

High Fidelity (or HiFi) color has become a very hot topic recently. In short, what HiFi color supporters desire is a more vibrant and colorful print process. HiFi color may be accomplished through a variety of techniques, but two of the most commonly mentioned ones are:

- Printing with more than the typical four colors of inks
- Halftoning with a frequency modulated screening method (like Linotype-Hell's Diamond Screening®).

Still, there are many techniques that may be used to improve the look of printed material but do not require seven inks or new halftoning methods. These techniques include premium paper stocks, specialty inks, touch plates, or even varnishes. In fact, improving the appearance of a printed piece may go beyond the issue of color alone.

**The role of paper**

<sup>1</sup>Specifically, this refers to light at 457 nanometers in the blue region of the visible spectrum.

Paper plays a vital role in the appearance of a printed piece. Papers may be graded by a number of important characteristics, including weight, color, brightness, whiteness, opacity, surface texture, dimensional stability, and gloss. Of these characteristics, **brightness** is particularly important.

| Brightness      | End uses   |
|-----------------|--|
| 85 and up.....  | Annual reports, high-quality commercial printing |
| 83 to 84.9..... | Commercial printing                              |
| 79 to 82.9..... | Other commercial printing, publishing, catalogs  |
| 73 to 78.9..... | Catalogs, publishing, some magazines             |
| Below 73.....   | Newspaper inserts, coupons, catalogs, magazines  |

Source: Zanders USA

Paper manufacturers define brightness in terms of the amount of light that is reflected from a paper surface.<sup>1</sup> This reading is converted into values that normally fall between about 70 and 95, where higher values are brighter. (See chart.)

Generally, colored inks appear more brilliant on papers with higher brightness values. This makes sense when you consider that light must travel from its source, hit the paper and reflect back to the viewer's eye for there to be the perception of color. Papers that absorb some of the light, or perhaps scatter the light, leave less light to reflect back to the viewer.

For black and white images, a low brightness value compresses the tonal range that may be produced on that paper. (See Figure 1.) Similarly, a low brightness value compresses the color gamut of color images that are printed on that same stock.

Coated papers are usually brighter than uncoated papers because **coating** provides a smooth surface that is less likely to absorb or diffuse the light that hits it. In addition, inks are not absorbed as deeply into the fibers of a coated paper. This gives the inks on coated paper a glossier appearance than inks on uncoated paper. For this reason, coated papers are usually used to reproduce halftones.

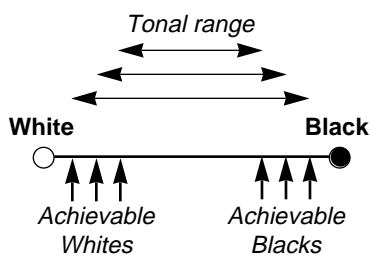


Figure 1 – Real papers and inks cannot produce a perfect white and black. This limits the tonal range that they can reproduce. Brightness provides one measure of paper white. Black is usually defined by the maximum density (or dmax) that can be printed on that paper.

While we usually think of papers in two broad categories, coated and uncoated, there are many kinds of coated paper. Paper manufacturers generally divide their coated papers into four types: matte, dull, gloss, and cast coated. Each of these terms describing the nature of the coating.

Finally, for good color reproduction it is important that the paper reflect all colors of light equally. But in some cases, blue or ultraviolet (UV) dyes may be added to make a paper appear whiter to the human eye. Unfortunately, this may cause problems with green and red image areas, and may result in less saturated colors or grayish yellows.

## Paper gloss

<sup>2</sup> The term substrate refers to anything that you can print on including paper, film, plastic, etc.

Gloss describes surface shine or luster of either a substrate<sup>2</sup> or an ink. As a paper characteristic, gloss helps light reflect back to the viewer and as a result it improves the look of most images. But gloss has its dark side as well: glare. Essentially, gloss and glare both refer to light reflecting off a surface but gloss is considered a positive attribute while glare is disturbing. Generally, gloss improves the appearance of images, but may make text harder to read. (See the section on varnishes, coatings, and laminates for more information on gloss and glare.)

## Specialty inks

<sup>3</sup> This effect is particularly noticeable under a so-called black light. Black lights, so popular in the 1960s and 70s, are fluorescent light sources that have a large ultraviolet component. In some black lights, light from the visible spectrum is filtered out as much as possible.

Some inks, primarily fluorescents and metallics, have unique characteristics that go beyond common color descriptions.

**Fluorescent inks** – Fluorescent inks produce intense, glowing, saturated colors by absorbing light, and retransmitting it in another portion of the spectrum. This boost produces unworldly, unbelievable colors.<sup>3</sup> There are two classes of fluorescents. One draws ultraviolet light (which is invisible to the human eye), and retransmits it in the visible spectrum. A different class of fluorescent colors actually draws light from within the blue portion of the visible spectrum and retransmits it as a higher wavelength of light. Both methods produce a similar fluorescent effect.

Some people have suggested using fluorescent cyans, magentas, or yellows instead of conventional CMY to take advantage of this phenomenon. Unfortunately, fluorescent inks are not as fade-resistant as other inks, and therefore the effect may not be permanent. Using a fluorescent ink as a fifth color or even as a process ink can expand the color gamut but it may do so at the expense of realism. It also raises questions about how to color separate to take advantage of the unique characteristics of fluorescent inks.

Finally, artists should be cautious about using fluorescent paints or papers for artwork that is planned for reproduction. Fluorescent colors are difficult to scan and are impossible to reproduce with CMYK inks.

**Metallic inks** – Metallic inks are shiny because of their reflectivity. In a sense, metallic inks work like mirrors. Reflections, along with the contrast between highlight and shadow, make an object glisten like a metal. While metallic inks can provide the reflectivity, the contrast must exist in the photograph for the metallic nature of the object to be reproduced. Therefore, lighting of the photograph is particularly critical.

<sup>4</sup> Warning: Not all printed pieces that contain metallic or fluorescent inks may be successfully run through a laser printer because of the heat setting process of the laser printer. Therefore, care should be taken in the use of metallic or fluorescent inks which are used on a letterhead.

Metallic inks, unlike their CMYK counterparts, are usually opaque. Metallic flakes in the ink provide reflectivity. These flakes print better on coated papers with a smooth surface.<sup>4</sup> Running a varnish over a metallic ink will dull the reflective effect. Some examples of metallic ink colors include gold, silver, bronze, copper, pewter, and rust. Pearlescent inks are similar to metallic inks in that they have a pearl-like shininess to them.

## Touch plates

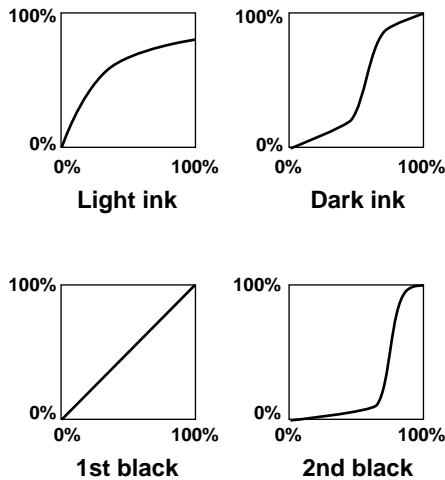


Figure 2 – Possible tone reproduction curves for a light and a dark ink duotone (top), and for a double black duotone (bottom). The horizontal axis represents input dot percent, the vertical axis represents output dot percent. These curves do not reflect dot gain or calibration adjustments.

Given the choice of printing a single additional color, printers will often choose to print a so-called touch plate. (This may also be referred to as a kiss, bump, match, or spot color plate.) Sometimes the color of a touch plate is chosen to make up for a specific lacking of the CMYK gamut that is shown off by the color content of the particular image. Often the color is a red, blue, violet, orange, or green. Touch plates produce a more brilliant color than conventional CMYK alone. Touch plates may also be used to assure color consistency for a logo, or, for particularly bright colors.

The topic of expanding the color gamut, or even just the tonal range is well illustrated by a duotone. A duotone uses two ink colors (or two passes of the same ink) to supplement the tonal range of an image. This can be done in a couple of different ways:

- By pairing a light and a dark ink, the light ink can be used primarily to represent the tonal range from highlight to midtone. The dark ink may be used to hold the tonal range from midtone to shadow. You might choose to use tone reproduction curves like the ones shown in Figure 2. Note that the light ink has its sharpest contrast (i.e., the steepest portion of the curve) below 40%, while the dark ink has its sharpest contrast above 50%.
- By running two passes of the same color ink, it is possible to extend the tonal range of the image. In a so-called double black duotone, the tone reproduction curves would be different from a light/dark ink pairing. Solid areas in a double black duotone benefit from the higher dmax and resulting extended tonal range that is achievable in two passes. However, since both inks are the same color, the second pass is used primarily to create darker blacks in 3/4 tone and shadow areas.

Touch plates usually expand the color gamut rather than the tonal range, but the principle is similar to that of double black duotones. (The touch plate would have a tone reproduction curve similar to the 2nd black ink.) Most touch plates have their greatest effect in solid and near-solid areas.

## Varnishes, coatings & laminates

<sup>5</sup> Inks rub off easily on a job that is chalking. Chalking may also be referred to as dryback.

Many designers choose to highlight a job, not with an extra color, but instead with a varnish, coating or laminate. **Varnishes** are used to give greater gloss or to improve rub resistance on printed matter. Varnishes may even save a job that is chalking.<sup>5</sup> Varnishes are generally used on items with a relatively short shelf life, such as weekly periodicals. Certain varnishes may be used to give the impression that the printed piece was printed on better quality paper. Varnishes may be glossy, matte, satin, tinted, or even pearlized. Varnishes are applied in-line on press and may be thought of as a 'clear' ink.

Varnishes may be used over the entire page, or only in certain areas (a so-called spot varnish). Sometimes, varnish is applied only to halftoned areas, because extra gloss in text areas would produce unwanted glare. Conversely, a dull varnish may be applied only to text areas to limit glare and improve readability on a glossy coated stock. Many publishers now use matte and gloss varnish on the same piece to accentuate the contrast between text and image areas (or even simply for design purposes).

Tinted varnishes may be used to combine the effect of a varnish and an extra color. For example, a tinted varnish over text areas can create the effect of a colored paper stock, while at the same time maintaining a pure paper white in halftoned areas. A tinted varnish may be used to simulate a duotone.

Specialized **coatings** are applied to items like menus, post cards, or book covers to improve durability. UV coatings are often used in this way, covering the entire sheet, although some printers do spot UV coating. Some coatings may even be applied without tying up a separate printing unit.

Coatings are often used to protect a printed piece while **laminates** physically

## Primary Uses

### **Varnish:**

- Provides rub resistance
- Often used to increase gloss or decrease glare

### **Coating:**

- Provides better surface protection than a varnish

### **Laminate:**

- More flexible than coating
- Protects against tearing
- Extremely durable

improve the strength of the piece against tearing. Laminates may also be used to improve durability. Examples of laminates include heavily-used items like travel industry books, parts catalogues, folders, and textbooks. Lamination must be done over the entire sheet; there is no spot lamination.

Your printer is in the best position to make recommendations concerning varnishes, coatings, or laminates, but here are some issues to consider:

- Normally in-line varnishes and water-based coatings are more economical than UV coating or lamination.
- Not all inks may be UV coated.
- Varnishes may require spray powder to keep sheets from sticking together. This may leave a gritty feel to the sheet. Coatings generally dry faster.
- Thermal film laminates may curl the sheet, depending on the caliper of the substrate. Thin substrates are more likely to curl.
- Generally, high solid content coatings and laminates provide better scuff resistance than varnishes.
- High gloss surfaces of any kind may accentuate fingerprints & paper flaws.

Every varnish, coating, or laminate has definable and measurable properties. The choice of which one to apply depends on the end use of the product. And this comes down to issues of gloss, added strength against tearing, durability, flexibility, and surface protection.

## Conclusion

The appearance of a document goes beyond color. Paper brightness, gloss, specialty inks, touch plates and varnishes are only a few of the most common tools for expanding the 'appearance gamut.' We often forget that viewing a book, magazine, or brochure uses all of the senses. The texture of the paper on the hands, the smell of the paper or ink, or the sound of pages turning all play a part in the experience. Compelling documents can take advantage of this, whether through texture, die cuts, holograms, perfume inserts, musical computer chips, embossing, or unusual substrates.

In a future article we will return to the issue of expanding the color gamut with five or more colors of ink. These methods require new separation techniques as well as added insight on issues like gray component replacement (GCR).

## Resources

There are two particularly good sources of information on inks and varnishes:

- **Inks** – Van Son produces a magazine called *Sign of the Windmill* which contains brief articles on many ink-related topics. For more information, call 800-826-7866, or write to Van Son at 92 Union Street, Mineola, NY 11501.
- **Varnishes** – An S.D. Warren book entitled *Varnish Techniques on Lustrous Recycled* provides examples of a wide variety of design effects for use with varnishes. For more information, call the Idea Exchange at 800-882-IDEA.

## Acknowledgements

I would like to thank the following people for their help in producing this document: Beryl Bridges of Zanders USA, Kim Crews and Paula Witt of Hunter Associates Laboratory, Bob Gradl of Laminating Arts and Finishes, Christine Leonard of Van Son Holland Ink Corporation, Ray Prince of GATF, and Charles Saleski of GTI Graphic Technologies, Inc.

**Please direct any questions or comments to:** Jim Hamilton, Marketing Department, Linotype-Hell Company, 425 Oser Avenue, Hauppauge, NY 11788 (For subscription information on the Linotype-Hell technical information series, please call 1-800-842-9721.)

October 1993, Part Number 7021

© 1993 Linotype-Hell Company. All rights reserved.

• Linotype and Hell are registered trademarks of Linotype-Hell AG and/or its subsidiaries.  
All other company and product names are trademarks or registered trademarks of their respective owners.