terminal strip are fully tightened.

Clean the outside of the burner, taking special care with the linkage 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 at any rate, do not correspond to good combustion. Record the new combustion values; they will be useful for subsequent controls.

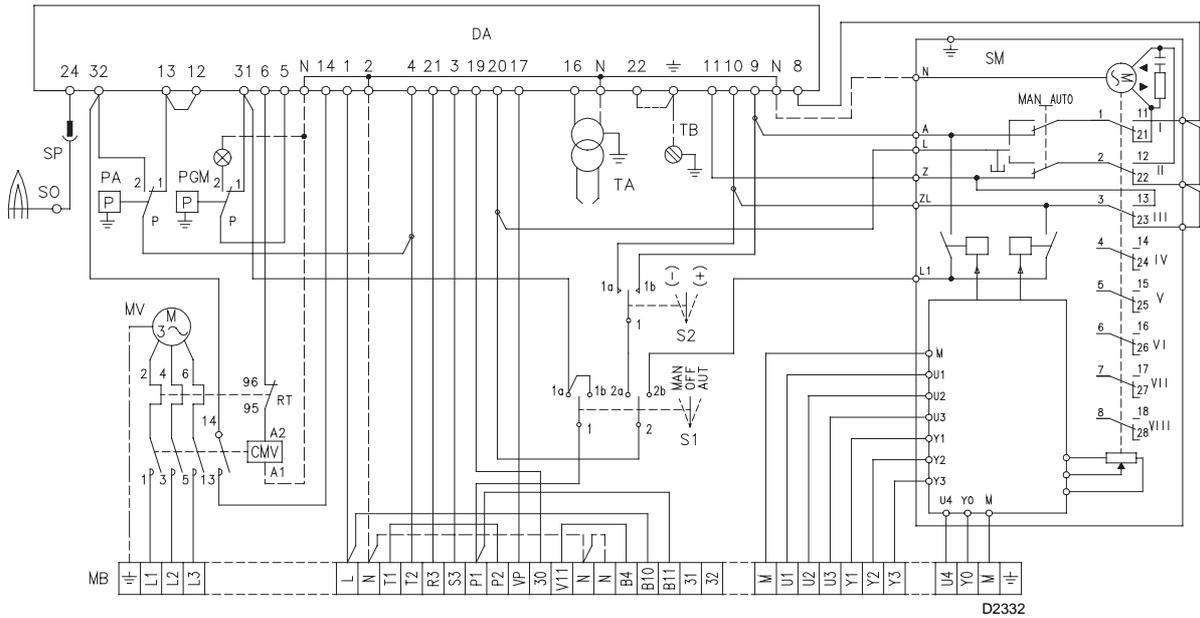
### TO OPEN THE BURNER (B):

- Switch off the electrical power.
  - Loosen screws 1) and withdraw cover 2).
  - Disengage the swivel joint 7) from the graduated sector 8).
  - Fit the two extensions onto the slide bars 4).
  - Remove screws 3), and pull the burner back by about 4" on the slide bars 4). Disconnect the probe and electrode leads and then pull the burner fully back.
- Now extract the gas distributor 5) after having removed the screw 6) and disconnecting the pilot gas line.

### TO CLOSE THE BURNER (B):

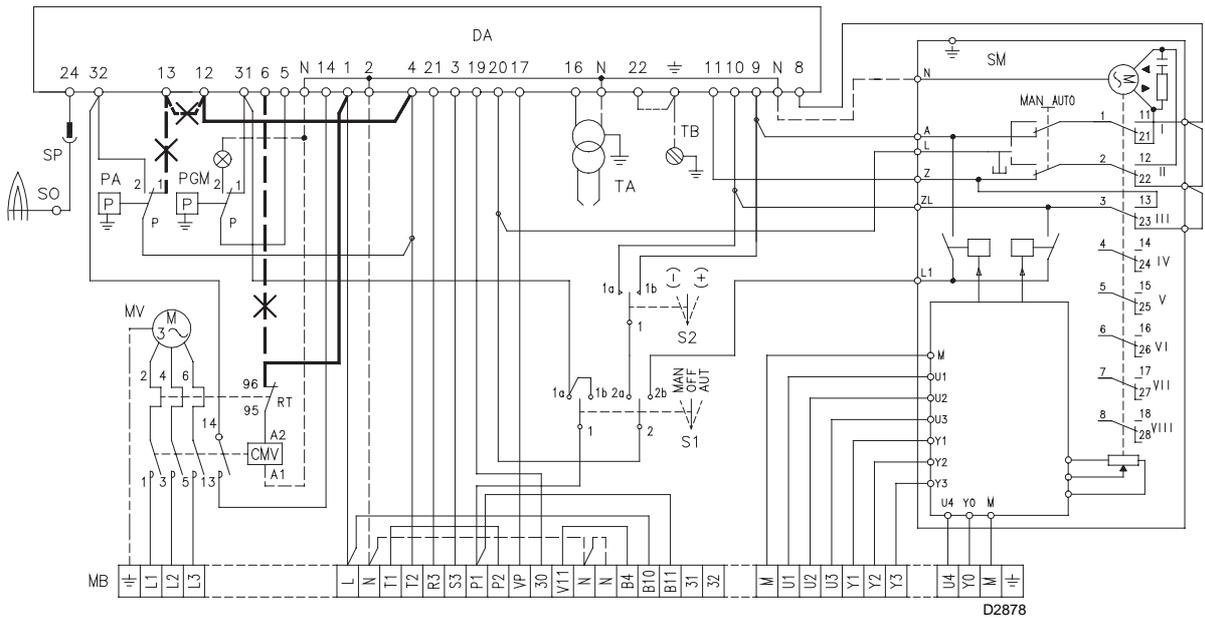
- Push the burner until it is about 4" from the sleeve.
- Re-connect the leads and slide in the burner until it comes to a stop.
- Refit screws 3), and pull the probe and electrode leads gently out until they are slightly stretched.
- Re-couple the swivel joint 7) to the graduated sector 8).
- Remove the two extensions from the slide bars 4).
- Connect the pilot gas line.

**Factory Wiring Diagram**  
**RS 190/M with burner mounted Siemens LFL control**



**Continuous fan operation**

Change the wire connection from terminal 6 to terminal 1, move the jumper from terminals 12-13 to terminals 4-12 and remove the wire from terminal 13 of control box as indicated below.



**LAYOUT (A)**

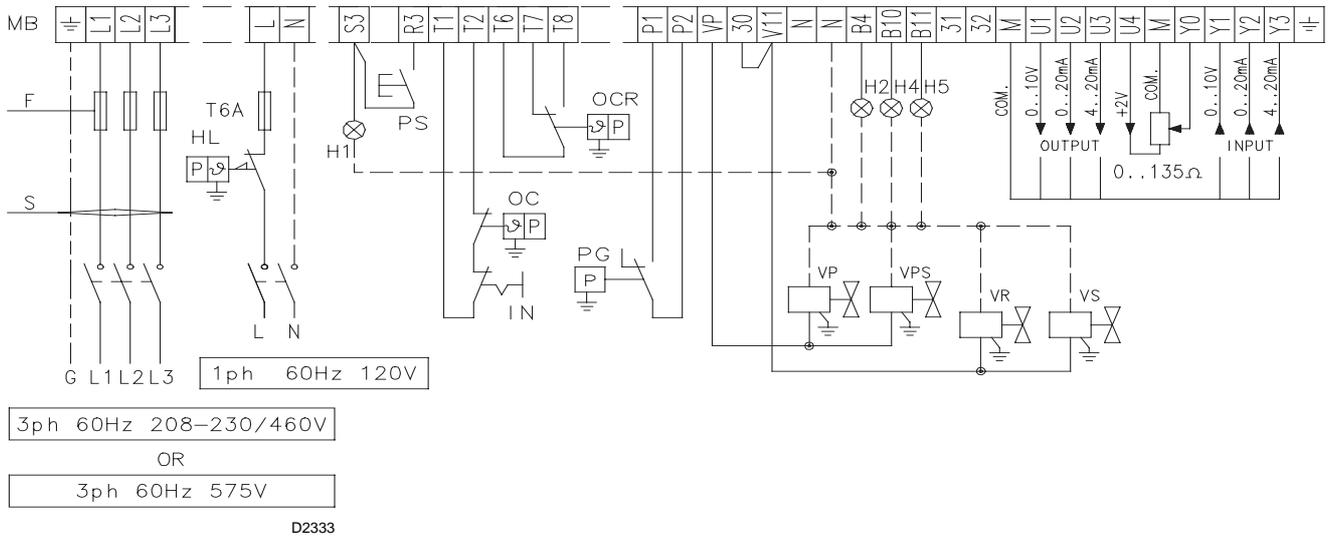
**Burner RS 190/M**

- Models RS 190/M leave the factory preset for **208-230 V** power supply.
- If **460 V** power supply is used, change the motor connection from delta to star and change the setting of the thermal cut-out as well.

**Key to Layout (A)**

- CMV - Motor contactor
- DA - LFL Control box
- MB - Burner terminal strip
- MV - Fan motor
- PA - Air pressure switch
- PGM - High gas pressure switch
- SM - Servomotor
- SO - Ionisation probe (flame rod)
- SP - Plug-socket
- TA - Ignition transformer
- TB - Burner ground

**Field Wiring Diagram**  
**RS 190/M with burner mounted Siemens LFL control**



(A)

		RS 190/M		
		208 - 230 V	460 V	575 V
F	A	T25	T20	T15
S	AWG	12	12	14

(B)

**ELECTRICAL CONNECTIONS**

Use flexible cables according to local Regulations.

**LAYOUT (A)**

Electrical connection RS 190/M burners

Fuses and wire size layout (A), see table (B).  
 Wire size when not indicated: AWG18.

**KEY TO LAYOUT (A)**

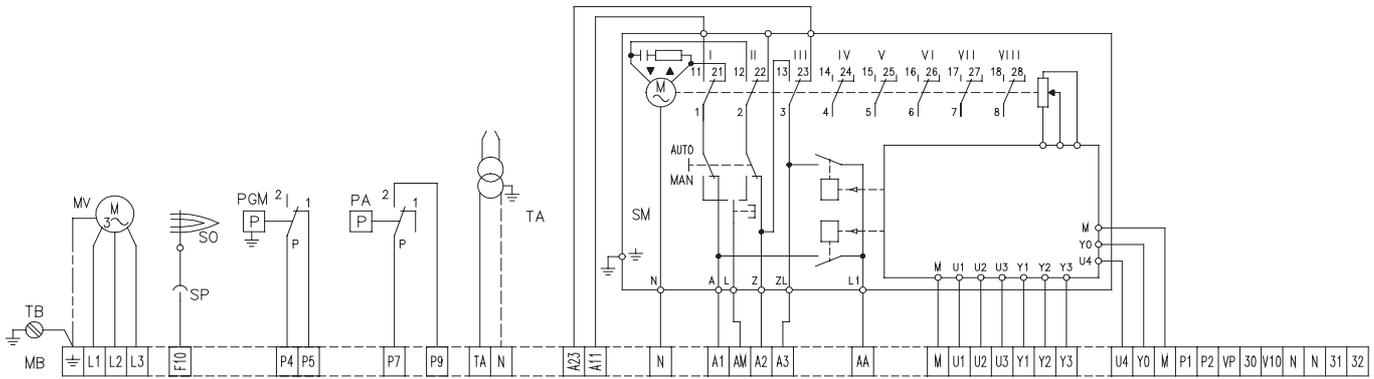
- IN - Burner manual stop switch
- MB - Burner terminal strip
- PG - Min. gas pressure switch
- PS - Remote lock-out reset
- H1 - Remote lock-out signal
- H2 - Burner on signal
- H4 - Power on signal
- H5 - Permission ok
- OC - Operating control
- OC2 - High-low control
- HL - High limit

- VP - Pilot adjustment valve
- VPS - Pilot valve (safety)
- VR - Adjustment valve
- VS - Safety valve

**NOTES**

- The setting of the thermal overload must be according to the total burner amperage draw.
- The RS 190/M burners leave the factory preset for **208-230 V** power supply. If **460 V** power supply is used, change the fan motor connection from delta to star and change the setting of the thermal overload as well.
- The RS 190/M burners have been type-approved for intermittent operation. This means they should compulsorily be stopped at least once every 24 hours to enable the control box 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.

**Factory Wiring Diagram  
RS 190/M with remote control panel**



**(A)**

D2397

**ELECTRICAL SYSTEM**

**LAYOUT (B)**

**Burner RS 190/M**

The flame safeguard is in remote panel.

See the internal electrical systems of the remote panel in order to have the complete wiring diagram.

**Key to Layout (A)**

- CMV - Motor contactor
- DA - Control box
- MB - Burner terminal strip
- MV - Fan motor
- PA - Air pressure switch
- PGM - High gas pressure switch
- SM - Servomotor
- SO - Ionisation probe (flame rod)
- SP - Plug-socket
- TA - Ignition transformer
- TB - Burner ground

## 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<sub>e</sub>:

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

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

Q<sub>e</sub> = equivalent delivery

H<sub>1</sub> = 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 H<sub>2</sub> of the firing rate.
- 5 - Multiply H<sub>2</sub> by F to obtain the maximum reduced pressure H<sub>3</sub> of the firing rate.

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

If H<sub>3</sub> is greater than H<sub>1</sub>, as shown in Fig. (B), the burner delivers the output required.

If H<sub>3</sub> is lower than H<sub>1</sub>, the burner's delivery must be reduced. A reduction in delivery is accompanied by a reduction of the pressure in the combustion chamber:

Q<sub>r</sub> = reduced delivery

H<sub>1r</sub> = reduced pressure

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

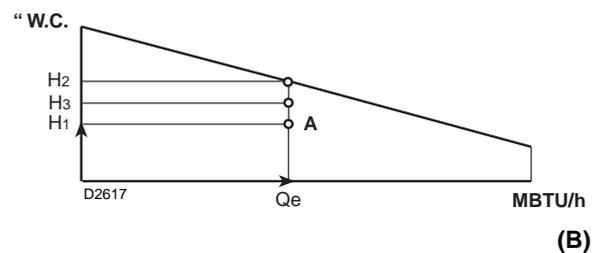
**Example**, a 5% delivery reduction:

$$Q_r = Q \times 0.95$$

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

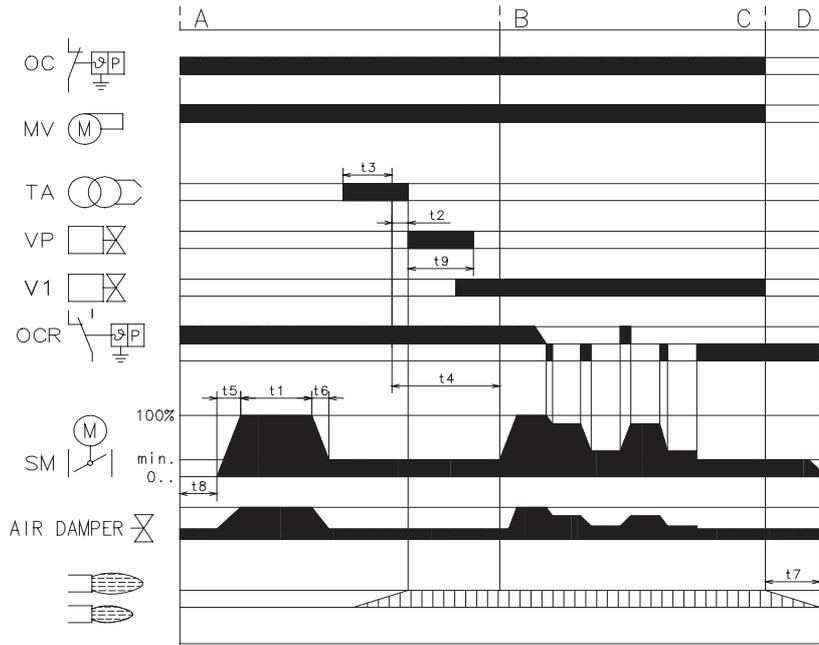
Steps 2 - 5 must now be repeated using the new Q<sub>r</sub> and H<sub>1r</sub> values.

**Important:** the combustion head must be adjusted in respect to the equivalent delivery Q<sub>e</sub>.



(B)

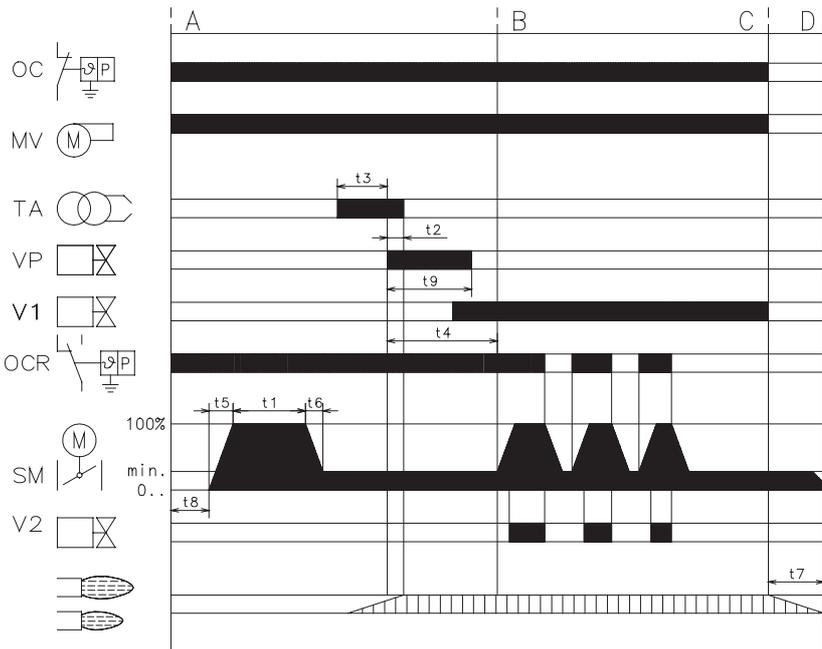
### Full Modulation



(A)

D2273

### Low - High



(B)

D2274

## BURNER OPERATION

### BURNER STARTING

- Load control close.
- Fan motor starts.
- Servomotor starts:
  - 130° rotation to right, until contact is made on cam 1)(A) page 12.
  - 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 cam 3)(A) page 12 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 12 s the main flame ignites and starting cycle ends.

### STEADY STATE OPERATION

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

(The LFL control box 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 cam 2. 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 air damper).

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

### LFL 1.335 Series 01

<b>t1</b>	30	<b>t6</b>	optional
<b>t2</b>	2	<b>t7</b>	12
<b>t3</b>	4	<b>t8</b>	4
<b>t4</b>	20	<b>t9</b>	16
<b>t5</b>	optional		

### 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
- t6** Running time of air damper into OPEN position
- t7** Running time of air damper into low-flame position (MIN)
- t8** Permissible after-burn time
- t9** Interval until OPEN command for the air damper is given
- t9** Running time of pilot

### 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!
  
- 1 **Lock-out**, because no flame signal is present after completion of the (1st) safety time.
  
- 2 **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.

## BURNER START UP REPORT

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

<b>GAS OPERATION</b>					
Gas Supply Pressure: _____	CO <sub>2</sub> : Low Fire _____	High Fire _____			
Main Power Supply: _____	O <sub>2</sub> : Low Fire _____	High Fire _____			
Control Power Supply: _____	CO: Low Fire _____	High Fire _____			
Burner Firing Rate: _____	NO <sub>x</sub> : 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: _____					

<b>OIL OPERATION</b>					
Oil supply pressure: _____	CO <sub>2</sub> : Low Fire _____	High Fire _____			
Oil suction pressure: _____	O <sub>2</sub> : Low Fire _____	High Fire _____			
Control Power Supply: _____	CO: Low Fire _____	High Fire _____			
Burner Firing Rate: _____	NO <sub>x</sub> : 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: _____				

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

<b>NOTES</b>
_____
_____
_____
_____



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