Shrink Sleeve Label Distortion

Dave Woods, Cal Poly San Luis Obispo

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Executive Summary

Shrink-sleeve labels represent an exciting new trend in the world of packaging and a growing opportunity for gravure printers. However, this opportunity brings with it a serious prepress challenge. As a shrink-sleeve label shrinks around a bottle, all of the graphics on the label become distorted in proportion with the bottle's dimensions. To compensate, all label graphics must be predistorted during prepress to ensure that the final label appears as the designer intended it. This paper explores the solutions available for performing shrink sleeve predistortion. Both manual and computer-automated methods of image predistortion are discussed in-depth, and the merits of both methodologies are debated.

Introduction

You're walking through your local grocery store. Your kitchen is practically bare at home, and you need to buy the usual foods—bread, cereal, meat, and some ice cream. You find the bread you want to buy, and you continue on through the store. Your next stop is the cereal aisle, but you take a wrong turn and head down the beverage aisle instead. Then, it happens. Something catches your eye. It's a new type of chilled fruit beverage that you've never heard of before. You pick it up and look at it. There is definitely something special about this product. It looks unique. It looks colorful. It looks more appetizing and thirst quenching than the other drinks on the shelf. And then, the impossible occurs. You, the person who repeatedly buys the same products at the grocery store, decide to put the beverage in your cart. You've just been seduced by the sexy allure of the shrink-sleeve label.

The preceding scenario may be an exaggeration of the selling power of the shrink-sleeve label, but it is true that products adorned with colorful shrink sleeve skins have sold very well in recent years. In fact, an unprecedented amount of new and revamped food and beverage products are being released in attractive shrink-sleeve wrappers, thus explaining the higher-than-average 7 percent per year growth projections seen in the shrink-sleeve segment of the printing industry (Gates, 2002).

According to Bob Fines of Avery Dennison Corporation, consumers are consistently looking for "new and different" products to purchase ("Substrate from the Source," 2003). To meet this desire, companies are continually trying to find new ways to differentiate their products from their competitors', and shrink-sleeve labels are a perfect means of doing so.

What Is a Shrink-Sleeve Label?

A shrink sleeve is a type of label that is printed on rolls of plastic film rather than on paper. Gravure is often utilized to print sleeves, especially if the shrink sleeve necessitates the highest quality graphics and/or very long runs. After the label is printed, it is then made into a tube by joining the two edges of the flat substrate together, thus forming a seam. Once the tube has been formed, the labels are then rolled back up and taken to the bottling conveyor belt. At this point, the roll is unwound. The tube is placed over a passing bottle, and a machine cuts through the tube leaving just one label surrounding the bottle. Finally, the bottle and surrounding sleeve pass through a heating unit that causes the label to shrink and conform to the size and shape of the bottle (Gates, 2002).

While this description sounds extremely simple, the truth is that shrink-sleeve labels pose a significant challenge for designers and prepress professionals. The reason—as the plastic film shrinks around a bottle, any text or graphics on the label will shrink pro-

portionately. Thus, a bottle that is physically large on the bottom and small near the top will force its label's graphics to adapt to those proportions, even if that is not the intended size and shape of the graphic. To account for this shrinkage, text and graphics must be predistorted in the design and prepress phase so that they appear correctly when sleeve shrinkage occurs (please see appendix A for a photograph of a label that required predistortion). This paper asks the question: what are the options available for the predistortion of shrink-sleeve graphics during prepress? This question will be answered through a combination of secondary research and elite and specialized interviews.

Methodology and Results
Manual Distortion of Images

As was mentioned previously, image distortion is the most challenging aspect of designing a shrink-sleeve label. If distortion is not accounted for during design and prepress, then the graphics on the label will appear incorrectly. To correct this problem, label designers must determine the amount of image shrinkage that will take place when the label is shrunk around the bottle and then compensate by predistorting the images in the opposite direction during the prepress stage.

Here's how it works. A designer will begin with the actual bottle and label that they will be working with. It is crucial that the designer know the label size and that they work with the actual plastic film that will be used during the press run. Otherwise, their distortion calculations will be inaccurate. Next, the designer will take a paper printout of the label graphics, lay the film over this printout, and trace around the edges of the images with a permanent marker. Then, this film tracing is shrunk around the bottle using a heat gun. Once the shrinkage is completed, the label is then cut off and laid flat by the designer. The amount of distortion is measured in millimeters to obtain precise measurements, and appropriate changes are made manually in the Illustrator or Photoshop file (Kronemann, 2003). For example, say an image shrinks by five percent in a certain area. To compensate, the designer expands this area of the original image by five percent. Thus, when the label shrinks, the image will return to its original and intended size rather than appearing too small (see Appendix B for a visual explanation of this process).

For bottles with unique curves and multiple diameters at multiple points, the process described above must be used. However, for bottles with fewer and less dramatic curves, the manual distortion process is slightly less complicated. For instance, say a beverage is packaged in a bottle that is parallel from the bottom to the middle, but then grows suddenly smaller where the neck begins. In this case, the film-tracing step can be eliminated. All that really needs to be considered is the percentage of diameter change from the thickest point to the thinnest point on the bottle's neck. If this is a 30 percent difference, then the corresponding graphics must be distorted 30 percent as well (Kronemann, 2003).

Image Distortion Software Applications

While manual distortion is by far the most popular method of image distortion for shrink sleeves, its prevalence does raise some important issues. For instance, the argument can be made that the process of determining distortion manually is time consuming. It would seem that if a more efficient means of distorting the images were available, it would save time and money in the design and prepress stage of label production. Also at issue is the accuracy of manual distortions. Because manual distortions are calculated and performed by humans, it could be surmised that manual distortions are not as mathematically and visually accurate as they could be. These issues beg the question: do software applications exist that perform shrink-sleeve distortion automatically and do so more accurately while saving time and money?

The answer to the first part of the question is simple. Yes, three software packages do exist that perform shrink-sleeve distortion automatically. They are Accuform's B-SIM, EskoGraphic's PackEdge with ShrinkSleeve module, and Artwork System's ArtPro with PowerWarp module.

Accuform's offering will be discussed first. B-SIM is a very complex application that is primarily used to design bottles that have not yet been fabricated, but will be manufactured using the extrusion blow-molding process. B-SIM can help the bottle engineer determine the exact bottle dimensions, the amount of heat present in each region of the bottle during the blow-molding process, and the exact wall thickness at each point on the bottle. These three-dimensional simulations are made possible through B-SIM's use of both the Initial Graphics Exchange Specification (IGES) and the Virtual Reality Modeling Language (VRML) 3-D modeling standards ("B-SIM," n.d.). In addition to structural functions, B-SIM can determine shrink-sleeve distortion through the use of an optional plug-in. This plug-in utilizes the 3-D models created during the development of the bottle itself to determine the amount of distortion necessary in the shrink sleeve label. Once B-SIM has calculated the distortion, a 3-D simulation of the finished label can be viewed, and the distorted label can be exported for output ("Image distortion," n.d.).

While B-SIM sounds promising (especially for structural engineers), it does have some significant disadvantages when it comes to shrink-sleeve production. For example, B-SIM will only run on the latest Windows PCs. It is not available for Mac OS X, which would hinder its integration with existing design and prepress workflows that tend to be Mac-heavy ("B-SIM," n.d.). In

addition, Accuform's Web site states that the only graphics formats that can be imported and distorted in B-SIM are Windows Bitmap (BMP) and JPEG in RGB format. No mention is made of the CMYK color model or the TIFF and EPS file formats that are standard in graphic arts workflows. Finally, Accuform states that the format used by B-SIM to export distorted graphics for print is the aforementioned IGES file format ("Image distortion," n.d.). It is doubtful that the Postscript RIPs prevalent in graphic arts production would be able to understand an IGES file, thus rendering B-SIM a completely inept software tool for automatic shrink-sleeve distortion.

While B-SIM is fundamentally flawed, EskoGraphic's PackEdge software excels at automatic shrink-sleeve distortion. On its own, PackEdge is a powerful packaging and label prepress tool, but its capabilities are enhanced when the optional Shrink-Sleeve module is installed as well. Unlike B-SIM, PackEdge with ShrinkSleeve deals entirely with graphic distortion and sheds the structural engineering features that are not needed by a design and prepress department. The process of image distortion begins by virtually recreating the bottle in PackEdge. This can be done by measuring the bottle and entering the measurements manually, or by importing a VRML model of the bottle from a CAD program (Conway, 2004). Next, graphics files are imported into PackEdge, and the image distortions are calculated. When finished, PackEdge provides the designer with a 3-D VRML representation of the bottle and finished label, as well as the files needed for the press (Western, 2003).

Perhaps the best feature of PackEdge is its use of graphic arts industry standards. For instance, PackEdge utilizes the PostScript 3 page description language. It can accept a wide variety of graphics file formats, including PostScript, PDF, and even Adobe Illustrator. To prevent issues with missing fonts, a font management tool is included. In addition, accurate color is guaranteed through the integration of ICC color profiles. When a file is ready for output, there's no need to worry—PackEdge is compatible with any PostScript RIP system ("PackEdge," n.d.). However, if a prepress shop lacks a suitable RIP, EskoGraphics offers their own RIP systems that turn PackEdge into a complete shrink-sleeve workflow (Western, 2003). Unfortunately, PackEdge does have one major flaw—like B-SIM, it only runs on Windows PCs, thus hindering its ability to integrate with most Mac-dominated prepress workflows.

The third software package capable of performing automated image distortion is Artwork System's ArtPro. This application offers a feature set that is very similar to and competitive with that of PackEdge. Also, like PackEdge, image distortion capabilities are achieved through the installation of an optional plug-in module known as "PowerWarp." However, despite their similarities, ArtPro does have one significant advantage over PackEdge—it runs on the latest version of Mac OS X (ArtPro, 2004). As a result, ArtPro with the PowerWarp module is arguably the easiest software application for prepress departments to incorporate into their existing workflows.

Clearly, a good software distortion package can be a great asset when creating a shrink-sleeve label. However, the question posed earlier must again be considered—do software solutions perform the distortions more accurately while saving time and money? Unfortunately, the answers do not bode well for image-distortion software. While software distortion definitely saves time, it does not offer a significant increase in distortion accuracy. PackEdge may be able to create distortions that are mathematically more accurate, but manual distortions are more than adequate as any slight inaccuracies due to human error would most likely be unnoticeable to the average consumer. But perhaps the most damning feature of image distortion software is the cost. While prices for Accuform's B-SIM and Artwork System's ArtPro were unavailable, Kathy Western of EskoGraphics states that a single-user license for PackEdge costs $22,500. Adding the necessary ShrinkSleeve module will cost an additional $5,000 for a total of $27,500. In addition, if an EskoGraphics RIP is needed to complete the workflow, it will cost the buyer at least $35,000 more (2003). With these numbers in mind, it becomes clear that manual image distortion is the best method for most users. Software packages would only be cost effective in prepress shops that cater to large companies with a need for long runs of shrink-sleeve labels for their best-selling products.

Shrinkage Side-Effect: Inconsistent Color

Shrink-sleeve labels are also the cause of another design and prepress problem. When a label is shrunk around a bottle, the halftone dots shrink proportionally as well. In areas on the bottle where only minor shrinkage occurs, the halftone is unaffected. However, if the bottle has a smaller neck where there is a large amount of shrinkage, the dots will shrink and clump together, thus creating a super-saturated area of color that is noticeably darker than the other areas of the bottle (Kronemann, 2003).

There are two methods of correcting this problem. First, if image distortion is being done manually, then the designer can desaturate those areas that will shrink the most by applying a gradient over these areas on the computer (Kronemann, 2003). The lighter portion of the gradient represents the area of the label that will shrink. When this shrinkage occurs, the halftone dots in the desaturated region will clump together, and the area will darken to achieve the intended color. If a software solution is being used, this desaturation is calculated automatically and applied to the digital file before output (Western, 2003). As a result of these

corrections, the final label will have accurate and consistent color in all regions (please refer to Appendix C for an illustration of the desaturation process).

Conclusions

Shrink-sleeve labels have established themselves as a compelling and popular means of packaging for a variety of food and beverage products. As more and more companies adapt shrink sleeves to their new and existing products, the demand for qualified shrink-sleeve designers and prepress specialists will grow as well. These designers must know about all the intricacies of the shrink-sleeve production process, including the unique challenges that must be overcome. Clearly, image distortion represents one of the greatest challenges when producing a shrink sleeve. Designers and prepress professionals need to be knowledgeable in both manual and automatic methods of predistortion, and they need to choose the method that is the most efficient and cost effective for their workflow. If designers and prepress specialists take these challenges to heart and do their job well, then even more shoppers will take a chance on an attractively packaged beverage when they stumble across it in the supermarket. ⚲

References

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Dave Woods' interest in the graphic arts began during high school when he took a class in Web site design. After high school, Dave began his college career at Palomar College in San Marcos, California, where he took additional Web development classes. Two years later, Dave transferred to California Polytechnic State University, San Luis Obispo, where he diversified his skill set by learning about design and production for print in the school's graphic communication department. Dave graduated from Cal Poly in December 2004. He now works at Wireless Facilities, Inc. in San Diego as the company's Web Developer & Graphic Designer.

APPENDIX A:
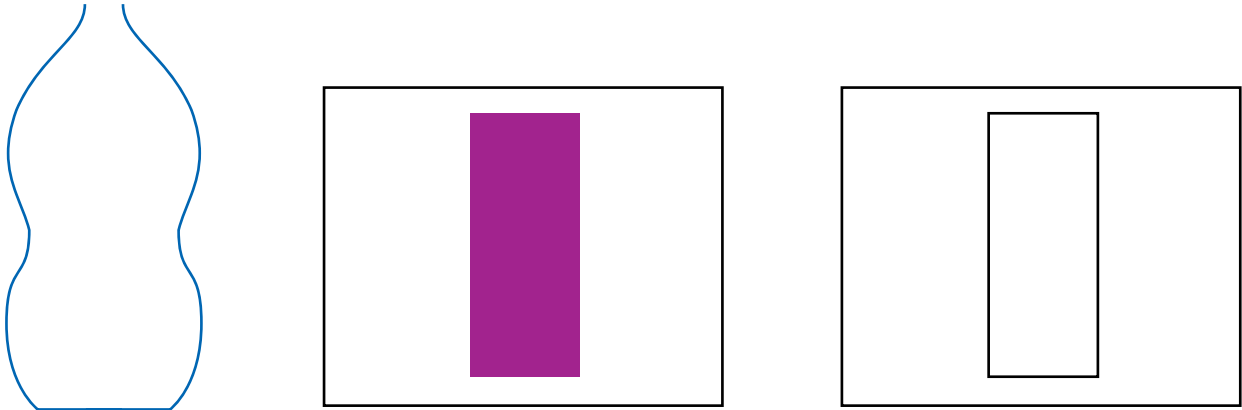### Example Label That Required Predistortion

The text highlighted above on this Guinness label is in a curved area of the bottle that would experience distortion when shrunk. Thus, the designer had to predistort the text so that it would show up correctly when printed.
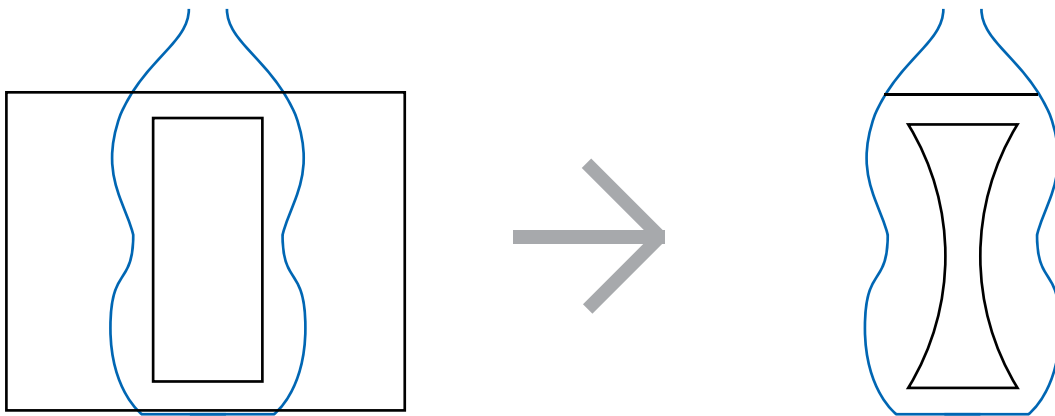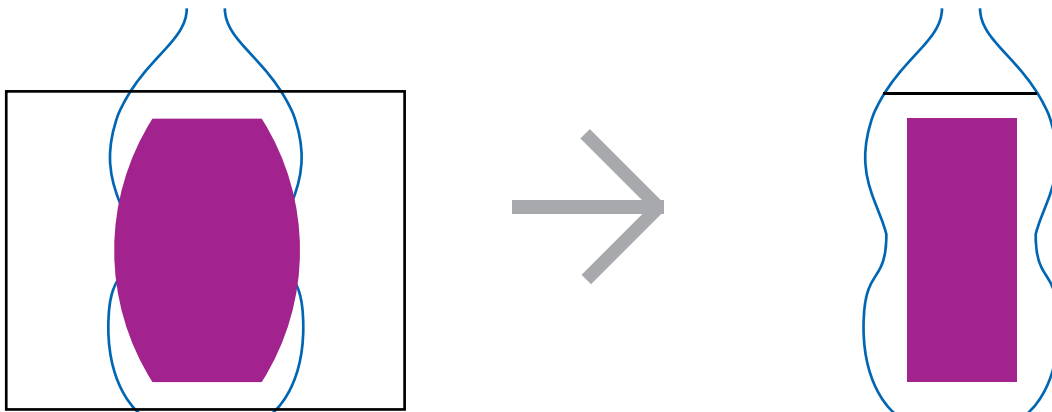
APPENDIX B:

Film Tracing Method of Manual Distortion

The designer begins with the actual bottle (left), a paper printout of the label (center), and a sample of the actual film that will be used. The designer lays the film over the printout and traces the graphic with a permanent marker (right).

The designer shrinks the tracing on the bottle with a heat gun. The label is then cut off, and the resulting distortion is observed and measured in millimeters for accuracy.

Based on the measurements, the designer distorts the graphic in the opposite direction on the computer so that when the final label is printed and shrunk around the bottle, it maintains the correct proportions.

APPENDIX C:

Color Desaturation

This label is meant to have a consistent cyan tint throughout. The illustration on the right shows how the halftone dots would look under a loop or microscope.
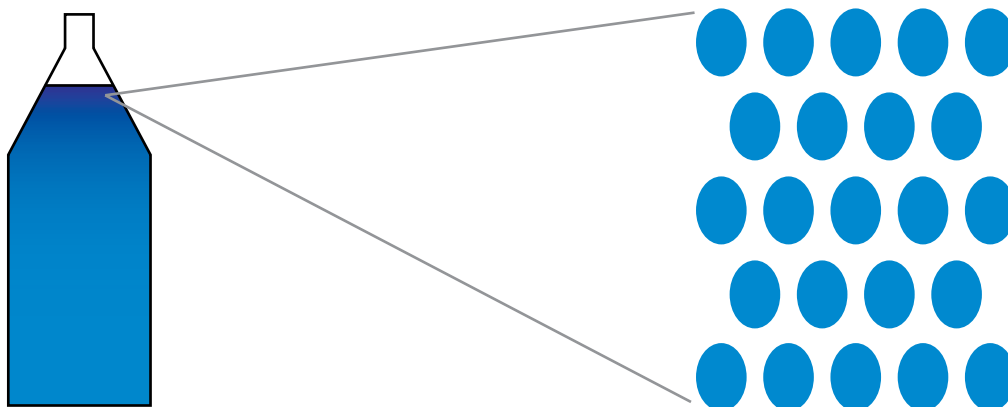
When the label is shrunk around the bottle, the dots in the area that shrinks the most (the bottle's neck) tend to clump together (shown at right) resulting in the super-saturated gradient effect in the shrunken label (shown at left).
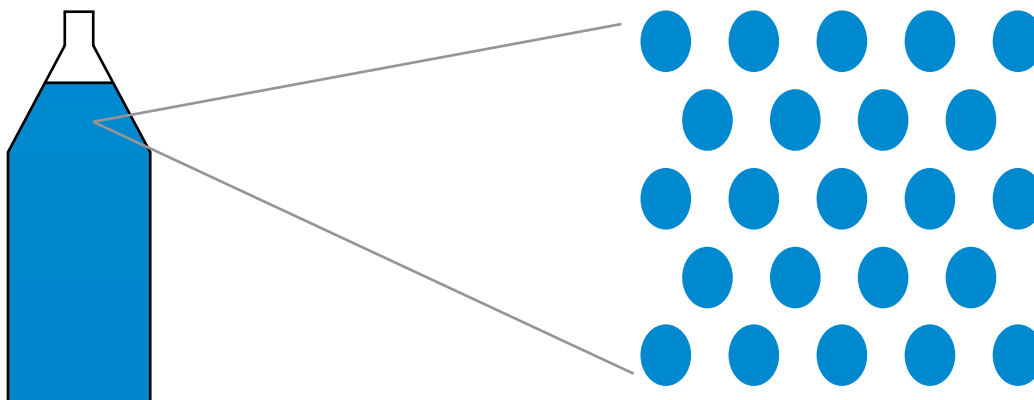
The solution is to desaturate the affected area during design and prepress so that the cyan tint remains consistent throughout when shrinkage occurs. Notice how the shrunken dots are smaller than the normal dots from the top illustration, but they are spaced farther apart, thus preventing the clumping shown in the middle illustration.