VETROTOOL
MAQUINARIA Y UTILLAJE PARA LA INDUSTRIA DEL VIDRIO

FURNACE HERAKLES

DESCRIPTION

MANUAL

Polígono Industrial de Caborana
33684 – Aller – Asturias – Spain

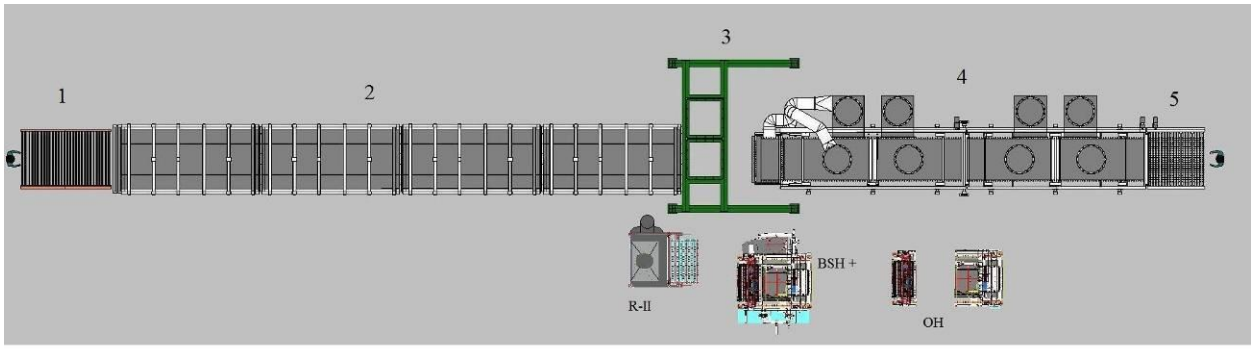
Teléfono (34) 985 481 566
Fax (34) 985 481 573

e-mail: vetrotool@vetrotool.com
web: www.vetrotool.com

INDICE:

GENERAL INTRODUCTION AND LAYOUT:

The Herakles furnace is a mixed furnace able to produce different types of curved and tempered glasses. To achieve that the system is equipped with different bending and tempering units (R-II, OH and BSH+). Depending of the glass to be produced the bending and tempering unit should be one type or another.
General Layoutshows a schematic overview of the furnace and the different bending units (RII, OH and BSH+).



General Layout

GENERAL DESCRIPTION:

The Herakles furnace is divided in the following sections:

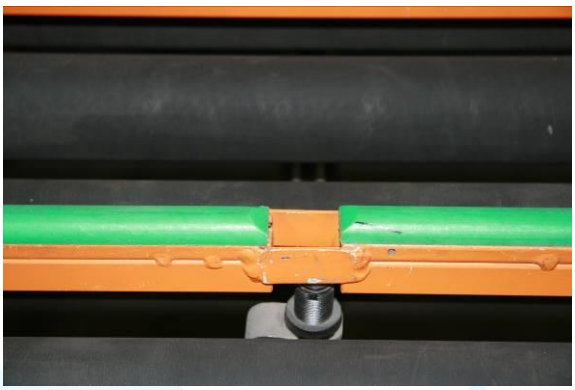
١. **LOADING TABLE:**

The loading of glasses is controlled by the furnace. In case of normal operation (no alarm active) the loading permission depends on the status of the loading switches. If the unloading table loading permission switch and the tempering cabinet loading permission switches are both active then the loading is enabled and the switch lights red. If any of both switches is off then the loading is not enabled.

Tempering cabinet loading permission switch

Unloading cabinet loading permission switch

A set of aligned sensors is installed at the end of the loading conveyor to follow up the glass through the heating tunnel.



Glass presence sensor

٢. HEATING TUNNEL:

The heating tunnel is made of 6 heating modules installed one after the other. It's equipped with electrical heating elements which heat the glass that travels through the tunnel on ceramic rollers.

Heating tunnel view

Each of the modules is made of two parts. The top part is mounted on four screw jacks and is supported on the bottom part. With a switch as show bellow it's possible to activate a motor that moves up or down the top part of the module opening or closing the heating module. The joints between each two modules are designed to lift up with any module opened.

Heating module open/close switch

Screw jack and module opened

Module opening motor and gear boxes

Do not open the furnace when hot, especially the last module !!! It could damage the electrical eye.

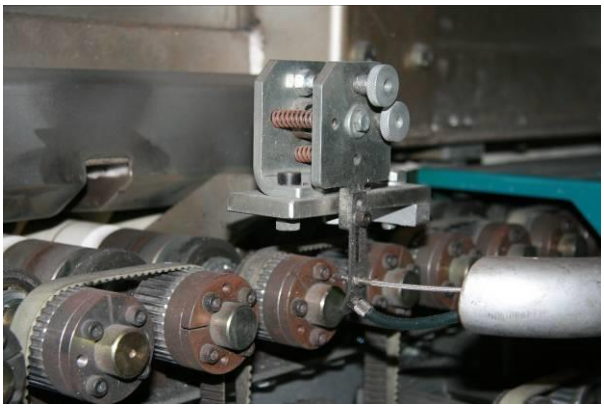
The glass is transported on ceramic rollers. There are 4 independent zones of transport: Main transport (258 rollers), speed-up 1 (2 rollers), speed-up 2 (4 rollers) and speed-up 3 (8 rollers).

The movement is done by 4 servomotors. Each servomotor transmits the movement to a shaft whit several "Tollok" nuts which transmit the movement to the rollers through a set of pulleys. The rollers are driven in groups of two rollers, connected between them with a timing belt. For the tension of each timing belt a spring tensor is installed.

Drive and spring tensor

When the glass is detected by the electrical eye at the end of the main transport zone, and if the fast speed is different than the line speed, then once the glass is completely into the speed up area (the electrical eye signal goes off), the speed up rollers change the speed to fast speed and they gradually engage again to line speed as the glass leaves each speed-up zone.

Speed up servomotors



Electrical Eye mounted on adjustment system

To heat the glass, a set of electrical heating elements is installed. The elements on the bottom part of the furnace are installed always perpendicular to the direction of the glass travel. Those elements are covered with some steel plates to protect them from glass falling.

Bottom heating elements with steel covers

The elements on the top part of the furnace are installed perpendicular to the direction of the glass travel on the first 4 heating modules and parallel to the direction of the glass travel on the last 2 heating modules. The control of the heating is done through thermocouples. On the first 4 heating modules, 4 thermocouples are installed on top and 2 on bottom of each module. On the last 2 heating modules, to achieve a better control of the heating, 20 thermocouples are installed on top and 4 on bottom, of each module.

Top heating elements of last 2 heating modules

To avoid the "smile" effect on the glass at the entrance of the heating tunnel due to the higher heat transmission through rollers contact, an air convection system is installed (aspirators). It insufflates compressed air into the first 3 heating modules to homogenize the temperature of the air and ceramic rollers.

The amount of air in each zone is controlled through analog valves which are controlled by the recipe respective set-point.

Top and bottom aspirator pipes into the heating tunnel

Top aspirator valve

Bottom aspirator valve

٣. **BENDING AND TEMPERING SECTION:**

The bending and tempering section is composed of a set of bending and tempering units and a superstructure for the quick change from a bending unit to another one.

A. SUPERSTRUCTURE:

A frame is installed over the bending and tempering zone. It's equipped with a pneumatically activated system to quickly connect the bending units air inlets to the ducts which conduct the tempering air from the blowers. Two holders for each connection are installed to grab the machine air inlets and connect them to the air ducts.For the electrical and pneumatic connection of the bending units, two sets of fast connectors are installed on the superstructure. They are mounted on rails and are moveable so that it's possible to move one bending unit out of the production position without unplugging it.

Air inlets grabbers

Electrical fast connector

For manually grabbing or releasing the air inlets of the bending units, two pneumatic levers are installed. There is also a pneumatic switch to change the bottom position of the holders for R-II or OH/BSH+ mode.

Pneumatic switch and grabbers pneumatic levers

To easily move the bending units in and out of the production position some rails are installed. Some clamping devices are installed to assure the correct positioning of the R-II bending units. Four rubber feet are also installed to assure the correct positioning and work of the BSH+ and OH.

Rails and clamping device for R-II

For properly centering the glass on the mold in BSH+ and OH mode, a laser sensor is installed at the exit of the heating section. It is mounted on a pneumatically activated cylinder to let the sensor hide to a protected position if not in operation.

Sensor in protected position

Sensor in operation position

On the superstructure it's also available a cabinet with switches to enable or disable the movement of the BSH+ and OH servomotors. Those switches can be lit or not indicating the enabled or disabled mode of the motors. An emergency stop and rearm white button is also installed. A red bulb is installed to show the output of the exit laser and a blue bulb is installed to show the output of the electrical eye. A switch is installed to enable or disable the loading, as per the loading table.

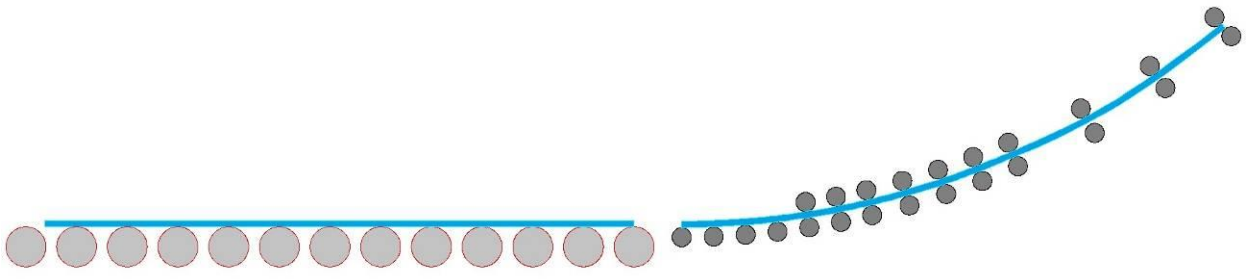
Tempering control cabinet

B. BENDING AND TEMPERING UNITS:

Depending on the glass to be produced a different bending and tempering unit will be used. There are three kind of bending units:

١) **R-II:**

The continuous bending and tempering unit (R-II) is made of two roller conveyors, mounted one over the other. Both are constructed with a radius (main radius) with two quench boxes installed so that quench nozzles are installed between the rollers. This way, when the hot glass passes through the R-II, it is bent and tempered.



R-II continuous bending process

To bend the spherical glass in the secondary direction (secondary radius) the transport rollers are interchangeable. Depending on the set of rollers used the secondary radius will be different: barreled rolls for spherical glass or flat rolls for cylindrical glass.

Secondary direction bending with flat and barreled rollers

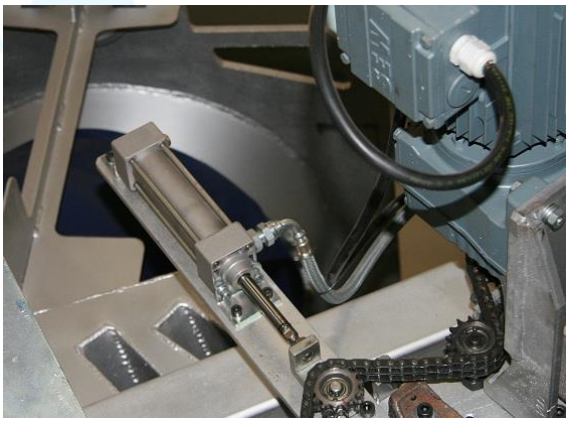
Depending on the thickness of the glass it may be necessary to adjust the gap between the top and bottom rollers. For that, 4 manually adjustable screws are installed.

R-II entrance gap adjustment screw

R-II exit gap adjustment screw

Before starting the production it's necessary to plug the electrical and pneumatic connectors. The unit has installed a pneumatic tensor for the rollers chain tension. The pneumatic pressure is necessary for that tensor. Because of that an alarm is installed to inform the pressure loss.

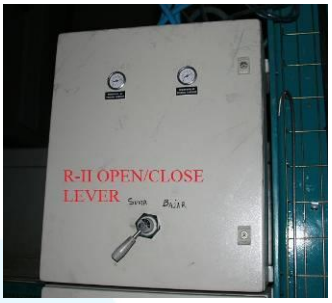
R-II electrical and pneumatic fast connectors



R-II chain pneumatic tensor

The R-II bending units are equipped with an easy change system for the rollers. Tochange the rollersand to clean the R-II bending unit it's necessary to open the unit with the pneumatic cylinder. It is done with a pneumatic lever. After opening it's mandatory to adjust the security blocker to avoid the bending unit closing.

R-II opened with security blocker

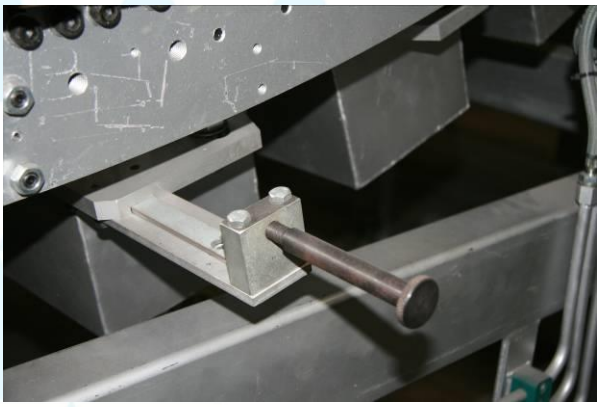


R-II lever to open/close

Rollers quick change system

At the entrance of the R-II bending units it's installed a manually adjustable system of air curtains called "knife". The main purpose of the knife is to avoid the tempering air to go to the furnace. Two screws are available to adjust the air pass on the knife.

Air knife nozzle



Screw for knife adjustment

٢) **OH:**

The OH press bending system is suitable for bending and tempering complex shape glasses (not geometrical glasses) when the curvature (both main and secondary) is not too deep. Usually the curvature shouldn't be bigger than 35 mm.

The OH technology could be designated as "press and release". The glass is brought to the press bending mold on transport rollers and, after press bending, it's released on the transport rollers and moved to the quench area.

The OH is divided in two elements: OH press bender and OH tempering unit.

OH press bender

OH tempering unit

Both press bender and tempering unit are equipped with electrical and pneumatic fast connectors. They also have a rollers quick change system exactly as the R-II units have. In fact the flat rollers are compatible and interchangeable between R-II and OH. The position for the rollers is fixed in the tempering unit. In the press bended, the position is not fixed and can be manually adjusted. The rollers quick change system is double as it is also used to install the model specific rollers that are included into the press ring.

Press bender rollers quick change system

OH specific rollers into the press ring

The mold is mounted on a manually movable structure with a screw jack. With a lever it's possible to change the mold press position. The press ring is mounted on a movable structure driven by cam/lever moved by a servomotor. This servomotor movement combined with the glass movement on the rollers assures the proper positioning of the glass on the press ring.

OH+ servomotor with cam for press ring movement

The glass comes on the transport rollers and specific rollers. Then the press ring moves up and takes the glass against the mold. After pressing, the ring leaves the bent glass on the rollers which quickly take it to the tempering unit for quenching. The press bender is ready for another glass. The tempering unit quenches are motorized and can be adjusted for the correct gap between them for a proper fragmentation.

٣) **BSH+:**

The BSH+ press bending system is suitable for bending and tempering complex shape glasses (not geometrical glasses) with deep curvature (backlites).

The main difference with the OH technology is that, after pressing the glass, it's left on a quench ring that keeps the glass into its shape instead of releasing it on the rollers. Due to this the glass can be hotter (as the shape won't be unbent) and so the bending of the glass can be much deeper.

The system is divided in two elements: BSH+ press bender and BSH+ tempering unit.

BSH+ press bender

BSH+ tempering unit

When the BSH+ bending and tempering units are installed into the furnace in production position they connect each other. The tempering unit is equipped with a set of pneumatic cylinders that are activated and force the press bender to assemble to the tempering unit with a set of conic male/female elements. This way both elements become a compact unit to reduce the vibrations.

Male conic connector

Female conic connector

Pneumatic connecting system

The rollers for the glass transport in the BSH+ are adjustable in position and shape. They are specific for each model as they must have the proper shape to be included into the press ring. The adjustment in shape is used for pre-bending the glass as it's taken to the press position. This adjustment for pre-bending must be gradual so that each roller pre-bends a little more than the previous one.

BSH+ gradually pre-bending process

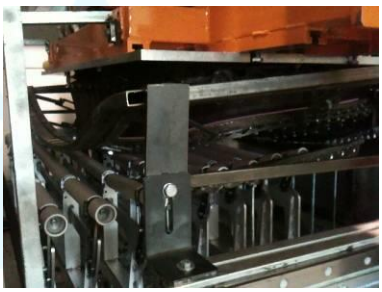
The press ring is installed on a movable structure activated by two servomotors with integrated screw jack (servo cylinders). This servomotors movement combined with the glass movement on the rollers assures the proper positioning of the glass on the press ring. The mold is installed on a movable structure connected with a cam to another movable platform. This secondary platform is movable by a servomotor

with screw jack. The screw jack assures the change of position for production start (preset). The cam servomotor is used to move the mold up and down during production.
The quench ring is mounted on two movable shuttles activated by magnetic linear motors. They assure the quick and accurate movement of the glass into the quench ring from press position to tempering position.
The quench boxes are moved by servomotors with screw jack and they are capable of movement during production cycle, not only for setup.

The glass comes on the transport rollers. Then the press ring moves up and takes the glass against the mold. Vacuum in the mold is activated. After pressing, the ring moves down. The cam moves the mold up (with the glass held) and the shuttles move the quench ring to press position. The cam moves the mold down and the vacuum is deactivated leaving the glass on the quench ring. The mold moves up again (with the cam) and the quench ring takes the glass the quench position. The press bender is ready for a new glass. The quench boxes move closer to the quench ring (if necessary) and the shuttle oscillates for tempering. Then a servo-motorized damper closes pass of the top tempering air so that the glass flies against the top quench. When the quench ring moves to press position for a new bent glass, the damper opens and the previously tempered glass falls on a secondary ring (only for extraction) and when the quench ring moves to tempering position, the extraction ring moves to exit position with the finished glass.

Press bending

Mold up



Glass leaving on quench ring

Mold up

Tempering

Glass flying against top quench

For the glass to be held on the mold, a vacuum pump is installed. There are two valves that pump the air from ambient through the mold or to the mold from ambient so, depending on how they are it's possible to use the same pump for vacuum or blow-off.

BSH+ utilities

٤. ADJUSTABLE COOLER CONVEYOR WITH ARTICULATE PART

It consists on a set of metallic rollers with vyton wheels mounted on them to transport the glass, installed between two sets of blowing nozzles to cool the glass. It is made of three modules. The appearance is as per the image below:

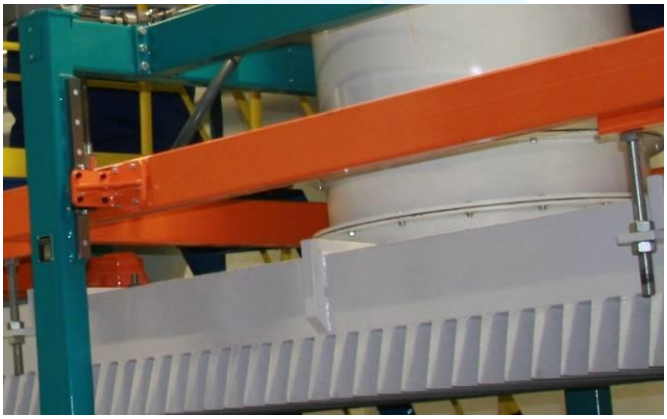
Cooler conveyors view

At the closest side to the heating tunnel, it's installed a system to allow articulation of part of the conveyor to change the usable length. This is used to adapt the tempering area space for BSH+/OH or R-II as needed. It's also equipped with two screw jacks with a motor to adjust the slope of the conveyor as per the image below.

Adjustment screw jack and articulation opened

To be able to close the articulated cooler it's necessary to have an R-II unit connected to the tempering area. This way it's not possible to close the cooler if the BSH+ is in the site, avoiding any crashing. It's also necessary to have the cooling conveyor in the horizontal position to avoid the top part of the articulated cooler to hit the superstructure.

The cooling conveyorsboxes are equipped with a system to adapt the distance between the nozzles and the rollers. This system is motorized. Once a model is loaded from the computer, the distance is automatically adjusted. If some modification is needed two buttons are installed for each cooling section.



Boxes distance adjustment system

The cooling conveyors boxes are also equipped with a system to adapt the width of the blowing area through the nozzles. When sidelites mode is selected the pneumatic cylinders activate and the air pass is closed through the sides of the boxes allowing only to blow in the middle.

- **UNLOADING TABLE**

It consists on a set of metallic rollers with vyton wheels mounted on them to transport the glass. The appearance is as per the image below:

Unloading table view

An emergency stop and rearm white button is installed. A switch is installed to enable or disable the loading of the loading system (robots).