pennekamp

Float- and Display Glass Annealing Lehr

pennekamp

Tradition, Innovation, Future. Discover our strength.

made in Germany

History
The company Pennekamp was founded in 1945 and dedicated to the glass industry, specializing in annealing (heat treatment) and handling of glass products.

The young company developed its products in the area of annealing flat and formed glass as well as for glass decoration.

Over the years, new products and machinery required in the industry had to be developed, addressing the speed and performance increases in manufacturing.

A constant growth and sustainable developments were required to always meet such market demands.

Today
It hasn't stopped since. Today demands may be different. Looking at lehrs, innovations related to productivity, efficiency, performance and energy recovery are required. For the automation and handling, "smoothness", reliability and overall performance are the key factors for success. Pennekamp therefore built a complete new facility in Ennepetal, specially designed to suit the manufacture of lehrs, automation and machinery.

With moving into the new facility in 2003, the company managed to control the cost structure and optimize the manufacturing by using latest fabrication technologies. Therefore Pennekamp is the lehr manufacturer to still use the quality term: "Made in Germany".

Outlook
A German expression says: "It is easier to become the leading manufacturer, than to remain the No. 1 for a long time".

That this expression is correct has proven itself many times. The company has demonstrated that it is possible to remain the leading manufacturer by increasing the know-how, innovation and maintaining high quality standards while all employees are focused on the customer's satisfaction. Any completion of a development is the beginning of the next one. It is necessary to develop new technologies and innovations in close cooperation with our customers.

Those efforts are also directly linked to the quality and performance improvements of our products.

„Lehrs and More"

Pennekamp is a supplier of complete solutions and manufactures equipment for thermal processes (lehrs) as well as machinery from other product areas within the glass industry:

Annealing:
- Container Glass & Table Ware
- Pattern & Solar Glass
- Float & Display Glass

Decoration:
- Container Glass & Table Ware

Bending & Toughening:
- Automotive Glass
- Specialty Glass

Automation:
Container Glass & Table Ware & Glass Decoration
- Ware Transfers
- Lehr stackers
- Cross Conveyors

Glass Coating:
Container Glass
- Cold End Sprays (Top & Under Belt)
- Material Dosing Units

Annealing lehr

Float- and Display Glass Annealing Lehr

The float and display glass annealing lehr is one of the important equipment within the glass manufacturing line to anneal (strain minimization) the glass. The energetic performance of such lehr is most essential for the cost effectiveness and success of the final product.

Today, special attention is directed towards energy consumption. Pennekamp has addressed this issue and operates an internal heat recovery system, called “draft system”. It balances the heating (annealing) and cooling area of the lehr. A centralized air cooling damper and air exhaust system monitors and maintains such balance for energy usage reduction, whereas the components are equipped with communication links among each other.

The float and display glass annealing lehrs are designed in modules (zones), all at a length of 2,25m each, in order to suit the standard truck or container loading. The lehr structure consists of the following main components:

Outer casing (tunnel zone housing)
The outer casing is manufactured from mild steels and provides the strength to support the internal components as well as the lehr accessories. The side walls may be from mild steel as well and in this case primer and paint coated to the buyer’s choice.

Additional, secondary side walls from polished stainless steel plates are supplied to prevent interference with factory air. The roofs are mechanically pre-bent in order to compensate the weight and thermal load from operation.

Inner hood
The inner hoods of the heated zones are generally manufactured from stainless steel, whereas the material thickness varies in relation to the use. Material thickness is in the range of 2 to 4mm. Additional anchor supports from the inner hood’s roof towards the outer casing increase strength and durability. Zones A to C designed with support structure for heaters and semi indirect cooler banks.

Lehr rollers
The lehr rollers are preferably from fused silica ceramic, in order to meet highest product quality demands. With its advantages towards stainless steel rollers, such as mechanical strength, lower bending, improved hardness and almost zero heat conductivity they are the best choice.

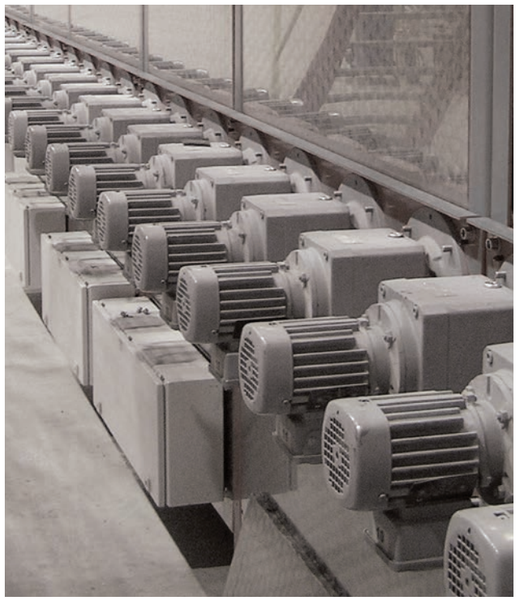
Thermal insulation
The thermal insulation is one of the components that requires to last very long. According to the temperatures involved, ceramic fibers and mineral wool are used in a thickness of 350mm. This ensures minimal thermal losses and side wall temperatures of ~20 to 25°C above ambient.

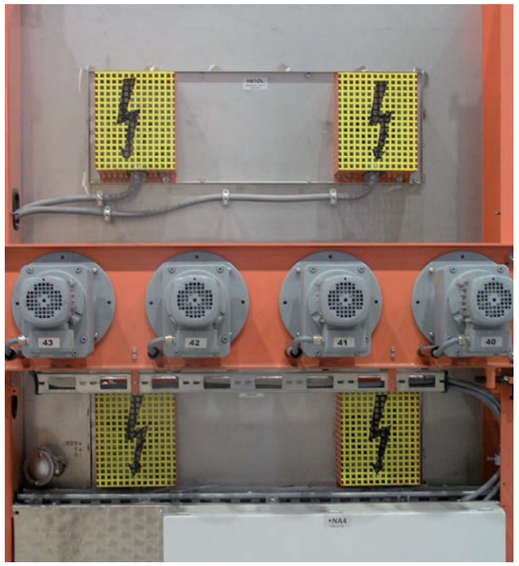
Heating systems
Electric radiation heaters are designed at various outputs, according to the requirements. The units are made from stainless steel and installed from either side above and/or below the glass ribbon. The six loop control is executed by thyristor via the PLC software. Additional integrated, electronically movable edge heaters are within the heating frames.

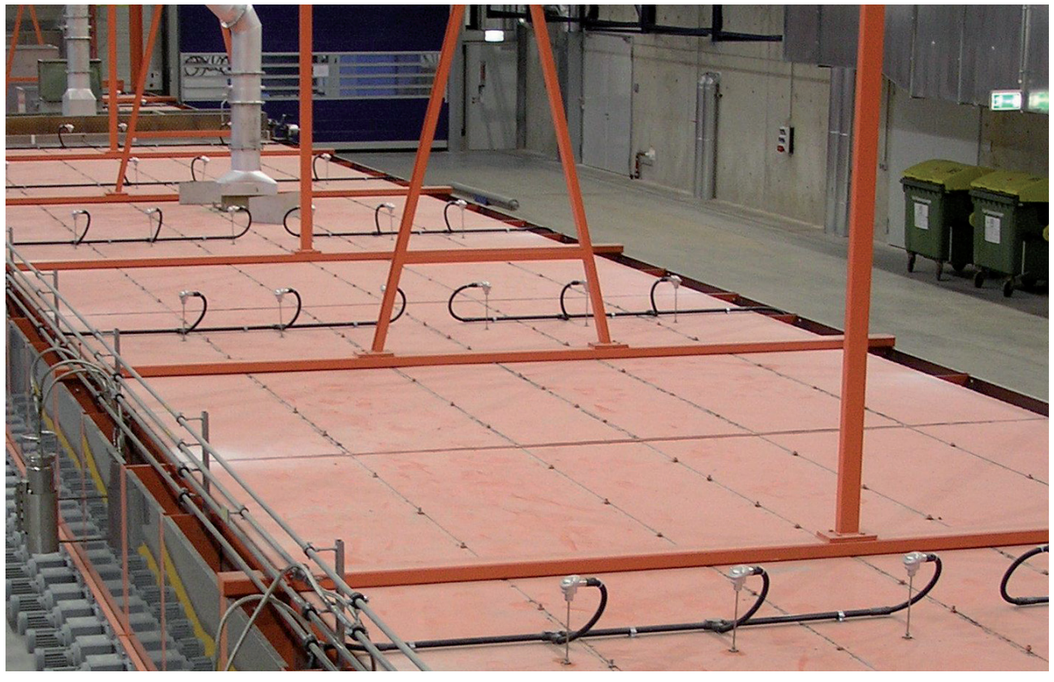
Roller driving
The roller driving is arranged in groups in order to compensate the glass shrinkage in the annealing and cooling process. This minimizes the effect of relative glass movements on the rollers. Its unique design and safety function allows a trouble free operation over life time. The individual drive configuration (one drive per roller) further allows lowering and/or replacement of individual rollers.

Roller support system
The rollers are generally supported with CNC machinedbeams, directly attached to the zone housing, each at a length of 2,25m. Adjustable in lateral and horizontal direction, they are fixed after installation. Repeatable positioning is no issue anymore.

Discharge and F zone cooling
This area is manufactured from mild steel, whereas the driving and supports are the same as on the tunnel zones. The discharge table may also accommodate additional equipments such as the cooling fan banks from above and below the glass ribbon. A modern design, by inverter driven mass cooling by side arranged blower fan assemblies is therefore used.

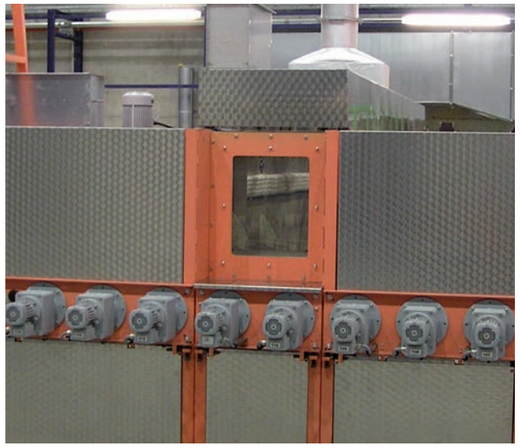






Accessories
As accessories parts and components such as automated air inlet and exhaust dampers must be mentioned. Designs are based on energy recovery and usage reduction. Additional installed thermocouples, IR spot and scanning pyrometers are required for precise monitoring and control.

RET zones
The RET zones are specially designed to provide the cooling of the glass ribbon according to needs. Banks of three or four individual fan assemblies provide the mass cooling air, whereas the outer ones also maintain certain under ribbon cooling.



Indirect and semi indirect cooling system
Unique banks of indirect and semi-indirect cooler assemblies, variable in positioning are installed for zone A to C. A six loop control, arranged over the glass ribbon width, is monitored and controlled by the PLC.

Ausstattung

- Glass ribbon width of up to 4,5m (15’)
- All tunnels zones (A,B, C, D and RET) with inner linings, manufactured from heat and chemical resistant stainless steel
- Electric radiation heating
- Electrical heating system operated by thyristor controls
- Six heating control loops across glass ribbon width
- Heating elements and semi indirect cooler units are manufactured from high temperature resistant stainless steels
- Integrated, electronically movable edge heaters
- Indirect and semi indirect cooler inserts in annealing zones (AtoC)
- Six cooling control loops across the glass ribbon width
- Special design down flow cooling fans in cooling zones (RET) to mix the internal air with cooling air
- Modular zones with side wall inserts, for flexible installation of heating and indirect/semi-indirect cooling units
- Special design for over and under ribbon heaters
- Double lateral wall system with stainless steel surface
- Use of ceramic rollers for glass transport for scratch minimization (low SO2)
- Individual drives, one unit per roller (no open sprockets/oil pans)

Optional cullet belt
The cullet belt in specific areas or throughout the lehr is one of the highlights. Within the frames of the discharge table, an additional cullet belt drive is installed. Another integral part, under such circumstance, is the automated cullet belt tensioning zone with its weight roller(s), distributing an even load onto the cullet belt, to compensate thermal expansion.
The cullet belt drive is equipped with the main drive gear/ motor assembly, providing the torque to the rubberized drive roller. An easy belt tracking adjustment is performed with the drive unit itself.

Control system
The main controls, consisting of power supply/distribution panel and control panel are scope of the Pennekamp concept.
According to customer’s demands and requests, the controls are equipped with a PLC system and the communication link to the plant process control for the easy operation of the lehrs.

- Drive configuration by inverters, to compensate the glass shrinkage of ribbon
- Additional backup inverters for operational roller drive safety
- Roller support arranged by zones, for easier alignment and higher accuracy
- Fully insulated lehr (all tunnel zones) with approx. 350mm (14”) ceramic fiber and mineral wool
- Fully automatic air inlet damper systems for temperature curve control
- Control of the lehr exit temperatures, required for optimal cutting results
- Individual inverter controlled cooling banks (decentralized) in F zones
- Optional automatic internal cullet removal system (patent pending) for RET and F zones
- Automatic process control for the control and monitoring of temperatures by PLC and backup system
- Optional communication processor (Ethernet or others) for link to plant process control
- Electronic control of the internal air movements (drift system) for a minimization of the energy consumption
- Optimal temperature distribution across the lehr width
- Full scope supply incl. control and field wiring

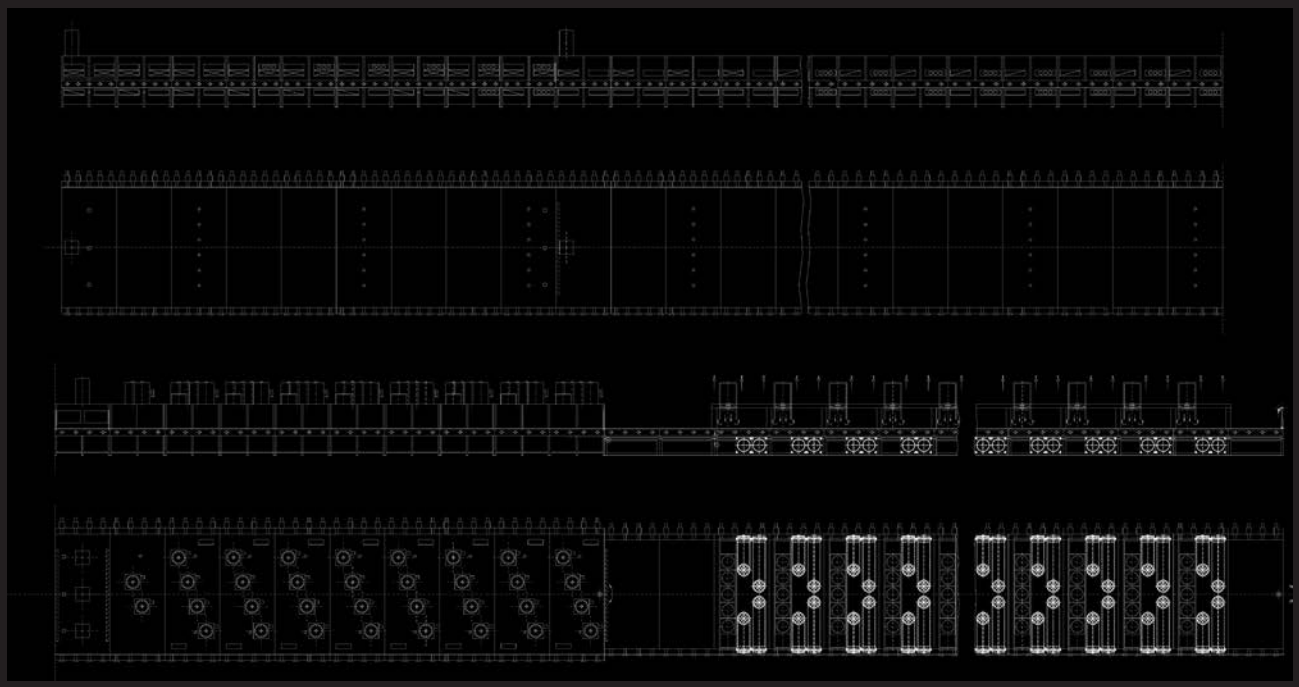
Thin glass specials (0,3 to 2,0mm):
- Balanced upper and lower ribbon heating/cooling
- Downscaled RET zone for optimized thin glass cooling results
- Minimized F Zone cooling
- Ceramically sealed inner hoods to minimize dust contamination
- All cooling air inlets with filters
- Retractable cover seal over F zones, to avoid dust contamination
- Optional full length cullet belt

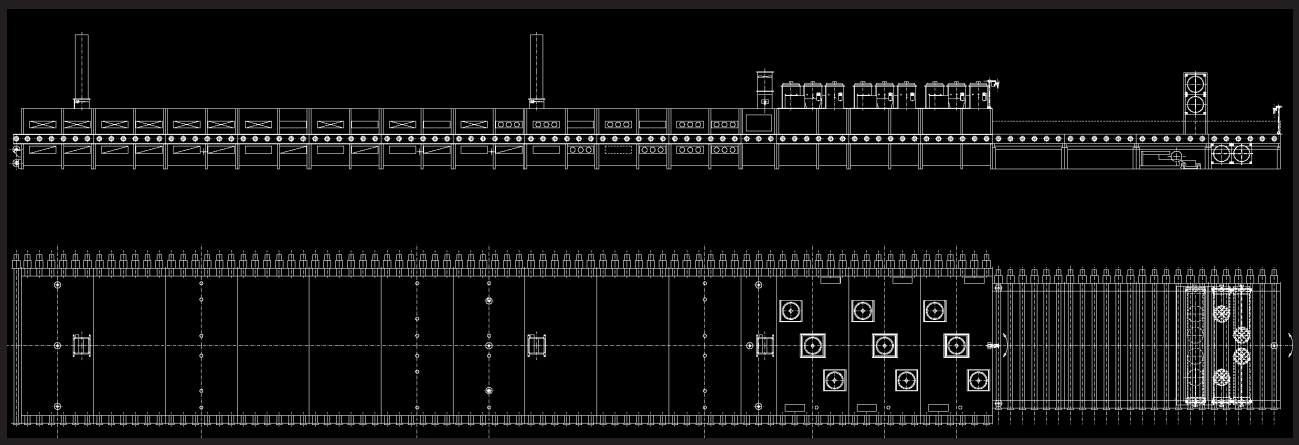
Options

- Roller drive system Dross-Box
- Cullet belt

Display-Glass:

- Dust protection cover (F-zone)
- Cooling air filter system





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