

GLASS PRODUCTION TECHNOLOGY

HORN
GLASS INDUSTRIES



HORN

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WHO WE ARE

WHO WE ARE

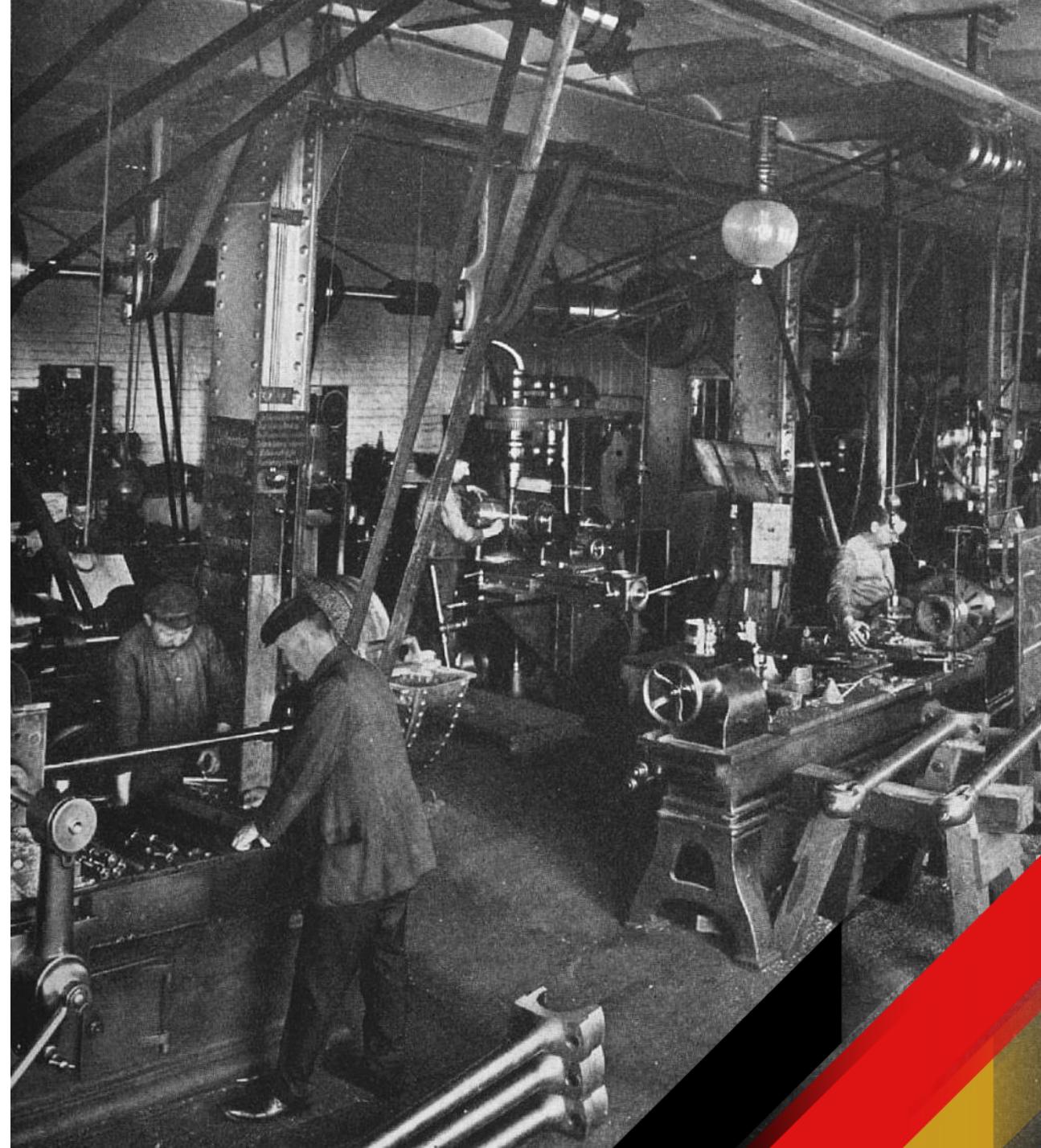
HORN is a medium-sized company with many years of experience in planning, engineering and building glass melting furnaces as well as turn-key glass plants.

As a passionate specialist and reliable partner for the global glass industry, the company provides its customers with tailor-made solutions, when it comes to the design and supply of glass melting technology all over the world.



HISTORY

- 🕒 **1884** The company August HORN was founded
- 🕒 **1999** Takeover by Certina AG
- 🕒 **2012** Acquisition of HORN Glass CZ s.r.o., HORN India Pvt. Ltd. and HORN Asia Pacific SDN. BHD. (Malaysia). Foundation of HORN Glass Technology (Beijing) Co., Ltd.
- 🕒 **2014** Foundation of EUROX® Sauerstoff Mess-Systeme GmbH
- 🕒 **2017** Foundation of HORN Glass Ukraine LLC.
- 🕒 **2018** Foundation of HORN cite a.s., Czech Republic. Now: HORN Moravia a.s., Czech Republic.
- 🕒 **2020** Foundation of HORN Glass Brazil Ltda.
- 🕒 **2021** Takeover of JSJ Jodeit GmbH



FACTS

- 🔥 Turnover: between 60 and 140 million euros
- 🔥 About 450 employees worldwide
- 🔥 650 customers in 75 countries
- 🔥 Approx. 15 – 20 major furnace projects per year
- 🔥 Approx. 35,000 t/d of glass produced by HORN
- 🔥 > 60 **e-Fusion** melting boostings in operation
- 🔥 > 1,000 HORN burners in operation
- 🔥 150 HORN furnaces in operation worldwide
- 🔥 11 turn-key plants in operation
- 🔥 > 150 automations in operation



innovation

ENGINEERED IN GERMANY

**TURN
KEY**

LET'S GO FULL CIRCLE.

PLANNING + ENGINEERING

MANUFACTURING

SERVICE / INSTALLATION + SUPPORT

HORN
GLASS INDUSTRIES
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ENGINEERED IN GERMANY

HORN
GLASS INDUSTRIES

2 WHERE WE ARE

HORN Bau & Service GmbH

ISJODEIT
MEMBER OF HORN®

WHERE WE ARE

The headquarters of HORN Glass Industries AG are located in the heart of Europe in Plössberg in South Eastern Germany.

VISITORS REACH IT EASILY FROM SEVERAL AIRPORTS:

-  Frankfurt a. M. – 270 km
-  Munich – 210 km
-  Nuremberg – 130 km
-  Prague – 180 km

AREA

-  Factory premises – 39,555 m²
-  Office space – 6.300 m²
-  Workshop area – 7,500 m²
(incl. storage area)



PLANT LOCATION

CONTAINER & SPECIAL
GLASS DEPARTMENT

ADMINISTRATION

GLASS PLANT
TECHNOLOGY
DEPARTMENT

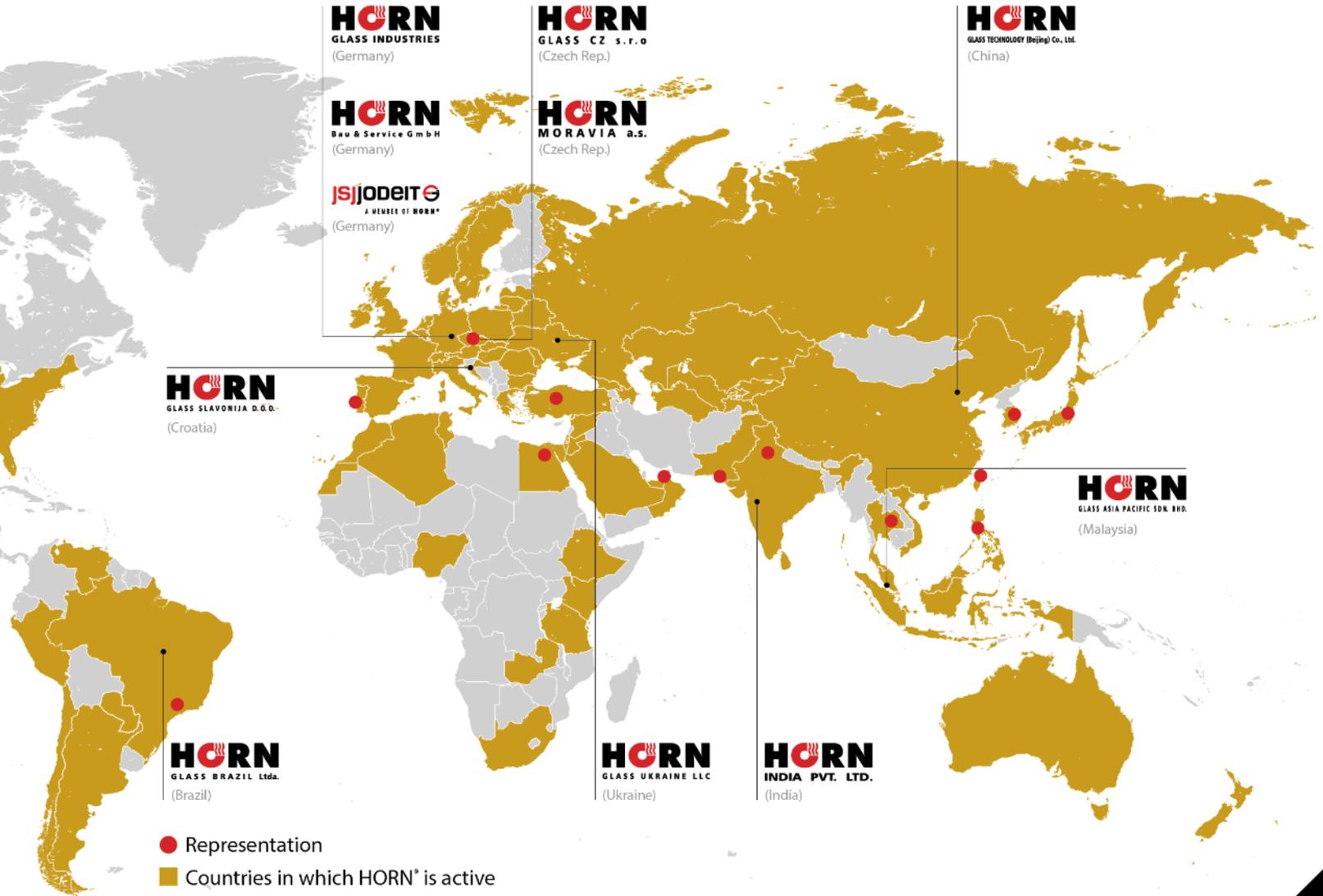
HORN BAU &
SERVICE GMBH

LOGISTICS +
MANUFACTURING

ELECTRICAL
WORKSHOP

HORN
GLASS INDUSTRIES
innovation
ENGINEERED IN GERMANY

THE WORLD OF HORN



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HOW WE DO IT

CAPABILITIES

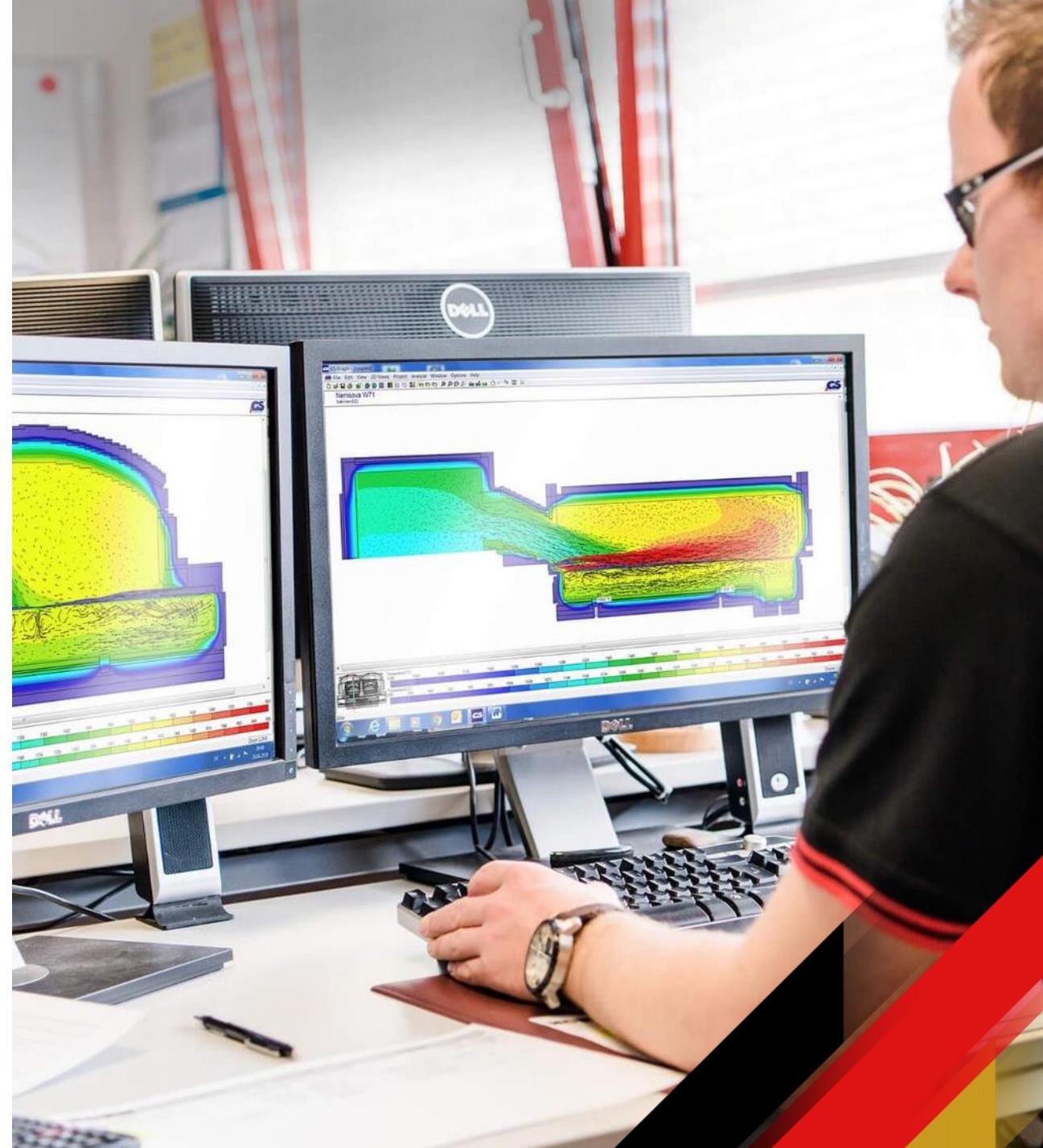
Planning + Engineering

Manufacturing

Service / Installation + Support

PLANNING + ENGINEERING

HORN gathered its knowledge from decades of work in the glass melting technology business. No matter if the customer needs a tiny, innovative technical detail or plans to build an entire glass plant – the project management and planning department is there from the start. HORN takes the customer by the hand and guides him through the whole process if he wants to.



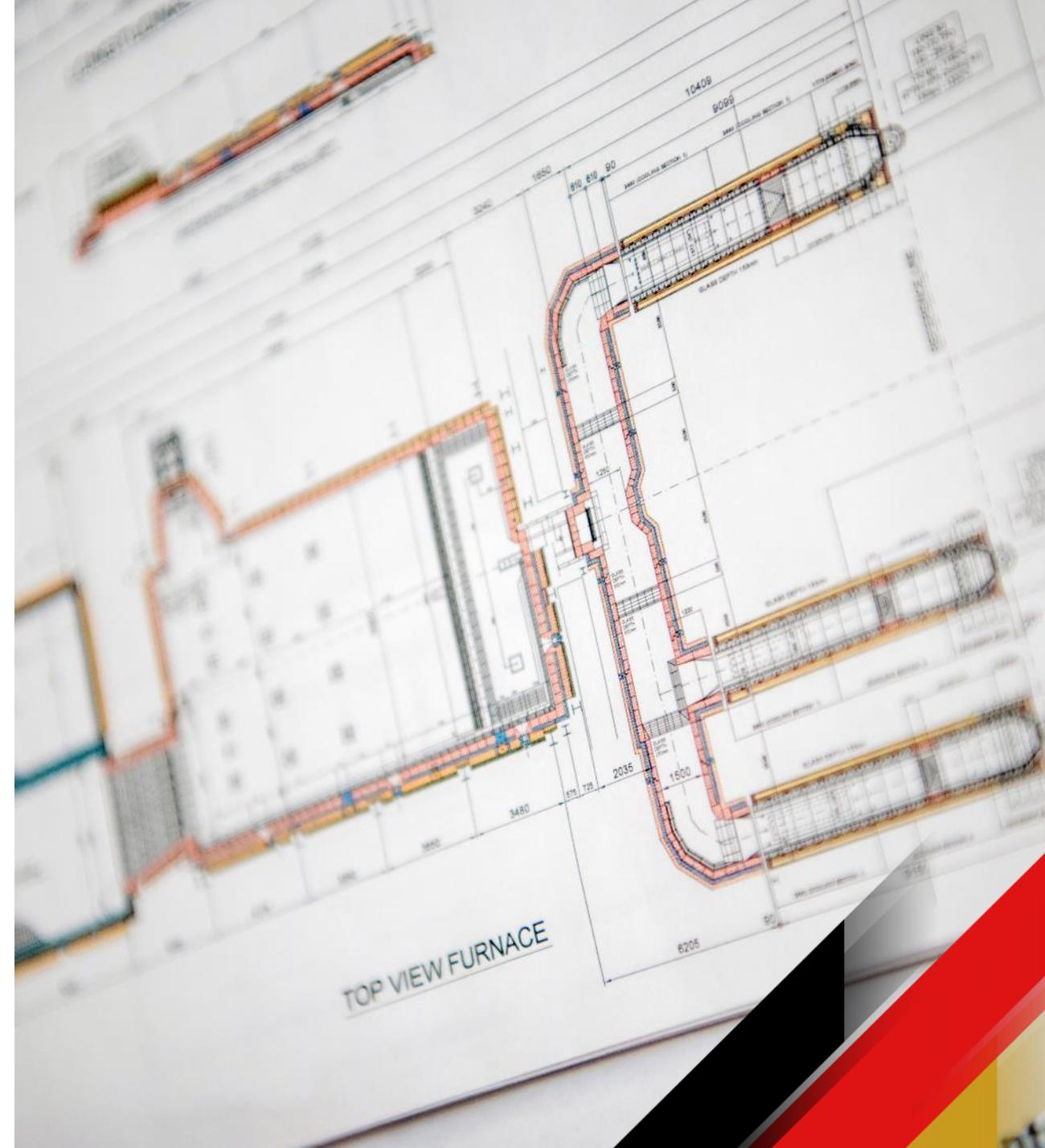
CONTAINER & SPECIAL GLASS DEPARTMENT

- Heart of the „know-how“
- About 140 engineers and technicians work in the following departments:
 - Furnace Design Department
 - Steel Design Department
 - Electrical Department
 - Utility Department
 - Mechanical Engineering Department



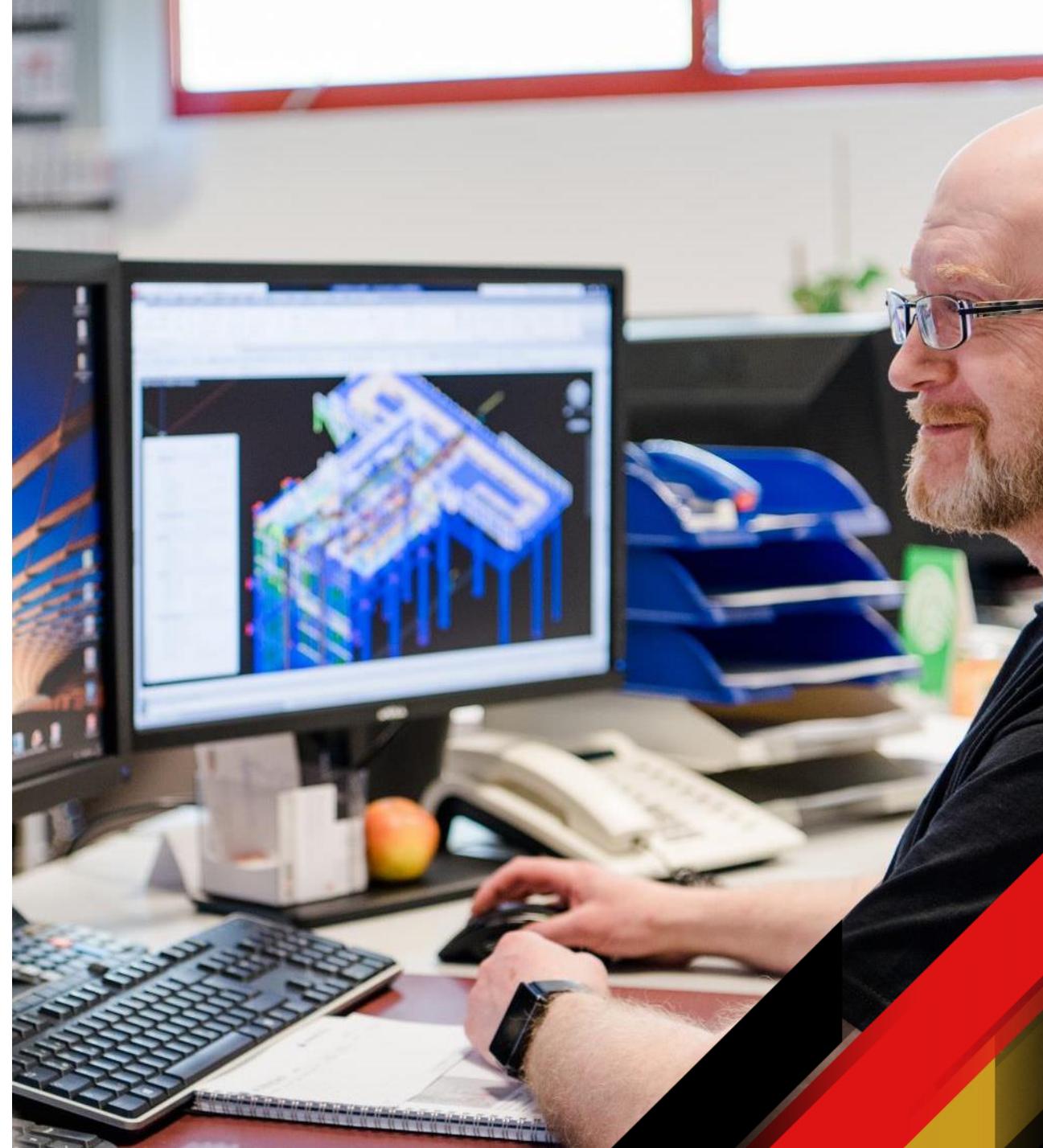
REFRACTORY ENGINEERING

- 19 furnace design engineers
- Creation of refractory drawings for different types of furnaces – in three steps:
 - Basic planning
 - Detailed planning
 - Assembly drawings
- Capacity for engineering: approx. 1050 hours/month
- Software in use:
 - AutoCAD
 - AutoCAD 3D
 - Inventor 3D
 - Excel for the bill of materials



STEEL ENGINEERING

- 19 steel design engineers
- Planning of the required furnace steel constructions
- Concept creation with comparison of all adjacent peripherals
- Static testing of the steel construction
- Creation of a 3D model for detailed production and assembly drawings with all required parts lists and, if required, NC data
- Optionally, all required maintenance platforms can be planned out in detail
- Complete documentation of the necessary steel construction for the furnace
- Engineering capacities: planning of up to **5 major projects simultaneously**



ELECTRICAL ENGINEERING

 20 electrical engineers

Planning & Automation

 Standard Engineering tools: EPLAN,
SIEMENS (Step 7, Win CC, PCS 7, TIA Portal)

 Upon customer's request: ABB, Allen-Bradley,
Honeywell, Eurotherm

Manufacturing & Instrumentation

 Control panels

 Power panels / MCC

 [e-Fusion](#) Boosting



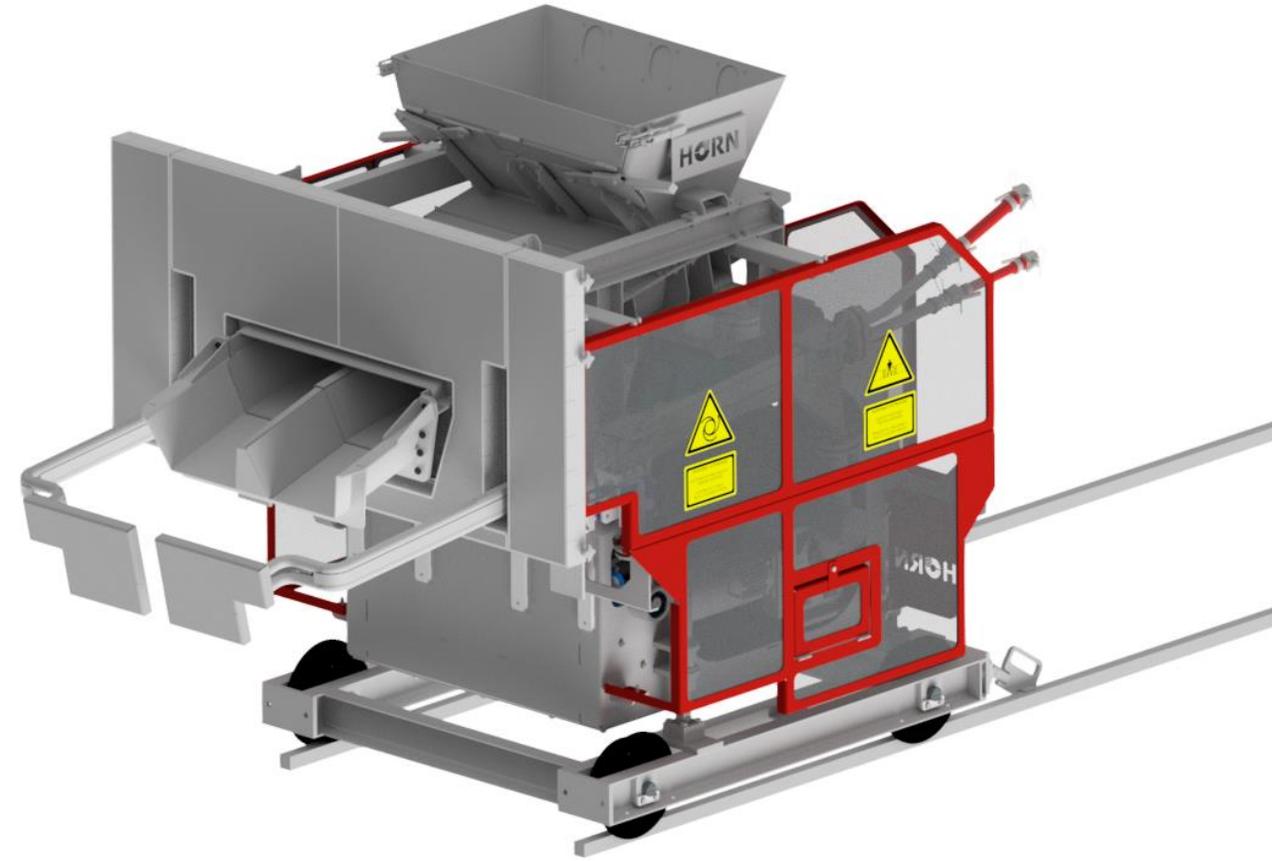
UTILITY ENGINEERING

- 10 specially skilled engineers (gas-certified) with a capacity of 400 hours/week
- Engineering services: media layouts, process flow diagrams, detailed assembly engineering and documentation
- On-site services: commissioning, optimisation and maintenance all over the world
- HORN handles all kinds of fluids: natural gas, LPG, air gas mixture, diesel, heavy fuel oil, oxygen, nitrogen, hydrogen, compressed air, combustion air, cooling air, high pressure cooling air and cooling water
- Provision of the HORN burner series



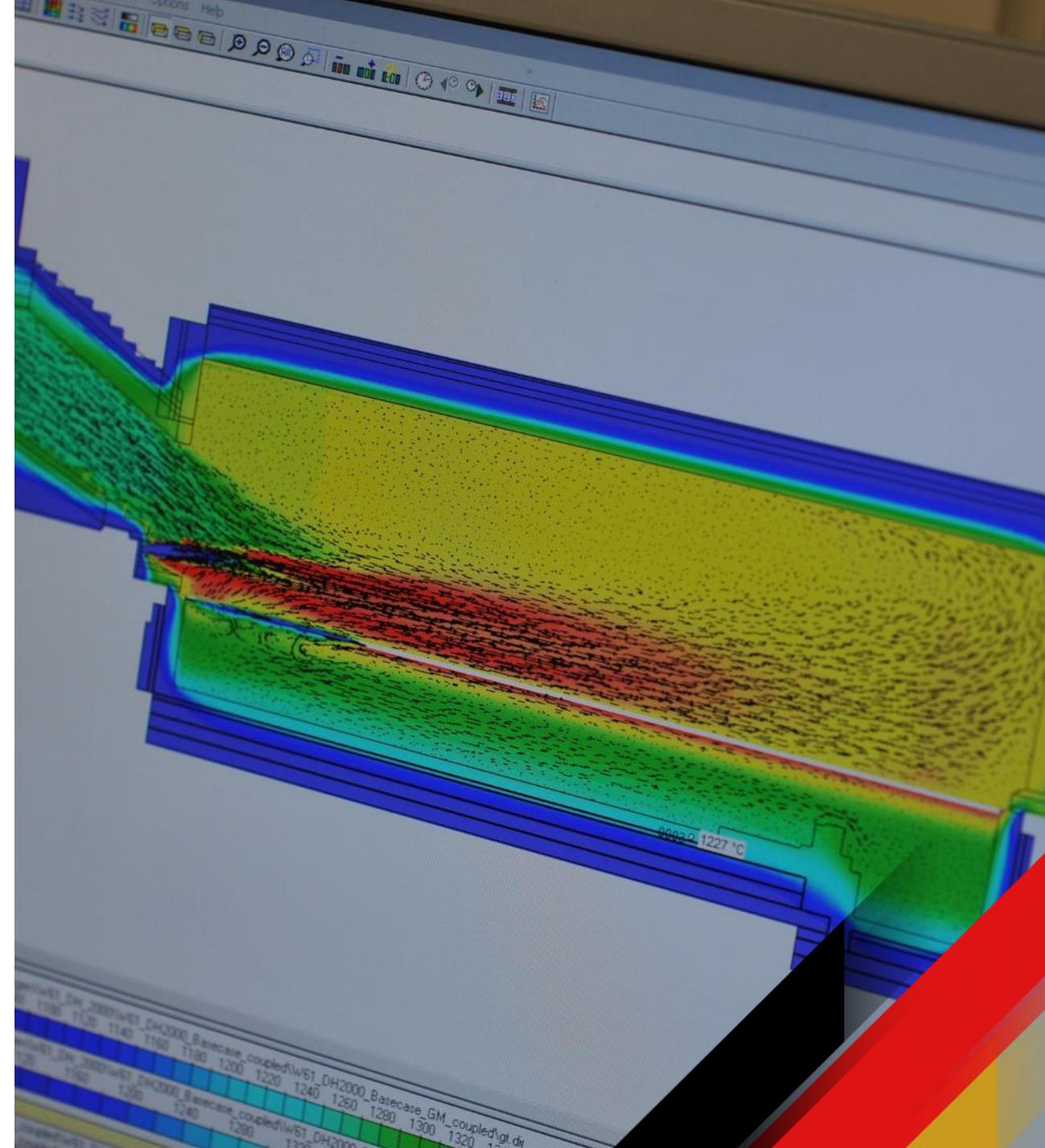
MECHANICAL ENGINEERING

- 10 mechanical engineers take over the planning
- Engineering of all machines for float and container lines (concept development, detailed engineering)
- Charging technology, stirrer technology, special installations & machines and tin bath equipment
- Planning of special installations, engineering of (new) machines, creation of new products for the customer
- Planning in 3D with simulation views



COMPUTER MODELLING

- Modelling of glass melting furnaces with superstructure, all electric furnaces as well as forehearths and regenerators
- HORN modelling is characterised by its high practical relevance and authenticity
- Advantages of modelling:
 - Visualisation of current processes to identify the problems of a plant
 - Prediction of furnace operation parameters
 - Evaluation of technical possibilities beyond conventional limits (melting surface load, energy consumption, bath depth, etc.)



FUNCTIONAL SAFETY

- CSE-Certified Safety Engineers by SGS-TÜV Saar
- "Functional safety" is when safety depends on the correct function of an electrical (e), electronical (E) and programmable electronic (PE) system (e/E/PE system)
- Functional safety is about reducing risk through safety features
- HORN applies the product standard for thermal process plants DIN EN 746-2 in order to implement the functional safety requirements for thermal process plants



TECHNICAL DOCUMENTATION

- 🔴 CSE-Certified Safety Engineers by SGS-TÜV Saar
- 🔴 HORN products are carried out in accordance with applicable directives and standards
- 🔴 HORN prepares detailed documentations with risk assessment, technical documentation, operating manuals, etc.
- 🔴 Contribution to the reduction/mitigation of risks on machines
- 🔴 Warnings and notes to the individual machines of HORN are listed in the internal risk assessment as well as in operating manuals, manuals, etc.



GLASS PLANT TECHNOLOGY DEPARTMENT

-  Glass Plant Technology, a dynamic team with years of experience
-  12 experienced experts in building turn-key plants
-  Led by Mrs. Ekaterina Firsova (Executive Director Glass Plant Technology)
-  Fully tailored skills and competencies to support the customer from the very first rough draught to the realisation and completion of a turn-key production plant



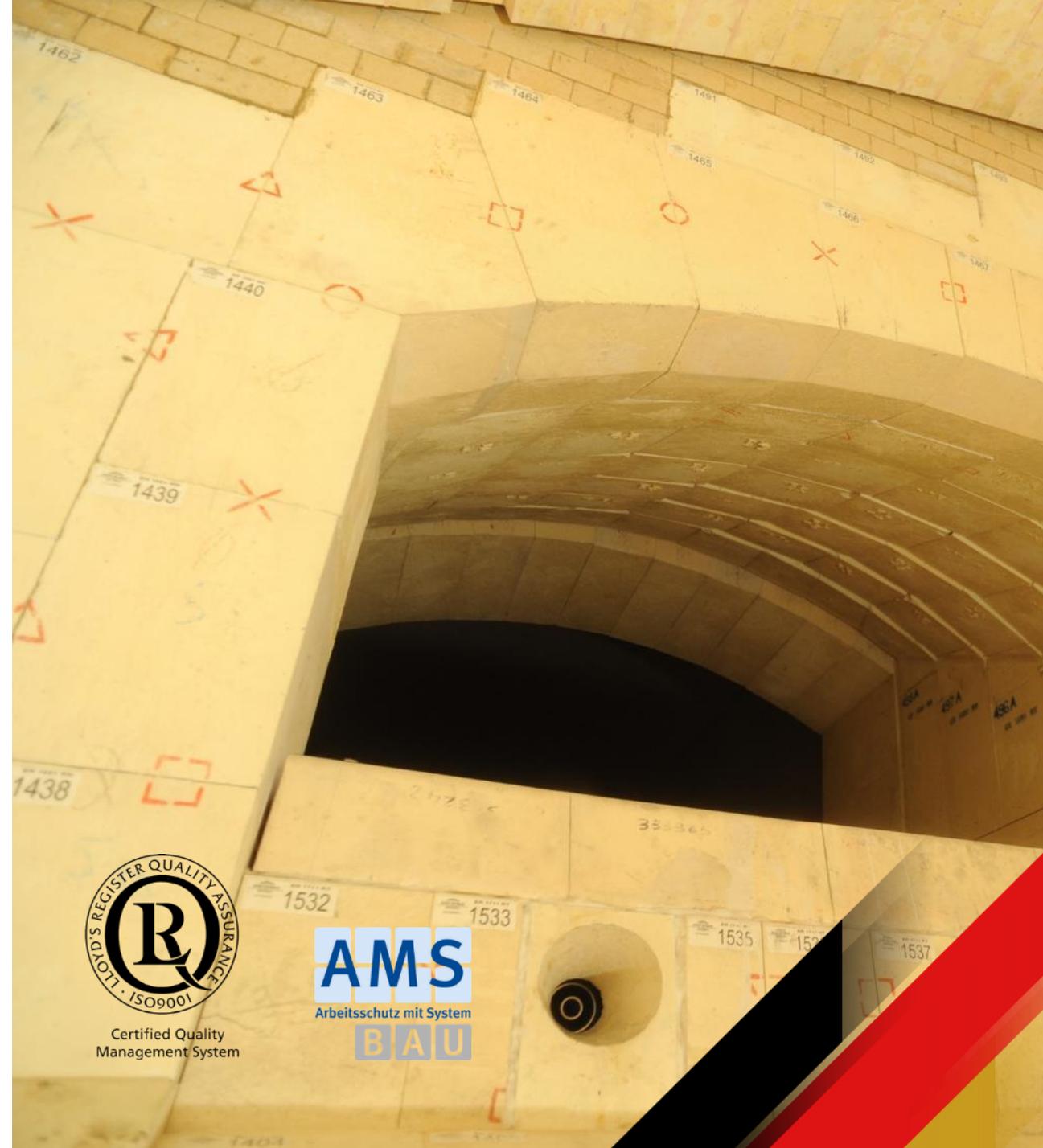
MANUFACTURING

- About 120 skilled workers (mechanics, electricians, quality managers, etc.)
- High flexibility due to 90% in-house production
- Own manufacturing department in Plössberg (headquarters)
- HORN's core competence: Machinery and plant engineering for the glass manufacturing industry (glass melting technology)
- Production area: 7,500 m²
- Special plasma cutting machine and welding robots for accurate manufacturing
- In the future: Even more optimised processes



HORN BAU & SERVICE GMBH

- Refractory supervisors and masons
- 100% daughter company of HORN Glass Industries AG
- Main jobs: Furnace drain, cold / hot repair, furnace heat up, furnace inspection and maintenance jobs
- Workshop for manufacturing special refractory bricks (burner blocks)
- Warehouse for equipment and refractory material
- B&S is certified according to
 - DIN EN ISO 9001:2008
 - AMS BAU



Certified Quality
Management System

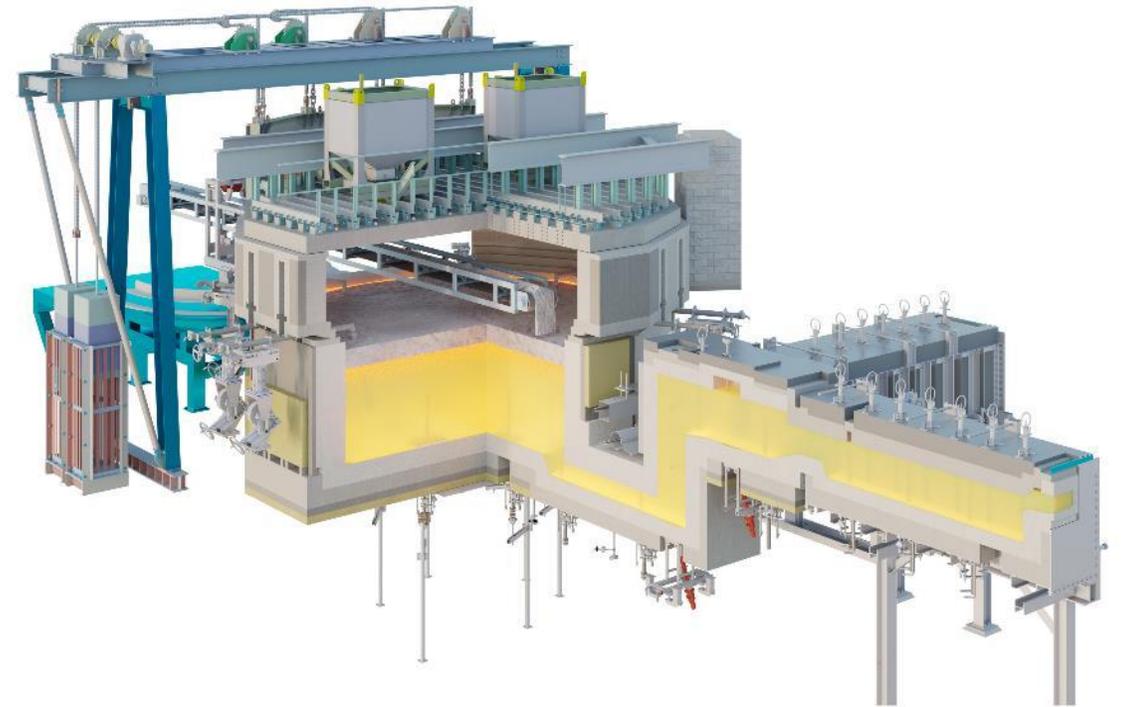


JSJ SPECIALITY GLASS

- A member of HORN Glass Industries AG
- Leading and globally renowned supplier of systems for the production of speciality glass
- JSJ's state-of-the-art all electric melting furnaces range from 5 t/d – 200 t/d
- Core competences: development, planning and realisation of melting furnaces, systems and
- components for the production of high-quality speciality glasses

JSJ Jodeit Portfolio:

- All Electric Furnaces (AEF)
- Oxyfuel Furnaces
- Electric heated glass conditioning systems
- Systems and Components



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WHAT WE DO

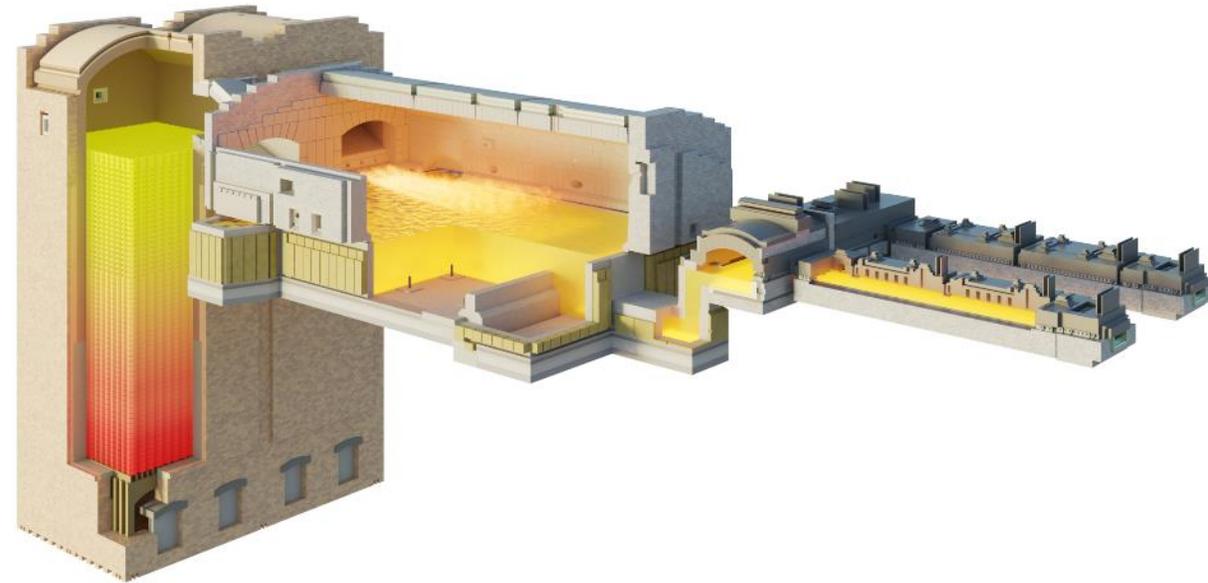
FURNACES + CONDITIONING

Melting furnaces for container-, special- and float glass

Distributor / Forehearth

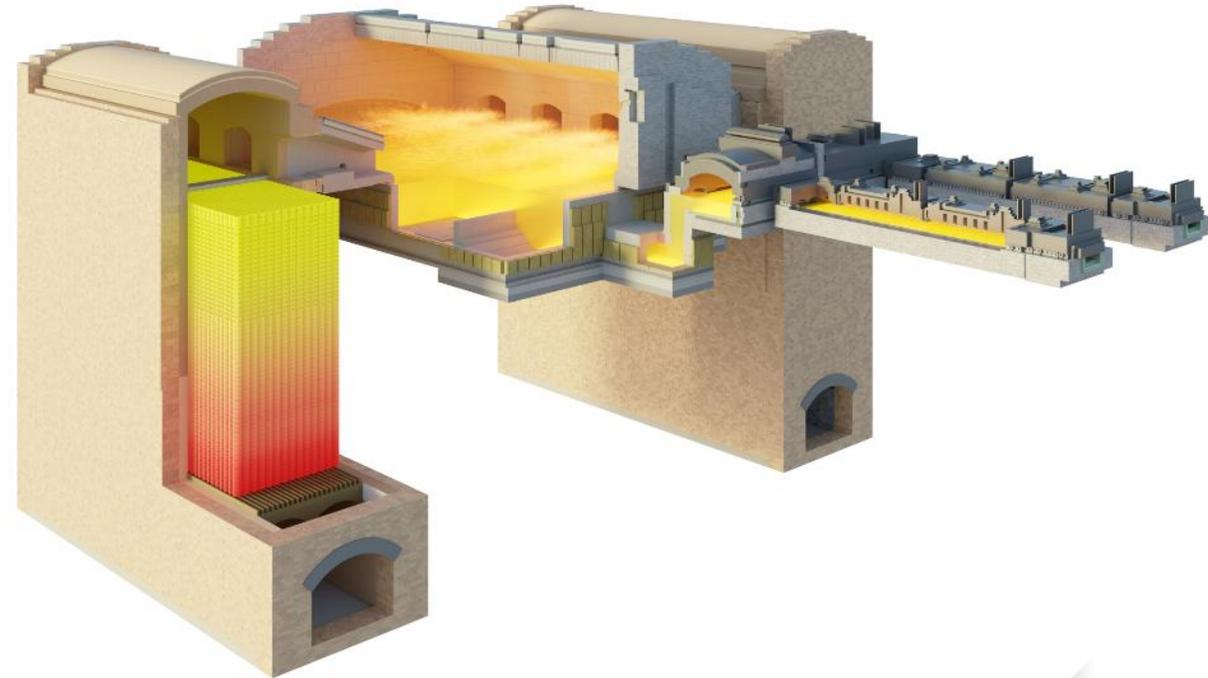
END FIRED FURNACE

- 🔥 Furnace capacity up to 650 t/d
- 🔥 Low energy consumption
- 🔥 Low emission values
- 🔥 High flexibility during production changes
- 🔥 High specific melting area load
- 🔥 Long lifetime



CROSS FIRED FURNACE

- High furnace capacity up to 750 t/d
- Easy adjustable temperature profile along the furnace
- Low energy consumption
- Low emission values
- High flexibility during production changes
- High specific melting area load
- Long lifetime



RECUPERATIVE FURNACE

- High glass quality due to stable firing and clean combustion air
- Easily adjustable temperature profile along the furnace
- Less NO_x-emissions than regenerative furnaces
- Lower investment costs
- Less space requirement
- High flexibility during production changes



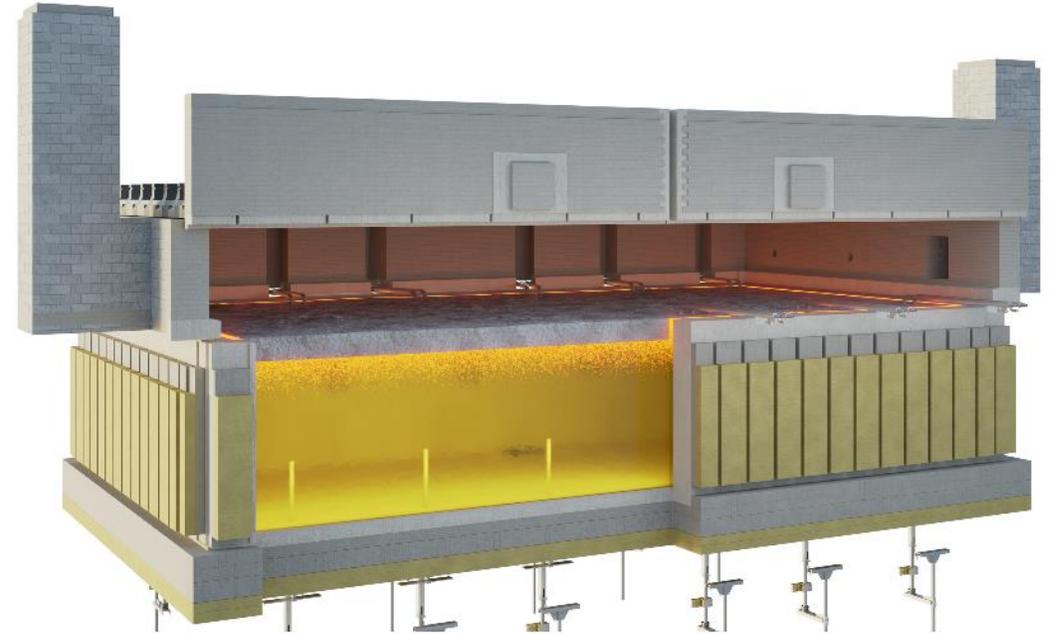
OXYFUEL FURNACE

- Reduction of the flue gas volume
- Less investment in waste gas equipment
- Low energy consumption
- Reduced NO_x-emission
- Reduced dusting of raw materials
- Improvement of the glass quality
- High specific pull
- High glass quality due to stable firing and clean oxygen



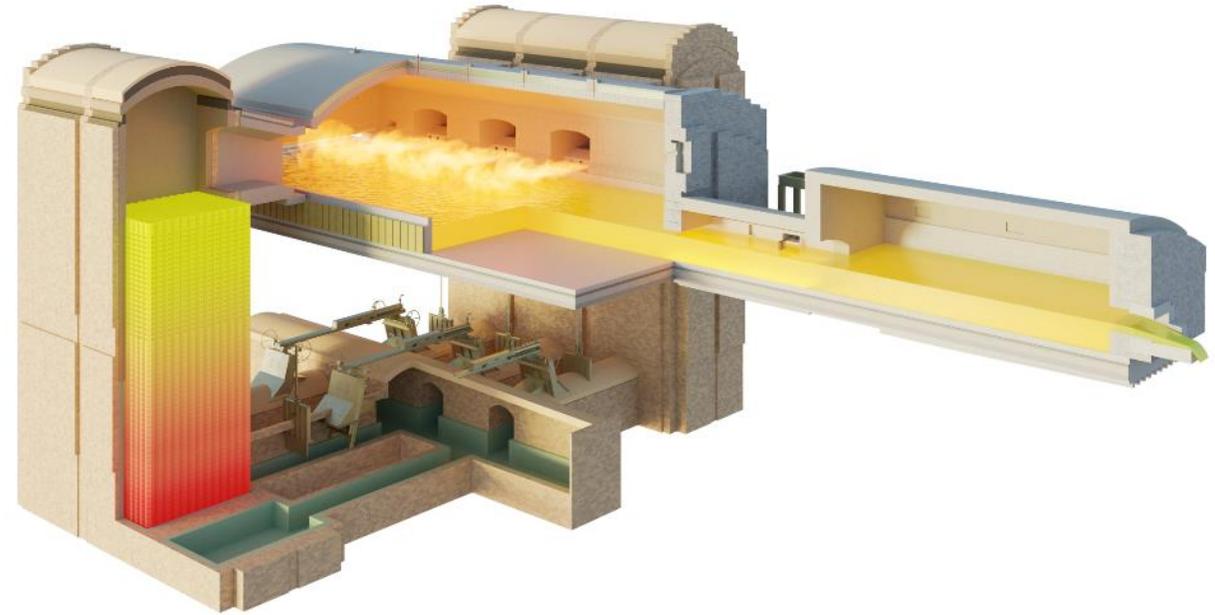
ALL ELECTRIC FURNACE

- 🔥 Furnace capacity up to 200 t/d
- 🔥 No dusting of the batch
- 🔥 Suitable for special glass production with expensive, easily evaporating and toxic batch components
- 🔥 Very efficient for small melting capacities
- 🔥 Very low waste gas emissions (SO_x, NO_x, CO₂)
- 🔥 Very high glass quality possible
- 🔥 Very low flue gas treatment costs



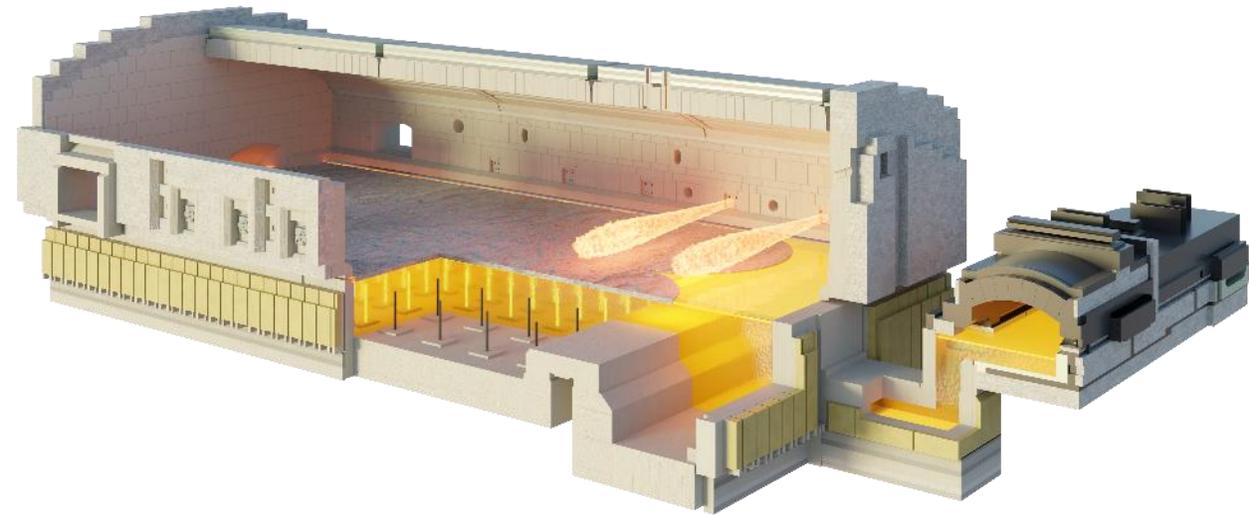
FLOAT GLASS FURNACE

- High furnace capacity up to 1000 t/d
- High quality glass for architecture or automotive purposes
- Low energy consumption
- Low emission values



HYBRID FURNACE

- High furnace capacity up to 750 t/d and even larger
- Overall energy consumption is reduced by approximately 5 to 10 %
- CO₂ emissions from combustion decrease 20 to 45 %
- Flexibility regarding energy (fossil <-> electric)
- Low energy consumption
- Low emission values
- Reduced NOx emissions



DISTRIBUTOR / FOREHEARTHS

- Glass Conditioning Systems (GCS®)
 - Distributor GCS® 100
 - Forehearth GCS® 200
 - Forehearth GCS® 301-advanced
- Electrical forehearths
- Colouring forehearths



TURN-KEY

Project Management

Glass Plants

Architectural Services

PROJECT MANAGEMENT

-  Feasibility Study
-  Basic Engineering
-  Detailed Engineering
-  Site Management
-  Operational Support
-  Training



GLASS PLANTS

- 🔥 Float Glass Plants
- 🔥 Container Glass Plants
- 🔥 Cast Glass Plants
- 🔥 Sodium Silicate Glass Plants



ARCHITECTURAL SERVICES

The construction of an entire glass plant requires a wide range of architectural services. HORN can provide a full scope of such services in collaboration with a highly experienced partner company specialised in architectural design. Since every plant project is a unique and complex effort, HORN's main objective is to develop customised architectural & technological solutions that satisfy the customer's needs and meet specific planning requirements.



PRODUCTS

PRODUCTS

PROCESS LINE

- Batch Plant & Cullet Return System
- Furnace
- Tin Bath
- Annealing Lehr
- Hot End Automation
- Cutting Line
- Miscellaneous
 - Warehouse Equipment
 - Waste Gas Treatment
 - Laboratory Equipment
 - Raw Material Treatment

FURNACE TECHNOLOGY

- Refractory Material
- Steel Structures
- Combustion System
- Flue Gas Equipment
- Tank Cooling

- Drainage System
- Stirrer Unit
- Control Equipment
- Electric **e-Fusion** Boosting System
- Glass Level Measuring
- Batch Charging Machines

GLASS CONDITIONING TECHNOLOGY

- Distributor / Forehearths
- Combustion System

TIN BATH TECHNOLOGY

- Top Roller
- Dross Box
- Tweel
- Coolers
- Venting System
- Linear Motor
- Graphite Equipment
 - Fences and Pusher
 - Flags

UTILITIES FOR TURN-KEY PLANTS

- Nitrogen Generating Plant
- Hydrogen Generating Plant
- N₂/H₂ Mixing Station
- SO₂ Station
- Cooling Water
- Compressed Air
- Electric Power Supply

ENGINEERING

- Refractory Engineering
- Steel Engineering
- Computer Modelling

WORKS & SERVICES

- Supervision of Installation
- Installation Works

- Hot Repair Works
- Glass Drain
- Heat Up Services
- Hot Inspection Services

PROJECT MANAGEMENT

- Feasibility Study
- Basic Engineering
- Detailed Engineering
- Site Management
- Operational Support
- Training

PROCESS LINE

- 🔥 Batch Plant & Cullet Return System
- 🔥 Furnace
- 🔥 Tin Bath
- 🔥 Annealing Lehr
- 🔥 Hot End Automation
- 🔥 Cutting Line
- 🔥 Miscellaneous
 - 🔥 Warehouse Equipment
 - 🔥 Waste Gas Treatment
 - 🔥 Laboratory Equipment
 - 🔥 Raw Material Treatment



BATCH PLANT & CULLET RETURN SYSTEM

- Different raw materials are stored, mixed and provided for the melting
- HORN's scope of supply comprises unloading, weighing, dosing, mixing and transfer system
- From the cullet hoppers, transport conveyors feed the cullet to a storage area directly to the batch plant cullet silos



FURNACE

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 coolers
- 🔥 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, 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 casing, bath roof, top roller, technological equipment and dross box



ANNEALING LEHR

- The lehr is designed for glass cooling under certain temperature conditions from 600 °C to 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



HOT END AUTOMATION

With the HORN Hot End Automation System the operation processes at

-  the glass melting furnace
-  the tin bath and
-  the lehr

are effortlessly controlled from one location, with only a few precise mouse clicks.

In the air-conditioned and well-equipped control station, where all necessary control and visualisation components are located, the Hot End Automation System assists the customer in controlling a complex production process. It even coordinates the measurement and control technology of the production process to form a fully integrated process control system.



CUTTING LINE

- After the annealing process the glass ribbon enters the cutting line. The glass ribbon will be processed by the following facilities:
 - Cutting in required glass formats
 - Quality inspection
 - Transportation 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 panels



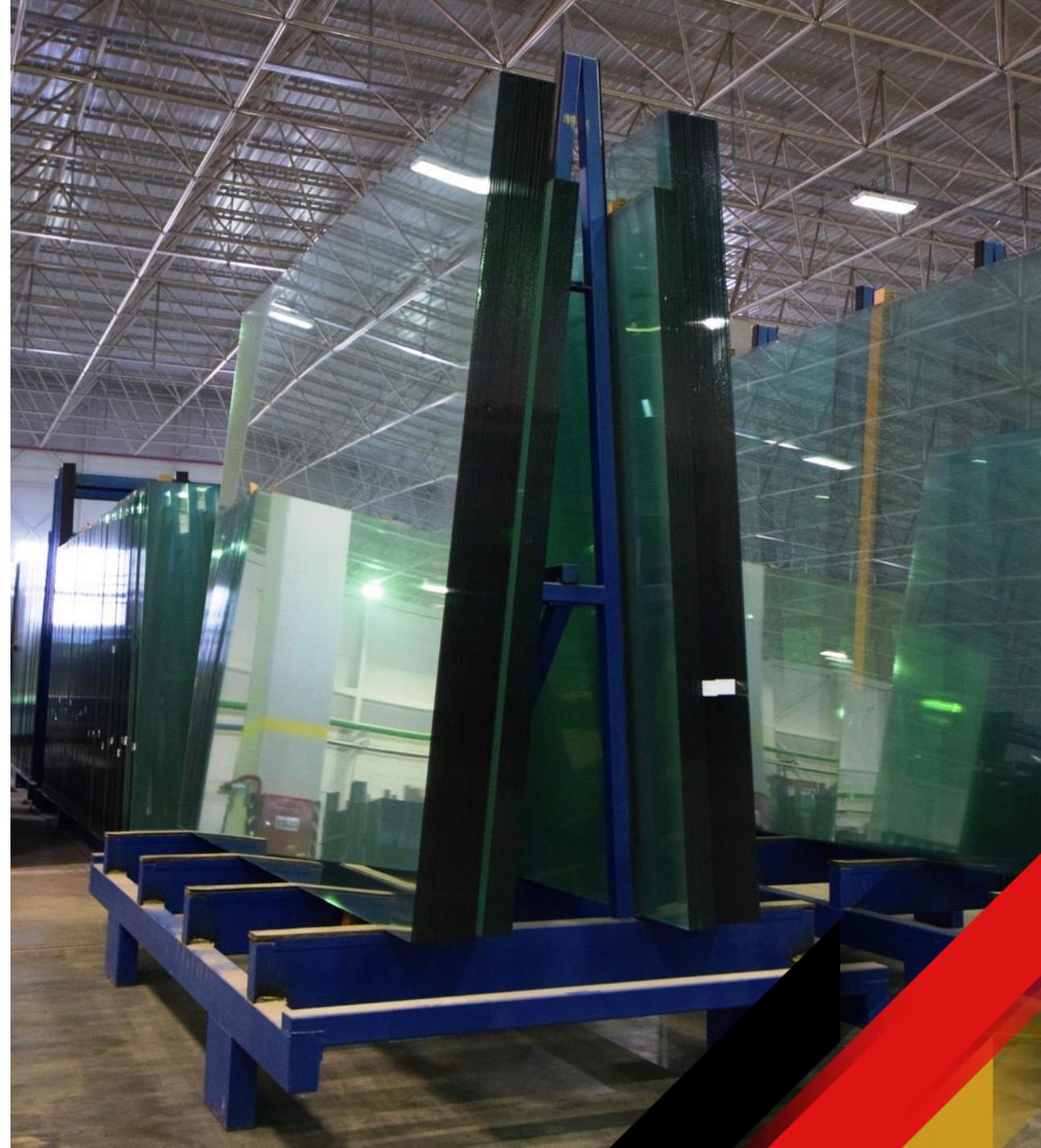
MISCELLANEOUS

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



WAREHOUSE EQUIPMENT

- Storage of produced products
- Logistics and equipment of warehouse depending on produced product range
- May include:
 - Side loaders
 - Box side loaders
 - Forklift trucks
 - Stillage transporters 30 t
 - Stillages
 - Automatic packing tables
 - Special glass handling for cranes



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 bypass to the chimney allows to bypass the complete waste gas treatment plant in case of emergency or for inspection purposes



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

- Sand and other materials
- Sand processing
- HORN brings the sand to the necessary quality
- HORN helps with the selection of the right equipment



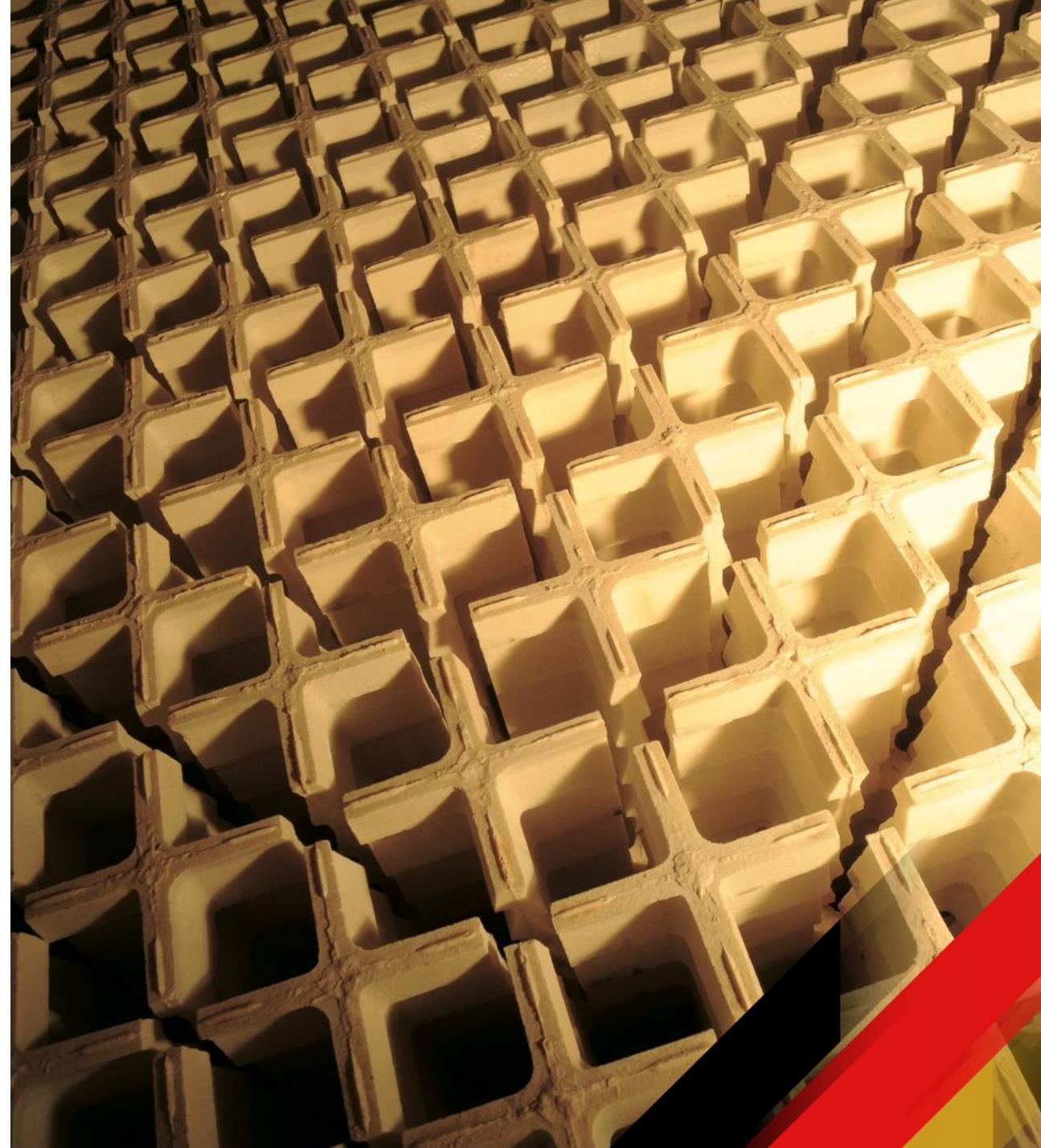
FURNACE TECHNOLOGY

-  Refractory Material
-  Steel Structures
-  Combustion System
-  Flue Gas Equipment
-  Tank Cooling
-  Drainage System
-  Stirrer Unit
-  Control Equipment
-  Electric Boosting System
-  Batch Charging Machines



REFRACTORY MATERIAL

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



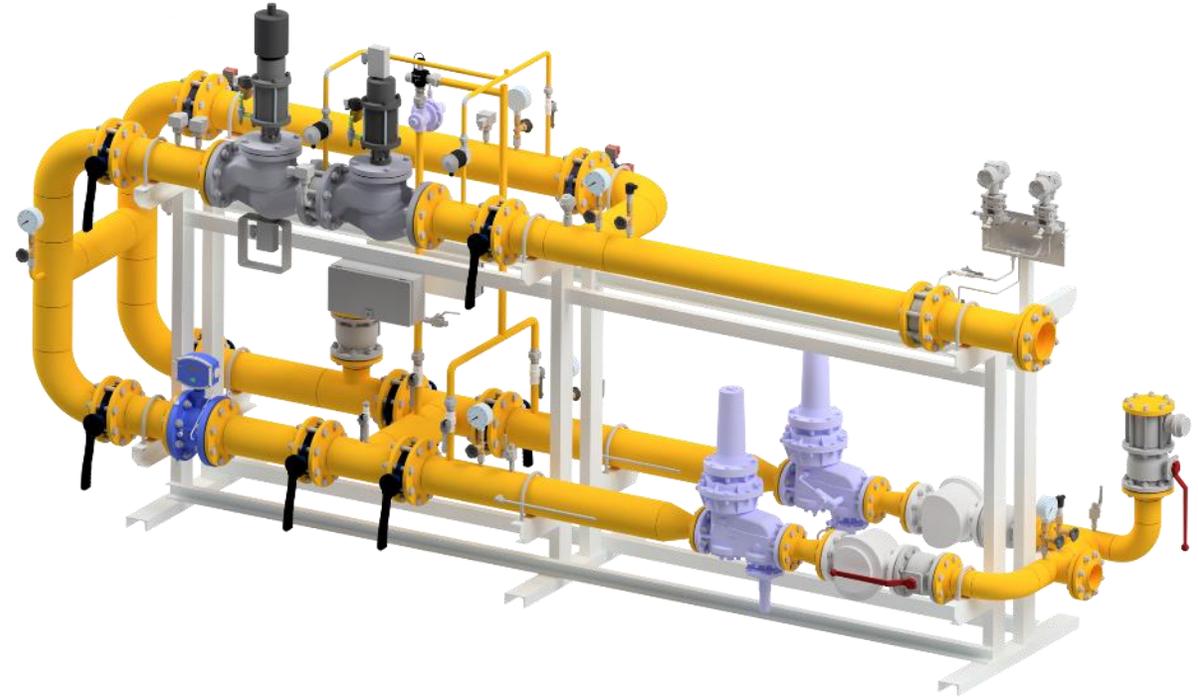
STEEL STRUCTURES

- 🔧 Scope of supply for turn-key projects, but normally local supply through customer
- 🔧 Manufacturing according to Euro-Code 3



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 of tailor-made systems
- Manufacturing, pre-assembly and test in HORN 's workshop



FLUE GAS EQUIPMENT

A HORN glass melting furnace fired with fossil fuels can be compared with a mechanical clockwork. All components have to interlock to ensure perfect combustion of the fossil fuels. Reversing systems are permanently mounted in the flue gas channel of the melting end.

HORN offers two types of reversing systems:

- 🔥 Reversing system RDS-E for end fired furnaces
- 🔥 Reversing system RDS-F for float glass furnaces



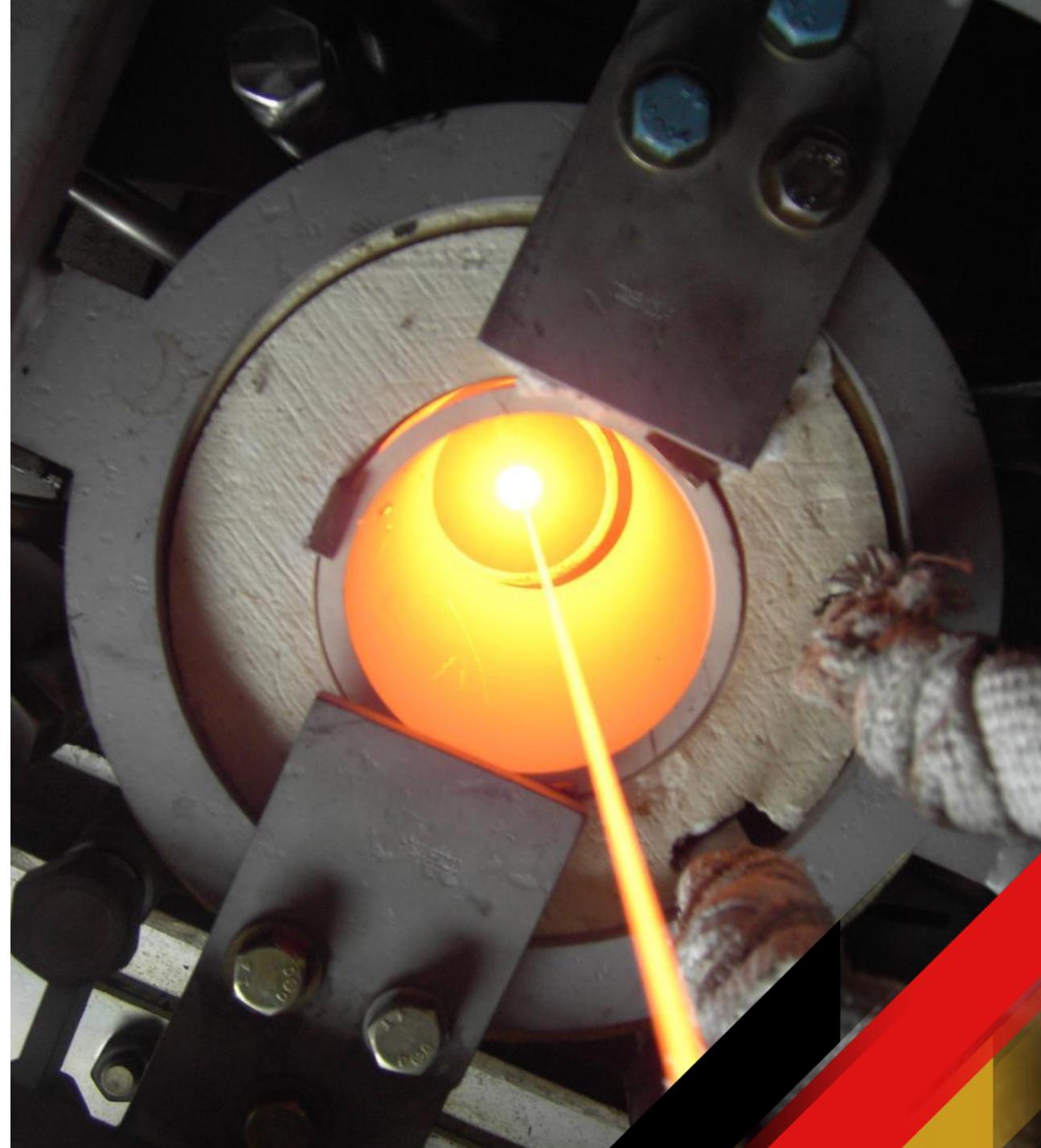
TANK COOLING

- Special nozzle design for tank and throat cooling
- Manual control flap for each nozzle
- Frequency controlled cooling fans
- Automatic temperature control (optional)



DRAINAGE SYSTEM

- To remove cat scratches and speed-up of colour changes
- Pull 0.2 - 2.0 t/d
- Special shaped drain block for new installations
- Refitting at running forehearth 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



STIRRER UNIT

HORN offers two types of stirrers:

- Stirring system for forehearths
- Stirring system for float glass furnaces

Characteristics:

- Installation at forehearth equalising section to remove zirconium cords
- Perfect in combination with the drainage 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



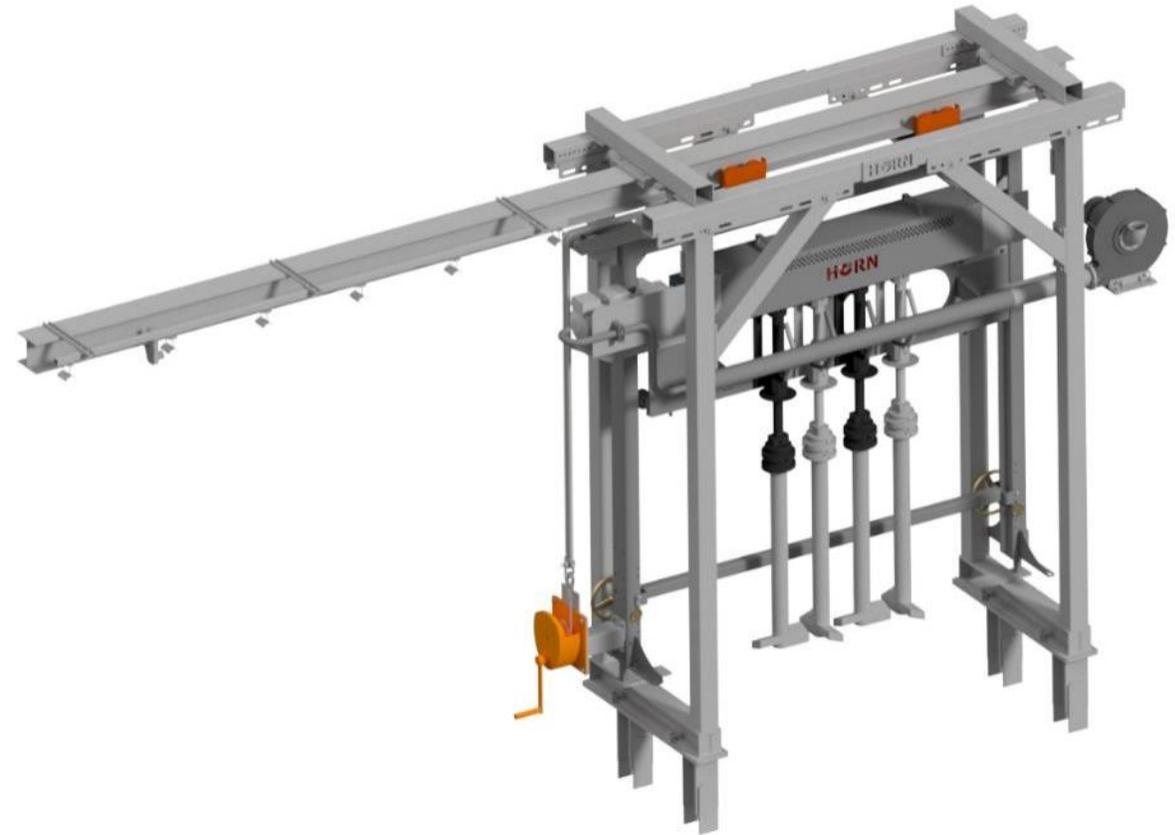
STIRRER UNIT

STIRRING SYSTEM FOR FOREHEARTHS

The HORN stirrer system enables mechanical treatment of the glass at the downstream part of the melting and conditioning at the equalising zone. It is typically installed to avoid cat scratches. The system could also be used to improve the thermal homogeneity index (THI %). The HORN stirrer system in combination with the HORN drainage system VARI-DRAIN works perfectly to avoid cat scratches.

Forehearth stirring system features:

- 🌀 Continuously adjustable rotation speed
- 🌀 Easy replacement of the stirrers through quick couplings
- 🌀 Maintenance free bearings and drive elements



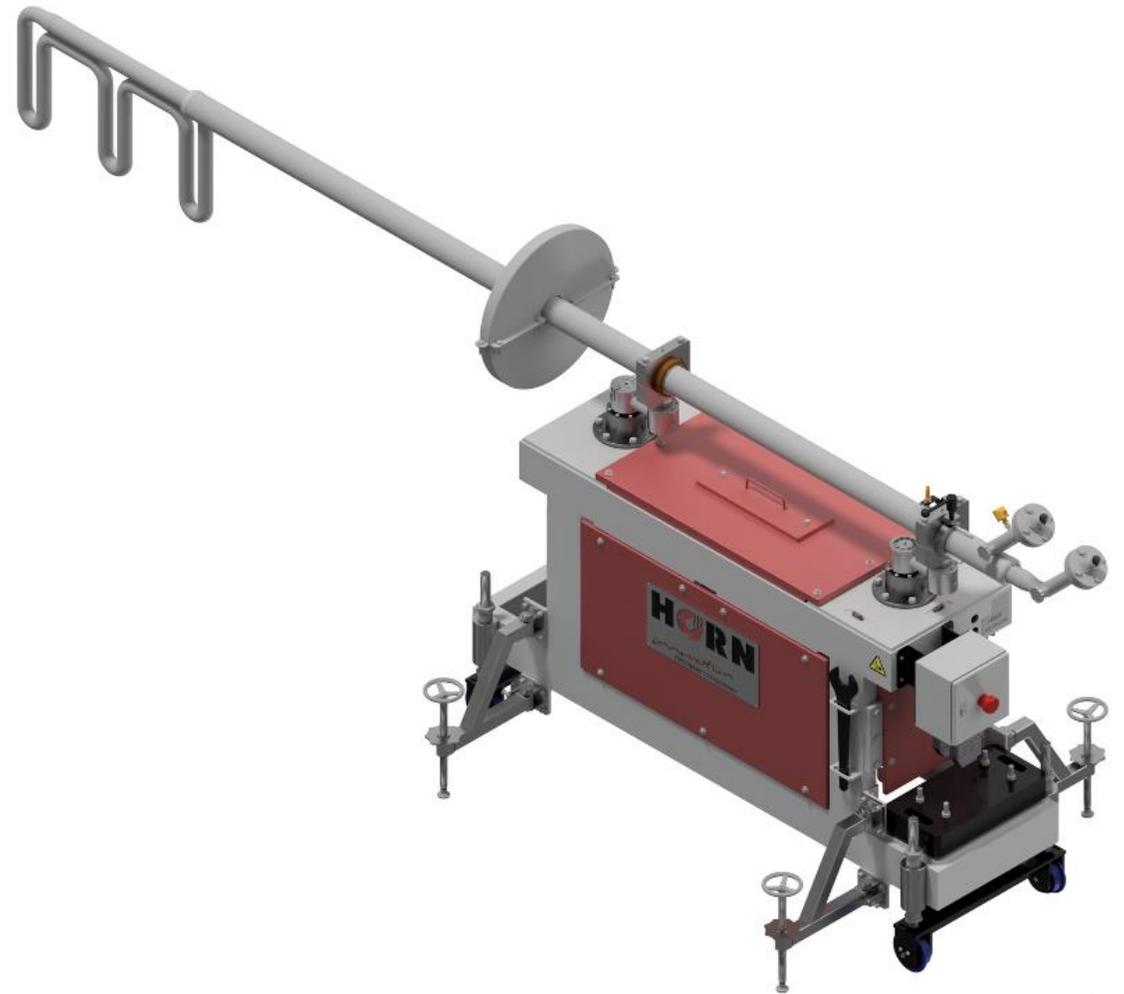
STIRRER

STIRRING SYSTEM FOR FLOAT GLASS FURNACES

The horizontal stirring appliance (HST) is used in float glass furnaces solely for conditioning of the molten glass at the neck to the melting area. Glass layers with different temperatures are mixed to a smooth and homogeneous temperature profile by the circulating movements of the stirring system.

Horizontal stirring appliance features:

- 🌀 Sensitive components are located at the cold side
- 🌀 Good accessibility
- 🌀 Homogenising of the entire traverse section of the channel
- 🌀 Continuous adjustable rotation speed and direction
- 🌀 Continuous adjustable immersion depth



CONTROL EQUIPMENT

- Four-level operational concept for melting process control:
 - Process supervision and visualisation
 - PLC – levels with independent operating units
 - Back-up hardware levels
 - Manual/Field operation level
- Only most reliable and durable equipment from special suppliers, e.g. Siemens S7 / WinCC / PCS 7 / TIA, Allen-Bradley / Rockwell, Wieland, etc. Other suppliers are also possible upon customer's request.
- FAT (Factory Acceptance Test) performed at HORN



e-Fusion ELECTRIC BOOSTING SYSTEM

Different types:

-  **e-Fusion** Melting Boosting
-  **e-Fusion** Barrier Boosting
-  **e-Fusion** Refining Boosting
-  **e-Fusion** Throat Boosting
-  **e-Fusion** Feeder Boosting

Consisting of:

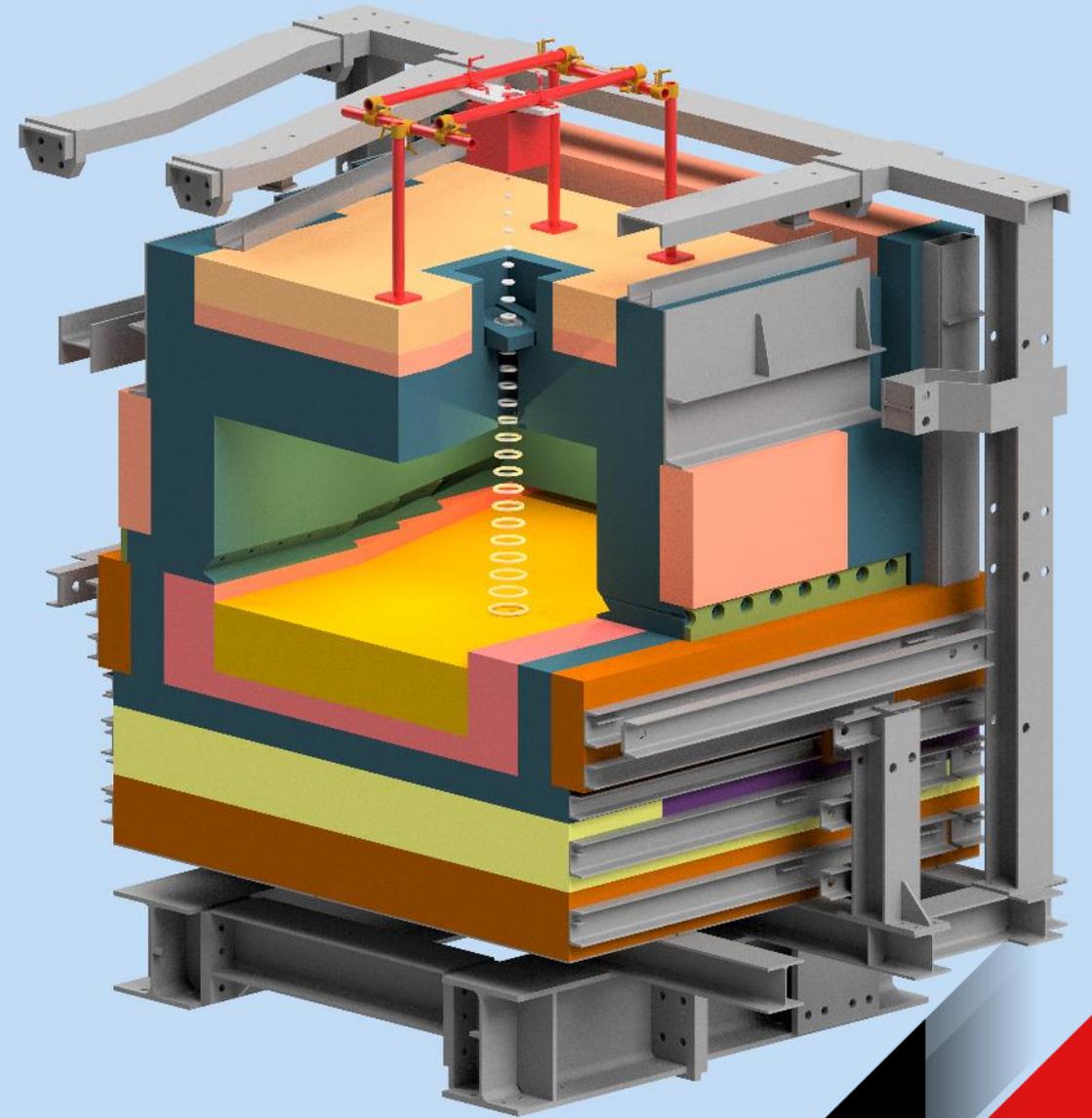
-  Transformer
 -  Oil cooled regulation transformer
 -  Dry transformer, thyristor controlled
-  Electrodes & holders
 -  Instrumentation and control system
 -  Cabling / busbar
 -  Cooling water equipment



GLASS LEVEL MEASURING

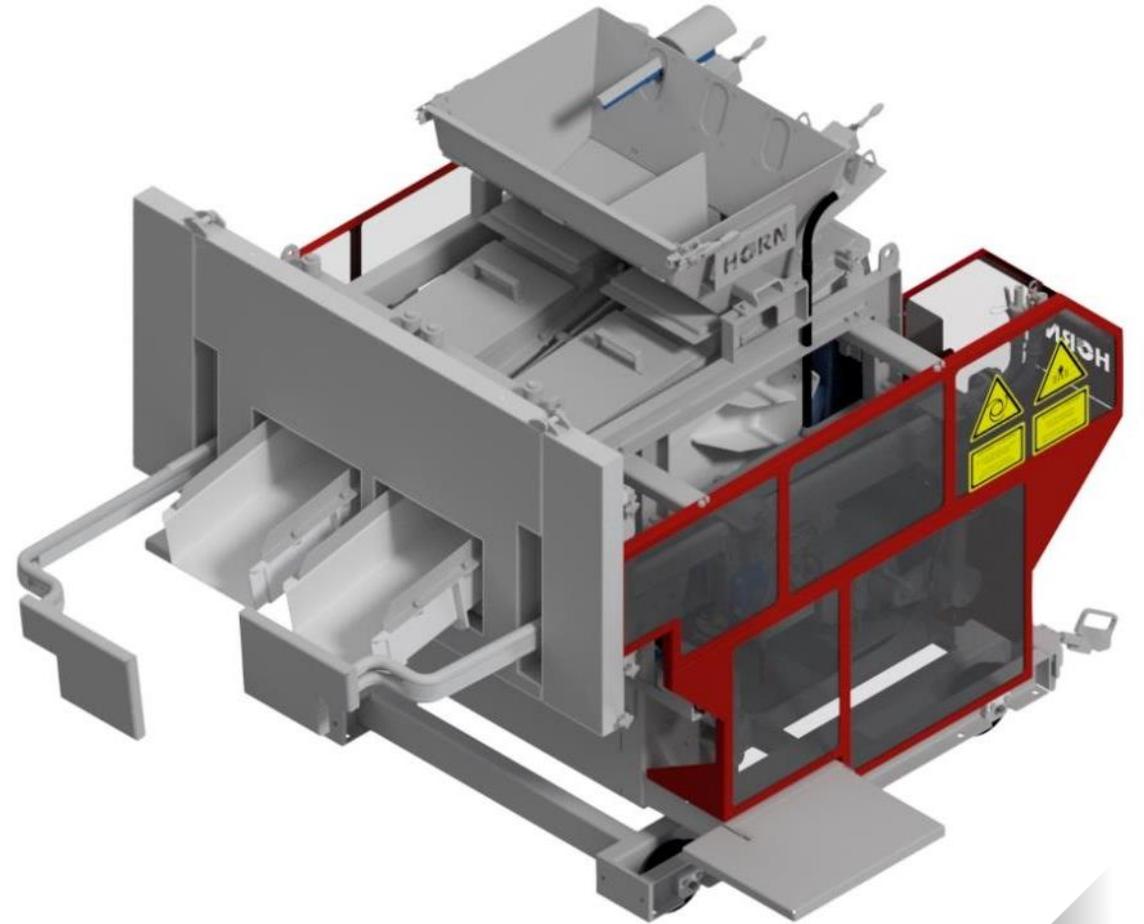
HORN RADAR BEAM HRD-BEAM

- 📡 Contactless glass level measurement based on radar technology
- 📡 The measurement device will be installed on top of the distributor or forehearth
- 📡 The high measuring accuracy allows the precise control of the glass level together with all common charging machines
- 📡 The measuring device can either be installed as a stand-alone version or can be integrated into a HORN control cabinet and comes together with a touchscreen evaluation computer
- 📡 Reduces all maintenance work to a minimum because no mechanical moving parts are built in
- 📡 Measurement accuracy: distance between glass surface and sensor at 2 m with an accuracy of ± 0.1 mm or better



BATCH CHARGING MACHINES

- 🔥 Oscillating chargers HVR
- 🔥 Vibratory batch charger HVR® 600 F/S-2P and HVR® 700 F/S-2P for closed doghouse
- 🔥 HVR® 2X300S-2P - the first batch charger with two independently controllable vibrating chutes
- 🔥 Screw batch charger
- 🔥 Piston batch charger
- 🔥 Cold top batch charger HVFE
- 🔥 Float batch charger



GLASS CONDITIONING TECHNOLOGY

 Distributor / Forehearths

 Combustion System CORA®



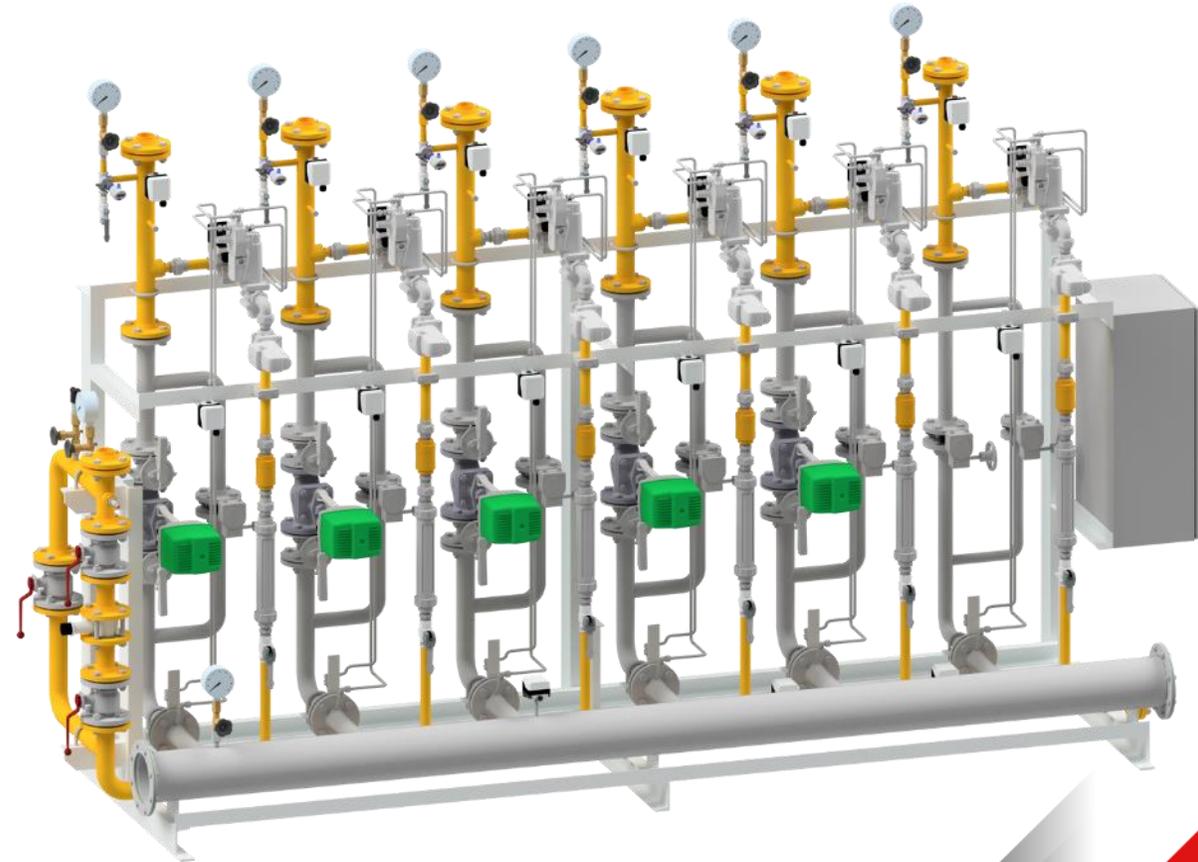
DISTRIBUTOR / FOREHEARTHS

- 🔥 Glass Conditioning System (GCS®)
 - 🔥 Distributor GCS® 100
 - 🔥 Forehearth GCS® 200 (with radiation cooling)
 - 🔥 Forehearth GCS® 301-advanced (with indirect & direct air cooling)
- 🔥 Electrical heated forehearth
- 🔥 Colouring forehearth



COMBUSTION SYSTEM

- Proportional gas and air volume control irrespective of pressure fluctuations
- Almost 100% stable gas/air ratio is realised 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



TIN BATH TECHNOLOGY

- Top Roller
- Dross Box
- Tweel
- Coolers
- Venting System
- Linear Motor
- Graphite Equipment
 - Fences and Pusher
 - Flags



TOP ROLLER

Top rollers are amongst the most important machines of a tin bath. These machines are always used in pairs in the forming section of the tin bath. Each pair, consisting of master and slave, works synchronously and thereby creates optimal conditions for a smooth production process.

HORN offers two different types of top roller machines:

- 🔥 The floor-based top roller, type HRTM-F, which is installed on the working floor
- 🔥 The suspended top roller, type HRTM-S, which is suspended from the tin bath steel structure

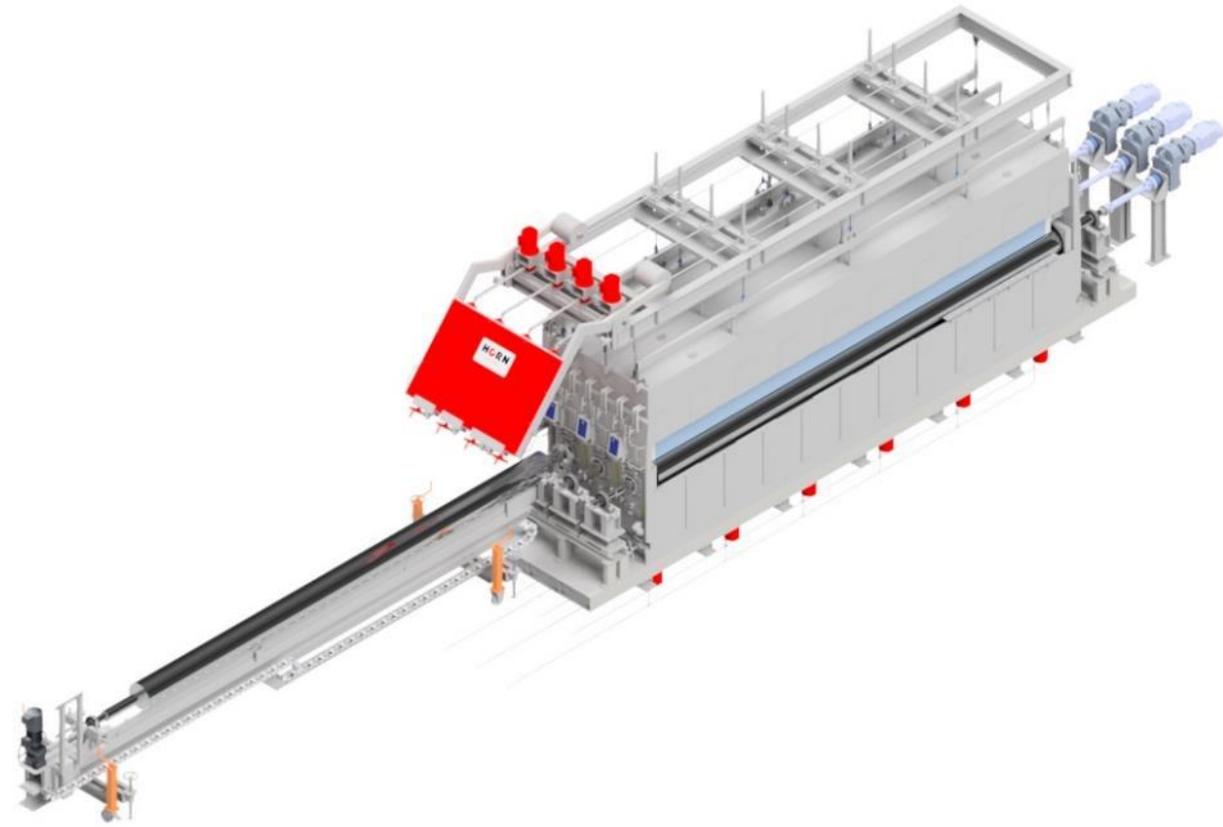


DROSS BOX

The dross box is the most important instrument for the smooth transfer of the glass ribbon from the tin bath into the annealing lehr.

The dross box consists of two big components:

-  Dross box casing
-  Dross box hood and curtains



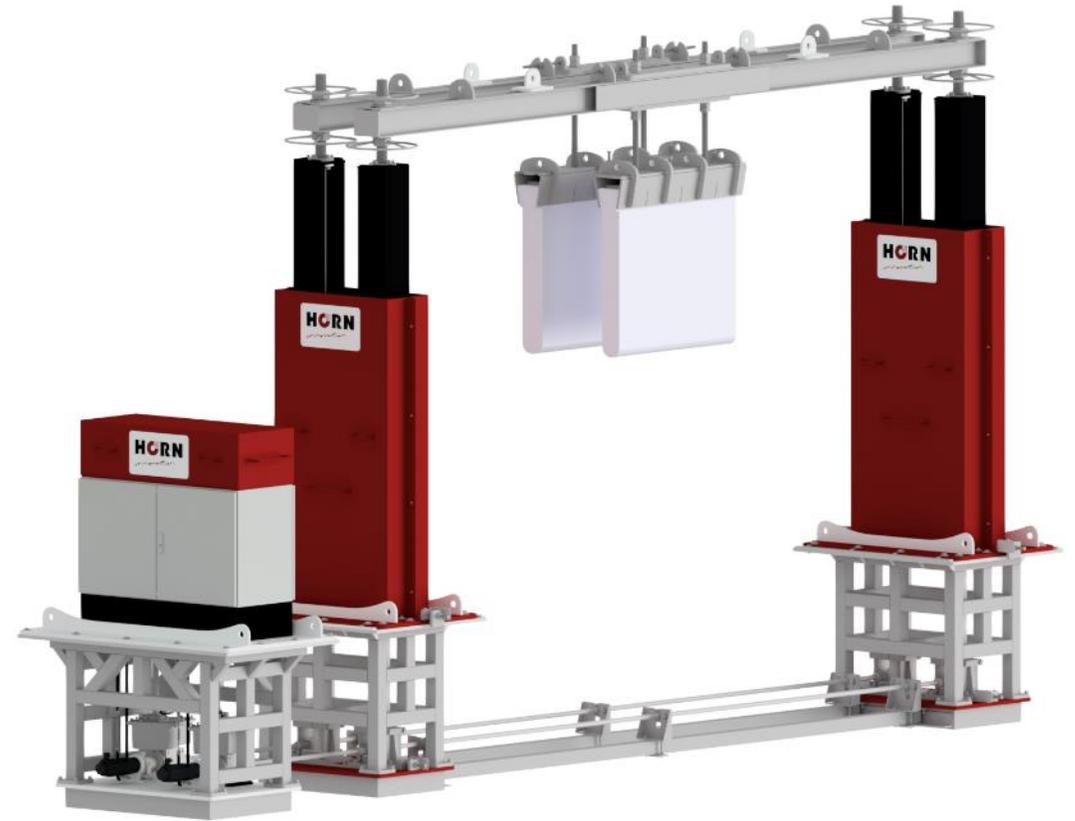
TWEEEL

The tweel is one of the most important control instruments within a float glass production plant. It controls the glass flow quantity from the melting end into the tin bath. By means of the tweel, the glass flow can also be stopped completely.

The HORN tweel type TW excels in its absolutely robust mechanical design.

The tweel consists of the following components:

- Control valve made of fireproof material
- Emergency valve, optionally made of fireproof material or stainless steel
- Tweel mechanism which implements the vertical movement of the two valves



COOLERS

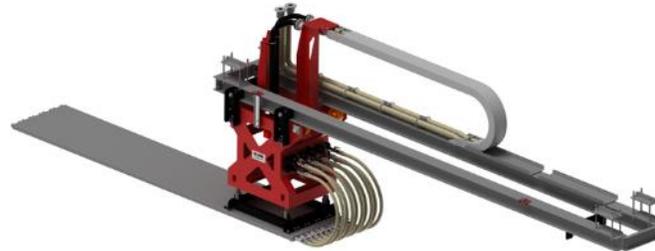
Tin bath coolers mainly serve to extract heat from the glass bath. Usually these are used in pairs on either side of the tin bath. The HORN coolers assist to achieve the optimal production process in the tin bath.

HORN offers the following three different tin bath cooler types and models:

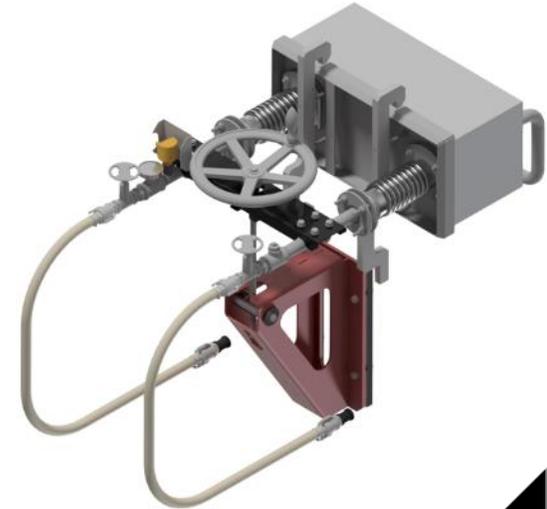
ENTRANCE COOLER TYPE HECO



EXIT END COOLER TYPE HEECO

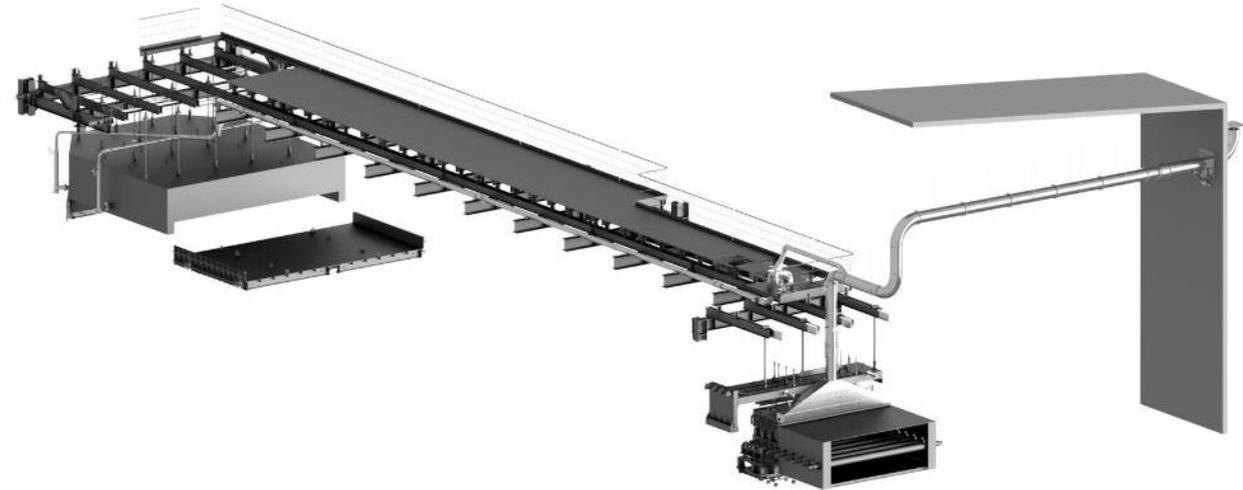


TIN COOLER HTICO 600



VENTING SYSTEM

- ❶ Venting tubes with water cooled condensation cleaning device
- ❷ Optimised positioning in the entrance area of the tin bath
- ❸ Easy access for maintenance and cleaning of the system
- ❹ Variable forced draft duct system, combined for venting and dross box hood
- ❺ Individual flow adjustment for each venting tube
- ❻ Individual flow and temperature measurement for each venting tube



LINEAR MOTOR

The HORN linear motor influences the tin flow in the narrow part of the tin bath by means of an electromagnetic field. HORN offers two types of linear motors: The stationary linear motor type HLM-6 (6-pole) and the mobile linear motor type HLM-12 (12-pole), which is installed on a mobile carriage. Therefore, it can be moved on the working floor along the tin bath to ensure flexible influence of the tin flow. It comprises four individual parts: the linear motor head (6-pole or 12-pole), the water-cooled support arm, the mobile carriage and the water distributor.



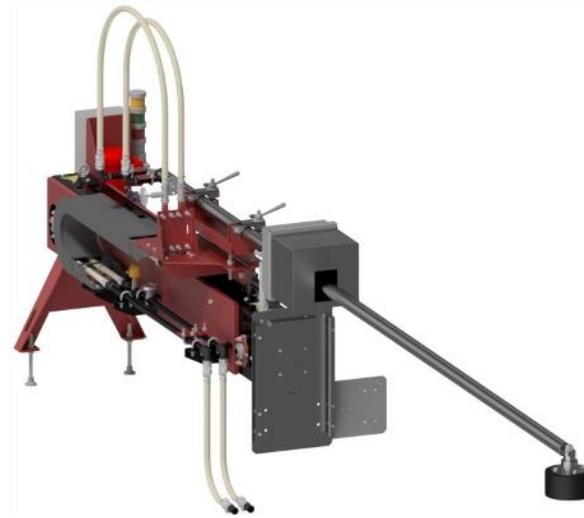
GRAPHITE EQUIPMENT

With its tin bath equipment HORN offers powerful solutions for a wide range of functions. The fence guides the glass ribbon safely and smoothly through the tin bath. If the glass ribbon is too wide, the pusher folds the edges of the glass ribbon, thus protecting the subsequent equipment parts from any damage. Both machines consist of a motorised positioning unit, a water-cooled supporting tube made of stainless steel and the graphite working element.

HORN MOTORISED PUSHER TYPE HMPUP



HORN MOTORISED FENCE TYPE HMPUF



GRAPHITE EQUIPMENT

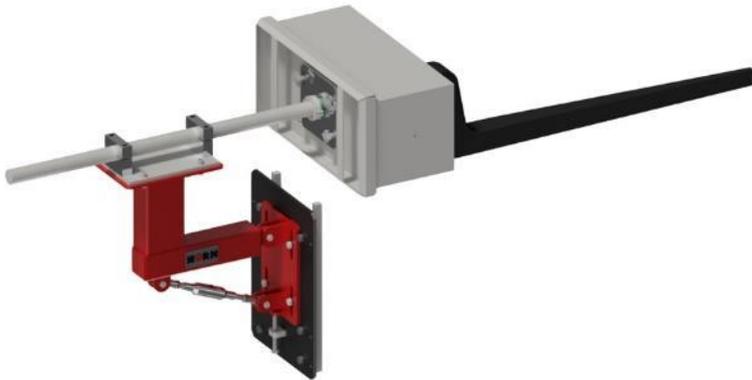
Flags are used to control the tin flows at the sides of the tin bath.

There are two different types of HORN flags:

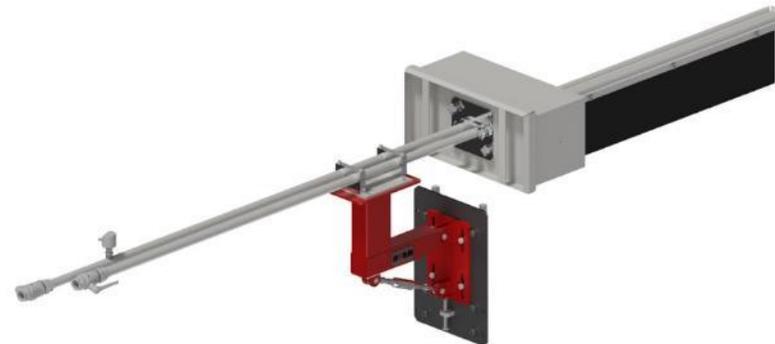
-  HORN full depth flag – type HFF
-  HORN submerged flag – type HFS

To enable the flags to achieve their full performance potential it is vital to install them in pairs, symmetrically positioned opposite each other. Both flags control the tin flows in the tin bath and thus increase production quality.

HORN FULL DEPTH FLAG TYPE HFF



HORN SUBMERGED FLAG TYPE HFS



UTILITIES FOR TURN-KEY PLANTS

-  Nitrogen Generating Plant
-  Hydrogen Generating Plant
-  N₂/H₂ Mixing Station
-  SO₂ Station
-  Cooling Water
-  Compressed Air
-  Electric Power Supply



NITROGEN GENERATING PLANT

- For prevention of oxidation of the tin melt, the atmosphere in the tin bath should be natural-reduced (without oxygen) by using Nitrogen and Hydrogen
- Production of Nitrogen is based on the cryogenic separation of atmospheric air into N_2 and O_2
- There are backup tanks with pressurised gaseous nitrogen



HYDROGEN GENERATING 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

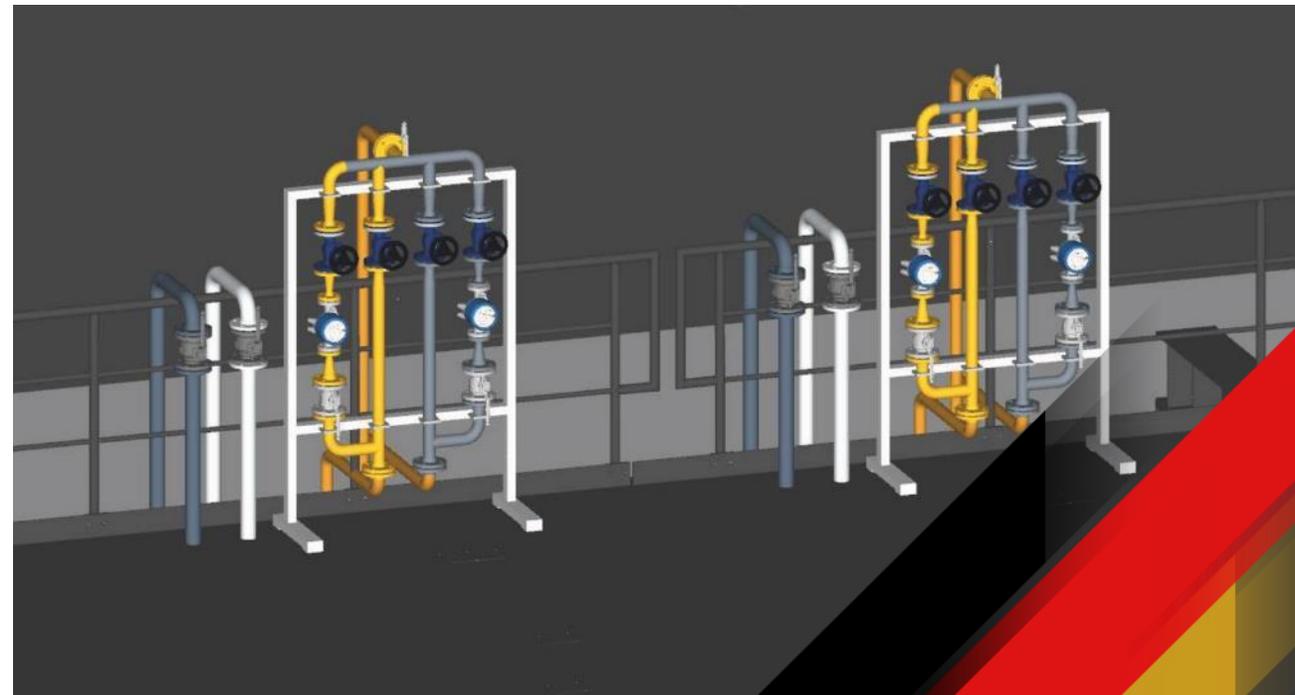


N₂/H₂ MIXING STATION

HORN offers a complete system for the generation and control of shield gas. The shield gas mixing station is integrated in a 40' sea container, which is divided into two gas-tight separated areas. The process chamber contains one redundant shield gas mixing station and two nitrogen pressure control stations. For individual adjustment of H₂ demand at each bay of the tin bath the tin batch shield gas control stations will be installed, which leads to further dilution of N₂H₂ gas with N₂.

Benefits

- Redundant-safe supply of shield gas
- Cost-effective dosing of the relatively expensive H₂ gas
- Optimisation of dew point along the tin bath
- Individual adjustment of N₂ and N₂H₂ ratio for each tin bath bay



SO₂ STATION

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



COOLING WATER

- ❶ Cooling water is used for cooling of the equipment in the hot production area
- ❷ 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.
- ❸ Supply water is specially treated in the water treatment unit before seeding to the water circulating loop
- ❹ For emergency water circulation an elevated tank, Diesel or UPS-driven pumps are foreseen



COMPRESSED AIR

The compressed air system supplies the compressed air for the whole float-line in the required quality.

It consists of:

-  Compressors
-  Treatment of compressed air
-  Flow control stations and piping
-  Instrumentation and automation



ELECTRIC POWER SUPPLY

- A main voltage transformer substation is foreseen for changing 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
- In addition, power supply by diesel generators ensures the production cycle



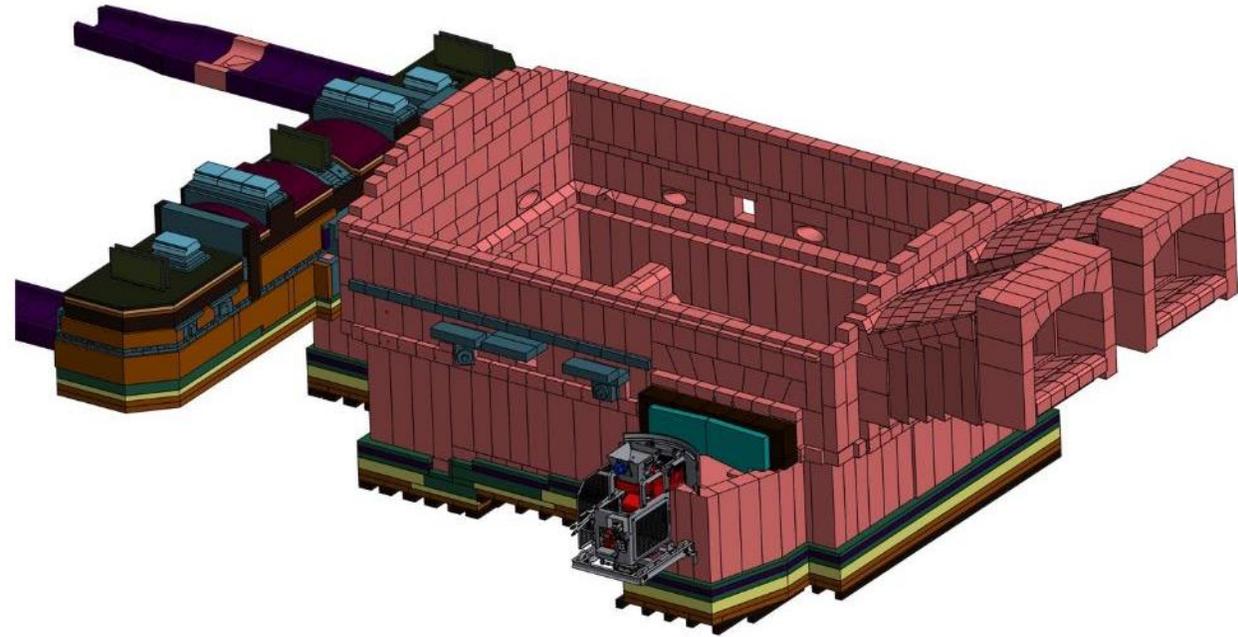
ENGINEERING

-  Refractory Engineering
-  Steel Engineering
-  Computer Modelling



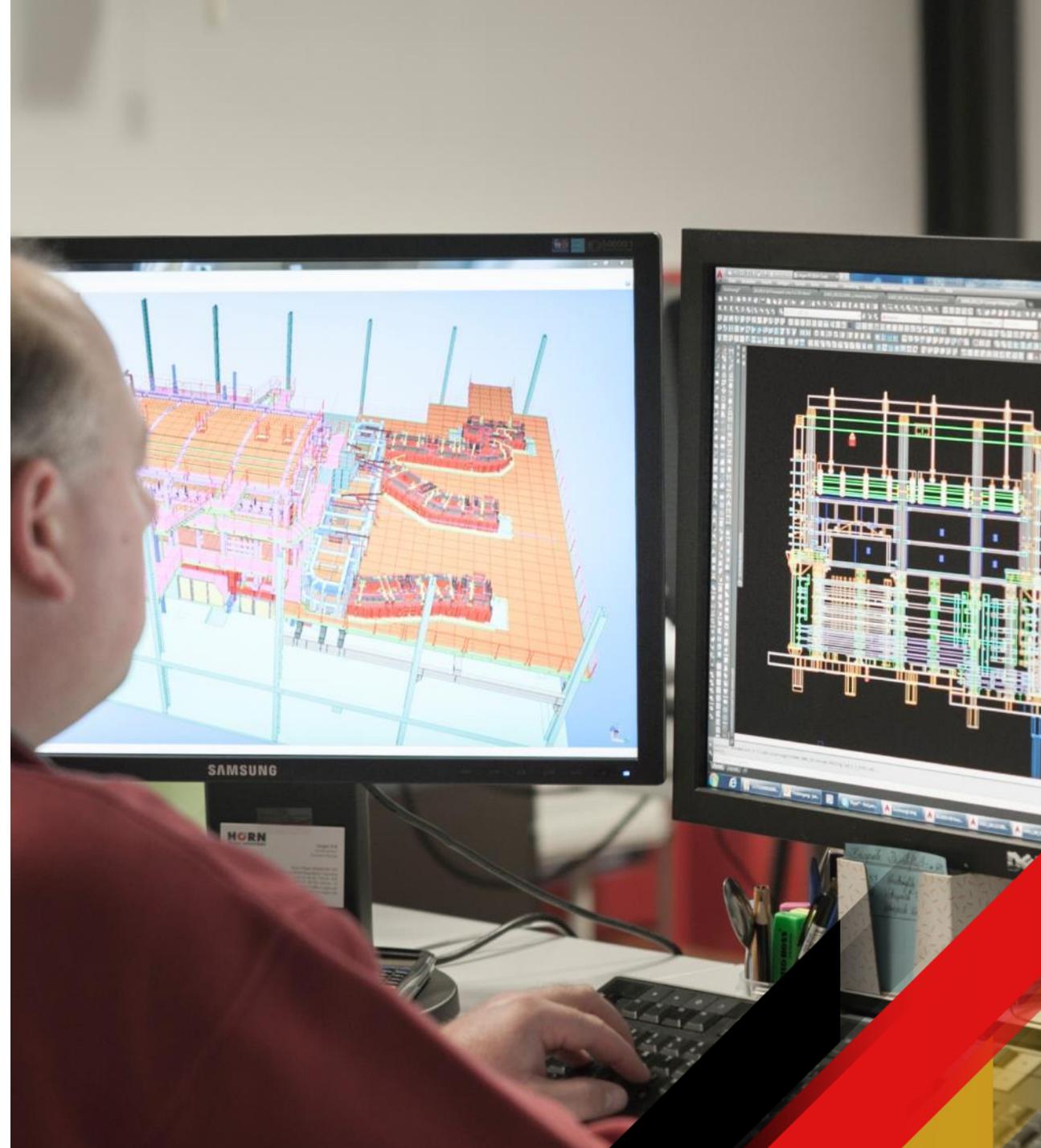
REFRACTORY ENGINEERING

- 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 worldwide manufacturer
- Assistance during sourcing of refractory material
- Documentation on paper and CD-ROM



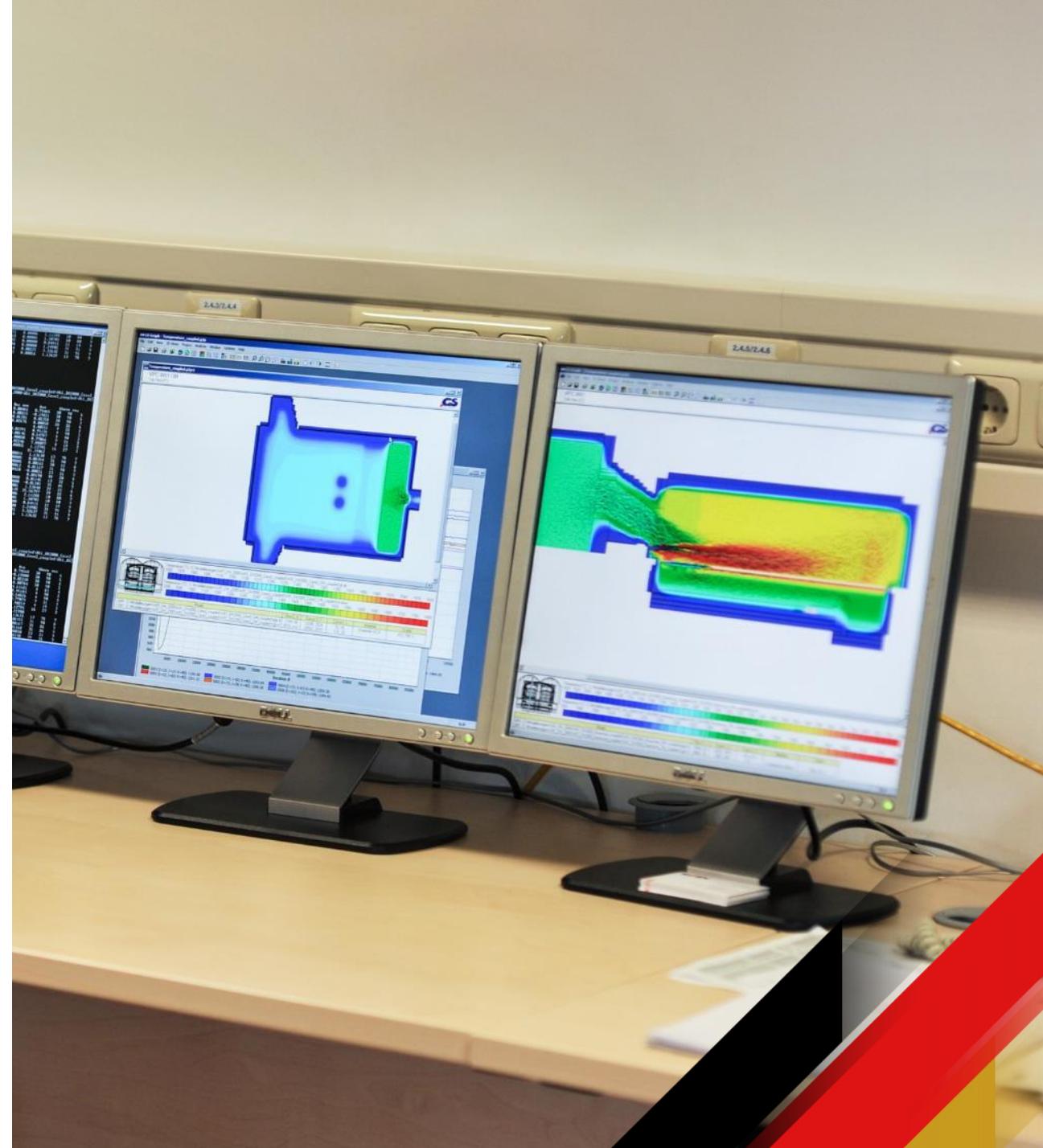
STEEL ENGINEERING

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



COMPUTER MODELLING

- Numerical calculation and representation of 3D temperature distributions and flows
- Assessment with regard to temperature limits, glass quality, geometry and electric **e-Fusion** boosting systems
- Visualisation of the current processes, also for newly planned plants
- Decision making concerning design and optimisation
- Practical comparison with operating data and own measurements



WORKS & SERVICES

-  Supervision of Installation
-  Installation Works
-  Hot Repair Works
-  Glass Drain
-  Heat Up Services
-  Hot Inspection Services



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 are on site



INSTALLATION WORKS

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



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 of openings for cleaning, inspection and placement of dampers



GLASS 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



HEAT UP SERVICES

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



HOT INSPECTION SERVICES

- Highly specialised 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 its cleaning



PROJECT MANAGEMENT

-  Feasibility Study
-  Basic Engineering
-  Detailed Engineering
-  Site Management
-  Operational Support
-  Training



FEASIBILITY STUDY

- General description of the project
- Raw Materials research
 - Studying all possible resources
 - Laboratory check
 - Selection of treatment equipment
 - Map with distances and types of transport
 - Concept for storage at site
 - Optimal batch calculation
- Environmental impact
 - Map of all emissions
 - Recommendations about additional equipment



FEASIBILITY STUDY

- General layout of the factory
 - Visiting available locations
 - Preparing different variants
 - Recommendations about choosing the location
- Equipment selection
- Utilities survey and calculation
- Personnel planning
- Bill of quantities for civil construction works
- Time schedule of the project
- Calculation of self-cost of the product



BASIC ENGINEERING

- Creation of financing model (Euler Hermes + German banks)
- Specification of technological equipment
- Basic data for the utilities; choosing the equipment for utilities
- Developing and signing the contracts with the suppliers of equipment
- Developing of the Master Time Schedule of the project



BASIC ENGINEERING

DELIVERABLES:

-  Technological line layout with equipment on all levels
-  Media layout and media list
-  Drawings with interfaces between different suppliers
-  Load plan
-  Master Time schedule
-  Emission list



DETAILED ENGINEERING

- Collecting and checking information from suppliers for architectural services
- Architectural services
- Logistics concept
 - General Packing List
 - Documents for the customs and bank
 - Unit customs code
 - Monitoring the route of transport units
 - Logistics concept for the warehouse



SITE MANGEMENT

- 🔧 Coordination of all activities at site: suppliers, customer, building company
- 🔧 Daily site meetings
- 🔧 Site reports: daily, weekly, monthly
- 🔧 Coordination of commissioning for the technological line and utilities
- 🔧 Executing the performance test
- 🔧 Document management



OPERATIONAL SUPPORT

- Glass production is a continuous process. In order to achieve a failure-free operation during the whole period of campaign, HORN provides operational support, which consists of two steps:
 - Operational Support during Commissioning
 - Operational Support for one year after the first glass
- A team of highly experienced specialists support customer's operational staff in their daily work. They provide production assistance, help in making decisions and provide additional training every day. In case of an emergency situation the HORN team helps with all their experience.



TRAINING

- Theoretical (Classroom) Training
 - 4–6 weeks for every group
- Off-Site Training
 - From two weeks up to 6 months
- Training by Supplier
 - Approx. 2 weeks
- On the job training
 - During erection, commissioning and performance test



REFERENCES

Turn - Key Plants

Container Glass Furnaces

Special Glass Furnaces

REFERENCES ON TURN-KEY PLANTS

FLOAT GLASS PLANTS

- Azerfloat, Azerbaijan
- Azmeel, Saudi Arabia
- Caspian Flat Glass, Russia
- Gomelglass, Belarus
- Interglass, Kyrgyzstan
- Pilkington, Germany
- Salavatsteklo, Russia
- TEPE Türkmen Insaat ve Ticaret A.S., Turkmenistan
- Zarafshon Oyna, Uzbekistan

CONTAINER GLASS PLANTS

- TEPE Türkmen Insaat ve Ticaret A.S., Turkmenistan
- Sirdaryo Universal Oyna, Uzbekistan

REFERENCES ON CONTAINER GLASS FURNACES

CONTAINER GLASS

- AGI glaspac, India
- AmBev, Brazil
- Ardagh Group
- Asia Brewery Inc., Philippines
- BelStekloProm, Belarus
- Campalia, Uzbekistan
- Cristaleries Toro SpA, Chile
- Crown Silices de Veracruz S.A., Mexico
- Dmitrov Steklo, Russia
- Encirc, United Kingdom
- Foshan Yuebo, China
- Frigo Glass, Nigeria
- Gerresheimer Group
- Gürok Turizm VE. MAD. A.S., Turkey
- HEINZ-GLAS, Germany
- Hindustan National Glass, India
- Huaxing Glass, China
- JG Containers, Malaysia
- Jiangsu Tianbo, China
- Kavminsteklo, Russia
- KC Glass & Material, Korea
- Malinovskij, Ukraine
- Milly Glass Works, Kenya
- Noelle + von Campe, Germany
- O-I Glass Inc., North America
- Orora Glass, Australia
- PGP Glassworks, Ukraine
- Piramal Glass Ceylon, Sri Lanka
- Piramal Glass, India
- Pochet du Courval, France
- Qixia Changyu Glass CO., Ltd., China
- RAK Ghani, UAE
- RASCO, Russia
- Rus Glass, Russia
- San Miguel, Vietnam, Philippines
- Santos Barosa, Portugal
- Shandong Jinyao, China
- Siam Glass, Thailand
- Sichuan Malaya Glass, China
- Sirdaryo Universal Oyna, Uzbekistan
- Sisecam, Turkey
- Sotuver, Tunisia
- Stölzle Group
- Ta Hsiang Container Co., Taiwan
- TEPE Türkmen Insaat ve Ticaret A.S., Turkmenistan (Turn-key technological plants)
- Tongchang Group, China
- Verallia Group
- Vetrobalsamo, Italy
- Vetropack Group
- Vidrala, Spain
- Vidroporto, Brazil
- Wadi Glass, Egypt
- Wellgrow, Thailand
- Wiegand-Glas, Germany
- Wolnogorskoje Steklo, Ukraine

REFERENCES ON SPECIAL GLASS FURNACES

TABLE WARE / COSMETIC

- BBC Glass, Indonesia
- HEINZ-GLAS, China
- Ishizuka Maspion, Indonesia
- LAV, Turkey
- Lucky Glass, Thailand
- Mahmood Saeed Glass, Saudi Arabia
- Nachtmann
- R.A.K. Glass, UAE
- Ritzenhoff
- Siseecam, Turkey

BOROSILICATE GLASS & TUBING

- LightTech, Hungary
- Philips
- Schott
- Tungsram Operations Kft., Hungary

FIGURED / SOLAR GLASS

- Lamberts, Germany
- Marvol, Ukraine

FIBRE GLASS / SPECIAL GLASS

- UNION LESNÍ BRÁNA - Rotaflex, a.s. (Czech Republic)
- GLASSEIDEN GmbH OSCHATZ (Germany)
- Fiber Glass Oasis Company, Saudi Arabia
- Glaswolle Wiesbaden, Germany
- S.D.R. BIOTEC GmbH, (Germany)
- VALMIERA GLASS (Latvia)
- PQ Corporation, Europe
- ISOVER, Germany
- ISOVER, Romania
- Eglass, Germany

**THANK YOU FOR YOUR
ATTENTION.**

HORN
GLASS INDUSTRIES

innovation
ENGINEERED IN GERMANY

