LUX in the Corrugated Post-Print Market
Executive Summary

The introduction of digital plates in the corrugated market a decade ago provided the trade shop considerable prepress workflow benefits. For trade shops that decided to have a complete digital workflow (i.e. no film negative generation), the digital corrugated plate was an excellent solution.

However, digital corrugated plates were found to cause higher levels of fluting in screens than corresponding analog plates. This print market segment, which was already challenged by quality issues due to substrate thickness variation, high volume ink metering, high impression levels, and often times antiquated printing equipment, was frustrated that digital plates had higher fluting levels than analog plates.

The reason digital plates flute more than analog plates is because of the dot shape differences between the two. Simply put, analog plate dots have a flat surface, and digital plate dots have a rounded surface. When a flat-topped dot is put under the impression required for ink coverage in corrugated, the contact surface of the dot remains constant. The rounded contact surface of the digital dot, tends to grow under impression, increasing gain. When trying to achieve even ink density on the uneven surface of a corrugated substrate, the dots printing on the top of flutes tend to be over-impressed in order for the valley of the flutes to be printed. This difference in the relative impression experienced by dots spatially near one another causes differences in gain, which are more pronounced for digital dots than for analog ones. This then causes the visual phenomenon of fluting.

LUX plates significantly reduce the fluting phenomena compared to digital plates because the LUX dot has a flat surface (a la analog), but retains both the digital platemaking process and the steep shoulders and deep reverse etch depth of digital dots. With LUX, the trade shop can benefit from the digital workflow, and the corrugated printer can minimize fluting in screens.

The LUX process has significant additional benefits that make it an attractive choice compared to other options for producing flat-topped dots on corrugated plates:

- Low capital cost, small equipment footprint
- Works with any existing digital prepress workflow
- No compressed gas required
- Works with existing exposure equipment without modification

For a trade shop or printer that has made the commitment to an all-digital workflow for corrugated plates, LUX offers improved printing compared to the classic digital plate in many situations, along with ease of installation, ease of use, and maximum leverage of existing assets.
Background

The corrugated market uses thick plates, rough and varied substrates, and large volumes of ink. The market can be broken out into 2 printing segments.

The “integrated” printers are vertically-integrated paper companies that make paper, corrugate the medium, make liner, combine the liner/medium and print/convert to make boxes for the packaging industry. These printers tend to print high volumes, have limited graphic capability and use many flexo/folder/gluer (FFG) printing equipment. Integrated printers typically don’t have fine anilox ink metering systems, and often will use .250” plates to print on a variety of liner/medium types. But even though they tend toward high volume operation, these printers are still concerned about quality and fluting has been a thorn in this market’s side for decades.

The “independent” printers (sometimes referred to as “sheet plants”) are companies who tend to have newer, higher end printing equipment, that is not necessarily tied to converting. These companies pay more attention to print quality, purchasing high quality sheets of high-grade liner and medium. These printers will often produce more point of purchase displays (POP), standees, and promotional items in corrugated than an integrated plant. This market segment tends to use thinner plates (to achieve better print quality) and have finer anilox ink metering and better printing equipment (more color stations, some servo driven presses). Like the integrated printers, the independents also suffer with fluting. This market segment competes directly with litho laminate and preprinted liner, and fluting is a defect that can cause the competitive print processes to take market share based on print quality.

What is fluting?

Print fluting in corrugated is a visible variation in print density that corresponds to the structural fluting of the corrugated board. Higher levels of print density on the top of the flutes compared with lower levels of print density in the valley of the flute make the representative screen tint to appear to have stripes in the direction of the corrugated. According to Martin Holmvall, "striping (aka “fluting”) in halftone printing, which also originates from the periodic pressure variations (in print), was found to be caused by the expansion of the halftone dots (dot gain)...". (Striping on Flexo Post-Printed Corrugated Board, 2007).
In Holmvall’s thesis, “Striping on Flexo Post-Printed Corrugated Board” (2007), he theorized that print density variations could be explained by pressure variations in the printing nip (p. 18). In corrugated printing, soft, thick plates are mounted on thick plastic materials and then onto the plate cylinder. Under these conditions, it is necessary to use high impression levels (compared to other flexo print processes) to achieve ink coverage of all copy (solids and screens or halftones). The soft plate dot thus deforms more on the surface of a flute tip (especially in coarsely fluted boards) than in the valley of the flute. When that same plate has solids on it, it needs even more impression due to the thickness loss distortion that occurs in solids, which sacrifices halftones even more.

In order to understand if a certain plate technology has an impact on fluting in screens, one must first be able to quantify fluting.
MacDermid developed a technique to measure the level of fluting based on density differences in print on corrugated board. Using an X Rite eye1 densitometer to scan density over large areas, the resulting data trace was used to calculate the difference in density from the tip of the flute to the base of the flute. This ‘peak to trough’ variation is described as the “F” Factor. A high “F” Factor (> 5) means there is heavy fluting. A low “F” Factor (< 2) means there is minimal fluting. Armed with this technique, it is now possible to quantify the amount of fluting, enabling one to concentrate on how to minimize it.

The “F” Factor calculation is determined by scanning the surface of a printed corrugated board. The densitometer measures the peak-to-valley amplitude of the density variations seen across the sample, with random variation removed by the data analysis algorithm.

In the samples below, there are two levels of fluting. The sample on the left has a high “F” Factor and the sample on the right has a low “F” factor. Visually, the samples are very different and the corresponding measurements from MacDermid’s fluting calculation quantify the difference.
What variables impact fluting?

In corrugated printing, there are numerous variables that can impact the level of fluting in screen tints or halftones. Plate-to-board impression, condition of the press, the type of liner and medium used, plate thickness, anilox line screen and volume—all of these can impact fluting. LUX plates can significantly reduce the amount of fluting in screens, but will not cure poor print conditions.

Why does a LUX dot print with less fluting?

Because the LUX dot has a flat surface and very well defined edges, it will compress differently under impression, compared to a standard digital plate. The LUX dot has a structure that, as impression is given to deliver ink to the substrate, minimizes the change in contact path at the plate-substrate. More simply put, the LUX dot does not distort as much under impression as the standard digital dot. In the examples below, you will see how the digital plate, because of the rounded surface structure of the dot, compresses more at the tip of the flute during printing than the LUX plate.

Let’s start with the plate: in this scenario, we have 2 plates made from the same material (Digital MGC). The dot sizes in the plate were the same; they were both measured as 10% by a Betaflex 335 flexo plate analyzer.

You can visually see differences between these dots. The “Standard” digital dots have a rounded surface and less non-image relief than the LUX dots. The LUX dots have a flat print surface, very sharp edges, and deep reverse etch depths. This characteristic LUX dot plate geometry-flat surface, well-defined edges, and deep reverse areas - lends itself to minimize fluting in screens.

Both these plates were put under similar impression situations on C flute corrugated board. We took photos of the plates at the tip of the flute and in the valley area. There is a discernable difference in the amount of distortion of the digital dot compared to the LUX dot, especially at the tip.
of the flute. The LUX dot does not distort as readily as the standard digital dot, so the flat print contact area of the dot remains more consistent under varying impression conditions.

Where has LUX shown a benefit in Corrugated?

The answer to that depends on the overall conditions in the pressroom. Generally speaking, LUX plates perform better with higher grades of liner and corrugated medium. However, there are many examples of LUX performing in more challenging conditions as well. The bottom line is that if a corrugated printer/converter is suffering from fluting in screens, and has good controls on press (anilox rolls are in parallel, ink viscosity and pH are controlled and the boards are not severely warped), LUX may well prove to be a benefit.

LUX has shown to have benefits over standard digital plates in print environments that have high line screen anilox rolls and run clay coated liner on a variety of flute types. In this example, the benefits of LUX were extreme. The printer used a Cuir Mark II press and printed samples on C flute with clay coated liner. The plates were .155” Digital MGC with a PVC premount package of .125”.
The samples below were printed on the same press but on recycled kraft liner. The coarser substrate clearly impacted the level of print quality, but LUX still improved fluting even this challenging printing substrate.

The following photos illustrate how LUX prints on different types of liners and flute types. These photos illustrate how LUX can perform very well in many areas of corrugated post-print, but LUX will not solve print issues surrounding warped or damaged board.
What about other flat top dot technologies?

Currently, there is only one other commercial digital flat top dot plate technology for corrugated post print applications. That technology uses nitrogen gas during the exposure process to eliminate oxygen. The resultant dot structures from nitrogen do indeed have flat tops.

There is a difference in Digital MGC made with LUX compared to the same plate type (Digital MGC) exposed in nitrogen. The geometry of the LUX dot compared to the nitrogen-produced dot is visibly different. The LUX dot has steeper shoulders and a deep reverse etch depth, compared to the same plate made under nitrogen.

When comparing the fluting performance of a LUX digital plate to that of a nitrogen-treated plate, both plate treatments printed similarly. These samples were printed on C flute on a Langston Flexo Folder Gluer (220 line anilox/4 BCM) with .125" plates mounted to PVC/Foam for a .280" undercut.
However, LUX provides the trade shop options that the nitrogen systems cannot. LUX does not require compressed gas or modifications to exposure units. LUX works with all plate types in all market segments, so it is not just beholden to the corrugated market. LUX carries very low risk to the trade shop because it is backwards compatible; not all jobs must use the LUX technology. Use it when you need it, but you retain the ability to use a standard digital plate workflow as well. Plus, the LUX lamination step is a mere 90 – 110 second operation, so there is no reduction in platemaking capacity.
Can I use my standard digital files with LUX?

No, you need to adjust the dot gain curves in order to take proper advantage of LUX. To understand why, it helps to understand how LUX works. In the LUX process, a LUX membrane material is laminated on the plate after ablation in the plate setter. The LUX membrane prevents oxygen from coming into contact with the plate during exposure, thus the plate image is 1:1 with the original file. Since there is no oxygen inhibition (dot recession) in the LUX process, the dots in a LUX plate are larger in diameter than a standard digital plate. These dots tend to print with lower mechanical gain and less fluting, therefore will print differently than a digital plate. We recommend that to start with LUX, the printer first prints a one-color linear test file from MacDermid. This file includes different screens and images to determine dot gain. Then, the printer can follow up with a verification run and live job. The dot gain compensation for LUX plates will be different than for digital, so it is not recommended to use the same digital files for live LUX jobs.

Will LUX bottleneck my workflow in platemaking?

Simply put, no. LUX does not add large expense, footprint, or time to the prepress workflow. For a full 5280 plate, the time to LUX a plate is less than 2 minutes. The graphic below is an illustration of a standard digital workflow compared to the same workflow with LUX. As you can see, LUX fits into the existing workflow without negatively impacting platemaking capacity.
Conclusion

- LUX plates can reduce fluting in the corrugated post-print market compared with standard digital plates.
- The LUX dot shape is unique, as it does not distort as readily under impression as a standard digital dot does, providing a more even print in screens.
- LUX can benefit printers in a wide variety of corrugated printing; “high end” POP display type printing, and “Mid end” Box plant type of printing.
- LUX can also benefit trade shops; it is a simple one-step process that creates flat top dots that have a unique geometry of steep shoulders, clear edge definition, and deep reverse etch depth.
- LUX does not use compressed gas or require modification to exposure units.
- LUX cannot solve issues with printing in environments with poor controls or press hygiene.

End Notes

Reference to Nitrogen plates having broad shoulders and not suitable for web flexo


"Striping on Flexo Post-Printed Corrugated Board", Martin Holmvall 2007