TECHNICAL SPECIFICATION AND DATA

HORIZONTAL BENDING AND TEMPERING SYSTEM HTBS™ 4124-3.8E+2400-3.8A-150FPS-L(R)

Glass thickness range

3.8...6.3 mm	bent glass *)	ECE R43
3.8....12 mm	flat glass **)	ANSI 97.1-1984

Loading area

4-phase	1240 mm x 800 mm *)
2-phase	1240 mm x 1500 mm *)
1-phase	1240 mm x 2400 mm **)

Maximum glass size *)	**ECE R43**	**ANSI 97.1-1984**
4.7...6.3 mm	1240 mm x 1500mm	1240 x 1500mm
3.8...4.6 mm	1240 mm x 1100mm	1240 x 1500mm

Maximum glass size **)		
4.7...12.0 mm	1240 mm x 2400 mm	1240 x 2400 mm
3.8...4.6 mm	-	1240 x 2400 mm

Minimum glass size

3.8...6.3 mm	350mm x 200 mm, bent glass (l x w)
3.8...6.3 mm	200 mm x 100 mm, flat glass (l x w)

Glass thickness tolerance + 0.20...0.00 mm.

Maximum bending radius
Flat

Minimum bending radius
1000 mm

Maximum production rates for flat or bent glass with K = 100 % *)

Glass thickness (mm)	Glass length L ≤ 800 mm (batches/h)	Glass length L> 800 mm (batches/h)
3.8	77	38
5,0	65	32
6,0	54	27

Maximum production rates for large flat glass with K = 100% and maximum sheet size of 1240 x 2400 mm. **)

4.0 mm	58 m^2/h
5.0	47
6.0	38
8.0	29
10.0	22
12.0	19

Installed power

Heating		293 kW
Drives		25 kW
Quenching		315 kW
Final cooling		160 kW
Total		793 kW

Quantity of compressed air needed 140 Nm^3/h

Dimensions of the plant:

Roller diameter	55 mm
Roller distance	75 mm
Total length	17 m
Working height	920 mm
Total width	4974 mm + abt. 7.0 m x 8.5m for blower room.

*) Values for bent and flat glass with maximum length of 1500 mm.
**) Values fo large flat glass with maximum length of 2400 mm.

TECHNICAL DESCRIPTION

TAMGLASS HORIZONTAL BENDING AND TEMPERING FURNACE WITH OPTION FOR LARGE FLAT GLASS HTBS 4000 / 6000-SERIES

GENERAL

The HTBS-furnace is concepted to produce cylindrically bent tempered glass. HTBS is also an effective flat tempering machine for up to the same glass sizes as for bent glass.

The maximum length of the glass is 750 mm (curved length). The axis of the bending radius is in a 90^{o} angle to glass movement. Cutting shape of glass can be **practically any common shape** within the specified size limits.

The minimum bending radius is 1000 mm. The radius is **steplessly and quickly adjustable** by the programmable control system and **no molds** are needed.

More than one sheet of glass can be loaded side by side on the loading area provided that the glass sheets have the same thickness and the same desired radius and size.

With option for large flat glass it is also possible to produce flat glass in thicknesses up to 12 mm. Maximum glass length is 2400 mm and width according to the machine width.

MAIN PARTS OF TAMGLASS HTBS

The equipment consists of the following main parts in operational order:

- loading table
- furnace
- combined bending / tempering section
- cooling section / tempering section for large flat glass
- unloading table
- associated electrical and controll equipment
- blowers, fans, etc.

SEMI-CONTINUOUS OPERATION

The basic operation mode of 4000 / 6000-series tempering and bending furnace is a semicontinuous mode, which is used both for bent and small flat glass. In this operation mode the glass sheets oscillate in the furnace for

about the whole of the glass length. The minimum gap between two consecutive glass sheets is approximately 250 mm.

Depending on the length of glass sheets the furnace contains several batches of glass at a time. At preset intervals a long forward oscillating movement follows.

During bending process the glass oscillates on the rollers which are displaced by a hydraulic system to form the desired radius. Before bending the air nozzles above the glass are lowered down to a preset distance from the glass surface along its whole length. Immediately after bending is completed tempering starts and the air blow is continued until tempering has taken place. The top air nozzles are then lifted away, bending conveyor is straightened up and a new working cycle can start. When producing flat glass, the function is similar, but without bending / straightening functions.

BATCH-TYPE OPERATION FOR OPTIONAL LARGE FLAT GLASS

In case there is a requirement to process large flat glass, the Tamglass HTBS can be **optionally** supplied with aftercooling section which functions as a chiller for large flat glass. The main differencies compared to standard HTBS are the following:

- high capacity blower and quenching nozzles for the Aftercooling section
- long loading and and unloading tables
- necessary control hardware and software
- electrical equipment to suit the above

In this mode of operation the bending section rollers are kept all the time straight on the same level with the cooling section rollers and the tempering of flat glass sheets up to 2400 mm takes place in the after-cooling section.

There can be one or two batches of glass in the furnace depending on the glass length. In one-stage operation mode one glass batch oscillates in the whole furnace length and in two-stage operation mode two glass batches oscillate using half of the furnace length.

LOADING AND UNLOADING TABLES

Loading and unloading table frames are manufactured of structural steel onto ch the bases of the roller bearing housings are machined. The rollers are precision steel rollers with ball bearings. The bearing housings are bolted to the frame structures. Power is transmitted from one roller to another for the whole table length by roller chain and chain sprockets. The loading table rollers are covered with plastic tubes, and the unloading table rollers with heat and wear resistant cloth.

FURNACE AND TRANSFER CONVEYOR

The furnace and transfer conveyor consist of modules which are separate from each other, but when clamped together, form one uniform furnace. The modules rest on steel wheels and rails. They can be easily separated from each other just by opening the clamping and pushing the modules apart. The

furnace frame is built of structural steel and steel plates. The insulation is made of thick heat-resistant mineral wool and covered with Al-silicate sheets.

The furnace rollers are of ceramic type. They are led through the side walls and thermal insulation by precision cut and sealed holes. The bearing housings are bolted on the outside surface of the furnace structures.

The upper heating elements are of coil type and radiate the heat to massive cast elements which, in turn, heat the glass from above. The heating elements are fitted with reflectors on the top. The lower heating elements are also of coil type and they are fitted with covers to protect the heating elements.

BENDING AND TEMPERING SECTION

These sections consist of heavy frame structures. The bending conveyor supporting rollers are linked together mechanically, and their movement is accomplished by hydraulic cylinders driven by a hydraulic power pack.
The pneumatic counter-force system keeps the bending movement stable. The air nozzles are between the rollers and move together with them.

The bending conveyor rollers are made of steel tube and surrounded with Kevlar cord. The snap-type locking system enables quick change of rollers. The press rolls at the bending section can be used, if necessary, to improve bending of the glass.

COOLING SECTION

After bending and tempering, glass is cooled down in the cooling section to temperatures which make glass handling possible. The cooling section is additionally operating as a quench for large flat glass.

The cooling section consists of rollers and air nozzles with a blower, its mode of operation is oscillation, and it is synchronized to the function of the whole HTBS in order to maximize cooling time.

ELECTRICAL EQUIPMENT

The electrical system is normally a five-wire system; three phases, neutral and earth. The electrical equipment consists of complete, internally wired and cabled electric switchgears. One switchgear is in the blower room for blowers, and another in the factory building for heating and drives. Top entry for cables is standard. Cable sets are provided with the equipment, and aluminum cable-racks are provided for cable installation.

CONTROL EQUIPMENT

A PLC-control system is used to control all heating, bending and quenching functions. The control equipment consists of a programmable logic controller with an advanced graphics user interface. The following functions are to control: **furnace temperature, crosswise heating profile, heating time, bending radius, bending time, quenching delay, quench blower pressure, mode of operation for different glass types and other necessary functions and auxiliary operations.**

All functions are clearly shown on the display and can be easily adjusted. The programmable control system also includes a hard disc into which the operating parameter sets can be saved / restored for different glass receipes to make the change-over time from product to product faster. Operation language of the programmable control system is English, other languages are optional.

The maintenance page shows the operating hours, the maintenance to be made and the time for it, as well as keeps record of the maintenance which has been made.

Pre-heat time control can be used to heat the furnace to the desired temperature for each weekday before the start of a shift. Hot store control is designed to drop the furnace temperature below the operation level for a short stop in the operation.