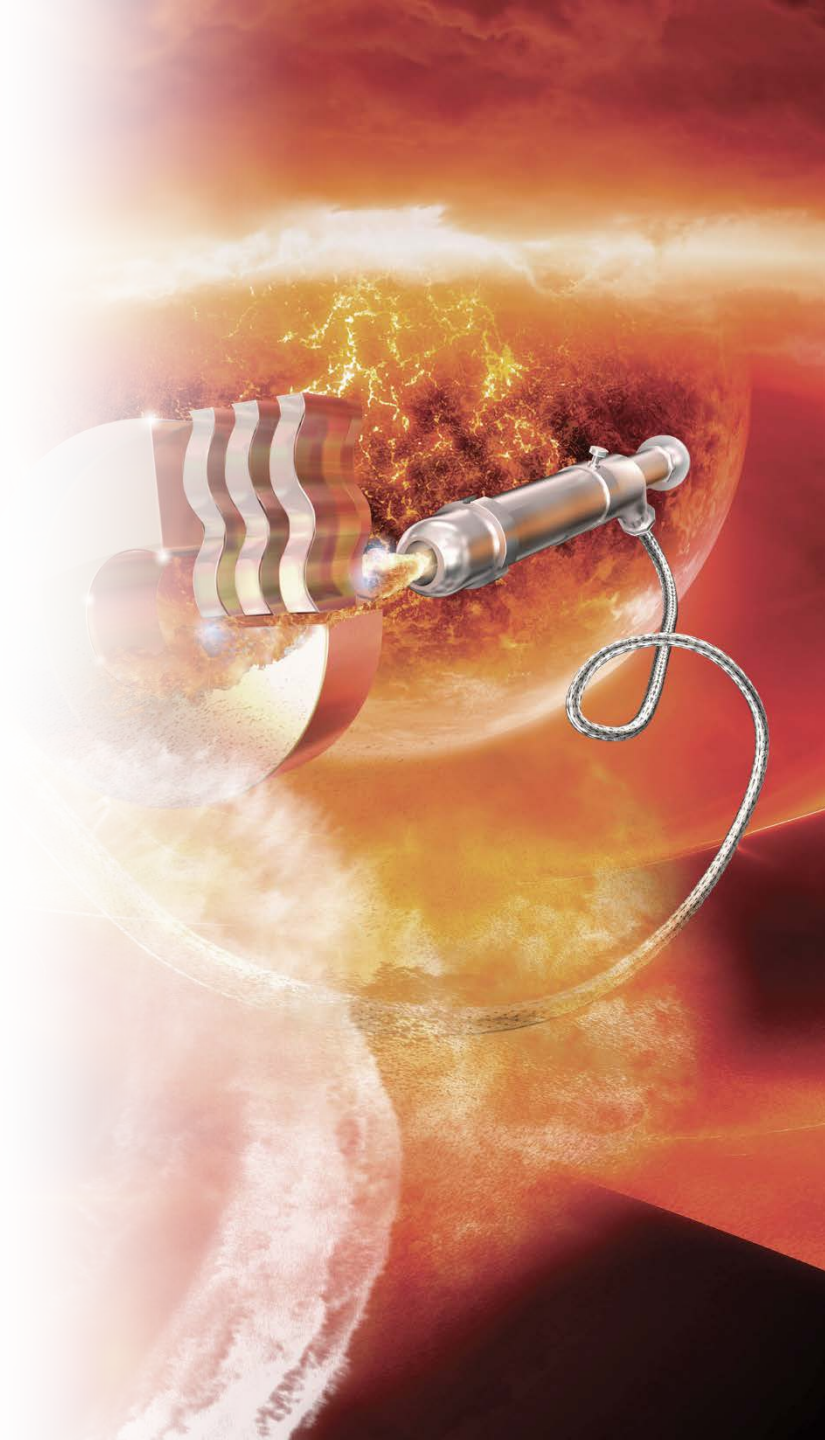


# GLASS MELTING TECHNOLOGY

**HORN**  
GLASS INDUSTRIES

INNOVATION ENGINEERED IN GERMANY

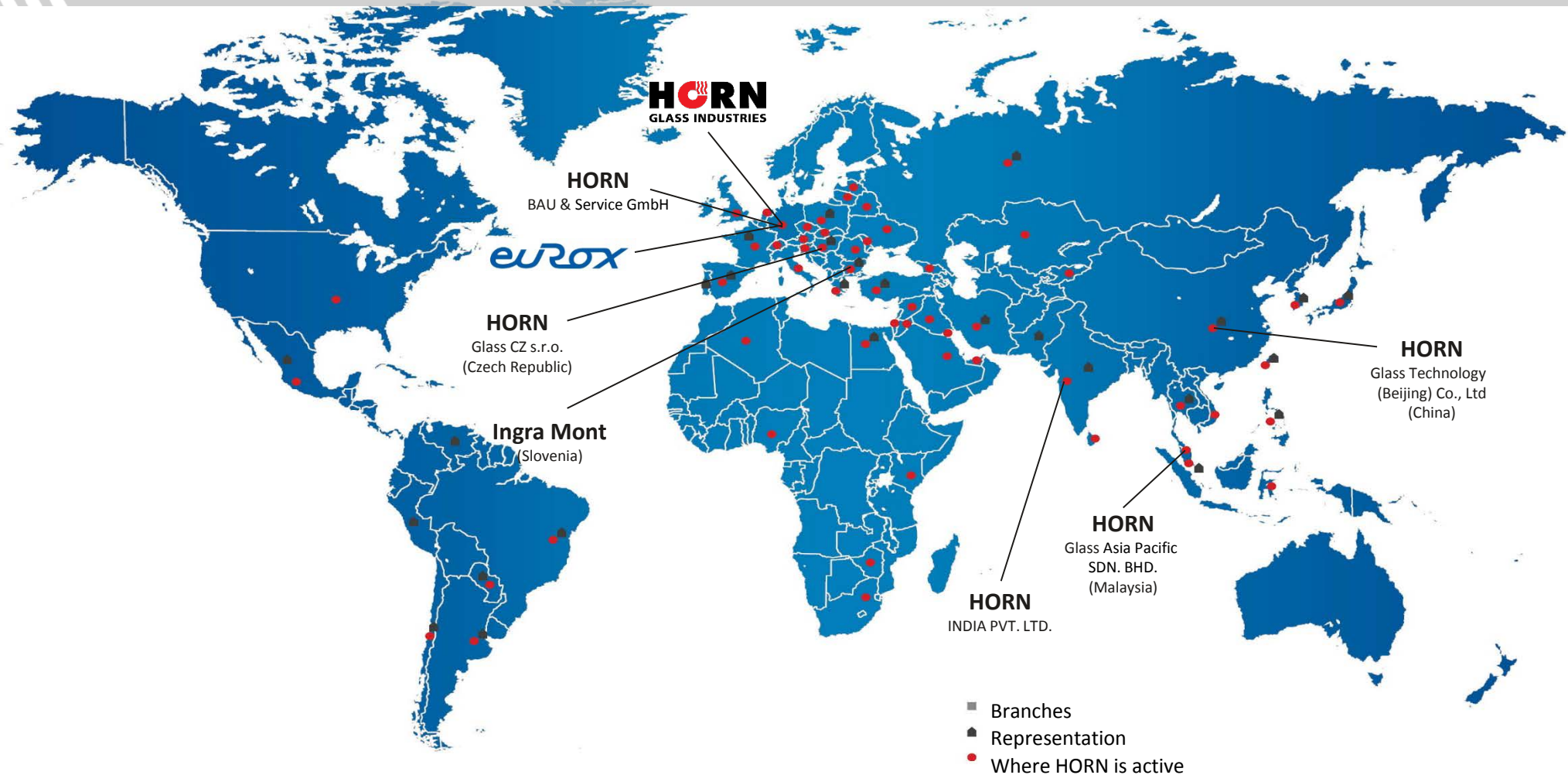


# History

- **1884** The company August HORN is founded
- **1999** Take-over & restructuring by Certina AG
- **2003** DIN EN ISO 9001:2000 certification by Lloyd's Register
- **2012** Acquisition of HORN Glass Cz s.r.o
- **2012** Acquisition of HORN Glass Cz s.r.o and HORN Asia Pacific SDN. Foundation of HORN Glass Technology (Beijing) Co
- **2014** EUROX Sauerstoff Mess-Systeme GmbH is founded



# The World of HORN



# Plant Location

Visitors to HORN can land at several airports:

- Frankfurt a. M.: 270 km
- Munich: 210 km
- Nuremberg: 130 km
- Prague (Czech Republic): 180 km





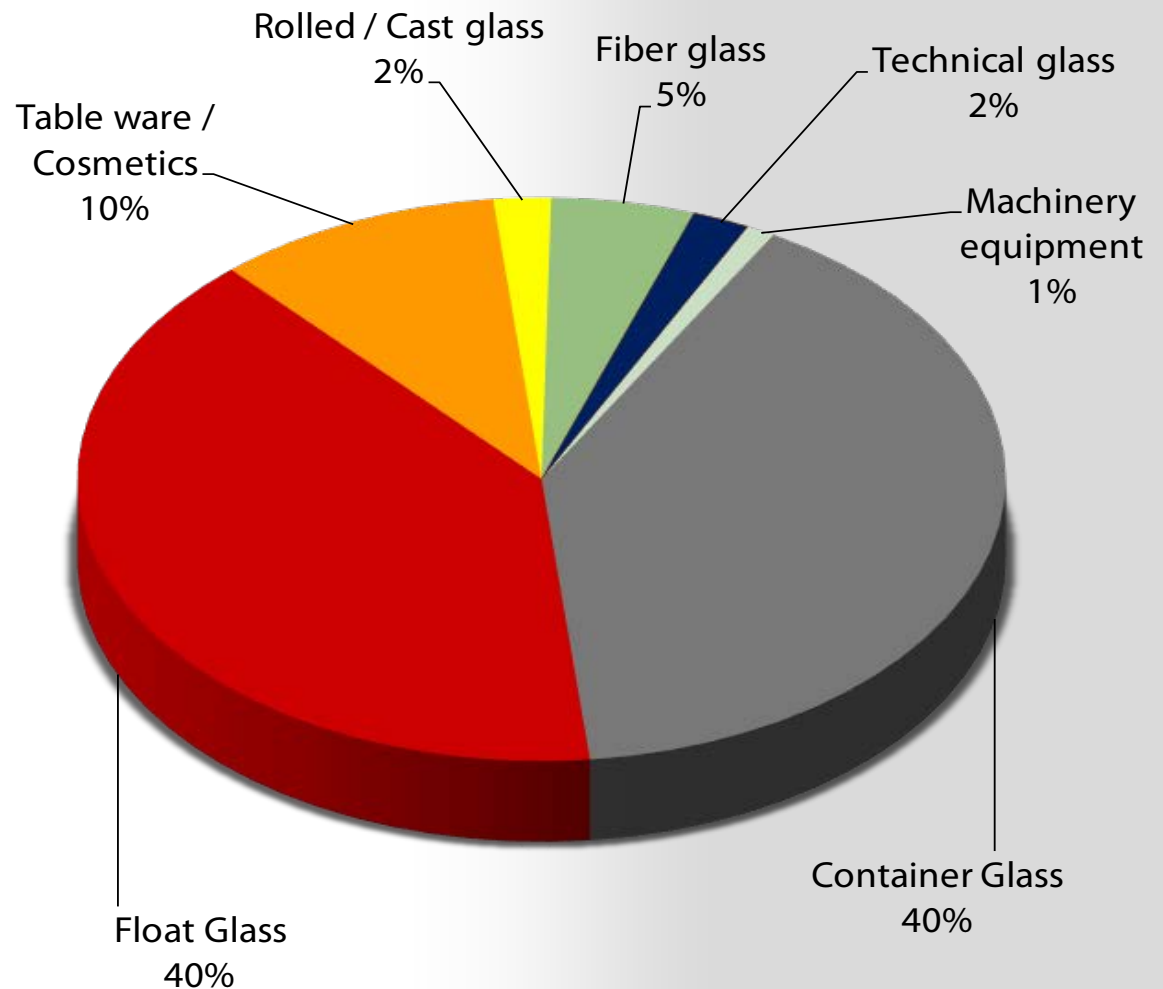
# Plant Area

- Plant area: 11.000 m<sup>2</sup>
- Office area: 2.500 m<sup>2</sup>
- Workshop area: 7.400 m<sup>2</sup> (incl. Storing area)



# Customer segments

- The main buyer of the products, systems or service are located in:
  - > container glass
  - > float glass
  - > table ware / cosmetic
  - > pharmaceutical
  - > cast glass
  - > fibre glass
  - > technical glass



# Facts

- Turn over: 40 - 80 Mio Euro
- Employees: ~ 240
- Customers: 440 in 61 countries.
- Export quota: 70-80%
- Furnace/plant projects per year: 10 - 15



PRODUCTS  
PID  
PNAME  
PDESC  
POOL

# References – Container Glass

- Vetropack Group
- Ardagh Group
- Verallia Group
- Gerresheimer Group
- Wiegand Glass, Germany
- Vetrobalsamo, Italy
- Vidrala, Spain
- Nampak, South Africa
- Sisecam, Turkey
- Razi Glass, Iran
- Shishe Va Gas Co., Iran
- RAK Ghani, UAE
- Wadi Glass, Egypt
- Milly Glass Works, Kenia
- Alver Spa, Algeria
- Sotuver, Tunisia
- Central Glass, Kenia
- Frigo Glass, Nigeria
- AmBev, Brasil
- Vidroporto, Brasil
- Asia Brewery Inc., Philippines
- Qixia Chang YU Glass Co., Ltd., China
- KC Glass & Material, Korea
- Dmitrovsteklo, Russia
- Kavminsteklo, Russia
- OMSK, Russia
- RASCO, Russia
- Wolnogorskoye Steklo, Ukrainia
- Malinovskij, Ukraine
- Hindustan National Glass, India
- Piramal Glass, India
- Piramal Glass Ceylon, Sri Lanka
- Hwa Hsia Glass Co. Ltd., Taiwan
- Ta Hsiang Container Co., Taiwan
- Wellgrow, Thailand
- San Miguel, Vietnam, Philippines
- Shenzhen Tongchan Group, China
- Sichuan Malaya Glass, China
- Saver Glass, U.A.E
- Malaya Glass, Malaysia
- JG Containers, Malaysia
- Gürok Turizm VE. MAD. A.S., Turkey
- Noelle+von Campe, Germany
- Campalia Glass Plant, Uzbekistan
- OOO “Sirdaryo Universal Oyna”, Uzbekistan







# References – other

## Float Glass

- Salavatsteklo, Russia
- Gomelglass, Belarus
- Interglass, Kirgistan
- Caspian Flat Glass, Russia
- Pilkington, Germany
- Azmeel, Saudi Arabia

## Fibre Glass / Special Glass

- Lipex, Germany
- Glaswolle Wiesbaden, Germany
- ISOVER, Germany
- ISOVER, Romania
- Eglass, Germany

## Figured / Solar Glass

- Jai Mata Glass, India
- El Nasr Glass, Egypt
- Al Majdal Co., Irak
- UBV, Brazil
- Lamberts, Germany

## Borosilicate Glass & Tubing

- Schott
- Philips
- General Electrics, Hungary

## Table Ware

- Nachtmann
- Schott Group
- Ritzenhoff
- LAV, Turkey
- Sisecam, Turkey
- Kedaung, Indonesia
- Durobor Group S.A., Belgium
- R.A.K. Glass, UAE
- Lucky Glass, Thailand
- Mahmood Saeed Glass, SA



# Product Range and Expertise

## FLOAT GLASS

### Process Line

- Batch Plant
- Furnace
- Tin Bath
- Annealing Lehr
- Automation
- Cutting Line
- Cullet Return System

### Utilities

- Nitrogen Generating Plant
- Hydrogen Generating Plant
- N<sub>2</sub> / H<sub>2</sub> Mix Station
- Cooling Water
- Compressed Air
- Electric Power supply
- SO<sub>2</sub> Station

### Miscellaneous

- Warehouse Equipment
- Waste Gas Treatment
- Laboratory Equipment
- Raw Material Treatment

## HOLLOW WARE & SPECIAL GLASS

### Furnace Technology

- Refractory Material
- Steel Construction
- Combustion System
- Flue Gas Equipment
- Tank Cooling
- Control Equipment
- Glass Level Control
- Electric Boosting System
- Charging Machines

### Glass Conditioning Technology

- Distributors / Forehearths
- Combustion System CORA

### Miscellaneous

- Drain System
- Stirrer Unit

## SERVICES

### Furnace Engineering

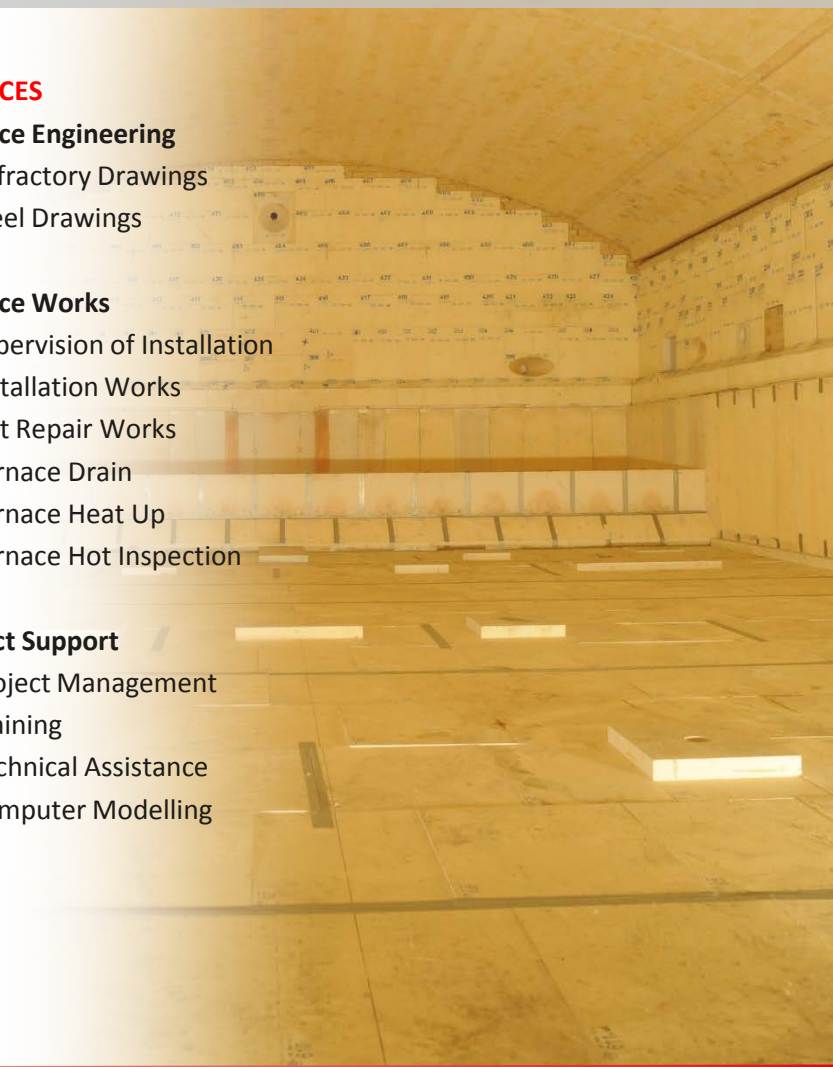
- Refractory Drawings
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### Furnace Works

- Supervision of Installation
- Installation Works
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- Furnace Drain
- Furnace Heat Up
- Furnace Hot Inspection

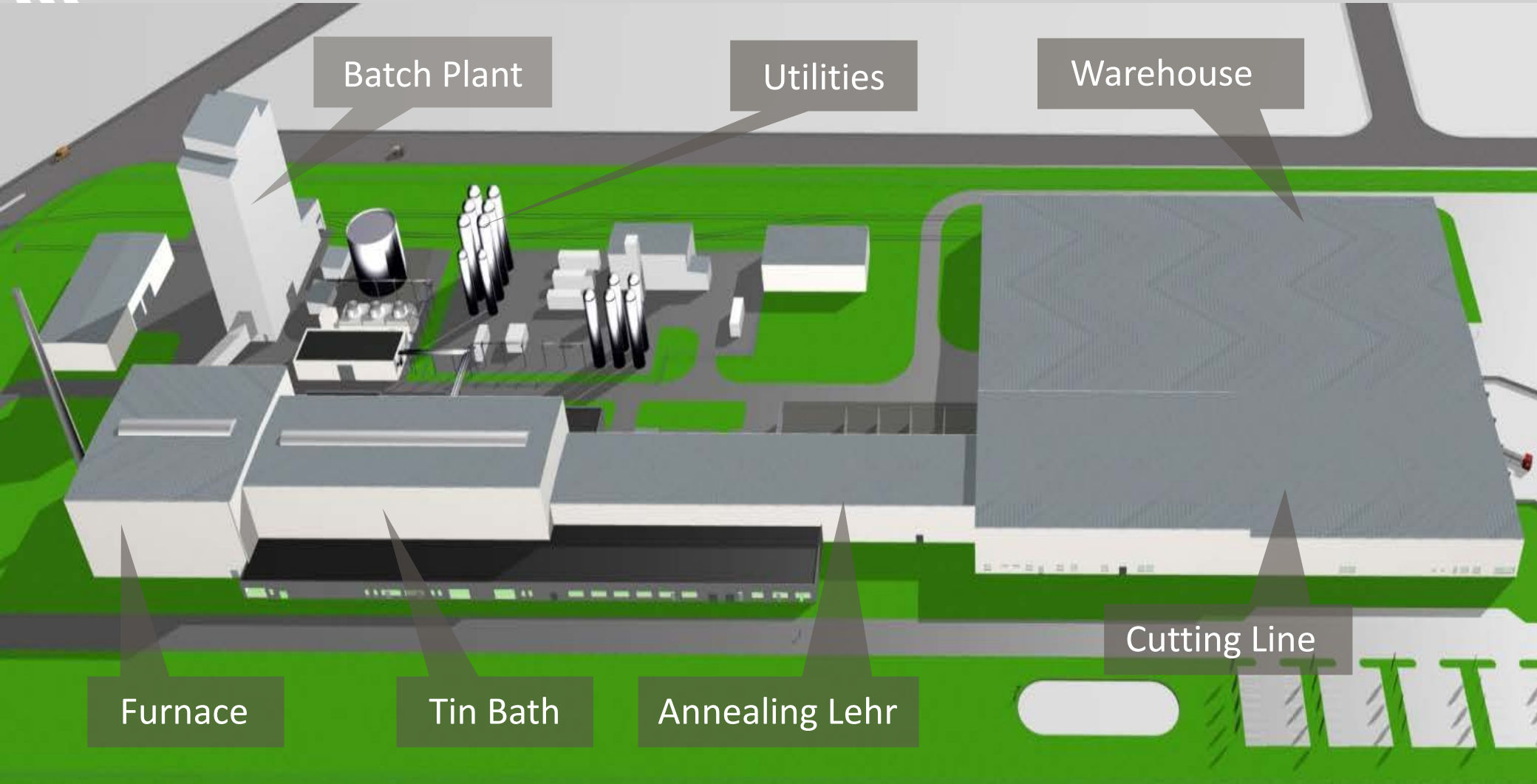
### Project Support

- Project Management
- Training
- Technical Assistance
- Computer Modelling



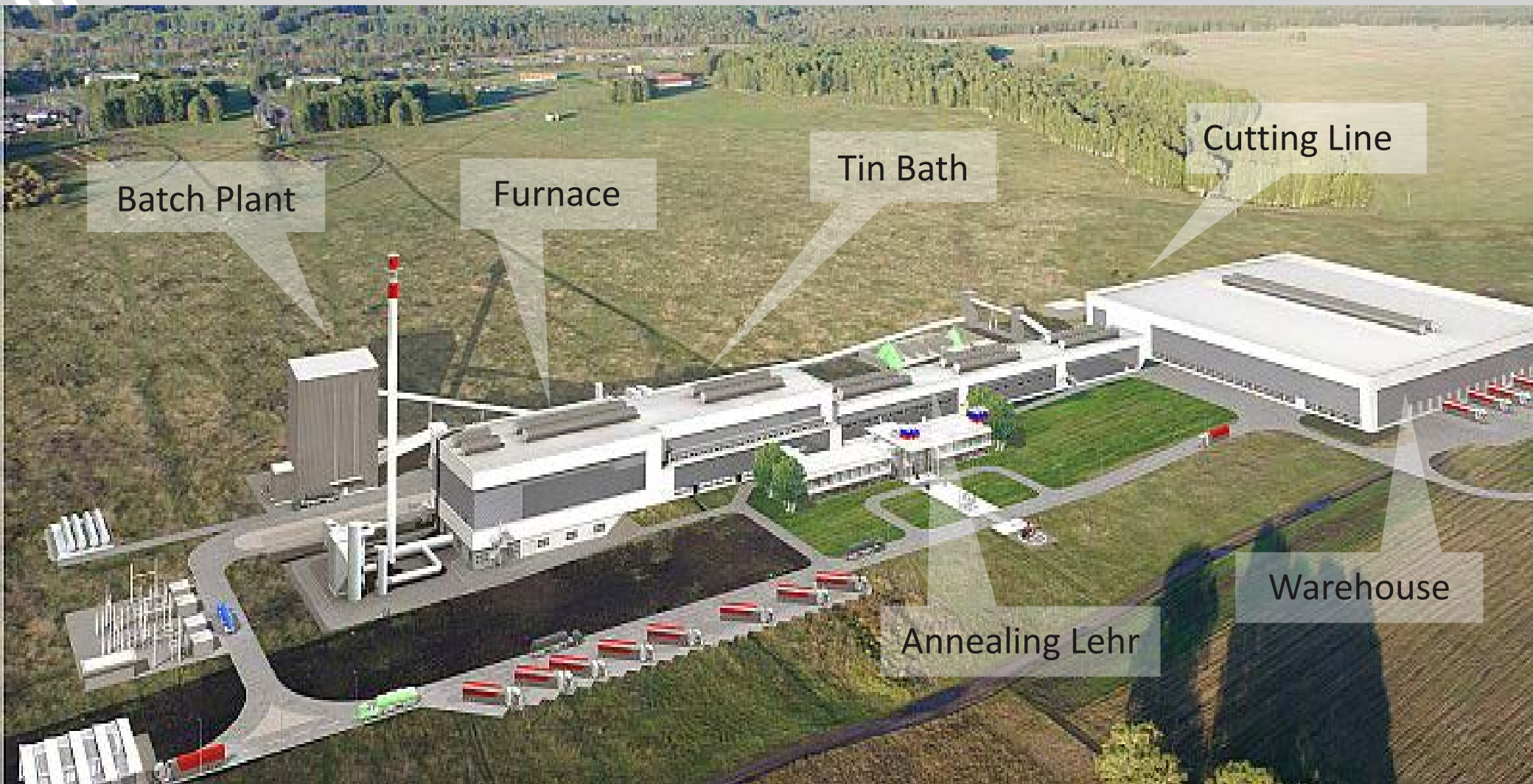
# Process Line

Float Glass



# Process Line

Float Glass



# Process Line

Float Glass

## Batch Plant

- Different raw materials are stored, mixed and provided for the melting
- HORN scope of supply comprises unloading, weighing, dosing, mixing and transfer system
- Batch dedusting as well as control system is included
- Silos and building usually by customer



# Process Line

Float Glass

## Furnace

The mixture of raw materials is molten at 1450 °C and conditioned for the subsequent forming process

The furnace consists of:

- Refractory material
- Steel construction
- Combustion system
- Tank cooling and combustion air supply
- Control system and glass level control
- Batch chargers
- Bubbling system
- Stirrer equipment and neck cooler
- Waste gas reversing unit
- Furnace camera system



### Tin Bath

- Glass melt from the furnace reaches the tin bath spout and floats onto the surface of the molten tin.
- Under gravity, surface tension forces and also stretching effect of top rollers as well as drawing effects of the annealing lehr conveyors, the glass melt turns into continuous glass ribbon of required thickness and width.
- Main components are spout, tin bath tank, bath roof, technological equipment and dross box.

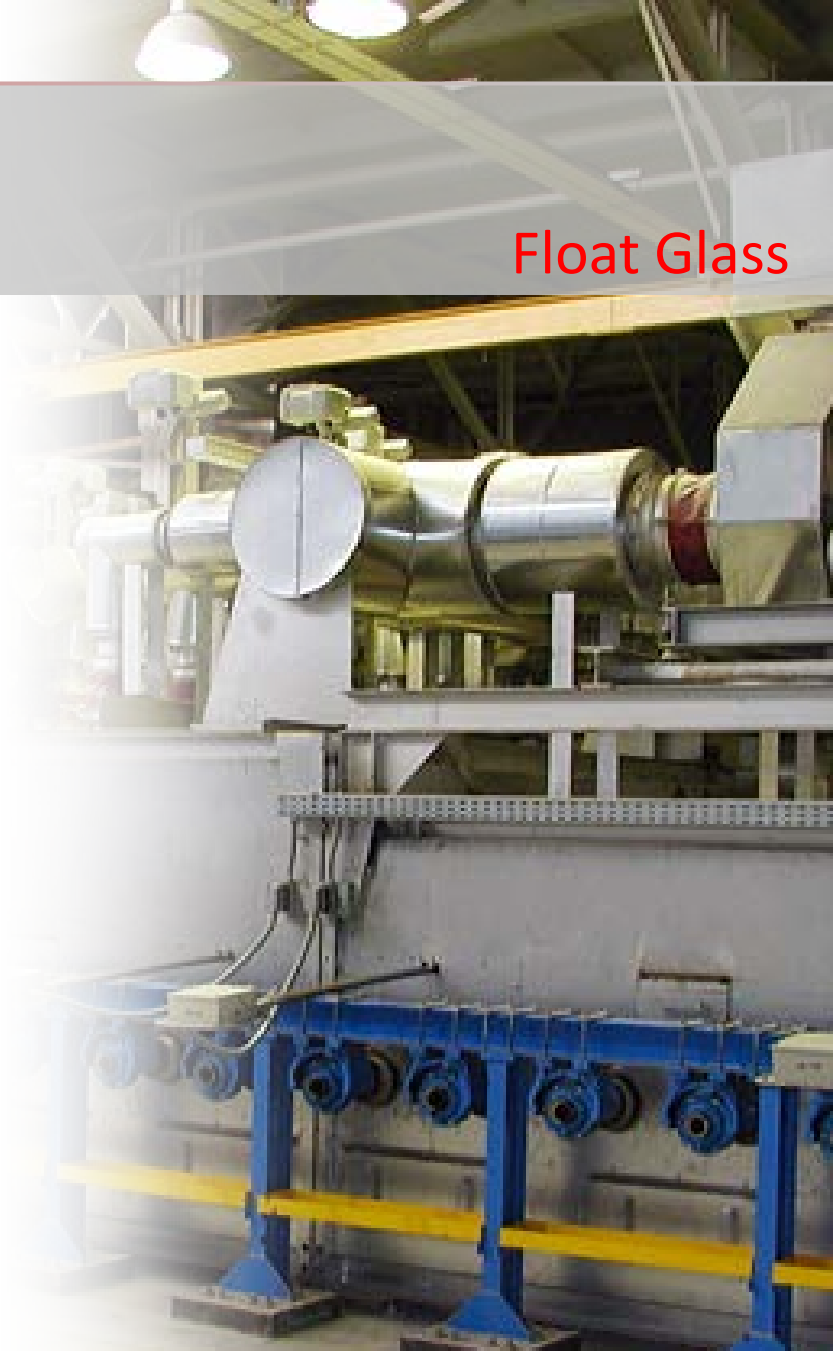


# Process Line

Float Glass

## Annealing Lehr

- The lehr is designed for glass cooling under certain temperature condition between 600 – 70°C to create the correct residual stresses.
- Highly insulated tunnel kiln in the closed area of the Lehr (A-C)
- Transport roller and lift out roller
- Electrical heating with power supply and control equipment
- Cooling equipment for cooling the glass ribbon



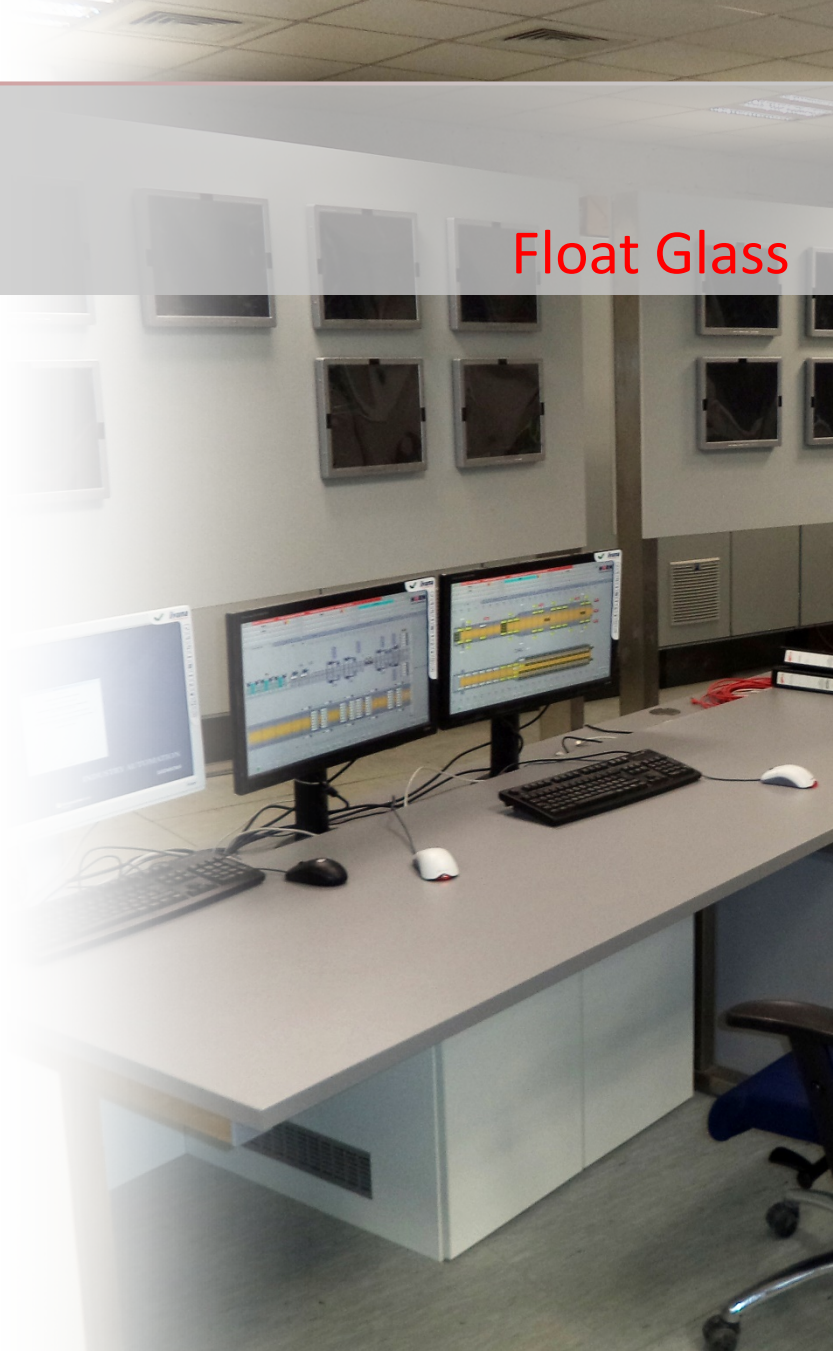


# Process Line

Float Glass

## Automation

- The automation simplifies the controlling of the process. All information is stored and analysed in personal computer based units. The entire plant and all of the control devices will be monitored on operator screens and can be operated in a centralized control room.
- Hot end automation for melting furnace, tin bath and annealing lehr and visualization of batch plant and cutting line.
- Automation includes field instruments, controllers, server and visualization

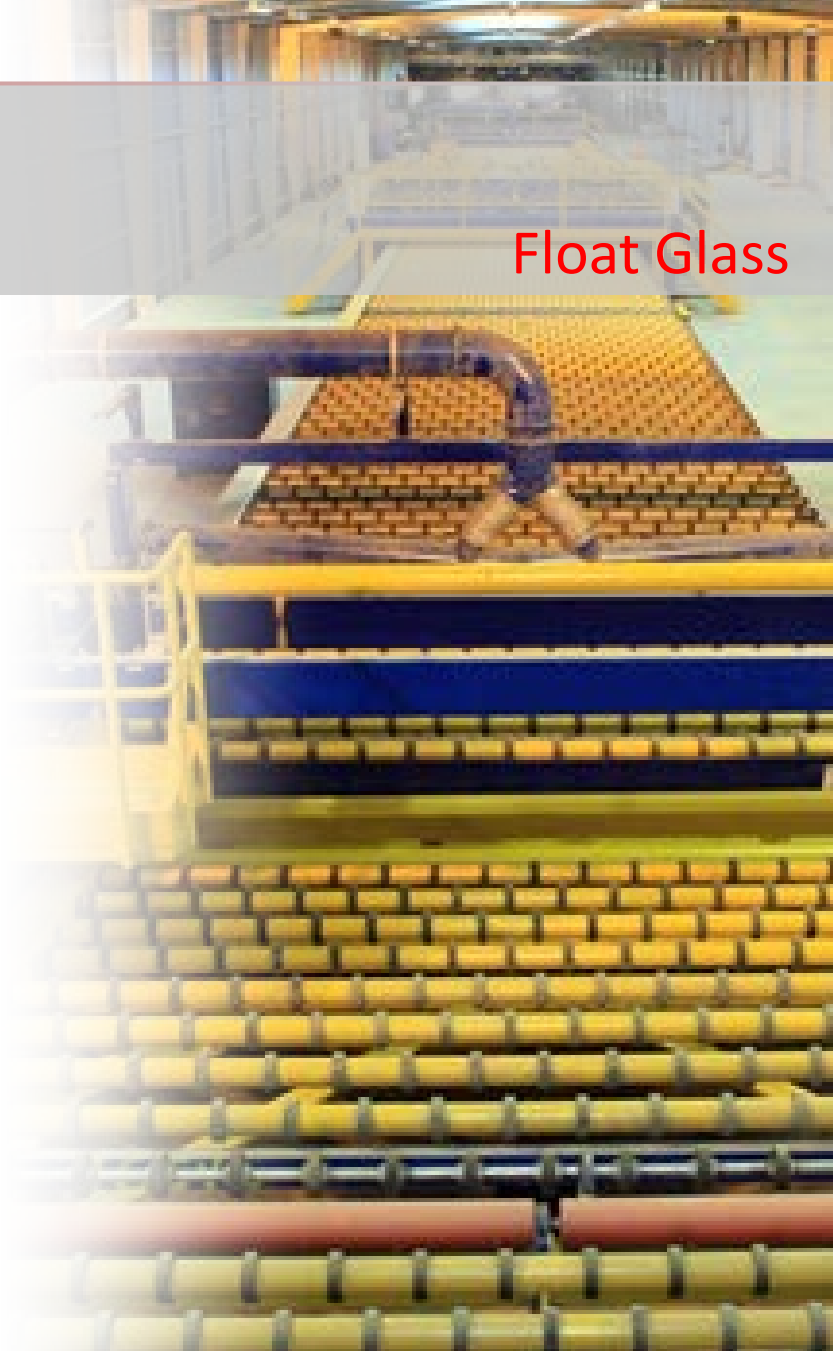


# Process Line

Float Glass

## Cutting Line

- After the annealing process the glass ribbon enters the cutting line. The glass ribbon will be processed by following facilities:
  - > Cutting in required glass formats
  - > Quality inspection
  - > Transported to stacking area
  - > Stacking from tin or air side by robot or swing stackers
- The cutting line will be controlled from Cold End Control Room, visualised in Hot End Control Room or operated at field control pannels.



# Process Line

Float Glass

## Cullet Return System

- Cullet on this line originating from
  - > Emergency cutting
  - > Edge cutting
  - > Glass ribbon and sheet quality control.
- After crushing all cullet are supplied to cullet hoppers below the line.
- From the cullet hoppers the cullet are fed by transport conveyors to the cullet storage area or direct to the batch plant cullet silos.





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- Compressed Air
- Electric Power Supply
- SO<sub>2</sub> Station

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## HOLLOW WARE & SPECIAL GLASS

### Furnace Technology

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- Steel Construction
- Combustion System
- Flue Gas Equipment
- Tank Cooling
- Control Equipment
- Glass Level Control
- Electric Boosting System
- Charging Machines

### Glass Conditioning Technology

- Distributors / Forehearths
- Combustion System CORA

### Miscellaneous

- Drain System
- Stirrer Unit

## SERVICES

### Furnace Engineering

- Refractory Drawings
- Steel Drawings

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- Supervision of Installation
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- Furnace Hot Inspection

### Project Support

- Project Management
- Training
- Technical Assistance
- Computer Modelling

# Utilities

Float Glass

## Nitrogen Generating Plant

- For prevention of oxidation of the tin melt, the atmosphere in the tin bath should be neutral-reduced (without oxygen) by using Nitrogen and Hydrogen.
- Production of Nitrogen is based on the cryogenic separation of atmospheric air into N<sub>2</sub> and O<sub>2</sub>.
- There are backup tanks with pressurized gaseous nitrogen.



# Utilities

Float Glass

## Hydrogen Generation Plant

- For production of gaseous hydrogen the process of water electrolysis or steam reforming is used.
- Reserve storage of hydrogen ensures the operation of the system



# Utilities

Float Glass

## N2 / H2 Mix Station

- The protective gases Nitrogen and Hydrogen are supplied into the tin bath as a mixture in specified proportions.
- Via pipelines the gases are supplied to the gas-mixing station where the mixing in certain ratios is done.



# Utilities

Float Glass

## Cooling Water

- Cooling water is used for cooling of the equipment in the hot production area.
- Water for equipment cooling is circulating in closed and open loops. In the water circuit an accumulating tank and pumps are installed to ensure the necessary pressure for the water circulation.
- Supply water is specially treated in the water treatment unit before seeding to the water circulating loop.
- For emergency water circulation an elevated tank, Diesel or UPS-driven pumps are foreseen.





# Utilities

Float Glass

## Compressed Air

Compressed air system supplies the compressed air for the whole float-line of the required quality.

- It consists of:
  - > Compressors
  - > Treatment of compressed air
  - > Flow control stations and piping
  - > Instrumentation and automation.



# Utilities

Float Glass

## Electric Power Supply

- A main voltage transformer substation is foreseen for changing to from high voltage at factory entrance to medium voltage.
- Local transformer substations are foreseen in the main production unit and for the equipment of the auxiliary workshops.
- During electricity shutdowns an uninterrupted power supply provides electricity for 20 minutes to maintain the production process.
- Power supply by diesel-generators ensures in addition the production cycle.

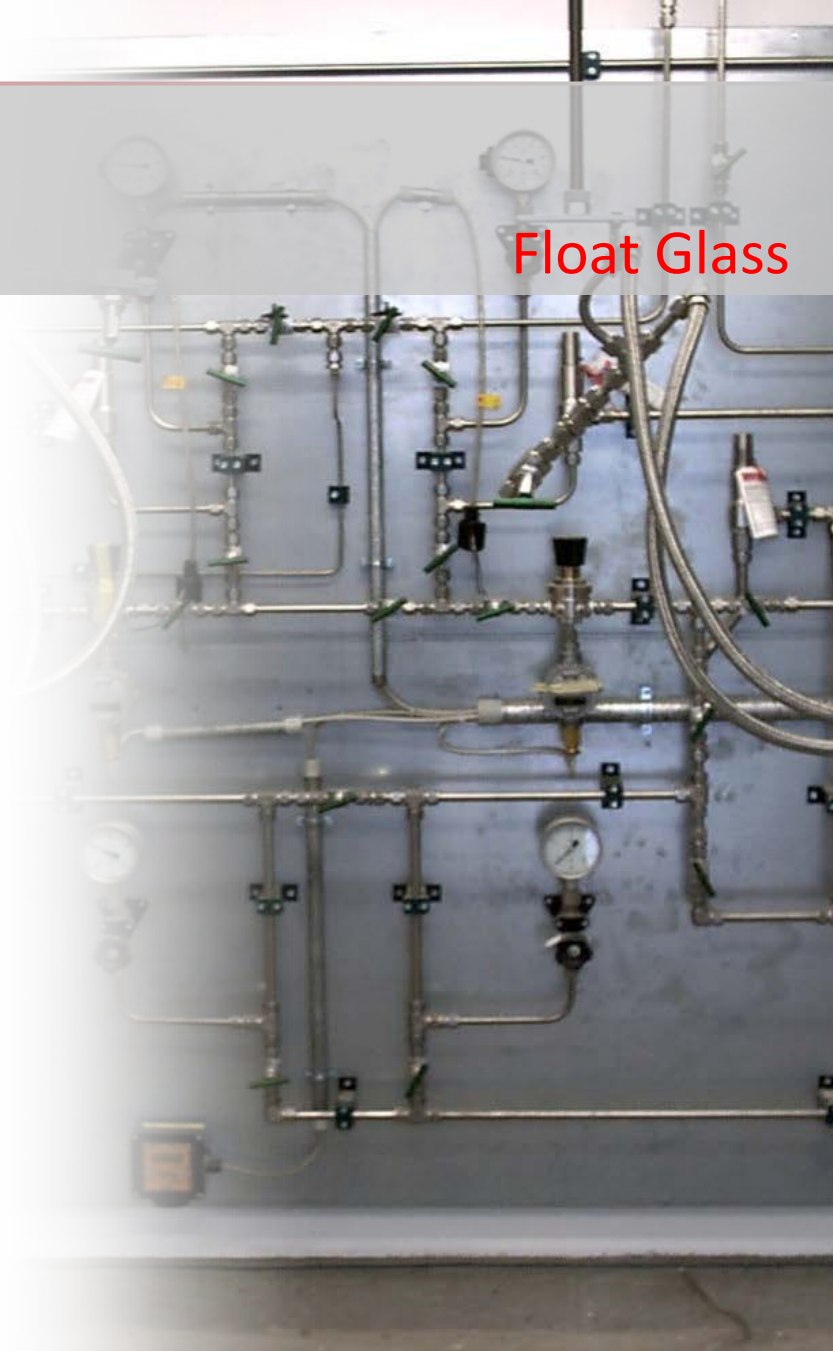


# Utilities

Float Glass

## SO2 Station

- Glass bottom surface is sensitive to the impact of the dross box and lehr roller.
- SO2 is injected proportionally to the ribbon bottom inside lehr and dross box.
- SO2 reacts with the Sodium (Na+) and Calcium (Ca+) at the glass surface to Sodium Sulphate.
- Consequences:
  - > Sodium Sulphate acts as „lubricant“ between rollers and glass surface
  - > Depletion of Sodium and Calcium in the glass surface enhances the stability of the glass ribbon surface





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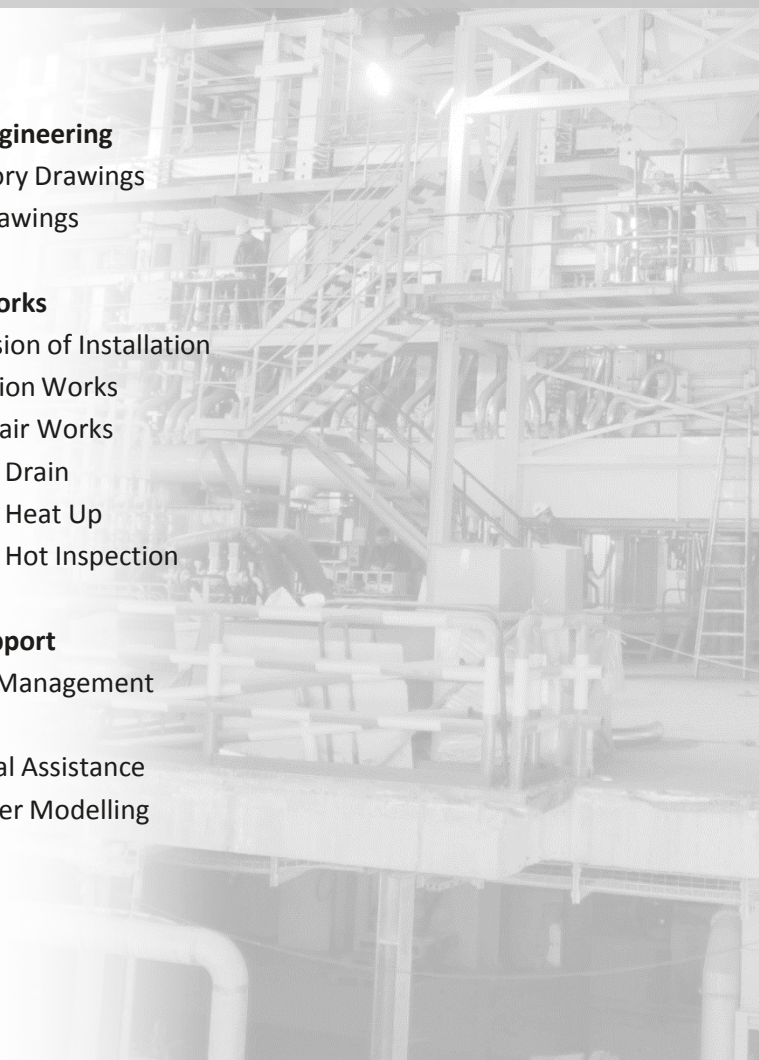
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# Miscellaneous

Float Glass

## Warehouse Equipment

- Storage of produced products
- Logistics and equipment of warehouse depending from produced product range
- May include:
  - > Sideloaders
  - > Box sideloaders
  - > Forklift trucks
  - > Stillage transporters 30 t
  - > Stillages
  - > Automatic packing tables
  - > Special glass handling for cranes



# Miscellaneous

Float Glass

## Waste Gas Treatment

- The flue gas from the float glass furnace has to be cleaned by an electrostatic precipitator (ESP).
- The waste gas will be led to the reaction tower and the ESP – Inlet. Afterwards the clean gas is induced to draft fans and released to the chimney.
- An additional by-pass to the chimney allows to bypass the complete waste gas treatment plant in case of emergency or for inspection purposes.



# Miscellaneous

Float Glass

## Laboratory Equipment

- The incoming raw materials and the produced glass must be controlled frequently.
- For raw material and glass analysis a standard XRF-spectrometer can be included
- Others are stereo microscope, zebra test, edge light test, sieve set, etc.



### Raw Material Treatment

- Mine
- Pond area for mud deposition and process water cleaning
- Raw material storage before pre-screening and wet processing
- Wet by-products storage
- Wet process plant with draining and storage area
- Primary crushing
- Dry process plant with storage area







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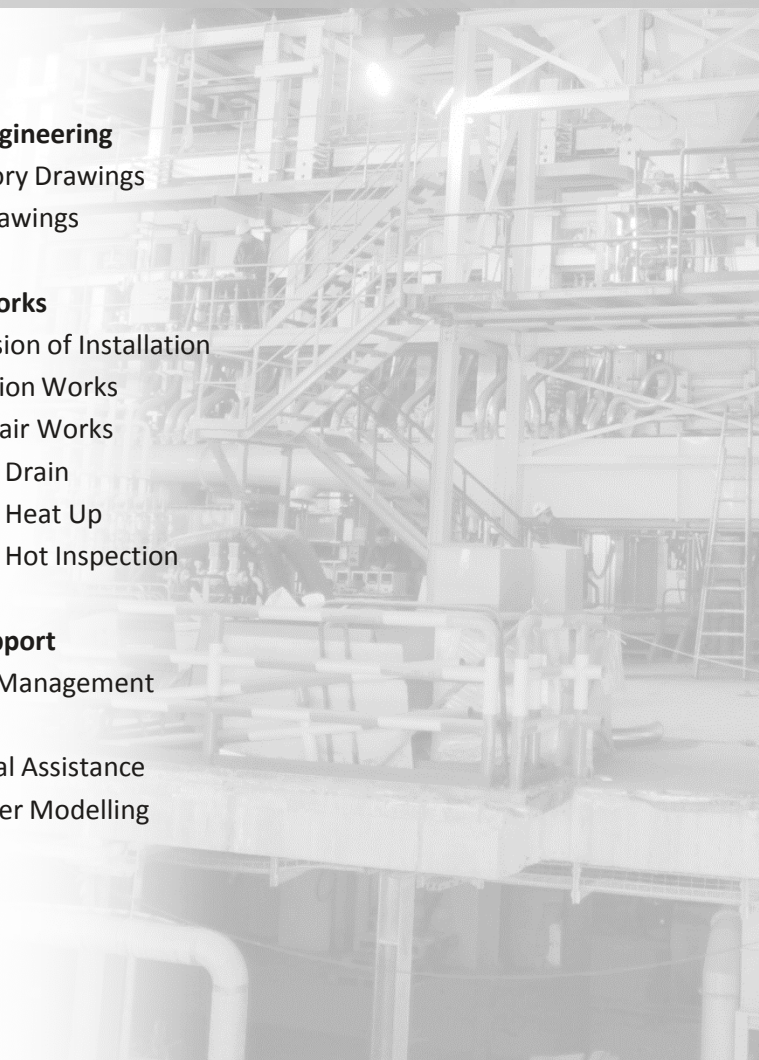
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# Furnace Technology

Hollow Ware & Special Glass

## Refractory Material

- Purchase at worldwide known manufacturer
- Selection of refractory material after evaluation of customers request (glass type, energy, furnace life and available budget)
- All refractory manufacturer follow the HORN quality standards
- Inspection of the refractory material after pre-assembly
- Assistance in purchase of refractory material in case of direct purchase of the customer at the manufacturer



# Furnace Technology

Hollow Ware & Special Glass

## Steel Construction

- Scope of supply for turn-key projects.  
But normally local supply through customer.
- Manufacturing according Euro-Code 3





# Furnace Technology

Hollow Ware & Special Glass



## Combustion System

- Burners (Natural gas / Heavy oil / Light oil)
- Media stations (Gas / Oil / Oxygen)
  - > Filter- and pressure control
  - > Safety station
  - > Measurement and control station
  - > Reversing station
- Own engineering office and manufacturing  
>>> tailor-made systems
- Manufacturing, pre-assembly and test in our workshop



# Furnace Technology

Hollow Ware & Special Glass

## Flue Gas Equipment

- Double-deck reversing unit
- Channel dampers
- Furnace pressure flap
- Steel chimney
- Combustion air supply
- Steel recuperators

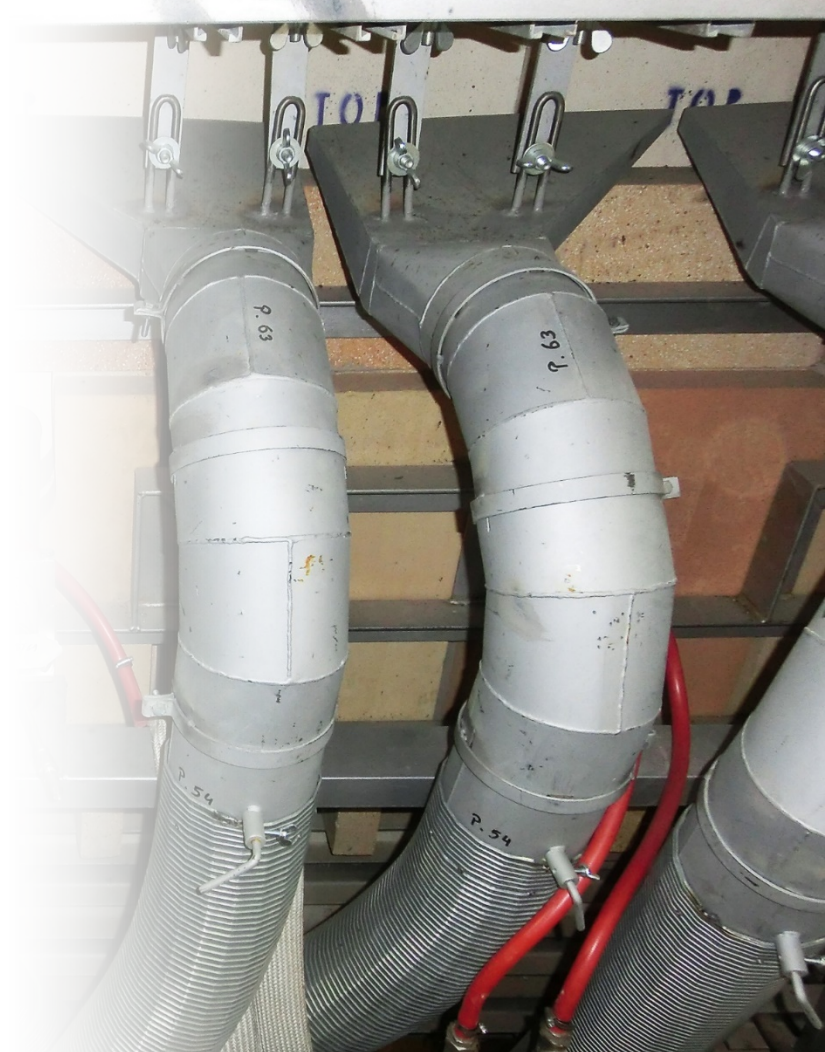


# Furnace Technology

## Hollow Ware & Special Glass

### Tank Cooling

- Special nozzle design for tank and throat cooling
- Manual control flap for each nozzle
- Frequency controlled cooling fans
- Optional automatically temperature control



# Furnace Technology

## Hollow Ware & Special Glass

### Control Equipment

- Four-level operational concept for melting process control:
  - > Process supervision and visualization
  - > PLC - levels with independent operating units
  - > Back-up hardware levels
  - > Manual operation level
- Only most reliable and durable equipment from special suppliers, e.g. Siemens, Honeywell, Allen Bradley / Rockwell, ABB, Eurotherm or AEG.
- FAT (Factory Acceptance Test) in our company



# Furnace Technology

## Hollow Ware & Special Glass

### Glass Level Control

- Installation at distributor, forehearth or working tank (opening 50 x 80 mm)
- Contactless measuring of glass level by +/- 0,1 mm
- Installation of laser and camera with maximum distance up to 5 meter
- Rare service intervals
- The evaluation unit consists of a closed industrial PC with integrated glass level controller
- Easy to operate with touch-sensitive display





# Furnace Technology

## Hollow Ware & Special Glass

### Electric Boosting System

- Different types:
  - > Melting Boosting
  - > Thermal Barrier Boosting
  - > Refining Boosting
  - > Throat Boosting
  - > Feeder Boosting
- Consist of:
  - > Transformer
    - Oil cooled regulation transformer
    - Dry transformer, thyristor controlled
  - > Electrodes & holders
  - > Instrumentation and control system
  - > Cabling / busbar
  - > Cooling water equipment



# Furnace Technology

Hollow Ware & Special Glass

## Charging Machines

- Vibratory charger HVR for open doghouse
- Vibratory charger HVR 700F-2P for closed doghouse
- Screw charger
- Piston batch charger
- Cold top batch charger HVFE





# Product Range and Expertise

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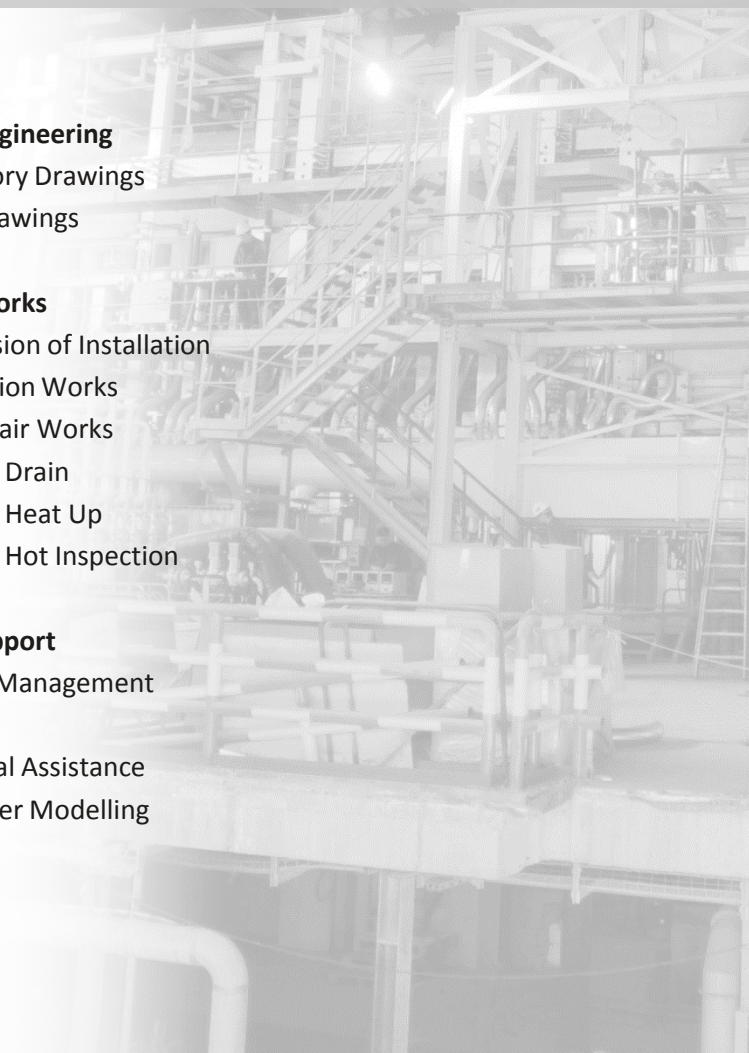
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- Project Management
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# Glass Conditioning Technology

Hollow Ware & Special Glass

## Distributor / Forehearths

- Glass Conditional System GCS:
  - > Distributor GCS 100
  - > Forehearth GCS 200 (with radiation cooling)
  - > Forehearth GCS 300 (with radiation/indirect air cooling)
  - > Forehearth GCS 301 (with radiation/indirect & direct cooling)
- Electrical heated forehearths
- Colouring forehearths



# Glass Conditioning Technology

Hollow Ware & Special Glass

## Combustion System CORA

- Proportional gas and air volume control irrespective of pressure fluctuations
- Almost 100% stable gas/air ratio is realized along the entire control range (2-70 mbar)
- Accurate gas/air ratio control (+/- 0,1% deviation)
- Homogeneous mixing of gas and air even at minimum output range due to exchangeable inserts in the mixer
- Stable combustion >>> increased glass quality
- Can be operated with LPG
- Constant pressure control of the combustion air through thyristor controlled fans >>> electricity saving
- Optional available with automatic Lambda control





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# Miscellaneous

## Hollow Ware & Special Glass

### Drain System

- To remove cat scratches and speed-up of colour changes
- Pull 0,2 – 2,0 tpd
- Special shaped drain block for new installations
- Refitting at running forehearths is possible
- All heating elements are outside of the glass and applied indirect >>> no counter electrode!
- Used for container-, tableware-, cosmetic-, pharma- and lighting glass



# Miscellaneous

## Hollow Ware & Special Glass

### Stirrer Unit

- Installation at forehearth equalizing section to remove zirconium cords
- Perfect in combination with the drain system
- Easy change of stirrers with quick-coupling
- Screw or paddle stirrer can be used
- Individual motor for each stirrer or one motor with roller chain
- Frequency driven motor to adjust stepless the stirrer rotation between 2- 20 RPM







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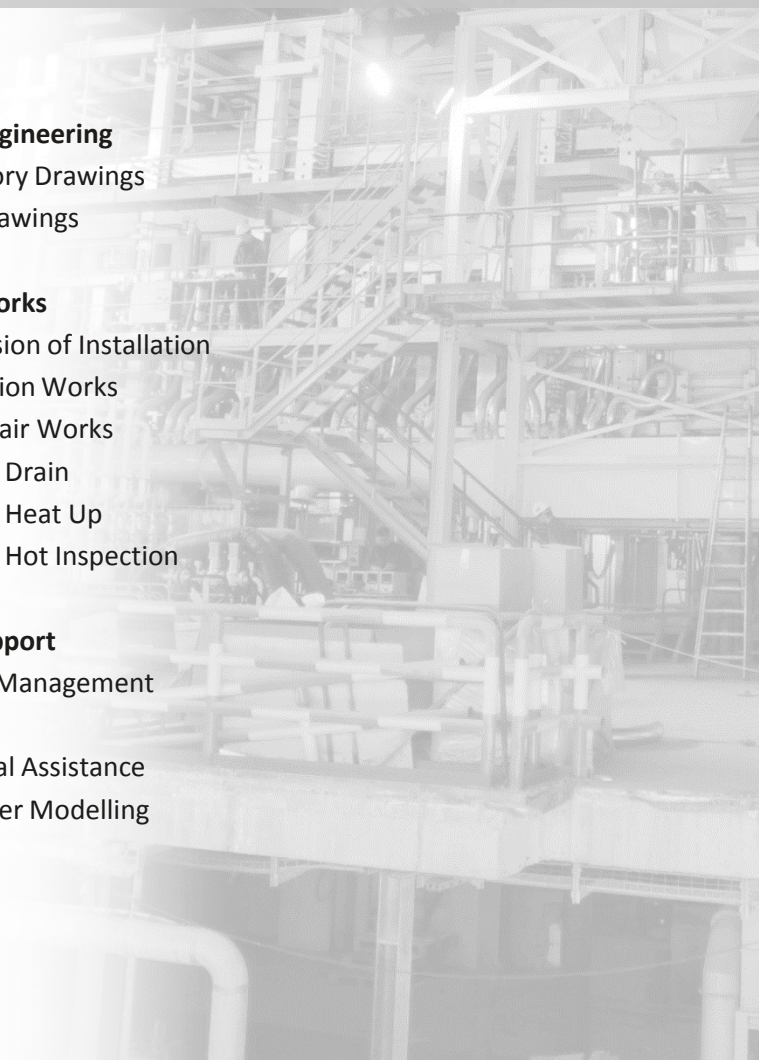
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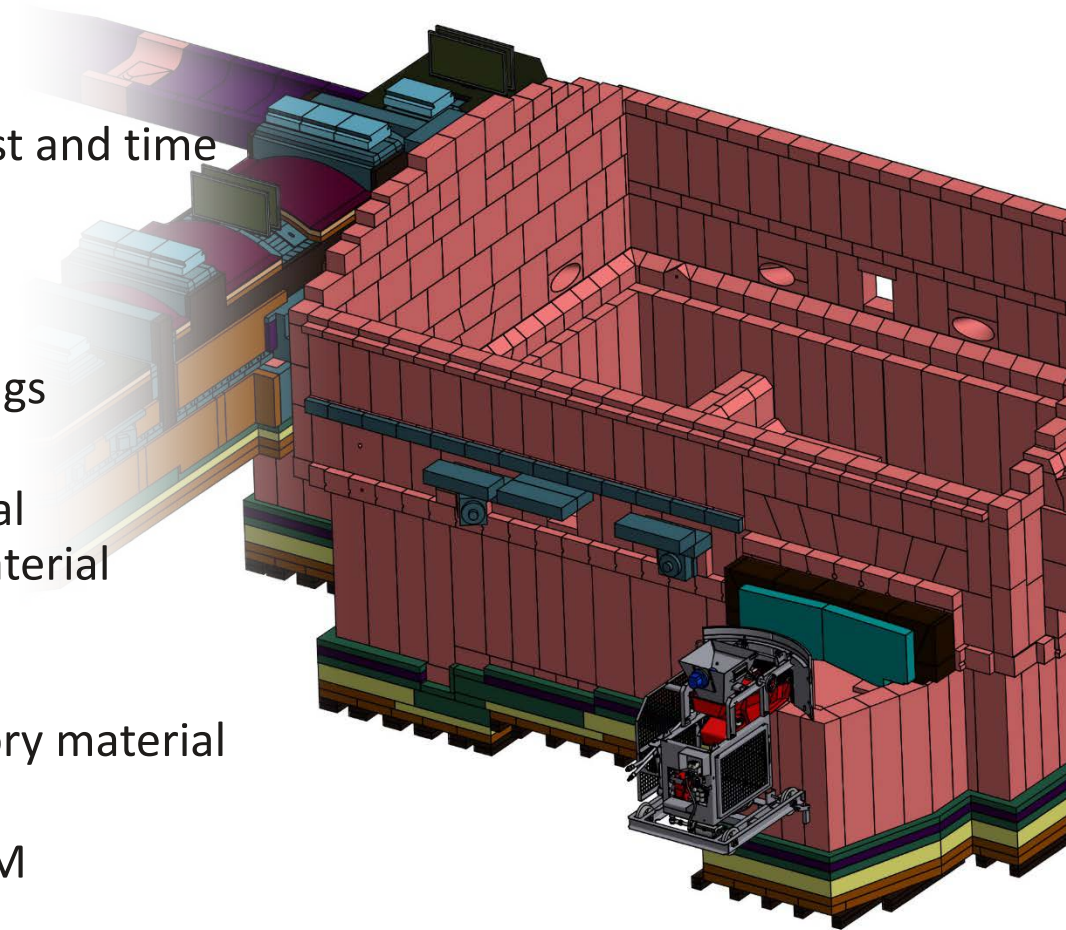
### Project Support

- Project Management
- Training
- Technical Assistance
- Computer Modelling



## Refractory Drawings

- Computer Aided Design to reduce cost and time
- 3D layouts
- Coloured layout and assembly drawings
- Independent engineering and material specifications to source refractory material from any world wide manufacturer
- Assistance during sourcing of refractory material
- Documentation on paper and CD-ROM

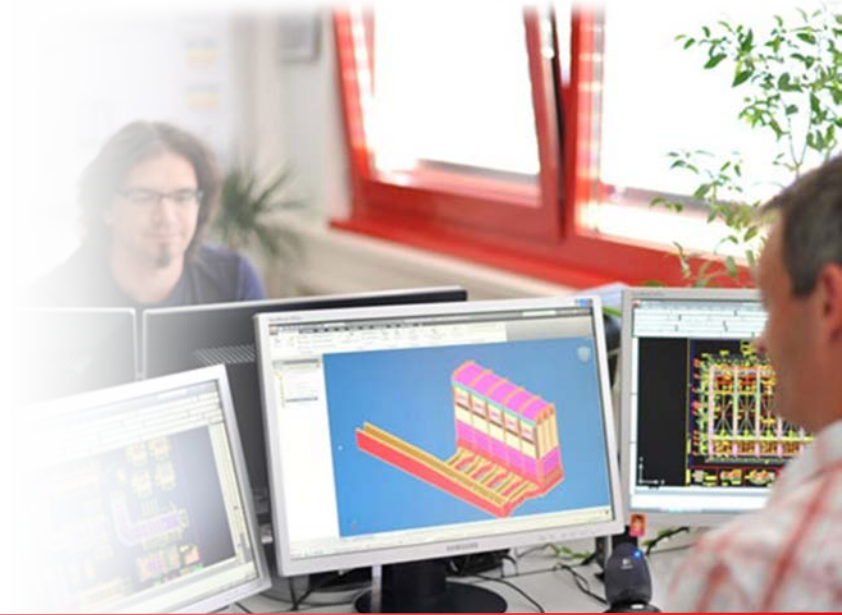
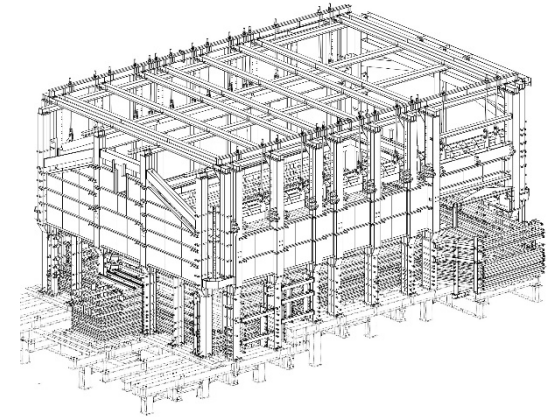


# Furnace Engineering

Services

## Steel Drawings

- Engineering according Euro-Code 3  
>>> required for CE Certificate
- 3D layouts
- Automatic generation of material lists and workshop drawings
- Collision test for steel construction
- Local available steel profiles are considered
- 3D scan of existing steel is possible





# Product Range and Expertise

## FLOAT GLASS

### Process Line

- Batch Plant
- Furnace
- Tin Bath
- Annealing Lehr
- Automation
- Cutting Line
- Cullet Return System

### Utilities

- Nitrogen Generating Plant
- Hydrogen Generating Plant
- N<sub>2</sub> / H<sub>2</sub> Mix Station
- Cooling Water
- Compressed Air
- Electric Power Supply
- SO<sub>2</sub> Station

### Miscellaneous

- Warehouse Equipment
- Waste Gas Treatment
- Laboratory Equipment
- Raw Material Treatment

## HOLLOW WARE & SPECIAL GLASS

### Furnace Technology

- Refractory Material
- Steel Construction
- Combustion System
- Flue Gas Equipment
- Tank Cooling
- Control Equipment
- Glass Level Control
- Electric Boosting System
- Charging Machines

### Glass Conditioning Technology

- Distributors / Forehearths
- Combustion System CORA

### Miscellaneous

- Drain System
- Stirrer Unit

## SERVICES

### Furnace Engineering

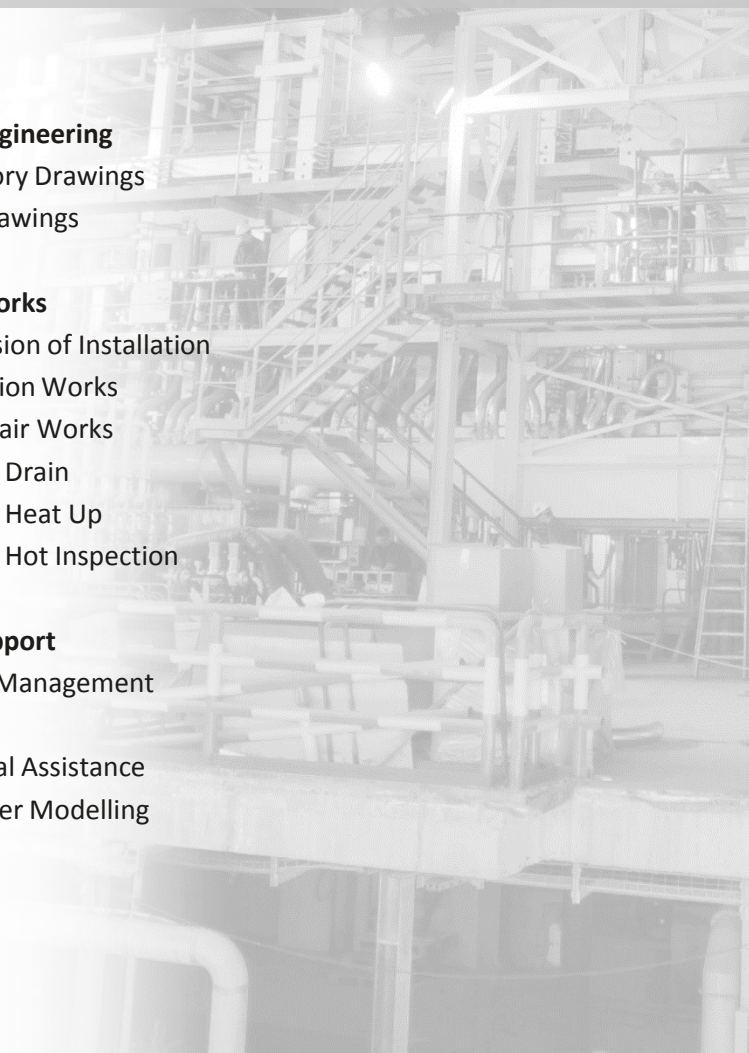
- Refractory Drawings
- Steel Drawings

### Furnace Works

- Supervision of Installation
- Installation Works
- Hot Repair Works
- Furnace Drain
- Furnace Heat Up
- Furnace Hot Inspection

### Project Support

- Project Management
- Training
- Technical Assistance
- Computer Modelling



# Furnace Works

## Supervision of Installation

- Includes furnace erection, heat up, commissioning and hot sealing
- Specialists with many years of experience in
  - > Refractory installation
  - > Steel installation
  - > Installation of combustion system and media supply equipment
  - > Installation of electrical components
- Installation staff and equipment is by customer



# Furnace Works

## Installation Works

- Includes installation staff and equipment for
  - > Unloading and storage
  - > Site preparation
  - > Steel works
  - > Refractory assembly
  - > Equipment installation
  - > Heating up
  - > Hot sealing works
- Reliable installation companies to ensure the guaranteed time schedule
- Plant rules as well as health- and safety instructions will be followed



# Furnace Works

## Hot Repair Works

- Furnace hot repair works
- Thermal regenerator cleaning
- Installation and exchange of electrode holders during production
- Patching of flux line and throat of the furnace
- Shaped block manufacturing and installation
- Repair of rat holes, removal of washouts, creation openings for cleaning, inspection and placement of dampers



# Furnace Works

## Furnace Drain

- Safe glass drain with experienced staff
- Own equipment for furnace drilling and glass drain to a scraper:
  - > Drilling machine with water cooled head
  - > Water cooled regulation cone
  - > Refractory lined glass drain chute
  - > Glass transportation tube





# Furnace Works

## Furnace Heat Up

- Continuously (24h) heat up, expansion control and cullet filling
- Experienced staff for correct heat up
- Own equipment:
  - > High velocity hot air burners
  - > Oil / gas skids with flame failure units
  - > Combustion air blowers
  - > Temperature recorder and thermocouples
  - > Expansion control equipment



# Furnace Works

## Furnace Hot Inspection

- Highly specialized photographic equipment
- Water cooled 90° lens makes it possible to image hidden areas
- A comprehensive photographic report facilitates expert discussion
- Advantages:
  - > More accurate planning of repair works
  - > Image the corrosion status of the regenerator checker system to plan cleaning of them





# Product Range and Expertise

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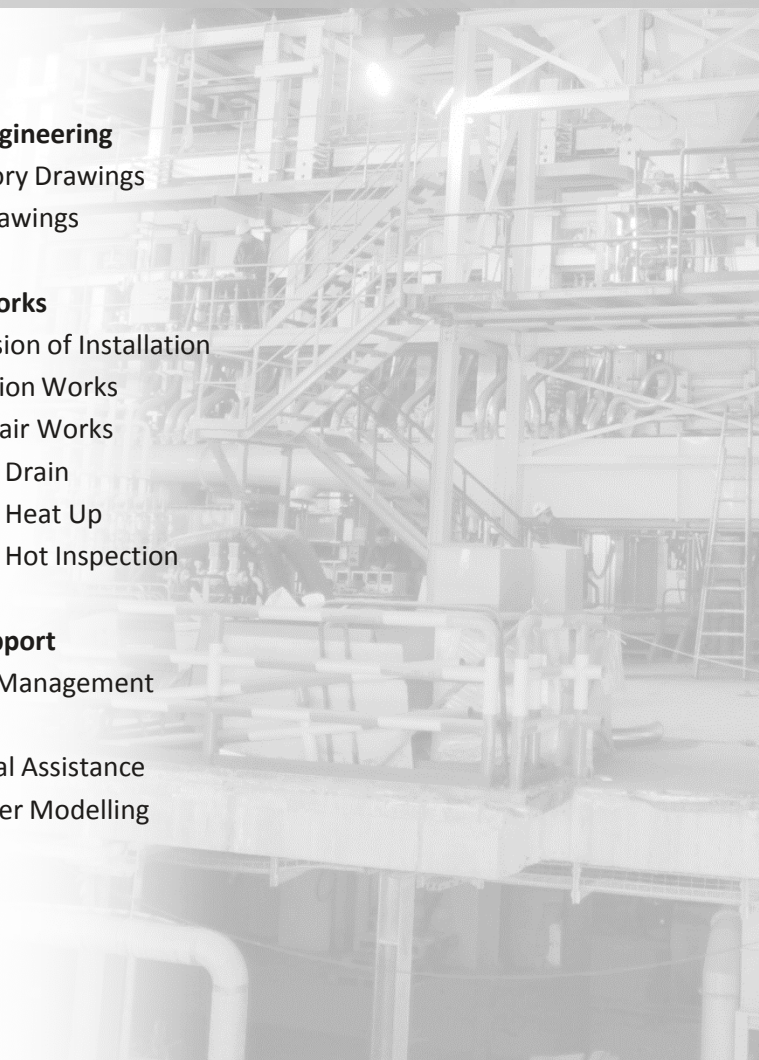
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# Project Support

Services

## Project Management

- Project Management for the complete range of technology in float and container glass
- Project Management includes:
  - > PM during engineering period  
*(Coordination of the cooperation partners for technology plants and all basic engineering works)*
  - > Site Management  
*(Management of supervision, assembly and start-up of each individual technology plant)*
  - > Production Assistance  
*(includes performance test, assistance and training of the production staff)*



## Training

- Theoretical class room training
- Practical on-site training
- Training for:
  - > Furnace or plant operation
  - > Glass conditioning
  - > Combustion and media systems
  - > Electrical equipment
  - > Basic information on glass production
- Training separated for operators and maintenance people
- Target:
  - > People should handle and operate the plant safe and trouble free
  - > People should be able to react in emergency cases in correct manner



# Project Support

## Technical Assistance

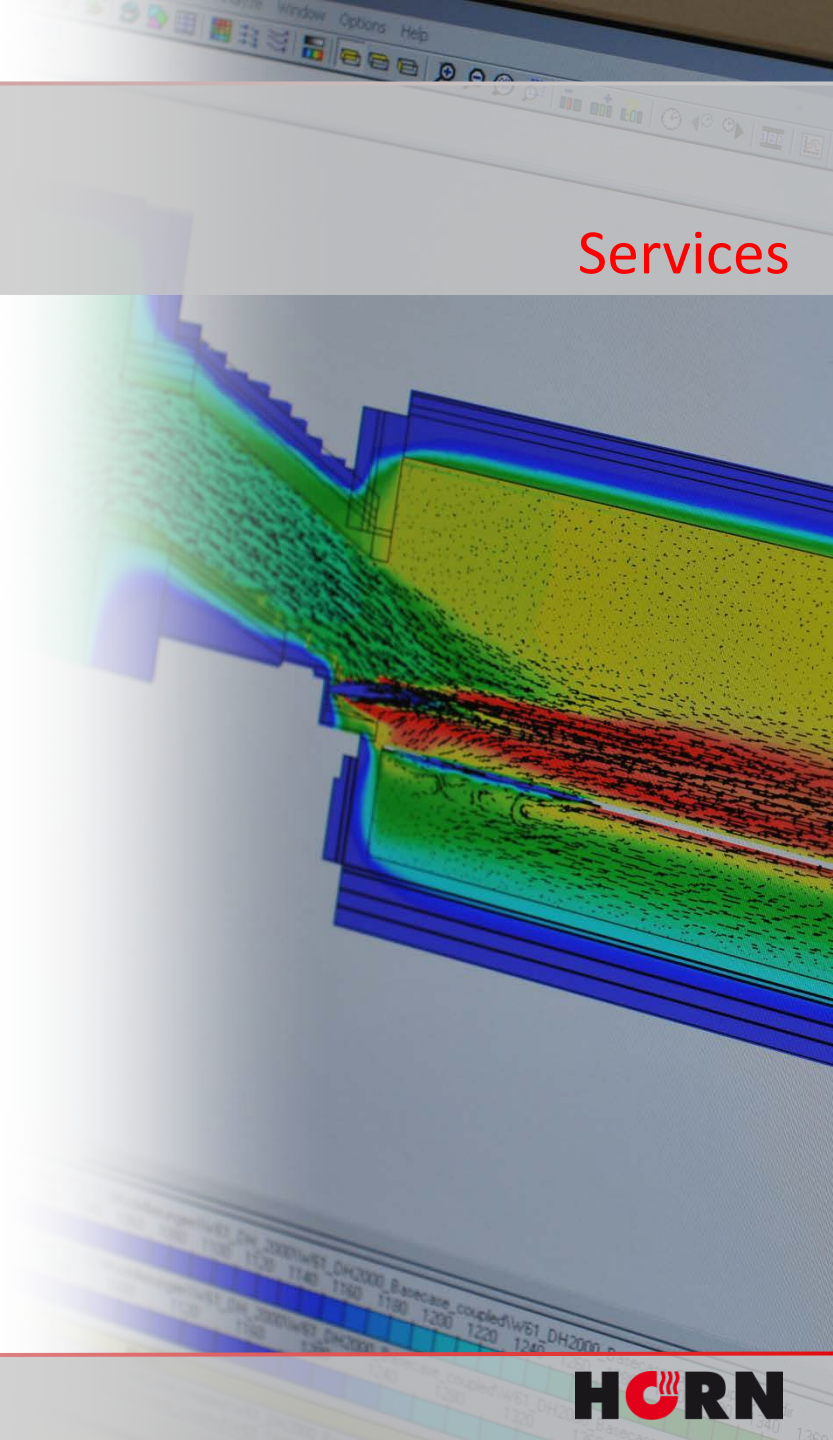
- Experts with many years of experience who are active all over the world
- Technical assistance at
  - > General furnace operation
  - > Raw materials
  - > Glass quality problems
- Individual solutions are developed for each specific problem



# Project Support

## Computer Modelling

- Glass bath modelling  
(e.g. glass temperatures, glass flow direction, electric boosting, refractory temperatures, refining ability, residence times)
- Regenerator modelling  
(e.g. flow of air respective waste gases or temperature profile air respective waste gas)
- Combustion space modelling  
(e.g. fuel flow, flame temperatures, concentration fields of CH<sub>4</sub> and CO, flame coverage)





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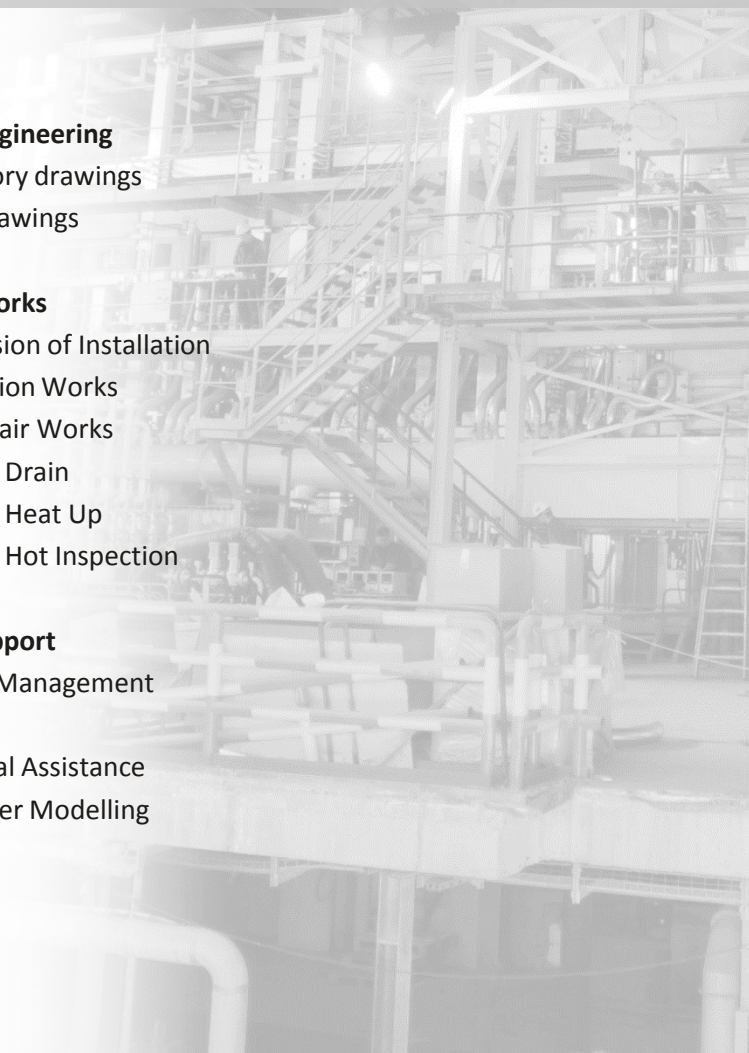
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# GLASS MELTING TECHNOLOGY

**HORN**  
GLASS INDUSTRIES

INNOVATION ENGINEERED IN GERMANY

