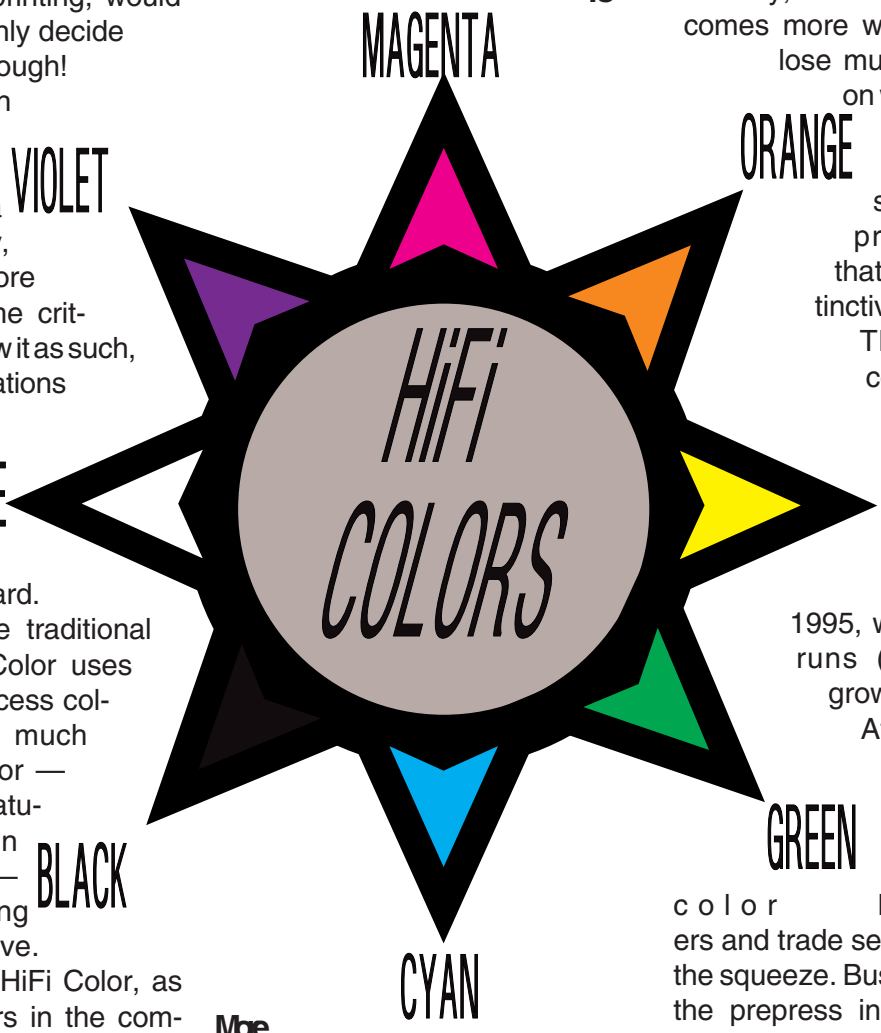
THE HI-FI COLOR PROCESS

New Process Tackles Deficiencies of Four-color

Why, just when you're getting confident in your ability to handle four-color printing, would the industry suddenly decide that it's not good enough! HiFi Color has been called a shameless attempt to set new standards, create a new level of mystery, and thus make more money! While some critics undoubtedly view it as such, there really are limitations to CMYK printing, and many of them could be overcome with the HiFi standard.

Instead of the traditional four colors, HiFi Color uses seven or more process colors to produce a much wider range of color — both in heavily saturated hues and in delicate pastels — than CMYK printing (alone) can achieve. You can now buy HiFi Color, as some major players in the computer, print materials, and prepress industries are betting that HiFi Color will snag a 15 to 20 percent share of the $150 billion worldwide color printing market by the end of the decade.

HiFi Color, is an ongoing research project now in its sixth year, and has an impressive list of supporters from the software, hardware, and materials Industries, including AM-Multigraphics, Apple Computer, Adobe Systems, DuPont, EFI, Fuji, KEPS, Pantone, Scitex, and SuperMac Technology.



Is More Necessarily Better?

So why is a seven-color process better than using four colors! The advent of technologies such as dollar-a-scan Kodak Photo CD and standardized color management systems by Apple, EFI, Eastman Kodak, and others has increasingly blurred the distinction between desktop color and high-end color.

As four-color work becomes more accessible, it is becoming a commodity business with shrinking profit margins for the printer. Similarly, as four-color work becomes more widespread, it will lose much of the impact on which advertisers depend to convey their messages. HiFi Color promises a look that's new and distinctive.

The demand for commercial, book, and office four-color printing quadrupled in 1995, with use for short runs (5,000 or less) growing even faster. At the same time, costs have plummeted.

This is good news for color buyers, but printers and trade services are feeling the squeeze. Business as usual in the prepress industry is impossible. The old printer's saw "fast, cheap, good — pick any two" will no longer apply . Customers will demand, and get, all three.

HiFi Color wasn't expected to be a mass-market technology, but it allows providers of high-end color both to differentiate themselves from the mass market and to remain competitive.

Not a New Concept

Printing with more than four colors isn't a new idea. Nineteenth-century lithographers often used 20 or more colors to create faithful reproductions of paintings, typified by the work of Currier and Ives. But creating the hand-built color separations was a craft requiring skilled artisans.

Photomechanical four-color process did for color printing what the assembly line did for automobile production: it turned a craft into an industrial process capable of supporting a mass market.

Four-color printing has improved greatly since its introduction, but the Achilles' heel of CMYK printing is its absence of pure pigments — there's always some magenta in cyan, for example. That's why a black plate is necessary in the first place.

In theory, with pure pigments we could reproduce the whole range of color using only cyan, magenta, and yellow inks. But in practice we need black to maintain neutral tones and to beef up shadow areas. The same impurities limit the range of color that CMYK can reproduce (which is a much smaller range than the human eye can perceive). It's extremely difficult to obtain the rich dark blues of a desert sky or to represent accurately all the green hues of a forest in springtime. To get both at once is virtually impossible.

To remedy these shortcomings, printers sometimes add spot colors to reproduce identity colors in line art — Camel yellow, Salem green, Ford blue, etc. To bump up the intensity of important colors in images, they use a *touch* or *bump* plate, overprinting a purer hue in critical areas of the image. Spot colors are relatively straight forward to deal with, but they increase the printing bill, because they are a manual, trial-and-error process and depend on the expertise of the printer in knowing how to increase the intensity of some colors without distorting others.

Expanding the Range of Colors

HiFi Color expands the available palette by using an expanded range of colors within an industrial process without resorting to the ad hoc methods used to produce touch plates. Most of the literature on HiFi Color tends to focus on seven-color printing, but in reality the system may use as few as six or as many as twelve colors (including CYMK.) The aim is not to run twelve-color print jobs but, rather, to provide a flexible family of process colors that can be tailored to the job at hand. Some HiFi print jobs will use only five or six colors — in effect, automating the touch plates. Few jobs need more than seven unless they include special effects such as metallics, fluorescents, and/or varnishes. These decisions will be made by printing crafts people; they aren't likely to be automated in desktop applications.

HiFi Color requires new technology

Printing presses have been capable of printing more than four colors for years. Art reproductions and security printing frequently use eight or more colors and modular presses that can be tailored to multicolor jobs are commonplace. But HiFi Color will demand new separation software, screening techniques, proofing methods, and inks — hence the necessity of wide-ranging support from a diverse group of companies.

Complex Separation Requirements

Seven-color separations require more computer horsepower than do four-color ones, but today's computers can provide sufficient power. The mathematical foundations of seven-color reproduction were laid down by German color expert Harald Kuppers, who holds several patents for seven-color reproduction.

Seven isn't just an arbitrary number. Kuppers' theory of achromatic color construction actually uses eight colors: two *achromatic* colors (black and white) plus six *chromatic* colors (cyan, magenta, yellow, orange, violet, and green). All the achromatic information (gray) is produced using black and white. The remaining colors are spread equally around the hue wheel. As a result, each picture element needs only two chromatic colors plus black. Any color in the reproducible spectrum can be achieved with only three inks, which means that with HiFi Color there are more total ink colors overall but fewer inks in any single area.

This approach is very different from the traditional four-color process, which creates most of its gray values using combinations of cyan, magenta, and yellow, with a "skeleton black" added only to stabilize neutral tones and add details in the shadow areas. An extra benefit of the multicolor process is that since each color is obtained using only two chromatic colors plus black, you need only three screen angles instead of the

four that cause such headaches in CMYK printing.

Scanning, too, will change. Today's high-end equipment scans for CMYK reproduction using built-in color computers to compress the tonal range of the image and separate it into CMYK components. With HiFi Color, scans must capture the maximum amount of detail from the image and deal less with tone compression and separations.

Final choice of process colors may not be made until the makeup of the entire print job has been determined. Some jobs may need a set of cyan, magenta, yellow, red, blue, green, and black process colors, while others may need orange, green, and violet as the extra process colors.

One of the goals of the ongoing research project is to establish color standards that will provide the most flexibility over the entire color spectrum. This research will probably result in at least twelve new process colors.

To help maximize the benefits of HiFi Color and keep separation file sizes to a minimum, the newest screening method is also employed.

Conventional halftone screens used today are comprised of variable-size but equally spaced dots. The new technique, *stochastic* screening, uses dots that are equally sized but variably spaced, much like the diffusion-dither patterns used by some low-cost color printers but at image setter resolutions.

Comparison tests using this approach have yielded promising results: the *apparent* resolution (this new way of producing halftones can't be measured in lines per inch; the *apparent* resolution is a means of comparison) is higher than that of a conventional half tone generated using the same amount of image data, and moiré is eliminated entirely.

Stochastic screening has also proven to be an exceptional performer for traditional four-color work and is not limited to HiFi Color.

Intended as A High-End Process

HiFi Color is not cheap but may not be any more expensive than today's high end six and seven-color jobs.

For designers and artists, HiFi Color offers more opportunities than challenges. Improved color management systems will make it possible to work in whichever color space is most comfortable (including RGB), without worrying about the intricacies of achromatic color construction.

HiFi Color is really not too much of a desktop issue because it occurs at the image setting and printing level. Achromatic color options have already been added to most major page layout and image processing applications. Quick adoption may be somewhat slow, however as the most effective use of the process takes entire printing signatures into account, not just individual pages or images. Most desktop operations function at the page level and are not equipped to deal with full signatures. Until true industry standards are developed (and accepted), for many jobs, the ink choices will be a decision left solely to the printer.

HiFi Color should produce a much closer correspondence between color on a computer monitor and color on the printed page. The process had its first public outing in the early 1990's Seybold Exposition in Boston. It showed the first real results from HiFi Color, and the technology became a commercial reality in 1995.

It is the newest imaging technique and is definitely an area for young, serious graphics and printing people to watch because it is becoming a major player in their careers and in the success of their customers.