LIITE 1

GLASTON HORIZONTAL TEMPERING FURNACE – *FC500*™

MAIN PARTS OF GLASTON *FC500*™

The flat glass tempering plant consists of the following main parts:

- a loading conveyor
- a heating furnace
- a cooling section
- an unloading conveyor
- a blower system with ductwork for the cooling sections
- electrical control panels, wiring and programmable control system

All these parts are connected to each other to form a complete production unit for tempering flat glass.

LOADING AND UNLOADING TABLES

The loading and unloading tables consists of welded steel frame with PVC-coated conveyor rollers and independent chain drive system. Both conveyors incorporate a foot-operated transfer system, to facilitate the loading and unloading operations. For transport, the tables are divided into sections, which are assembled together with bolts at site. For handling large sheets of glass, both the loading and unloading tables are equipped with lifting castor beds, which can be raised from underneath the conveyor level. There are also side rolls on the side of the loading and unloading tables to facilitate the loading and unloading of the large glass sheets from the side.

Loading table includes sensors that are used for measuring the loading shape. This information is used in the automatic recipe selection.

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FURNACE

HIGH VOLUME CONVECTION CHAMBER – energy saving convection

The furnace has a welded steel housing made of steel profiles and having steel sheet as outer surface. The furnace includes the heating elements for heating and ceramic rollers for glass transport.

The FC500 heating system is based on accurate individual heater control and efficient hot air convection system. The main method for glass heating is by convection. The hot air on top is circulated with durable highly reliable convection blower. The air is taken through the heating elements where the heating elements heat the air and air heats the glass. This generates high volume, high efficiency convection with excellent accuracy due to accurate heating control. The high volume convection, heating profiles and the proportional heating power system make it possible to produce high quality tempered glass.

The bottom part of the furnace includes cross-wise heaters for accurate control and easy maintainability. One cross-wise heater is further divided into zones for more accurate heating. Heaters can be removed from the sides of the furnace. Bottom heaters are controlled with unique roller temperature measurement system. System measures the roller temperature and automatically fires the bottom heaters accordingly. Main benefit of this system is the keep the roller temperature stable.

The furnace is equipped with a lifting mechanism which allows the upper parts of the furnace chambers to be raised apart from the lower half of the furnace. The furnace has a separate transmission system including main motor, a DC operated emergency drive and an advanced belt drive. The belt drive guarantees a very smooth and accurate movement of transmission of the furnace rolls.

The furnace is equipped with an emergency cooling system.

High quality fused silica rollers are used. SO_2 gas can be added to the furnace environment in order to form a protective film onto the ceramic rollers.

The furnace is equipped with a timing system, which allows an automatic preheating up to the operating temperature before a working shift begins. Should the shift not start in time, the heating goes off automatically. The heating elements are fully computer controlled.

CHILLER

The cooling section consists of a welded steel frame, which supports the nozzle structures for the distribution of cooling air. The air is supplied to the upper and lower nozzles via air channels. The air channels are designed for very low pressure drop and precise flow control.

The shape of the air nozzles is optimized for a uniform distribution of quenching pressure and low power consumption of the blowers.

The height positioning of nozzle blocks is adjustable for each glass thickness and type. Adjusting can automatically be chosen from the computer library.

The lifting mechanism of nozzle blocks is controlled by frequency converter. The self cleaning mode facilitates the removal of broken glass pieces between cycles.

The blower(s) are of centrifugal type, designed for industrial heavy use. The blower(s) include AC motors. The fan and the motor are fastened to a steel frame, which rests on the vibration dampers. The blower(s) have Variable Speed Drive (VFD, inverter) for the regulation of air flow, and are connected with air ductwork leading to the cooling section.

The chiller rollers are covered with spiral Kevlar based cord for optimum durability and heat resistance.

A vibrating cullet conveyor at the bottom of the chiller is provided for the removal of cullet from the chiller.

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ELECTRICAL AND CONTROL SYSTEM

A PC-based field distributed Input/Output control system with graphical user interface is used. The movements, the control of the heating and the control of the blower pressure and timing are carried out by the control system, iControL Dynamics™.

The control system also includes the following tasks:

- continuous self-diagnosis
- fault recording and alarms
- maintenance diary
- program parameter library

Electrical panels are made of painted steel sheet with profile reinforcements. All necessary relays, contactors, switches etc. are included and pre-wired.

Wires and cables for the field wiring are provided.

The pneumatic system comprises a distribution center with valves, actuators, filter, accessories and inner piping.

OPERATION - Control Panel, Video Monitor and Keyboard

The operator monitor panel provides a sophisticated interface between the process and the operator, bringing within easy reach features, which facilitate process control (e.g. plain language messages, instructions on service, start-up and testing procedures).

The system has a fully graphical operator interface with touch screen supported by mouse and keyboard. All functions and main components are clearly shown on the display as symbols.

One monitor with the keyboard is situated by the loading table of the furnace.

Supervision of the process is carried out by using the controllers menu system.

The operation parameters can be chosen from the library according to the set names or glass thickness.

Quenching pressures can be changed directly during operation.

A load step operation allows the user to change the length of the glass movement at the loading table. The load step refers to the forward movement of glass when the loading pedal is pushed.

Glaston reserves the right to changes without notice.

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TECHNICAL SPECIFICATION

GLASTON HORIZONTAL TEMPERING FURNACE

FC500™-2860-380-HS12-Boost315 (opt)

Glass thickness range

Thickness	Standard
3,15..19 mm tempering	EN 12150-1 - 2015, ANSI Z97.1 - 2009
3,15..12 mm heat strengthening	EN 1863
3,15..10 mm heat strengthening	ASTM C1048

Loading area

Thickness	Area
3,15 mm and over	2100 x 3300 mm
3,8 mm and over	2800 x 6000 mm

Maximum glass sizes with clear float glass

Thickness	Size (EN 12150-1 - 2015, ANSI Z97.1 - 2009)
3,15 mm and over	1600 x 2800 mm
3,8 mm and over	1800 x 2800 mm
4,7 mm and over	2800 x 6000 mm

Maximum glass sizes with soft coated Low-E (0,02) glass

Thickness	Size (EN 12150-1 - 2015, ANSI Z97.1 - 2009)
3,15 mm and over	1500 x 2300 mm
3,8 mm and over	1800 x 2800 mm
4,7 mm and over	2300 x 3800 mm
5,7 mm and over	2800 x 6000 mm

Minimum glass size

Thickness	Size (EN 12150-1 - 2015, ANSI Z97.1 - 2009)	Size (EN 1863, ASTM C1048)
3,15 mm and over	200 x 450 mm	200 x 450 mm
3,8 mm and over	100 x 250 mm	200 x 450 mm

Capacity [Loads/hour]

Thickness	Clear	Low-E 0,02	HS Clear
3 mm	16	16	16
4 mm	25	20	25
5 mm	20	16	20
6 mm	16	13	16
8 mm	12	10	10
10 mm	10	8	6
12 mm	6	-	5
15 mm	4	-	-
19 mm	3	-	-

Above capacities are based on 65% loading efficiency and with glass size 865mm x 1930mm according to standards mentioned in the beginning of this document. Final capacity depends on glass size, shape and edgework quality.

Dimensions of the plant

Dimension	Value
Roller diameter	95 mm
Roller distance	120 mm
Total length	28,0 m
Total height	3,4 m
Working height	900 mm
Total width	7,0 m
Floor flatness	± 10 mm

The plant can be installed on a flat floor. Dimensions are indicative and final plant dimensions are given in machine layout.

Installed power at sea level

Unit	Type	Power
Heating and drives		1559 kW
Quench blowers	2 x 315 kW with 2 x inverters	630 kW
Compressor for Boost unit and 1x10m³ tank	1 x 90 kW [10bar]	90 kW
Total		2279 kW
Convection demand	[8bar]	7,8 m³/min

Compressor for convection heating system, to be provided by the Buyer

Environmental conditions

Condition	Value
Temperature	20..40°C
Relative humidity	< 80%

Minimum distance of sheets from each other is 50 mm.

Glass exit temperature over factory temperature + (20 ... 60)°C.