klöckner pentaplast

white paper

OPTIMIZING THE LAMINATION PROCESS

A recipe for success

INTRODUCTION

The optimization of the lamination process can yield substantial benefits to the card production process. One can maximize productivity; reduce scrap related to burn and flow; and create a successful and repeatable environment for consistent and enhanced card aesthetics.

Believe it or not rigid PVC, and, for that matter, most other plastic substrates, can bond to itself given enough time, heat, and pressure. The key lies in establishing a proper balance of those parameters within the standard stack-lamination equipment widely used in the card industry today. The ideal scenario that best supports the above statement would be to achieve an indestructible bond between the two sheets of core material positioned in the center of a book. For a 30-mil financial transaction card, this would typically be a combination of 2 outer layers of clear PVC over laminate 1.8- to 3-mil thick and 2 inner layers of printed PVC stock 12.8- to 13.5-mil thick (i.e., typically a 2-13-13-2 card construction as pictured in figure 1). Again, we are specifically interested in the center bond between the two 13-mil core-stock sheets.

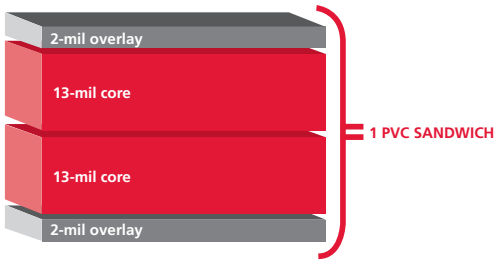

Figure 1

Hybrid cards containing dissimilar materials may require a unique lamination profile and the bonding of overlaminate to printed surfaces requires the balancing of additional variables, such as the adhesive and inks used in the processing of the card product. Thus, the only "pure play" for this exercise is the center-to-center bond between the two 13-mil pieces of core stock.

PROCEDURE

To obtain the optimal processing conditions within the lamination process, an iteration process is typically followed. Tools required include a digital thermometer with J-probes (thermocouples) and an IR thermometer. We are assuming 10 sandwiches per lamination opening (see figure 2). Let's get started and take some of the black magic out of the lamination process.

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QUICK START LAMINATION GUIDE

1. **Temperature set point:** 285° to 310° F
2. **Heat time:** 20-22 minutes at 125 to 150 psi
3. **Cooling time:** 18-22 minutes, 125 psi for first 2 minutes; 250 to 300 psi for all remaining minutes

While the above processing parameters give a general range for lamination processing, use your current cycle settings and measure a temperature profile of both the center outside and center middle sheet in an opening throughout the whole heating and cooling cycle in one-minute intervals using the J-probes and digital thermometer (see figure 3). Use the IR thermometer late in the heating cycle to assess heat consistency throughout whole lamination stack by targeting the surface temperature of each platen. At the end of the lamination cycle, make outer and middle sheet evaluations of the product. For example, look for burnout or flow on outer sheets and good center-to-center bonding in the middle sheet by pulling at the corners to ensure sheets cannot be separated. Also, cut into the sheet at one of the corners and examine under 10x magnification to ensure the two halves have melded together.

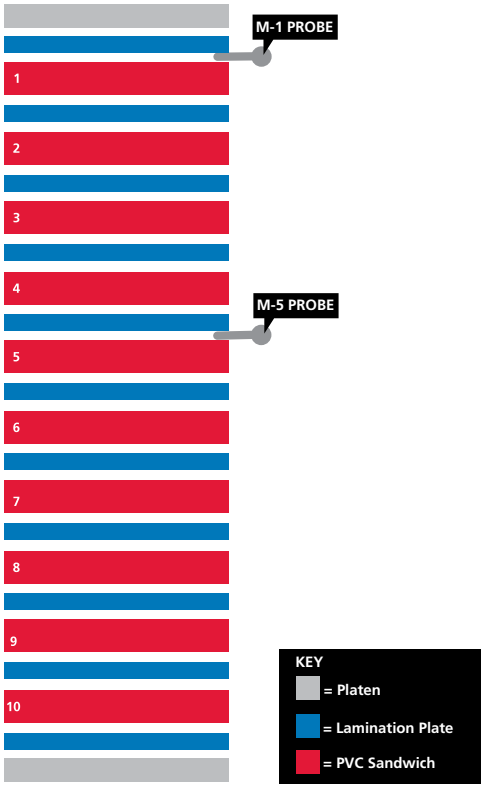

Figure 2

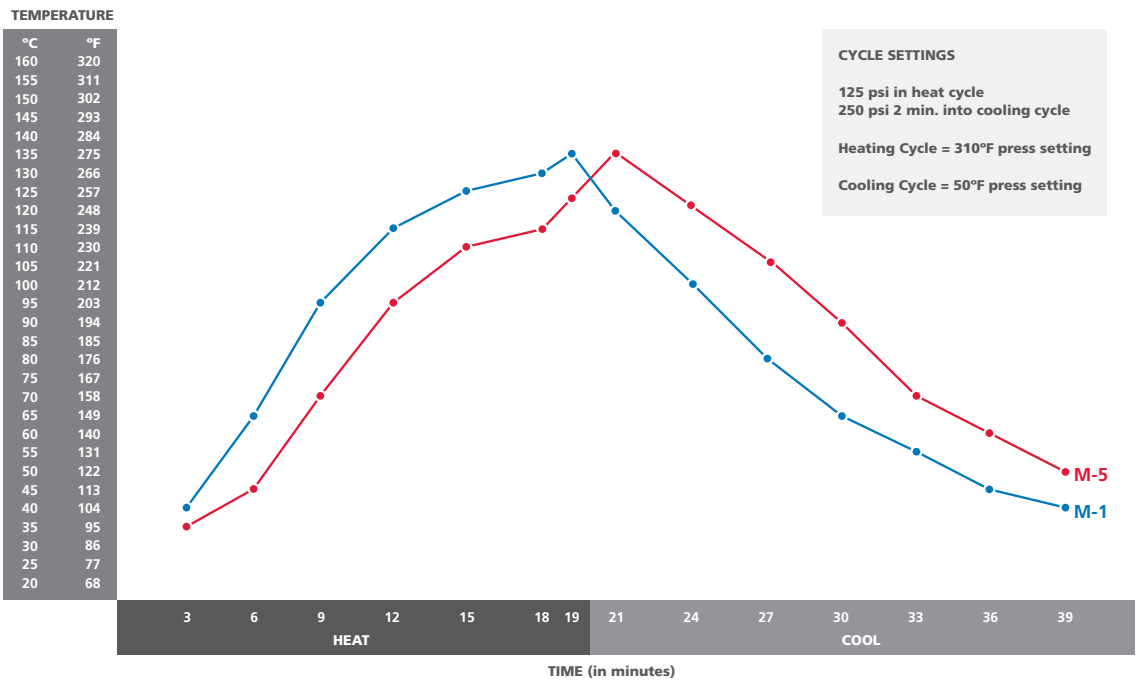

Figure 3

continued >

DETAILED GUIDE

The temperature set point will vary from lamination press to lamination press. The goal of the heating cycle is to get the middle sheet in any book or opening to reach a probe temperature of approximately 270° F for an 80° C VICAT A rated material. At that point, you want the outside sheets (top and bottom sheet in opening) to be as close to 270° F as possible. We would expect the delta between the middle sheet and top and bottom sheet to ideally be 5° to 7° F and not greater than 10° F. Achieving the 270° F temperature on the center sheet will guarantee maximum center sheet core-to-core bonding for split core construction type card product. A variation in temperature from the middle to top or bottom sheet in any one opening of greater than 10° F would be a concern for yellowing and possible distortion to the outer most sheets. Note that once the center sheet temperature in any opening reaches 270° F for the 80° C VICAT A substrate, you can immediately go into the cooling cycle. The material only needs to reach the 270° F temperature for an instant to achieve maximum benefit. In other words, it does not have to cook for a period of time after that point. Most cycles are set with one pressure setting which is suggested to be around 125 psi in the heating cycle. More intricate cycles may call for a ramp of multiple pressure plateaus within the heating cycle. Typical cooling pressure is two times maximum pressure used in the heating cycle.

The goal in any cooling cycle is to bring the material down to ambient room temperature. The maximum exit temperature for the material out of the lamination press is recommended at 100° F. Higher exit temperatures could lead to card warpage. Some presses have chillers, others don't. If a chiller is available, set its exit temperature between 55° to 60° F. Elapsed time for the cooling cycle is the time required by the lamination press to bring the exit temperature of the film to 100° F or lower. Thus, cooling time will vary depending upon the temperature of the cooling water. With a chiller, 18 to 20 minutes would be typical. Pressure for the first two minutes of cooling is kept at the same setting the material saw just prior to exiting the heating cycle. During this time, the center sheet temperature in each opening is still rising (see figure 3). After two minutes, the pressure is doubled to further ensure that that the layers of PVC materials remain intact during cooling.

EVALUATION OF MATERIAL

Compare sheet results to historical or desired results. Make adjustments to cycle settings as required. Temperature is the most important characteristic for bonding. Repeat the above process until desired results are obtained. If the center core-to-core is weak, additional heat is required. This can be best achieved by lengthening the heating time cycle. Another less attractive approach is to raise the temperature set point. Keep in mind that lamination is much like cooking and we want to bake the chicken or PVC and not broil the steak. Broiling extremes would result in discoloration and/or distortion on the outer most sheets with a raw center meaning poor center-to-center bonding at the middle sheet(s) in any given opening.

Each piece of lamination equipment is unique. Therefore, it is recommended to repeat this process for each laminator in your facility.

FORCE ON MATERIAL

On occasion, you may want to know the total force applied to the plastic. Let's assume we are in the cooling cycle at 250 psi of ram and the sheet size is a 72-up format of 27.75" by 22.75". To find the **total force**, you multiply the psi times the area of the lamination press ram. Measure the circumference of the ram using a cloth tape. Let's assume you measured a circumference of 31.4". C = ΠD or 31.4 = 3.14 X D; D = 10" or r = 5". A = 3.14 X (5 X 5) = 78.5 sq. inches. 78.5 sq. inches X 250 psi = 19,625 pounds of total force.