Honeywell

krom schröder

Self-recuperative burner ECOMAX for gas

Technical Information · GB
7 Edition 08.18

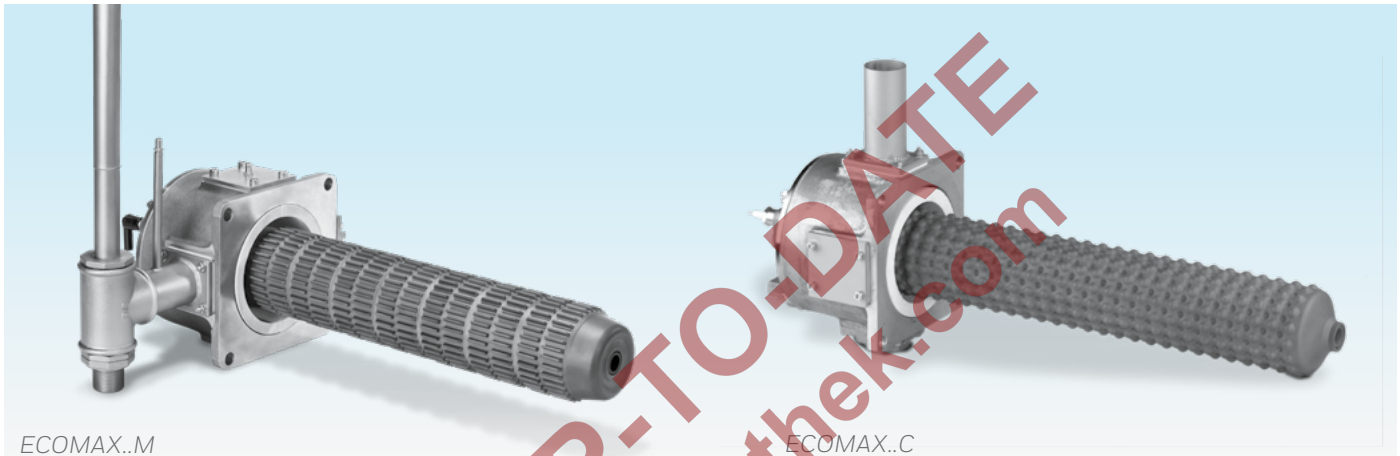
- For direct and indirect heating
- Economical, energy-saving operation by virtue of internal air preheating up to 650°C
- Uniform distribution of temperature by means of a high burner impulse
- 7 sizes from 25 to 500 kW
- Highly efficient with a ceramic burled tube recuperator or a cast steel ribbed tube recuperator.

EAC

Contents

= To be continued

1 Application



ECOMAX..M ECOMAX..C

Self-recuperative burners ECOMAX are used for heating on either direct or indirect furnace systems in ON/OFF intermittent mode. The hot flue gases are fed through the ceramic or metallic heat exchanger, which is integrated in the burner, heating the additional supply of cold combustion air flowing in the opposite direction. The maximum achievable air preheat temperature amounts to approx. 650°C, depending on the application.

1.1 Direct heating

In conjunction with an eductor EJEK to extract the flue gases, the burner ECOMAX is used to save energy in a direct heating system without long hot air pipes requiring insulation.

Applications include heat treatment furnaces in the iron and steel industry and in the non-ferrous metal industry.

1.2 Indirect heating

Self-recuperative burners ECOMAX are used in conjunction with metallic or ceramic radiant tubes and ceramic segmented flame tubes SICAFLEX for indirect heating. Indirect heating equipment is used whenever the combustion gases are to be separated from the product, e.g. in heat treatment furnaces with inert gas atmospheres in the steel industry or when heat-treating aluminium.

1.3 Application examples

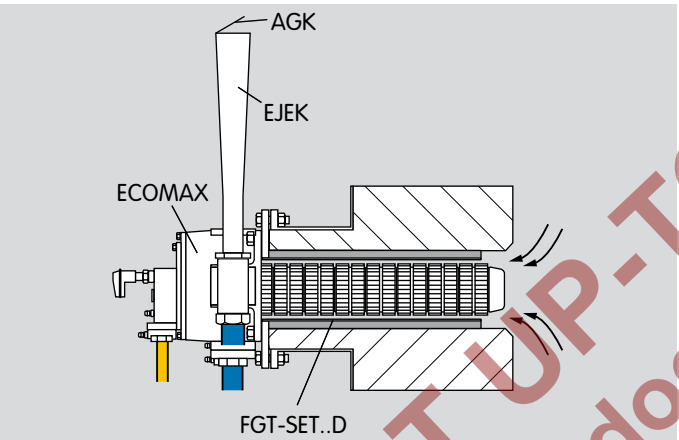
Roller hearth furnace

Bogie hearth furnace

Batch furnace

1.4 ECOMAX for direct heating systems

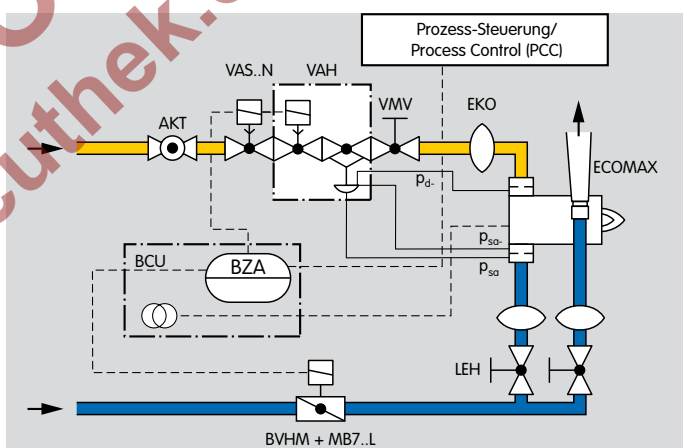
In direct heating systems, the burner ECOMAX is combined with a flue gas guide tube FGT Set..D for routing the flue gases through the furnace lining and a flue gas eductor EJEK.



Eductor EJEK generates a negative pressure by forcing air through a centrally positioned nozzle and thus draws the flue gases out of the furnace chamber through the burner's heat exchanger. The motive air flow is adjusted on the basis of the negative pressure measured on the pressure tap between the burner and the motive air nozzle. A flue gas valve AGK on the eductor, which closes due to its own weight, minimizes backflow of hot flue gas from the furnace into the burner or infiltrated air being sucked into the furnace when the burner is switched off.

1.4.1 Flow rate control

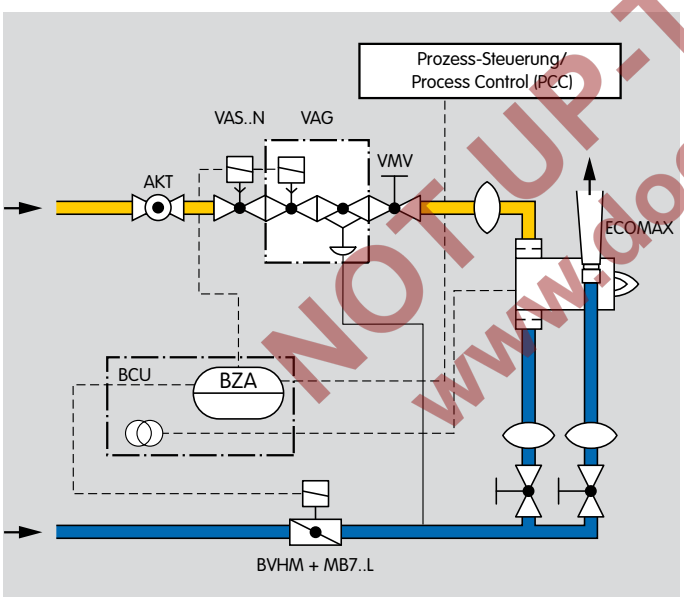
For direct heating, flow rate control should be integrated in the system. The pressure loss in the recuperator depends on the furnace temperature. When the furnace temperature is increased (at a constant air supply pressure), the air flow rate drops. This change in the air flow rate is measured by the orifice and the VAH changes the gas volume accordingly to ensure that the air index (lambda) on the burner is not dependent on the furnace temperature.



The ECOMAX is equipped with an integrated air orifice. This can be used for recording the air flow rate as a reference variable for the VAH. A separate upstream air orifice is then no longer required. The impulse line p_{d-} for gas is connected to the burner downstream of the integrated orifice so that the minimum gas pressure is sufficient.

1.4.2 Air/gas ratio control

If the system does not include flow rate control, temperature-dependent pressure losses in the burner are not compensated for. The air index lambda drops with increasing furnace temperature (increasing air preheating). Therefore, in a cold furnace, an increased lambda value is to be set to ensure sufficient excess air, even when the furnace temperature is at its maximum. A furnace at 1100°C with $\lambda = 1.1$ (approx. 2% O_2) requires a burner setting of approx. 4% O_2, for example, when the furnace is cold.

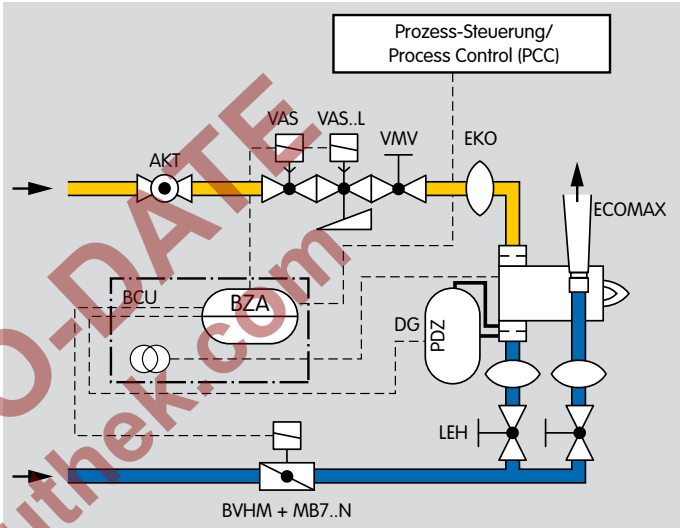


1.4.3 No pneumatic air/gas ratio control system

When there is no pneumatic air/gas ratio control system, slow opening gas valves and quick opening air control valves are to be used to ensure a safe burner start.

If there is no pneumatic air/gas ratio control system, the gas and air pressures must be controlled and monitored in the supply lines. Fluctuations in the supply pressure affect the burner capacity and the air index (lambda).

Air flow monitoring is recommended as low air pressure protection (pursuant to EN 746-2 and ISO 13577-2) if the system does not include a pneumatic air/gas ratio control system. The ECOMAX is equipped with an integrated air orifice which can be used for this. The air flow monitoring system may also be used to monitor pre-purge.



1.5 ECOMAX® for indirect heating systems

For indirect heating, various radiant tubes are used.

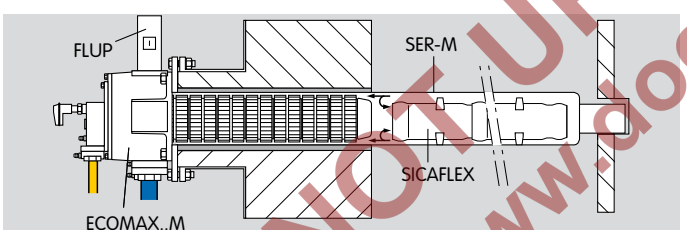
Single ended radiant tube

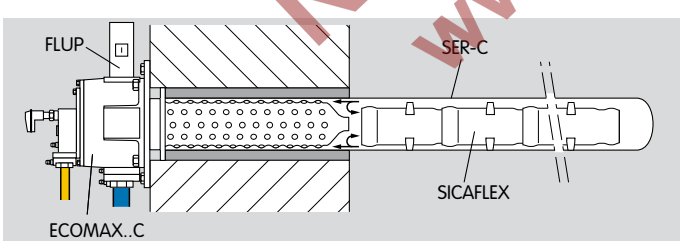
Indirect heating with the ECOMAX burner can be carried out using a metallic radiant tube SER-M or a ceramic radiant tube SER-C. A flame tube made of SICAFLEX elements is fitted inside the radiant tube to guide the flue gases. The flue gases are discharged via a flue gas connector FLUP.

The high outlet velocity of the flame causes a recirculation of the flue gases and thus:

– a reduction in NO_X emissions,

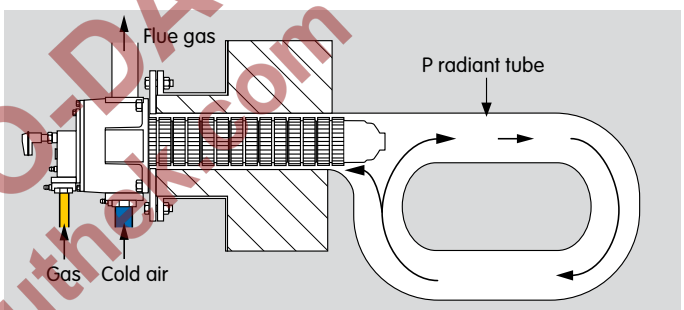
– a uniform radiant tube temperature.

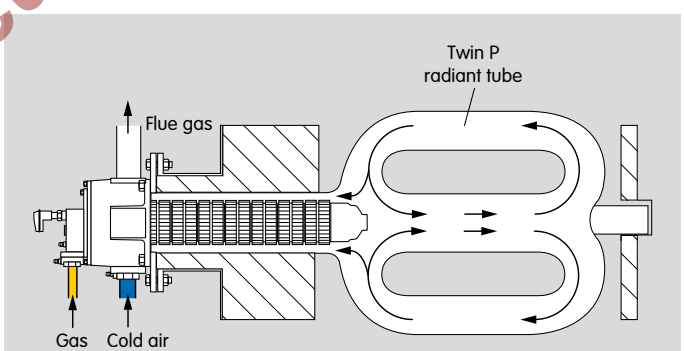




P and twin P radiant tube

P and twin P radiant tubes are used in some processes, for example in heat treatment systems for steel strip as an alternative to U or W radiant tubes. The new burner version ECOMAX..P with a special recuperator head is for use in P radiant tubes.



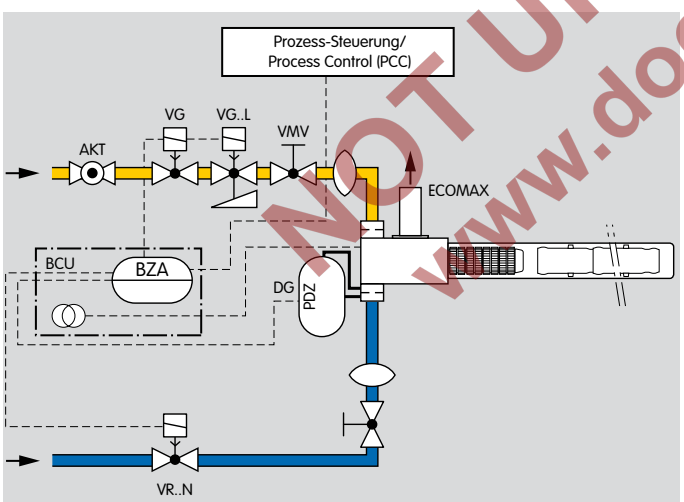


1.5.1 No pneumatic air/gas ratio control system

For indirect heating, slow opening gas valves and quick opening air control valves are to be used to ensure a safe burner start.

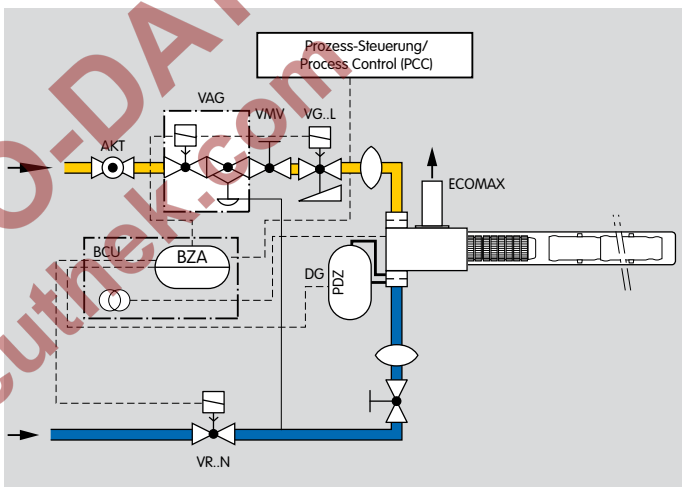
If there is no pneumatic air/gas ratio control system, the gas and air pressures must be controlled and monitored in the supply lines. Fluctuations in the supply pressure affect the burner capacity and the air index (lambda).

A system which includes air flow monitoring is recommended to monitor pre-purge and as low air pressure protection (pursuant to EN 746-2 and ISO 13577-2). The ECOMAX is equipped with an integrated air orifice which can be used for this.



1.5.2 Air/gas ratio control

The pneumatic air/gas ratio control system ensures that changes in the air pressure in the air supply line are compensated for by controlling the gas pressure at the burner accordingly.



A system which includes air flow monitoring is also recommended to monitor pre-purge (pursuant to EN 746-2 and ISO 13577-2) even if there is a pneumatic air/gas ratio control system.

2 Certification

Certificates – see www.docuthek.com.

Machinery Directive

The product ECOMAX is a partly completed machine pursuant to Article 2g of Directive 2006/42/EC and complies with the essential health and safety requirements in accordance with Annex I, as stated in the Declaration of Incorporation.

Eurasian Customs Union

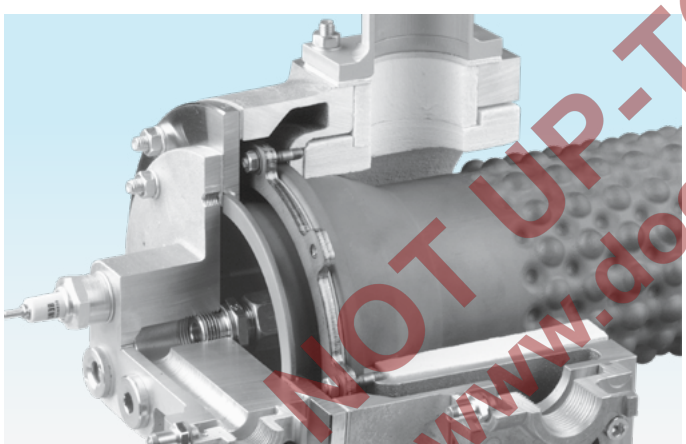
EAC

The product ECOMAX meets the technical specifications of the Eurasian Customs Union.

3 Structure

The burner ECOMAX is composed of four modules: burner body, recuperator, air guide tube and gas insert. The modular design facilitates adapting the burners to the respective application or integrating them into an existing furnace system. Maintenance and repair times are reduced, and existing furnace installations can easily be converted.

3.1 Burner body



The burner body is made of cast aluminium, which means it has a low weight. The housing has a double-wall design. The combustion air is fed into the burner via the outer annular void. This cools the burner body and reduces emissions. A shaped part made of vacuum-formed ceramic fibres (RCF) is fitted in the housing as internal insulation on the flue gas side.

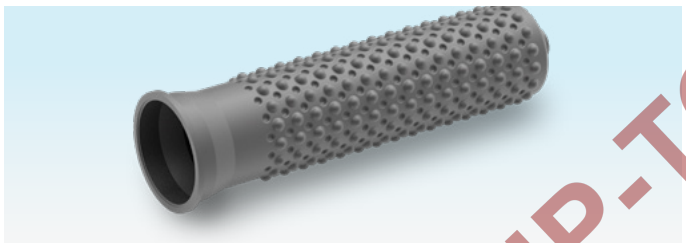
From construction stage B, the ECOMAX is equipped with two pressure taps on the air connection, which allow the differential pressure to be measured across the orifice so that the burner can be adjusted.

3.2 Recuperator

The burner ECOMAX is available in three versions:

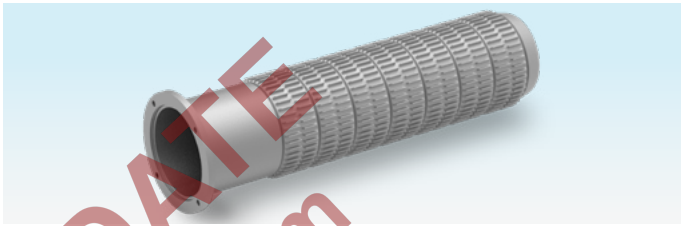
– ECOMAX..C with ceramic burled tube recuperator
– ECOMAX..M and ECOMAX..P with cast steel ribbed tube recuperator
– ECOMAX..F with metallic flat tube recuperator

Ceramic burled tube recuperator



The surface of the ceramic recuperator, which is made of SiSiC for high thermal stress, is burled in order to achieve high efficiency.

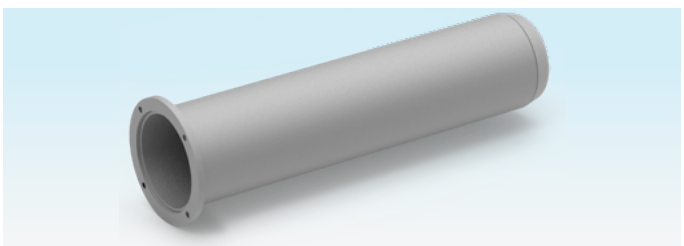
Cast steel ribbed tube recuperator



The ribs on the cast steel ribbed recuperator offer a large surface area, allowing it to achieve high efficiency even at low temperatures.

The burner version ECOMAX..P with a special recuperator head is available for use in P radiant tubes. The geometry is tailored to this application to improve gas recirculation and therefore the temperature uniformity of the radiant tube.

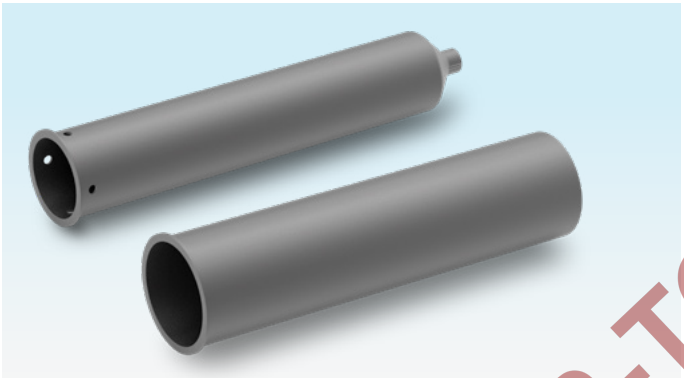
Flat tube recuperator



The flat tube recuperator has a smooth surface. It is a cost-effective alternative at a lower efficiency level.

3.3 Air guide tube

ECOMAX..C



Burners ECOMAX..C are equipped with a ceramic air guide tube that for sizes 0 to 3 also serves as the combustion chamber.

ECOMAX..M, ECOMAX..F and ECOMAX..P

Air guide tube for ECOMAX..M and ECOMAX..F

Burners ECOMAX..M and ECOMAX..F are equipped with an air guide tube made of heat-resistant steel.

3.4 Gas insert

The gas insert consists of the gas connection flange, the torch with burner head and the spark electrode (also serves as monitoring electrode). A measuring orifice, which is integrated in the gas insert, allows for simple measurement of the gas flow rate. The orifice is designed depending on the gas types (see 5.4.2).

To ensure accurate measurements of the pressure differential on the integrated orifice, flow to the orifice must not be disturbed. For this reason, burners ECOMAX are equipped as standard with a special pipe nipple to serve as inlet section on the gas connection.

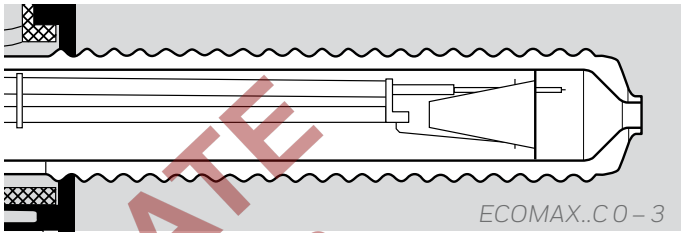
Gas insert without combustion chamber for ECOMAX..C (sizes 0 to 3)

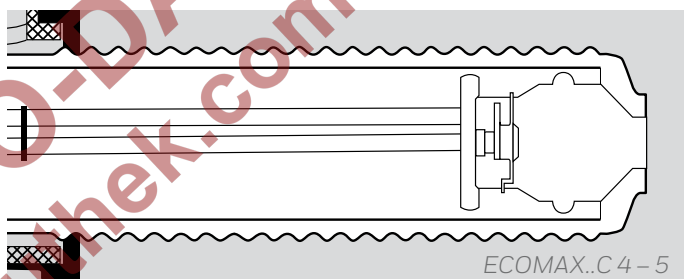
Gas insert with combustion chamber for ECOMAX..M (sizes 1 to 3)

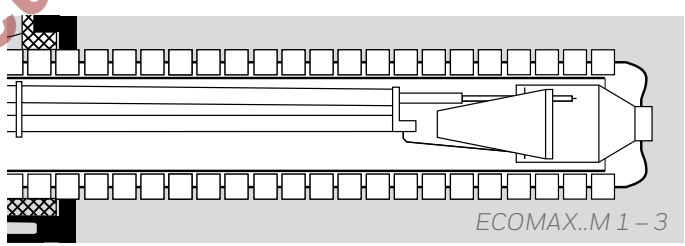
Gas insert with combustion chamber for ECOMAX (sizes 4 to 5)

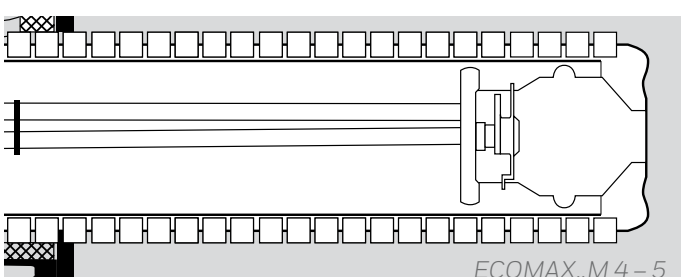
3.5 Version overview

Burner	Size	Gas insert	Air guide tube
ECOMAX..C	0 – 3	With mixing funnel	Ceramic, with integrated combustion chamber
	4 – 5	With swirl plate and ceramic combustion chamber	Ceramic
ECOMAX..M ECOMAX..P ECOMAX..F	1 – 3	With mixing funnel and ceramic combustion chamber	Metallic
	4 – 6	With swirl plate and ceramic combustion chamber	Metallic

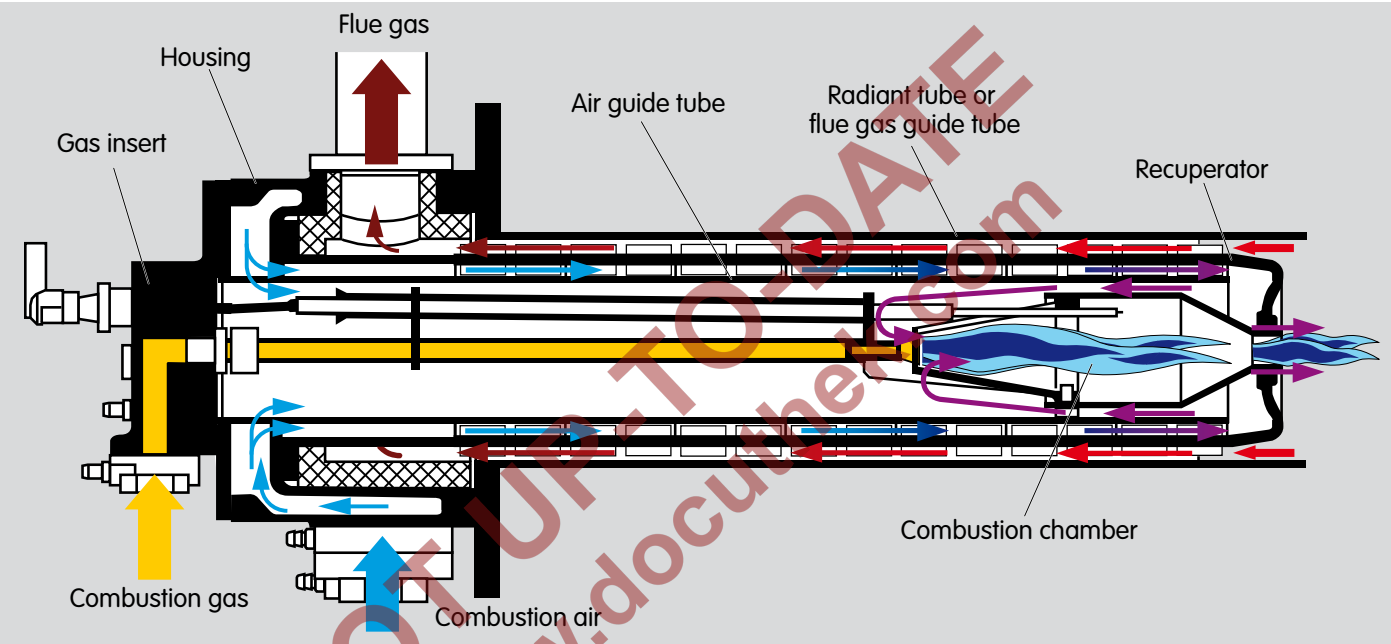

ECOMAX..C 0 – 3


ECOMAX..C 4 – 5


ECOMAX..M 1 – 3


ECOMAX..M 4 – 5

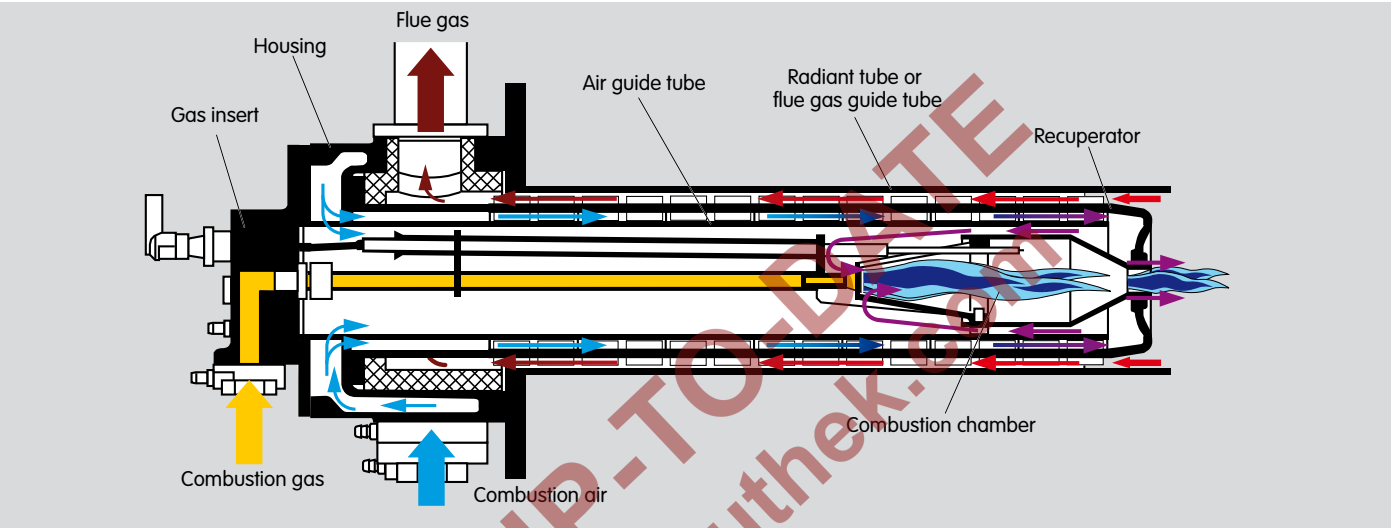
4 Function



The self-recuperative burner ECOMAX uses the heat from the flue gases to preheat the combustion air. The heat exchanger (recuperator) required for this is part of the burner.

After entering the gap between the air guide tube and the recuperator, the combustion air flows towards the tip of the burner (blue arrows). Some of this air is fed into the inside of the burner, where it is combusted in the first combustion stage.

The rest of the combustion air flows out through the gap between the combustion chamber and the recuperator head at high speed before combustion takes place in the second combustion stage here (violet arrows). This process means that fewer pollutant emissions are produced. The hot flue gases, flowing in the opposite direction, leave the furnace chamber on the outside of the recuperator (red arrows). Heat is exchanged between the hot flue gases and the cold combustion air through the recuperator wall.



Influence of the furnace temperature

The higher the furnace temperature, the greater the pressure loss in combustion air and flue gas in the recuperator.

When the furnace temperature is increased (at a constant air supply pressure), the air mass flow rate (= standard air flow rate) drops while the gas flow rate remains virtually unchanged. In a system with air/gas ratio control or without pneumatic air/gas ratio control, temperature-dependent pressure losses in the burner are not compensated for. The air index lambda drops with increasing furnace temperature.

In direct heating systems with flue gas eductor EJEK, the quantity of flue gas extracted from the furnace chamber via the burner decreases as the furnace temperature increases. If flue gas extraction at maximum furnace temperature is 80 – 90%, negative furnace pressure is generally avoided even if the furnace temperature is reduced by 400 – 500°C.

Ignition and flame control

The burner is directly ignited.

Ignition and flame control are provided by a combined spark electrode/flame rod (single-electrode operation). Flame control with UV sensor is required if a furnace temperature of 1150°C (2102°F) for direct heating or 1050°C (1922°F) for indirect heating is exceeded.

5 Selection

5.1 Burner type

Selection is dependent on the type of heating and the furnace temperature. Details on selection, see page 31 (Heating system design) for direct heating or page 48 (Heating system design) for indirect heating.

Burner	Max. flue gas temperature at recuperator inlet	
	[°C]	[°F]
ECOMAX..C	1250	2282
ECOMAX..M ECOMAX..P	1150	2102
ECOMAX..F	1050	1922

5.2 Burner size

Burner						
Size	Capacity[1]		Recuperator			
	kW[2]	10^3 BTU/h[3]	C	M	P	F
ECOMAX 0	25	95	●	–	–	–
ECOMAX 1	36	136	●	●	–	●
ECOMAX 2	60	227	●	●	●	●
ECOMAX 3	100	378	●	●	●	●
ECOMAX 4	180	681	●	●	●	●
ECOMAX 5	250	945	●	●	–	●
ECOMAX 6	500	1890	–	●	–	–

● = *available*

1) *For operation with natural gas. For operation with coke oven gas, the capacity is approx. 80%, for operation with LCV gas, approx. 65%.*

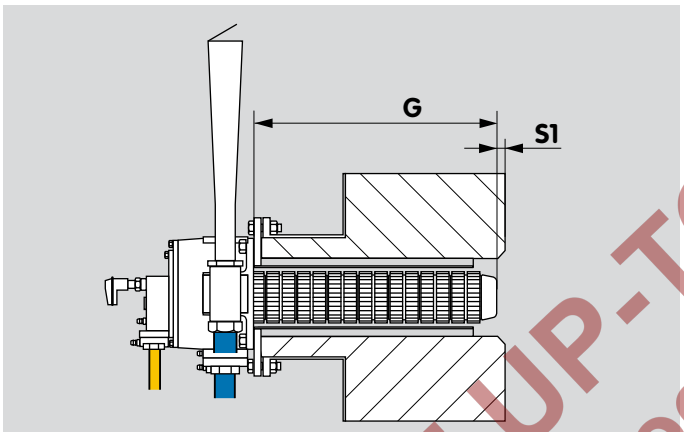
2) *Capacities in kW refer to the lower calorific value H_u.*

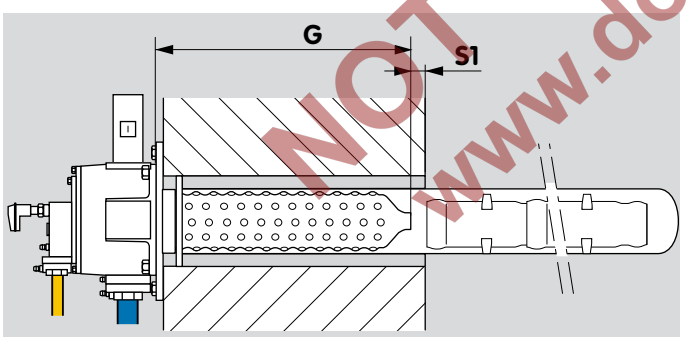
3) *Capacities in BTU/h refer to the upper calorific value H_o.*

When using the burner in geodetic ranges over 500 m above MSL, the possible capacity is reduced due to a decrease in the density of gas and air. Guide value: reduction of 5% per 1000 m above MSL, more details on request.

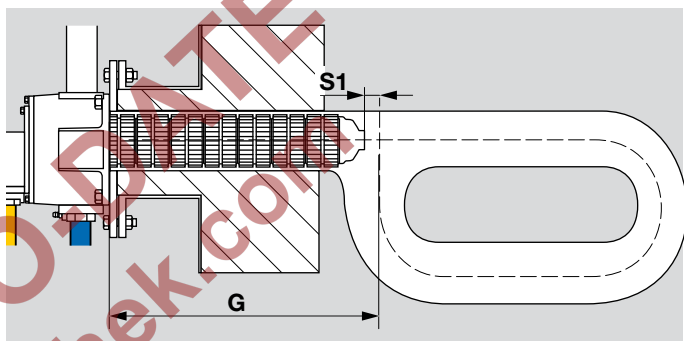
5.3 Burner length

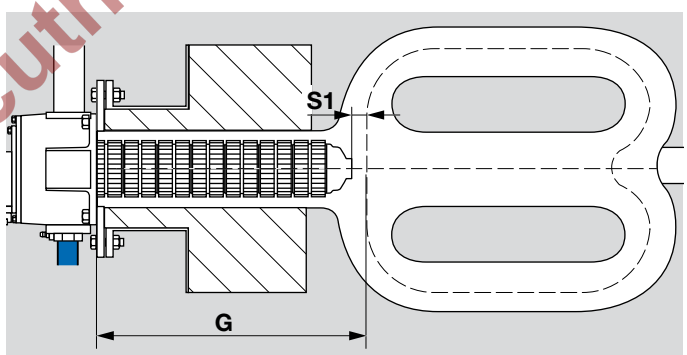
The recuperator length **G** should be selected so that the burner is flush with the inside edge of the furnace lining (**S1** = 0 ± 20 mm).





When using P radiant tubes, the recuperator head should be positioned on the centre line of the radiant tube (**S1** = 0 ± 20 mm).





5.4 Burner head

5.4.1 Use

The burner ECOMAX can be equipped with 2 different burner heads. Stage combustion is standard. For some burner variants, a menox version is also possible, which allows for switchover to menox® low NO_X mode with flameless combustion when the furnace temperature exceeds 850°C in a direct heating system.

Use	Burner head code letter
Standard flame mode	S
menox® low NO_X mode[1)]	M

1) *menox® low NO_X mode on request.*

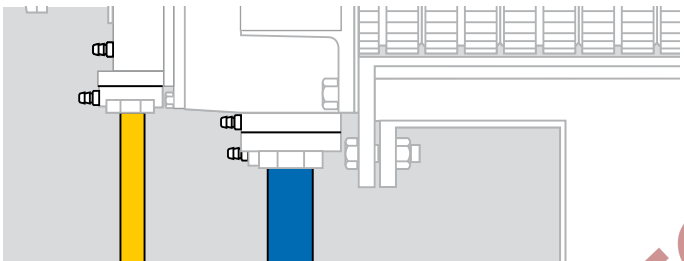
5.4.2 Gas type

Gas type	Code letter	Calorific value range		Density ρ	
		kWh/m³(n)[2)]	BTU/scf[3)]	kg/m³(n)	lb/scf
Natural gas L and H quality	B	8 – 12	810 – 1215	0.7 – 0.9	0.041 – 0.053
Propane, propane/butane, butane	G	25 – 35	2560 – 3474	2.0 – 2.7	0.118 – 0.159
Coke oven gas, town gas	D	4 – 5	421 – 503	0.4 – 0.6	0.024 – 0.035
Low calorific value gas	L	1.7[1)] – 3	161 – 290	0.9 – 1.15	0.053 – 0.068

1) *Calorific value range < 1.7 on request.*
2) *Calorific value ranges in kWh/m³ refer to the lower calorific value H_u.*
3) *Calorific value ranges in BTU/SCF refer to the upper calorific value H_o.*

5.5 Type of heating

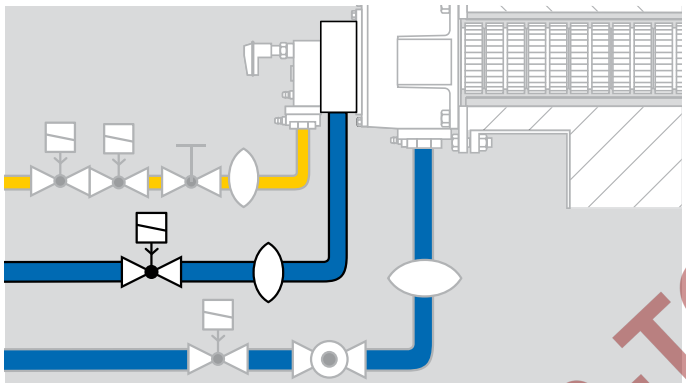
The ECOMAX is supplied with an integrated orifice on the gas and air connections.



The gas orifices depend on the gas type, the air orifices on the type of control and the system configuration.

Type of heating	Code letter	Explanation
Direct heating with eductor	/D-	Air orifice adapted to an air pressure of 65 mbar (= EJEK motive air pressure)
Indirect heating without an eductor	/R-	Air orifice adapted to an air pressure of 50 – 60 mbar

5.6 Connection for additional furnace cooling



The air volume supplied to the burner in cooling mode can be increased using an optional intermediate flange with an additional cooling air connection on the burner ECOMAX.

The air supplied via the additional air connection flows in the centre of the burner inside the air guide tube. The air volume is twice the standard combustion air volume.

5.7 Electrode made of Kanthal APM

Burners ECOMAX..M and ECOMAX..P can be equipped with a bend-resistant electrode made of Kanthal APM as an option. This is recommend for direct heating as of 1050°C and indirect heating as of 950°C, see page 38 (Flame control).

On ECOMAX..C, the Kanthal electrode is standard.

5.8 Selection table

5.8.1 ECOMAX..C

	395	475	545	556	593	613	617	636	641	681	689	-S	B	D	G	L[1)]	/D-	/R-	(1 – 99)	A – E	–	K	T
ECOMAX 0C	●	●		●				●				●	●	●	●		●	●	●	●	○	○	○
ECOMAX 1C			●		●				●		●	●	●	●	●		●	●	●	●	○	○	○
ECOMAX 2C			●			●				●		●	●	●	●	○	●	●	●	●	○	○	○
ECOMAX 3C			●				●				●	●	●	●	●	○	●	●	●	●	○	○	○
ECOMAX 4C			●									●	●	●	●	○	●	●	●	●	○	○	○
ECOMAX 5C			●									●	●	●	●	○	●	●	●	●	○	○	○

[1)] *On request.*
ECOMAX..C is supplied with Kanthal electrodes as standard.
● = *standard*, ○ = *available*

Order example
ECOMAX 1C545-SB/R-(31)B

5.8.2 ECOMAX..M

	545	595	645	695	-S	-M	B	D	G	L[1)]	/D-	/R-	(1 – 99)	A – E	–	K	A	T
ECOMAX 1M	●	●	●	●	●		●	●	●		●	●	●	●	○	○	○	○
ECOMAX 2M	●	●	●	●	●		●	●	●	○	●	●	●	●	○	○	○	○
ECOMAX 3M	●	●	●	●	●	○	●	●	●	○	●	●	●	●	○	○	○	○
ECOMAX 4M	●	●	●	●	●	○	●	●	●	○	●	●	●	●	○	○	○	○
ECOMAX 5M	●			●	●	○	●	●	●	○	●	●	●	●	○	○	○	○
ECOMAX 6M	●			○	●		●	●	●	○	●	●	●	●	○	○	○	○

[1)] *On request.*
● = *standard*, ○ = *available*

Order example
ECOMAX 3M545-SB/D-(34)B

5.8.3 ECOMAX..P

	645	695	-S	B	D	G	L[1)]	/R-	(1 – 99)	A – E	–	K	T
ECOMAX 2P	○	●	●	●	○	●	○	●	●	●	○	○	○
ECOMAX 3P	○	●	●	●	○	●	○	●	●	●	○	○	○
ECOMAX 4P	○	●	●	●	○	●	○	●	●	●	○	○	○

1) On request.
● = *standard*, ○ = *available*

Order example

ECOMAX 3P695-SB/R-(34)B

5.8.4 ECOMAX..F

	545	595	645	695	-S	B	D	G	L[1)]	/D-	/R-	(1 – 99)	A – E	–	K	T
ECOMAX 1F	●	○	○	○	●	●	○	●		●	●	●	●	○	○	○
ECOMAX 2F	●	○	○	○	●	●	○	●	○	●	●	●	●	○	○	○
ECOMAX 3F	●	○	○	○	●	●	○	●	○	●	●	●	●	○	○	○
ECOMAX 4F	●	○	○	○	●	●	○	●	○	●	●	●	●	○	○	○
ECOMAX 5F	●	○	○	○	●	●	○	●	○	●	●	●	●	○	○	○

1) On request.
● = *standard*, ○ = *available*

Order example

ECOMAX 3F545-SB/D-(34)B

5.8.5 Type code

Code	Description
ECOMAX	Self-recuperative burner for gas
0 – 6	Burner size
C M P F	Ceramic burled tube recuperator made of SiSiC Cast steel ribbed tube recuperator Cast steel ribbed tube recuperator for P radiant tube Flat tube recuperator, metallic
E	Special recuperator version
395 – 695	Recuperator length in mm
-S -M[1)]	Standard flame menox® low NO_X operation
B D G L[1)]	Gas type[2)]: natural gas coke oven gas LPG LCV gas
/D- /R- /V- /E- /nnn- /N-	For direct heating with eductor For radiant tube heating without eductor For radiant tube heating with VAH Burner with customized orifices Burner construction stage X for nnn kW Burner without orifices
(1 – 99)	Burner head identifier
X, A, B, ...	Construction stage
–	The following features differ from the standard version:
K	Additional cooling air connection for increased furnace cooling
A	Electrode made of Kanthal APM
T	NPT connections
S	SICAFLEX spacer
W	Air connection without intermediate flange
Z	Special version

[1)] *On request.*
[2)] *Other types of gas on request.*

5.9 Selection table for flue gas eductor EJEK

	Axis spacing	-Kxxx*	Height	-Tzzz*	-H	-V	-3**	-9**	-F..	-R..	-AGK	-HT***	-A	-B	-S
EJEK 0	- K269	○	- M625	○			○	○	○	○	●	●		●	●
EJEK 1	- K269	○	- M625	○	●	●	○	○	○	○	●	●			●
EJEK 2	- K285	○	- M540	○	●	●	○	○	○	○	●	●	●		●
EJEK 3	- K292	○	- M620	○			○	○	○	○	●	●	●		●
EJEK 4	- K345	○	- M920	○			○	○	○	○	●	●	●		●
EJEK 5	- K345	○	- M1165	○			○	○	○	○	●	●	●		●
EJEK 6	- K530	○	- M1618	○			○	○	○	○	●	●	●		●

* *Special dimensions on request.*

* *Only relevant for special dimension Tzzz.*

*** *HT version for ECOMAX..C.*

● = *standard*, ○ = *available*

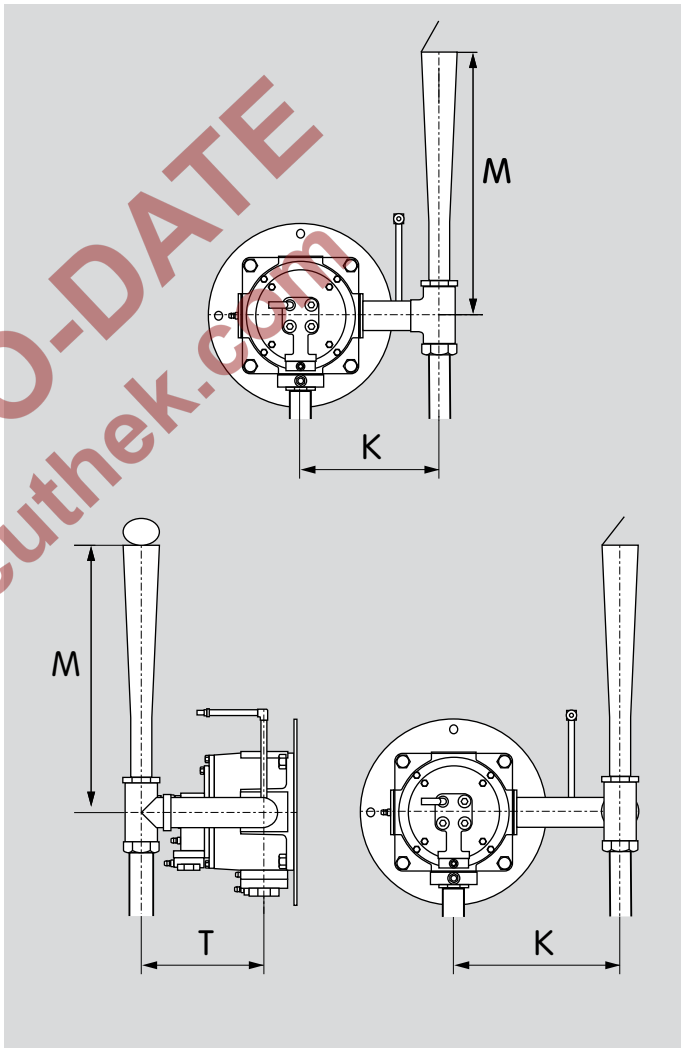
Order example

EJEK 4-K345-M920-AGK-HT-A-S

5.9.1 Type code

Code	Description
EJEK	Flue gas eductor
0 – 6	Size for ECOMAX 1 – 6
-Kxxx	Axis spacing K in mm
-Myyy	Height M in mm
-Tzzz*	Distance T in mm
-H -V	Burner installation position: horizontal vertical
-3 -9	Installation on the burner**: right-hand side left-hand side
-F5 to -F15 -R5 to -R15	Eductor angle in °: pointing towards furnace pointing away from furnace
-AGK	With flue gas valve
-HT***	High temperature version
-A -B	Construction stage
-S	Standard dimension

* *If "none", this letter is omitted.*
** *Only required for special dimension Tzzz.*
*** *HT version for ECOMAX..C.*



5.10 Selection table for flue gas connector FLUP

	-32	-50	-65	-100	D	F	-Kxxx	Installation height	-Myyy*	-Tzzz*	-H**	-V**	-0**	-3**	-9**	-C	-A	-HT	-B	-S
FLUP 0	●				●	○	○	-M230	○	○			○	○	○	●	○	○	●	●
FLUP 1 – 2		●			●	○	○	-M331	○	○	○	○	○	○	○	●	○	○		●
FLUP 3			●		●	○	○	-M353	○	○			○	○	○	●	○	○		●
FLUP 4 – 5				●	●	○	○	-M399	○	○			○	○	○	●	○	○		●

* *Special dimensions on request.*

** *Only relevant for special dimensions Kxxx and/or Tzzz.*

● = *standard*, ○ = *available*

Order example

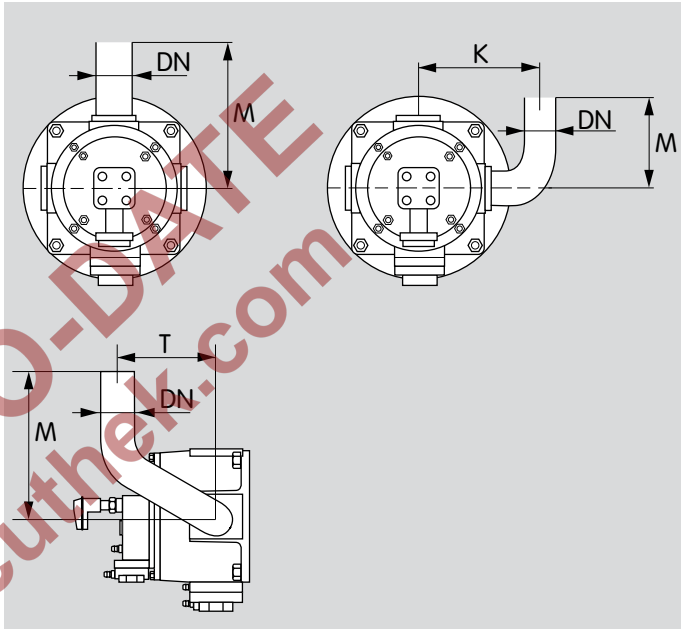
FLUP 3-65D-M353-0-S

5.10.1 Type code

Code	Description
FLUP	Flue gas connector
0 1/2 3 4/5	For ECOMAX 0 – 5
-32 to -100	Nominal size
D F	Pipe connector Flange to ISO 7005
-Kxxx	Axis spacing K in mm
-Myyy	Installation height M in mm
-Tzzz*	Distance T in mm
-H -V	Burner installation position: horizontal vertical
-0 -3 -9	Installation on the burner**: top right-hand side left-hand side
-C -A	Measuring port with sealing clip Threaded pressure tap with cap
-HT	High temperature version
-A -B	Construction stage
-S	Standard dimension

* *If "none", this letter is omitted.*

** *Only required for special dimension Tzzz.*



6 Project planning information for direct heating

6.1 Heating system design

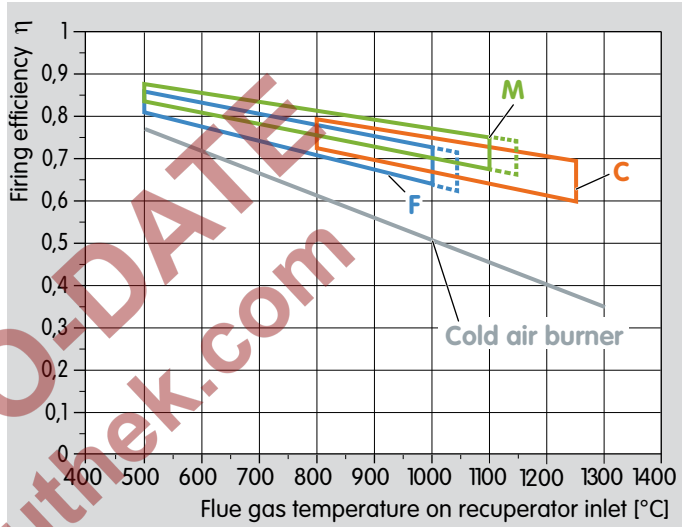
Selection of the burner type is dependent on the furnace temperature.

Burner	Recommended range of use		Max. flue gas temperature at recuperator inlet	
	[°C]	[°F]	[°C]	[°F]
ECOMAX..C	up to 1250	up to 2282	1250	2282
ECOMAX..M	up to 1100	up to 2012	1150	2102
ECOMAX..F	up to 1000	up to 1832	1050	1922

Burners ECOMAX..M (sizes 1 to 5) and ECOMAX..F can be used for furnace temperatures up to the max. application temperature if it is ensured that the burner head cannot overheat, e.g. due to burners positioned opposite the ECOMAX or non representative temperature measurements, see also page 37 (Furnace temperature measurement).

Selection of the burner size is dependent on the net heat output. From this, the required burner capacity is calculated using the firing efficiency value.

$$\frac{\text{Net heat output [kW]}}{\text{Firing efficiency } \eta} = \text{Burner capacity [kW]}$$

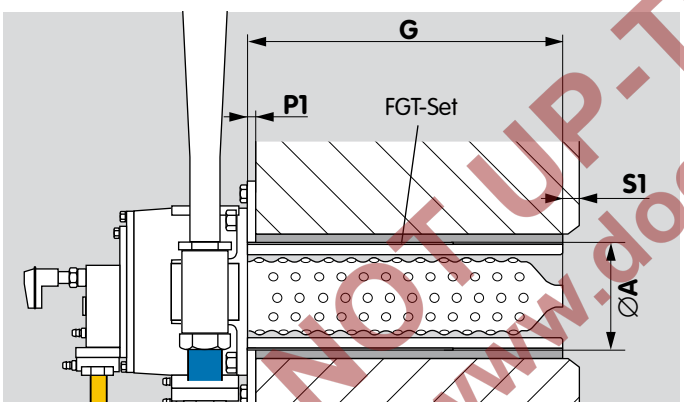


Details on heating system design on request.

6.2 Flue gas guide tube FGT set

The furnace flue gases are routed by the flue gas guide tube through the furnace lining via the recuperator. The FGT set must be ordered separately and is not included in the burner delivery, see page 64 (Flue gas guide tube FGT Set..D).

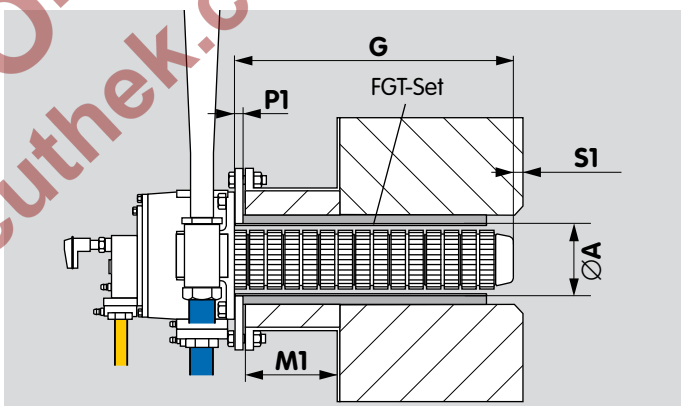
The flange thickness **P1** of the flue gas guide tube is 15 mm. Plan the length of the furnace extension **M1** so that the front edge of the recuperator is flush with the inside edge of the furnace lining (**S1** = 0 ± 20 mm).



Burner	FGT OD A in mm
ECOMAX 0C	142
ECOMAX 1C	180
ECOMAX 2C	200
ECOMAX 3C	236
ECOMAX 4C	300
ECOMAX 5C	336

Force must not be applied to the flue gas guide tube by the furnace lining.

When installing the FGT, the tube must be wrapped in a ceramic fibre blanket so as to ensure that no hot furnace atmosphere may reach the furnace wall or furnace extension. The installation opening in the furnace wall must thus be larger than the FGT outside diameter **A**, leaving an annular gap corresponding to the size of the fibre blanket, e.g. 25 mm.



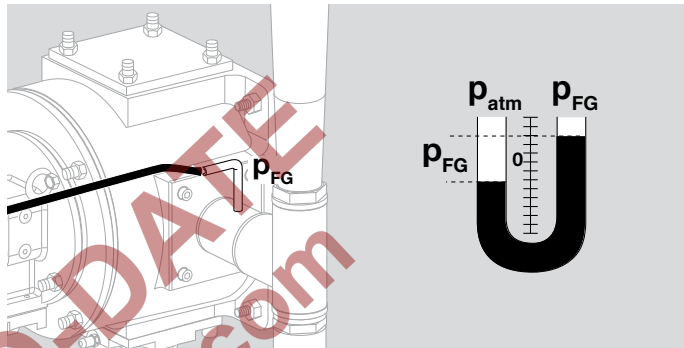
Burner	FGT OD A in mm
ECOMAX 1M/ECOMAX 1F	133
ECOMAX 2M/ECOMAX 2F	156
ECOMAX 3M/ECOMAX 3F	193
ECOMAX 4M/ECOMAX 4F	254
ECOMAX 5M/ECOMAX 5F	287
ECOMAX 6M/ECOMAX 6F	390

6.3 Flue gas eductor EJEK

Flue gas eductor EJEK is available in 2 versions. The standard version EJEK is used in conjunction with ECOMAX..M and ECOMAX..F. The high temperature version EJEK..-HT is intended for use in conjunction with ECOMAX..C.

The eductors serve to extract the flue gas via the burner ECOMAX and cannot be used for furnace pressure control. We recommend discharging 10 to 20% of the flue gases via an additional flue gas opening on the furnace fitted with a furnace pressure control system.

With 80 to 90% flue gas extraction at max. furnace temperature, a positive furnace pressure can generally be maintained even at low furnace temperatures. In the case of heavily leaking furnaces, flue gas extraction must be reduced, where necessary, to avoid pulling in cold air due to negative pressure in the furnace chamber.



The motive air is set at the eductor by measuring the negative flue gas pressure p_{FG} between the burner and eductor.

If the furnace temperature is too high, damage can occur to burners which are switched off due to the flow of hot flue gases over them.

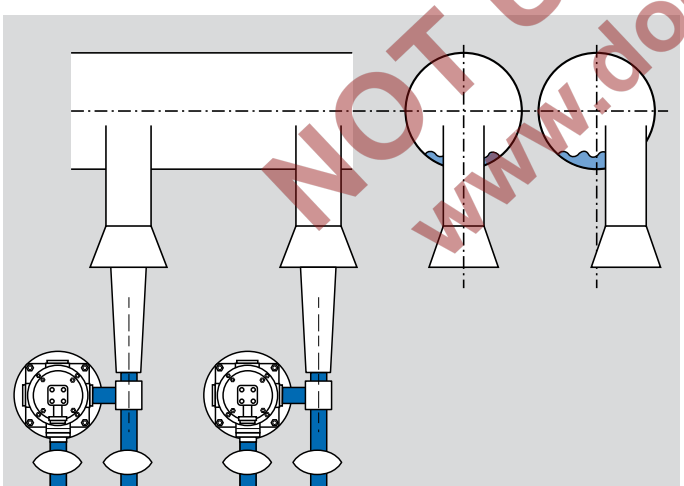
For direct heating, eductors EJEK..AGK with mechanical flue gas valve (AGK) are recommended so as to avoid gas creepage while the burner is switched off.

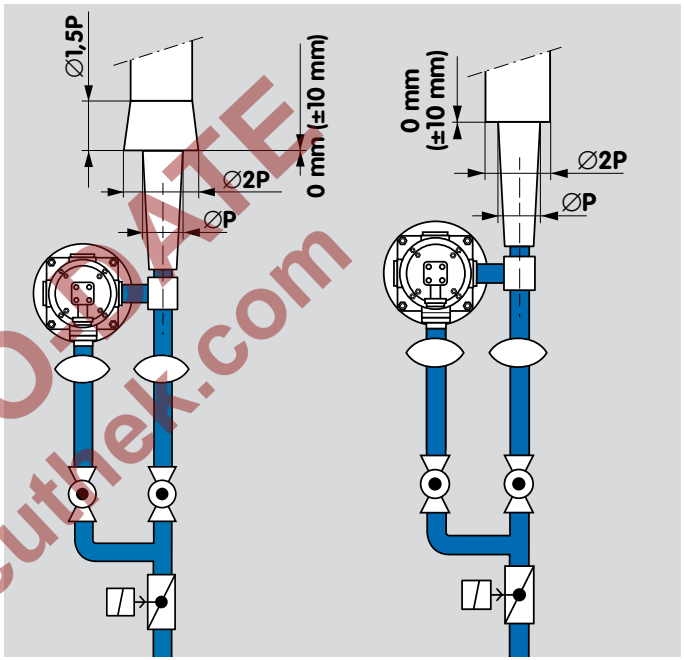
6.4 Furnace flue gas system

A flue gas system must be fitted on the furnace as a means of guiding the flue gas to the chimney. In the flue gas system there should be a low negative pressure thanks to the draught of the chimney or an exhaust fan.

The flue gas system on the furnace should be fitted flush with the eductor (± 10 mm). The diameter of the flue gas pipe on the furnace should be twice the eductor diameter **P**. If the diameter is too small, even with the EJEK..AGK with flue gas valve there is the danger of hot flue gases creeping through the burner when it is switched off.

The branch lines from the furnace flue gas manifold to the individual burners should be designed such that condensate cannot seep upstream into the burner.

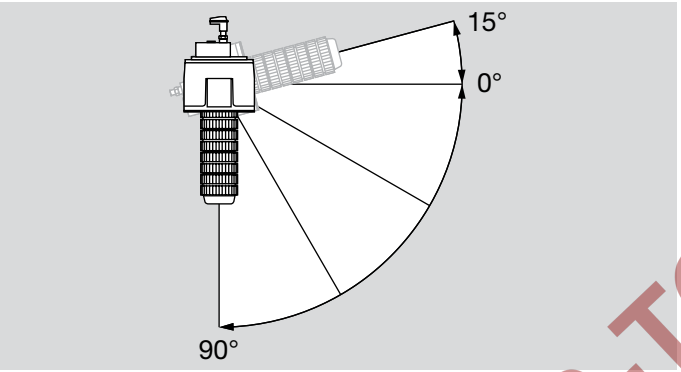




		∅ P [mm]
ECOMAX 0	EJEK 0(B)	43
ECOMAX 1	EJEK 1	43
ECOMAX 2	EJEK 2(A)	83
ECOMAX 3	EJEK 3(A)	98
ECOMAX 4	EJEK 4(A)	128
ECOMAX 5	EJEK 5(A)	153
ECOMAX 6	EJEK 6(A)	215

6.5 Installation

6.5.1 Installation position



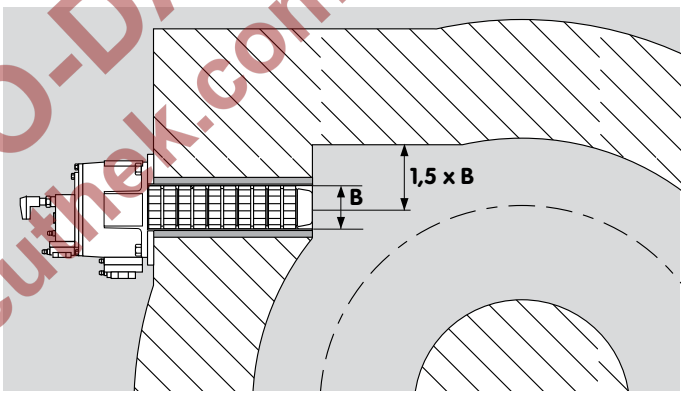
The burner ECOMAX can be installed in any position between 0° (horizontal) and 90° (vertical from top to bottom). The ECOMAX may be oriented upwards at an angle of max. 15° from the horizontal.

Eductor EJEK installation position:
vertical, max. angle 10°.

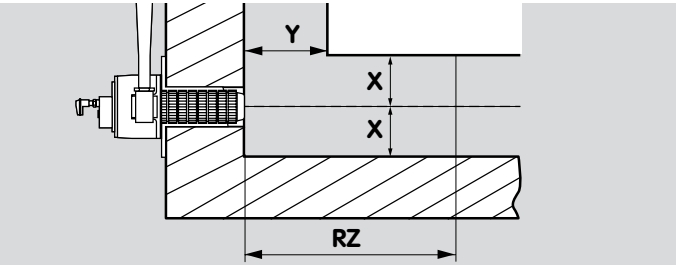
If the burner is installed at an angle of more than 10° from the vertical or horizontal, a special version of flue gas eductor EJEK is required. This is available on request.

6.5.2 Tangential or angled burner installation

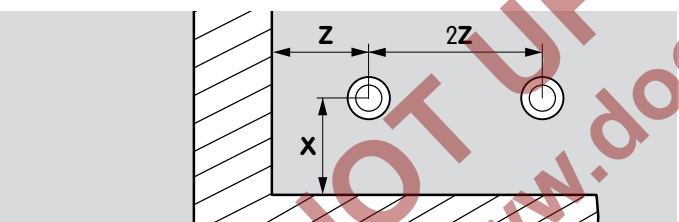
If the burner is installed tangentially or at an angle, an opening should be provided in the furnace lining to ensure unobstructed flue gas extraction. The choice of furnace lining in this area should take account of the burner's very high outlet velocity. In addition, reflection from the furnace wall to the burner must be considered.



6.5.3 Clearances



Allow for adequate clearance from the charge and the interior furnace wall so as to ensure complete combustion and avoid local overheating. Due to the high air preheat temperature of the ECOMAX, the flame temperature is also higher than usual.



The minimum lateral clearance between two burners or between a burner and the furnace side wall is determined by the geometric dimensions of the burners including the eductor.

In addition, it must be noted that burners facing each other can cause overheating of the recuperator heads.

Flame mode

Burner	Reaction zone RZ (mm)	Clearance (mm)	
		X	Z
ECOMAX 0	500	130	270
ECOMAX 1	700	155	270
ECOMAX 2	900	200	285
ECOMAX 3	1200	250	300
ECOMAX 4	1600	340	350
ECOMAX 5	1800	400	400
ECOMAX 6	2200	570	570

For menox® low NO_X mode, a sufficiently large reaction zone (RZ) and undisturbed recirculation of the flue gas into the reaction zone are required. Operation in very small combustion chambers leads to an increase in NO_X emissions.

menox® low NO_X mode

Burner	Reaction zone RZ (mm)	Clearance (mm)		
		X	Y	Z
ECOMAX 3M	2100	300	320	300
ECOMAX 4M	2800	360	400	360
ECOMAX 5M	3300	400	480	400

6.5.4 Furnace temperature measurement

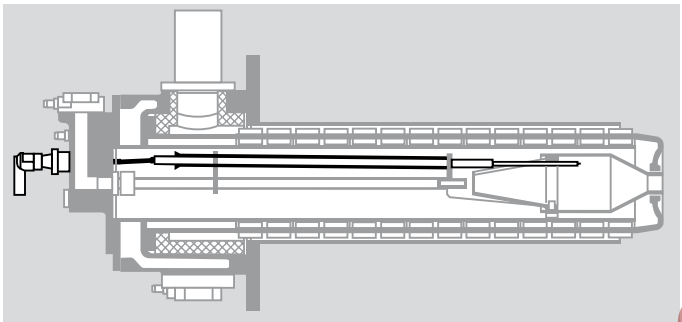
Measurement of the furnace temperature must be representative for the flue gas temperature in the extraction zone on the burner. If measurement is not representative, this will involve a risk of overheating of the recuperator head.

6.5.5 Heat guard

During operation, the burner body and eductor or flue gas connector can reach surface temperatures of over 80°C. Do not insulate the burner, eductor and flue gas connector to prevent material overheating.

We recommend that warning signs and a contact guard be fitted, for example made of perforated sheet metal.

6.6 Flame control



Burners ECOMAX are equipped with a combined spark electrode/flame rod. For direct heating, ionization control is possible up to a temperature of 1150°C (single-electrode operation). In this respect, it must be noted that the burner control unit BCU must feature at least firmware version FW 16xx, see page 39 (Burner control units and ignition transformers).

Flame control with UV sensor is only necessary if furnace temperatures of 1050°C for direct heating or 1150 °C for indirect heating are exceeded.

We also recommend using bend-resistant Kanthal electrodes for ignition on ECOMAX..M as of a furnace temperature of more than 1050°C. These are fitted as standard on ECOMAX..C.

We recommend the UV sensor UVS 10D1 with integrated purge air connection (Order No. 84315202) for UV control.

For ECOMAX 0, the UV sensor UVS 10L1 (Order No. 84315203) with lens is required for UV control. For burners ECOMAX 1 – 6 with a burner length of more than 545 mm, the UV sensor UVD 10L1 with lens is also required for UV control.

An adapter set is required for connection to the UVS 10, see page 63 (UV adapter set).

6.7 Burner control units and ignition transformers

ECOMAX burners with burner control unit BCU

ECOMAX burners are designed for On/Off control.

We recommend burner control unit BCU 460..L or BCU 465..L. In order to be able to carry out ionization control up to 1150°C, the burner control unit must be equipped with firmware FW 16xx or higher.

For burners ECOMAX..K with additional cooling air connection, we recommend using burner control unit BCU..C with additional circuit board for signal distribution.

For ignition, the ECOMAX burners require an ignition transformer with 7.5 kV high voltage and an output current of 20 mA. An appropriate ignition transformer is already integrated in burner control units BCU 460..8 and BCU 465..8.

For further information on burner control units and ignition transformers, see www.docuthek.com, Technical Information BCU 460, 465.

6.7.1 Burner control unit configurations

Description	Configuration D1	Configuration D2	Configuration D3	Configuration D4
Flame control	Ionization	UVS 10	Ionization	UVS 10
Pneumatic air/gas ratio control	VAH/VAG	VAH/VAG	None/VAH/VAG	None/VAH/VAG
Air flow monitoring	–	–	Differential pressure switch PDZ	Differential pressure switch PDZ

Hardware	BCU 460..L	BCU 460..L	BCU 465	BCU 465
Ignition transformer	8 = TZI 7,5-20/33	8 = TZI 7,5-20/33	8 = TZI 7,5-20/33	8 = TZI 7,5-20/33
Rewiring for electrode operation	1 electrode	2 electrodes	1 electrode	2 electrodes

Description	Parameter	Configuration D1	Configuration D2	Configuration D3	Configuration D4
Switch-off threshold of the flame amplifier	04	4 µA	4 µA	4 µA	4 µA
Air flow monitoring during purging	06	N/A	N/A	1	1
Air flow monitoring during operation	07	N/A	N/A	1	1
Delayed air flow monitoring	08	N/A	N/A	1	1
Safety time during operation t_{SB} for V1 and V2	14	1	1	1	1
Minimum burner on time t_B	20	8	8	8	8
Minimum burner pause time t_{BP}	21	4	4	4	4
Safety time on start-up t_{SA}	22	3	3	3	3
Air valve control	30	1	1	1	1
Air valve can be activated externally on start-up	31	1	1	1	1
Low fire over-run time t_{KN} after a controlled shut-down	36	N/A	N/A	0	0
Pre-ventilation time t_{VL} before start-up	37	N/A	N/A	0	0
Post-ventilation time t_{NL} after a controlled shut-down	38	N/A	N/A	0	0
Pre-ventilation time after safety shut-down	39	N/A	N/A	0	0
Pre-ventilation for restart/start-up attempts	40	N/A	N/A	0	0
Pre-ventilation after reset	41	N/A	N/A	0	0

BCU for direct heating	Configuration D1	Configuration D2	Configuration D3	Configuration D4
230 V	88613276	88614259	88614263	88614267
230 V, Profibus	88611901	88613865	88614264	88614268
230 V, HT operation	88614257	88614260	88614265	88614269
230 V, HT operation, Profibus	88611887	88611883	88614266	88614270

6.8 Gas connection

6.8.1 Selecting components

To ensure a safe burner start, use a pneumatic air/gas ratio controller together with a slow opening air valve. If there is no pneumatic air/gas ratio control system, use a slow opening gas valve and a quick opening air valve.

The following gas valves are recommended for natural gas:

Burner	Flow rate control	Air/gas ratio control	No pneumatic air/ gas ratio control system
ECOMAX 0	VAS 115..N + VAH 115..B + VMV 115	VAS 115..N + VAG 115..B + VMV 115	VG 15..N + VG 15..L + VMV 115
ECOMAX 1	VAS 115..N + VAH 115..B + VMV 115	VAS 115..N + VAG 115..B + VMV 115	VG 15..N + VG 15..L + VMV 115
ECOMAX 2	VAS 115..N + VAH 115..B + VMV 115	VAS 115..N + VAG 115..B + VMV 115	VG 15..N + VG 15..L + VMV 115
ECOMAX 3	VAS 115..N + VAH 115..B + VMV 115	VAS 115..N + VAG 115..B + VMV 115	VG 15..N + VG 15..L + VMV 115
ECOMAX 4	VAS 120..N + VAH 120..A + VMV 120	VAS 120..N + VAG 120..B + VMV 120	VAS 120..N + VAS 120..L + VMV 120
ECOMAX 5	VAS 125..N + VAH 125..A + VMV 125	VAS 125..N + VAG 125..B + VMV 125	VAS 125..N + VAS 125..L + VMV 125
ECOMAX 6*	VAS 240..N + VAH 240..A + VMV 240	VAS 240..N + VAG 240 + VMV 240	VAS 240..N + VAS 240..L + VMV 240

* *As of 360 kW, ignition with a start rate of < 33% is required (pursuant to EN 746-2 and ISO 13577-2); a pneumatic ratio control system and a BVH with IC 40 must be used for this.*

A bellows unit EKO should be provided between the burner and controls to prevent external force being applied to the burner.

A connection set with 6 x 1 compression fittings is available to connect the VAH control line, see page 63 (VAH connection set). The set is installed on the burner before delivery.

6.8.2 Gas pressure

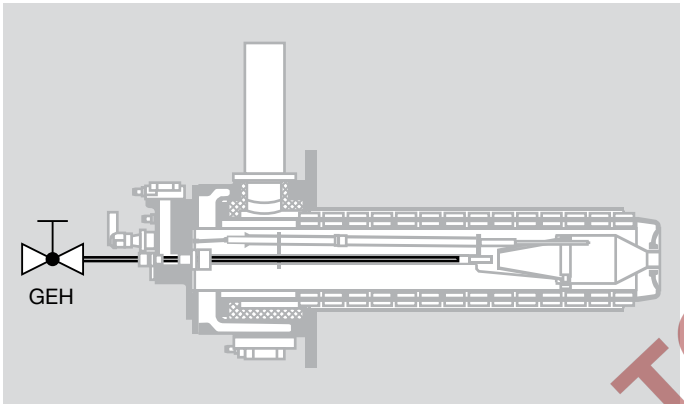
The required gas pressure depends on the burner size, the gas type and the system configuration.

		Gas supply line pressure*	
	Gas pressure upstream of burner	Natural gas H	Natural gas L, LPG
Flow rate control	50 – 65 mbar	100 mbar	120 mbar
Air/gas ratio control**	50 – 65 mbar	100 mbar	120 mbar
No pneumatic air/ gas ratio control system	50 – 65 mbar	80 mbar	100 mbar

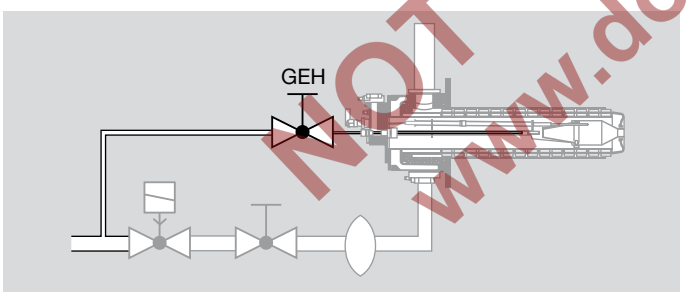
* *If a stainless steel flexible tube ES is used instead of the stainless steel bellows unit EKO, the higher pressure loss must be taken into account.*

** *Gas pressure in the supply line min. 10 – 20 mbar greater than the air pressure in the supply line.*

6.8.3 Operation with LPG



For operation with LPG, it is essential to cool the gas lance via a central air lance in order to prevent the LPG from cracking in the gas lance and soot formation during combustion.



The central air volume is approx. 3 to 5% of the combustion air volume and must also flow while the burner is switched off.

Open the adjuster in the central air lance fully. On the ECOMAX 1, the adjuster must be restricted to 45° or 50%.

If high temperature operation without flame control using ionization or a UV sensor is intended for LPG, air flow monitoring using an ECO air flow detector set must be provided to prevent backflow of the central air into the gas line or of gas into the air line in the event of the flue gas route being blocked.

6.9 Air connection

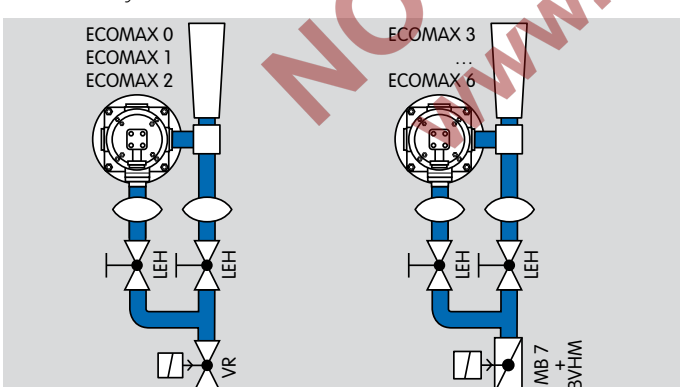
6.9.1 Selecting components

In the case of a pneumatic air/gas ratio control system, slow opening air valves or butterfly valves with solenoid actuator are required. If the system does not include a pneumatic air/gas ratio control system, quick opening air valves or butterfly valves with solenoid actuator are to be used.

The following air control valves are recommended for air:

Burner	Flow rate control or air/gas ratio control	No pneumatic air/gas ratio control system
ECOMAX 0	VR 40..L	VR 40..N
ECOMAX 1	VR 50..L	VR 50..N
ECOMAX 2	VR 65..L	VR 65..N
ECOMAX 3	BVHM 65 + MB 7..L	BVHM 65 + MB 7..N
ECOMAX 4	BVHM 80 + MB 7..L	BVHM 80 + MB 7..N
ECOMAX 5	BVHM 80 + MB 7..L	BVHM 80 + MB 7..N
ECOMAX 6*	BVHM 100 + MB 7..L	BVHM 100 + MB 7..N

* *As of 360 kW, ignition with a start rate of < 33% is required (pursuant to EN 746-2 and ISO 13577-2): a pneumatic ratio control system and a BVH with IC 40 must be used for this.*



6.9.2 Air pressure

The motive air setting for eductor EJEK is critical when designing the air supply. The required pressure depends on the burner capacity, the flue gas extraction via the burner and the furnace temperature:

	Motive air pressure upstream of eductor*	Air supply line pressure*
ECOMAX 0 and 1 at a furnace temperature of 1000°C	approx. 100 mbar	approx. 115 mbar
ECOMAX 2C – 5C with EJEK ..-HT-A (construction stage A) at a furnace temperature of 1250°C	approx. 65 mbar	approx. 80 mbar
ECOMAX 2M – 6M with EJEK ..-A (construction stage A) at a furnace temperature of 1100°C	approx. 65 mbar	approx. 80 mbar

* *The air pressures apply for burner ratings at the specified furnace temperatures and 80% flue gas extraction.*

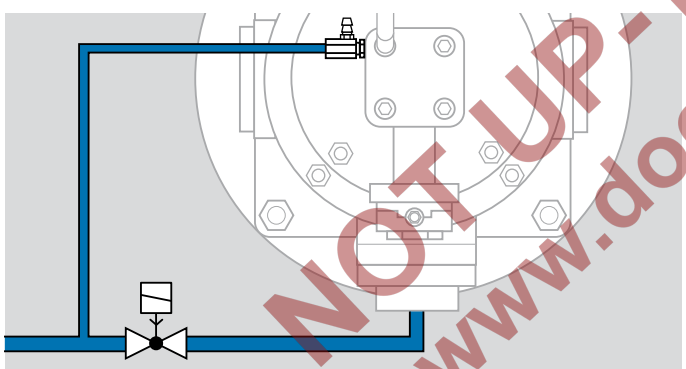
Flow rate curves are available in the Docuthek for EJEK construction stage A to allow precise dimensioning.

To ensure accurate measurements of the pressure differential on the integrated orifice, flow to the orifice must not be disturbed. We recommend using the connection set for air, which guarantees correct measurement at the measuring orifice, see page 62 (Air connection set). The attachment of a coupling, a bellows unit or a pipe bend directly upstream of the orifice can cause turbulence in the gas flow resulting in the burner being incorrectly adjusted.

6.10 Air flow monitoring

A system which includes air flow monitoring is recommended to monitor pre-purge and as low air pressure protection (pursuant to EN 746-2 and ISO 13577-2) if there is no pneumatic air/gas ratio control system. This is implemented using a differential pressure switch at the air connection together with a burner control unit BCU 465. An air flow monitoring set is available for this purpose as an accessory, see page 62 (Air flow detector set).

6.11 Purge air and cooling air



Purge air must be connected to the burner ECOMAX in order to ensure safe ignition and monitoring. Otherwise, wet flue gas will enter the burner in the case of direct heating, due to the furnace pressure.

The required purge air volume is approx. 0.5 to 1.0% of the air volume for rated capacity, or a minimum of 1 $m^3_{(n)}/h$.

The purge air is connected to the gas connection flange next to the electrode, or in the case of UV control to the purge air connection of the UV sensor. The purge air is tapped upstream of the air control valve so that the purge air continues to flow even if the burner is switched off.

In order to limit the volume of purge air, special nozzles can be used which are adjusted to the required air supply pressure for the ECOMAX – see page 63 (Purge air/cooling air nozzles).

Burner	Nozzle for electrode purge	Purge air nozzle on UV sensor
ECOMAX 0	Nozzle electrode ECO 0 Rp 1/4 D = 2.5 /E	Nozzle UV ECO 0-3 Rp 1/4 D = 2.5 /B
ECOMAX 1 – 3	Nozzle electrode ECO 1-3 Rp 1/4 D = 2.5 /E	Nozzle UV ECO 0-3 Rp 1/4 D = 2.5 /B
ECOMAX 4 – 6	Nozzle electrode ECO 4-6 Rp 1/4 D = 4.0 /E	Nozzle UV ECO 4-6 Rp 1/4 D = 4.0 /B

At very high furnace temperatures, we recommend cooling the burner head by selecting a larger nozzle or a supply line with a diameter of 8 mm without a nozzle.

6.12 Condition on delivery

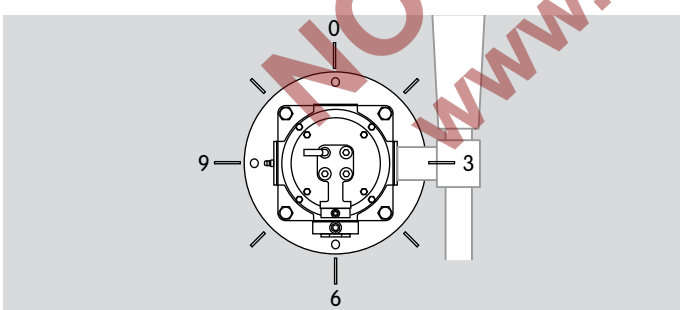
The position of the gas, air and flue gas connections can be customized depending on how the burner is to be installed on the furnace. The connection positions are coded using the numbers 0, 3, 6 and 9.

Code	Connection position
0	Top
3	Right-hand side
6	Bottom
9	Left-hand side

The codes relating to the positions of the connections are specified in the following order: flue gas – air – gas.

Provided that there are no specifications, the burners are supplied as follows:

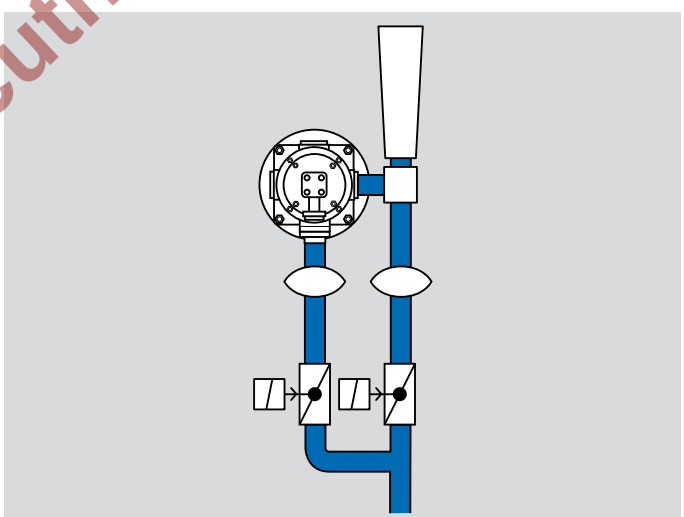
ECOMAX../D for direct heating with connector position 366, i.e. flue gas connection for eductor installation on the right-hand side and gas and air connections at the bottom.



The FGT Set..D for direct heating is installed on the burner at the factory, provided that it is ordered at the same time as the burner. This also applies to all add-on components with the marking /E, such as the air flow detector set, UV adapter set, purge air nozzle, inlet section for gas and air, see page 62 (Accessories).

6.13 Cooling with ECOMAX

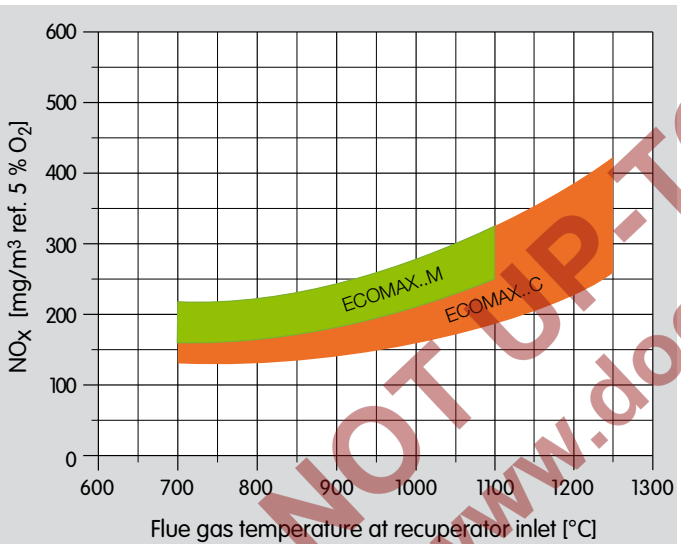
Extraction of the flue gases via the burner and thus the preheating of the combustion air can be switched off to ensure controlled cooling of the furnace. Install separate valves for combustion air and motive air instead of an air valve for this. In this case, a separate flue gas route must be opened on the furnace, via which the cooling air can be discharged from the furnace.



6.14 Emissions

CO and NO_X values depend on the furnace temperature, air preheat temperature, burner type and burner settings (NO_X values on request).

If operated with LPG, NO_X values are approx. 25% higher.



NO_X values in the diagram apply to natural gas.

6.15 Build up of noise

The sound level of a naked flame may be significantly more than 90 dB(A) due to the high flame velocity. In the case of fitted burners, the sound level of the single burner which can be measured outside the furnace is usually between 75 and 82 dB(A).

In a furnace system, the value which can be measured depends on the capacity, excess air volume, flue gas extraction and flue gas temperature of the single burners as well as the burner arrangement and ambient influences.

6.16 Process boundary conditions

In direct heating systems, the flue gases are routed out of the furnace chamber via the burner. Impurities from the process can affect burner operation. Deposits of dust or components from the material to be heated which turn to gas (e.g. molybdenum) can accumulate on the recuperator. This means that the volume of flue gas routed via the recuperator falls and thus the burner is less efficient. Furthermore, this can also lead to increased furnace pressure and damage to the furnace and burner. In this case, increased maintenance and shorter cleaning intervals are required.

Other impurities, such as alkalis formed during the heating of cast parts or from cooling and washing liquids, can cause chemical attacks on the material. This reduces the service life of the recuperator and the flue gas guide tube. We therefore advise against use in forging and heating furnaces, in which raw materials are heated. We also advise against use in aluminium smelting furnaces due to the dusty furnace atmosphere, the danger of liquid metal spillings and possible chemical attacks.

Avoid sub-stoichiometric burner operation. A reducing atmosphere can lead to damage to the burner insulation on the flue gas side, the metallic recuperator and flue gas guide tube, and the vacuum-formed parts of the flue gas guide tube for ECOMAX..C.

6.17 Resistance of SiSiC

The ceramic recuperator of the ECOMAX..C consists of reaction-bound silicon carbide (SiSiC), infiltrated with metallic silicon. During the manufacturing process, a protective layer made of SiO_2 is formed on the surface, which ensures good chemical resistance.

When installing the burners, it must be ensured that the protective layer on the ceramic surface is not damaged.

The burners should be adjusted so that an excess air value of 1 – 5% O_2 in the flue gas is maintained in order to preserve the protective layer. In the case of sub-stoichiometric burner operation (concentration of CO > 1000 ppm), white deposits can build up on the SiSiC over a long period of time. This reduces the service life of the ceramic material.

Impurities such as fluorine, chlorine and alkali compounds (e.g. with sodium or potassium) in the furnace atmosphere also lead to chemical attack and shorten the service life of the ceramic recuperator. We therefore advise against use in forging and heating furnaces, in which raw materials are heated. We also advise against use in aluminium smelting furnaces.

7 Project planning information for indirect heating

7.1 Heating system design

When designing a radiant tube heating system, it must be ensured that the energy can be transferred to the furnace chamber via the surface of the radiant tube to avoid exceeding the maximum permissible flue gas temperature at the recuperator inlet of the burner.

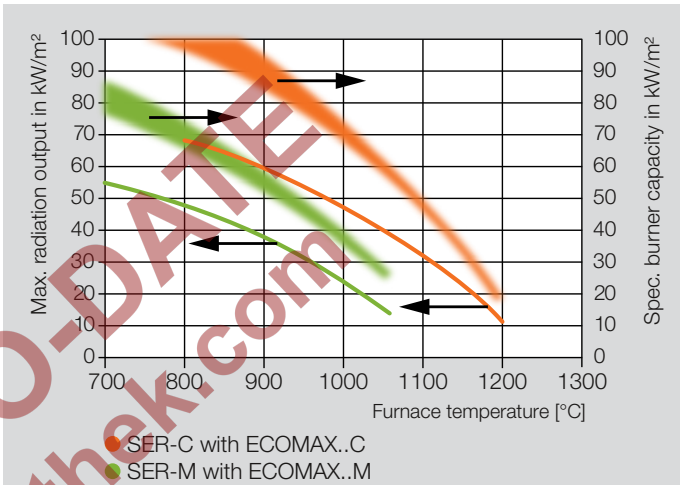
It must also be ensured that the permitted material temperature of the radiant tube and, in the case of single ended radiant tubes, of the flame tube used is not exceeded.

Burner	Max. flue gas temperature at recuperator inlet	
	[°C]	[°F]
ECOMAX..C	1250	2282
ECOMAX..M/ECOMAX..P	1150	2102
ECOMAX..F	1050	1922

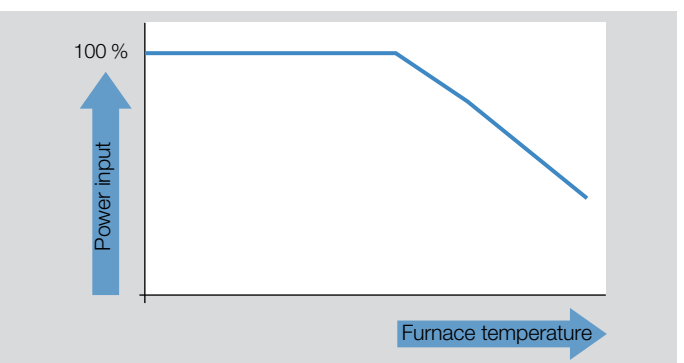
The possible radiation output in the furnace depends on the furnace temperature and the surface of the radiant tube as well as the material that the radiant tube and burner are made of.

The burner capacity also depends on how efficient the burner is.

The heat exchange must be determined to ensure safe design of a radiant tube heating system. To this end, please consult a member of the sales team.



Depending on the system configuration, it may be necessary to reduce the power input on the basis of the furnace temperature, e.g. by reducing the duty cycle. In this case, the combustion time should not exceed 2 minutes to avoid thermal overload of the radiant tube and burner.



7.2 Radiant tubes

For ECOMAX..C

Burners ECOMAX..C are intended for use with ceramic radiant tubes SER-C.

See Technical Information SER-C.

Standard combinations:

Radiant tube	Burner	Segmented flame tube
SER-C 100/088	ECOMAX 0C	SICAFLEX 100/088/084
SER-C 142/128	ECOMAX 1C	SICAFLEX 142/127/123
SER-C 162/148	ECOMAX 2C	SICAFLEX 162/147/143
SER-C 202/188	ECOMAX 3C	SICAFLEX 202/186/182

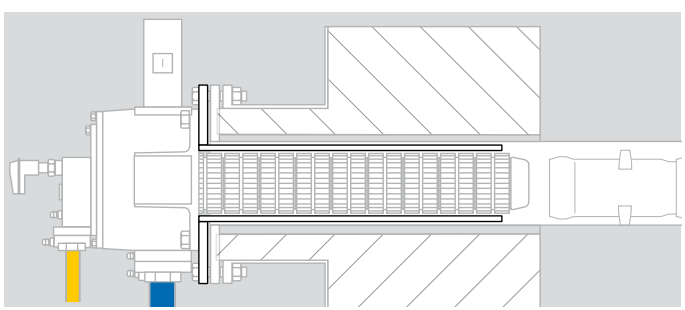
In special cases, a ceramic burner ECOMAX..C can be installed in a metallic radiant tube. Here, external forces on the ceramic burner due to the radiant tube being deformed must be excluded, however.

For ECOMAX..M

Metallic radiant tubes are available in a variety of dimensions in either centrifugal casting or in welded form. The efficiency of the burner ECOMAX..M is determined by the inside diameter $\mathbf{d_i}$ of the radiant tubes in the vicinity of the burner. The following dimensions are recommended:

Burner	Min. radiant tube inside diameter d_i [mm]	Radiant tube inside diameter d_i as of which a flue gas guide tube FGT set is recommended [mm]
ECOMAX 1M	128	140
ECOMAX 2M	147	164
ECOMAX 3M	185	202
ECOMAX 4M	248	266
ECOMAX 5M	280	298

If the inside diameter of the radiant tube is considerably larger than that of the burner, a flue gas guide tube FGT set should also be used.

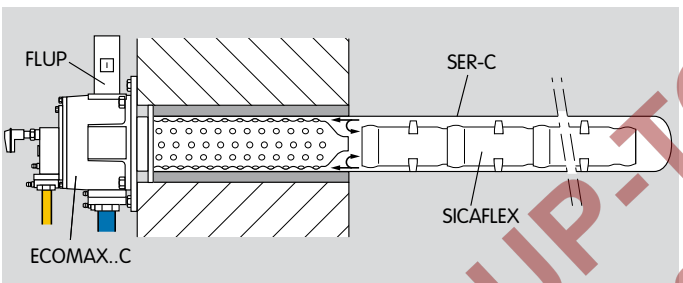


Depending on the geometry, additional adapter flanges may be required for radiant tubes.

7.3 Flue gas channelling

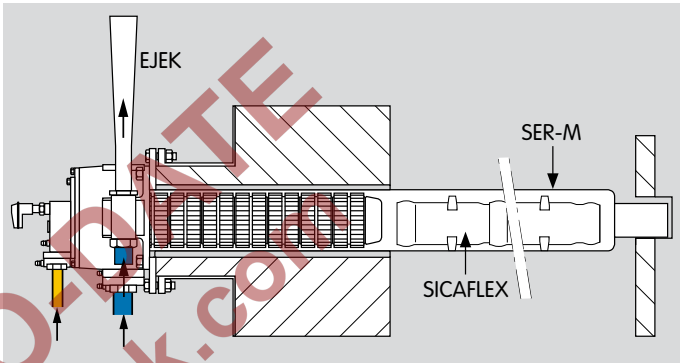
A flue gas connector FLUP, which is to be ordered separately, is available as standard to channel flue gas in an indirect heating system. In special cases, an eductor EJEK can also be installed to channel flue gas. This also must be ordered separately.

Flue gas connector FLUP



Flue gas connector FLUP serves to discharge the flue gases into the furnace flue gas system and features an opening which is closed by a clip to connect flue gas analysis equipment.

Eductor EJEK

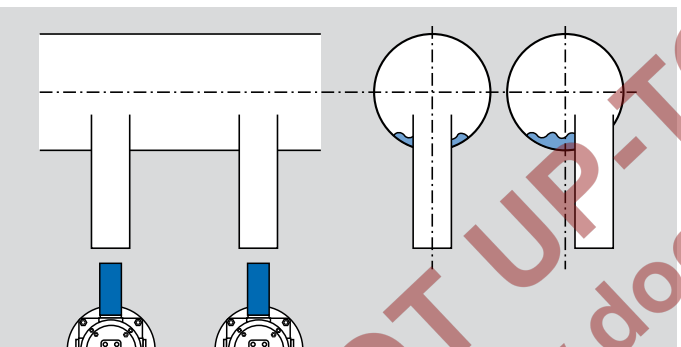


In indirect heating systems with metal radiant tubes, eductor EJEK can generate a negative pressure in the radiant tube. This prevents the inert gas atmosphere in the furnace being contaminated by flue gases from the burner in the event of leakage from the single ended radiant tube.

7.4 Furnace flue gas system

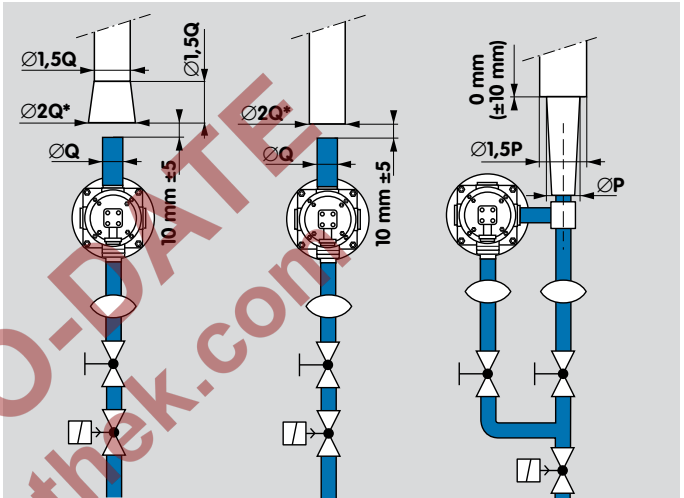
A flue gas system must be fitted on the furnace as a means of guiding the flue gas to the chimney. In the flue gas system there should be a low negative pressure thanks to the draught of the chimney or an exhaust fan.

The branch lines from the furnace flue gas manifold to the individual burners should be designed such that condensate cannot seep upstream into the burner.



The branch lines to the burner should stop 10 mm away from the flue gas connector FLUP, or be fitted flush with the eductor EJEK.

For indirect heating with flue gas monitoring kit DW and BCU 465, excessive negative pressure in the flue gas system or an excessively narrow flue gas pipe diameter on the furnace can cause problems with setting the switching point of the pressure switch.



** With flue gas monitoring kit DW; without flue gas monitoring kit DW: 1.5Q to 2Q.*

	FLUP dia. Q	EJEK dia. P
ECOMAX 0	DN 32	43
ECOMAX 1	DN 50	43
ECOMAX 2	DN 50	83
ECOMAX 3	DN 65	98
ECOMAX 4	DN 100	128
ECOMAX 5	DN 100	153

In a closed flue gas system, a pressure regulator is to be fitted. The gas and air flow rates depend on the total pressure differential between the supply lines and the flue gas system. If the pressure in the flue gas system fluctuates, the burner capacity changes. In a system without air/gas ratio control, the lambda may also change.

7.5 Installation

Installation of burners with FLUP in the horizontal position, in the vertical position with the firing end pointing downwards or at an angle with the firing end pointing downwards.

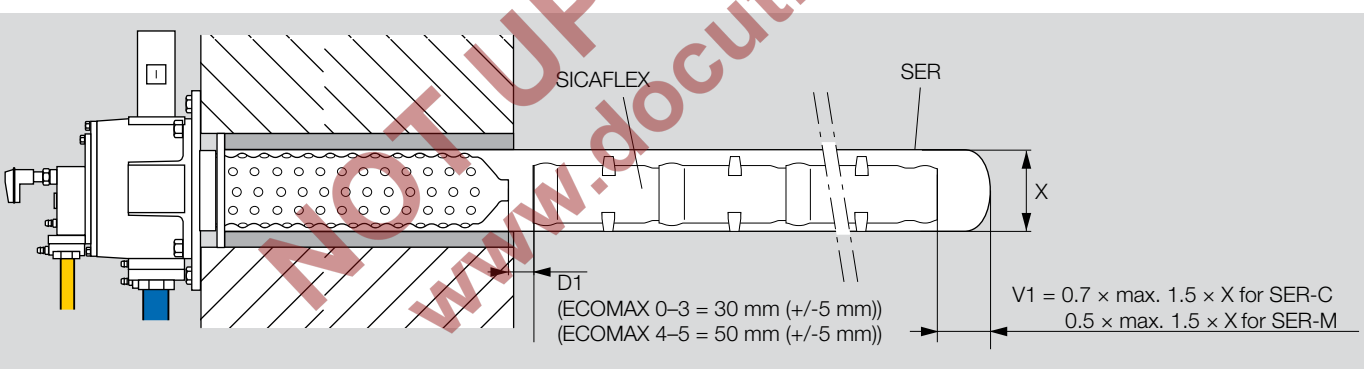
Allow for adequate clearance between the radiant tubes and the furnace wall to avoid local overheating, see Technical Information SER-C.

Ensure that there is a recirculation gap **D1** between burner and flame tube, e.g. SICAFLEX, (30 mm for ECOMAX 0 – 3 or 50 mm for ECOMAX 4 – 5). The deflector gap **V1** should equal 0.7 to 1.5 times (SER-C) or 0.5 to 1.5 times (SER-M) the radiant tube diameter **X**.

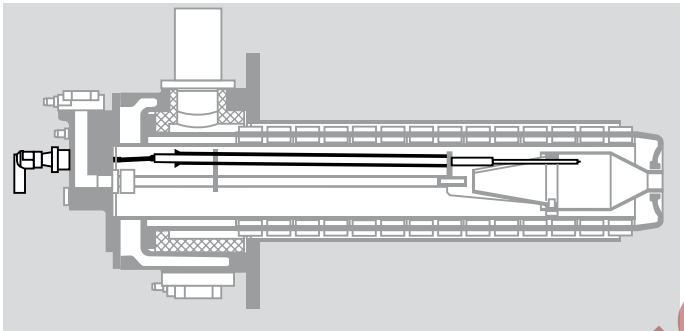
7.5.1 Heat guard

During operation, the burner body and flue gas connector or eductor can reach surface temperatures of over 80°C. Do not insulate the burner, flue gas connector and eductor to prevent material overheating.

We recommend that warning signs and a contact guard be fitted, for example made of perforated sheet metal.



7.6 Flame control



Burners ECOMAX are equipped with a combined spark electrode/flame rod. For indirect heating, ionization control is possible up to a furnace temperature of approx. 1050°C (single-electrode operation). In this respect, it must be noted that the burner control unit BCU must feature at least firmware version FW 16xx, see page 54 (Burner control units and ignition transformers).

Flame control with UV sensor is required if a furnace temperature of 1050°C for indirect heating is exceeded. We recommend using bend-resistant Kanthal electrodes for ignition on ECOMAX..M as of a furnace temperature of more than 950°C. These are fitted as standard on ECOMAX..C.

We recommend the UV sensor UVS 10D1 with integrated purge air connection (Order No. 84315202) for UV control.

For ECOMAX 0, the UV sensor UVS 10L1 (Order No. 84315203) with lens is required for UV control. For burners ECOMAX 1 – 6 with a burner length of more than 545 mm, the UV sensor UVD 10L1 with lens is also required for UV control.

An adapter set is required for connection to the UVS 10, see page 63 (UV adapter set).

7.7 Burner control units and ignition transformers

ECOMAX burners are designed for On/Off control.

We recommend burner control units BCU 465. In order to be able to carry out ionization control up to 1050°C, the burner control units must be equipped with firmware FW 16xx or higher.

Pre-ventilation should be performed after every safety shut-down in order to purge the radiant tube (parameters 39 and 40 of the BCU 465).

For burners ECOMAX..K with additional cooling air connection, we recommend using burner control unit BCU..C with additional circuit board for signal distribution.

For ignition, the ECOMAX burners require an ignition transformer with 7.5 kV high voltage and an output current of 20 mA. An appropriate ignition transformer is already integrated in burner control units BCU 460..8 and BCU 465..8.

For further information on burner control units and ignition transformers, see www.docuthek.com, Technical Information BCU 460, 465.

7.7.1 Burner control unit configurations

Description	Configuration R1	Configuration R2
Flame control	Ionization	UVS 10
Pneumatic air/gas ratio control	None/VAG	None/VAG
Air flow monitoring	Differential pressure switch PDZ	Differential pressure switch PDZ

Hardware	BCU 465..L	BCU 465..L
Ignition transformer	8 = TZI 7,5-20/33	8 = TZI 7,5-20/33
Rewiring for electrode operation	1 electrode	2 electrodes

Description	Parameter	Configuration R1	Configuration R2
Switch-off threshold of the flame amplifier	04	4 µA	4 µA
Air flow monitoring during purging	06	1	1
Air flow monitoring during operation	07	1	1
Delayed air flow monitoring	08	1	1
Safety time during operation t_{SB} for V1 and V2	14	1	1
Minimum burner on time t_B	20	8	8
Minimum burner pause time t_{BP}	21	4	4
Safety time on start-up t_{SA}	22	3	3
Air valve control	30	1	1
Air valve can be activated externally on start-up	31	1	1
Low fire over-run time t_{KN} after a controlled shut-down	36	0	0
Pre-ventilation time t_{VL} before start-up	37	0	0
Post-ventilation time t_{NL} after a controlled shut-down	38	0	0
Pre-ventilation time after safety shut-down	39	7	7
Pre-ventilation for restart/start-up attempts	40	1	1
Pre-ventilation after reset	41	1	1

BCU for indirect heating	Configuration R1	Configuration R2
230 V	88614271	88614275
230 V, Profibus	88614272	88614276
230 V, HT operation	88614273	88614277
230 V, HT operation, Profibus	88614274	88614278

7.8 Gas connection

7.8.1 Selecting components

For indirect heating, slow opening gas valves and quick opening air control valves are to be used to ensure a safe burner start.

The following gas valves are recommended for natural gas:

Burner	No pneumatic air/gas ratio control system	Air/gas ratio control
ECOMAX 0	VG 15..N + VG 15..L + VMV 115	VAG 115..B + VG 15..L + VMV 115
ECOMAX 1	VG 15..N + VG 15..L + VMV 115	VAG 115..B + VG 15..L + VMV 115
ECOMAX 2	VG 15..N + VG 15..L + VMV 115	VAG 115..B + VG 15..L + VMV 115
ECOMAX 3	VG 15..N + VG 15..L + VMV 115	VAG 115..B + VG 15..L + VMV 115
ECOMAX 4	VAS 120..N + VAS 120..L + VMV 120	VAG 120..B + VAS 120..L + VMV 120
ECOMAX 5	VAS 125..N + VAS 125..L + VMV 125	VAG 125..A + VAS 125..L + VMV 125

A bellows unit EKO should be provided between the burner and controls to prevent external force being applied to the burner.

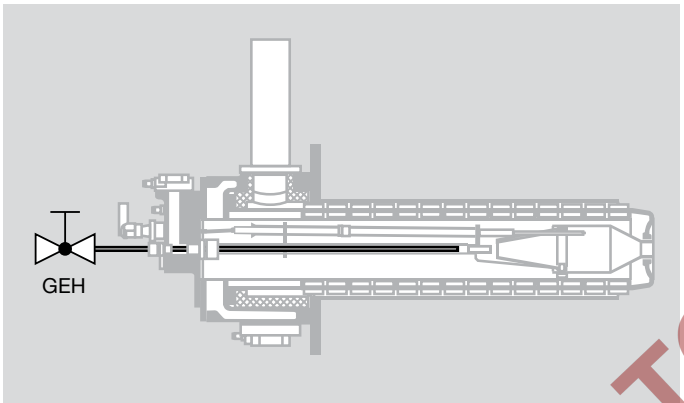
7.8.2 Gas pressure

The required gas pressure depends on the burner size, the gas type and the system configuration.

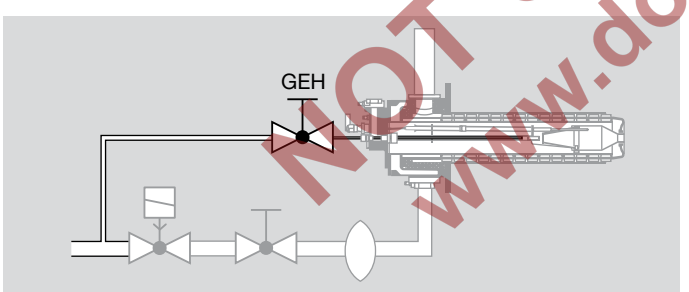
		Gas supply line pressure*	
	Gas pressure upstream of burner	Natural gas H	Natural gas L, LPG
Air/gas ratio control	65 – 70 mbar	100 mbar	120 mbar
No pneumatic air/gas ratio control system	65 – 70 mbar	80 mbar	100 mbar

* *If a stainless steel flexible tube ES is used instead of the stainless steel bellows unit EKO, the higher pressure loss must be taken into account.*

7.8.3 Operation with LPG



For operation with LPG, it is essential to cool the gas lance via a central air lance in order to prevent the LPG from cracking in the gas lance and soot formation during combustion.



The central air volume is approx. 3 to 5% of the combustion air volume and must also flow while the burner is switched off.

Open the adjuster in the central air lance fully. On the ECOMAX 1, the adjuster must be restricted to 45° or 50%.

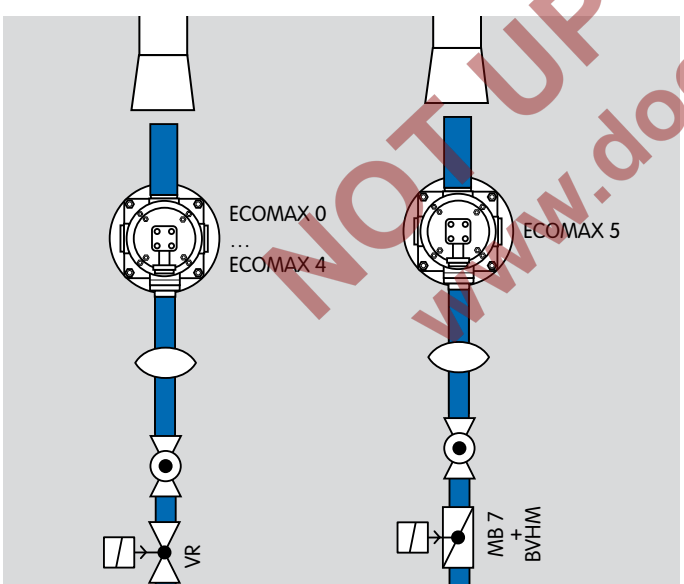
If high temperature operation without flame control is intended for LPG, air flow monitoring using an air flow detector set ECO must be provided. If the flue gas route is blocked, the central air will be prevented from flowing into the gas line or gas will be prevented from flowing into the air line.

7.9 Air connection

7.9.1 Selecting components

For indirect heating, a quick opening air valve should always be used to ensure a safe burner start. The following air valves or butterfly valves/solenoid actuators are recommended:

Burner	No pneumatic air/gas ratio control system	Air/gas ratio control
ECOMAX 0	VR 20..N	VR 20..N
ECOMAX 1	VR 25..N	VR 25..N
ECOMAX 2	VR 40..N	VR 40..N
ECOMAX 3	VR 50..N	VR 50..N
ECOMAX 4	VR 65..N	VR 65..N
ECOMAX 5	BVHM 65/MB 7..N	BVHM 65/MB 7..N



7.9.2 Air pressure

The required air pressure depends on the burner size, the gas type and the system configuration.

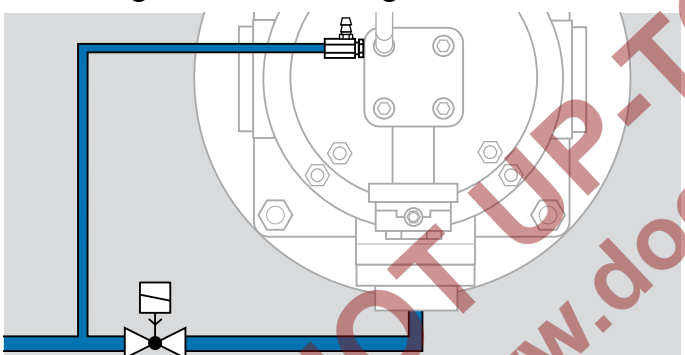
		Air supply line pressure	
	Air pressure upstream of burner	Natural gas H	Natural gas L / LPG
Air/gas ratio control	approx. 50 – 60 mbar	80 mbar	100 mbar
No pneumatic air/gas ratio control system	approx. 50 – 60 mbar	80 mbar	80 mbar

To ensure accurate measurements of the pressure differential on the integrated orifice, flow to the orifice must not be disturbed. We recommend using the connection set for air, which ensures correct measurement at the measuring orifice, see page 53 (Connection set for gas and air). The attachment of a coupling, a bellows unit or a pipe bend directly upstream of the orifice can cause turbulence in the gas flow resulting in the burner being incorrectly adjusted.

7.10 Air flow monitoring

A system which includes air flow monitoring is recommended to monitor pre-purge (pursuant to EN 746-2 and ISO 13577-2). This is implemented using a differential pressure switch at the air connection together with a burner control unit BCU 465. An air flow monitoring set is available for this purpose as an accessory, see page 62 (Air flow detector set).

7.11 Purge air and cooling air



Purge air must be connected to the burner ECOMAX in order to ensure safe ignition and monitoring, and in order to avoid problems caused by condensation and/or overheating:

The required purge air volume is approx. 0.5 to 1.0% of the air volume for rated capacity, or a minimum of 1 Nm^3/h.

The purge air is connected to the gas connection flange next to the electrode, or in the case of UV control to the purge air connection of the UV sensor. The purge air is tapped upstream of the air control valve so that the purge air continues to flow even if the burner is switched off.

In order to limit the volume of purge air, special nozzles can be used which are adjusted to the required air supply pressure for the ECOMAX – see page 63 (Purge air/cooling air nozzles).

Burner	Nozzle for electrode purge	Purge air nozzle on UV sensor
ECOMAX 0	Nozzle electrode ECO 0 Rp 1/4 D = 2.5 /E	Nozzle UV ECO 0-3 Rp 1/4 D = 2.5 /B
ECOMAX 1 – 3	Nozzle electrode ECO 1-3 Rp 1/4 D = 2.5 /E	Nozzle UV ECO 0-3 Rp 1/4 D = 2.5 /B
ECOMAX 4 – 5	Nozzle electrode ECO 4-6 Rp 1/4 D = 4.0 /E	Nozzle UV ECO 4-6 Rp 1/4 D = 4.0 /B

7.12 Condition on delivery

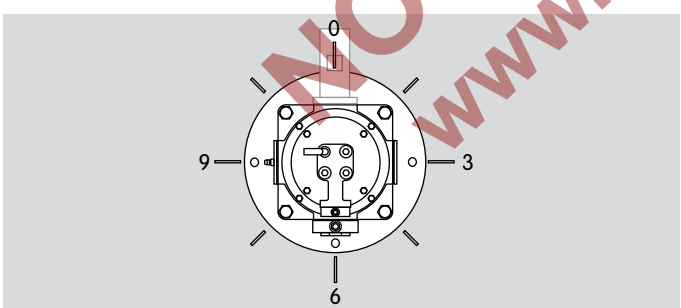
The position of the gas, air and flue gas connections can be customized depending on how the burner is to be installed on the furnace. The positions of the connections are coded using the numbers 0, 3, 6 and 9.

Code	Connection position
0	top
3	right-hand side
6	bottom
9	left-hand side

The codes relating to the positions of the connections are specified in the following order: flue gas – air – gas – and cooling air (increased furnace cooling) if required.

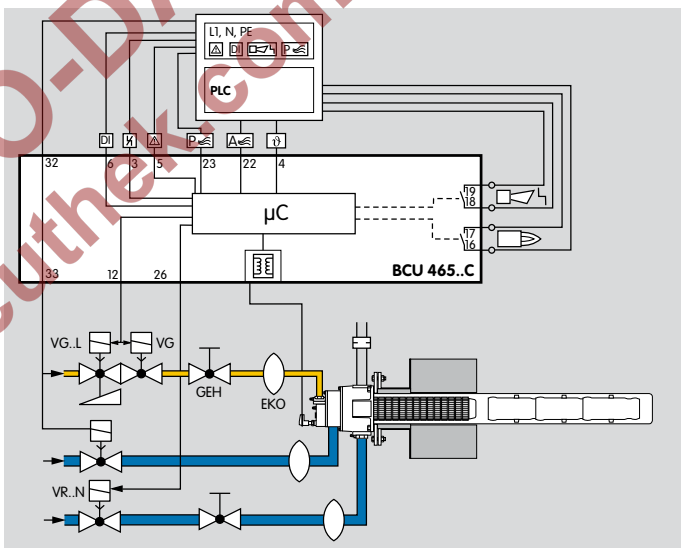
Provided that there are no specifications, the burners are supplied as follows:

ECOMAX../R for indirect heating with connector position 066, i.e. with flue gas connection at the top and gas and air connection at the bottom.



Add-on components with the marking /E, such as the air flow detector set, UV adapter, purge air nozzle, etc, are installed on the burner at the factory, provided that they are ordered at the same time as the burner.

7.13 Increased furnace cooling with ECOMAX..K



Depending on the technical requirements for the process, cooling can be implemented in two stages.

Actuating the air valve for the burner (terminal 22) initiates "normal" cooling; actuating a second air valve for the additional cooling air connection initiates additional cooling. The additional cooling air valve is actuated separately by the process control system. For wiring on site, we recommend using a BCU..C with a supplementary terminal strip (e.g. terminals 32/33 for additional air valve).

In the case of "additional" cooling air, the combustion air valve must be activated together with the cooling air valve in order to prevent the recuperator from overheating.

7.14 Build up of noise

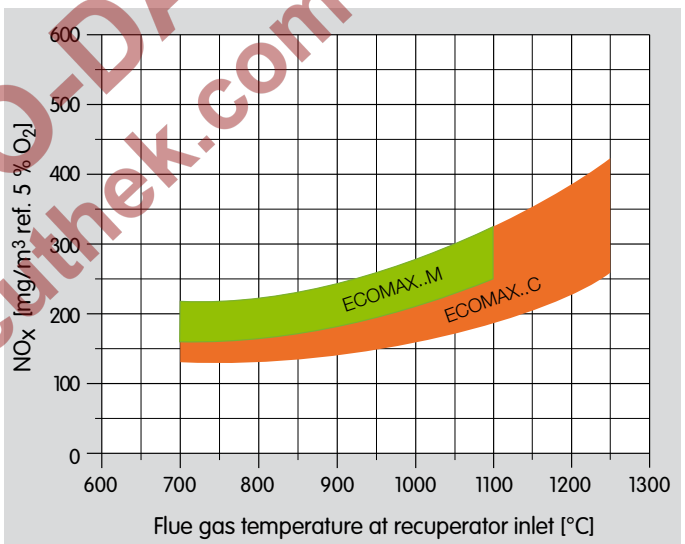
In the case of fitted burners, the sound level of the single burner which can be measured outside the furnace is usually between 75 and 82 dB(A).

In a furnace system, the value which can be measured depends on the capacity, excess air volume, flue gas extraction and flue gas temperature of the single burners as well as the burner arrangement and ambient influences.

7.15 Emissions

CO and NO_X values depend on the furnace temperature, air preheat temperature, burner type and burner settings (NO_X values on request).

If operated with LPG, NO_X values are approx. 25% higher.



NO_X values in the diagram apply for natural gas

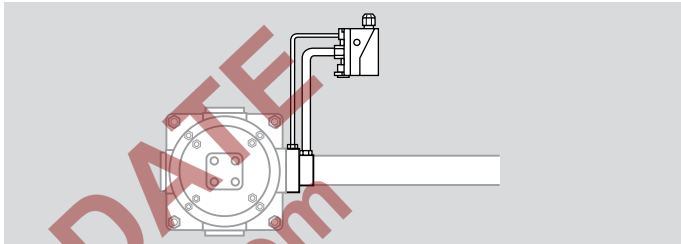
8 Accessories

8.1 Air connection set

Specially machined barrel nipples which ensure reliable, correct measurement at the orifices installed in the burner. Version /E is installed in the burner on delivery.

Designation	Order No.
Air inlet pipe ECO 0 – 1 R 1 /E	22802897
Air inlet pipe ECO 2 R 1 1/2 /E	22802898
Air inlet pipe ECO 3 – 5 R 2 /E	22802899
Air inlet pipe ECO 6 R 3 /E	22802900

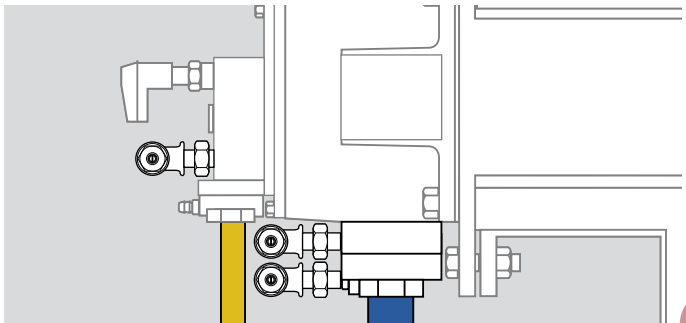
8.2 Air flow detector set



The differential pressure switch for air flow monitoring is used for the automatic monitoring of the air flow on the burner ECOMAX in conjunction with the burner control unit BCU 465. The differential pressure switch monitors the air flow during pre-purge and burner operation. If there is no air pressure, the burner is switched off or is not enabled. The pressure switch switching point should be set to approx. 80% of the differential pressure in normal operation.

Designation	Order No.
Air flow detector set ECO /E	21802994

8.3 VAH connection set



The VAH connection set also comprises the connection for gas control line p_{d-}, which is connected behind the gas orifice integrated in the burner to ensure that a gas supply pressure of 80 mbar in the supply line (recommended value: 100 mbar) is sufficient.

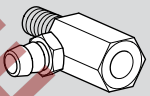
Designation	Order No.
Connection set VAH ECO /E	21800791

8.4 UV adapter set

For attaching the UVS 10, an adapter is required.

Designation	Order No.
Adapter set Eco 1-5-UVS 10 /E	21800791

8.5 Purge air/cooling air nozzles



Nozzle to limit the volume of purge air in order to achieve safe ignition and monitoring of the ECOMAX burner and to avoid condensation and overheating.

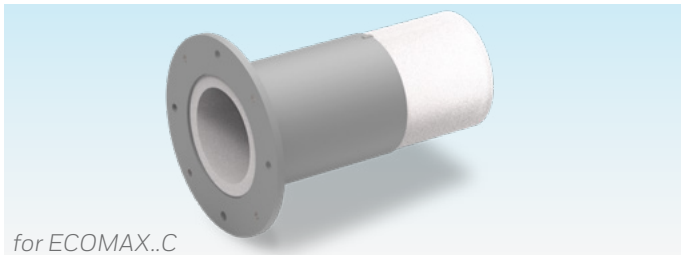
Nozzle for electrode purge

Burner	Nozzle designation	Order No.
ECOMAX 0	Nozzle electrode ECO 0 Rp 1/4 D = 2.5 /E	21802944
ECOMAX 1 – 3	Nozzle electrode ECO 1-3 Rp 1/4 D = 2.5 /E	21802945
ECOMAX 4 – 6	Nozzle electrode ECO 4-6 Rp 1/4 D = 4.0 /E	21802946

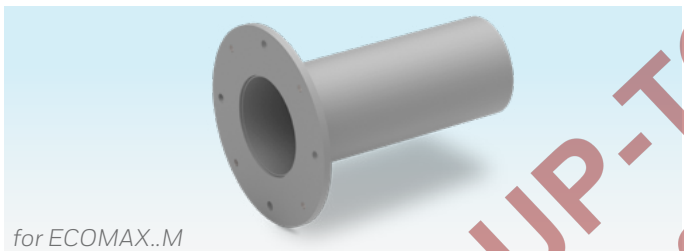
UV sensor purge air nozzle

Burner	Nozzle designation	Order No.
ECOMAX 0 – 3	Nozzle UV ECO 0-3 Rp 1/4 D = 2.5 /B	21802989
ECOMAX 4 – 6	Nozzle UV ECO 4-6 Rp 1/4 D = 4.0 /B	21802990

8.6 Flue gas guide tube FGT Set..D



for ECOMAX..C



for ECOMAX..M

When using the ECOMAX burners for direct heating, a flue gas guide tube FGT Set..D is required.

The FGT Set..D is available in lengths in various increments, which are suited to different burner lengths.

For ECOMAX 1C, 2C and 3C, there is a standard version for furnace temperatures up to 1200°C and a high temperature version for furnace temperatures from 1200°C to 1250°C.

Scope of delivery: flue gas guide tube FGT with burner gasket, mounting gasket, as well as 4 threaded bolts, washers and nuts for attaching it to the burner.

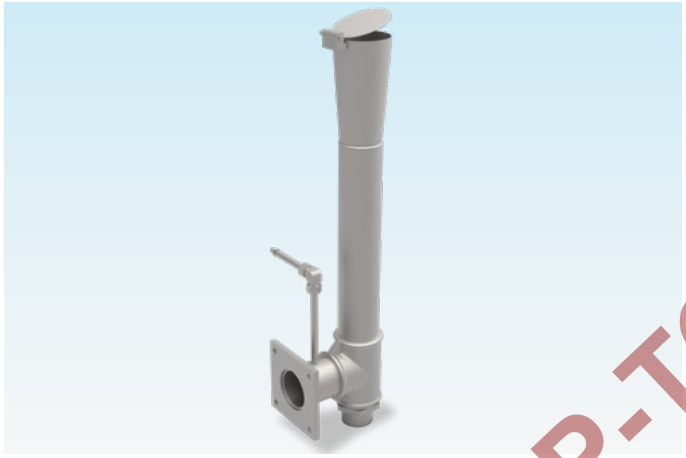
ECOMAX..C

Flue gas guide tube	Order No.
FGT SET ECO 1C545/D-HT	21800926
FGT SET ECO 2C545/D-HT	21800928
FGT SET ECO 3C545/D-HT	21800930
FGT SET ECO 4C545/D-HT	21800629
FGT SET ECO 5C545/D-HT	21801325

ECOMAX..M

Flue gas guide tube	Order No.
FGT SET ECO 1M545/D	21800195
FGT SET ECO 2M545/D	21800177
FGT SET ECO 3M545/D	21800694
FGT SET ECO 4M545/D	21800162
FGT SET ECO 5M545/D	21800499
FGT SET ECO 6M545/D	21800660

8.7 Flue gas eductor EJEK



For direct heating

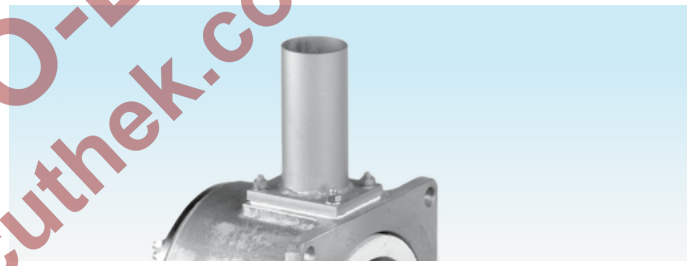
The eductor EJEK generates a vacuum with a centrally positioned nozzle and thus draws the flue gases out of the furnace chamber through the burner's heat exchanger.

Designation for ECOMAX..C	Order No.
EJEK 1-K269-M625-H-AGK-HT-S	22800872
EJEK 2-K285-M540-H-AGK-HT-A-S	22802953
EJEK 3-K292-M620-AGK-HT-A-S	22801413
EJEK 4-K345-M920-AGK-HT-A-S	22801701
EJEK 5-K345-M1165-AGK-HT-A-S	22801828

Special version on request.

Designation for ECOMAX..M	Order No.
EJEK 1-K269-M625-H-AGK-S	22800931
EJEK 2-K285-M540-H-AGK-A-S	22802952
EJEK 3-K292-M620-AGK-A-S	22801159
EJEK 4-K345-M920-AGK-A-S	22801700
EJEK 5-K345-M1165-AGK-A-S	22801826
EJEK 6-K530-M1618-AGK-A-S	22801903

8.8 Flue gas connector FLUP

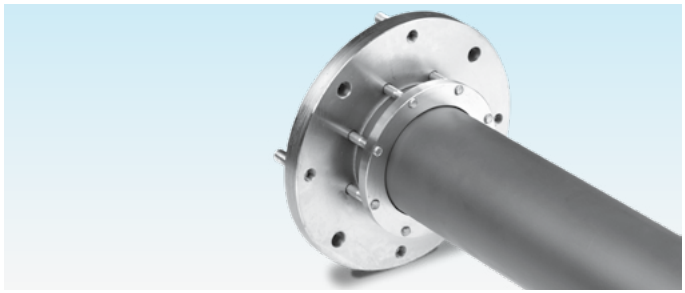


In indirect heating systems, flue gas connector FLUP discharges the flue gas into the furnace flue gas system to be provided by the customer.

Designation	Order No.
FLUP 0-32D-M230-C-B-S	21801830
FLUP 1/2-50D-M331-C-S	21100612
FLUP 3-65D-M353-C-S	21102259
FLUP 4/5-100D-M399-C-S	21102718

Special version on request.

8.9 Ceramic radiant tube SER-C



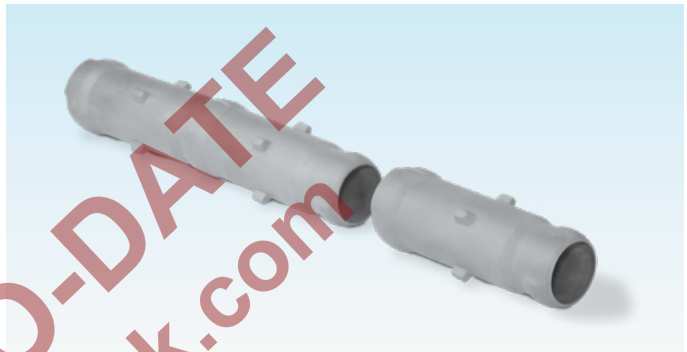
For heat treatment processes in which combustion gases must be kept separate from the product. The patented flange connection is air-tight.

Material: SiSiC, max. application temperature: 1300°C.

Further information can be found in the Technical Information bulletin “Ceramic radiant tube SER-C”.

Order No. on request.

8.10 Segmented flame tube SICAFLEX

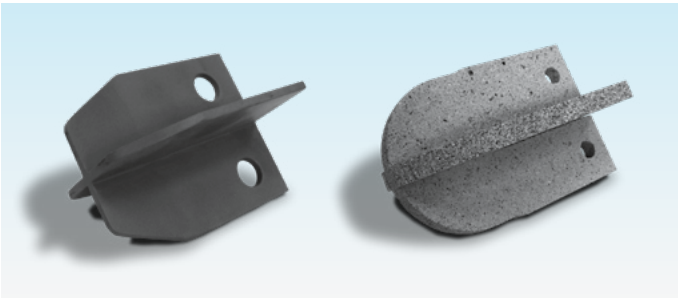


For guiding hot flue gases in single ended radiant tubes.

Further information can be found in the Technical Information bulletin “Segmented flame tube SICAFLEX”.

Order No. on request.

8.11 Cruciform spacer



For installation of the segmented flame tube SICAFLEX® in vertical radiant tubes. The cruciform spacer ensures optimum sizing of the recirculation gap between the segmented flame tube and the burner.

Material: refractory clay.

Available on request in different sizes depending on the SICAFLEX® sizes and different heights.

8.12 Flue gas guide tube FGT SET ECO.. SER-C

To guide the flue gases if smaller burners are used than those normally intended; see page 49 (Radiant tubes). The flue gas guide tube ensures sufficient heat exchange via the burner recuperator.

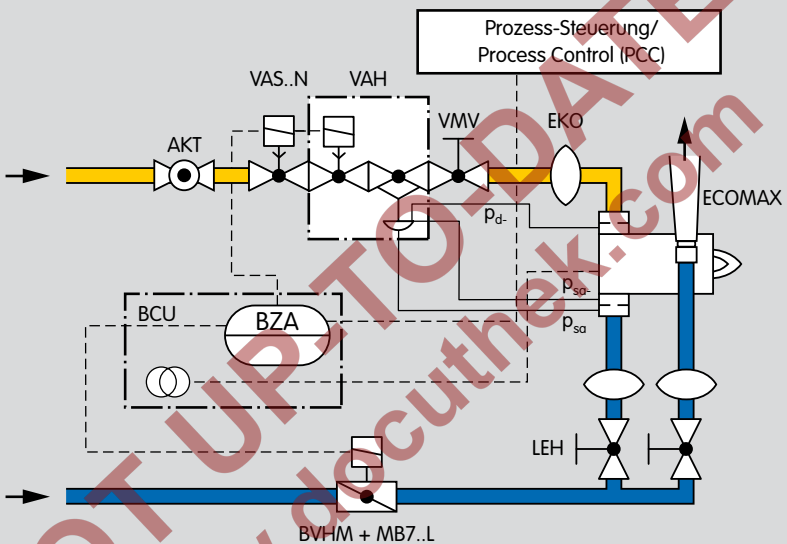
Material: Shaped part made of vacuum-formed ceramic fibres (RCF).

Available on request in different sizes and versions suitable for the SER-C and ECOMAX burner sizes.

8.13 Piping

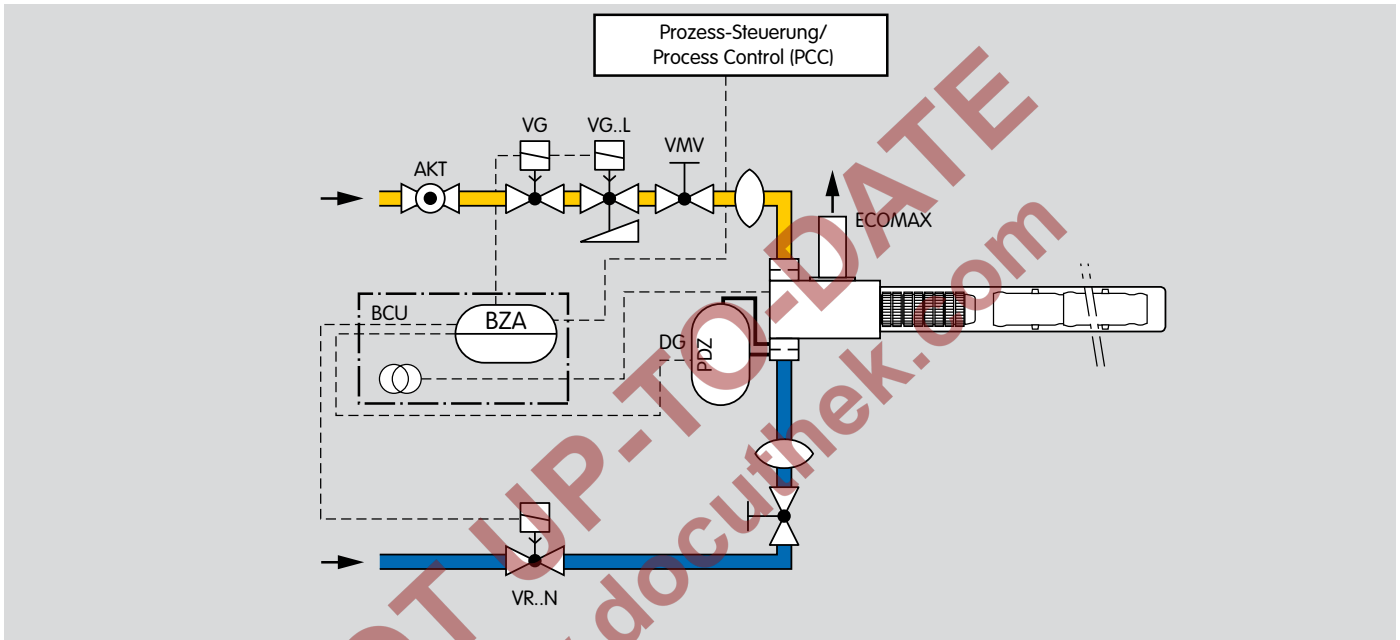
The burners can be optionally supplied with pre-mounted pipework for gas and air.

8.13.1 Direct heating



	ECOMAX	Material No.	Designation	Combinations
Gas	0 – 3	86594777	GVRS 15R05-15R05-W-ECO 0-3	VAS...N + VAH... + VMV...
	4	86594778	GVRS 20R05-20R05-W-ECO 4	VAS...N + VAH... + VMV...
	5	86494779	GVRS 25R05-25R05-W-ECO	VAS...N + VAH... + VMV...
	6	86594776	GVRS 40R05-40R05-W-ECO 6	VAS...N + VAH... + VMV...
Air	0	86594782	L 40R-25R-32R-W-ECO 0-EJEK	VR...L + LEH... + CIM...
	1	86594783	L 50R-25R-32R-W-ECO 1-EJEK	VR...L + LEH... + CIM...
	2	86594784	L 65R-40R-40R-W-ECO 2-EJEK	VR...L + LEH... + LEH...
	3	86594785	L 65R-50R-50R-W-ECO 3-EJEK	BVHM...MB7LW6 + LEH... + LEH...
	4	86594786	L 80F-50R-65R-W-ECO 4-EJEK	BVHM...MB7LW6 + LEH... + CIM...
	5	86594787	L 80F-50R-65R-W-ECO 5-EJEK	BVHM...MB7LW6 + LEH... + CIM...
	6	–	L 100F-80R-100F-W-ECO 6-EJEK	BVHM...MB7LW6 + CIM... + CIM...

8.13.2 Indirect heating



	ECOMAX	Material No.	Designation	Combinations
Gas	0 – 3	86594195	GS 15R02-15R02-W-ECO 0-3	VG...N + VG...L + VMV...
	4	86594654	GS 20R05-20R05-W-ECO 4	VCS 1 (VAS...N + VAS...L) + VMV...
	5	86594687	GS 25R05-25R05-W-ECO 5	VCS 1 (VAS...N + VAS...L) + VMV...
Air	0 – 1	86594689	L 25R-25R-W-ECO 0-1	VR...N + LEH...
	2	86594693	L 40R-40R-W-ECO 2	VR...N + LEH...
	3	86594694	L 50R-50R-W-ECO 3	VR...N + LEH...
	4	86594696	L 65R-50R-W-ECO 4	VR...N + LEH...
	5	86594697	L 65R-50R-W-ECO 5	BVHM... + CIM...

9 Technical data

Gas supply pressure and air supply pressure each depend on the use and gas type.

Direct heating:

Gas supply pressure, see page 41 (Gas pressure),

Air supply pressure, see page 43 (Air pressure).

Indirect heating:

Gas supply pressure, see page 56 (Gas pressure),

Air supply pressure, see page 58 (Air pressure).

(pressure differentials for gas and air: see burner diagrams at www.docuthek.com – registration required).

Type of heating: direct with eductor or indirect in radiant tube.

Control type: On/Off.

Adjusting range: 60% to 100%.

Flame velocity: approx. 130 to 170 m/s.

Flame control: direct ionization control (UV control as an option).

Ignition: direct spark ignition.

Burner	Recuperator	Max. flue gas temperature at recuperator inlet
ECOMAX..C	Ceramic (SiSiC)	1250°C*
ECOMAX..M	Cast steel	1150°C
ECOMAX..F	Metallic	1050°C

* *We advise against use in forging and heating furnaces, in which raw materials are heated.*

Burner	Capacity [kW]	Flame length [mm]*
ECOMAX 0	25	300
ECOMAX 1	36	300
ECOMAX 2	60	400
ECOMAX 3	100	450
ECOMAX 4	180	800
ECOMAX 5	250	800
ECOMAX 6	500	1000

* *Visible range for natural gas operation in the open air, max. connection rating and air index 1.15.*

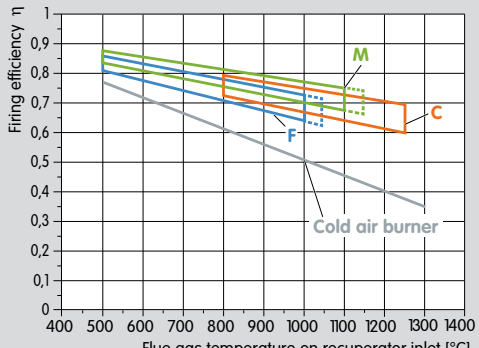
The visible flame diameter is 0.3 to 0.5 times that of the burner Ø B for natural gas operation in the open air, max. connection rating and air index 1.15.

REACH Regulation

Information pursuant to REACH Regulation No. 1907/2006, Article 33.

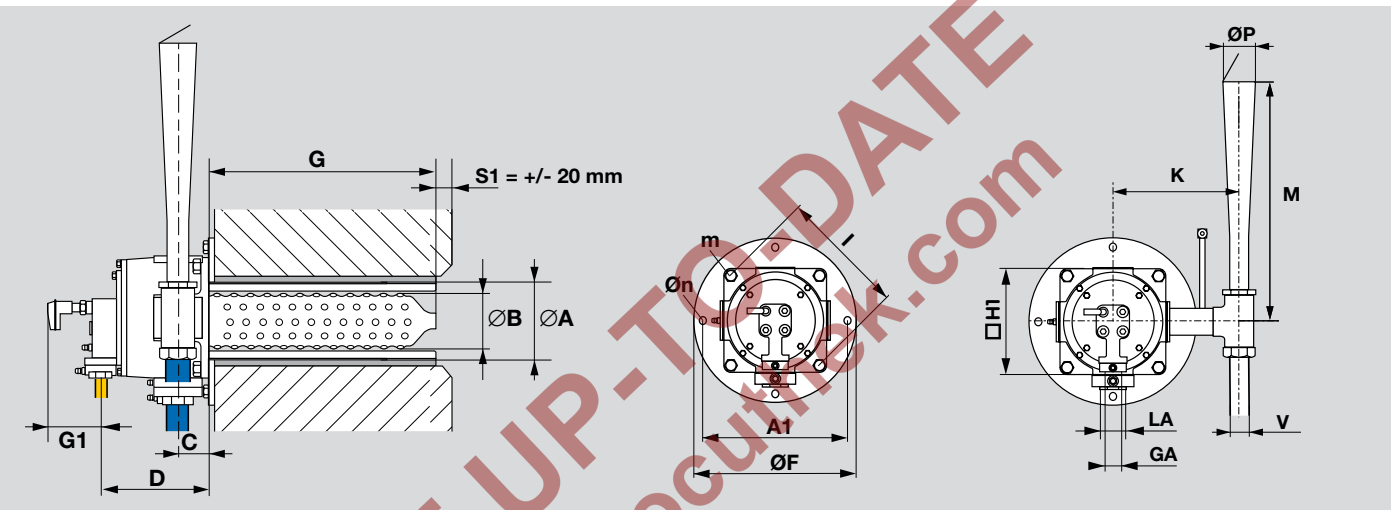
Insulation contains refractory ceramic fibres (RCF)/aluminium silicate wool (ASW).

RCF/ASW are listed in the Candidate List of the European REACH Regulation No. 1907/2006.



9.1 Dimensions

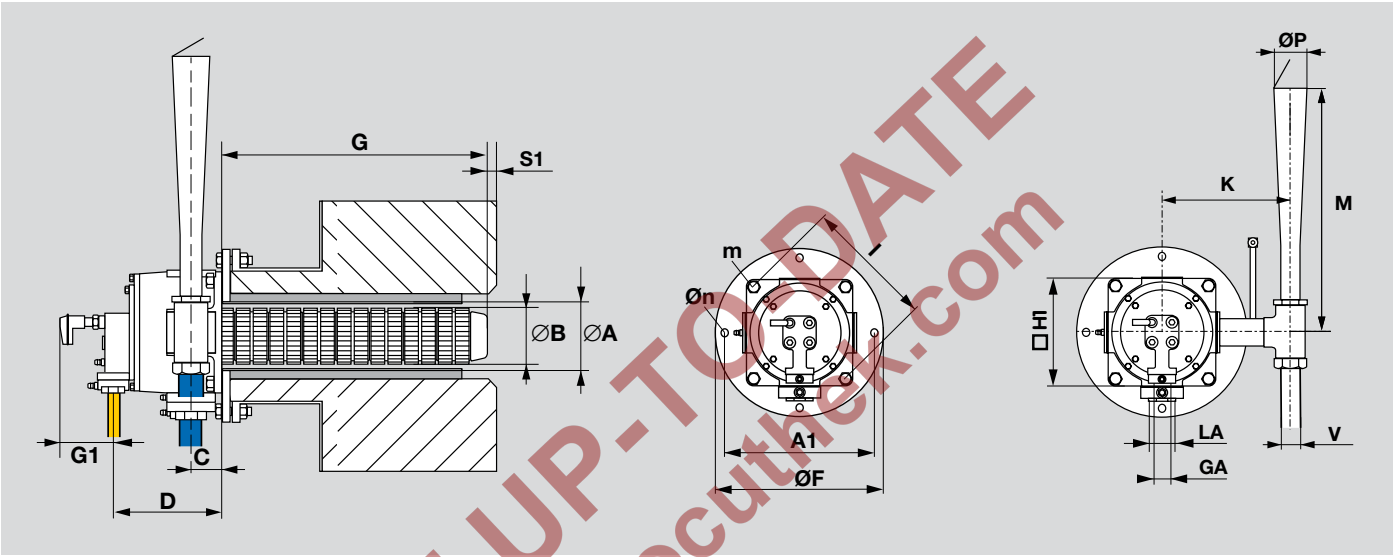
9.1.1 ECOMAX..C for direct heating



Type	ECOMAX								FGT set						EJEK				
	GA	LA	Ø B	C[1]	D[1]	G1	G	□H1	Ø A[2]	Ø F	A1	Ø n	l	m	V	K	M	Ø P	Weight
			mm						mm						mm				kg[3]
ECOMAX 0C	R ½	Rp 1	86	60	179	~78	395, 475, 556, 636	182	142	300	260	4 x 18	210	4 x M12	R 1¼	269	625	43	~11
ECOMAX 1C	R ½	Rp 1	123	60	212	~80	545, 593, 641, 689	236	180	330	280	4 x 19	290	4 x M16	R 1¼	269	625	43	~19
ECOMAX 2C	R ½	Rp 1½	142	60	212	~80	545, 613, 681	236	200	330	280	4 x 19	290	4 x M16	R 1½	285	540	83	~21
ECOMAX 3C	R ½	Rp 2	178	83	262	~80	545, 617, 689	280	236	385	325	4 x 19	330	4 x M16	R 2	292	620	98	~33
ECOMAX 4C	R ¾	Rp 2	240	95	298	~86	545	368	300	480	420	4 x 19	445	4 x M16	R 2½	345	920	128	~48
ECOMAX 5C	R 1	Rp 2	273	95	298	~86	545	368	336	480	420	4 x 19	445	4 x M16	G 2½	345	1165	153	~55

1) *Excluding gasket (t = 1.3 mm)*
2) *Diameter excluding plate bracket (with plate bracket: Ø A + approx. 3 mm)*
3) *Weight of burner of shortest length.*

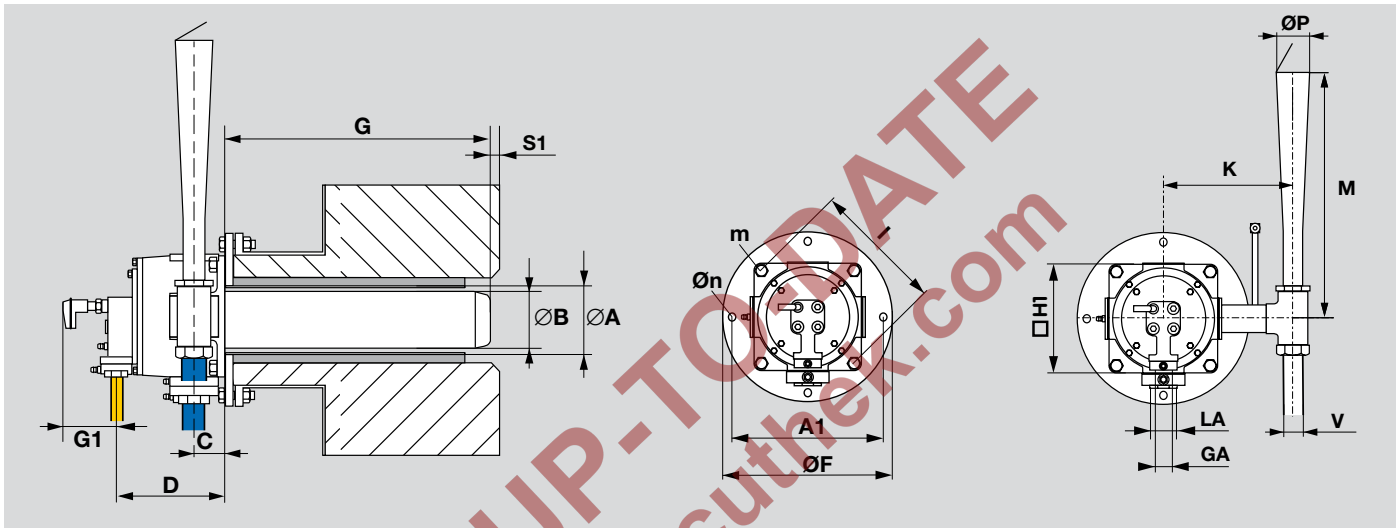
9.1.2 ECOMAX..M for direct heating



Type	ECOMAX								FGT set						EJEK				
	GA	LA	Ø B	C[1]	D[1]	G1	G	□H1	Ø A	Ø F	A1	Ø n	l	m	V	K	M	Ø P	Weight
						mm						mm				mm			kg[2]
ECOMAX 1M	R ½	Rp 1	123	60	212	~78	545, 595, 645, 695	236	133	330	280	4 x 19	290	4 x M16	R 1¼	269	625	43	~35
ECOMAX 2M	R ½	Rp 1½	142	60	212	~80	545, 595, 645, 695	236	156	330	280	4 x 19	290	4 x M16	R 1½	285	540	83	~41
ECOMAX 3M	R ½	Rp 2	178	83	262	~80	545, 595, 645, 695	280	193	385	325	4 x 19	330	4 x M16	R 2	292	620	98	~53
ECOMAX 4M	R ¾	Rp 2	240	95	298	~86	545, 595, 645, 695	368	254	480	420	4 x 19	445	4 x M16	R 2½	345	920	128	~90
ECOMAX 5M	R 1	Rp 2	273	95	298	~86	545, 695	368	287	480	420	4 x 19	445	4 x M16	G 2½	345	1165	153	~91
ECOMAX 6M	R 1½	Rp 3	370	150	401	~137	545, 695	540	390	740	690	8 x 23	650	4 x M20	DN 100	530	1618	215	~265

1) *Excluding gasket (t = 4 mm)*
2) *Weight of burner of shortest length.*

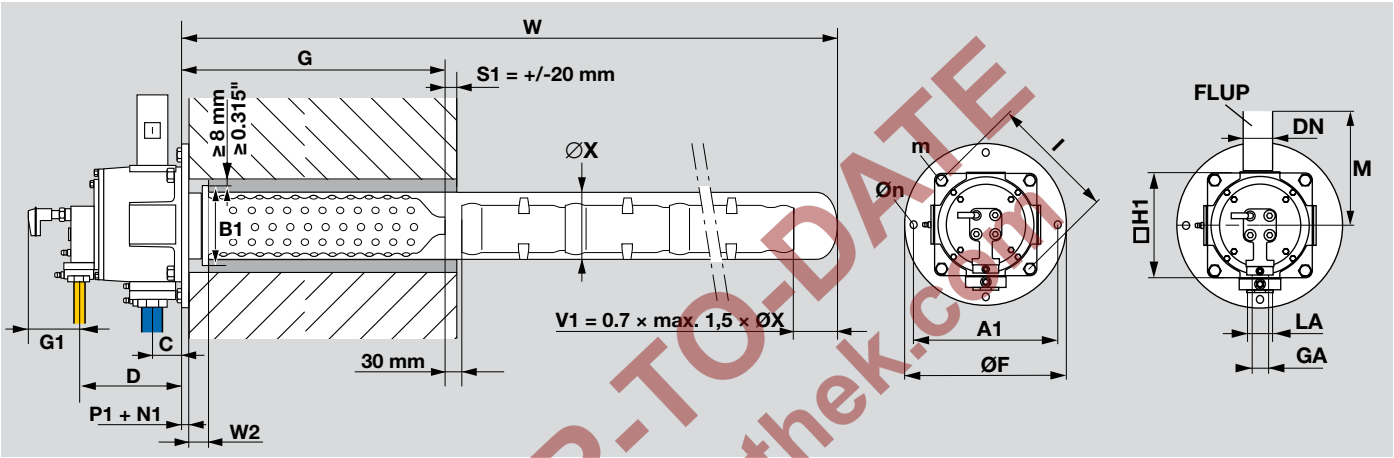
9.1.3 ECOMAX..F for direct heating



Type	ECOMAX								FGT set						EJEK				
	GA	LA	Ø B	C[1]	D[1]	G1	G	□H1	Ø A	Ø F	A1	Ø n	l	m	V	K	M	Ø P	Weight
			mm						mm						mm				kg[2]
ECOMAX 1F	R ½	Rp 1	109	60	212	~78	545, 595, 645, 695	236	133	330	280	4 x 19	290	4 x M16	R 1¼	269	625	43	~27
ECOMAX 2F	R ½	Rp 1½	128	60	212	~80	545, 595, 645, 695	236	156	330	280	4 x 19	290	4 x M16	R 1½	285	540	83	~31
ECOMAX 3F	R ½	Rp 2	164	83	262	~80	545, 595, 645, 695	280	193	385	325	4 x 19	330	4 x M16	R 2	292	620	98	~47
ECOMAX 4F	R ¾	Rp 2	216	95	298	~86	545, 595, 645, 695	368	254	480	420	4 x 19	445	4 x M16	R 2½	345	920	128	~75
ECOMAX 5F	R 1	Rp 2	224	95	298	~86	545, 595, 645, 695	368	287	480	420	4 x 19	445	4 x M16	G 2½	345	1165	153	~76

1) *Excluding gasket (t = 4 mm)*
2) *Weight of burner of shortest length.*

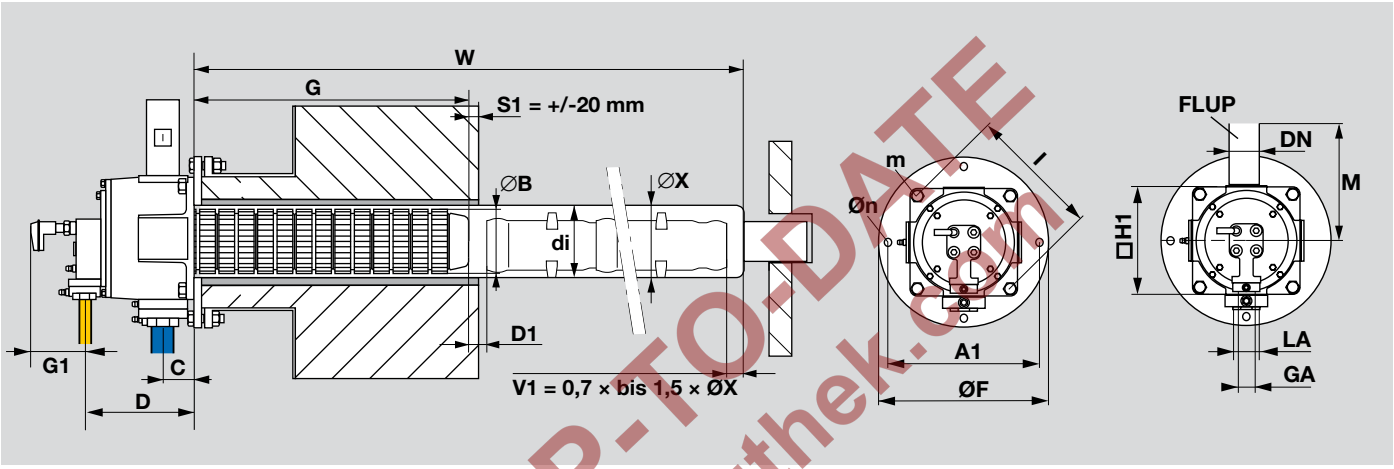
9.1.4 ECOMAX..C for indirect heating



Type	ECOMAX											SER-C						FLUP		
	GA	LA	C[1]	D[1]	G1	G	□H1	P1 + N1	W2	B1	Ø X	W	Ø F	A1	Ø n	l	m	DN	M	Weight kg[2]
ECOMAX 0C	R ½	Rp 1	60	179	~78	395, 475, 556, 636	182	~34	35	160	100	1000–2600	290	240	4 x 14	210	4 x M12	32	230	~11
ECOMAX 1C	R ½	Rp 1	60	212	~80	545, 593, 641, 689	236	~37	50	200	142	1500–2600	330	280	4 x 19	290	4 x M16	50	331	~19
ECOMAX 2C	R ½	Rp 1½	60	212	~80	545, 613, 681	236	~37	50	220	162	1500–3000	330	280	4 x 19	290	4 x M16	50	331	~21
ECOMAX 3C	R ½	Rp 2	83	262	~80	545, 617, 689	280	~37	50	260	202	1500–3000	385	325	4 x 19	330	4 x M16	65	353	~33

1) *Excluding gasket (t = 1.3 mm)*
2) *Weight of burner of shortest length.*

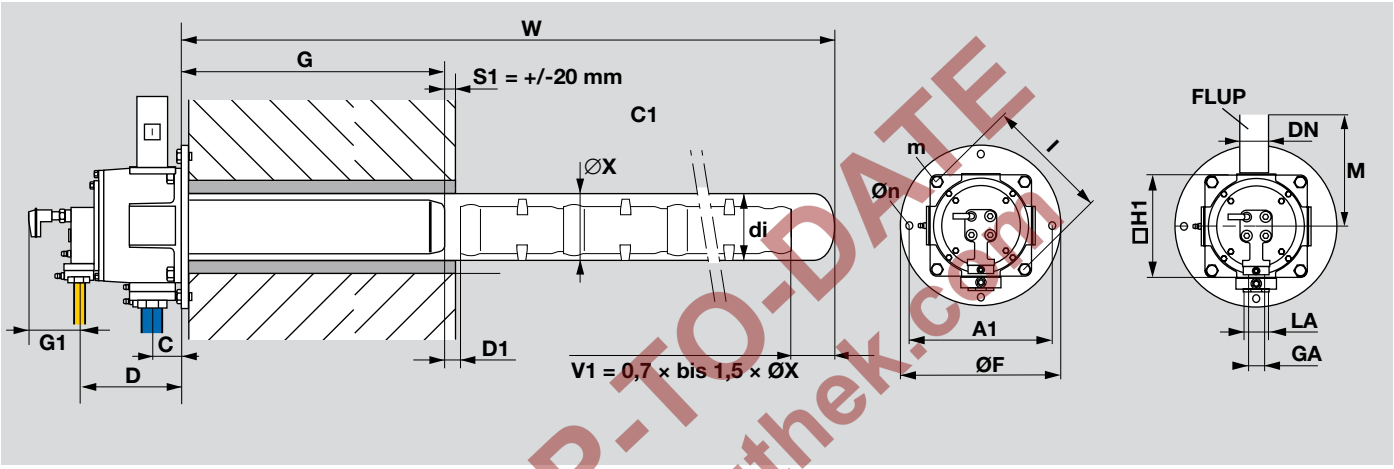
9.1.5 ECOMAX..M for indirect heating



Type	ECOMAX								SER-M								FLUP		
	GA	LA	Ø B	C[1]	D[1]	G1	G	□H1	D1	di	Ø X[2]	Ø F[3]	A1[3]	Ø n[3]	l	m	DN	M	Weight
			mm						mm									mm	kg[4]
ECOMAX 1M	R ½	Rp 1	123	60	212	~78	545, 595, 645, 695	236	30	› 128	di + 2*s	330	280	4 x 19	290	4 x M16	50	331	~35
ECOMAX 2M	R ½	Rp 1½	142	60	212	~80	545, 595, 645, 695	236	30	› 147	di + 2*s	330	280	4 x 19	290	4 x M16	50	331	~41
ECOMAX 3M	R ½	Rp 2	178	83	262	~80	545, 595, 645, 695	280	30	› 185	di + 2*s	385	325	4 x 19	330	4 x M16	65	353	~53
ECOMAX 4M	R ¾	Rp 2	240	95	298	~86	545, 595, 645, 695	368	50	› 248	di + 2*s	480	420	4 x 19	445	4 x M16	100	399	~90
ECOMAX 5M	R 1	Rp 2	273	95	298	~86	545, 695	368	50	› 280	di + 2*s	480	420	4 x 19	445	4 x M16	100	399	~91

1) *Excluding gasket (t = 4mm)*
2) *s = radiant tube wall thickness.*
3) *provided by the customer. Data is just a recommendation.*
4) *Weight of burner of shortest length.*

9.1.6 ECOMAX..F for indirect heating



Type	ECOMAX								SER-M							FLUP		
	GA	LA	Ø B	C[1]	D[1]	G1	G	□H1	D1	di	Ø X[2]	Ø F[3]	A1[3]	Ø n[3]	l	m	DN	M	Weight
			mm						mm									mm	kg[4]
ECOMAX 1F	R ½	Rp 1	109	60	212	~78	545, 595, 645, 695	236	30	› 128	di + 2⋆s	330	280	4 x 19	290	4 x M16	50	331	~35
ECOMAX 2F	R ½	Rp 1½	128	60	212	~80	545, 595 645, 695	236	30	› 147	di + 2⋆s	330	280	4 x 19	290	4 x M16	50	331	~41
ECOMAX 3F	R ½	Rp 2	164	83	262	~80	545, 595, 645, 695	280	30	› 185	di + 2⋆s	385	325	4 x 19	330	4 x M16	65	353	~53
ECOMAX 4F	R ¾	Rp 2	216	95	298	~86	545, 595, 645, 695	368	50	› 248	di + 2⋆s	480	420	4 x 19	445	4 x M16	100	399	~90
ECOMAX 5F	R 1	Rp 2	224	95	298	~86	545, 595, 645, 695	368	50	› 280	di + 2⋆s	480	420	4 x 19	445	4 x M16	100	399	~91

1) *Excluding gasket (t = 4mm)*
2) *s = radiant tube wall thickness.*
3) *provided by the customer. Data is just a recommendation.*
4) *Weight of burner of shortest length.*

10 Maintenance

Twice per year, but if the media are highly contaminated, this interval should be reduced.

Feedback

Finally, we are offering you the opportunity to assess this “Technical Information (TI)” and to give us your opinion, so that we can improve our documents further and suit them to your needs.

Clarity

- ○ Found information quickly
- ○ Searched for a long time
- ○ Didn’t find information

  What is missing?
- ○ No answer

Comprehension

- ○ Coherent
- ○ Too complicated
- ○ No answer

Scope

- ○ Too little
- ○ Sufficient
- ○ Too wide
- ○ No answer

Use

- ☐ To get to know the product
- ☐ To choose a product
- ☐ Planning
- ☐ To look for information

Navigation

- ○ I can find my way around
- ○ I got “lost”
- ○ No answer

My scope of functions

- ○ Technical department
- ○ Sales
- ○ No answer

Remarks

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We reserve the right to make technical modifications in the interests of progress.

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