

Cool Running

Poor corrugator heat management can lead to warp, scoreline fractures, blisters and brittle bonds. With increased quality expectations from customers, shorter corrugator runs, the push for reduced waste, and the use of high performance and graphic liners, heat management is more crucial than ever. In this edition of *Paperwise*, the factors that make heat management necessary and the recommended temperature standards are discussed.

The Need for Heat Management

Since the early 1990's, many of the changes in papermaking have been aimed at providing customers more packaging and display options. Technological advancements in wet-pressing have led to linerboards with higher compression strength. The adoption of ECT-based packaging has led to a proliferation of high performance grades. Additionally, the demand for more sophisticated graphics and the use of color fostered the creation of white top linerboard, and the introduction of coated liners. Also, environmentally-conscious customers have promoted the use of recycled fiber in linerboard production.

The nature of high performance and graphic linerboards, such as white top and coated, makes them more difficult to run than the standard kraft liners corrugator crews are accustomed to using. The following is a list of some of the modern papermaking practices that have necessitated better corrugator heat management:

- Increased pulp refining and extended-nip wet pressing promotes higher compression strength per pound of fiber.
- Increased use of recycled fiber, which is a more brittle fiber. Some recycled liner mills also have extended-nip wet pressing to boost strength levels.
- Increased use of graphic white liners that have shorter fibers and mineral fillers in the white layer to enhance their visual appearance. Moreover, they undergo smoothing operations and coating applications to improve printability which densifies the liner even more.
- Increased use of lighter weight liners, which tend to be drier than heavier weight liners and heat up faster when running on a corrugator.

All these practices create a denser, less porous liner that heats up faster and can warp or fracture along scorelines. Some paper properties are irreversibly changed by the removal of moisture and even rehydration can not restore properties, such as stretch, to their original levels. So, running a cooler corrugator is factually supported.

Service and quality expectations have risen as well. Just-in-time orders translate into shorter runs that take away time to fine-tune corrugator settings. Consequently, the tendency is to operate the corrugator at higher temperatures in response to the board combination swings associated with the shorter runs. Additionally, customers now scrutinize box quality more closely, meaning box plants see more order returns. All of these factors, combined with changes in modern papermaking practices, place a greater demand on corrugator crews to do it right the first time.

Keep Your Cool

Many things can be done to improve the quality of corrugated board, given the advances in papermaking. Running liners as cool as possible, while maintaining a consistently firm bond, is the primary objective. Many producers fear losing a strong bond when operating at cooler temperatures. But, considering that corrugated starch-adhesives gel around 150°F and water boils at 212°F, a good bond can be achieved on a corrugator that is operated so that the board does not get much hotter than 212°F. It also allows for moisture retention in the paper. Board temperatures only need to be 10-15°F degrees above the gel point to bond.

To test bond strength, check green or rip bond of both the single-face and double-face liner. Still not convinced? Allow your test sheet to cool before performing your ripbond test, then check the condition of the gluelines. If the bond feels like sandpaper, the board may be overheated (provided the gel point is not excessively low).

Using too much adhesive can also compound the problem. Starting with the typical glue gap settings, reduce the gap by increments of two thousandths (0.002 inches) until the adhesive bond zippers or the fiber tear is lost. Then, open the gap by one thousandth (0.001 inch) to recover the bond strength. This technique assures that the adhesive application is optimum.

In the table below, corrugator operating temperature standards that counteract warp and scoreline fractures are outlined. Figures 1 and 2 diagram the locations described and the appropriate temperature ranges.

Table 1 Corrugator Operating Temperature Standards

	Location	Range
1	Singleface Liner - between 36-inch and 8-inch preheaters (Peanut Rolls). Measured 6 inches from the last preheater wrap arm idler.	170°F - 200°F
2	Corrugating Medium - between preconditioner and singlefacer. Measured 6 inches from the last preconditioner wrap arm idler.	150°F - 160°F
3	Singleface Web - entering the incline belts. Measured 12-15 inches from the pressure roll nip point.	<210°F
4	Doubleface Liner - between the 36-inch preheater and glue machine. Measured 6 inches from the last preheater wrap arm idler.	170°F - 200°F
5	Singleface Web - at the doubleback station. Measured 6 inches from the last preheater wrap arm idler.	170°F - 200°F
6	Bottom Facing of Combined Board - after hot plates. Measured between last hot plate and traction section. <i>Cascading and other older style steam systems</i> <i>Donahue, Stickle and other modern steam systems</i>	250°F - 280°F 230°F - 250°F
7	Top Facing of Combined Board - after traction section. Measured 6-8 inches from the head pulley.	165°F - 175°F

Speed Along for Better Results

Even with the best use of wrap arms and other temperature controls, some evidence suggests a minimum speed of 550 feet per minute to meet the temperature ranges for very lightweight board combinations. Throttling the steam supply to the "peanut" rolls (the two - eight-inch diameter pre-heater rolls integral to the singlefacer on the liner side) is also a good way to further reduce the temperature of the singleface web, as it leaves the singlefacer.

Preserving paper moisture is also critical. Moisturizing the liner using methods ranging from moisture sprays, to more expensive perforated direct-steam heating cylinders, have been tried with varying degrees of success. But, if you run the corrugator at a reduced temperature and increased speed, you can preserve the paper moisture levels that were there when the rolls were shipped. If running faster is not an option, then consider equipment modifications that allow for cooler running temperatures.

Tips for Beating the Heat

Running the corrugator cool also makes sense for energy conservation and helps side trim (less shrinkage). While the "run as cool as possible and as fast as possible" solution works, these operating practices may not be the complete answer. Unfortunately, many plants are not set up to minimize heat.

The moisture content of combined board, as it comes off the corrugator, changes very quickly. So, if plant humidity is low, as it tends to be in the cold of winter, corrugated board moisture can drop below five percent. This can lead to scoreline fractures or checking. Obviously, humidifying the plants would solve a lot of our problems, but for some, plant humidification

is not practical. The next best thing is to process combined board within eight hours of corrugating to minimize moisture loss.

Figure 1 Singleface Temperature Diagram

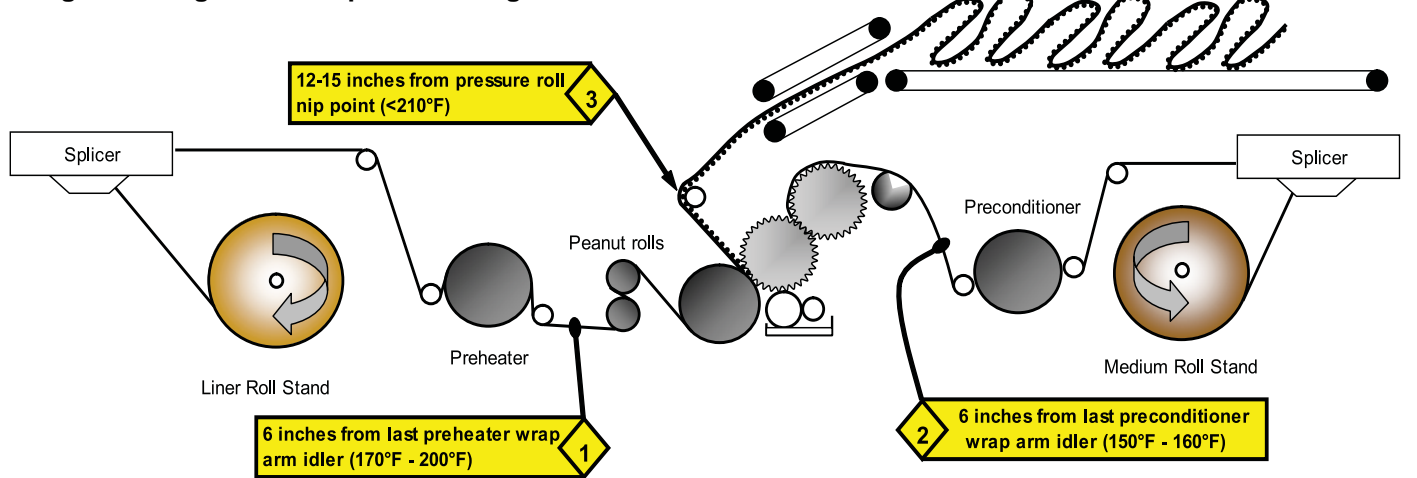
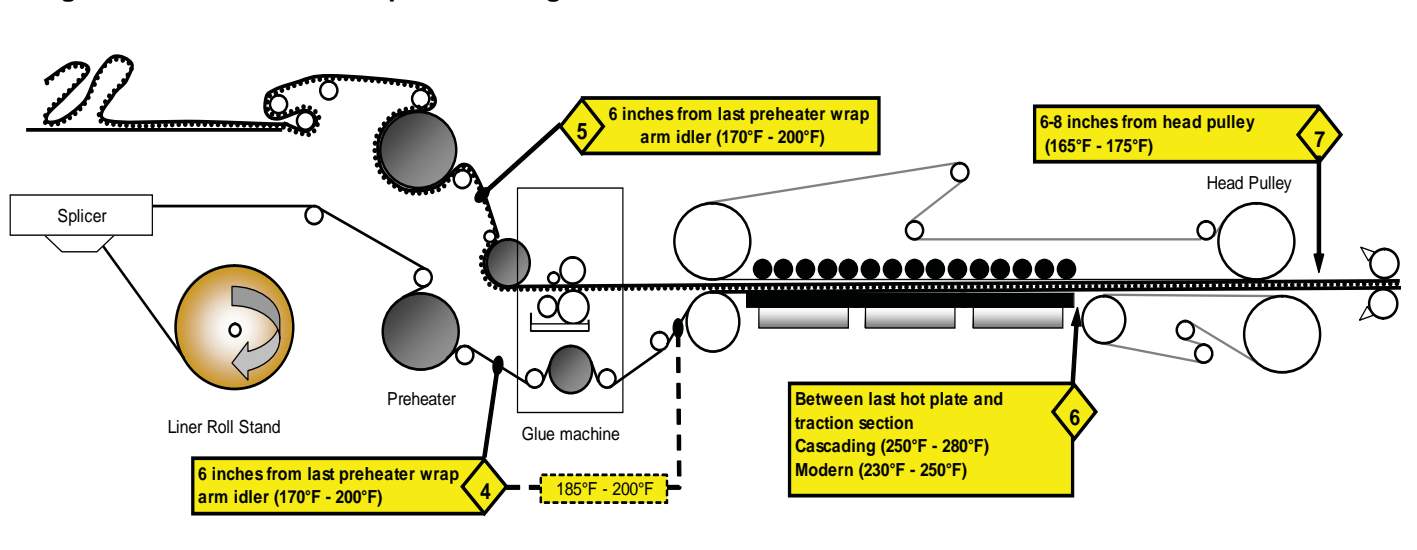


Figure 2 Doublebacker Temperature Diagram



Here are some additional heat management tips:

- Paper moisture should be uniform and above seven percent when delivered to the plant. However, not all mills can provide seven percent moisture, particularly with lightweight liners.
- If relative humidity in your plant is under 40 percent, run the board with the intent to reduce moisture loss. This can be done using steam showers on the top liner, if they are available. At the very least, reduce corrugator heat to preserve the moisture that is in the liner. Consider the wrap at the pre-heaters and at the two small pre-heater rolls at the singlefacer (peanut rolls) – steam valves can be installed to control steam (heat) to the peanut rolls and thus reduce further heating up and drying the liner.

- While minimizing the moisture loss or adding moisture, keep in mind that warping can happen if there is a moisture imbalance between the top and bottom liners. Whatever is done to the top liner should be done to the bottom liner to prevent moisture and tension imbalances.
- Maintaining board moisture levels above five percent is paramount. Seven to seven and a half percent is ideal.
- Reduce the temperature in the hot plate section to avoid overdrying the board in the corrugator dry end.

By running cooler, board moisture is preserved and more resilient to the converting operations that follow. Changes in papermaking have led to high performance and graphics-grade linerboards that react differently than standard kraft liners. Consequently, to keep waste and order returns low, better heat management is a must.

If you would like more information on heat management or other technical topics, contact your Smurfit-Stone Sales Manager or call us toll free at 1-877-785-7835, or e-mail us at paperwise@smurfit.com. You can also download and print related articles from the Paperwise Archive section of our Web site, www.scccboardsales.com.