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AUTOCLAVE FREE

LAMINATING

WITH TROSIFOL® HR PVB

TROSIFOL™ - WORLD OF INTERLAYERS

Kuraray's Trosifol™ business is a leading global specialist in the development, manufacture and supply of PVB and ionoplast interlayers for laminated safety glass applications in the architectural, automotive and photovoltaic industries.

The evolution of the Trosifol™ & Glass Laminating Solutions (GLS) merger has resulted in consolidation of the Trosifol®, SentryGlas® and Butacite® product brands into a single brand: the new Trosifol™.

Trosifol™ offers the world's broadest portfolio of innovative glass-laminating solutions, including structural and functional interlayers for safety and security applications, sound insulation and UV protection. For decorative applications, it supplies colored interlayers, digitally printable films and other innovative products for interior design projects. Trosifol® UltraClear films exhibit the lowest Yellowness Index (YID) in the industry.

Trosifol® products give applications an expression of strength, clarity and their own character, delivering advanced capabilities that enable engineers, designers and architects to save energy, increase safety and build with greater design freedom. Applications range from automotive and other transportation glazing, to architectural and structural glazing - located overhead, underfoot, and all around some of the world's most interesting spaces.



PRODUCTION PROCESS

1. Trosifol® HR PVB film is particularly suitable for autoclave free processing. Even though other grades of Trosifol® PVB may also be used, due to the rougher surface pattern, HR allows for more efficient de-airing.

2. For best results, dry the 0.76 mm Trosifol® HR PVB (and all material to be used in the vacuum bagging process if using disposable bags) overnight freely suspended for at least 12 hours at $\leq 10\%$ relative humidity at a temperature less than 25°C . Insufficiently dry interlayer has the potential of forming edge bubbles. If the PVB is hanging in single sheets, the drying is more effective than drying the PVB as a small roll.

3. Wash the glass using your standard washing process. Demineralized water or a reverse osmosis process is recommended with a water quality of $< 20 \mu\text{S}$. The primary function of washing is to eliminate any visible particles from the glass surface to obtain an optically perfect laminate without visual defects. Since the adhesion of PVB to glass is also dependent on the chemical composition of the glass surface and any ions deposited on the glass surface, the quality of washing is very critical to obtain the expected final adhesion.

4. It is recommended to construct the laminates inside a clean room environment whenever possible. This not only keeps the PVB at a low moisture level, it also reduces the risk of contaminants getting on the glass and sheeting. A tacky roller may be used on the glass and sheeting to insure that both are contaminate free. Tempered glass used during lamination should be nested/spooned to reduce interlayer intrusion during the laminating process (See troubleshooting guide on page 6).

5. Both re-usable silicone rubber vacuum bags and disposable vacuum bags can be used for this process (See figures 1 and 2).



Figure 1: Re-usable Silicone Envelope Bag



Figure 2: Disposable Vacuum Bag

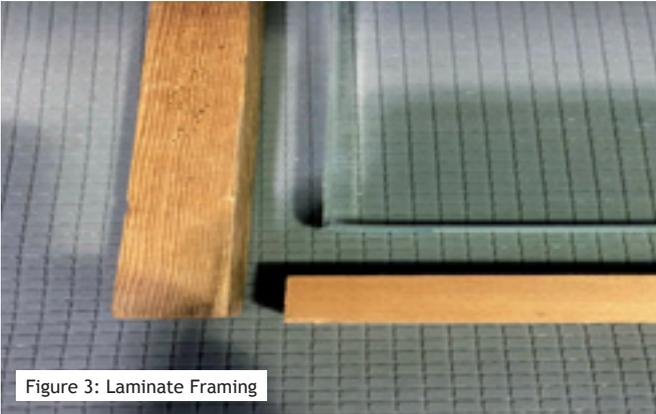


Figure 3: Laminate Framing

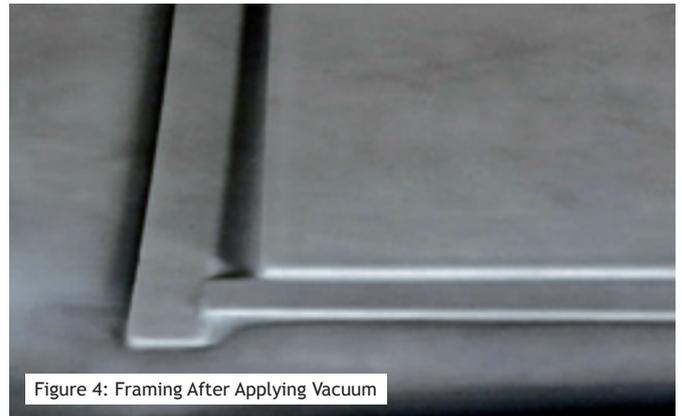


Figure 4: Framing After Applying Vacuum

6. When using disposable vacuum bags, it is necessary to use a breather material along the edge of the laminate inside the plastic bag to allow complete de-airing of the laminate. If sticking occurs between the strip and the interlayer, use of a perforated release film between the two is recommended. Any material used in the vacuum process should be rated for high temperature.
7. Re-usable silicone vacuum bags, such as the ones that come with non-autoclave oven systems, generally come with a mesh material to facilitate de-airing. It may be necessary to add additional breather material around the laminate to obtain maximum de-airing. Laminates may also be “framed” to aid in reduction of edge pinching (See figures 3 and 4).
8. After placing the prepared laminates on the trays, apply vacuum (≥ 28 ” Hg). After a few minutes of vacuum, verify the bag is properly sealed by pinching the vacuum hose or turning off the vacuum and listening or looking for leaks. A **minimum** of “cold” vacuum time of 15 minutes is recommended. Additional time can be added to assist in removing moisture from the interlayer.
9. As a general guide, heat the laminates up to 135°C (275°F) under vacuum and hold for a **minimum** of 1 hour. Thicker laminate constructions will need additional time. Once this step is complete, cool down to a temperature $\leq 50^{\circ}\text{C}$ with the vacuum still on prior to opening the bags. Breaking the vacuum bag seal prior to cooling below $\leq 50^{\circ}\text{C}$ can cause edge bubbles in the laminate.
10. Due to the increasing number and types of non-autoclave laminating ovens that are now available, specifying the proper conditions for each in this guide is not practical. Contact your Kuraray Technical Representative for assistance in optimizing non-autoclave process parameters to produce defect free laminates while minimizing process time.

PERFORMANCE MONITORING TESTING

All customers are strongly encouraged to submit Trosifol® PVB test laminates to Kuraray on a regular basis for Performance Monitoring (PM) Testing. The results are then sent to the customer to monitor quality as a function of time by Kuraray.

The following are the recommended PM submission guidelines

- 1. Laminates should be submitted representing the customer process. However, since the number of laminates and the frequency of submissions may vary by location, please consult your Kuraray account manager or technical representative for more information.
- 2. The Trosifol® roll number and the lamination date on the label should be included with the submitted samples.
- 3. If in house testing is performed, QA test results should be included on the label.
- 4. Sample labels and boxes are available by contacting your Kuraray account manager or technical representative. Below is an example of the preferred label for submitted test laminates (See figure 5).




TROSIFOL® PERFORMANCE MONITORING

Customer Name CUSTOMER - X

Production Date 2016. 5. 18

Trosifol® Roll Number 66A0123-1

(Sheeting/Laminate) Moisture 0.45 %

Other Data PART NO. ABC-CO1A
LINE 2 SHIFT 3, PUMMEL 4.5
BAKE/BOIL OK, 4M BALL DROP OK

Figure 5: Preferred Performance Monitoring Label Information

TROUBLESHOOTING GUIDE

Troubleshooting Guide

Problem	Potential Cause	Solution
Small spherical bubbles along the perimeter of the laminate especially in the corners	<ul style="list-style-type: none"> High moisture in interlayer 	<ul style="list-style-type: none"> Dry out the interlayer Lower relative humidity level in clean room
Bubbles throughout laminate	<ul style="list-style-type: none"> Loss of vacuum Insufficient sealing of vacuum bag tray 	<ul style="list-style-type: none"> Check vacuum level and bags for leaks
Random bubbles inside of laminate	<ul style="list-style-type: none"> Insufficient de-airing channels 	<ul style="list-style-type: none"> Open up de-airing channels using a breather material or add additional vacuum ports Move laminate closer to vacuum port
Edge kink	<ul style="list-style-type: none"> Distortion from the tempered glass 	<ul style="list-style-type: none"> Nest the glass to minimize the edge kink Improve tempering process Use thicker interlayer
Contamination in laminates	<ul style="list-style-type: none"> Improper practice of clean room protocol 	<ul style="list-style-type: none"> Control transferring path of rolls from storage to lay-up and unwinding path of PVB to glass to prevent any external contamination getting into the clean room Clean glass washer on a regular basis Use a tacky roller to remove any possible surface contaminates from the glass and interlayer If source of contamination is difficult to trace, contact your Kuraray Technical Representative to assist you with recommendations for preventative measures and lab identification

ADDITIONAL INFORMATION

If there are questions regarding Kuraray Trosifol® PVB lamination or for processing requests that fall outside of this laminating guide, please contact your Kuraray representative. Product safety information is available upon request. It is the user's responsibility to determine the level of risk and the proper protective equipment needed for the user's particular purposes.

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