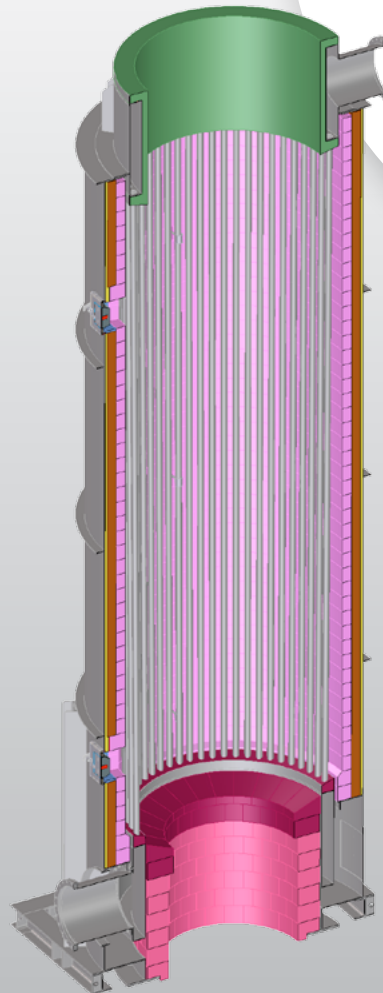
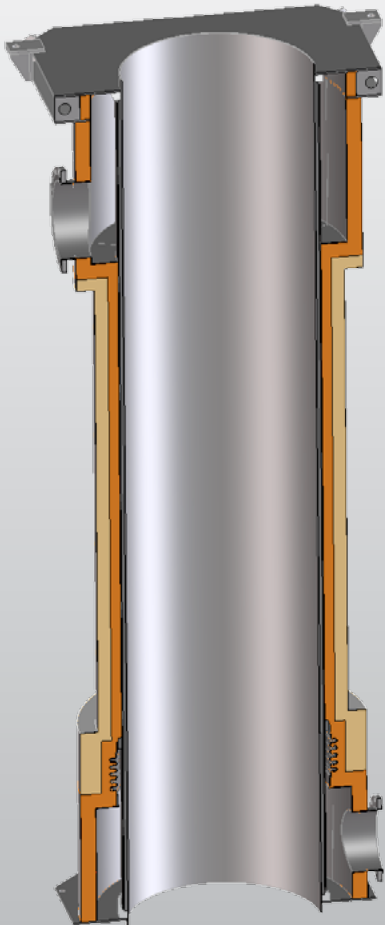




SOLUTIONS FOR THE GLASS INDUSTRY

HEAT RECUPERATORS





The glass industry is very energy intensive and measures to save or recover energy is a key factor in the design of glass melting furnaces.

Glass Service has developed several technologies to save energy saving including the recovery of thermal energy from the waste gases using metal recuperators.

Metal recuperators are a simple and low cost investment for the recovery of waste heat and preheat the combustion air.

The **Glass Service** technology has developed two different recuperator type:

- Double shell
 - o Low investment
 - o Temperature of combustion air preheating max 600°C
 - o Easy maintenance and easy installation

- Tube bundle
 - o Temperature of combustion air preheating max 800°C
 - o External refractory shell can be used for several campaign

Both recuperators can be installed with either bottom/top waste gas flow or top/bottom flow.

The steel quality used is a function of the glass type to be melted and the fuel used (NG or heavy oil) as well as the pollutants in the fuel (e.g. Sulfur). Thanks to over 22 years experience designing and constructing metal recuperators for continuous use, the **Glass Service**, design plus the selection of the correct steel quality can guarantee a long recuperator life.

The fuel saving from recovering waste heat can be calculated as approximately 5% for each 100°C of combustion air preheat. **Glass Service** can calculate the specific fuel saving for each specific application.

Double shell type heat exchanger are manufactured from stainless steel with refractory and outer insulation.

These type of recuperators are made from one inner and one outer stainless steel shell with a suitably positioned axial expansion joint. The assembly is then insulated with ceramic fiber and rock-wool and clad with 0.6 mm thick aluminum sheet.

Combustion air flows between the inner and outer shell while melter exhausts flow inside the inner shell. To improve the heat exchange, stainless steel fins are fitted to the inner tube. For a double shell recuperator, the maximum preheat temperature is 600°C depending on the application.

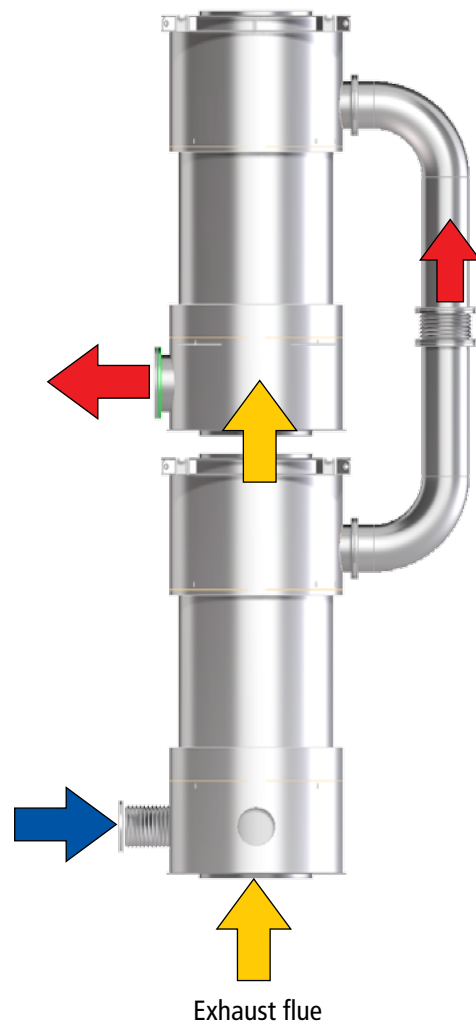
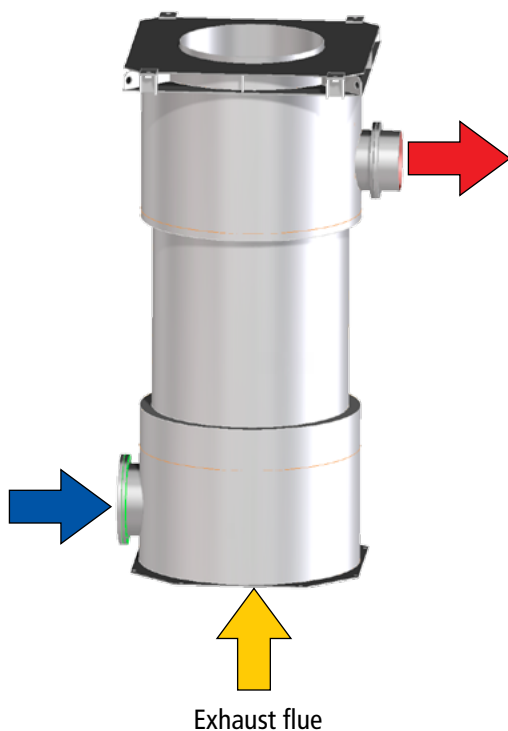
The combustion air is introduced at the base of the recuperator and exits at the top (parallel flow - for combustion air and exhaust gases).

Double shell recuperators can be supplied in two versions:

- SINGLE STAGE, comprising a single recuperator
- DOUBLE STAGE, comprises two recuperators, installed one over the other.

In the DOUBLE STAGE configuration, after the combustion air leaves the lower recuperator, it flows into the upper recuperator from the top and exits from the bottom as shown in the picture.

Each recuperator is suspended from a steel structure with 4 supporting rollers to allow lateral movement for maintenance.



SINGLE STAGE DATA

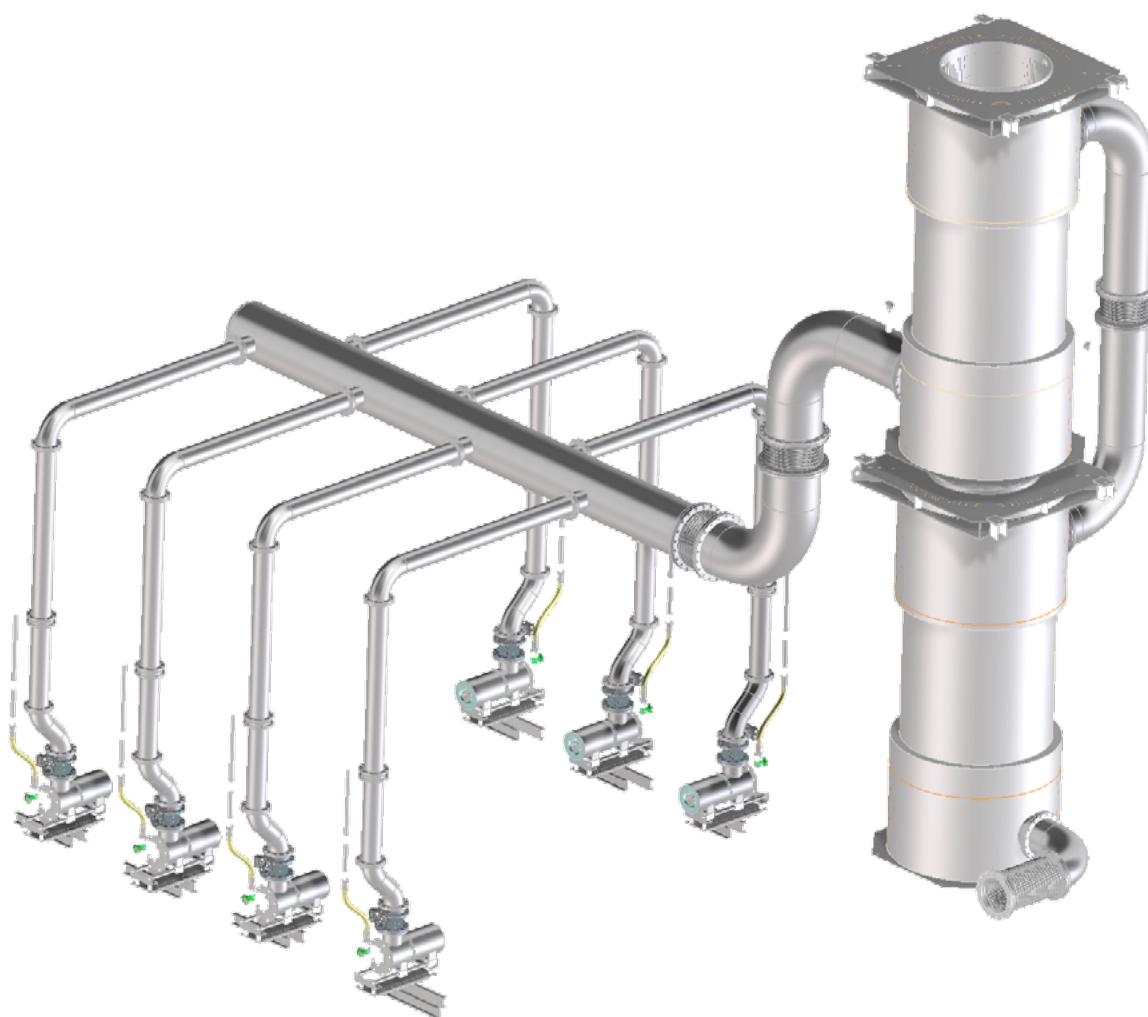
Type	Double Shell - SINGLE STAGE					
Model		REC-C-080/200-...-S-AA	REC-C-095/300-...-S-AA	REC-C-095/450-...-S-AA	REC-C-120/300-...-S-AA	REC-C-120/300-...-S-AA
Number of stages		1	1	1	1	1
Internal diameter	mm	800	950	950	1200	1200
Total height		2000	3000	4500	4500	5500
Theoretical preheat temperature	°C	550				
Exchange surface	m ²	5,0	9,0	13,4	17	21
Natural Gas Max Flow P.C.I.: 8500 Kcal/Nm ³	Nm ³ /h	65	110	170	220	270
Stainless steel flexible joint diameter to burner manifold	Inch	10	12	16	16	16



Typical installation of a single stage recuperator over furnace stack

DOUBLE STAGE DATA

Type of heat exchanger	Double Shell - DOUBLE STAGE				
Model		REC-C-095/300-...-S-AA	REC-C-095/450-...-S-AA	REC-C-120/450-...-S-AA	REC-C-120/550-...-S-AA
Number of stages	mm	2	2	2	2
Internal diameter		950	950	1200	1250
Total height		6000	9000	9000	11000
Theoretical preheat temperature	°C	550			
Exchange surface	m ²	17.9	26.9	33.9	42
Natural Gas Max Flow P.C.I.: 8500 Kcal/Nm ³	Nm ³ /h	230	340	440	550
Stainless steel flexible joint diameter to burner manifold	Inch	12	16	18	18





TUBE BUNDLE RECUPERATORS

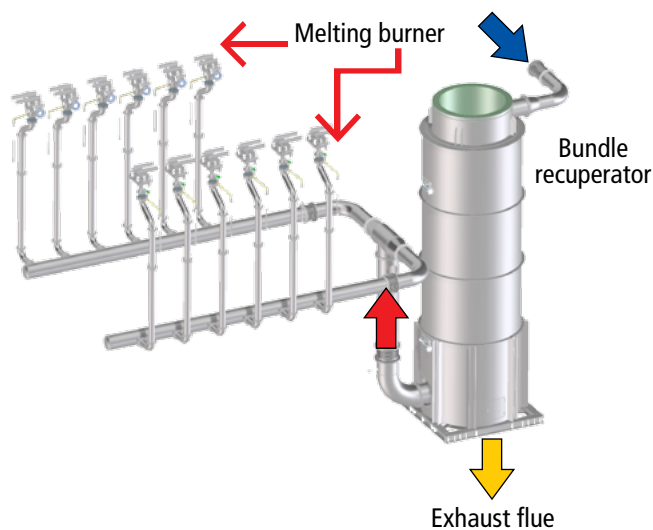
Tube bundle recuperators can be supplied in two versions:

- SINGLE STAGE, comprising a single recuperator
- DOUBLE STAGE, comprising two recuperators, one over the other.

In this case first one is a tube bundle recuperator, the second in the top position is a double shell recuperator

The tube bundle recuperator comprises:

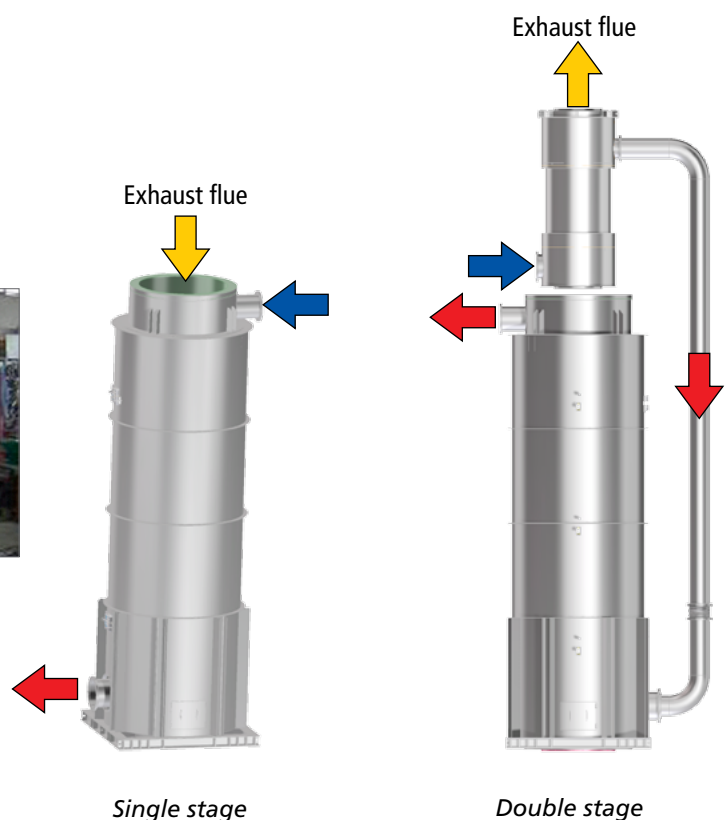
- An external metal cylindrical shell lined with a layer of insulating refractory with a high temperature, high resistance layer, the material selected being dependent on the nature of the glass being melted
- The tube bundle cage, includes special finned stainless steel tubes for improved heat exchange
- Monitoring thermocouple in several locations



For a single stage tube bundle recuperator, the typical maximum preheat temperature is considered to be 650°C, a two stage recuperator, 850°C depending on the application

The design and resulting design of a recuperator is specific to the application taking into consideration:

- Temperature of exhaust gases
- Exhaust gas flow
- Preheating conditions
- Excess air
- Glass type, etc.



Single stage

Double stage



CUSTOMERS WORLD WIDE

HRE-17-01-E



turn key project

batch plants

furnaces:

recuperative

regenerative

gas fired

oil fired

oxy-fuel fired

mixed fuel

electric

forehearth:

colouring forehearth

combustion systems

day tanks

mini melters

boosters

bubblers

metallic recuperators

batch chargers

stirring machines

glass level controls

frit dosing and transport

control cabinets

SCADA and DCS

cooling systems

robotics

gathering - 4 or 5 axis

services:

installation and supervision

commissioning

training

preheating

technology transfer

assistance

laboratory and analysis

refractory consulting

project financing



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