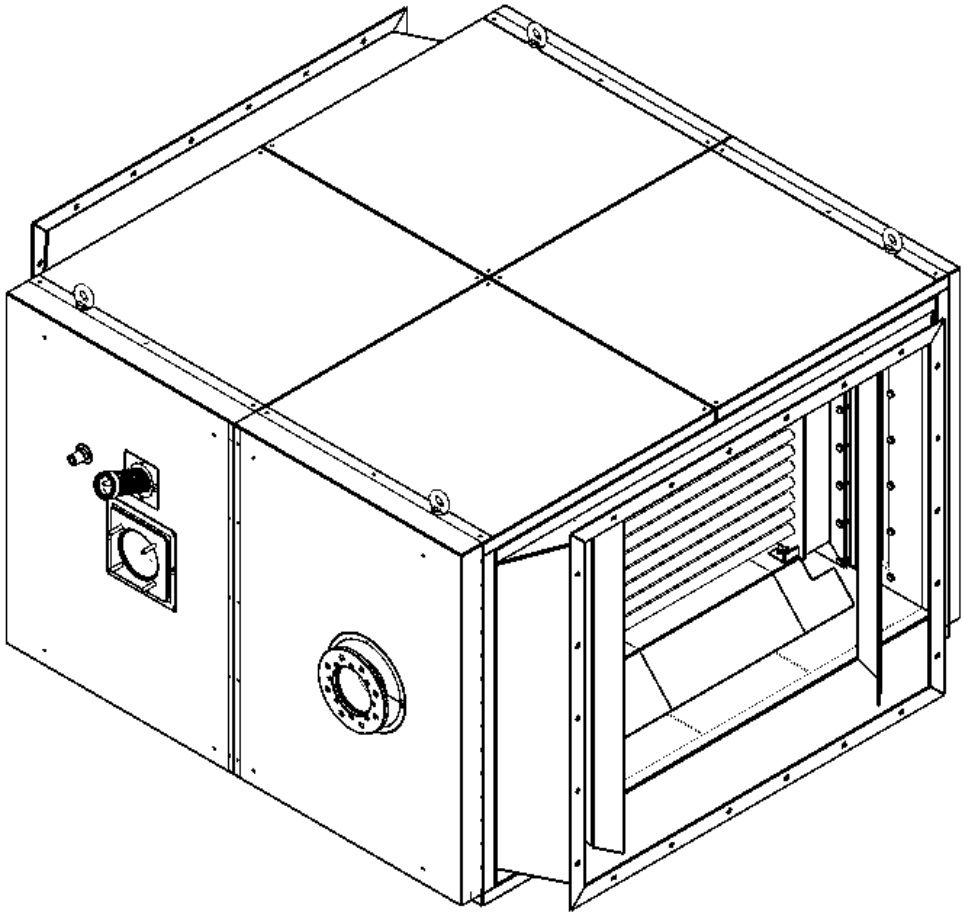
fives
Industry can do it

EMHAGM-20200609

ITAS HOT AIR GENERATOR - HF

ENGINEERING MANUAL (METRIC)

Version June 2020



Copyright

Disclaimer / Responsibility declining
The manufacturer will decline all responsibilities for damages to the product, machine or production or injuries to persons in any of the following cases:

- Improper use of the product;
- Use of the product by non-qualified personnel;
- Not following regulations of the country where the product is installed;
- Improper erection of the product;
- Improper integration of the product into any machine;
- Use of parts other than manufacturers parts or advised by manufacturer;
- Maintenance by unskilled personnel;
- Exceptional events;
- Not following instructions mentioned in this document.

Liability and warranty
ITAS Hot-Air-Generator-HF is a “partly completed machinery” and cannot be used without further integration into a combustion system or machine. Fives ITAS S.p.A. liability limits to the product only. Fives ITAS S.p.A. will not be liable for any injury, loss, damage or expense (whether direct or consequential), including but not limited to loss of use, income, or damage to material arising in connection with sale, installation, use of, inability to use or repair or replacement of Fives ITAS S.p.A. products.

It is the intention of Fives ITAS S.p.A. of making this manual as accurate and complete as possible. In case any typos, mistakes, errors or missing elements were found in this document, please bring them to our attention so we can correct them. This document is under continuous supervision and modification of Fives ITAS S.p.A. document specialists. Therefore, it is the users’ responsibility to make sure they have the most recent version of documents at any time.

TABLE OF CONTENTS

1. INTRODUCTION

All involved personnel shall carefully read this entire manual before integrating the product into a combustion system. If any part of the information in this manual is not clear, contact Fives ITAS S.p.A. before proceeding.
This manual provides information regarding the design of the heaters for their specific design purpose. Do not deviate from any instructions or application limits described herein without written approval from Fives ITAS S.p.A.

1.1 Audience

This manual is intended for engineers having experience with all aspects of combustion. These aspects include, but are not limited to, nozzle-mix burners and its related components such as gas trains, blowers and fans, burner management and air flow design.

1.2 Symbols

⚠WARNING The warning signal used in this document indicates a subject requiring special attention when designing the combustion system. Improper design of the combustion system might result in death or injury when operating the system.

1.3 Assistance

Should the user need any assistance, contact the local Fives ITAS S.p.A. representative or contact the Headquarter:

Fives ITAS S.p.A.
Via Metauro, 5 – 20900 Monza (MB) – Italy
Tel. +39 039 27331

1.4 Related documents

This engineering manual comes is provided with, and cannot be used without:

- Technical datasheets of the ITAS Hot Air Generator-HF series. Each heater size has its own datasheet.
- Engineering manual ITAS Hot Air Generator-HF (present document)

1.5 Purpose of this manual

The purpose of this document is to ensure a safe, effective and trouble-free selection of the Hot Air Generator-HF and to support a trouble-free design of the system where the heater is to be integrated. This document is not applicable for Hot Air Generators -BS series.

2. THE PRODUCT

2.1 Description

ITAS Hot-Air-Generator-HF (HAG-HF) has been designed for recirculation systems of ovens and dryers for processes where the process air stream is isolated from the burner flue gases. The burner fires into a chamber. The single pass units are easy to install and are pre-tested. For the heat supply the heater shall be equipped with a compact burner with gas train and controls.
Features:

- High efficiency
- Low pressure drops
- Rugged construction
- Packaged design
- No product contamination

2.2 Intended use

ITAS HAG-HF is designed for use on a wide range of industrial air-heating applications, Typical industrial applications are:

- Automotive paint booths
- Food drying and baking
- Metals coating, drying and curing
- Ceramics white ware drying
- Pharmaceutical air heating

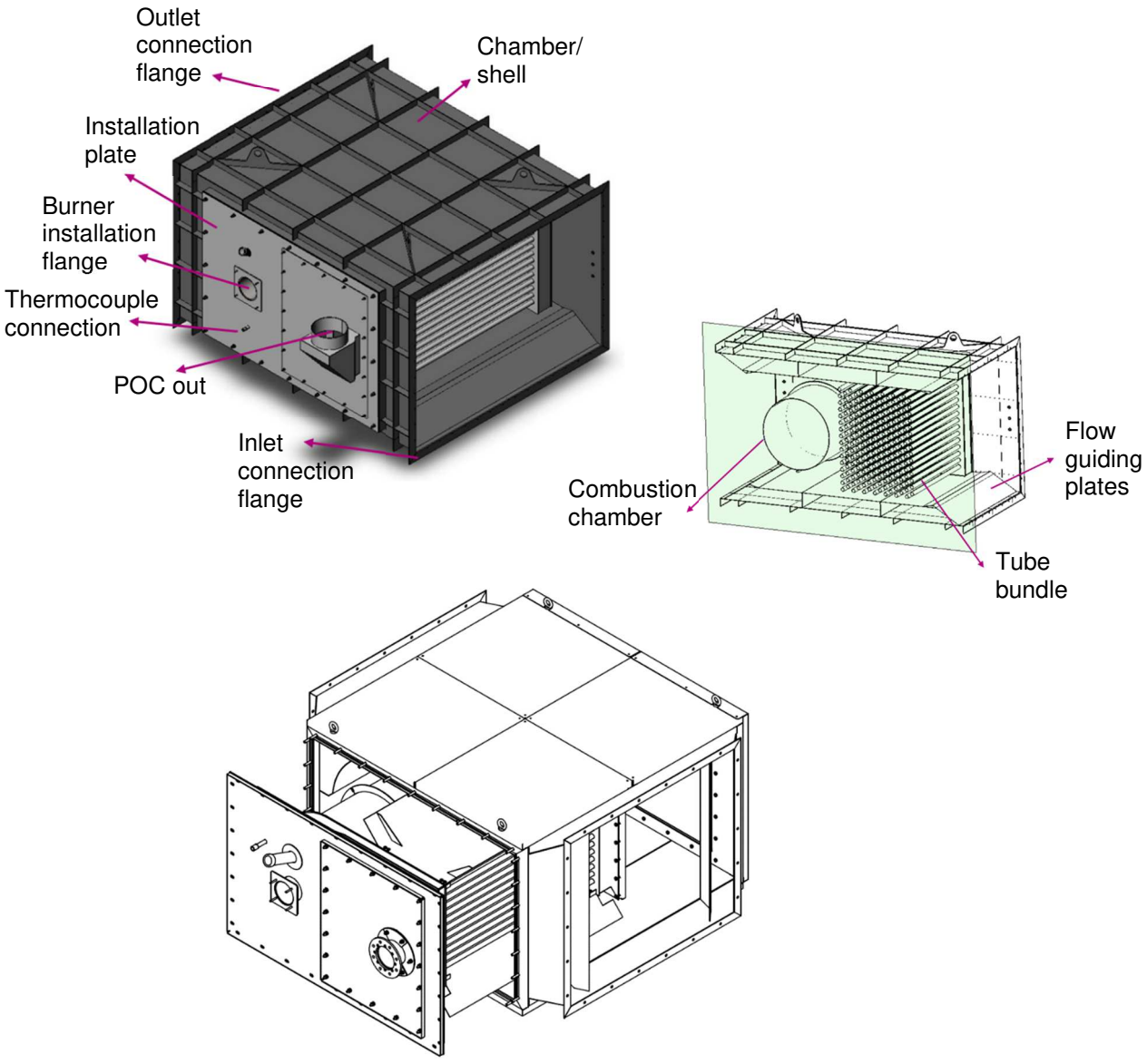
2.3 Certification

ITAS HAG-HF complies with the EN746-2 and the machine directive 2006/42/EC. This can be confirmed by manufacturer's Declaration of incorporation.
ITAS HAG-HF meets the technical specifications of the Eurasian Customs Union (EAC).

2.4 Mechanical construction

The heater is available in eight (8) different sizes from 100 kW up to 800 kW thermal output. The heat input comes from a gas-fired burner, to be added. The heater consists of main components:

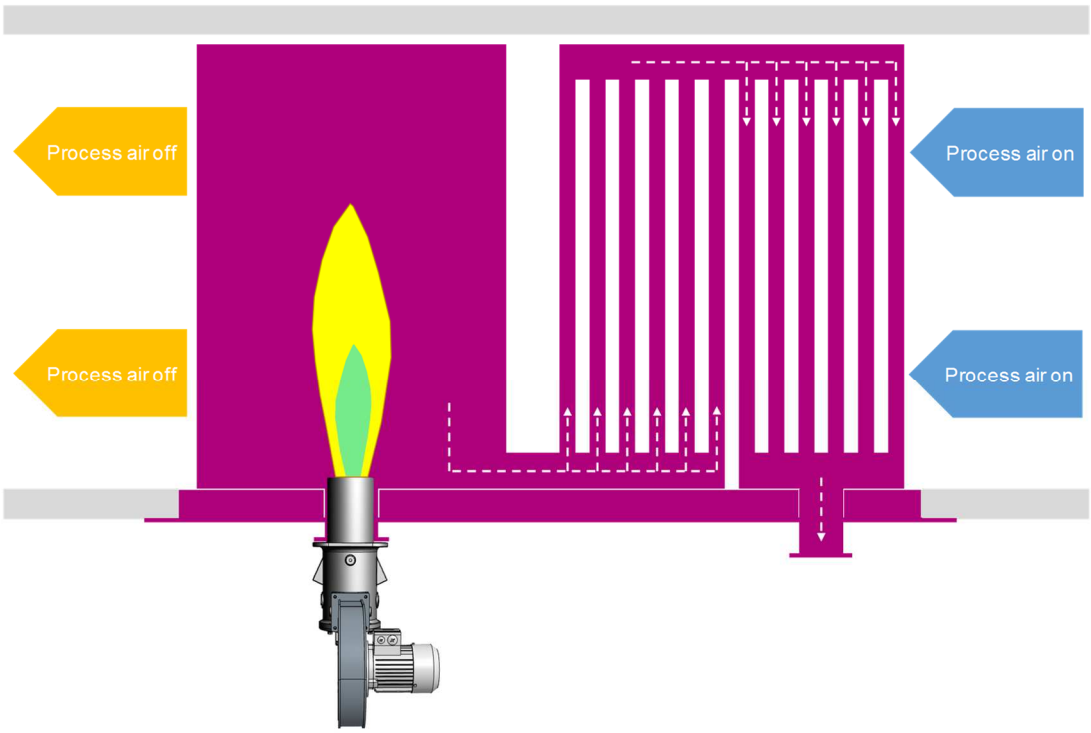
- Combustion chamber made in AISI 310
- Tube bundle in AISI 304
- Installation flange to fit the burner
- Outlet for Product of Combustion
- Installation plate
- Optional outer shell
- Optional outer insulation
- Thermocouple for safeguarding of the combustion chamber
- Connection points for the process air pressure switch



2.5 Functioning and definitions

The function of a hot air generator is to transfer (conduction) heat from a hot medium to a colder medium.
A burner fires into the combustion chamber and product of combustion (POC) passes through the tube bank to the outlet. At the same time, process air flows at the outside over the tube bundle and over the combustion chamber. The travelling path of the POC (products of combustion) and the process air are isolated from each other.
In this manual:

- Process air is the medium to be heated; flowing at the outside of the combustion chamber;
- POC is the hot “product of combustion” inside the combustion chamber transferring his thermal energy via the steelworks to the air.



2.6 Control methodology

ITAS HAG-HF offers 2 ways of capacity control. The thermal input is controlled via the burner assembled on the heater. Refer to specific burner documentation for data, installation and operating detail. The quantity of process air is controlled by client’s process air fan and shall stay within the minimum and maximum allowable values as mentioned in the heater’s technical datasheet. The thermal energy transferred into the process air is a combination of thermal input from the burner and process air over the heater.

3. HEATER SELECTION AND SYSTEM DESIGN

3.1 Heater selection

The heater shall properly suit the application where it is intent to be used on. Use the ITAS HAG-HF datasheets when following the selection process.

Thermal output: The maximum allowable thermal output of the heater is written in the Technical datasheet of each heater. The real thermal output of a heater depends on process conditions. A heat balance of the process defines the required thermal output from the heater into the application. Consider all aspects like quantity of air, composition of the air, on temperature and desired off temperature to determine the required thermal output from the heater to the process air.

Maximum temperature increase per pass: Depending on the airflow and the thermal output of the heater, graph 1 of the datasheet shows the maximum temperature increase per pass over the heater. Double check if this value is in line with the values of the heat balance calculations.

Thermal efficiency of the heater: The thermal efficiency reflects the percentage of available heat effectively used for heating the process air. The thermal efficiency of the hot Air Generator is to be taken from Graph 2, consider the value as a theoretical estimate. This graph shows 2 lines. Before reading the graph, complete the formulas on the graph's legend by entering the dT of the heat balance calculation and reading of graph 1.

Thermal input into the heater: The thermal energy added to the heater in generated by a gas fired burner. The required burner capacity is the result from the heater's thermal output (graph 1) and the estimated thermal efficiency (graph 2) of the heater when used in that typical circumstances. The thermal input into the heater could be calculated or read from graph 3. (Qin = Qout / %eff)

The burner installed onto the heater shall provide the correct amount of thermal input into the heater. ITAS Dryflamepack burners are the perfect solution to fire a Hot Air Generator. Make sure the burner is set up properly not to exceed the maximum allowable thermal input mentioned in the heater's technical datasheet.

Hot Air Generator	Max. thermal input [kWlhv]	ITAS Dryflamepack
HAG-HF0100	122	DFP01-NSI1TG2…..
HAG-HF0200	243	DFP02-NSI1TG2…..
HAG-HF0300	366	DFP03-NSI1TG2…..
HAG-HF0400	487	DFP05-NSI1TG2…..
HAG-HF0500	610	DFP07-NSI1TG2…..
HAG-HF0600	732	DFP07-NSI1TG2…..
HAG-HF0700	854	DFP09-NSI1TG2…..
HAG-HF0800	976	DFP12-NSI1TG2…..

⚠WARNING Do never exceed the maximum thermal input into the heater as mentioned in the product's technical datasheet. This might cause damages to the heater and unsafe circumstances.

Air flow: During operation of the heater, the airflow over the heater shall stay within the minimum and maximum ranges mentioned in the technical datasheet. Too low- or too high airflows might cause insufficient cooling onto the heater and might causes damages on the heater. The airflow is in direct relation with the air pressure drop over the heater.

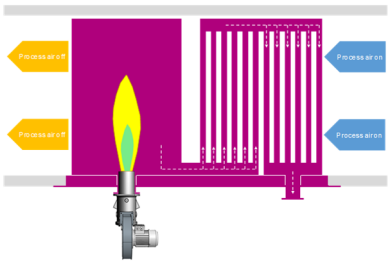
Air pressure drop: When designing the systems around the heater, consider a certain level of pressure drop over the heater. The pressure drop is a combined result of flows and temperatures. To protect the heater against overheating and unsafe circumstances, the pressure drop is safeguarded by a pressure switch.

POC pressure drop: For proper design of the burner it is important to take the pressure drop of the flue gas when travelling through the heater. This pressure drop shall be considered as back pressure whilst selecting combustion air blower.

Maximum allowable chamber temperature: To increase lifetime of the heater, the temperature of the process air shall not exceed the maximum mentioned in the technical datasheet.

Mounting position: The heater is designed for horizontal or vertical installation. The installation position does not impact the mechanical design of the heater, but only the assembling position of all components connected to the heater.

Air flow direction: Make sure at any time, the air flows first over the tube bundle and then over the combustion chamber.



The values in the heater's technical datasheet are all based on environmental "Nominal Conditions", defined as:

- 20°C (293,15 K)
- 1 atm (1013,25 mbar, 101,325 kN/m², 101,325 kPa)

Deviations on the above might come from pre-heating process-air, operating on elevated altitudes or different pressure conditions. The thermal output of the heater may be reduced when operating on non-nominal conditions. Contact Fives ITAS S.p.A. in case of questions or doubts.

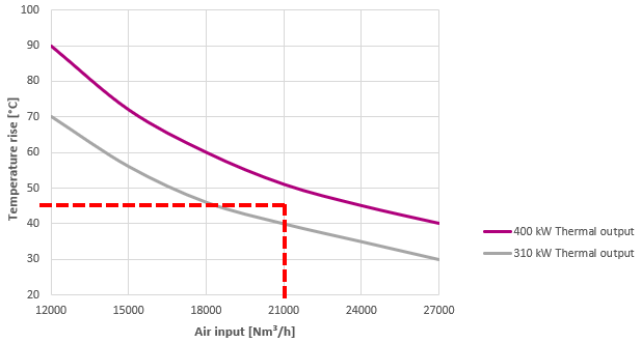
3.2 Calculation example

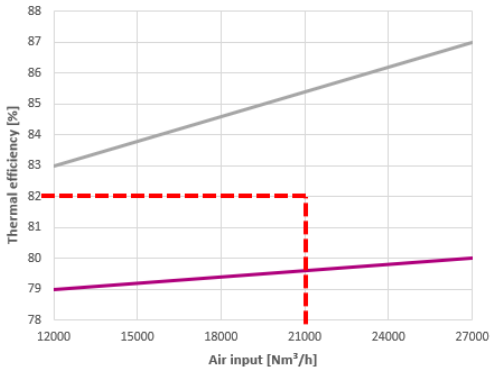
An airflow of 21000 nm³/h shall be heated from 100°C to 145°C. Thermal analysis of the process learned this requires 350 kW of thermal input into the airflow.
Vair = 21.000 [nm³/h]
t1 = 100 [°C]
t2 = 145 [°C]
Qout = 350 [kW]

Parameter	Value
Maximum thermal output [kW]	400
Maximum thermal input [kWlhv]	487
Minimum air flow [Nm³/h]	12000
Maximum air flow [Nm³/h]	27000

a. Select the appropriate heater model:
The technical datasheet shows the maximum thermal output of the HAG-HF0400 is 400 kW. Also, the air flow fits between the presented minimum and maximum.

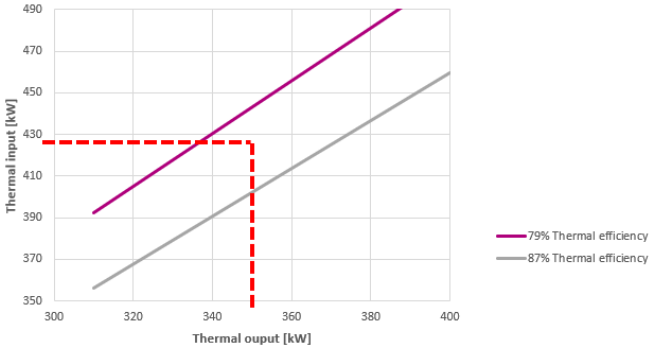
b. Confirm thermal analysis:
Graph 1 of the datasheet confirms that 21000 nm³/h requires about 350 kW heat input to increase the temperature with 45 degrees (100 to 145°C).
Δt = 45 [°C]





c. Determine estimated heater efficiency:
Read graph 2 and calculate the legend of the graph. In this example the grey line shows that Tout = 55 °C (10°C + 45°C). The purple line shows Tout = 200°C. The Tout = 145°C in this calculation example is somewhere in between the 2 lines given.
The graph shows the estimated thermal efficiency of the heater in this example shall be 82%

d. Determine required thermal input:
Calculate the required thermal input from the burner into the heater.
Qin = Qout / eff%
Qin = 350 / 82%
Qin = 427 kWlhv
Graph 3 shall be used to double check the calculated value.



3.3 Gas burner system

The gas burner added onto the heater shall be designed in a proper and safe way in compliance with all local safety standards and codes. Regulations might be, but are not limited to:

- EN 746-2 with CE mark
- NFPA with listing marks from UL, FM, CSA

Make sure high-quality safety components are selected and assemble these as per suppliers advise. Pipe diameters shall be selected in a correct way. Fives ITAS S.p.A. can support in the design and delivery of the main gas train for fuel supply to the burner.

Use the burner's assembling flange to connect the burner to the heater.

- Make sure the heater flange is designed for that specific burner.
- Make sure the heater flange is strong enough to bear the weight of the burner.
- Engineer a gasket between the burner flange and the heater flange.
- The outlet of the combustor shall not stick into the lining of the heater;
- The position of the burner nozzle shall be adapted to the thickness of the heater wall.
- Engineer a pipe union in the gas- and airline to the burner. This simplifies installation and removal of the burner.

The use of flexible pipes (expansion joints) is recommended to absorb stress due to heat expansion and slight misalignment. Be aware that flexible pipe nipples might cause inaccurate measurements of pressures.

3.4 Burner and heater Management

The heater shall be equipped with a management system. The management system shall apply to local regulations and shall be equipped with, but not limited to, burner relay, temperature safeguarding and pressure alarms. Contact Fives ITAS S.p.A. in case of questions or doubts.
Additional to the burner management, consider that the heater is provided with:

- A thermocouple to safeguard maximum temperature inside the combustion chamber. This thermocouple is additional to the client's safeguarding and measurement of the process air. Therefore, the management system shall be equipped with an additional maximum temperature switch;
- A pressure switch to check (and safeguard) the availability of sufficient air flowing over the heater.

3.5 Duct design

The Hot Air generator is supplied including a chamber (shell) (see picture page 5). The design of the process air ducting before and after the hot air generator shall be in such way that the airflows are as uniform as possible.

Poor uniformity of airflows (on- and off the heater) can turn into noise, vibration and finally reduced lifetime of the heater. Inlet and outlet duct design is costumer's responsibility. Supplier cannot accept any responsibility for problems which may result from poorly designed ductwork. As a guideline the following criteria could be considered when designing the ducting before and after the heater.

Ducting before the heater:

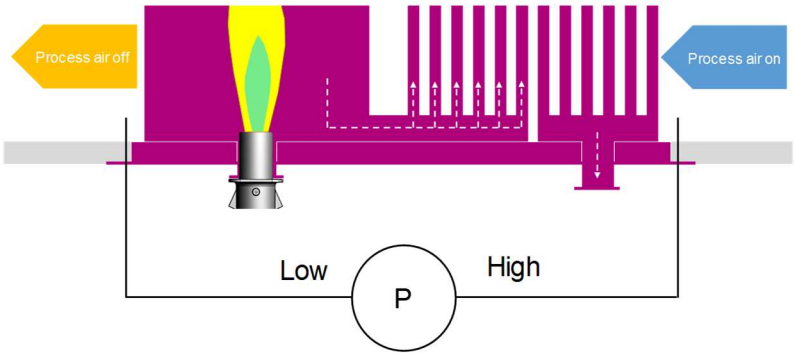
- In case of straight duct: the straight length shall be identical (minimal) to the length of the heater duct; (read technical datasheet)
- In case of a tapered duct: the length shall be enough to provide a 7° taper;

Ducting after the heater:

- In case of straight duct: the straight length shall be identical (or longer) to the length of the heater duct; (read technical datasheet)
- In case of a tapered duct: start with 350 mm straight before tapered duct starts. The length of the following duct shall be enough to provide a 7° taper;

3.6 Process air pressure switch

The Hot Air Generator is equipped with a differential air pressure switch to ensure that process air flow over the heater is available. Make sure the switch is wired to the burner's safety loop.



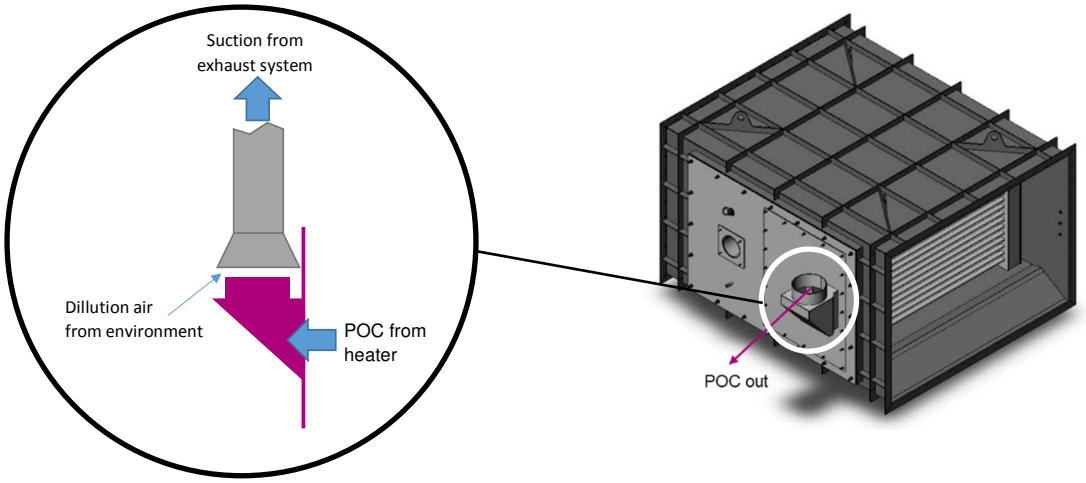
The minimum and maximum allowable process air pressure drop could be taken from the technical datasheet.

3.7 Combustion chamber temperature

To make sure the combustion chamber does not get overheated, the heater is equipped with an excess temperature protection. The combustion chamber includes a thermocouple to monitor the chamber temperature. This thermocouple shall be wired to an excess temperature switch in the heater's control cabinet.

3.8 Connecting the POC exhaust system

The Hot Air Generator is provided with an outlet to exhaust the products of combustion from the heater. Make sure that the exhaust system does not create negative pressure in the heater. A properly designed exhaust system includes a draft breaker. An example of a draft braking system is shown in the picture below.



In the "draft braking hood" principle, the system shall be designed to provide a slight draught at the flue break during full fire operating conditions.

4. NOTES

On this page personal engineering notes may be taken.