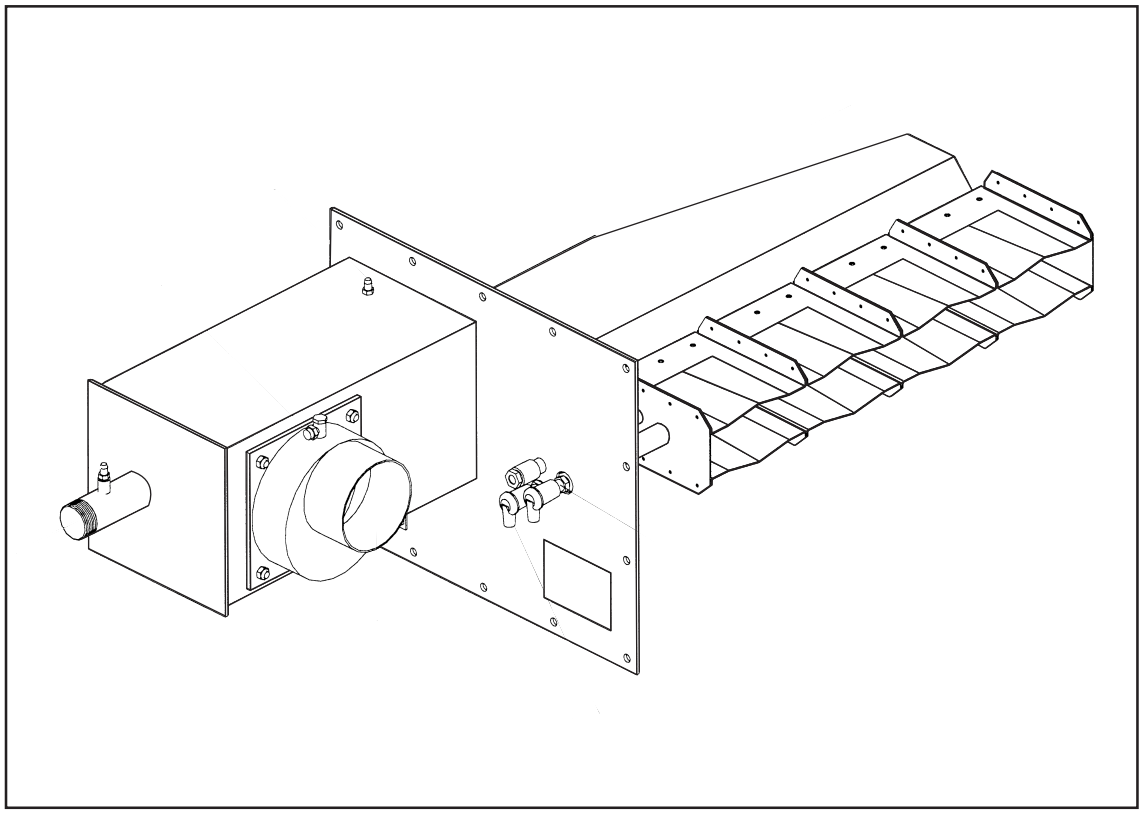
Installation Guide
No. 159, 2/20/04

Eclipse Combustion

Linnox SP Burners

Model CCS-LS

Version 1



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About this manual

Audience

This manual has been written for personnel already familiar with all aspects of pre-mix burners.
These aspects are:

- Installation
- Use
- Maintenance
- Safety

The audience is expected to be qualified and have experience of this type of equipment and its working environment.

CCS-LS Documents

Installation Guide No. 159 IG

- This document

This document covers the basic standard Linnox® burner configurations. Normally this document is part of the over-all project documentation covering the complete burner system.

Data Sheets 159-1 and 159-2

- Appropriate data to be provided with this Guide

Related Documents (Attached if applicable)

- EFE 825 (Combustion Engineering Guide)
- Eclipse bulletins and Info Guides:
  610, 710, 720, 730, 742, 744, 760, 930

Purpose

The purpose of this manual is to make sure that you carry out the installation of a safe, effective and trouble-free combustion system.

Document Conventions

There are several special symbols in this document. You must know their meaning and importance.
Following is an explanation of the symbols. Please read thoroughly.

Danger:

Indicates hazards or unsafe practices which WILL result in severe personal injury or even death. Only qualified and well trained personnel are allowed to carry out these instructions or procedures.
Act with great care and follow the instructions.

Warning:

Indicates hazards or unsafe practices which could result in severe personal injury or damage.
Act with great care and follow the instructions.

Caution:

Indicates hazards or unsafe practices which could result in damage to the machine or minor personal injury.
Act carefully.

Note:
Indicates an important part of the text.
Read thoroughly.

How to Get Help

If you need help, contact Eclipse Combustion or your local Eclipse representative.

Table of Contents

Introduction

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Product Description

The Linnox burner is a pre-mix type burner, especially designed for direct-air heating applications where the lowest achievable NOx and CO levels are required.
The Linnox burner combustion is based on high excess air pre-mix combustion to keep the flame temperatures low. At the same time the burner geometry establishes an internal recirculating flame pattern. These two factors result in both very low NOx and CO emissions at a high turn-down rate while maintaining extremely stable combustion.

The Linnoxe burner is designed for applications where a linear heat distribution is required.

A special feature is the possibility to configure the burner for different capacities along the burner length by choosing from a wide range of exchangeable burner modules of 300 mm length.

The Linnox burner is designed to provide:

- Reliable operation
- Simple adjustments
- Direct spark ignition
- Exchangeable igniter and flame rod from outside of the installation.
- Modulating control (Air and gas)
- Exchangeable burner modules varying from 24 to 720 kW per 300 mm.

Safety

2

Introduction

This section is provided as a guide for the safe operation of the Eclipse Linnox burners. All involved personnel should read this section thoroughly before operating this system.

Safety

Danger:

The burners covered by this Guide are designed to mix gas with air and burn the resulting mixture. All gas burning devices are capable of producing fires and explosions if improperly applied, installed, adjusted, controlled or maintained.
Do not bypass any safety feature! Fire or explosion could result.
Never try to light a burner if it shows signs of damage or malfunction.

Note:

Personal safety and the Safety of others is a direct result of how equipment is installed, operated and maintained. Read and understand this Guide before attempting to light the burner. The Guide provides information for installing, operating and maintaining the Eclipse burner within the limits of its design specifications. Do not deviate from any instructions or application limits without written advice from Eclipse Combustion.

Capabilities

Only qualified personnel, with good mechanical / electrical aptitude and experience with combustion equipment, should adjust, maintain or troubleshoot any mechanical or electrical part of this system

Installation

3

Introduction

This section provides guidance for correct installation of the Eclipse Linnox burners.

Warning:

Only qualified competent personnel with experience of combustion systems are allowed to install, adjust or maintain the burner.

All installation work must be carried out in compliance with current legislated standards.

Handling and Storage

Handling

Inspect the burner package, ensuring that all components are clean and free from damage.

Use appropriate support and handling equipment when lifting the burner.

Protect the burner from weather, damage, dirt and moisture.

Protect the burner package from excessive temperatures and humidity.

Storage

When storing the burner for an extended period, Eclipse recommends placing it in a cool, clean, dry room.

Pre-installation Checklist

Air Supply

Provide an opening in the burner room of at least one square inch per 4000 BTU/hr (6 cm^2 per 1 kW) to supply the burner intake with fresh, outdoor, combustion air.

Exhaust

Do not allow exhaust gases to accumulate in the work area. Provide a means for exhausting these gases from the building.

Access

Install the burners so they may be easily accessed for inspection and maintenance.

Environment

Be sure the burner operating environment matches the original operating specifications. Check the following items:

- Voltage, frequency, and stability of power.
- Fuel type and supply pressure.
- Adequate fresh and clean combustion air.
- Humidity, altitude and temperature of the supply air.
- Presence of damaging corrosive gases in the air.
- Prevent direct exposure to water.

Burner Mounting

Because Linnox burners are tailor made for your application please refer to the attached assembly drawing for information of mounting plate dimensions and insulation thickness.

The burner mounting plate is provided with:

- sight glass for flame observation
- pressure tap for measuring process pressure
- with or without insulation box (refer to assembly drawing)
- with or without gasket between mounting plate and installation. (refer to assembly drawing).

Caution:

The burner flame shields can reach a temperature of 1650°F (900°C) at 480°F (250°C) process temperature before the burner. Measurements should be taken to prevent excessive thermal load on the process ducting.

Gas Supply

The burner should not be used as a support for the incoming gas supply pipe work. Suitable brackets or hangers should be provided for this purpose. Care should be taken to ensure that the incoming gas pipe is adequately sized for the necessary gas flow and burner pressure (See appropriate data sheet for gas pressure requirements).

Warning:

Gas inlet pressures must stay within the specified range. Pressure above the specified range can damage the ratio regulator.

Pressure below the specified range can impair the ability of the ratio regulator to control the gas flow.

Electrical Supply

The burner should be controlled via a sequence programmer, approved according the local standards. For connections, please refer to the related wiring diagrams.

Warning:

Wiring to the burner must be in accordance with current wiring standards. It is vital that the live and neutral wires are connected correctly as reversal could present a hazard. Also the earth bonding must be checked to ensure a good connection. (Wiring diagrams are provided with this Guide)
GAS PIPEWORK MUST NOT BE USED FOR EARTHING PURPOSES.

If burner control signals are supplied via a flame safeguard control panel provided by others, Eclipse Combustion can not accept any responsibility for incorrect interfacing.

CheckList After Installation

To verify the system was properly installed, perform the following checks:

1. Be sure there are no leaks in the gas lines.
2. Be sure all wiring is properly connected.
3. Be sure all interlocks are working properly.
4. Be sure correct air and gas pressures are available.
5. At systems with high negative or positive process pressures, take care that pressure switches and pressure regulators (purge air) are cross connected to the process pressure.

Description of Burner Operation

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Description of Start up Sequence

The complete start-up sequence is controlled by the burner programmer (This may be supplied with the burner or, it may be installed in a separate control panel supplied by others).

The combustion chamber or ducting must be purged in accordance with current standards prior to the burner start up sequence.

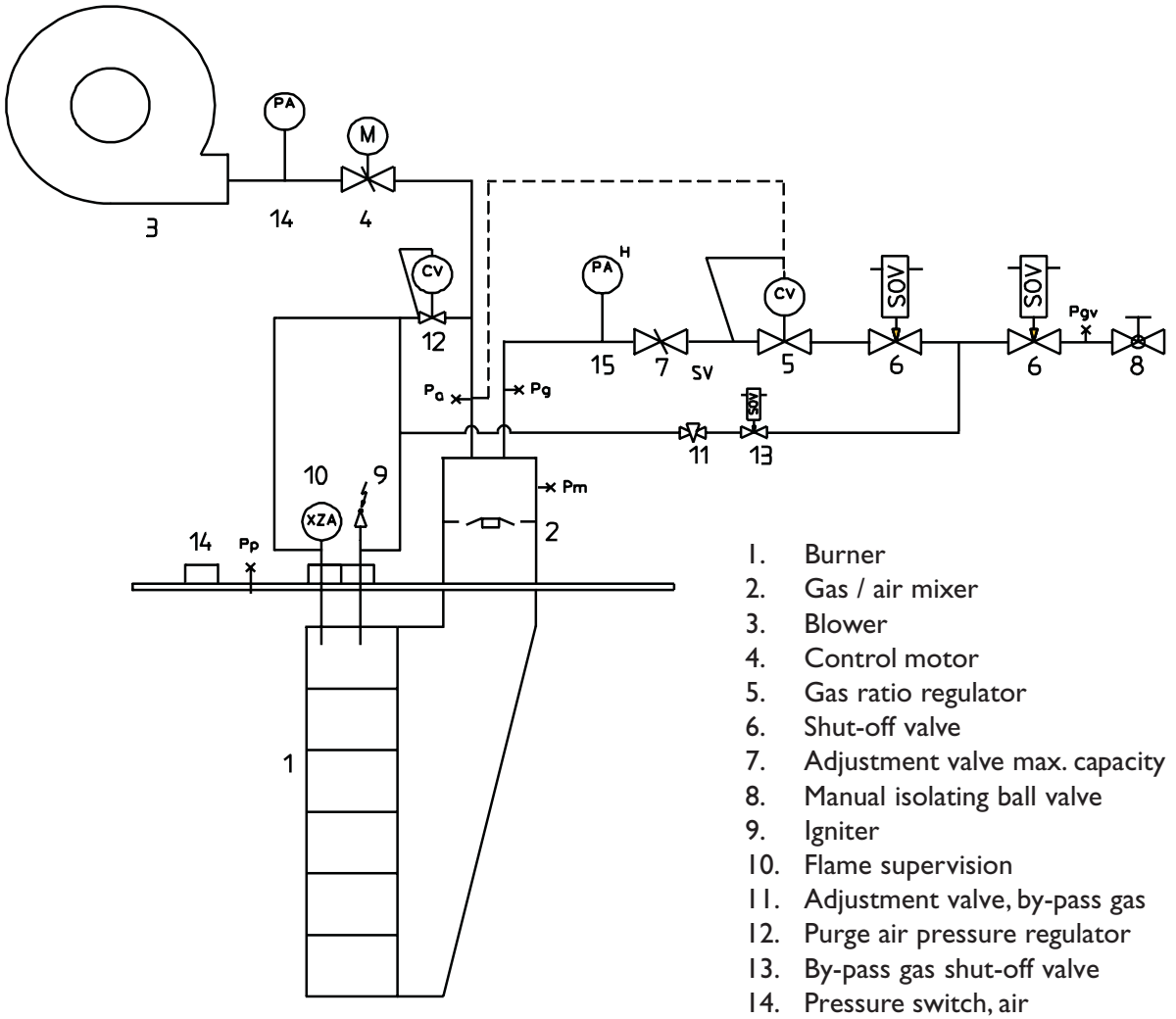
After the start up signal to the burner, the combustion air blower (3) will be energised. As soon as the combustion air pressure switch (PA) is activated by sufficient combustion air pressure and the micro switch in the control motor is closed, the burner programmer starts to cycle.

The control motor will travel to its start position (20% of max. capacity). Then the ignition transformer will be energised by the burner programmer and a spark will be generated at the igniter (9). The igniter is so called "gas supported" and is supplied through a by-pass gas valve(13). To prevent condensation, both flame rod or UV Cell and igniter are purged with combustion air, branched after the first shut-off valve. To limit the purge air flow a pressure regulator (12) is mounted in the purge air line.
At the same time that the igniter is energised, the first shut-off valve (6) and the by-pass valve (13) open. A small support flame will appear that will later help to ignite the main flame. The support flame will extinguish after the main flame comes in.

The second safety shut-off valve (5) will next be energised. The gas flows through both safety shut-off valves and the internal gas ratio-regulator to the mixer unit, where it mixes with the combustion air. The gas flow is controlled proportionally to the air flow by the gas ratio-controller, which has been cross connected to the air pressure and the mixture pressure to reach a stable gas-air ratio, independent from process temperature and pressure. The mixture is ignited at the burner base, after which the flame is detected and monitored by a flame ionisation probe or an ultra violet scanner (10).

After the flame detection device is satisfied that a stable flame has been established, the burner programmer releases the burner for control by the temperature controller (supplied by others). The air control motor will be positioned to satisfy the set point of the temperature controlling instrument. The air valve opens which results in an increased air pressure at the burner. The gas ratio-controller supplies a gas flow corresponding to the amount of combustion air.
The high fire gas flow is limited by an adjusting valve, that has to be adjusted for the specified gas type at the location of operation.

DIAGRAM (PID)



1. Burner
2. Gas / air mixer
3. Blower
4. Control motor
5. Gas ratio regulator
6. Shut-off valve
7. Adjustment valve max. capacity
8. Manual isolating ball valve
9. Igniter
10. Flame supervision
11. Adjustment valve, by-pass gas
12. Purge air pressure regulator
13. By-pass gas shut-off valve
14. Pressure switch, air
15. Pressure switch, gas

Pg. Gas pressure at mixer inlet
Pa. Air pressure at mixture inlet
Pm. Mixture pressure
Pp. Process pressure
Pgv. Gas pressure at valve train inlet

Commissioning

5

Introduction

This section describes how to start up and adjust the Eclipse Linnox burners.

Danger:

The burners covered by this Guide are designed to mix gas with air and burn the resulting mixture. All gas burning devices are capable of producing fires and explosions if improperly applied, installed, adjusted, controlled or maintained.
Do not bypass any safety feature! Fire or explosion could result.
Never try to light a burner if it shows signs of damage or malfunction.

Factory Settings

All pressure switches are factory adjusted.

The mixer gas nozzles are sized for the correct gas type.

Adjustment

Adjustment steps:

1. Preparation
2. Dry run
3. Combustion air check
4. Start-up and low fire adjustment
5. Operating checks

Step 1: Preparation

1. Ensure all installation work has been completed in compliance with current legislated standards.

2. Ensure that all gas supply pipework has been purged of air in compliance with current legislated standards.

3. Ensure that all required services are available.

4. Ensure that all pre-checks have been completed in compliance with current legislated standards.

5. Ensure that the following instruments are available
   - digital or "U"- tube manometer for pressure adjustments.
   - µA - meter to measure flame signal strengths.

6. Check the setting of the maximum gas pressure switch and the minimum air pressure switch. The maximum gas pressure switch is adjusted 20% higher than the maximum gas pressure on the burner. The minimum air pressure switch is adjusted to approx. 20% of the maximum air pressure.
The air pressure depends on the selected combustion air blower. Please refer to the related project documentation.

Step 2: Dry run

1. Ensure that the process air blower is running.

2. Ensure that the manual isolating ball valve is closed.

3. Initiate the electrical supply to start the operating sequence. The combustion air blower will start running. If the sequence is operating correctly, the programmer will run through to the point of ignition, the safety shut-off valves will open and, in absence of a flame, will proceed to a lockout condition.

Danger:

If simulated limits or simulated flame failures do not shut down the fuel system within the required response time, immediately correct the problem before proceeding.

Step 3: Combustion air check

Note:

On multiple burner systems with a central combustion air blower, one should remember that the combustion air pressure will change, depending on the total air demand.
If one burner is adjusted, it is advised to set the combustion air of all other burners to at least 50% of the maximum capacity if not in operation. This will prevent flame failures or inability to reach the high fire capacity when the installation is switched to normal operation.

Low fire air adjustment procedure:

1. Start the combustion air blower.
2. Drive control motor to low fire position (activate the manual switch or lock first).
3. Measure air differential pressure between tap (Pa) and the process tap (Pp).
4. Adjust low fire air if necessary.

Note:

The slot at the end of the BV (air damper) shaft indicates the position of the BV. The BV is closed when the shaft slot is perpendicular to the direction of air flow through the BV.
For adjustment of the BV, adjust the lever mechanism.

5. Verify high fire air
   a. Drive control motor to high fire, fully open.
   b. If high fire air is insufficient, refer to Section 7, "Trouble-shooting".

6. Return the control motor to low fire position.

7. Close the pressure taps.

Step 4: Start-up

Start-up procedure:

1. Check the pre-setting of the adjustment valves.

2. Switch the control motor to "automatic".

3. Open the manual isolating ball valve.

4. Initiate the burner management system to start the operating sequence. The control motor will be controlled to the start position after which the ignition will take place.

The ignition support flame should appear approx. 2"-8" (5 - 20 cm) beyond the flame shields in a mixed blue and yellow colour. If flame is too weak or too big, adjust the support flame with adjusting valve (7). Support flame appearance also depends on the start position of the combustion air valve.

After the pre-ignition time (2 sec. according EN 746-2) the 2nd shut-off valve will open and the Linnox burner will be ignited. A clear blue line flame will appear at the burner base. The appearance will vary for the different capacity ratings of the burner elements.

If the burner does not light the first time it will be necessary to reset the burner programmer and follow this procedure again.

5. If the the burner did not ignite:
   a. Attempt to ignite the burner again after purging air from the gas piping.
   b. If the support flame does not appear, open the adjusting valve (11) 1 turn.
   c. If the flame appears at ignition, but the main burner does not light, turn the bias adjusting screw of the gas ratio regulator (5) one turn clockwise to increase gas flow and try to ignite the burner again.
   d. Repeat steps b and c until burner ignites. If the burner does not ignite, follow guidelines in Section 7 "Trouble-shooting".

Low fire settings

6. Set system control to stay at low fire during and after ignition sequence or set control motor to manual.
7. Adjust gas flow with the low-fire bias adjustment screw for lowest gas flow that maintains a stable flame signal:
   - clockwise, for more fuel
   - counter-clockwise, for less fuel

With ionisation flame safe guarding adjust until a stable flame signal of min. 15 µA at cold recirculation air conditions or 20 µA at hot recirculation air conditions>390°F (>200°C).

With UV flame safe guarding, ensure that lowest flame signals are stable and significantly higher than the switch off.

At low fire the gas diffential pressure across the mixer will be too low, approximately .08"w.c. (0,2 mbar) for a reliable adjustment.
Eventually, the static gas pressure at the mixer can be used as a pre-setting of the burner.

Note:

A visual check of the flame is important to ensure the correct burner adjustment.

If the recirculating process air is cold >212°F *(<100°C), the burner elements will not glow or just partly start to glow.*

If the recirculating process air is hot >390°F *(>200°C), the burner elements will partly glow.*

The visual appearance of the low-fire flame is clear blue, with some glowing parts of the burner elements.

High fire settings

8. Set the burner to high fire:
   a. Check the differential air pressure.
   b. Adjust the corresponding gas pressure with the adjustment valve (7).

   Fasten the lock screw at the adjustment valve after finishing adjustment.

Note:

A visual check of the flame is important to ensure the correct burner adjustment. The flame will be sharp blue-white with a slightly orange glowing tip. The length of this tip depends on the burner capacity rating.
If the flame tip is dominantly orange, the burner may be set too gas rich. Refer to Section 7 for trouble-shooting tips.

The burner flame shields are allowed to glow red hot, depending on the burner capacity rating and the process temperatures.

9. If the setting of adjustment valve (7) has been changed, repeat step **6** and **7** again to check and re-adjust the low fire setting.

Caution:

Adjusting the burner too gas-rich will shorten the life time of the burner elements and flame shields. Therefore, have a qualified Eclipse engineer adjust and regularly check the burner settings.

Step 5: **Operating checks**

1. Simulate a flame out condition by closing the manual inlet ball valve. Run the ignition cycle again.

2. Check high gas pressure switch for correct operation by reducing the set point until it trips. The burner must be at high fire. Re-set to the original setting and run the ignition cycle again.

3. Check the combustion air pressure switch for correct operation by increasing the set point until it trips. Re-set to the original setting and run the ignition cycle again.

4. Measure and record the gas and air differential pressure and flame signal at low and high fire for future reference.

Danger:

If simulated limits or simulated flame failures do not shut down the fuel system within the required response time, immediately correct the problem before proceeding.

Caution:

Do not turn the combustion air blower off until the chamber temperature is below 250°F (120°C). This will prevent hot gases from flowing back through the burner and the blower and causing damage to the burner.

Maintenance 6

Introduction

Preventative maintenance is the key to a reliable, safe and efficient system. The core of any preventative maintenance programme is a list of periodic tasks. Preventative maintenance is the key to a reliable, safe and efficient system. The core of any preventative maintenance programme is a list of periodic tasks.

Maintenance

Note:

These are guidelines only. The customer should make the final judgement on maintenance intervals and tasks to be performed while considering the working environment.

		Interval					
Subject	**Action**	1 month after commissioning	3 months	6 months	12 months	As per supplier's instructions	Depending on circumstances
Adjustments	• Check and compare burner adjustments with the original recorded settings. Correct the settings if they are outside the specified tolerance range.	x			x		
Combustion air filter	• Check and clean or replace the combustion air filter if necessary.						x
Air control valve	• Check for correct operation.				x		
Gas filter	• Check and clean or replace the gas filter if necessary.	x			x		
Gas components	• Check all components for damage (visually). • Leak test shut-off valves. • Check manual shut-off valve for correct operation.		x x		 x		
Cables and connectors	• Visually check all cables and connectors for damage and tightness.		x				
Gas piping	• Check all gas piping and connections for leakage. Leakages must be cured immediately. • Check tightness of all bolted / screwed joints.	x x			x x		
Burner / mixture duct	• Check burner and mixer unit for leakage, damage or deterioration. Especially those parts in contact with the process environment, must be inspected thoroughly. • Check the flame shields, burner elements and all joints for wear or damage. • Check if the burner element fixing nuts are tight. • Clean the burner. Flame shields must not be covered with dust or dirt.	x x x		x x x			 x

Maintenance (Continued)

Flame safety	• Check the interlocks by simulating fault conditions. Resolve all flame safety problems before re-starting the burner. • Replace the UV sensor within the time frame as specified by the supplier.				x	x	
Igniter / flame rod	• Check and clean or replace the igniter / flame rod			x			
Thermal overlaod	• Check the direct burner surroundings for signs of excessive corrosion or deformation due to thermal overload. Repair or replace insulation or thermal protection shields if necessary.	x			x		

Troubleshooting

7

Introduction

Trouble shooting of electrical circuits should be done by qualified plant electricians, technicians or engineers experienced in all facets of this type of combustion equipments.

Troubleshooting Procedures

PROBLEM	POSSIBLE CAUSE	SOLUTION
Cannot initiate a start up sequence.	• Combustion air pressure switch has not made "No Air" contact.	Check air pressure switch adjustment (See para. 5 step 1). Check air filter if fitted. Check blower rotation. Check outlet pressure from blower.
	• External interlock failure.	Check all external interlocks.
	• High gas pressure switch has activated.	Check pressure switch settings (See para. 5 step 1).
	• Malfunction of the burner programmer. • No power supply to the burner programmer.	Have a qualified electrician troubleshoot and correct the problem.
Burner sequence starts but locks out before ignition.	Combustion air fault: • Blower failure. • Blocked blower inlet or filter. • Pressure switch failure. • 3 way solenoid valve failure.	 Check blower and remedy fault. Clean inlet. Clean or replace filter. Check pressure switch and replace if necessary. Check solenoid valve. Replace coil if necessary.
Burner start up sequence runs but does not light.	No ignition: • No power to the ignition transformer. • Open circuit between the ignition transformer and the ignition electrode. • Ignition electrode needs cleaning. • The ignition electrode is not properly grounded to the burner. • Ignition electrode insulator is broken.	 Restore power to the ignition transformer. Repair or replace wiring to the ignition electrode. Clean the ignition electrode. Clean the threads on the ignition electrode and burner. Inspect the ignition electrode and replace if broken.
	Not enough gas: • The support gas valve is not opening. • The support gas flow is adjusted too low.	 Check wiring to the support gas valve. Check the output from the burner programmer. Open adjusting valve 1 turn.

Troubleshooting Procedures (Continued)

PROBLEM	POSSIBLE CAUSE	SOLUTION
Support flame appears, but main burner does not ignite.	Not enough gas: • 2nd shut-off valve not opening. • MultiBloc low fire setting too low or too high. • High fire adjusting valve closed.	 Check wiring to the second shut-off valve. Check the output from the burner programmer. Open manual ball valve. Replace coil if necessary. Adjust ratio controller bias. Open adjusting valve to correct pre-setting.
Burner lights and then goes to lock-out.	No flame signal: • Broken flame rod • Dirty UV scanner lens. • Ignition electrode and flame rod connections reversed.	 Measure flame signal. Inspect and clean sensor. Replace if necessary. Exchange ignition electrode / flame rod wiring.
The high fire flame is orange or yellow. Burner parts are excessively hot.	Gas / air ratio out of adjustment: • Gas mixer nozzle blocked. • Blocked loading line. • Air mixing plate blocked.	 Clean nozzle. Check / clean loading line. Clean gas / air mixer.
	Gas pressure too high: • High fire adjusting valve too far open. • Gas ratio regulator failure.	 Check burner data for correct pressures. Replace gas ratio-regulator.
The low fire flame is orange or yellow. Burner elements are glowing.	• Too much gas	Adjust ratio-regulator.
The low fire flame is weak and unstable, flame signals are low.	• Insufficient gas flow to the burner. • Not enough air.	Adjust the low fire setting on the ratio-regulator. Adjust combustion air valve. Clean or replace filter. Check blower rotation.
High fire flame is weak and blue, flame signals are low.	• Insufficient gas flow to the burner.	Check burner gas adjustment and re-adjust. Gas nozzle blocked.
Burner does not reach its specified capacity.	Not enough air: • Air bv does not open. • Blower running in reverse. • Inlet or filter blocked. • Burner elements blocked.	 Check air contro lmotor limit settings. Check and correct blower wiring. Clean inlet or filter. Replace filter if necessary. Clean burner elements.
	Not enough gas (Air is OK): • Gas pressure into the ratio regulator is too low.	 Check for sufficient gas pressure.
Flame has irregular pattern showing holes.	• Burner elements blocked.	Clean burner elements.

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