The ABC's of Proofing

UNDERSTANDING A KEY ELEMENT OF THE PRINT PRODUCTION PROCESS

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ABC's of Proofing

Understanding a Key Element of the Print Production Process

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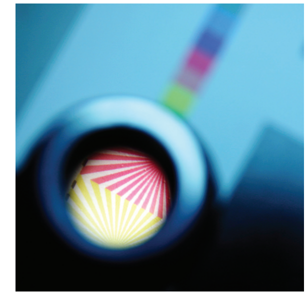
Introduction



Introduction

Like just about everything else in the fast-paced, competitive world of graphic arts, proofing is a dynamic and rapidly changing area of the business. The ABC's of Proofing is designed to provide insight into the role of proofing in the print production process. Additionally, it will act as a proofing primer for your customers and employees. It will explain the basics of proofing and share tips and hints about how to select proofing solutions that will best meet the evolving needs of your business and of your customers.

Types of Proofing

Proofing is one of the most important steps in the print production process. In the world of conventional offset printing, there were several stages to the proofing process. Today, as the workflow has gotten increasingly digital and proofing technologies have evolved, the process has gotten simpler—but no less important.

With a proof, you are presenting the customer with a prototype of the final product you are going to manufacture. That customer will expect the final product to look just like the proof. Proofing is how you communicate what you are going to produce, and how you set customer expectations. Most printers—and in fact, most buyers of print—are extremely reluctant to produce a final print project, especially one involving long runs, without a proof that has been signed off by the customer. This is primarily to ensure customer satisfaction and to avoid potential liability should there be errors in the job.

So proofing benefits both the buyer of print—to assure them that they are going to receive the product they expect to receive, and the print service provider—to ensure that any inadvertent mistakes made during the file preparation process are discovered prior to moving to production.

Typically, graphic arts workflows encompass three different proofing stages:

- Content, or Preliminary
- Position, or Page Imposition
- Contract—the final proof against which the job is produced

These days, customers tend to do most of the content proofing themselves, meaning that when materials are forwarded to the printer, the customer has already verified that the actual content of the piece is correct. That doesn't mean that there won't be changes to content as the production process moves along. Content errors can be caught at almost any time in the production process—up to the point the plate is produced, with limited cost ramifications.

In the conventional film-based production of offset printing plates, the position or page imposition proof was a "blueline"—a one-color blueish monochrome print that was output on low-quality stock and was primarily used to ensure that page imposition was correct prior to making the printing plates. Many printers today produce page imposition proofs using an inkjet printer, and this proof is used as a final check on content accuracy as well as the accuracy of the page imposition. Sometimes it is the only proof produced and it is used to check color accuracy as well, with customer sign-off reflecting the final "contract proof" stage. In other cases, there is a separate color-managed half-tone, film-based or inkjet proofing step as part of the process to acquire the final customer sign-off.

"Our EFI [digital] proofing saves a tremendous amount of time and money for packaging when it comes to the preflight process, imposition and the production of overlays or digital color keys. Before, we were making halftone film and producing analog proofs or a conventional color key – all very expensive processes. We've seen real savings in materials and time. And by eliminating film, the solutions have reduced the number of steps in our workflow, which means less equipment to run those steps."

Frank Melchione,
Vice President, Schawk, Inc.,
Stamford Division

Additionally, as monitor and remote proofing increasingly are used and as more tools are available to ensure proper color calibration of not only computer monitors but proofing systems installed in geographically disparate locations, early proofing can increasingly be accomplished electronically, or with hardcopy proofs printed at the remote location on a color calibrated printer. These developments significantly benefit all parties due to their ability to reduce cycle times and overall costs—especially costs incurred as a result of using overnight shipping or courier services to transport hardcopy proofs.

Despite the increasing quality and variety of proofs available today, it is still quite common for the print buyer to be present as the offset print run is produced for a press check—to check the press sheets against the proof as they come off the press.

In a toner-based digital printing environment, proofs are generally produced on the digital press itself, since digital presses have the ability to cost effectively produce a single copy directly from the customer's file due to minimal make-ready times. Additionally, with short runs and tight cycle times often required in a quick turn digital printing environment, soft proofs—or no proofs at all—are frequently the standard approach, especially in a situation where the buyer and the print service provider have worked together previously and have developed a comfort level and a mutually acceptable set of expectations relative to the quality of the printed output the shop can produce.

Table 1 shows the various ways these three types of proofs can be delivered and indicates the overlap that exists among the process steps and proofing methodologies.

Proof Type	Color Laser	B&W Laser	Inkjet	Halftone	PDF	Monitor
Content	■	■	■		■	■
Position	■	■	■		■	■
Contract	■		■	■		

Table 1. Proofing Methodologies

Thus, depending upon the complexity of the job and the individual customer requirements, some or all of these proofing stages—as well as the final press check—may need to be included. An effective proofing system provides the ability to generate any and all of the different types of proofs your customer relationships require.

As color calibration tools for computer monitors continue to improve and to decline in cost, and as customers become more comfortable with soft proofing, you can expect to see a migration to PDF or monitor proofs even for certain types of contract proofs, particularly in short-run, quick-turn applications where moving hardcopy proofs around compromises already tight schedules.

Proofing Basics

The purpose of a proof is to provide a reliable prediction of how the project will look in final printed form. In the past, this required specialized—and generally expensive—solutions to deliver a proof that both the printer and the customer were comfortable with prior to proceeding with a press run.

Today, as the entire print production workflow becomes more digital, so, too, has proofing. Relatively inexpensive inkjet proofing devices, combined with properly calibrated proofing software, are increasingly becoming the de facto standard for proofs at all stages of the process. By combining early-stage color-calibrated soft proofs, or monitor proofing, with later-stage imposition and contract proofs produced on digital inkjet proofing devices, the overall proofing process can be expedited.

Our primary focus will be on hardcopy proofs and the hardware, software and work processes required to make them effective. Soft proofing and monitor proofing will be addressed as appropriate.

Color Standards

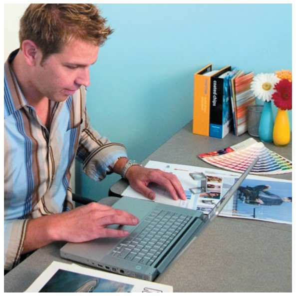
Perception of color by the human eye can be very subjective. Two individuals may see the exact same color differently, or even be unable to distinguish between two different colors. Luckily, for graphic arts practitioners, color is also scientific and colors can be exactly measured. We'll discuss that further as we talk about color management.

The organization that offers the ultimate word on color definition is the International Commission on Illumination (CIE) or *Commission Internationale de l'Eclairage.*[1] CIE is devoted to international cooperation and the exchange of information among its member countries on all matters relating to the science and art of lighting. Since its inception 90 years ago, the CIE has been accepted as the highest authority on the subject and as such is recognized by the International Standards Organization (ISO) as an international standards body. An international standard developed by CIE can be used for measurement of the attributes of any color.

[1] http://members.eunet.at/cie/

Color that is produced and/or displayed electronically can be either device-dependent or device-independent color. Device-dependent color means that when you display or print a specific color with its color definition calibrated to a specific device, you get an accurate rendering. But when you display or print the same color definition on another device, you may get another rendering that could be dramatically different. This means that a file prepared with device-dependent color destined for a specific proofing device may very likely look different when printed on another inkjet proofing device, or even on an offset press, undermining the assurance to a customer that the proof is a virtual replica of what the final output will be.

ICC Profiles create standardization across devices



With device-independent color as an input, color values are accurate across devices. However, to accomplish that accuracy, you must adjust your output device to produce the right color. This is achieved by using industry color standards as designated by standards organizations such as the International Color Consortium,[2] or ICC. The ICC is the official arbiter of color standards for the various types of output devices used in the graphic arts industry. The ICC was established in 1993 by a group of industry vendors for the purpose of creating, promoting and encouraging the standardization and evolution of an open, vendor-neutral, cross-platform color management system architecture and components. The outcome of this cooperative effort was the ICC profile specification. ICC profiles are based on scientific standards developed by CIE discussed earlier that define the parameters that can be used to describe all visible colors.

The intent of the ICC profile is to provide a cross-platform device profile format that ensures consistent, device-independent color throughout the entire production process. Device profiles can be used to translate color data created on one device into another device's native color space. The acceptance of this format by operating system and graphic application vendors allows end users to transparently move profiles and images with embedded profiles between different operating systems and applications.

It also simplifies the proofing process between designers and printers, since both are working with the same color reference. Designers can achieve accurate color matching by designing with the same color profile that will be used on press. The same is true for commercial printers that have multiple plants; they will be able to reproduce the same color quality at various locations by using well-defined ICC profiles. In other words, ICC profiles allow users to be sure that their images will retain color fidelity when moved between systems, locations and applications. ICC profiles also allow a printer manufacturer to create a single profile for multiple operating systems.

ICC profiles have also become increasingly important with the rise in popularity of digital cameras, making it easy to faithfully reproduce digital photogra-

[2] www.color.org

phy on ink jet printers and offset presses. As the range of color applications continues to expand, the vendor community is working hard to evolve ICC standards to meet the industry's dynamic needs.

It should also be noted that in designating the ICC profile for a given job, in addition to setting the device driver specifications, the ink and paper being used must also be considered. A good proofing system will supply standard profiles for all conceivable combinations, automatically loading the matching ICC profile as the user enters ink, proofing medium and print settings into the software interface.

As the graphic arts industry continues to embrace and advance standards development, a range of international printing and proofing standards are being developed that can be used independent of individual manufacturers to produce comparable results. National and international printing and proofing standards facilitate the exchange of print data and proofs. What's more, print shops can set presses to a standard and know that they will be able to work reliably with the proofs supplied by various customers or third parties. These emerging standards also include quality control specifications, and this is the wave of the future for color management.

The ICC specification is widely used and has been incorporated in many international and other *de facto* standards. More information on the International Color Consortium, and the latest news on new developments in the color management arena, can be found at the ICC's website, www.color.org.

Regional Standards

Due to the variability of inks, papers and other elements of the print production process in different parts of the world, as well as production differences between heatset web, coldset web (newspaper) and sheetfed printing, a number of regional color standards have emerged. The basic color science underlying these regional standards is based on ICC and CIE work. Graphic creation packages can be configured to produce files compliant with these specifications, depending on where the project will ultimately be produced. These standards include:

- **SWOP:** Specifications for Web Offset Printing, a North American standard largely used in the production of newspaper and magazine advertising to ensure color consistency for ads regardless of where they are printed. This is important to advertisers, who need to ensure brand integrity in their ads and other printed materials. This standard generally assumes printing on commercial grade glossy paper. (www.swop.org)
- **SWOP-Uncoated:** Designed for use with the same ink sets, but on uncoated paper.
- **SNAP:** Specifications for Non-Heatset Advertising Printing, a standard for newspaper printing using SWOP ink sets. (www.gain.net)
- **GRACoL:** General Requirements for Applications in Commercial Offset Lithography, a set of tools and standards for sheetfed and web offset developed by IDEAlliance (International Digital Enterprise Alliance). It is designed to help print buyers, designers, and print specifiers work more effectively with print suppliers. GRACol-compliant ICC profiles are rapidly becoming the standard for digital proofing in North America. SWOP and IDEAlliance have recently formed an affiliation to address the coordinated development of specifications and guidelines, certification programs, software tools, educational seminars, and peer support networks. (www.gracol.org)
- Japan's printing standard is called Japan Standard or DIC. It is characterized by different yellow tones than some of the other standards.
- In Europe, printers generally use the Eurostandard ink set. Recently, trade associations like FOGRA[3] and bvdm[4] have invested significant effort into colorimetric refinement of those standards, resulting in the Medienstandard Druck and a series of FOGRA tolerances that further clarify European color standards.

Color Space

Device-independent color definitions have three dimensions, and these dimensions make up what we call a color space:

- **Hue:** According to the American Heritage Dictionary,[5] hue refers to a particular gradation of color; a shade or tint—as in "all the hues of the rainbow."
- **Saturation:** This refers to the vividness of hue or purity of a color.
- **Brightness** (also called luminancy): This refers to the dimension of a color that can range from very dim (dark) to very bright (dazzling).

[3] www.fogra.org

[4] www.bvdm-online.de

[5] The American Heritage Dictionary of the English Language, Fourth Edition, Houghton Mifflin Company, 2000.

Conventional four-color offset printing uses four colors, Cyan, Magenta, Yellow and Black, as subtractive primary colors to create a wide range of additional colors in what is known as four-color process. These four colors, referred to as CMYK, with "K" representing black, have long been the primary color space utilized in the world of printing.

However, when an image is captured or created digitally—that is, scanned, captured with a digital camera, or created using desktop publishing software—it is more commonly represented using Red, Green and Blue (RGB), the additive primary colors that are used in displaying images on a screen.

CMYK and RGB represent two different color spaces. With the world's increasing volume of digitally captured files, most of which are in RGB format, preparing a file for print must include which color space various elements are created, and have processes in place to convert them as appropriate for the intended output device. To convert values obtained from an input device, such as RGB from a scanner or digital camera, into the device code values needed by an output (rendering) device, such as a CMYK printer, a transformation is needed to appropriately modify the data. And this is the role of the ICC profile. As input and/or output devices are added to your operation, such a transformer is required between every new pair of devices. A good proofing solution will incorporate the capability to use RGB profiles to simulate CMYK on-press color with an inkjet printer, thus ensuring a more accurate proof.

Paper and Ink

How color actually appears when produced on an offset press is affected by a number of factors, including the quality of the printing plates produced from the original file or master, the settings at the press, and the types of paper and ink that are used to produce the job and even the condition of the press itself. The press operator has significant influence on the way colors are produced in print. Factors include increasing or decreasing the amount of ink that is applied to the page, and shifting the CMYK balance—that is, increasing the amount of one or more of the primary colors independent of each other. By taking these types of actions, the press operator can "match the proof," fine-tune an offset press during print production to produce a printed sheet equivalent to the contract proof the customer has approved.

Managing these dynamics can be complex and requires the press operator to have a good knowledge of color. As presses become increasingly automated, many of the settings and adjustments required to match the proof can be incorporated into a device-specific file that is part of an automated workflow, resulting in automated production of printing plates and even press set-up. While this automation can streamline the production cycle and take some of the variability out of the process, a skilled press operator is still required to ensure that optimum quality is achieved.

An additional complication in matching final printed output to the contract proof lies in the fact that the proofing device uses different inks and may be printing on different paper than is actually used in final production at the offset press. For example, more intense colors can be produced on a high-quality coated paper than on a less expensive, uncoated paper. If a proof is produced on coated stock with the final product produced on uncoated stock, it will be difficult to obtain an accurate color match at press time.

The density with which the ink is applied to the paper can be measured with a densitometer, which allows the press operator to deliver consistency, from sheet to sheet, and even job to job, especially if a job is being reprinted.

While there are fairly consistent standards that apply to offset inks, there do not appear to be consistent standards relative to inkjet inks that are provided by different suppliers. Additionally, different types of papers can result in different ink absorption rates, which in turn causes color to vary from one type of paper to another. The print drivers—or the instructions that bridge the document creation software and the print hardware—for inkjet printers generally have an option that can be selected to specify paper type. This will reduce that variability somewhat. However, the inkjet proofing process inherently has more variability than the offset printing process and must be carefully controlled to ensure the best quality proofs that are most likely to be able to be successfully color matched at press time.

A good proofing solution will take these facts into consideration and offer ICC profiles for different combinations of printer model, paper and ink type. Additionally, some proofing solutions vendors offer their own range of papers designed to work more effectively with the proofing system's hardware and software.

All of this requires coordination between the creator of the original file and the various stages of processing as the job makes its way to final production to ensure that what is ultimately produced meets the customer's expectations.

Color Management

With all of the variability that can occur within the offset printing process, within the inkjet proofing process, and between the two, it might seem nearly impossible to generate a good proof on an inkjet device and then match it satisfactorily on an offset press. In fact, with the right processes in place, it is not so difficult. And color management is a key element of building a reliable, predictable process.

The ICC defines color management as the "communication of the associated data required for unambiguous interpretation of color content data, and application of color data conversions as required to produce the intended reproductions."[6]

The ICC further defines a color management system as: "A system that transforms data encoded for one device (such as scanner RGB) into that for another device (such as printer CMYK) in such a way that it reproduces in print the same colors as those scanned. Where exact color matching is not possible, the result should be a pleasing approximation of the original colors. In general, the term color management system is usually reserved for those systems that use the internationally accepted CIE system of color measurement as a reference."

Since the colors that result from printing a file on an inkjet proofing device and an offset press can differ based on the papers, inks and other parameters, color calibration is critical to the overall process to ensure a close match between the two processes and to deliver a proof that is as accurate a representation of the final product as possible. And as monitor proofing gains ground, monitors should be color calibrated as well, using the same ICC standards for proofing.

For inkjet technology, matching the color of another device, like a litho press, is a two-tiered process. The first step is linearization. In order to control the amount of ink that the printer puts on the paper, linearization is performed by measuring patches on a sample print, making the ink densities linear with tonal values in the file. The number of patches required to be sampled varies among the different proofing solutions on the market. When selecting a proofing solution, it is important to understand the dynamics of its linearization process in terms of the accuracy of the results and the time it takes to accomplish it. Following linearization, the characterization or "profiling" can take place, being accomplished using color measurement equipment (spectrophotometer) and test forms that contain several hundred color patches representing all of the mixing ratios for cyan, magenta, yellow and black. Once test forms have been printed, individual color patches are measured with a spectrophotometer and a value for each CMYK patch on the test form is derived. The process of measuring the values for CMYK mixed colors on a print results in characterization data. Characterization data is converted to ICC profiles for each device being calibrated.

[6] International Color Consortium, www.color.org

The characterization process is not limited to printing. It can also be used for the colorimetric measurement of scanners and monitors, making a complete color managed workflow possible across various devices and locations.

Furthermore, using ICC profiles that conform to the ICC specification allows profiles to be exchanged and correctly interpreted by other users. The two primary types of profiles are source (input) and destination (output) profiles, and they consist of tables of data that relate the device coordinates to those of the standard color space as defined by the ICC. A third type of profile used in a color management workflow is the simulation profile. This profile allows users to simulate various output technologies and/or devices with a single printer. For example, a digital photographer may wish to see what his or her RGB images will look like when they are printed in a magazine using a web offset press. This is called an RGB to CMYK to CMYK workflow, and is very important in a variety of production environments. Another variation allows the user to simulate the print capabilities of one CMYK printer onto another CMYK printer.

"For us it's been a set-it-and-forget-it process. Once you establish your device characteristics – those ICC profiles – there's really no management to it. The administrative overhead is next to nothing. The staff calculates and prints and in the meantime they're doing something else."

Steven Miller, Vice President,
Quality Graphics

An increasing number of software applications and workflows now have color management and default ICC profiles built in to supplement the manual test and calibration processes and to improve predictability and repeatability throughout the entire print production workflow.

To learn more about color management, visit the ICC website (www.color.org), or read one or more of the following books:

- Color Essentials: Color Quality for the Graphic Arts and Sciences, Volumes 1 and 2, Gary G. Field, 2001 and 2004, published by GAIN (www.gain.net)
- Understanding Digital Color, Phil Green, published by GAIN (www.gain.net)
- Digital Color Management, Giorgianni and Madden, Prentice Hall, 1998.
- Print Production Workflow: A Practical Guide, Chuck Gehman, NAPL (www.napl.org), 2003

Analog versus Digital Proofs

Analog, film-based proofing systems, such as DuPont Chromalin and KPG Matchprint, have long been standards in the graphic arts industry. With these systems, screened files that can ultimately be used to produce printing plates are used to produce proofs for customer approval. These analog proofs are produced from the same films that will be used to produce printing plates, thus ensuring accuracy.

This requires a several-step process as one color separation after the other is exposed and imaged by applying toner or color films to the substrate. Analog proofing systems produce an accurate depiction of the screening that will be in evidence in the final offset printed product, since the original screen dots are photographically transferred to the substrate from the film. But this accuracy comes with a steep price. Analog proofs are time-consuming to produce; even with a skilled operator, a single proof can consume as much as 30 minutes of production time. A darkroom environment is required and the consumables are expensive. Moreover, the specific hues of the cyan, magenta, yellow and black primaries in such systems are determined by the manufacturer's choice of dyes and cannot be color managed, which makes such systems inflexible relative to special printing standards. Perhaps the biggest disadvantage, though, comes with the increasing adoption of computer-to-plate and computer-to-press operations within the printing industry. With these digital processes, film and darkroom environments are no longer required. Print shop or prepress houses using these analog proofing systems must continue to support film and its associated chemicals and darkroom environment for use only in the proofing process, both of which are expensive in terms of dollars and productivity. Analog proofing devices can cost up to ten times as much as inkjet proofing devices to purchase and operate.

For those reasons and more, the industry is rapidly moving to digital proofing solutions. Digital proofing allows files to be sent directly to an inkjet or laser print device from a software proofing application without the need for film, eliminating the requirement for a darkroom environment. Additionally, digital proofing solutions feature less manual intervention and increased automation. A good digital proofing solution will incorporate sophisticated ICC-compliant color management tools, support a variety of inkjet output solutions and include ICC profiling, delivering a productive, cost effective and color-accurate workflow. Inkjet proofing can also produce two-sided proofs on a wide variety of substrates.

When we went from analog to EFI Color Proofing, our customers applauded the reduced cost (a $40 proof was now $8.) But the true blockbuster is the ICC-compatible color management that produces a perfectly accurate proof from our inkjet printer about 10 minutes after we get the file.

-Jay Goldner, CEO, The Harman Press

Continuous Tone versus Halftone Proofs

All photographs and those illustrations having a range of shades not made up of dots are referred to as continuous tone, often abbreviated as contone. Continuous tone images contain real gradients of grays or colors. A halftone image, on the other hand, is an image that has been screened and appears on film, paper, printing plate or the final printed product as a series of dots. Traditionally, in the analog world, buyers were used to a halftone proof that closely represented the final printed product, and they proofed the job by examining the image down to the dot level. But with the move to digital, a more photograph-like continuous tone proof was made possible using inkjet or even laser proofing.

While customer requirements will vary based on the individual application and customer preference, it is likely that the continuous tone proof will increasingly become the standard requested. Meanwhile, a digital proofing solution should offer both options to satisfy a wider range of customer needs.

Today's more sophisticated inkjet proofing software (such as EFI's Colorproof XF) can accept the original 1-bit TIFF files (screened and color managed) that will be used to create plates, processing those files to generate an accurate representation of the press results. This process can show potential errors such as moiré patterns that might appear in the final printing process. Using these types of systems, what is seen is more than just a color accurate proof—it is a screened proof that will be much more effective in communicating the look and feel of the final printed product, making communications between the printer and the customer much crisper.

Managing the Proofing Process

Now let's take a look at the process of generating a proof. First, keep in mind that different types of proofs may be appropriate at different parts of the job cycle, ranging from monitor and PDF proofs to a final, full-color, contone, screened or halftone proof. The actual requirements will depend upon customer preferences, total cycle time for the job, and the ultimate manufacturing process employed. For very quick turn digitally printed work, a simple PDF proof—or no proof at all—may fit the bill. For an annual report or a long-run, free-standing advertising insert, the proofing workflow may cover the entire gamut.

Regardless of the elements that are included, it is important to ensure an end-to-end color-managed workflow to the maximum extent possible in order to deliver a predictable product that will meet the customer's expectation. This means that graphic creation and page layout software and scanners used in the creation process should employ ICC profiles that ensure correct color settings in the relevant application programs as well as customized monitor profiles. For scanned images, a color-managed workflow might look something like this:

- The images in the scanning software are converted from the scanner's color space to the print color space by means of the ICC profiles.
- In Photoshop, the subsequent print is simulated for CMYK scans.
- The layout program combines graphics, images and text into a finished CMYK document.
- A proof is then generated for this document.

For an effective, end-to-end, color-managed workflow, it is important to use the same profile for offset printing over the entire workflow from scanning to image editing, layout and proof. Many practitioners are choosing to keep image data—whether from a scanner, digital camera or image creation/editing application—in its original format or a medium-neutral format to maintain maximum flexibility through the process. Typically, the RGB color space is the preferred choice here, leaving the conversion of the image, if required, until the last possible moment in the workflow. Another reason for this process is the increased need to leverage content and graphic design for multi-channel communications; if an image will be used on the Web, it will remain in RGB format; if it is to be printed, it will be converted to CMYK.

The Role of the RIP in a Proofing Solution

As we have been discussing, the purpose of a proofing solution is to reproduce the anticipated print result as accurately as possible in terms of both color and content. In a complex file destined for print production, there are a number of important elements that may need to be considered. These include device link profiles, special colors, overprinting and various PostScript and PDF constructs, such as those created by the latest generation of layout and graphics programs. These elements can create problems during the proofing process, but in many cases also affect the PostScript RIPs for filmsetters and CTP systems as well. Therefore, it is important to think about the entire production process, including how the file is processed by the RIP for the proofing system, and how best to match the results between the proof and the imagesetter or filmsetter RIP for complex PostScript and PDF. The proofing solution RIP must incorporate such capabilities as ICC-compliant color management, linearization, sophisticated printer drivers and workflow integration to deliver optimum results. It cannot operate effectively as an isolated application with proprietary tools. Rather, the RIP used with the proofing solution must easily integrate with any production environment and facilitate the exchange of proofs and color profiles among the various parties involved in the proofing process, including designers, prepress operators and printers, including compatibility with CTP workflow.

It is also important to keep in mind that graphics creation packages allow users to create files that can be very difficult to print—and that many designers have little in-depth knowledge about the offset printing process and less awareness that their design will create production issues. At a minimum, an effective proofing system must be able to accommodate these complex constructs in a manner that can closely represent the final offset printed product and widen the range of files that can be accepted into the production process.

Device Link Profiles. For those who repeatedly use the same specific configuration that includes a combination of device profiles, some proofing software has the capability of creating device link profiles. A device link profile offers a means of saving and storing a series of profiles corresponding to a specific configuration and can save time both in file preparation and in file processing.

Why would you need device link profiles? One example would be when a scanner application does not embed the source profile in the document containing the image it creates. By storing the scanner's profile, there is no need for the proofing application to query the user for the appropriate source profile each time the user wants to create a proof using the configuration involving that scanner. Perhaps a user may want to see how a scanned image will look when printed using a specific printer, or to look at many images captured on the same scanner at different times before printing the image. Because the same devices are involved in the process, the proofing application could display a list of device link profiles that the user had previously created for various configurations and allow the user to select the appropriate one for the current proofing activity.

Special colors. The ability to accurately produce special colors is an important requirement for proofing systems. A special color is sometimes called a PMS color; or a Pantone, HKS or Toyo color; or a corporate color. This color is generally printed using a special ink during the offset printing process rather than being "matched" with four-color process printing. In the proofing process, of course, special colors will often be simulated using a CMYK match. Special colors are generally stored as a separate value in the proofing system, allowing the color management system to convert them to CMYK values for the proof medium. However, if the special color is screened and/or printed over other colors in a duplex image, the color management system may not be effective since there are currently no ICC profiles available for handling composite prints of special colors with other colors. Therefore, the offset print must be simulated by means of internal, proprietary calculations performed in the proofer's RIP. Some high-end printing and packaging applications utilize additional colors to extend the color gamut—such as orange and green. This color model is known as HexaChrome. HexaChrome ICC profiles contain information about orange and green in addition to CMYK. In other cases, devices use red, green and blue as gamut extenders to enable the matching of a wider array of colors.

Overprinting. Overprinting is not a straightforward matter, either. If the proofer is controlled directly from the layout program for each color separation, individual color separations will arrive at the RIP already containing all the information required for overprinting. The RIP re-assembles the separations into a file and then uses the color management system to perform a conversion to the proof medium's color space.

If unseparated PDF data is fed into the proofer's RIP, overprinting is likely to be implemented differently by different brands of RIP. The process can also be complicated further if the proofing system correctly matches all the overprinting elements of the PDF file but overprinting is interpreted differently by the RIP for film or plate imaging. In this case, a proof may not provide an accurate preview of the subsequent print result.

PostScript and PDF in the Proofing Process

The latest generation of graphics and layout programs can generate PostScript and PDF data that are often handled differently by the RIPs of proofing systems and the RIPs for imagesetters for film and Computer to Plate. Manufacturers of application software packages, proofing systems and RIPs for filmsetters and CTP imagesetters are working to resolve these problems for users through industry standards efforts and partnerships and alliances. In selecting a proofing solution, it is important to understand how involved the manufacturer is in these efforts.

We have already made several references to Adobe's Acrobat Portable Document Format (PDF) in this publication. Adobe's intent, upon introducing PDF to the market a number of years ago, was to make it a ubiquitous file transport protocol, and that objective has surely been achieved. Thus, PDF is an ideal format for soft proofing since it can be reviewed by almost anyone, anywhere on any computer monitor. Additionally, Adobe has continued to refine the PDF specification, adding incremental capabilities to it, with the latest release, Acrobat 7.0, containing an increased level of annotation, color management and preflighting capabilities.

PDF/X is an international standard that describes the requirements that PDF files used in the prepress stage, including proofing, need to satisfy. The Ghent PDF Workgroup[7] is an international assembly of industry associations whose goal is to establish and disseminate process specifications for best practices in graphic arts workflows and has ongoing efforts to refine PDF file specifications designed to meet a wide variety of graphic arts needs, including the appropriate specifications for producing a PDF file for the following environments:

- Newspaper and magazine advertising
- Commercial sheetfed offset printing
- Commercial coldset web offset printing (newsprint), with allowance for low resolution
- Commercial heatset web offset printing

PDF/X incorporates what is known as the Output Intent. The PDF/X specification is further subdivided into PDF/X3 (dominant in Europe) and PDF/X1a (more prevalent in North America. The output intent contained in PDF/X, PDF/X3 and PDF/X1a is an item of information included in the PDF file indicating the printing color space for which the PDF file was prepared. This information can take the form of either a text file referring to a standard printing color space or it can be an ICC profile. If the ICC profile variation is used, it provides new prospects for automating the digital proofing process by automatically loading the ICC profile in the Output Intent from a PDF/X file to a hot folder workflow. This means that anyone creating a PDF/X file has precise control over how the file is proofed, including deployment in monitor and remote proofing applications.

File Formats Used in the Proofing Process

With potential differences in file process by proofing and CTP systems, deviations between the proof and the finished printing form for very complex files can be prevented by using RIPped imagesetter data to produce the proof. This method is especially helpful for environments using computer to plate, since there are no imaged films involved with computer to plate that can be checked against the proof on a light table. When transferring RIPped data from the imagesetter for film or CTP, it is possible to use the unscreened intermediate format generated by the imagesetter RIP to create a proof of the screened data.

A number of systems generate an intermediate format after RIPping where the images, text and vector graphics are available as bitmaps in various resolutions. In this format, all elements of the finished printing form have a permanent location but have not yet been screened. Also, the information for overprints or complex PostScript and PDF constructs is integrated into the intermediate format. By using this format for proofing, you can be sure that the proofer shows exactly what will appear later on the printing plate. Various manufacturers of RIPs for filmsetters and CTP systems use different intermediate formats. The best known of these are:

CT/LW or Continuous Tone and Line Work. This format is primarily used by suppliers who manufactured dedicated electronic image processing systems.

[7] www.GhentPDFWorkgroup.org

These were very expensive systems with special hardware and software for editing images, text and graphics in a single system. These systems were made less popular as desktop computers began to increase in capability. CT/LW is still used by a number of systems.

TIFF/IT. TIFF/IT is an international standard for high-resolution bitmaps that is used to describe complete or partial printing forms. TIFF/IT is of a later generation than CT/LW, and a number of imagesetter RIPs support it as an export format.

Delta lists. Delta lists are a format from Heidelberger Druckmaschinen which is supported as an export format in the popular Delta RIPs supplied by Heidelberg.

When thinking about a proofing workflow that requires the export of RIPped data from a filmsetter or imagesetter RIP, it is important to verify that an intermediate format can actually be exported from the RIP and ingested by the proofing system. It may be necessary to acquire an add-on program for the filmsetter or CTP imagesetter RIP to accomplish this function.

The intermediate formats would generally be transferred to the proofing system before files are actually screened. This means that the proof reproduces the exact color and content of the subsequent print. However, using unscreened data, it is not possible to determine whether moiré occurs between individual motifs and the screen. However, a good proofing solution will be able to pick up the individual pixels of the screened data from the filmsetter or CTP imagesetter and represent this screen accurately in the proof.

Selecting a Proofing Solution

Since proofing is critical to the overall print production process, integral to the success of the print project and the ultimate satisfaction of the buyer, carefully review your options when selecting a proofing solution. Some things to consider include:

- Select a system that offers a logical growth path as your requirements change. A good proofing solution will be scalable even to complex environments with dozens of users and multiple locations, ensuring that your investment will provide a proofing platform that can grow with your business.
- Look for a solution that has good support for industry standards, both in terms of color management as well as the import/export of various file formats.
- A digital proofing solution should be easy to operate while also offering advanced controls to advanced users. This minimizes the initial training effort without limiting the ultimate capabilities of the system.
- Make sure that the color management technology incorporated in the proofing system is state of the art and takes maximum advantage of ICC profiling.
- Since many digital proofers are six-color (hexachrome), ensure that the proofing system software provides hexachrome support, including the ability to manage the various ink channels (Light Cyan and Light Magenta as well as orange and green), maximizing the quality and minimizing the amount of ink used by the printer.
- While there are many flavors of PostScript interpreters available, you should give strong consideration to acquiring a system with a true Adobe PostScript interpreter. This will ensure that you have access to new Adobe PostScript capabilities as soon as they reach the market rather than waiting for development efforts of clone developers to catch up, an operation that is often delayed by as much as several months after an Adobe release. An Adobe PostScript interpreter ensures a solution that conforms to an indus-

try standard and that promises repeatability and consistency with other workflow components

- Proofing solutions come with a wide range of price tags. Look for an attractive entry price that will enable you to start digital proofing, but choose a scalable system to enable growth.
- It is an added benefit when the supplier of the proofing solution also provides paper and inks designed to operate with the total solution. While you should have the option to use third party inks and papers, proprietary offerings can deliver advantages in overall performance.
- Finally, when selecting a proofing solution, evaluate the learning curve, training continuum and overall ease of use of the system. Since most companies must deal with employee turnover and retraining, ease of use will pay big dividends over time.

"We needed a proofing solution that could print those 5th, 6th, even 7th colors. [EFI digital] proofing solutions are capable of printing out more than 4-color separations and they allow us to print PMS colors accurately on an inkjet device."

Frank Melchione,
Vice President, Schawk, Inc.,
Stamford Division

EFI Proofing Solutions

As a professional working in this world of digital color, you have to accept color data in a host of formats, process it, and deliver it to a variety of output devices—offset, flexo, gravure, silk screen and digital presses, wide-format ink-jet printers—located in the next room, or on the next continent. The backbone of the workflow is fast, flexible, easy-to-use, consistent digital color proofing. EFI's proofing solutions offer power, flexibility, expandability and affordability that will meet your proofing needs today and tomorrow. They include:

EFI Colorproof XF. With EFI Colorproof XF's state-of-the-art client-server architecture and modular concept, you can specify the proofing solution that's right for your business today and know that it will still be right for you tomorrow. Solutions start with the basic package of EFI Colorproof XF Server Option, EFI Colorproof Client Option and EFI Colorproof Printer Option M. By adding extra Output and Product Options, you can expand and tune the configuration.

- **Server:** The primary proofing and printing operations take place on the EFI Colorproof XF Server. Standard features include multiple file format support; Adobe CPSI interpreter for key functionality such as overprinting, in-RIP separation and font download for Japanese fonts; standards-compliance including ICC, PDF/X and JDF; ad continuous tone proofing functionality based on ICC color management; and support for multi channel and individual device link profiles.
- **Client:** The EFI Colorproof XF Client Option is the window into the EFI Colorproof XF Server, controlling its functionality. With EFI Client Option's three-tier architecture—User, Administrator and Job Monitor—you can allocate specific access and management privileges to each client workstation, enhancing flexibility and building a customized configuration.
- **Output:** EFI Colorproof XF offers three output options depending on the size of your printer – Option M (for A3/A2 printers up to 17"), Option XL (for 18"-24" printers), and Option XXL (for printers from 25" upwards).

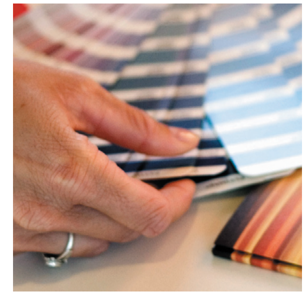
- **OneBit/Dot Creator.** Create ICC-based color-accurate contract screened proofs on a drop-on-demand (DOD) inkjet printer working with the same data that will drive the final output device. With EFI Dot Creator, you can apply screening to continuous-tone files to create the "look and feel" of offset.
- **Spot Color.** Process and output color-accurate proofs of supported file formats which include spot colors – providing a professional solution for the packaging and decorative printing markets.
- **Color Manager.** With EFI Color Manager, you can create consistent, predictable proofs optimized for the unique characteristics of the local proofing printer and the final output device or process to meet all your digital proofing and photographic needs.
- **Color Verifier.** This simple-to-use quality assurance solution measures and compares color values – from proof-to-proof, print-to-print, proof-to-profile, or print-to-reference. With EFI Color Verifier, you can ensure consistency between a reference print and subsequent prints; check that your proofs match your prints; or check that your proofs comply with a key standard such as ISO 12647.

EFI Photo Edition. EFI Photo Edition creates outstanding quality prints and proofs. In addition, EFI Photo Edition converts your camera's RGB data into a device-independent color format or into a printable data format (CMYK-TIFF). With the appropriate color profile, CMYK data can be tailor-made for a specific printing press or inkjet printer. Besides producing proofs, EFI Photo Edition enables you to produce inkjet prints from your pictures. The integrated RGB workflow guarantees the usage of the device's full color gamut and therefore provides vivid, saturated colors. EFI Photo Edition ships as a hybrid version, running on Mac OS X as well as on Windows.

EFI Designer Edition. EFI Designer Edition is an uncomplicated digital proofing solution for the creative, prepress and production stage. EFI Designer Edition turns a number of popular desktop printers into a powerful, yet cost-effective digital proofing system. The software is focused on easy and high-quality proofing with minimized setup time. The output quality relies on the same drivers and profiles included in EFI Colorproof, producing top-notch results. EFI Designer Edition ships as a hybrid version, running on Mac OS X as well as on Windows.

EFI Color Profiler. The EFI Color Profiler is an optional, client-based kit that includes the EFI Spectrometer—a fast, hand-held color measurement device. Color information can be measured using individual patches or full strips of patches. The EFI Spectrometer can also be used as a densitometer, measuring the day-to-day fluctuations of printer inks and toners. Color calibration with the EFI Spectrometer will compensate for these fluctuations. Simple and flexible, the EFI Color Profiler is based on EFI's leadership in developing digital color profiles and tools for use by the most demanding color professionals. It is a turnkey application that enables the creation of ICC profiles with CMYK digital printers (ICC profiles accurately describe the color response of printers and can be used in PCs, Macintosh systems, and EFI servers).

Glossary



GRACoL General Requirements for Applications in Commercial Offset Lithography, a set of tools and standards for sheetfed and web offset developed by IDEAlliance (International Digital Enterprise Alliance)

Hue a particular gradation of color; a shade or tint

Saturation the vividness of hue or purity of a color

Brightness the dimension of a color that can range from very dim (dark) to very bright (dazzling)

Print driver the instructions that bridge the document creation software and the print hardware

Color Management the communication of the associated data required for unambiguous interpretation of color content data, and application of color data conversions as required to produce the intended reproductions

Linearization linearization is performed by measuring patches on a sample print, making the ink densities linear with tonal values in the file

Spectrophotometer color measurement equipment

Characterization process of measuring the values for CMYK mixed colors on a print

Simulation Profile allows users to simulate various output technologies and/or devices with a single printer

Contone continuous tone, or a range of shades not made up of dots

Halftone an image that has been screened and appears on film, paper, printing plate or the final printed product as a series of dots

CTP Computer-to-Plate; generation of a printing plate directly from a digital file, eliminating the need to use film in the plate production process

Device Link Profile a means of saving and storing a series of profiles corresponding to a specific configuration

Ghent PDF Workgroup an international assembly of industry associations whose goal is to establish and disseminate process specifications for best practices in graphic arts workflows

Customer Quotes

"[In selecting a proofing solution] we considered cost, how the technology was, how open the standards were, how reliable, how accessible it was for modifications and maintenance. Vendor support was very important… From Day 1 the technical advisors for EFI Colorproof have been the most responsive vendor representatives that I've dealt with."

Andrzej Siwkiewicz, Senior Creative Operations Analyst, American Greetings

"By using EFI Colorproof and inkjet technology, the creative teams can evaluate the color almost instantly and they can expect that color to be reproduced later on the press. So we have a tremendous cost savings when consistency and quality can be maintained using these technologies – savings in equipment costs, time, labor and resources."

Andrzej Siwkiewicz, Senior Creative Operations Analyst, American Greetings

"When we went from analog to EFI Color Proofing, our customers applauded the reduced cost (a $40 proof was now $8.) But the true blockbuster is the ICC-compatible color management that produces a perfectly accurate proof from our inkjet printer about 10 minutes after we get the file."

Jay Goldner, CEO, The Harman Press

"We needed a proofing solution that could print those 5th, 6th, even 7th colors. [EFI digital] proofing solutions are capable of printing out more than 4-color separations and they allow us to print PMS colors accurately on an inkjet device."

Frank Melchione, Vice President, Schawk, Inc., Stamford Division

"Our EFI [digital] proofing saves a tremendous amount of time and money for packaging when it comes to the preflight process, imposition and the production of overlays or digital color keys. Before, we were making halftone film and producing analog proofs or a conventional color key—all very expensive processes. We've seen real savings in materials and time. And by eliminating film, the solutions have reduced the number of steps in our workflow, which means less equipment to run those steps."

Frank Melchione, Vice President, Schawk, Inc., Stamford Division

"What we discovered, more than anything else [after implementing EFI digital proofing] was greater speed to market. In a market where getting a product on the shelf one day sooner could mean savings to a client, that's very important to us."

Frank Melchione, Vice President, Schawk, Inc., Stamford Division

"Our customers spend a lot of money on advertising; they're looking for a standard of excellence. Color accuracy is essential. We were wowed by the ease of use, the low cost in supplies, just the general flexibility [of EFI digital proofing solutions]."

Paul Smith, Partner, Color Paramount, LLC

"Transferring files, RIPping them, printing them – it's all very easy. All the way through it saves time. And our material costs are about a quarter of what they were before implementing digital proofing."

Paul Smith, Partner, Color Paramount, LLC

"The previous high-end system would only take certain kinds of image files and only CMYK and we had a lot of problems with PostScript files. You had to dance this fine dance to get it to accept the files… with the Colorproof, it just sails right through."

Paul Smith, Partner, Color Paramount, LLC

"Even though we decreased the price of proofs, our margins have improved tremendously because of the lower cost of materials, equipment, reduced labor, increased speed – everything."

Paul Smith, Partner, Color Paramount, LLC

"… our fundamental problem was that we were using the wrong approach by having a million-dollar press try to match a hundred-dollar proof, rather than the other way around."

Steven Miller, Vice President, Quality Graphics

"We've cut the cost of proofing by 90 percent and we've cut a day off a typical four-day job. Today, the three people in our commercial prepress department produce twice the volume that five people produced with our old system. What portion of that would I attribute to our proofing workflow – the EFI Colorproof and inkjet solution? About 20 to 25 percent of it. And it's an enabler for all the other savings in that department."

Steven Miller, Vice President, Quality Graphics

"For us it's been a set-it-and-forget-it process. Once you establish your device characteristics – those ICC profiles – there's really no management to it. The administrative overhead is next to nothing. The staff calculates and prints and in the meantime, they're doing something else."

Steven Miller, Vice President, Quality Graphics

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