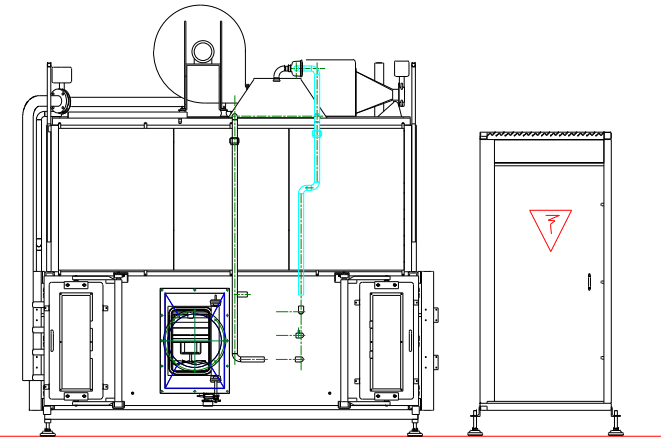
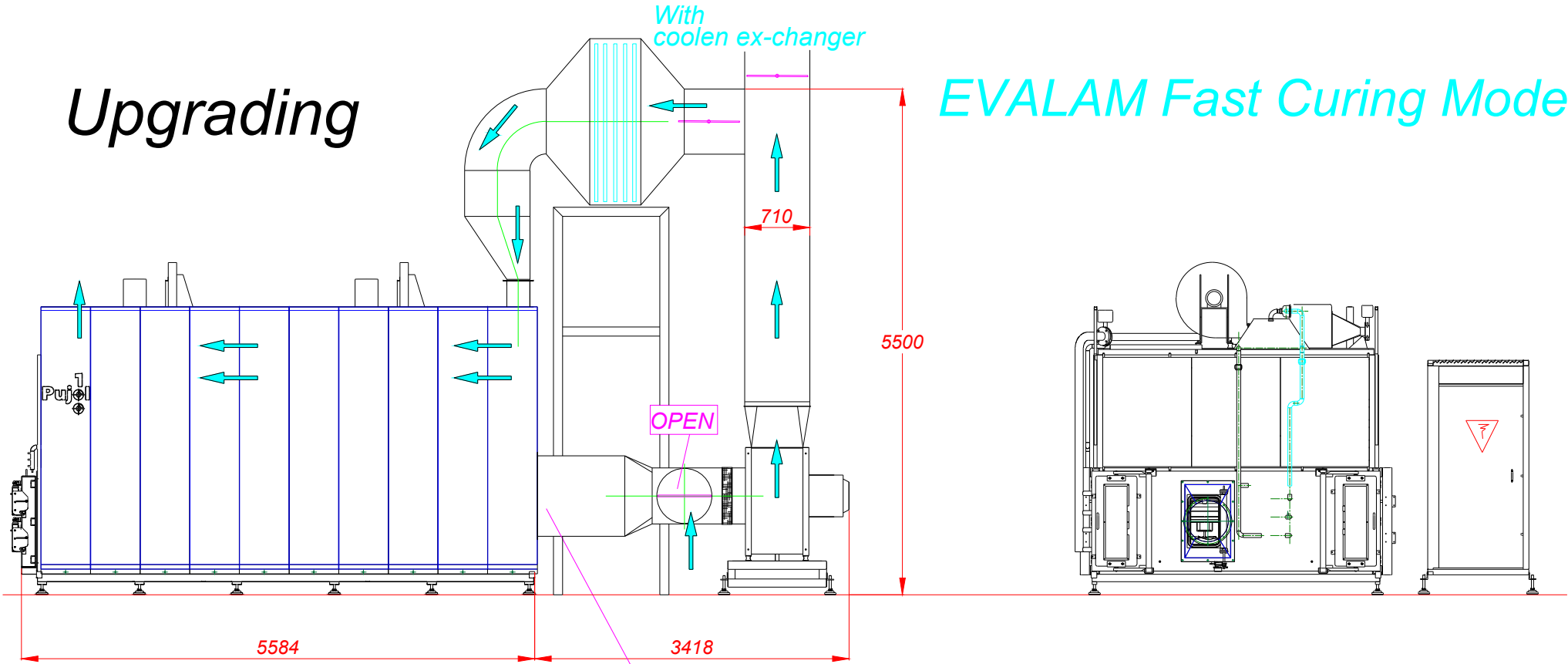


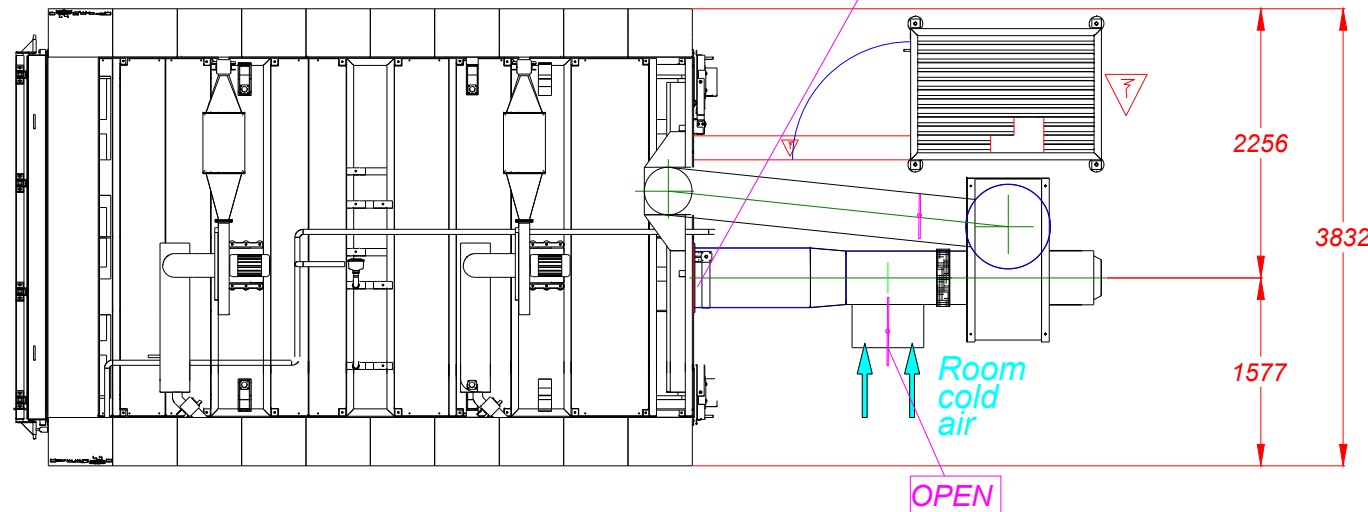
# Upgrading

# EVALAM Fast Curing Mode

With coolen ex-changer



CLOSE



		Material :	
		Cantidad :	
Dibujado	Fecha	Nombre	Hornos Industriales Pujol Sant Feliu de Llobregat (Barcelona)
Modificado	17/06/19	R.Olaya	
Escala	DENOMINACION		Nº de Proyecto
( 1 : 15 )	CONJUNTO REFRIGERACION		Nº de Plano PVB-50.28.000enf



**PUJOL-100 PVB+ & FAST CURING SYSTEM**

**QUOTE**

**"OVEN & LINE FOR THE PRODUCTION OF LAMINATED GLASS"**



Offer number O12981  
Ref. 409.10 Date: 17/06/2019  
Our Ref. PJL UK Our Note: @/05/19

**RAVENSBY**

To the attention of Hamish Ogilvie  
FLOWER ROAD WEST PITKERRO INDUSTRIAL  
ESTATE, DD5 3RU DUNDEE  
(UNITED KINGDOM)



**AUTOMATIC ASSEMBLY LINE OF LAMINATED EVA GLASS QUOTE  
BY PUJOL-100 PVB+ & FAST CURING SYSTEM  
"OVEN & LINE FOR THE PRODUCTION OF EVA LAMINATED GLASS"**

Dear Sirs,

In response to your request, we are pleased to attach you the detail of our commercial offer of the **OVEN FOR PRODUCTION OF LAMINATED GLASS PUJOL-100 PVB+ & FAST CURING SYSTEM** for your consideration.

On behalf of the entire team of Hornos Pujol, we would like to express our sincere gratitude for the interest shown, as well as the confidence placed in our brand.



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## 1. WHO WE ARE

**Hornos Pujol**, is a fourth-generation company founded in 1911, consolidated worldwide in more than 90 countries as a company specialized in the sector of laminated glass and offering a complete 360º service based of ovens and complete laminating solutions, consumables, training, and Technical Assistance Service, covering all needs of our customers.

We have 2 own factories; First unit dedicated for Machinery and Complete Equipment for Laminate (Plant in Barcelona) and a 2nd one for EVA Film extrusion (Plant in A Coruña), we also have own Service & Commercial Office in Russia and Uruguay. The human team at PUJOL Group is made up of more than 70 highly qualified professionals who are dedicated to attending customers needs.

Our best guarantee and our greatest pride are the more than 3.000 satisfied customers who, in the last 15 years, have experienced our quality solutions and accompanied us in our growth and international expansion until reaching a turnover of over 16,000,000 euros and, at last, to achieve our motto: **"SINCE 1911 NO LIMITS IN GLASS CREATION"**

Jorge Pujol  
CEO Hornos Pujol



Laminate Machinery and Equipment Plant. (Barcelona)



EVA film extrusion plant. (A Coruña)



## 2. BASIC BENEFITS OF THE PRODUCT

### FLEXIBILITY



**Independent isolated work chambers**, Maximum heat distribution and energy efficiency, resulting in ultra-fast work cycles and a very low specific energy cost per m2 of laminated glass.

### PRODUCTIVITY



**Automatic rapid cooling system**, thanks to a rapid distribution of cold air from the outside of the oven through a different series of high pressure fans located on the ovens back, in both Heating chamber & cooling Buffer.

### CONTROL



**UNIQUE Software control system** which allows controlling all the segments of the process through monitoring complete cycle variables such as: Temperature / time / Vacuum ON-OFF / Vacuum Pressure / Cooling; segment by segment.

### UNIFORMITY



**Distributed double-layer radiation system** that is reinforced with an air homogenization convection equipment by impulse fans "**Pujol Impeler Convection System**", this translates into a homogenization of the heat in the chamber of +/- 3 °C



**Vacuum bag with fast closing** vacuum bag of 2mm of easy and fast closing, avoids strong pressures in the edge that cause poor aeration defects plus optical distortion but at the same time is durable due to its characteristics of resistance to elongation.

### CONSTANTIBILITY & REPETEABILITY



**Repetitiveness of the process, thanks to the LCEVA System**® which is a complete, sophisticated and precise automatic device that guarantees the different and demanding states of pressure inside the bag, in order to reach in the "ON" mode the perfect de aeration, as well as the best adhesion. In the "OFF" mode it is possible to avoid both the annoying optical distortions and the excesses of EVA at the edges.

### ERGONOMIC



**Ergonomics** designed for an optimal work of the operator in the factory thanks to the hydraulic platform

### ECO-FRIENDLY



**Energy savings** thanks to faster cycles and software control that allows the oven to be automatically switched on at the desired time. Normally the delay Switch ON control is used to start the cycle automatically without the presence of an operator at night or early morning with best electric rates or better loading optimization.



**More information:**  
<http://youtu.be/o6VVQVeteW4>

### 3. DESCRIPTION AND CHARACTERISTICS OF THE INSTALLATION

- The **PUJOL-100 PVB + SYSTEM** has been developed and designed to help the client to work basically with layers of PVB without the need to install a heated room and have additional fixed operating costs, expensive NIPPER roll processes and inefficient air conditioning accessories for humidity control and temperature.
- When using **EVA** film, it works as a high-uniform convection oven for glass lamination according to the PUJOL-EVALAM FAST CURING System, all integrated in the assembly line for glass production. This makes it possible to reduce the cost of manufacturing and increase the quality of the laminate, allowing it to keep pace with the short cycle times of the Fast Curing System of Pujol.
- Due to its high production and flexibility, it is possible, for example, to produce as much as 450 m2 of EVA Laminate glass per day(24H/ 3shifts) in a 50x28 oven; and more in the larger ovens. Therefore, it is possible to offer a rapid response to important and urgent orders, as well as small ones, improving the service and the final customer service.

#### System Overview

##### 1 Possibility of laminating with PVB / EVA

2 System based on **double vacuum**, first and **only** in the market.

3 **Humidity and temperature control is not required** in both storage and / or treatment.

4 **Does not require** pre-laminated line: therefore, it is not necessary to pre-oven and calender system.

5 **Does not require** a large consumption compressor.

6 **There is no risk of explosion**, as there is with an autoclave.

7 **Reduction of costs** for energy efficiency, up to a reduction of 70% compared to traditional autoclave systems.

There is no additional energy cost for:

- High Power Transformer,
- Compressor.
- Pre-Laminate Lines (Heating Oven and Calender)
- Climate Control Assembly Room
- High volume heating and space by inertia of the Autoclave.

8 **Up to 40 mm. of thickness** in a piece or of several pieces of independent compositions, to full tray and up to 60mm in smaller glasses.

9 **High temperature uniformity system** using 96/150 (s / model) heating plates that radiate above and below the surface of the glass.

10 **Minor Area required in the factory.** The lines without calender are shorter than the autoclave systems and less space for loading / unloading the autoclave cars.

11 **The standby position and the double platform units optimize the process cycle time.** While half is processed in the kiln, the other half is discharged and loaded for the next cycle, reducing the introduction and extraction process and the LAM resumption process in the kiln to a few minutes.

12 **The costs of Lamination do not depend on the volume of production**, even if production decreases, the energy cost remains constant and linked only to what is produced.

13 **High production volumes with minimum personnel.**



## 4. OVEN

### 4.1 Metallic structure

- Completely finished and ready for easy location in the plant once the oven has been completed in our workshops. The oven is built on the basis of our own original designs that comply with current building standards, but also developed and adapted to the needs of plant location.
- The structure consists of sheet steel and is reinforced with profiles that provide a high level of strength and resistance. The outer casing is equipped with steel plates to support the anchoring of the refractory insulating elements, support materials, as well as the heating equipment. Resulting in a solid unit with a balanced design and pleasant appearance.

#### Finishing treatment:

- Once the entire structure has been assembled, an anionic degreaser layer is applied to the metal sheet and a layer of antioxidant primer both inside and outside the oven.
- After this, or after completing the refractory assembly, we apply 2 coats of industrial anticorrosive paint Gradur2-C for external protection.

#### Door

- Hermetic type with oscillating pneumatic closing movement.
- Double form of movement, with a high inflection point in the final adjustment for an efficient heat-sealing,

#### Loading vacuum platforms

- The furnace consists of 4 bases reinforced load platforms on metal bearings, designed to operate up to 150 °C without deforming and without gripping the rolling elements.



### 4.2 Insulation

- The outer panels of the oven are covered with a very low density mineral fiber insulation, which can comfortably cope with the maximum working temperature. This provides a very low heat transfer coefficient, allowing for rapid heating times.



### 4.3 Fans

#### Heating areas

- 8 Units (4 + 4) (50x28) depending on the model. High Volume Axial fans installed in the roof of each oven chamber to achieve a perfect temperature distribution and homogeneity.
- Thanks to the high volume and speed of the air flow through the heating chamber, a Jet-Stream effect is created that provides a high temperature uniformity in all glass pieces, which results in fast cycle times and high quality.
- A special design of blades located in the propeller, helps to obtain a high uniformity in the whole machine.



#### Cooling

- 1 high pressure Centrifugal system and cooling flow to guarantee ultrashort oven cooling cycles.

### 4.4 Heating equipment

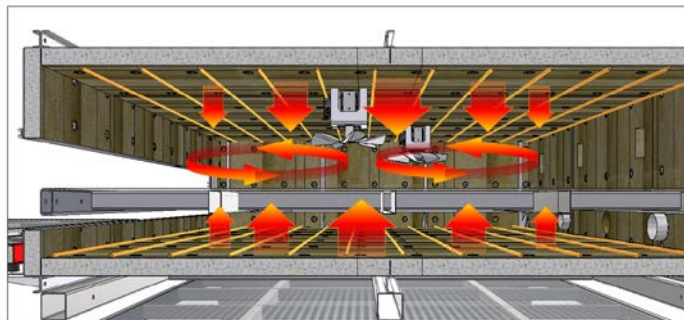
#### **RADIATION + CONVECTION SYSTEM = FAST + LOW CONSUMPTION + EFFICIENCY.**

Thanks to a studied system of Engineering; PUJOL offers its heating system DOUBLE DECK an exclusive and unique system in the lamination market that allows to have work chambers tray by tray.

The oven is divided into independent chambers thermally isolated one by one, placing in the upper and lower layers of the tray and glass 2 + 2 independent groups of resistances according to "Kanthal" specifications located both above and below the vacuum bag and the glass, in a double uniform system of radiation. This offers to the users of PUJOL-100 PVB + system: ultra-short, Energy efficient and Low Consumption lamination cycles.

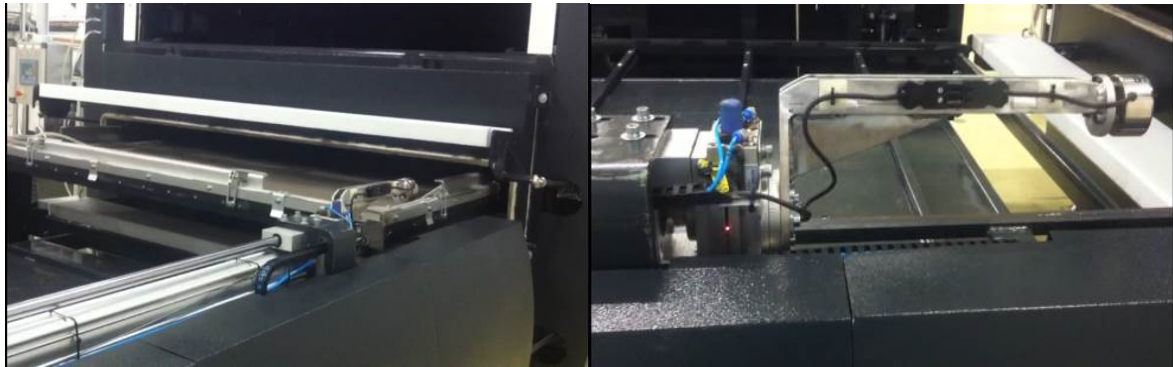
It is supplied conveniently assembled and prepared in the oven for easy connection between it and the control panel.

The double layer of uniform heating by radiation is reinforced by a convection homogenization system with high-flow upper agitation turbines, which allow to work up to 150°C, uniformizing the temperature on the surface of the glass



along its entire diagonal of the tray with  $\pm 3^\circ\text{C}$  maximum or thermal dispersion, resulting in greater heat transmission to the load with shorter cycles and lower energy consumption per m<sup>2</sup> produced

#### 4.5. Automatic Movement Trays & Automatic Plug-in Vacuum System (OPTIONAL)



**More information:**

<https://www.youtube.com/watch?v=3uQwJJ77Sk0>

- In order to work in FAST CURING mode, the PUJOL-100 line ovens can be supplied with an automatic tray handling system and vacuum connection in each slot of the process. Thanks to this, a correct, fast and effective without risk of burns for the Operators is achieved.
- Supply includes:
  - Pneumatic arms pushers with rotating push heads and magnetic extruders on the frame of the trays.
  - Complete and adequate reinforcements of the Hydraulic Platform of the oven.
  - New Fairings Complete Protection Platform.
  - Encoder coupled in Platform for exact positioning of the height of the Platform.
  - Automatic vacuum suction cups placed in each work tray, as well as machined aluminium plates for coupling the vacuum cups and all the control equipment by electro-valves in each working slot of each tray. All electrical elements of wiring the System.

#### 4.6. Automatic heating control and regulation equipment

- All the necessary equipment for regulation and control, is provided completely connected and mounted in a closed electrical cabinet. This is attached to the side of the oven (following CE electromagnetic standards).
- The following automatic regulation and control can be found inside and on the front:
  - Master switch with a safety mechanism to disconnect the power.
  - Buttons to start and stop the vacuum pump.
  - Automatic electronic control by zone control through temperature controllers and master switch-off of emergency with visual and audible alarm.
  - Overheating regulators independent of those that regulate the main system, controlling the temperature by means of double, independent thermocouples that regulate the control of the main areas.
  - 12 pyrometric rods (temperature probes) type PT100 scale 0-450° C. (to regulate the system temperature and as a safety measure for maximum superheat and to visualize the final cooling curve).
  - Electrical protection mechanisms (transformer with galvanic isolation, thermal magnet and fuses)
  - Relays and switches for the power circuit and start control.

#### Visual and sound warning for the following failures:

- Excessive or erroneous temperature due to the temperature change in the temperature of the system that is in operation (12 independent alarms - 1 per regulation zone).
- Failure in convection fans.
- Deviation or excess of temperature of the heating curve program.
- Deviation or lack of vacuum value.

#### Visual signals for the system that indicate:

- Connected voltage.
- Vacuum bag made.
- Camera vacuum made.
- Electric heating in operation.
- Automatic / manual mode.
- Automatic cycle in operation.
- Operating cooling cycle.
- End of the program.
- Configuration of the regulation of modular elements, parameters P.I.D, dead zone, etc.
- Visual and sound signals for the end of the process.



#### Pyrometric and control devices

- The system variables "Temperature-time vacuum-cooling events" are governed by an SIEMENS-PLC electronic controller format with 5.7 "color touch screen on the front interface.
- This controller allows the user to create up to 20 programs x 10 segments each to divide them into each automatic heating configuration as the user requires.
- An extra "Safety" controller works by following the main controller to ensure that no temperature sensor fails or the Power equipment does not break down by uncontrolled heating, stopping the machine immediately and returning the system to zero point to ensure correct function of the machine and to avoid possible deterioration of the product and the oven due to an excess of temperature.
- 12 thermocouple type PT100 sensors with a special vacuum cover, located in the whole oven, to ensure a uniform daily control, 4 additional thermocouple in the heat resistors for more safety, in accordance with the CE norms.

**All electrical safety and control devices are manufactured in full compliance with CE standards.**

#### 4.7 Motorized Hydraulic Lift to lift the load

- Adjustable elevator, specially reinforced, to equalize the different levels of the furnace chambers, those of the parking rack of pre-vacuum cooling.
- The hydraulic lift is designed to lift 2.300 Kg. depending on model size & configuration.



#### 4.8 Buffer racks of loading-unloading section, pre-vacuum and cooling period

- The system consists of two independent racks of Pre-Vacuum and Cooling, which have been designed to optimize the personnel required in the line, reducing the need for downtime for unloading, loading and cooling the trays and the licked glass.
- If the optional system is chosen, it also includes a AUTO PLUG IN vacuum auto-connector, and a pneumatic tray opening / closing system that:
  - Reduces the time of opening and closing bags.
  - Minimizes the risk of breakage and leakage of large dimensions bags.
  - Optimizes the space required for storing bags at the factory.



#### 4.9. Vacuum edge leakage control:

##### L.C.EVA System.

- A complete, sophisticated and precise automatic system that guarantees the different and demanding states of pressure inside the bag, in order to reach in the "ON" mode the perfect deaeration, as well as the best adhesion. In the "OFF" mode it is possible to avoid both the annoying optical distortions and the excesses of EVA at the edges.



\* Edge Leakage appearance at a 0,38 & 0,76 mm EVA thickness

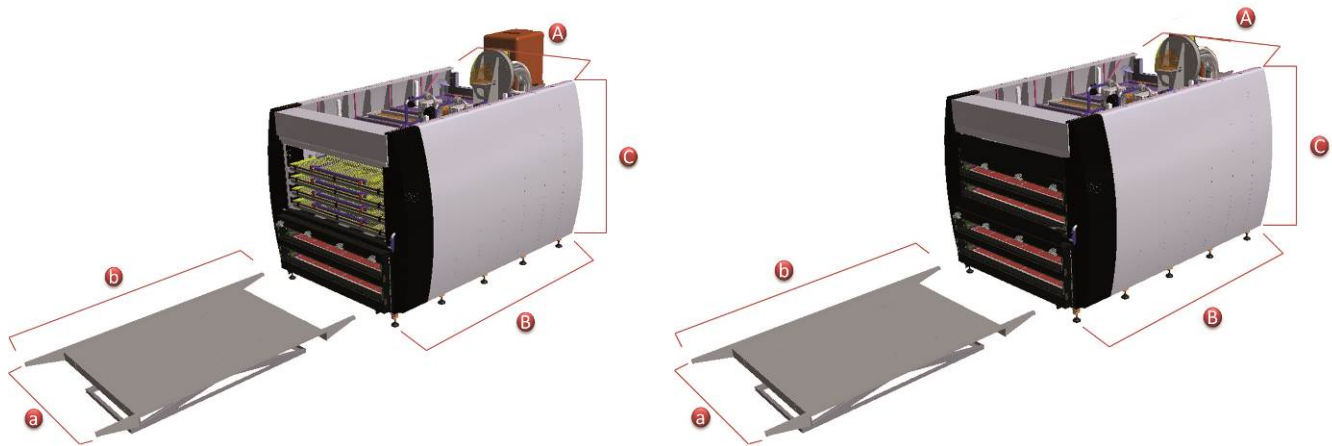
## 6. OVEN TYPE

### 6.1 General Technical Data

<b>Batch type of</b>	Close vacuum chamber
<b>Heating media</b>	Electrical
<b>Models</b>	2-C (Chambers)
<b>Moving platforms / cars</b>	On metal wheels
<b>Working Temperature</b>	PVB Process: 130 ÷ 145 °C EVALAM Process: 80÷145 °C
<b>Maximum Temperature</b>	150 °C
<b>Total Power Installed x Model</b>	100 Kw. 50x28 /2C
<b>Electrical Tension</b>	380-410 v.III + N.- + E.-
<b>Type of Heating Source</b>	Black radiation plates of Low Radiation wave
<b>Number of Heating Plates</b>	240c Elements /2C
<b>Type of atmosphere required</b>	Double Vacuum Process



## 6.2 General dimensions of the installation



MODEL	A	B	C	a	b	Glass	kw
40x24-2C	3450	5800	3750	2400	4000	3.6 x 2.1	58
40x28-2C	3850	5800	3750	2800	4000	3.6 x 2.5	68
50x28-2C	3850	6800	3750	2800	5000	4.5 x 2.5	72

### 6.3 Production Rates Performance

#### MODEL 50x28

##### **PVB TYPE CYCLE**

Maximum dimension of glass: 4.5x2.5 m stackable up to 40mm.

	Cycle (min)	Type 2 + 2		Type 4 + 4	
		LOAD	PRODUCTION /24 Hrs	LOAD	PRODUCTION /24 Hrs
<b>Mass</b>		2.250 Kg	9,0 Tn.	4.500 Kg	18,0 Tn.
<b>Glass 5+5</b>	300	90 m <sup>2</sup>	360 m <sup>2</sup>	180 m <sup>2</sup>	720 m <sup>2</sup>
<b>Glass 10+10</b>	300	45 m <sup>2</sup>	180 m <sup>2</sup>	90 m <sup>2</sup>	360 m <sup>2</sup>

##### **FAST CURING TYPE CYCLE**

Maximum dimension of glass: 4.5x2.5 m without stacking.

	CICLO (min.)	Type 2 + 2		Type 4 + 4	
		LOAD	PRODUCTION /24 Hrs	LOAD	PRODUCTION /24 Hrs
<b>Glass 5+5</b>	45 min.	22,5 m <sup>2</sup>	650 m <sup>2</sup>	45 m <sup>2</sup>	1.300 m <sup>2</sup>
<b>Glass 10+10</b>	90 min.	22,5 m <sup>2</sup>	360 m <sup>2</sup>	45 m <sup>2</sup>	720 m <sup>2</sup>

*Production Datas are Bases in FULL CAPACITY of the Loading Tray working on 24 H/3shifts. A correction factor of 65-75% of Load Charge should be considered.*

## 6. ASSEMBLY AND COMMISSIONING

### 6.1 Assembly

- The kiln leaves our factory workshops completely assembled (Structure and Refractory) and pre-wired. All that remains is a final *in-situ* coupling, electrical connection, assembly of the modules and definitive emplacement in the area where it will be used.

### 6.2 Commissioning

- Our engineers will undertake the set up, commissioning and training.
- Conditions of acceptance of the machine will be under Pujol Standard Protocol.
- Commissioning consists of: Full load & 10% load at 4+4 & 8+8.
- Is responsibility of customer to have the glass ready for commissioning firings, in case that glass is not ready, machine will be understood accepted, or customer will carry out all charges of additional travel of engineers to perform remaining tests.

