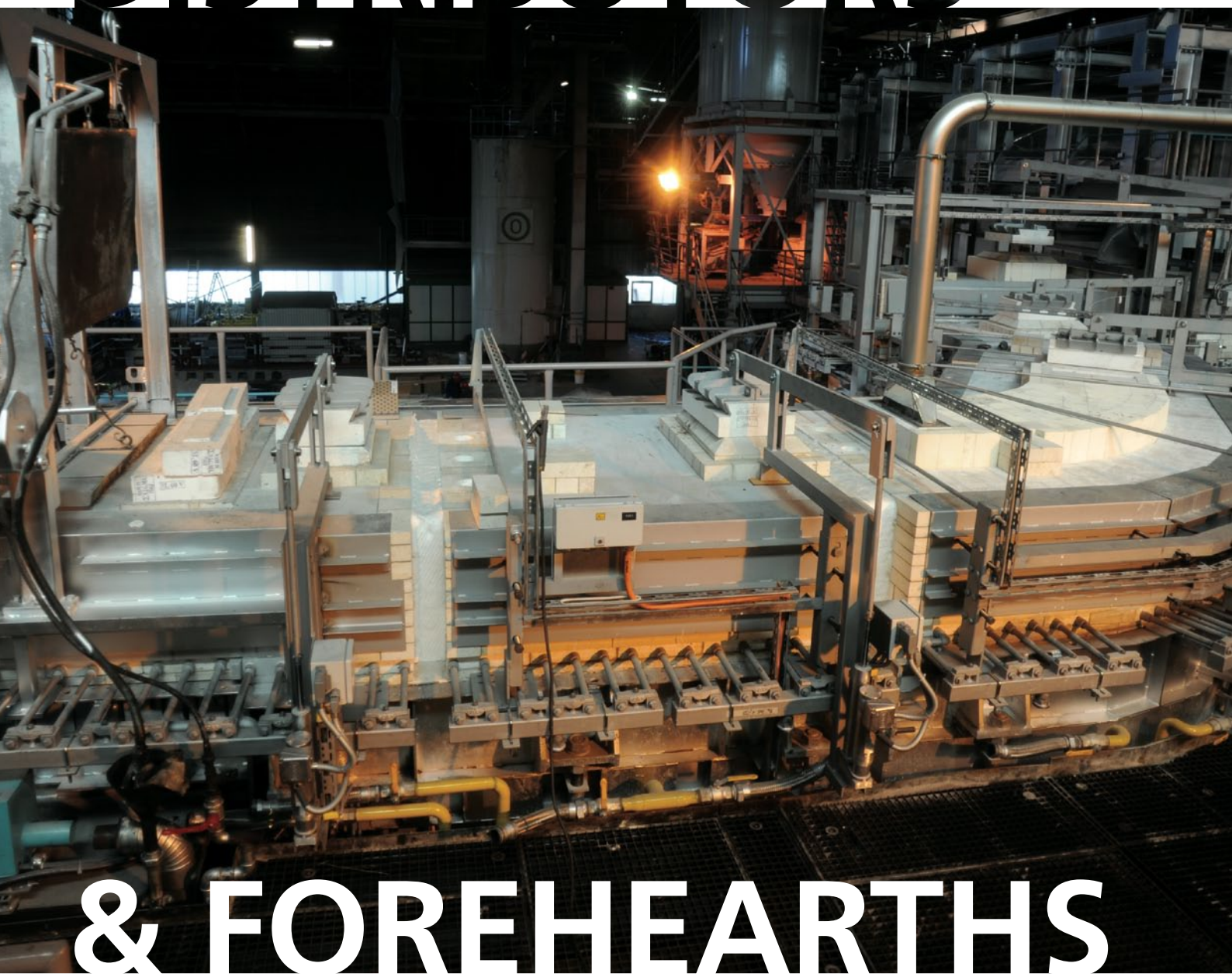
DISTRIBUTORS



& FOREHEARTHS

innovation
ENGINEERED IN GERMANY

HORN
GLASS INDUSTRIES

Distributors and forehearths are vital components of a glass melting plant and are used to forward the molten glass to the production machines. The HORN system allows specific conditioning of the molten glass for each particular forming process while ensuring the highest possible temperature homogeneity (K-factor) of the gob. Glass conditioning always and without exception starts in the distributor and is continued and completed in the forehearths. Therefore the HORN distributor and forehearths are an interconnected system and are engineered as a single unit for the conditioning process.

DISTRIBUTOR "Glass Conditioning System" SERIES 100

Design:

- "Distributor channel" instead of classic "working end"
- Restricted entrance to minimise glass level fluctuations during job changes
- Higher superstructure at the entrance zone – crown execution
- Flat cover blocks at downstream zones
- Optimally calculated distances from the furnace centreline to each forehearth to minimise the risk of glass flow short-circuiting and to optimise the forehearth entrance temperature
- Differentiated control sections for accurate temperature adjustment

Features:

- "Blind" connection for the subsequent installation of an additional forehearth possible
- Opening available for the glass level measuring device "Optibeam"
- Tailor-made for optimised pre-conditioning of the glass
- Different cooling systems are available and adapted to the specific requirements

Dimensions:

- Width from 500mm up to 1.600mm
- Length individually customised to available space, number and arrangement of forehearths

Depth:

- Flint glass up to 500mm in entrance zone
- Green and amber glass up to 400mm, not deeper, due to heat transmission reasons
- Graded glass bath depth (ascending) along the distributor to attain the optimal residence time of the glass inside the distributor channel / glass velocity in front and behind each forehearth entrance

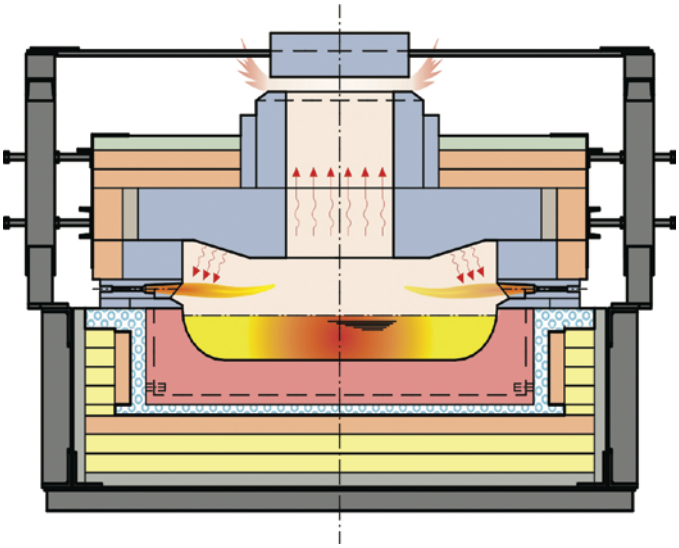
Cooling systems:

Several natural or forced cooling systems are available which are adapted to the design of each distributor:

- Radiation openings
- Direct cooling system (individually adjustable)

FOREHEARTH “Glass Conditioning System” SERIES 200

The system with radiation cooling and waste gas openings



Design:

- Conventional channel design, different refractory qualities possible (e.g. BPAL, HPAL, Alpha-Alumina, fused cast)
- The superstructure is designed to obtain the best possible effect from the combustion system into the glass
- Lowered central section creates flame turbulences for better heat transmission to the lateral outside area of the glass
- Modular construction system to achieve optimum thermal homogeneity combined with minimum energy output
- Used for low to medium tonnage

Dimensions:

- Standard length from 14 to 30ft
- Standard width from 16” to 26”
- Standard glass depth of 4” to 6”
- T-type or Y-type for tandem production available, depending on total pull and/or product

Radiation and waste gas openings:

- Radiation openings are provided in the forehearth superstructure at each cooling zone
- Openings are sized according to the required cooling and are located at the beginning of each zone
- Through adjustment of the damper, the heat radiation through the opening is variable
- All damper mechanisms can be operated manually or automatically
- Separate openings are used for waste gases to escape in case the dampers of the radiation openings are closed during low forehearth pull

Features

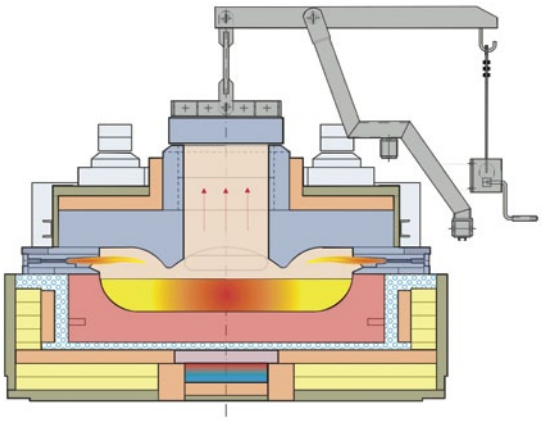
- Special cover block design to achieve high temperature homogeneity
- Fast and effective cooling with radiation flaps
- Refractory can be designed for additional stirrers, drain system or forehearth boosting

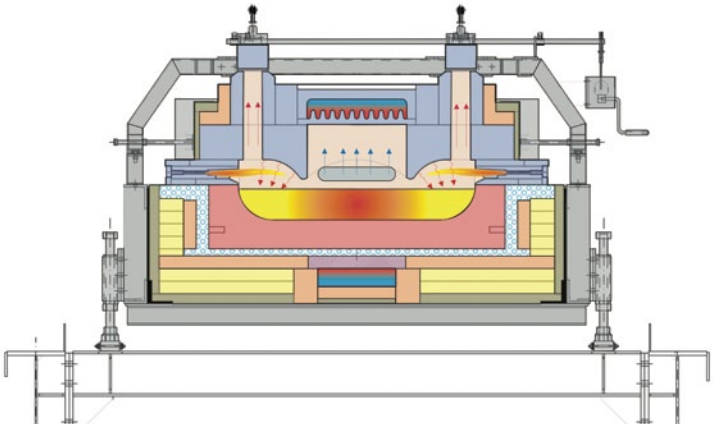
FOREHEARTH “Glass Conditioning System” SERIES 301

System with indirect forced cooling and direct rapid cooling

Design:

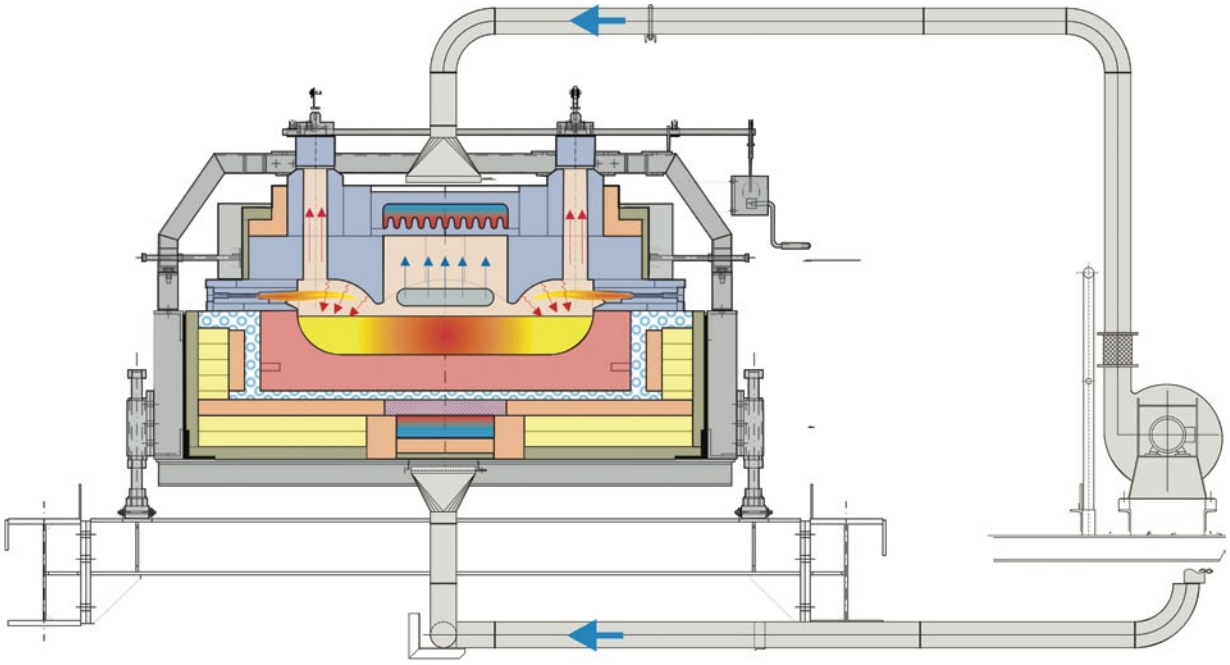
- The GCS Series 301 is based on the design of the GCS Series 300 with an additional direct forced cooling system to increase response time and flexibility
- Special roof cover block for area separation along the control zones:
  - separated boundary areas to heat the glass particularly at the side of the forehearth
  - separated central section to guide direct cooling air
- Roof design with indirect centreline cooling
- The GCS Series 301 design allows a wide range of gob temperatures required to produce different sized articles and multiple job changes
- Improved glass conditioning
- Reduced insulation layers for higher flexibility





Dimensions:

- Standard length from 20 to 50ft
- Standard width from 36” to 54”
- FT-type or Y-type for tandem production available, depending on total pull and/or product



Radiation openings:

- Radiation openings are provided in the forehearth superstructure of the cooling zones
- Openings are sized according to the channel width and located at the end of each zone
- Through adjustment of the damper, the heat radiation through the opening is variable
- All damper mechanisms can be operated manually or automatically
- By exact adjustment of the dampers, the residence time of the waste gas (see above) moving into the central area of the forehearth can be controlled

Note:

This system provides the possibility of influencing the heat intensity in each separated area. By balancing the waste gas portions in each separated area along the forehearth, the highest thermal homogeneity can be achieved.

Features:

- Roof design to separate each control section in two boundary areas and one central area
- Central area with direct and indirect air cooling
- Adjustable direct cooling air above glass surface to cool central area and left and/or right boundary area
- The GCS Series 301 design allows a wide range of gob temperatures required to produce different sized articles and multiple job changes
- High thermal homogeneity for flint glass and coloured glass (incl. forehearth boosting)
- Refractory can be designed for additional stirrers, drain system or forehearth boosting

Centreline top cooling (indirect):

- Cooling zones are constructed with a central channel inside the refractory superstructure
- This channel stretches across approx. 70% of the length of the cooling zone
- Between glass surface and cooling channel, slots are positioned to channel the heat radiation from the glass to a "heat exchanger plate" with profiled surface for heat convection purposes
- Cooling air provided by a fan can be blown through the channel with the glass flow direction and extracts the heat through convection on the "heat exchanger plate"
- The amount of cooling air is controlled by a blower with butterfly flap and actuator

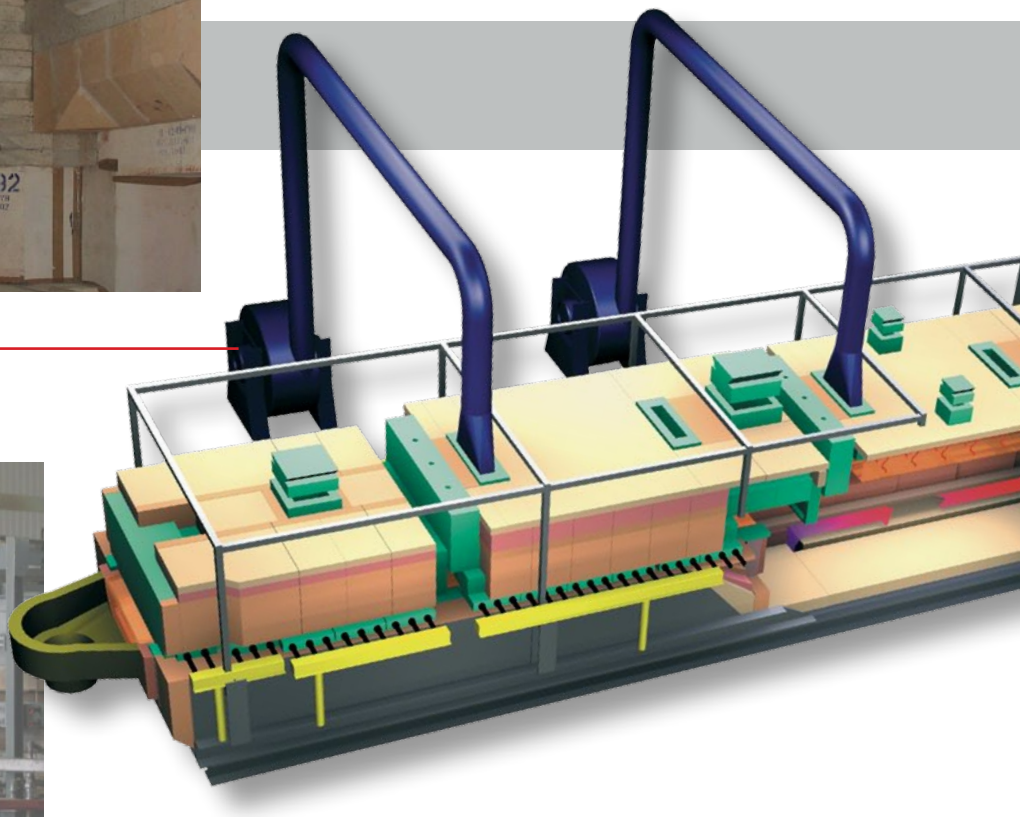
Centreline top cooling (direct):

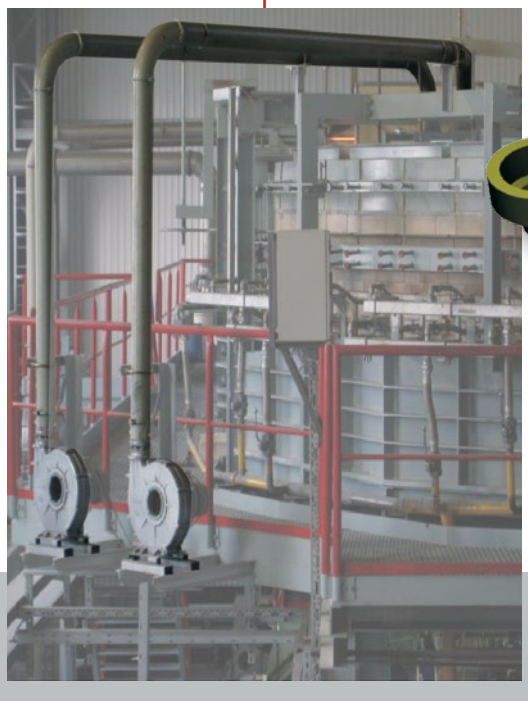
- Direct cooling air is applied onto the glass surface in the central section of the forehearth. The cooling air is inserted via holes in the mantle block by fans
- The cooling air is channelled between the separated boundary areas, underneath the superstructure, and leaves the forehearth through the central radiation opening
- In order to "spread" the air layer on the glass surface to the right and/or left boundary sections, the air can also be released via the right and/or left lateral chimneys

Centreline bottom cooling:

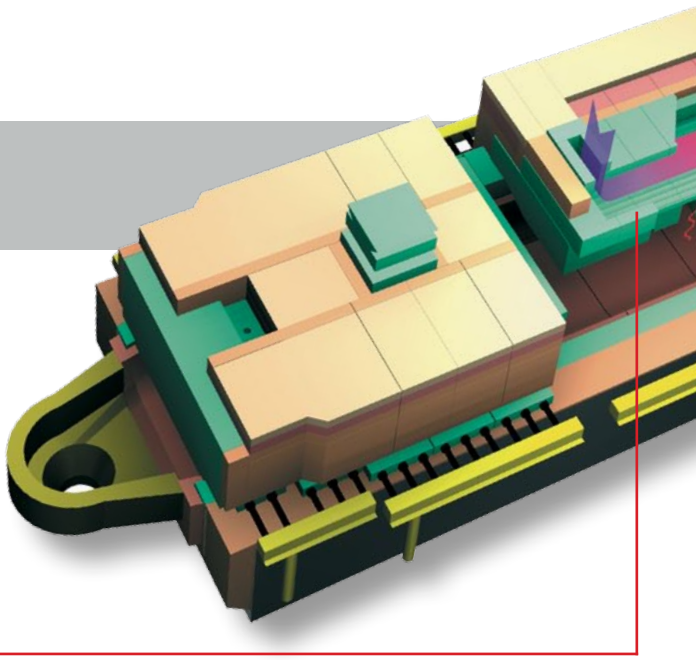
- The bottom cooling works according to the same principle as the top cooling
- The cooling channel is located under the channel blocks, in the entrance zone of the forehearth
- It is located under the centreline and restricted to the inner third of the channel width
- The cooling air flow direction is against the glass flow direction
- The bottom cooling channel is a standard installation in GCS Series 200 and 301 for the subsequent installation of a blower, in case the product profile changes

Direct cooling distributor



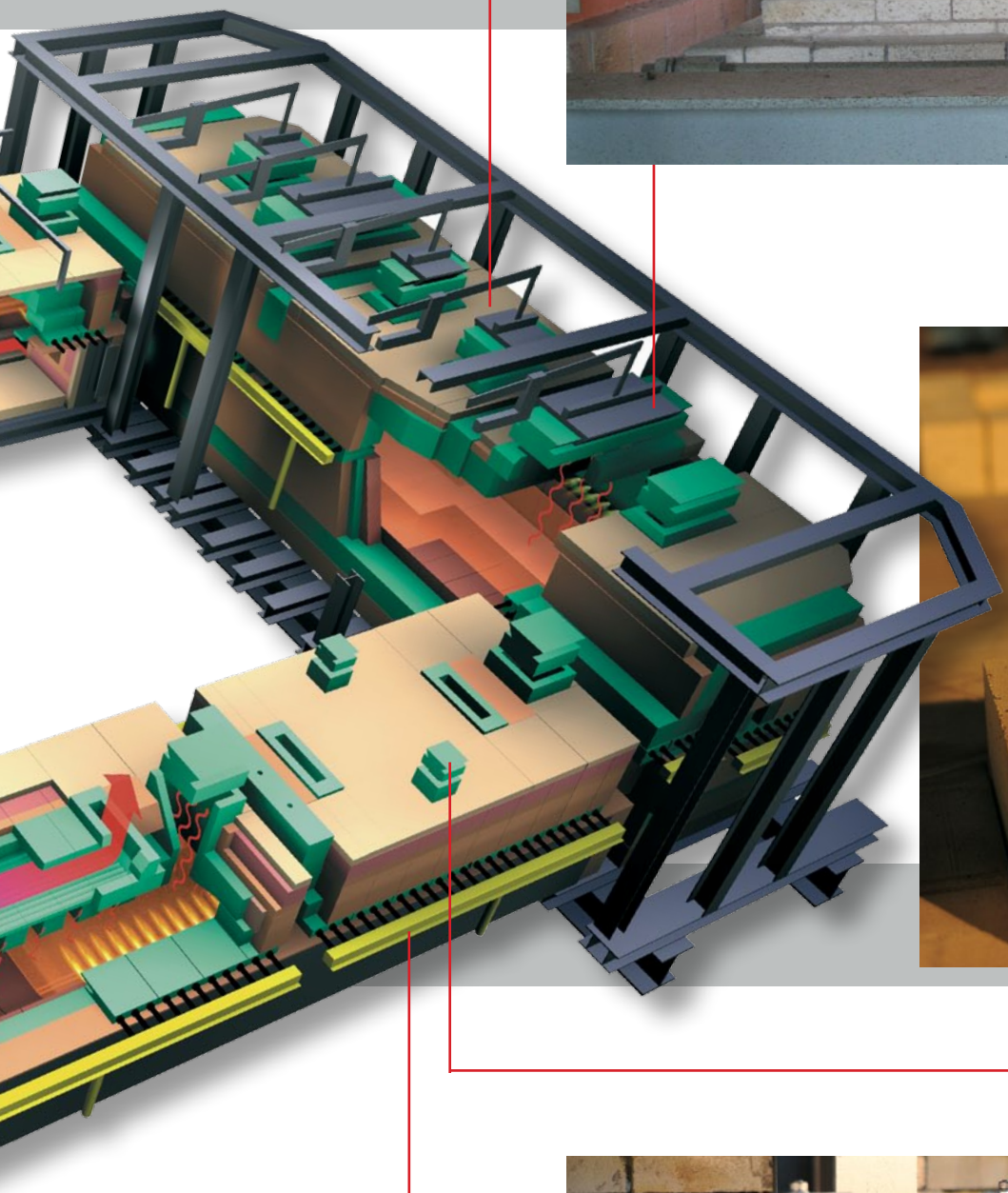


Cooling fan

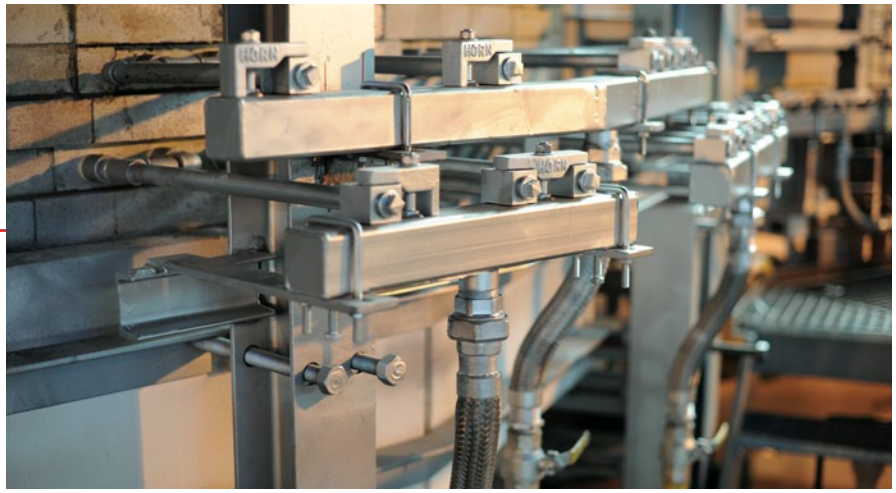


Centreline top cooling

Radiation flap



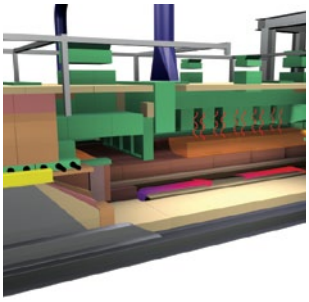
Waste gas openings



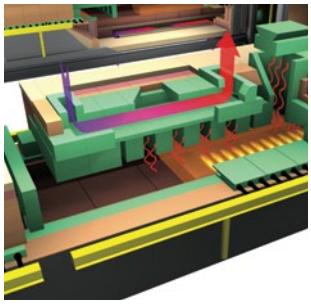
Double burner manifold

Gas / air mixture burners

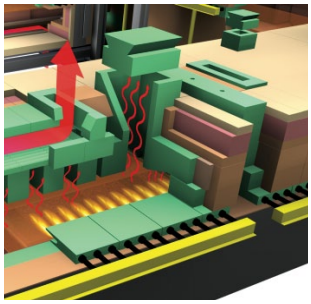
OPTIONS



Indirect bottom cooling



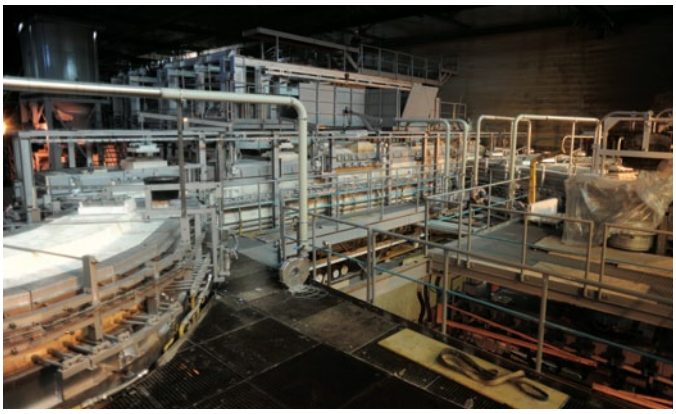
Indirect superstructure cooling



Radiation opening

Direct cooling

	GCS 100	GCS 200	GCS 300/301
CoRa-Heating	X	X	X
Radiation openings	X	X	X
Waste gas openings	X	X	X
Indirect cooling	O	O	X
Direct cooling	O	-	O/X
Stirrer bank	X	O	O
Equalising-Booster	X	O	O



Key: X: included O: available -: not included

Steel work

- Assembly of the forehearths follows conventional design
- Substructure refractories are enclosed in steel casings
- Superstructure is held together by bracing work

Refractories

- Designed for today's technical requirements to achieve optimum thermal homogeneity combined with minimum energy requirement
- Channel blocks of zircon mullite, fused AZS or alumina material (e.g. BPAL, HPAL or AlphaAlumina)
- Channel block joints are reinforced with zirconium mullite split tiles and surrounded by suitable graded insulation material
- Forehearth superstructure in sillimanite material and insulated with suitable graded material

CORA mixture heating system

- Constant gas-air Ratio
- Safety switch-off system (in accordance with DIN EN 746-2)
- Automatic lambda (λ) control (optional)
- Preassembled skids for easy installation including pipework
- Used at distributor and forehearths (GCS Series 200 and 301)

Measurement and control system

- Fully automatic temperature control loops in each zone
- Different types of temperature measurements (thermocouples & pyrometers) are available for each zone
- High measuring accuracy by immersed thermocouples
- Grid-measurement in equalising zone with K-factor calculation, according to formula of choice (e.g. Owens, Emhart 9 or 5-point formula, or specific customer formula)
- All measuring and control instrumentation housed in a completely assembled and wired control panel
- Spout bowl controlled manually or automatically

Optional equipment for forehearth GCS 200 & 301:

Prevention of "cat scratch":

- HORN draining system "VARI-DRAIN®"
- Stirrer bank in equalising zone

Increased thermal homogeneity:

- Stirrer bank in equalising zone
- Forehearth boosting

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HORN GLASS INDUSTRIES

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