Issue 2005 – 3

Technical Bulletin

Carbonless Papers

Printing and Handling

Carbonless papers were introduced into the marketplace in 1954. Constant improvements in design, quality, manufacturing and printing have followed since that date. Carbonless papers are designed for use in multiple part business forms so that the use of carbon paper is unnecessary. Due to convenience, cleanliness, and environmental concerns, most multiple part business forms are now printed on carbonless paper.

HOW CARBONLESS PAPERS WORK

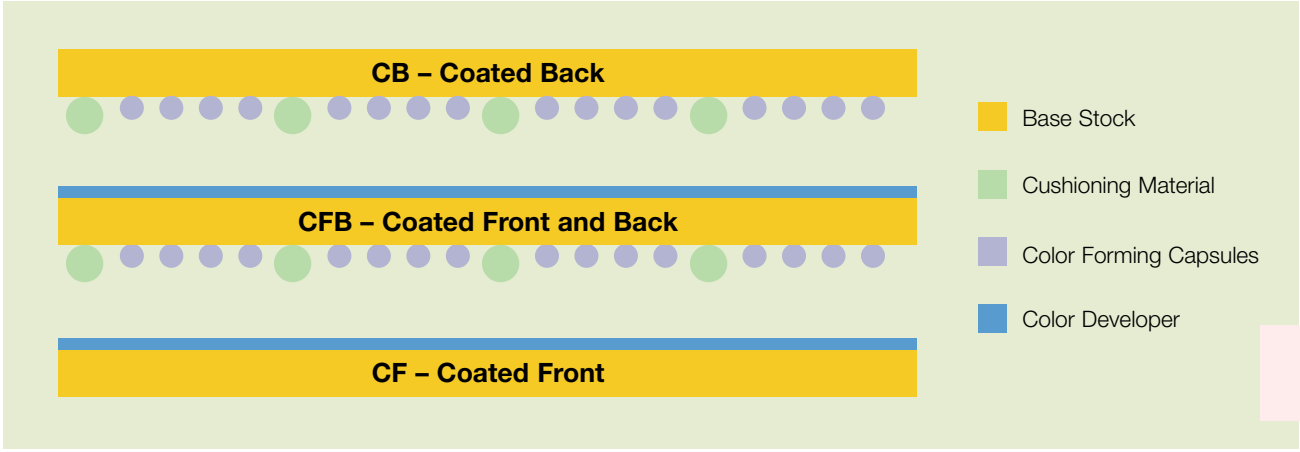
In order to understand why a certain amount of care is required to print carbonless paper, it must be understood how carbonless papers work. As a result of imaging techniques, two different types of carbonless papers have been developed and are manufactured. One type of carbonless paper is designed for use in the "mated" system, and the other is designed for use in the "self-contained" system.

The mated system **(Figure 1)** consists of a coated back (CB) paper, which contains microencapsulated colorless dyes (leuco dyes) and oils, and a coated front paper (CF). Under pressure, the capsules of the CB ply are ruptured, and the colorless dyes are released to react with the developer on the coated front (CF) paper in order to form a visible image. The mechanism for capsule rupture is best described as catastrophic release. Note, the CF sheet, coated with color developer, is not pressure-sensitive.

To make more than a two-part "mated" form, an intermediate sheet, termed CFB (coated front and back), is required. The CFB sheet combines the respective coating formulations previously described onto one sheet with microcapsules on the CB side and developer on the CF side; hence the term CFB.

Self-contained carbonless paper **(Figure 2)** has both the microencapsulated dyes and the color developer on the front of the sheet. When the capsules are ruptured, they react side by side with the developer; therefore, only one ply of carbonless paper is needed. A second version of self-contained paper is self-contained CB (SC CB). In this case, a three-part

Figure 1. Three-part mated carbonless form



form may be constructed as shown in **Figure 3** below. As one can see, the possibilities are quite numerous as to the types of form, the number of imaging plies and the type of carbonless paper used in each ply.

PRINTING CARBONLESS PAPERS

Some caution must be exercised when printing carbonless papers. This is necessary primarily because the CB, CFB and SC carbonless papers contain pressure-sensitive coatings. Although the CF coatings are not pressure-sensitive, these coatings and their color development properties must also be kept in mind during the printing operations.

GENERAL PRINTING PRACTICES

The core ingredients of the microcapsule (i.e., dyes and oil) must be contained throughout the entire printing operation. Therefore, when the capsule-coated papers (CB, CFB and SC) are being printed, printing pressures must be kept to a minimum. Too much printing pressure will rupture capsules, resulting in reduced imaging ability. Capsule damage increases with increasing back cylinder pressure in a linear fashion. It is recommended that **Glatfelter** carbonless papers be printed with a back cylinder squeeze in the range of 0.003 to 0.005 inches. **Glatfelter** carbonless paper is designed to withstand the above recommended squeeze through multiple units. Excessive squeeze through multiple units greatly increases capsule damage since capsule damage can be cumulative when units are set improperly.

BACKPRINTING PRACTICES

When backprinting carbonless paper, that is, when printing the capsule-coated surface, some additional precautions will ensure that the final job is of top quality.

Figure 2. Two-part form using self-contained carbonless paper

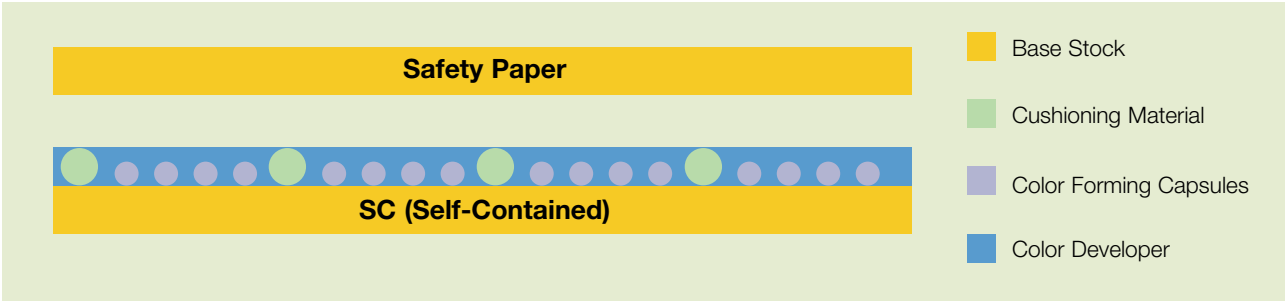
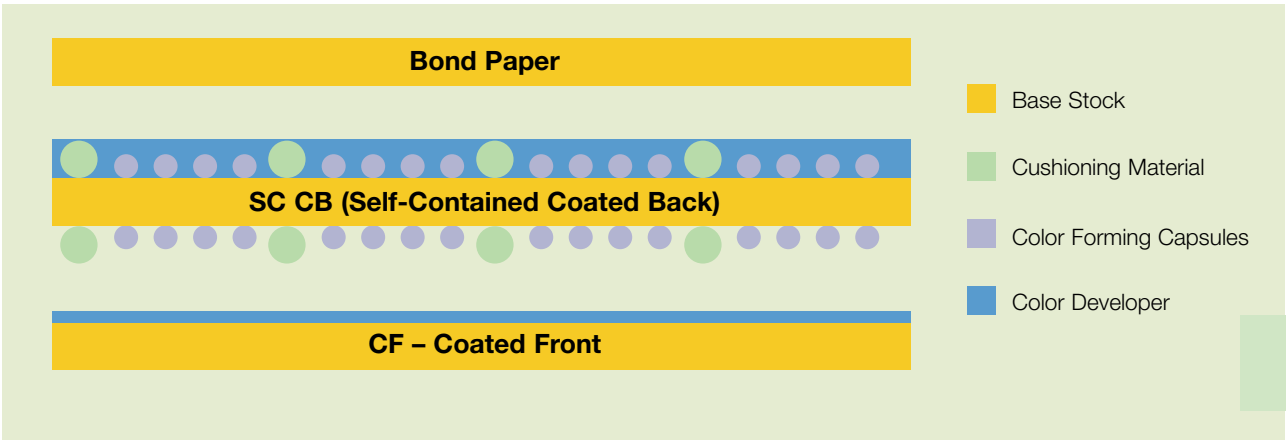


Figure 3. Three-part form using bond with SC CB and CF carbonless papers



It is recommended that all backprinted images be screened. Experience indicates that 100-133 line screen images of 50% tone value or less produce the best overall result. The reasons for taking such precautions are threefold.

First, solid ink coverage results in "show-through," which is the backprinted ink showing through to the face side of the sheet. Screening results in less ink coverage and thus less show-through.

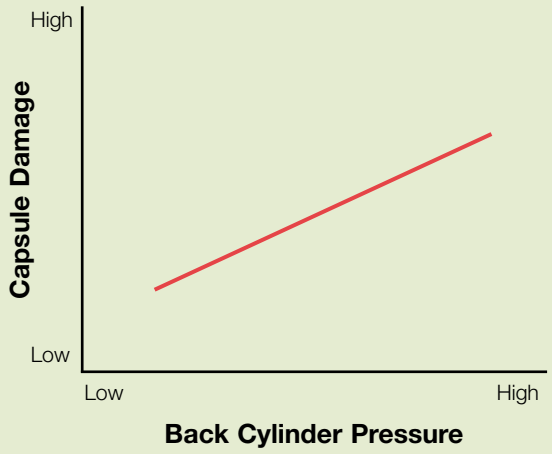
Second, offsetting of backer ink to the front side during rewinding on the press is eliminated or minimized with low ink coverage.

Third, migration of the backprinting ink through the sheet is less likely to occur since the actual volume of ink applied is greatly reduced (as compared with solid ink coverage). Migration is greatly pronounced with excessive printing pressures since released dye and oil from ruptured capsules serve as an ink vehicle.

SELF-CONTAINED PRACTICES

Printing self-contained carbonless paper requires some care as well. Fortunately, the printer has a built-in damage detection system when printing self-contained. Although the capsules and developer are in close contact with each other, the capsule wall and the binding system have been designed to withstand most carbonless handling and printing requirements. Remember that the surface usually printed is the capsule/developer surface. According to our field tests, the following items need to be considered for a successful print job:

Figure 4. Capsule damage increases as back cylinder pressure increases



1. On web equipment, maintain minimal web wrap and contact on all press rollers. Worn grater rolls (e.g., worn sandpaper covered rollers) increase surface area contact and thus the probability of damaging capsules. If a covering must be used, Velcro™ yields the best results.
2. On web equipment, maintain minimal web tension throughout the press. High web tension through process units with large amounts of web wrap can cause capsule damage. Printers with the greatest success printing self-contained have automatic tension control systems.
3. Maintain minimal printing unit pressure. Capsule rupture due to high printing pressures causes the blanket and sometimes the plate to become oil covered. If enough oil is transferred to the plate, the non-image area of the plate may become ink receptive. In addition, the blanket and plate may also turn the color of the capsule dyes. Recommended printing nip squeeze is 0.003 to 0.005 inches.

PUNCHING CARBONLESS PAPERS

Occasionally printers report that "hanging punches" are more of a problem on carbonless papers than on forms bond and ledger. Hanging punches are the holes from the marginal punch units that are not completely detached from the web. This causes the finished forms to have an unsightly appearance that in turn is perceived as an indication of poor quality by the customer or end-user. If there are enough hanging punches, they may interfere with the collation of forms or feeding of the forms through the printing device.

Carbonless papers are different from most forms papers because of their functional coatings. Due to the

ingredients in the coatings, the punch dies and perforating blades and wheels may dull more rapidly when processing carbonless paper than when processing forms bond. The printer should anticipate slightly more punch wear and plan accordingly. Conventional punch and die rings must be timed properly and be free of gear backlash for best performance. Gear backlash is the increased tolerance (play) caused by everyday wear. Dies that are worn or misaligned result in holes that are not cleanly cut. Paper punches that hang by mere fibers are the result of worn or misaligned dies. To eliminate gear backlash and timing adjustments, some manufacturers produce an improved punch and die system (such as the Meaden New Generation Tooling system or those manufactured by the David Hart Company). In the improved system, the die is gear driven (bottom driven), and the punch crown is free spinning (ball bearing); therefore, timing is not required and backlash is eliminated. The punches and dies are non-serrated and are available in two materials, one of which is tungsten carbide. Additionally, the punches can be turned end-for-end, thus doubling their lifetime. The initial cost of this system is offset by extended service life, reduced downtime, and no hanging punches.

HANDLING CARBONLESS ROLLS

The importance of roll handling cannot be overemphasized. Carbonless CF rolls require similar care as when handling forms bond. However, CB, CFB and SC rolls require special handling procedures, a few of which are outlined here:

1. Carbonless rolls should always be stored on their flat ends to prevent capsule damage that could develop if rolls were stored on their rounded face.
2. Rolls handled by clamp trucks should be clamped with minimal pressure. When handling fully wrapped rolls, Glatfelter clamp truck pres-sures are set at 600 psi gauge pressure. This translates to just enough pressure to lift a roll.
3. A medium density sponge attached to the clamp jaws serves to eliminate gouging through the protective wrapping. It also increases clamp friction for easier lifting.
4. Rolls should never be tipped on edge, rolled over hard objects, or rolled long distances without the protective wrapping.
5. Installation of a foam mat or carpet to areas of the floor under press unwind mechanisms will provide cushioned surfaces. The foam roll wrappers may also be used for this purpose.
6. Keep rolls in their moisture barrier wrappers until they are needed at press. Keep CB, CFB and SC grades in protective foam wrappers until placed on the press unwind.
7. When CFB rolls have capsule damage, the damage is readily apparent since an image is formed in the damaged area. If the capsules are damaged on a CB roll, no image will be formed; however, the damage may show up as poor image intensity on the finished forms. Equal care should be exercised when handling both CB and CFB rolls.

The economics of roll damage, especially at the outside, may be surprising. For example, one inch of paper slabbed off a 40 inch diameter roll represents 9.8% of the total weight of the paper. On the other hand, one inch of paper slabbed at the core represents a mere 1.3% of the original roll weight.

Carbonless Roll Paper Troubleshooting Chart

Carbonless Roll Paper—Troubleshooting Chart

Problem	Probable Cause
Capsule damage noted on CFB or self-contained surface before beginning presswork…	Excessive pressure has been applied to roll when moved from storage to in-feed. Roll was dropped to floor during relocation. Roll has been stored on rounded face side. Rough handling of roll from storage to in-feed. Roll has been tipped from either flat to rolling position or rolling to flat position.
Capsule damage noted on CFB or self-contained surface after printing job…	If overall damage observed except at blanket gap, excessive pressure applied at nip. If overall damage observed, too much web wrap, grater roller surface worn, tension too high. If localized or specific damage, blanket may be damaged. If smudge lines or streaks, excessive tension was applied by infeed rollers, drive mechanisms, or frozen rollers, etc.
Web breakage or other press feed difficulties…	Excessive tension has been applied by rollers, drive mechanisms, etc. Slime holes present in the paper. Roll has cracked edges or cuts due to gouges. Splices on roll are stuck.
Coating pick or tendency to stick to blanket…	Ink is excessively tacky. Blanket is too tacky.
Back printing discoloration on front side of paper…	Free oil from damaged capsules has carried ink through base stock.
Backprinting creates a dusting situation…	CB cushioning material is loosened as web travels over turn bars or frozen rollers.
Finished roll-to-sheet forms exhibit curl…	Rolls were unwrapped too long before printing, especially if shop is not climate controlled. Excessive fountain solution was applied.

Recommended Corrective or Preventive Action
Keep protective foam wrapping on roll until it is placed on press in-feed. When using clamp truck, apply the minimum pressure needed to just lift the roll. **Glatfelter** clamp pressures are set at 600 psi gauge pressure. Take care not to drop roll on floor. Store rolls on flat end, never on rounded sides. Do not roll across rough surfaces or tip on edge; place foam mat or carpet on floor at in-feed and rewind areas. Do not tip roll on ends.
Back off blanket to cylinder pressure until image breaks, then increase pressure slowly until image is satisfactory. The recommended squeeze is 0.003 to 0.005 inches. Reduce tension to the minimum amount needed to run satisfactorily through the press. Wrap grater rollers with Velcro™ if surface is worn. Replace blanket; do not increase pressure to achieve satisfactory image. While maintaining satisfactory operating levels, reduce pressure of infeed rollers on web. Make sure all rotating mechanisms are rotating at web speed.
Make sure all rotating mechanisms are moving at web speed. Collect samples to send to mill for corrective action. Take care not to bump rolls in storage or during handling to in-feed and inspect rolls before loading. Samples of stuck splice should be sent to mill for corrective action.
Use low tack inks—10 to 12 on the Thwing-Albert Inkometer (1,200 rpm at 2 minutes). Use a compressible blanket. Replace old tacky blankets.
Back off blanket to cylinder pressure until image breaks, then increase pressure slowly until image is satisfactory. Screen images that are backprinted (100-133 line screen, 50% or less tone density) to reduce the volume of ink to be carried by ruptured capsules.
Print CB surface first. Dust will then be released and will not interfere during CF or uncoated surface printing. Check for frozen or dragging rollers.
Store rolls in their protective wrappers until required at press. Allow rolls to become temperature conditioned to pressroom before use. Fountain setting should provide minimum water transfer to plate.

Carbonless Sheet Paper Troubleshooting Chart

Carbonless Sheet Paper—Troubleshooting Chart

Problem	Probable Cause
Paper curl before printing…	Paper is either absorbing moisture from pressroom atmosphere or releasing moisture to it.
Paper curl in delivery…	Ejector wheels are improperly adjusted. The paper is grain short. Excessive fountain solution has been used.
Paper tumbling on delivery…	Side guides in delivery tray are misaligned or too tight.
Paper double-feeding…	Air and vacuum settings are incorrect. Paper stack is too high. Sheet separators are worn or deformed. Stack guide pressure is insufficient on tail of sheet. Static charges are excessive.
Poor registration…	Sheet is being jogged too far. Excessive pressure is present on sheet retainers. Tail wheels are set incorrectly.
Coating picks/sheets stick to blanket…	Ink tack is excessive. Blanket is too tacky.
Capsule damage noted on CB surface…	Excessive pressure is being applied to paper.

Recommended Corrective or Preventive Action

Allow paper to become temperature conditioned to pressroom before use. Keep paper sealed in original packaging until needed at press.

Set ejector wheels and rings to compensate for curl and to allow consistent delivery and jogging.

Feed paper through press in the same direction as the grain of the sheet for best results.

Adjust fountain solution setting to provide the minimum amount of water necessary to maintain good print quality.

Use scrap paper to build up delivery stack in order to prevent lead edge of sheet from dropping too far.

Use only enough air to blow sheets up to sheet separators consistently. Optimize vacuum setting until consistent feeding is obtained. On presses equipped with multiple suckers, turn off every other sucker (keep edge suckers on).

With air blowers off, adjust stack height so paper is approximately 1/4 inch below sheet separators.

Reform separators to original shape. Check for cracks in spring separators. Separators should be adjusted out over stock to maintain consistent separation.

Adjust stack guide to maintain gentle but firm pressure against stack.

Use tinsel cord to dissipate static. Increase humidity.

Use minimum side jog (i.e., sheet should be jogged just enough to contact stationary spring guide). Edges of sheet should not turn up during jogging.

Minimum pressure should be applied with metal hold down straps or marble guides. Position these guides near the edges of the sheet to prevent edges from turning up during jogging. Check to ensure that wheels, brushes, etc., are not too tight. Careful attention to all pressures will also help to minimize capsule damage.

Tail wheel should just touch the sheet after it has come in contact with the head stop.

Use low tack inks (10 to 12 on a Thwing-Albert Inkometer).

Apply blanket powder or replace with a compressible blanket. Use blanket hardener.

Minimize all pressure points during printing. Uniform, yet minimal pressure between blanket cylinder and impression cylinder is necessary to avoid capsule damage. Worn or swollen blankets should be replaced. All delivery systems should be set so as to apply minimal pressure.