SUN IS RISING.

Ypsator®

Multi-Opening Lamination Technology

BÜRKLE

PROCESS TECHNOLOGIES

BÜRKLE PROCESS TECHNOLOGIES

Bürkle's core technologies include Precision Coating and Lamination for a broad group of industry requirements. Located in the city of Freudenstadt in the Black Forest Bürkle has been designing and manufacturing System Solutions for over 90 years.

Focussed on markets requiring precision and reliable manufacturing equipment Bürkle has served major markets including the wood based panel industry for finishing and lamination systems, the printed circuit board industry, plastic card industry, photovoltaic industry, building and automotive industries.

From low volume production to high volume applications Bürkle has experienced design teams available to provide standalone machines or complete custom system solutions. Reliable and predictable process control is one of the distinguishing features of Bürkle's design.

As an internationally focused company Bürkle systems are found globally. Distribution and service centers are located in all major countries of the world.

e.a.sy solutions – economic applications, systems and technologies

Bürkle's customers rely on highly sophisticated and future oriented technologies. Bürkle's machines, lines and systems are the solution for economic applica-tions and technologies.

From the planning to the development and design to installation and start-up of a line Bürkle has one goal: it must be e.a.sy!

Bürkle's machines, lines and systems are designed to provide a high return on the customer's investment enabling predictable processes with a high level of process control.

Bürkle's e.a.sy service is based on highly skilled and trained service technicians, a service hotline and state of the art diagnostic systems as well as remote support capabilities.

e.a.sy® solutions | *economic application systems by* **BÜRKLE**

BÜRKLE INNOVATION CENTER

Bürkle's Innovation Center provides the capability to test lamination and coating processes for recipe development and operational feasibility tests for existing and potential customers as well as material suppliers.

Your Application – Bürkle's Systems and Solutions

Bürkle's experienced process engineers, technicians and researchers develop new processes, test new materials and provide assistance to solve your lamination or coating challenge. This enables you to develop the best process for your application and production.

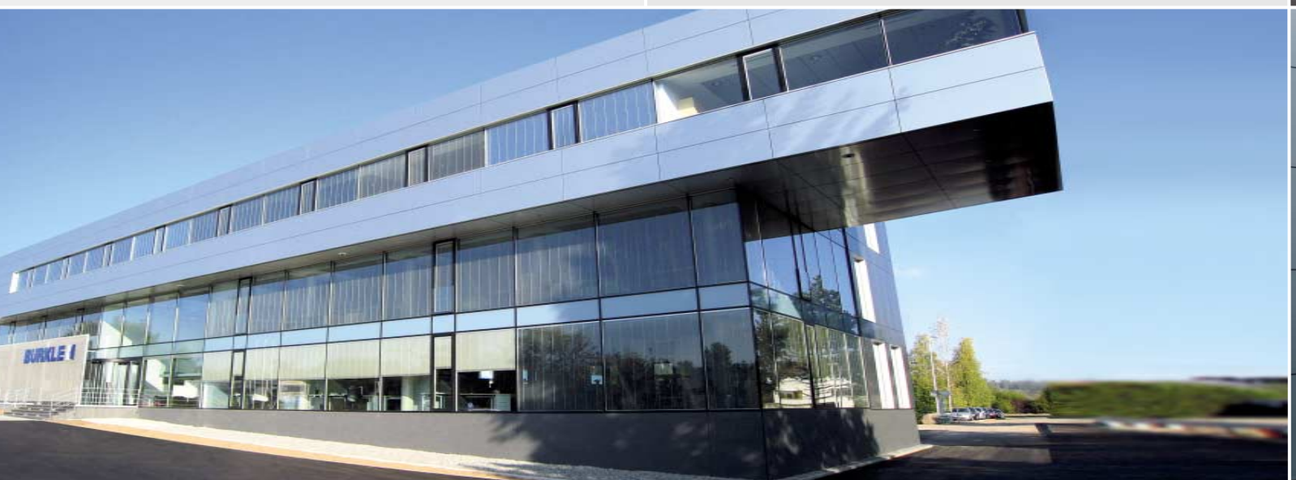
Examples of new applications and processes include our proven split "Ypsolar® Lamination Process" for glass-glass modules using a membrane lamination step followed by a flat press for final lamination and a cooling step. Other new developments have included the "SL-Short Lamination Process" reducing the lamination cycle time for crystalline glass-backsheet modules by nearly 50%. Both processes have been developed by Bürkle and are just two examples for the Power of Innovation at Bürkle.

Multi-Opening Lab Laminator for test purposes at Innovation Center

Quality improvement of your product, faster processes and higher production capacities combined with a higher level of process control and reliable and reproducible processes are the advantages and characteristics of Bürkle's Single-Opening Lamination Lines e.a.sy-Lam and Bürkle's Multi-Opening Lamination Lines Ypsator® as well as Bürkle's Coating Lines e.a.sy-Coater.

Bürkle Process Technologies

See for yourself how Bürkle's lamination and coating experience can benefit your manufacturing process improving reliability and quality.



"Bürkle's Innovation Center in Freudenstadt, Germany"

Bürkle's **Multi-Opening Lamination Line Ypsator®** is a well proven high volume production system for the encapsulation of solar modules. More than 50 systems haven been supplied to customers all around the world since market launch in 2008.

Two machine configurations are available based on the end product:
- Ypsator® SL for glass-backsheet modules using the Short Lamination Process.
- Ypsator® S for glass-glass modules using the Split Ypsolar Process.

Advantages of the Multi-Opening Lamination Line Ypsator®:
- High volume production line for 24/7 operation
- Small overall footprint.
- Robust and reliable system design.
- High yield and high equipment utilization.
- Predictable and reproducible process.
- High level of process control.
- Controlled and uniform heating and pressure application for a high product quality.
- Thermal oil heating in combination with steel heating platens provides uniform temperature accuracy of ± 2°C.
- Dry-running vacuum pumps with short evacuation times.
- Spring-loaded lifting pins to hold off modules during transportation and evacuation in step 1.
- Fast replacement of membranes under heated operating conditions. Membranes are installed in an exchangeable vacuum frame.
- Active cooling under pressure (top and bottom cooling platens) or fan cooling.
- Maintenance friendly and good accessibility.
- Openings can be deselected.
- High sophisticated process visualization and control system.

Ypsator®– Bürkle's High Volume Lamination Line

Bürkle's well proven High Volume Lamination Line

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Bürkle – The Pioneer of the Multi-Opening Technology and ...

Ypsator® S for Glass- Glass Modules

The Ypsolar® Process Technology:
- Split lamination process:
  1st Step: Vacuum lamination with a membrane for pre-lamination.
  2nd Step: Flat pressing with top and bottom heating platens (non vacuum process) for final lamination.
- Dedicated process recipe.

Advantages of the Ypsator® S:
- Split lamination process to shorten cycle time and to maximize capacity on a small flootprint.
- Flat press for final lamination avoids "edge pinch" effect and provides a uniform thickness of the laminated module.
- No support frames around the module during the lamination process are required. No handling or cleaning of frames necessary.
- Top and bottom heating provides uniform curing of the encapsulation material and minimizes the internal stress and bowing of the module.
- Cooling under pressure to minimize internal stress and bowing of the module.

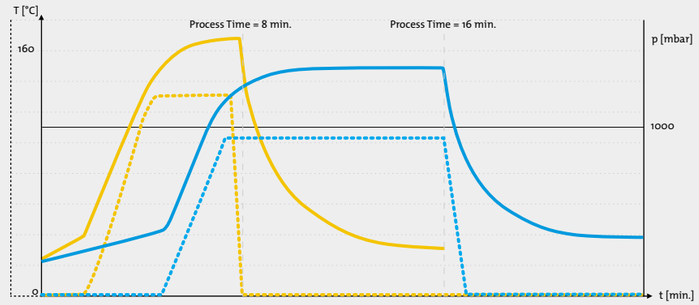
Ypsator® SL for Glass- Backsheet Modules

The Short Lamination Process Technology:
- Reduction of evacuation time (approx. 50 % of typical evacuation time).
- Higher operating temperature allows increase of cross linking speed (e. g. 10°C higher operating temperature will double the cross linking speed).
- Higher pressure (> atmospheric pressure) avoids emerging of gasses out of the material and thus avoids formation of bubbles.
- Dedicated process recipe.

Advantages of the Ypsator® SL:
- Short cycle times and high production capacity with one lamination step.
- No shrinkage of backsheets caused by pressureless transfer in an incomplete lamination status (as with split lamination process).
- Cooling under pressure.

...the Pioneer of the Short Lamination Technology

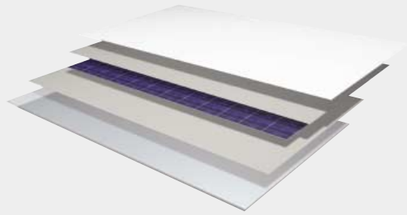
Diagram of SL Process versus Conventional Process



SL Lamination Process
- **Module Temperature**
- **Pressure**

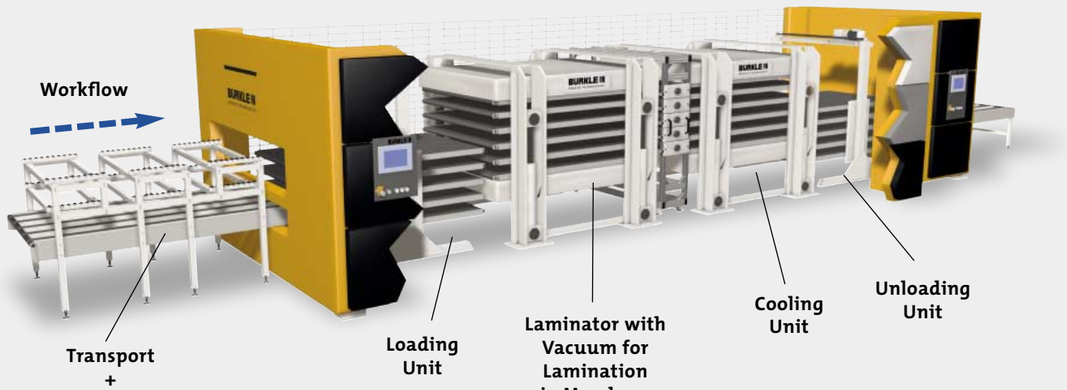
Conventional Lamination Process
- **Module Temperature**
- **Pressure**

Multi-Opening Lamination Line Ypsator® SL



For Glass-Backsheet Modules

1 Step Lamination Process with Cooling



Technical Data	Ypsator® 1722 SL	Ypsator® 2022 SL
Useful lamination area [mm]	1700 x 2200	2000 x 2200
Number of openings	4–10	4–10
Number of modules per opening	2 (1700 x 1000 mm)	2 (1700 x 1000 mm) or 2 (2000 x 1000 mm)
Assumed cycle time [min.]	9,5	9,5
Capacity* per opening based on 8000 hrs. working time (number of modules per opening x module power)	2 x 240 Wp: 24 MWp	2 x 240 Wp: 24 MWp 2 x 285 WP: 29 MWp
Number of lamination steps	1	1
Operating temperature max. [°C]	180	180
Heating medium	Thermal oil in combination with steel heating platens	Thermal oil in combination with steel heating platens
Number of heating units	1	1
Temperature accuracy [°C]	< ± 2	< ± 2
Specific pressure [N/cm²]	0,5–19	0,5–19
Final vacuum pressure [mbar]	< 1	< 1
Evacuation time to 1 mbar [sec.]	< 60	< 60
Cooling unit	optional	optional
Cooling	cooling platen	cooling platen

* depending on bill of material, number of openings and atmospheric pressure

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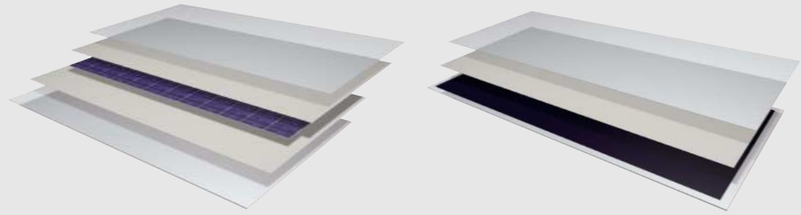
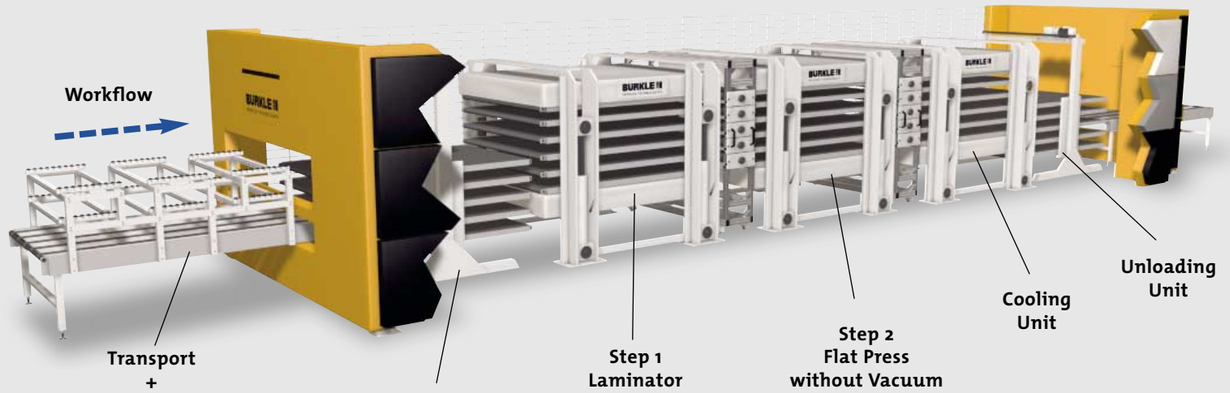
Multi-Opening Lamination Line Ypsator® S



For Glass-Glass Modules

2 Step Lamination Process (Split Lamination Process) with Cooling



Technical Data	Ypsator® 1228 S	Ypsator® 1722 S	Ypsator® 2022 S
Useful lamination area [mm]	1200 x 2850	1700 x 2200	2000 x 2200
Number of openings	4–10	4–10	4–10
Number of modules per opening	2 (1100 x 1400 mm) or 4 (1200 x 600 mm)	2 (1700 x 1000 mm) or 3 (1700 x 650 mm)	2 (1700 x 1000 mm) or 2 (2000 x 1000 mm)
Assumed cycle time* [min.]	< 12	< 12	< 12
Capacity* per opening based on 8000 hrs. working time (number of modules per opening x module power)	2 x 150 Wp: 12 MWp 4 x 85 Wp: 14 MWp	2 x 240 Wp: 19 MWp 3 x 140 Wp: 17 MWp	2 x 240 Wp: 19 MWp 2 x 285 Wp: 23 MWp
Number of Lamination Steps	2	2	2
Operating temperature max. [°C]	180	180	180
Heating medium	Thermal oil in combination with steel heating platens	Thermal oil in combination with steel heating platens	Thermal oil in combination with steel heating platens
Number of heating units	2 (1 per step)	2 (1 per step)	2 (1 per step)
Temperature accuracy [°C]	< ± 2	< ± 2	< ± 2
Specific pressure in Step 1 [N/cm²]	0,5–10	0,5–10	0,5–10
Final vacuum pressure in Step 1 [mbar]	< 1	< 1	< 1
Evacuation time to 1 mbar in Step 1 [sec.]	< 90	< 90	< 90
Specific pressure in Step 2 [N/cm²]	up to 20	up to 20	up to 20
Cooling unit	optional	optional	optional
Cooling	cooling platen	cooling platen	cooling platen

* depending on bill of material, number of openings and atmospheric pressure

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