

Technical Tip:

Thermoforming

Whether you're thermoforming pre-laminated sheeting into pan faces or raised letters, each step or fabrication is critical to the success of your finished sign.

For successful thermoforming, the following factors must be considered:

- Drying of sheet before and after lamination of film
- Lamination step
- Temperature of sheets and molds
- Rate of application and level of vacuum
- Sharpness of corners and edges

I. Predry - Remove protective masking from the surface to receive vinyl and predry all acrylic and polycarbonate sheets prior to lamination of film. Predrying prevents bubbling during the forming cycle. Predrying is more critical to forming success when working with vinyl laminated plastic sheet than with sheet alone – especially for polycarbonate signfaces. Preferred method: Oven drying of suspended and separated sheets at approximately 200°F (93°C) for six hours. The simplest method is to load the drying ovens at the end of the workday for the following days fabrication. This allows the use of lower temperatures, down to 180°F (82°C) and more than enough time for adequate ventilation. For example, 6 hrs at 200°F is minimum drying time for .080 in. thickness, according to a major polycarbonate fabrication guideline. Alternate method: (adequate for thin gauge acrylic sheeting)

- Quick dry suspended and separated sheets at 230°F (109°C) for 30 minutes.
 - Slow dry sheets by removing masking and putting in a warm/dry area of the shop for 24 hours.
- Note:* Once the sheet has been dried it should be further processed within 12 hours of being removed from dryer.

II. Lamination - Although lamination may be wet or dry, wet lamination, can lead to problems with bubbles and cracking of film if all the surface water is not squeegeed away and dried before heating and forming

- **Dry Application** When applying full sheets of uncut film with a mechanical laminator use the highest practical laminating pressure at throughput speed of about 30'/min. (10m/min).
- Vinyl is best applied as free film immediately after being stripped away from the release liner. The point of stripping should be where the film and liner are in tight contact with a rubber lamination roller. This eliminates stretching and unevenness as the film travels toward the laminating nip.
- The shorter the distance between stripping station and lamination nip the better. The combination of tacky adhesive surface and the static generated by stripping the liner away creates an environment highly susceptible to dust contamination.
- **Wet Application** This method is used when lamination is done by hand, either as background color or at the point of multicolor registration of cut graphics. Use only proven application fluids such as Rapid Tac, or the following mix of water, clear unscented liquid detergent and alcohol: 20 oz. and 1/2 tsp. respectively.
- Lay film upside down, strip paper release liner and discard. Avoid getting paper liner wet before it is removed from vinyl. Water damages the paper liner which then leaves small pieces of paper on the adhesive. Synthetic lined product is less sensitive to wetness and may be splashed or sprayed with no effect. Wet the whole film and substrate. It is advisable to use more liquid at the location where squeegeeing will begin and let this wave of water travel ahead of the squeegee rather than saturating the entire sheet and ending up with excess water on the work table, floor and installer.

- Spray a fine mist on the adhesive surface of the film, turn it adhesive side down and position the graphics until registration marks are aligned. Squeegee the top couple of inches of material or application paper in place to establish a straight line.
- Lift the remaining graphic (up to the squeegee line) and allow it to drape loose but square. Squeegee in overlapping strokes from center to edge and towards the lifted end. The squeegee should be dragged at a shallow angle for effective and stretch free work. Keep the vinyl unattached to the sheet surface for as long as practical by lifting it; this keeps trapped fluid to a minimum and helps avoid wrinkling along the edges.
- Once all water has been squeegeed from underneath the vinyl and a secure bond has been established remove the application tape by spraying it with a light mist of water, allowing 30 seconds for the water to loosen the adhesive and immediately peeling it from the graphic. Use even pressure and a low angle of removal to prevent graphic edges lifting.
- After application paper has been removed and discarded, resqueegee the edge of any graphics that may have lifted or come lose while the application tape was being lifted.
- If the application is being done without application paper, it is advisable to mist the vinyl surface with the same application fluid to avoid scratching or stretching the vinyl while it is being laminated.
- Wipe off the face of the sign with clear water to remove any soap residue from the application fluid. If soap remains and dries it can leave streaks of discoloration on the vinyl. This is particularly true for film to be later thermoformed.

III. Post Lamination Conditioning - If the vinyl has been dry laminated no dwell time or additional dehydration is needed prior to forming. If wet laminated, all residual surface moisture must be removed prior to the thermoforming process. Temperature and time needed to dry the laminate vary according to facility and can range from 24 hours at room temperature to as little as 2 hours at 210°F (96°C). As with the initial dehydration step it is important to separate the sheets for best ventilation and fastest drying and least chance of "mark-off".

IV. Preforming Staging - Prior to forming it is important to store the sheets in such a way that they are uniformly warm and dry. Warm sheets going to the thermoformer will process faster and more consistently than if taken from cold or moist environments. The best possible practice is to store sheets in drying ovens or other options include racks along walls free from direct contact with the ground moisture.

- Sheets may not remain in an uncontrolled shop for more than 12 hours during dehydration and forming. If more time elapses return sheet to dehydration conditions.

V. Forming - For extremely thick polycarbonate materials that demand high forming temperature, a modification of standard technique is needed. Rather than bring a bare sheet immediately to its closest position relative to heating elements it is better to bring the laminated construction toward the heat source in two stages. For example; if the distance for successfully forming unlaminated sheet is 6.5 inches (17cm) from the heat elements and the dwell is 7 minutes but excessive staining or bubbling is observed in a finished sign made from a laminated construction a good solution is to lengthen the distance and time, i.e. 12 inches (30 cm) from elements for 3 minutes, 6.5 inches (17cm) inches for 5 minutes.

VI. Molds - The tooling and design used for forming a laminated piece is only successful where the vinyl does not come in contact with the mold. If one tries to mold vinyl against the mold face a variety of problems develop.

- At high temperature the adhesive softens and vinyl is pulled away from the sheet as the vacuum is created.
- At high temperature the vinyl becomes molten seeks to take the shape of all minor seams, joints and surface discontinuities of the mold when a vacuum is created.
- As the surface of vinyl is slightly tacky until cool it does not release easily from the mold shape. Mold depth and consequent distortion and stretching of translucent film should be kept in mind while designing draw distance, corner radius, wall relief and draft angle. The film may be drawn over mold depths of 4 inches (10 cm) providing the sheeting stretches uniformly. Corners should be radiused generously to avoid "bright spots" at the outer corners and angles.