164 Installation Guide
9/24/2010

Eclipse RatioStar

Burners

Model RAS

Version 1

ECLIPSE®
Innovative Thermal Solutions

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Document Conventions

There are several special symbols in this document. You must know their meaning and importance.

The explanation of these symbols follows below. Please read it thoroughly.

How To Get Help

If you need help, contact your local Eclipse representative. You can also contact Eclipse at:

1665 Elmwood Rd.
Rockford, Illinois 61103 U.S.A.
Phone: 815-877-3031
Fax: 815-877-3336
http://www.eclipsenet.com

Please have the information on the product label available when contacting the factory so we may better serve you.

This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

DANGER Indicates a hazardous situation which, if not avoided, will result in death or serious injury.

WARNING Indicates a hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

NOTICE Is used to address practices not related to personal injury.

NOTE Indicates an important part of text. Read thoroughly.

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Introduction 1

Product Description

Ratio-star burners, design is based on ratio controlled philosophy, which means that gas and air are controlled in predetermined settings. The basic design has a excess air percentage of 15 - ~~20~~%. ~~Lowe~~r ratios are possible and should be discussed with Eclipse Engineers.

The applications for this burner type are in case of low oxygen content in the process stream, when good temperature uniformity is required and in high temperature processes where no standard airheater can be used. The conventional Air Heat burner-design operates on very high excess air values. This generates emissions problems when running on lower capacities, because the air flow is constant through its relative "cold" flow it quenches the flame thus forming CO levels which are unacceptable nowadays.

The burner is a modular design and allows itself to built into almost every desired configuration. The process (flue gases) up-stream the burner can be up to 750ºC and be lift up to maximum 1200ºC without deviating from the basic concept. In addition with its very small dimension we can conclude that this burner is very attractive in much process application.

Typical Operating Range

Burner module capacity of 125 kW with a fuel gas pressure of 85 mbar on the gas tip and a flame length of ~ 1.5 meter. The minimum capacity per burner module is 15 kW. This determines the turn-down ratio.

Summary

- low resistance that implies hardly any pressure drop added
- can be easily adapted to required heat release
- can handle process temperatures up to 700ºC up-stream burner and temperature up to 1200ºC down-stream without any major changes to the standard design
- extremely good temperature profile through the burner duct
- requires very little space between the interconnecting ducting
- excellent emission figures : CO - NOx - UHC
- single ignition source even at complex configurations, though for practical reasons multiple ignition sources are used
- the average turn-down ratio without staging is 10:1

Audience

This manual has been written for personnel already familiar with all aspects of a gas burner and it's add-on components, also referred to as the burner package.

These aspects are:

- Installation
- Use
- Maintenance
- Safety

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

Purpose

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

RatioStar Documents

Installation Guide No. 164

- This document

Datasheet Series No. 164

- Required to complete installation

Related Documents (Attached if Applicable)

- Burner Parts List and Recommended Spares
- Burner Specifications Sheet
- Burner Operating Data

Safety

2

Important notices for safe operation of the burner system will be found in this section. To avoid personal injury, damage to property or the facility, the following warnings must be observed. Read this entire manual before attempting to start the system. If any part of the information in this manual is not understood, contact Eclipse before continuing.

Safety Warnings

⚠ 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.**

⚠ WARNING

- **The burner and duct sections are likely to have HOT surfaces. Always wear protective clothing when approaching the burner.**

NOTICE

- **This manual provides information in the use of the burner for its specific design purpose. Do not deviate from any instructions or application limits described herein without written advice from Eclipse.**
- **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.**

Capabilities

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

Operator Training

The best safety precaution is an alert and trained operator. Train new operators thoroughly and have them demonstrate an adequate understanding of the equipment and its operation. A regular retraining schedule should be administered to ensure operators maintain a high degree of proficiency.

Replacement Parts

Order replacement parts from Eclipse only. Any customer supplied valves or switches should carry UL, FM, CSA, CGA and/or CE approvals where applicable.

Installation 3

Introduction

In this section you will find the information and instructions needed to install the burner and system components.

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 & Storage

Handling

- Make sure the area is clean.
- Inspect the burner, ensure 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 and components from excessive temperatures and humidity.

Storage

- Make sure the components are clean and free of damage.
- Store the components in a cool, clean, dry room.
- After making sure everything is present and in good condition, keep the components in original packages as long as possible.

Approval of Components

Limit Controls & Safety Equipment

All limit controls and safety equipment must comply with all applicable local codes and/or standards and must be listed for combustion safety by an independent testing agency. Typical application examples include:

- American: NFPA 86 with listing marks from UL, FM, CSA
- European: EN 746-2 with CE mark from TuV, Gastec, Advantica

Electrical Wiring

All the electrical wiring must comply with all applicable local codes and/or standards such as:

- NFPA Standard 70
- IEC60364
- CSA C22
- BS7671

Gas Piping

All the gas piping must comply with all applicable local codes and/or standards such as:

- NFPA Standard 54
- ANSI Z223
- EN 746-2

Where to Get the Standards:

The NFPA Standards are available from:
National Fire Protection Agency
Batterymarch Park
Quincy, MA 02269
www.nfpa.org

The ANSI Standards are available from:
American National Standard Institute
1430 Broadway
New York, NY 10018
www.ansi.org

The UL Standards are available from:
333 Pfingsten Road
Northbrook, IL 60062
www.ul.com

The FM Standards are available from:
1151 Boston-Providence Turnpike
PO Box 9102
Norwood, MA 02062
www.fmglobal.com/approvals

Information on the EN standards and where to get them is available from:
Comité Européen de Normalisation
Stassartstraat 36
B-1050 Brussels
Phone: +32-25196811
Fax: +32-25196819
www.cen.eu

Comité Européen de Normalisation Electronique
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Checklist Before Installation

Access

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

Environment

Make sure the local environment matches the original operating specifications. Check the following items:

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

Duct Configuration

NOTE: The ducting for the burner, which normally is the combustion chamber should be designed to provide a uniform velocity distribution of process air around the burner. Deviations from the uniformity of only 25% are allowed.

The duct with or without a profile plate should ensure an actual velocity of 5 to 25 m/s along the burner.

NOTE: Make sure the pressure drop is also within the above range when starting up. Especially when it is calculated with preheated process air, the pressure drop in at lower temperatures can be considerably lower.

Suspending the Burner

The RatioStar burners is normally delivered inside a duct and it is suspended in this construction. In exceptional cases the burner is delivered loose or on a mounting plate and then the suspension needs to be done by the client.

CAUTION

- **Suspensions should allow for thermal expansion of the burner and duct as the temperature of the components increase. Piping expansion joints should be used outside of the duct to accommodate movement of the duct section when heated.**

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. The necessary gas pressures for the different gas types are presented in the Ratiostar datasheet No. 165.

Electrical Supply

The burner should be controlled via a sequence programmer, approved according to 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 ground must be checked to ensure a good connection.**

- **Gas pipe work must NOT be used for grounding purposes.**

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.

Adjustment, Start & Stop

4

Introduction

In this chapter you will find instructions on how to adjust, start, and stop the burner system. Become familiar with burner control methods before attempting to make adjustments.

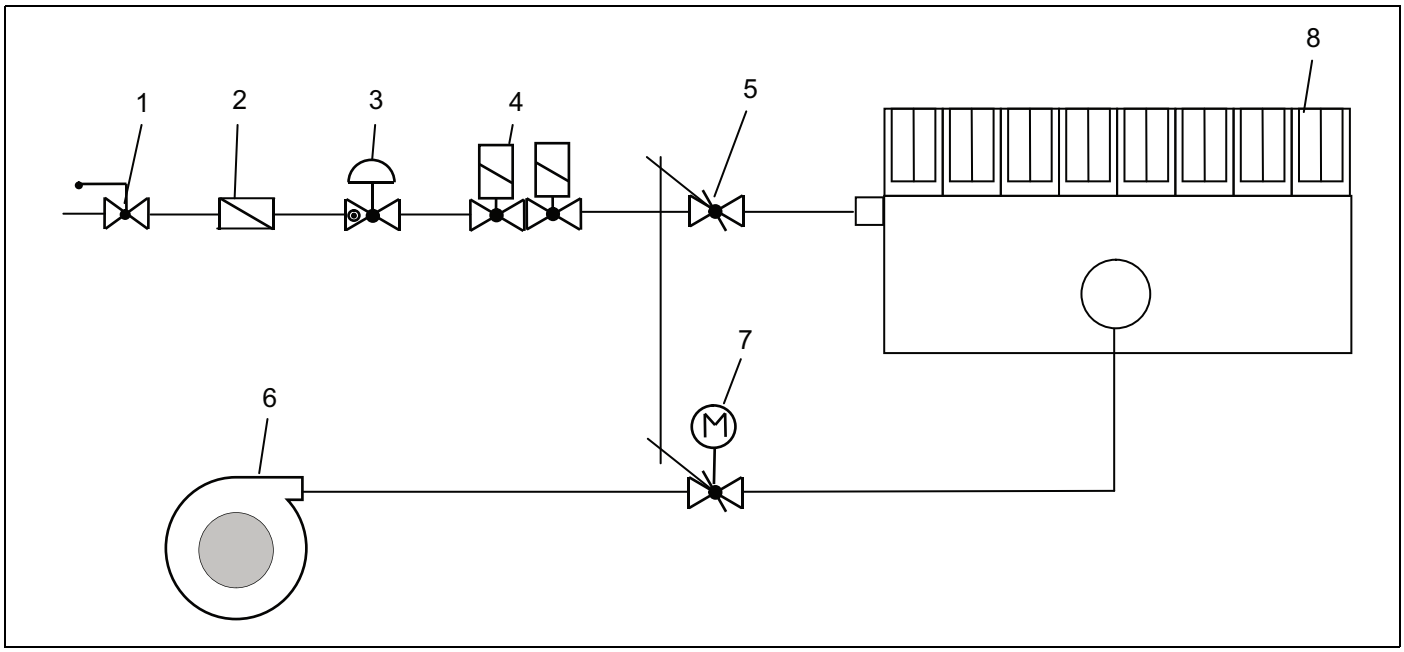
DANGER

- **Do not bypass any safety features; fires or explosion could result.**
- **Never try to light a burner if it shows signs of damage or malfunction.**
- **Obey the safety precautions in the Safety chapter.**

NOTE: Adjustment requires two manuals, this Installation Guide and Datasheet No. 165.

Adjustment Procedure

Below a typical P&ID is presented for a RatioStar with gas train.



Ref. No.	Description
1	Gas cock
2	Gas filter
3	Gas pressure controller
4	Double solenoid valve
5	Gas control valve
6	Blower
7	Air control valve with actuator
8	Burner

NOTE: This P&ID is for working principle only. Check your local regulations for more safety requirements.

Typically the gas input is controlled by means of a motor driven butterfly valve (5). The pressure before the motor is set with a gas pressure controller (3) which then is determining the maximum input. The combustion air is also driven by a motor driven butterfly valve. The butterfly valve of gas and air are mechanically or electronically linked. The air flow should be set so that in maximum input the burner is firing at approximately lambda 1,15 to 1,3. At turn down this lambda stays almost constant, but increases to approx. lambda 2,5 in the minimum 1:10.

⚠ CAUTION

- **Because the burner is generally used as a air heat burner , the process (fan) has to be in operation when starting up the burner. Otherwise the system can become overheated.**

Adjustment

Step 1: Preparation

1. Ensure all installation work has been completed in compliance with current legislated standards.
2. Ensure that all gas supply pipe work 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. The minimum differential air pressure switch is adjusted at approx. 20% below the minimum air pressure.

Step 2: Check Air Pressure

The combustion air pressure to the burner has to be measured. This combustion air pressure drop over the stabilization plate should be 2,5 mbar at maximum fire. The combustion air fan has to supply enough air to achieve this value.

NOTE: The ΔP over the stabilization plates needs to be measured to the process pressure. For this enough pressure taps need to be fitted and supplied.

Step 3: Set Gas Pressure

Adjust the maximum gas pressure before the burner according to the adjustment data in the Data Sheet No. belonging to the actual type of gas.

Step 4: Start-Up

Start-up procedure:

1. Check the presettings 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. 5 - 20 cm beyond the flame shields in a mixed blue and yellow color. If flame is too weak or too big, adjust the support flame with adjusting valve. 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 RatioStar burner will be ignited.

   At every burner nozzle a small rotating flame will appear.

   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 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 one turn.
   c. If the flame appears at ignition, but the main burner does not light, adjust the minimum setting of the servo motor, so a higher minimum input will be used.
   d. Repeat steps b and c until burner ignites. If the burner does not ignite, follow guidelines in section 7 "Troubleshooting".

Low Fire Settings

6. At low fire the separate flames at every nozzle should at least touch each other. With RatioStar the low fire input is depended on the air pressure drop across the burner. At highest pressure drop the minimum input is 10% of the maximum. At lowest pressure drop, the minimum input can go as low as 2,5% of the maximum. Setting of the minimum can be done with pressure or visually.

   NOTE: Again: the pressure drop across the burner changes with temperature of the incinerator. Starting the burner should be possible at low temperatures as well as high temperatures. Adjustment of the minimum input should be done at highest pressure drop which can occur in the operating of the incinerator.

High Fire Settings

6. Set the burner to high fire:
   Adjust the corresponding gas pressure with the pressure controller.

   NOTE: A visual check of the flame is important to ensure the correct burner adjustment. The flame will

be bright yellow at higher capacities. From all modules or nozzles the flame shape should be approximately equal.

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 process air differential pressure switch for correct operation by decreasing 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.**

Maintenance & Troubleshooting

5

Maintenance

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.

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.

Subject	Action	Interval					
		1 month after commissioning	3 months	6 months	12 months	as per suppliers instructions	depending on circumstances
Adjustments	Check and compare burner adjustments with the original recorded settings. Correct settings if they are outside the specified tolerance range.	X			X		
Gas filter	Check and clean or replace the gas filter if necessary.	X			X		
Gas components	Check all components for damage (visually)		X				
	Leak test shut-off valves				X		
	Check manual shut-off valve for correct operation		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 solved immediately.	X			X		
	Check tightness of all bolted / screwed joints.	X			X		
Flame safety	Check the interlocks by simulating fault conditions. Resolve all flame safety problems before re-starting the burner				X		
	Replace the UV sensor within the time frame as specified by the supplier of the UV scanner					X	
Igniter / flame rod	Check and clean or replace the flame rod and igniter			X			
Thermal over load	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

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

Problem	Possible Cause	Solution
Cannot initiate a start up sequence.	External interlock failure.	Check all external interlocks.
	High gas pressure switch has activated.	Check pressure switch settings. (See par 5. step 1).
	Malfunction of the burner programmer.	Have a qualified electrician troubleshoot and correct the problem.
	No power supply to the burner programmer.	Have a qualified electrician troubleshoot and correct the problem.
Burner sequence starts but locks out before ignition.	Process air fault; Process blower failure.	Check blower and remedy fault.
	Process air fault; 3 way solenoid valve failure (If fitted).	Check solenoid valve. Replace coil if necessary.
Burner start up sequence runs but does not light.	No ignition; There is no power to the ignition transformer.	Restore power to the ignition transformer.
	No ignition; Open circuit between the ignition transformer and the ignition electrode.	Repair or replace wiring to the ignition electrode.
	No ignition; The ignition electrode needs cleaning.	Clean the ignition electrode.
	No ignition; The ignition electrode is not properly grounded to the burner.	Clean the threads on the ignition electrode and the burner.
	No ignition; Ignition electrode insulator is broken.	Inspect the ignition electrode and replace if broken.
Burner start up sequence runs but does not light.	Not enough gas; The support gas valve is not opening.	Check wiring to the support gas valve. Check the output from the burner programmer.
	Not enough gas; The support gas flow is adjusted too low.	Open adjusting valve 1 turn.
Support flame appears, but main burner does not ignite	Not enough gas; 2nd shut-off valve not opening.	Check wiring to the 2nd shut-off valve. Check the output from the burner programmer. Open manual ball valve. Replace coil if necessary.
	Not enough gas; Butterfly valve should be more open at minimum fire.	Increase the minimum position of the butterfly valve.
Burner lights and then goes to lock-out.	No flame signal; Broken flame rod. Dirty UV scanner lens.	Measure flame signal. Inspect and clean sensor. Replace if necessary.
	No flame signal; Ignition electrode and flame rod connections reversed.	Exchange spark electrode/flame rod wiring.
At minimum input one or more modules have no flame	Minimum fire is too low; Butterfly valve should be more open at minimum fire.	Increase minimum gas with minimum position butterfly valve.
Burner does not reach its specified capacity	Not enough gas; Gas pressure into the butterfly valve is too low.	Check for sufficient gas pressure.

Appendix

Conversion Factors

Metric to English

From	To	Multiply By
actual cubic meter/hr (am^3/h)	actual cubic foot/hr (acfh)	35.31
normal cubic meter/hr (Nm^3/h)	standard cubic foot /hr (scfh)	38.04
degrees Celsius (°C)	degrees Fahrenheit (°F)	(°C x 9/5) + 32
kilogram (kg)	pound (lb)	2.205
kilowatt (kW)	BTU/hr	3415
meter (m)	foot (ft)	3.281
millibar (mbar)	inches water column ("w.c.)	0.402
millibar (mbar)	pounds/sq in (psi)	14.5×10^{-3}
millimeter (mm)	inch (in)	3.94×10^{-2}
MJ/Nm^3	BTU/ft^3 (standard)	26.86

Metric to Metric

From	To	Multiply By
kiloPascals (kPa)	millibar (mbar)	10
meter (m)	millimeter (mm)	1000
millibar (mbar)	kiloPascals (kPa)	0.1
millimeter (mm)	meter (m)	0.001

English to Metric

From	To	Multiply By
actual cubic foot/hr (acfh)	actual cubic meter/hr (am^3/h)	2.832×10^{-2}
standard cubic foot /hr (scfh)	normal cubic meter/hr (Nm^3/h)	2.629×10^{-2}
degrees Fahrenheit (°F)	degrees Celsius (°C)	(°F - 32) x 5/9
pound (lb)	kilogram (kg)	0.454
BTU/hr	kilowatt (kW)	0.293×10^{-3}
foot (ft)	meter (m)	0.3048
inches water column ("w.c.)	millibar (mbar)	2.489
pounds/sq in (psi)	millibar (mbar)	68.95
inch (in)	millimeter (mm)	25.4
BTU/ft^3 (standard)	MJ/Nm^3	37.2×10^{-3}

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