ColorSync

ColorSync
Technology Brief

The Color Management
Workflow Standard

An Industry Perspective on Color Management

This technology brief was written and illustrated by Brian P. Lawler, a consultant to the graphic arts industry.

I have been in the prepress industry for many years, and have wrestled with the difficulties of delivering customer-pleasing color for all types of printing processes.

The way my employees and I used to handle color was to work with a tightly controlled color prepress system. This meant that we almost never changed any of our procedures. Variables were introduced at our peril. As a result, we kept our fingers crossed a lot of the time—because that's the way our color was "managed." The truth is that our system managed us!

Much has changed since Apple's ColorSync 1.0 software was introduced in 1993—the PowerPC processor has made Macintosh computers many times faster, and ColorSync 2.0 (which shipped in 1995) has empowered color management to the point where software publishers have responded with some great products. The latest version of ColorSync includes better speed, better color, and more ways to use it as a scriptable application. I have had great success writing AppleScript micro-applications that convert color from scanner to monitor, or from monitor to printer CMYK. AppleScript is part of the Mac OS; it lets you control and integrate the actions of many applications. With AppleScript, you can make repetitive work into custom programs that automate and expedite workflows.

On the last few pages of this paper are diagrams of workflows that support Apple ColorSync in production. Illustrated in those diagrams are color measurement instruments, a variety of profiling software, and a selection of production tools—proofing printers, monitors, and presses. The tools that support ColorSync have grown to include almost every professional product and device in our trade.

ColorSync has received worldwide recognition within our industry. The Newspaper Association of America (NAA), Inca-FIEJ Research Association (IFRA), and Agence France-Presse have all announced support for ColorSync as the basis for training and use of color management in content creation, delivery, and production.

For the last four years I have been working with ColorSync software, spectral measurement instruments, and a variety of proofing and printing machines, and I have seen success on printing presses in a growing number of locations.

My own monitor and scanner are now calibrated and characterized, and they're impressively accurate. The color output and consistency of my scanner is stunning, and I have learned to trust the color I see on my monitor. I can make a proof on each of my printers, and know that the image I simulate is extraordinarily close to the printed product. I have these tools at my disposal now, yet I think back occasionally to the days when I made a color change with trepidation, expecting it to cause a catastrophe later.

ColorSync

The color management workflow standard

As a consultant, I have been working to guide my clients into the world of managed color, and the results are excellent. Color management is really here, and as more and more designers and printing firms adopt a color-managed process, it will become a way of doing business.

Applications such as Adobe PageMaker, Photoshop, and Illustrator; QuarkXPress; Macromedia Freehand; and Multi-Ad Creator2 all support ColorSync. Each provides a platform that can be used to succeed with managed color.

In June 1998, Microsoft shipped Windows 98, which contains ICM2, that firm's first capable color management implementation. When this was announced, I was concerned that Microsoft would try to force a new standard on the industry, but I was relieved to learn that ICM2 uses the same Color Management Module (CMM) used by default in Apple's ColorSync.

Like Apple's QuickTime, the universal standard for time-based media—audio, video, 3D, and animation—ColorSync sets a standard for managing color in cross-platform workflows.

The hundreds of thousands of designers and artists who use Macintosh computers to create artwork the world over know it's best to develop on Macintosh for cross-platform publishing. ColorSync makes their efforts more effective by adding managed color to their toolbox.

CMM—Color Management Module

ColorSync uses a default CMM developed by Apple and Linotype-Hell (now called Heidelberg Color Publishing Solutions), one of the world's leading developers of prepress technologies. The CMM represents the mathematical methods by which color conversions and modifications are made.

LinoColor supplies the default CMM to Apple, and is providing its color science to Microsoft Corporation for inclusion in some versions of the Windows operating system.

This industry standard for color management helps to ensure consistency as we move forward with advanced prepress systems.

Managed Color

Desktop publishing is the process of designing and producing professional-quality graphic arts projects using a personal computer and a variety of software applications.

The desktop publishing revolution began in 1984 with three powerful graphic arts tools—the Macintosh computer, Aldus PageMaker software, and the Apple LaserWriter printer using Adobe PostScript.

These tools were great emancipators; they freed creative professionals from the bonds of drafting tables and galleys of type, from wax and X-Acto knives.

Though it had humble beginnings, desktop publishing is a multi-billion-dollar industry today. We're proud to say that the Macintosh computer made it possible, and ColorSync makes reliable color reproduction possible.

Promised for years, color management has been touted by many manufacturers as a "push-button solution" to maintaining color accuracy in the world of computer-generated art and images.

In 1995, with ColorSync 2.0, Apple Computer delivered color management that works. ColorSync is system-level color management so effective and easy to use that today the entire industry is following with support of the Apple color management standard. ColorSync is now supported by more than 90 products that work to help you manage color.

Supplied with every copy of the Mac OS, ColorSync can help artists, designers, and prepress professionals to achieve repeatable, reliable, and consistent color on screen, in print, and for electronic delivery—in multimedia and on the World Wide Web.

Apple's ColorSync is a scientific standard for managing color on computer monitors, scanners, and a variety of output and printing devices. ColorSync provides the color management engine that can control color through device-independent mathematics to deliver managed color to the desktop.

ColorSync works at all levels of production—from the individual designer's Macintosh to the prepress house to the multimedia or web production firm to the high-quality printing firm.

The evolution of color as a commodity

In 1984, desktop publishing started a revolution in the production of artwork for printing. As creative people began adopting the Macintosh, their artistic potential blossomed. They used more images and better type fonts; they added graphics to their documents to make everyday work look dramatically better. Because quality work was achieved more easily than ever before, the business of graphic design has flourished.

Along with this growth has come an added interest in images, in illustrations, and in high-quality color. Where a document would have been typed before 1984, it was typeset on a Macintosh computer in 1985, illustrated with compelling graphics in 1986, had photos added in 1989, and was printed in beautiful color in 1991.

Color commands attention and gets better results. Color is very much a part of the fabric of commerce. Yet color alone is not satisfactory. We want quality color, color that matches the original, color that is reliable, color that is affordable. To achieve these goals, we can now turn to ColorSync, the software that makes color work for us, rather than making us work for color. With ColorSync we are able to manage color—to cause color to be a salable commodity, a product as viable as a sweater or a sports car. Color is business, and that business is now under our control.

When you add ColorSync to your production methods, you are turning the management of color into a new business opportunity. With this new business, you'll meet new customers and be able to do more work for your existing customers. Managed color helps you create work that is more profitable, more repeatable, and much easier to achieve than ever before.

Why we need color management

Mail-order firms that trade in garments and household goods report that the most common reason that a consumer returns an item is color. The customer expected the color to be different than it was when it arrived, but the catalog colors didn't match the product faithfully enough to be effective.

In a world of managed color, we can ensure that the film will be scanned accurately, the monitor will display the color correctly,* and the customers will see the color as accurately as possible.

Without a doubt, the success of any design, prepress, or printing operation is measured in productivity. The greatest concerns are reduction of waste and getting more quality work completed during the business day. When this happens, *productivity enhances profitability.*

Companies are also concerned with return on investment, as they should be. The greatest return possible from any investment in technology is to have more work get through production without difficulty. Apple's ColorSync can make this process easier. ColorSync can correct for color shifts on a scanner; adjust color to display on a monitor with greater accuracy; and make proofing, printing, and viewing color more accurate than ever before.

Companies that incorporate color management see immediate gains in productivity. Trust in the image on the monitor becomes routine in a color-managed operation.

In addition, working with color-managed proof printers and printing presses helps to build customer confidence, which results in increased business. Clearly, investing in color management is wise because it helps creative professionals and their suppliers work within the capabilities of their technology to deliver more reliable work—more quickly and easily.

Apple has led the industry revolution in color

Just as Apple led the revolution in desktop technologies, Apple is leading the way again with color management.

With more than 90 products shipping today that support ColorSync, the Macintosh platform is the only one that combines powerful computers, a successful color management system, and a wide range of third-party software. There are image manipulation programs, page layout programs, image database programs, remote viewing programs, color palette builders, monitor calibrators, profiling hardware and software, and a host of other products that are tied to ColorSync.

Apple has worked with developers the world over to get ColorSync to the level where it provides a solution to everyday color needs. And Apple was instrumental in establishing the International Color Consortium (ICC), the standards committee for color management.

Most people involved in the World Wide Web must eventually deal with the difficulties of doing business over the Internet. Called electronic commerce, the process involves selling and exchanging products and services in an all-electronic environment.

Color is just one problem facing those wishing to do business on the web, but ColorSync makes the process easier. Internet Explorer software from Microsoft Corporation supports ColorSync on Macintosh now.

Source color	Destination color
Monochrome	Monochrome
RGB	RGB
CMYK	CMYK
LAB	Hexachrome**
	Hi-Fi color†

ColorSync can support input in four color modes, and can convert that color (as appropriate) into any color space for which there is an output profile—in as many as eight colors.

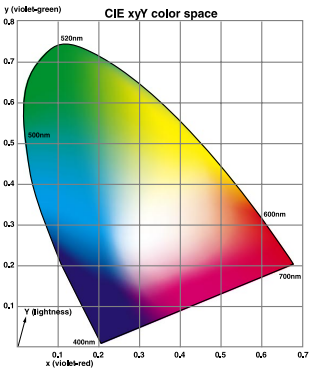
ICC—the International Color Consortium

Apple was a charter member of this consortium of software and hardware manufacturers who believe color management is critically important. The ICC has developed a standard for color management profiles, one that can work on all computers and provides the necessary elbow-room for growth.

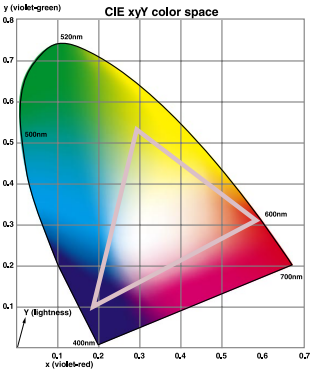
Apple's ColorSync abides by the standard, and works with all ICC profiles—the software files that describe the color capabilities of an individual device. This standard allows for the cross-platform communication of color so that when other computers add color management, these files can be exchanged freely.

*Due to their age or condition, some monitors cannot be calibrated.
**Hexachrome is Pantone's trade name for six-color printing.
†Hi-Fi color includes Hexachrome, but can include up to eight colors.

How Color Management Works



The chromaticity diagram maps the spectrum of colors visible to the average human eye. Lightness, the third dimension of the chart, is not shown.



This portion of the chromaticity diagram demonstrates the spectrum, or "gamut," of colors that can be displayed by a computer monitor. It is a significantly smaller spectrum than the visible colors of the overall chart. The outer limits of the monitor's gamut are defined by its red, green, and blue phosphors. Levels of these colors constitute the "tristimulus" values of the monitor's RGB color space.

Color management is a scientific approach to matching the color of the original (film, print, painting, digital illustration, and so on) to the colors visible on the computer monitor, then to the proof, and ultimately to the printed page.

In today's diverse multimedia world, however, the printed page may not be the ultimate destination for an image—or it may be just one of several destinations. ColorSync acknowledges the diversity of uses that an image might enjoy, and allows for the conversion from one color process to another for any publishing purpose without changing the original images.

What we see versus what we *can* see

The human eye is a very sensitive and subtle measurement device. It sees a broad range of colors in the spectrum of electromagnetic radiation that falls between infrared and ultraviolet light.

We map what the eye can see on a chromaticity diagram. Devised by the Commission Internationale de l'Eclairage (called the "C-I-E" by color scientists) in 1931, this chart (top left) shows what average humans can see.* We'll call it a spectrum for this discussion.

The charts at left show just two dimensions of that spectrum. The third dimension, lightness, projects outward toward the viewer to describe how light or dark a color is. The hue component of the diagram (points along the perimeter) is a good measure of fully saturated colors, and is an excellent method for comparing the color capabilities of various devices.

In any discussion of color management, we must address the shortcomings of devices in their ability to display or print color. These inabilities are called gamut limitations. If we superimpose a plot of the colors that can be displayed on a computer monitor over the chromaticity diagram (bottom left), we see immediately that the monitor can display only a fraction of the visible spectrum.

If we carry this further and superimpose the plot of printable colors on top of the chart, we see that the printing press does no justice to the visible spectrum, as shown in the chart on the next page.

It is the function of color management software to convert the color from a source device to a destination device with as little loss of color quality as possible, while taking into account the color capabilities of each device in the chain of processes between the original and the final product.

*Because this page is printed in CMYK, the "full" range of colors in the chromaticity diagram is much less than what the human eye can see.

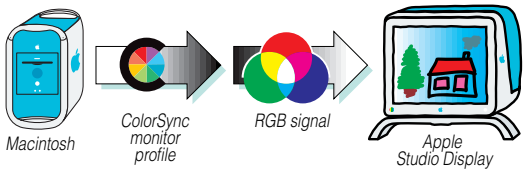
Color management means calculated color compensation

A color management system, under the best of circumstances, must compensate and arbitrate between the spectra that are possible on various devices. To do this effectively, ColorSync converts all the colors it reads into a superset of color coordinates called CIELAB, or just LAB color (see chart at right). This "device-independent" color space allows ColorSync to make calculations and conversions between devices without damaging the color values.

The LAB space can be equated to that of a master translator. It understands many languages of color. Limitations can be equated to limited vocabularies. Once in the LAB color space, a scanner's RGB data can be corrected and adjusted to account for its measured limitations, and the color of a monitor can be adjusted for consistent display. Color for any destination device can be processed as well, making the whole system work as a unified process. Only system-level color management can fulfill these complex objectives.

Monitor calibration and profiling

Monitors are red-green-blue devices that create light on the face of a picture tube. It's important to understand that the colors possible on a computer monitor are different from those printable on a printing press (see chart at right). A monitor can be calibrated, and it will display color with impressive accuracy, but it will never match the printed page perfectly because of the physics of color involved. For example, the color yellow on a monitor is made up of red and green light; the viewer perceives red and green illuminated pixels to be yellow.



The monitor profile controls the color from the Macintosh to the monitor. Called the "System Profile," it manages all color displayed on the monitor, regardless of the source application.

Monitor calibration and profiling* is done with software and an instrument, either a colorimeter or a spectrophotometer,** that attaches to the face of the picture tube. The software sends a series of colors to the screen, and the instrument reports back the value of the colors that actually arrive there. (Some monitors have an internal calibration system.)

The profiling software then builds a corrective profile that is used by ColorSync to drive the monitor. In some cases, the device is used to reset the color look-up table (CLUT) on the computer logic board or graphics card, and the corrected colors are automatically sent to the monitor.

Practical steps to improve color on the monitor

Other things can also be done to ensure quality color. Some solutions are low-tech or no-tech. When calibrating a monitor for color-managed computer processing, it's wise to eliminate as many variables from the monitor's environment as possible.

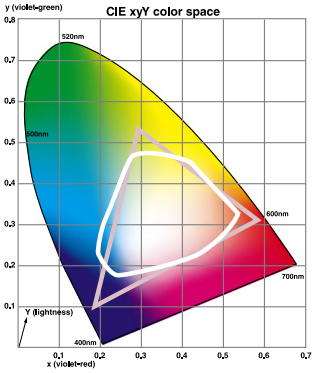
Room glare and natural reflections on the screen from windows and skylights can be as much a problem as an uncalibrated monitor. To reduce the problem of glare, construct a glare hood out of black mat board and affix it to the monitor, as shown at right.

*Profiles are the tools of ColorSync. Each device is measured, and a profile is made to describe its particular color capabilities. The profiles are then used to modify the color from that device to correct for its inherent qualities and inaccuracies.

**A spectrophotometer is an instrument that reads the spectral signature of a color. A colorimeter is a device that measures only red, green, and blue light. Several inexpensive yet highly effective instruments of this type have arrived on the publishing scene in the past few years.

Monitors work with energized phosphors that glow red, green, or blue. When red, green, and blue lights are added together, we see white light. Thus, RGB is called an "additive" color space.

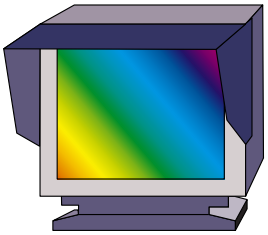
Printing devices use cyan, yellow, and magenta ink (with black serving to improve the "key," or shadow detail). When white light is reflected off white paper and passes through these inks, a portion of the spectrum is absorbed, or subtracted by the pigments, and the light viewed is the color of the pigment. Therefore, CMYK is called a "subtractive" color space.

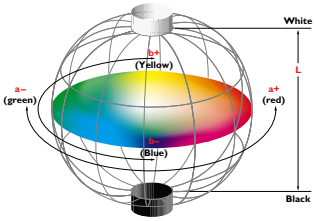


When we superimpose the chart of printable (CMYK) colors on the chart, it is evident that the printing process produces a much more limited—and slightly different—spectrum of colors than the visible or displayable.

Monitors should be calibrated on a regular basis. Once every two weeks is usually adequate.

Several Apple monitors recalibrate themselves automatically under software control. The new 21-inch Apple Studio Display and several previous models feature built-in calibration capabilities. These displays offer lifetime color accuracy and can create ColorSync profiles. ColorSync also includes a software calibration tool that allows for the visual calibration of almost any monitor.





This diagram of the LAB color space shows how the values of LAB fit into a theoretical spherical shape. The colors of the spectrum charts on the previous pages are all within the available space of the LAB system.

The benefit of LAB color is its ability to describe the color position of any color without introducing mathematical error. Conversions inside the LAB space are also mathematically efficient, which makes it possible for ColorSync to convert between color spaces more easily—and more quickly.

The term "device-independent color" describes color that has not been fixed to a particular printing or imaging technology.

Trends in imaging are encouraging us to use color modes such as LAB and scanner RGB to store our original files so that the color in those files remains independent. ColorSync can be used to convert to device-specific color spaces, maximizing quality for a given printer, display, or image recorder.

You can make the room lighting consistent by removing dimmer switches from light circuits. If possible, lighting should be very low to maintain consistency. Color experts recommend diffuse fluorescent lighting with "complete spectrum" tubes (though even these do not really have a complete spectrum). Egg-crate lighting diffusers are also nice for computer areas.

Scanner calibration and profiling

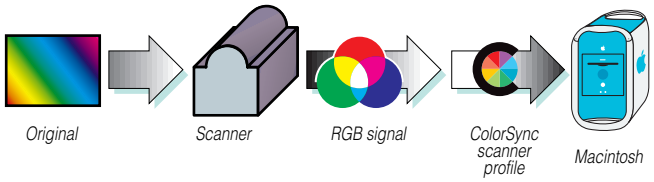
When a file is created on a scanner, ColorSync reads a profile to learn the color range captured by the calibrated device. The method for calibrating and profiling a scanner is to scan a standard color target. Known in the photographic industry as an IT-8, this analog, physical target contains 244 color patches that are "seen" by the color scanner and recorded digitally to create a file for analysis.

It's important to set all the controls of the scanner to neutral points before making this scan test. With neutral settings and consistent placement of color targets, one can return to the same starting point later to make successful scans time and time again.

Profiling software is then used to analyze the scanner test file. This software compares an IT-8 data file to the values in the scanned file and determines the characteristics of the scanner. The results help to create a scanner profile that is used for future scans to correct the color of images made on that device. The scanner profile is used as a filter through which images are passed as they enter the process of reproduction and display.

Scanning in RGB and scanning in CMYK

All scanners begin with an RGB signal.* The scanner uses unique red, green, and blue filters to make an initial "separation" of the full range of colors using these primaries.



Scanned originals can be imported through an input profile to the Macintosh. The input profile corrects for the inherent color inaccuracies of the scanner. Such input profiles can be created for scanners and for many digital cameras.

Some scanners deliver either RGB or CMYK data directly from the scanner, using the captured RGB scan information to generate a CMYK file. Many professionals feel that it is better to create the black channel, or "K" (key), in the scanner. This is especially true of high-end drum scanner operators who perceive that the resident RGB-to-CMYK algorithms are superior. These opinions are influenced by experience in using these scanners, quality expectations, personal evaluation, and choice.

The RGB gamut is typically larger than that of CMYK. More information can be translated to CIELAB (device-independent color space), so scanning to RGB is generally preferred. Once in CIELAB, images can easily be converted to other color spaces, including CMYK.

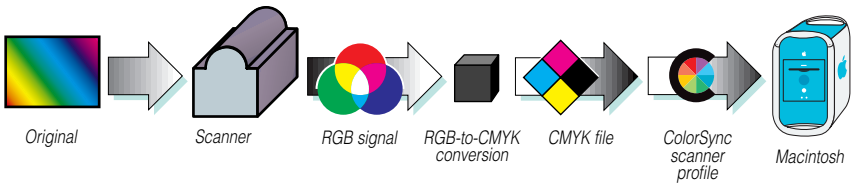
The same RGB or LAB file can then be prepared for Hi-Fi color printing in up to eight colors using another ColorSync profile.

* All scanners work with a white light source and red, green, and blue filters. The filters make the color separation photomechanically, and the resulting signals represent the red, green, and blue elements in the original. Some scanners convert electronically to CMYK as the signals pass through their circuitry.

When the customer wants to move the image to the World Wide Web for an electronic version of the printed materials, that same image can be processed through a different RGB ColorSync profile to prepare it for the World Wide Web.

CMYK files are locked in to the color gamut of the process for which they are separated. This makes the conversion to other CMYK spaces difficult or impossible, and causes the conversion back to RGB to result in a less-than-optimum image for RGB purposes. Furthermore, if under-color removal (UCR) or gray component replacement (GCR) has been applied to a CMYK image to help ensure neutral grays on press, the resulting file's color quality is compromised.

If possible, scans should be saved in the original RGB scanner file format to preserve the maximum amount of color and to ensure that the image can be used for a number of different purposes.



Some scanners convert from the RGB scan signal to CMYK on the fly, creating a color-separated file from the original image. This conversion is a less desirable approach to scanning because it makes the resulting file device-dependent, and limits the potential uses to which the image can be put.

Other reasons to scan and save in device-independent color (RGB or LAB)
Color correction and color modification are dramatically easier to accomplish in the RGB mode than in CMYK—where color gamut reduction has already taken place. Also, many of the creative tools in programs such as Adobe Photoshop and LivePicture require that the file be in RGB to work. Many of Adobe's Gallery Effects creative filters, for example, will work only on RGB files.

Another practical reason to save your files and work in RGB or LAB is that the file size of a three-channel color file is 25 percent smaller than the same image saved as CMYK.

Photoshop has a feature called CMYK Preview that allows you to preview in CMYK and still keep the file in RGB or LAB color. Adobe Photoshop 5.0 also has the ability to open and manage images using ColorSync profiles. This ability makes it possible for Photoshop to make a color separation through the Mode change function that is the same as the separation that can be made by the ColorSync plug-ins for Adobe Photoshop.*

Proofing and printing with color management
Proofing devices, printing presses, and film recorders create additional opportunities to put ColorSync to work.

The process of profiling output devices includes the creation of a target file that is appropriate to the printing process. A four-color file is made for a printing press (part of one is shown at right); an RGB file is made for a color film recorder that produces transparency film.

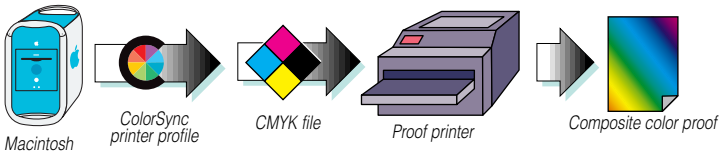
This segment of a test target shows rows of color patches measured by a spectrophotometer to make a ColorSync profile. Using the profile, ColorSync can be instructed to make a color-correct separation that takes all qualities of the device into account.

*Apple provides a set of three free plug-ins for Adobe Photoshop that handle ColorSync functions. One is a filter; the other two are Import and Export plug-ins that apply ColorSync to images as they are imported or exported. You can download the plug-ins at www.apple.com/colorsync.

The target file is printed on the device, then measured with a color spectrophotometer. After the target is printed and evaluated, the profiling software makes a ColorSync profile that describes the color capabilities of that device. This profile then becomes the output profile that adjusts the color of the file as it is printed.

Using this output profile, a proof printer can be called into action to make a proof to show the client—in advance of making film or plates—what the job will look like when printed on a printing press.

A number of digital proofing devices are becoming popular as substitutes for the conventional film-generated contact proofing materials that have been used for decades.



When proofing a job to a digital color printer, an output profile can be applied. The output profile can correct for color inaccuracies in the printer, or can be combined with a printing press profile to simulate the effect of the press on the proof printer.

The nature of imagesetting has changed dramatically since the revolution began in 1984. While all printing was done from film in that long-ago era, a good percentage of printing is now done with images exposed directly to the plate.

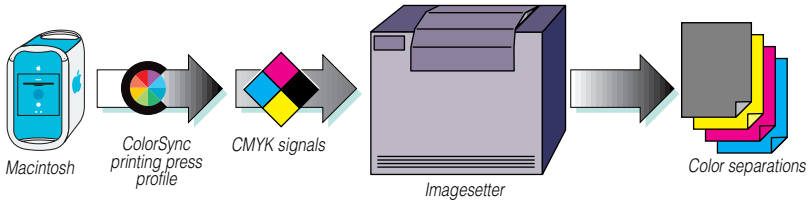
Also, direct-digital presses exist now that use no plates at all, or that expose the plates right on the press.

ColorSync is an essential component of these trends, because you can't abandon film without a precise and reliable method for managing—and proofing—color.

Dye-sublimation printers and ink-jet printers are stepping in to fill the demand for all-digital proofs for today's printing processes. These machines produce dotless color images that can simulate the press sheet quite closely (especially when controlled by a ColorSync profile), and at tremendously lower cost than conventional methods.

Some printers insist that there must be halftone dots on the proof for the press operators to accept the proof as a legitimate indication of color and quality. There is one very high-resolution printing device that delivers not only quality color but accurate screen simulations, too.*

Other devices push the boundaries even further. High-quality color printer/copiers can now be used for the production of proofs as well as short-run impressions of finished color printing.



Output of separation film on an imagesetter is made with a ColorSync profile for the printing press. For this process to be successful, the imagesetter's output must be linear, and the printing press must be able to deliver consistent results.

*The Kodak Digital Approval uses dye-sublimation technology at an impressive 1,800 pixels per inch. The machine can be connected to the same RIP that runs the imagesetter. The resulting halftone patterns are virtually identical to those on the final printed sheet.

What about dot gain?

Some people accept the idea of color management, but don't understand that color management systems make a profile of the total performance of the printing press.

Not only is the hue of the inks taken into account, but also the contamination of colors, press gains and losses, all plate gains and losses, any changes from nonlinearity of the imagesetter—the whole picture. The profile also accounts for the color of the paper on which the printing is done. Paper absorptivity is measured as part of the spectral readings of each profiling software process.

From this harvest of information about the performance of a printing press, the ColorSync profile compensates for all of these factors, to the extent that it can, while working within the gamut of the inks, the paper, and the condition of the equipment.

Publishing beyond the world of CMYK

A tremendous amount of publishing is done in media that are not printed. Publishing on the World Wide Web, as described earlier, is an option—and an opportunity—for virtually every customer. The material that is printed in a brochure will almost always end up in electronic form in today's Internet-focused economy. Microsoft Internet Explorer supports ColorSync, and other web browsers will soon display accurate color on the monitor.

Color film recorders are yet another example of a printing medium that does not use the printer's CMYK system, but uses film or photo print material. ColorSync handles output for all of these publishing methods, and will manage the color of the job according to the profiles applied to the uncorrected files.

Some designers are working on artwork that is destined for videotape. Though it is similar in color requirements to that of multimedia, video for broadcast television has a different color space and contrast quality. Again, by characterizing the specific video process, an output profile can be created that will correct the color for that process, making it as good as possible for this method of distribution.

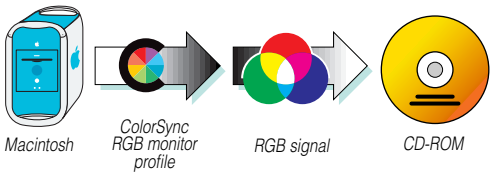
ColorSync fits the future of computer-to-plate and digital printing

As new printing processes are developed, and as the graphic arts industry moves farther away from analog film, the need for a "contract" proof that is generated for digital images and managed color is quite evident. Computer-to-plate systems and direct-digital printing systems must rely on managed color to be successful. Apple's ColorSync provides a solution to this problem—today.

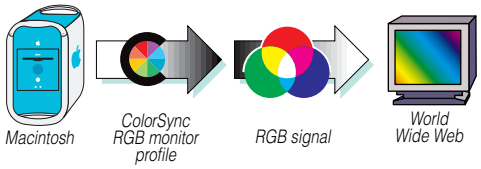
Direct-digital printing is becoming a more important market segment in the printing industry. The ability to purchase a short run of high-quality full-color printing in a matter of hours is changing the perceptions of the corporate and business printing buyer. With no time for reruns, the purchaser of direct-digital printing should invest the time and money necessary to implement a complete color-managed system for artwork creation.

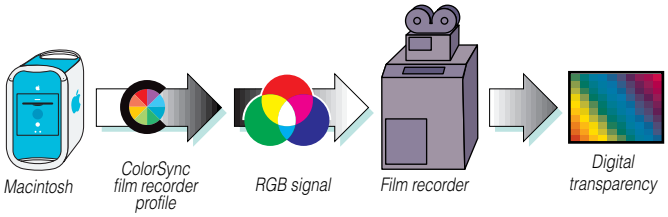
The digital printing systems on the market today are currently running with old-style color management—little or none. The operators of these impressive machines will be turning soon to Apple's ColorSync on the front end to aid in expanding this part of the printing industry.

Color for the World Wide Web and for some multimedia productions is limited to a 256-color palette (or less). Called 8-bit color (2^8 colors), the palette can cross platforms—Macintosh, UNIX, and Windows—while still showing roughly the same colors. This assumes that the recipient has a monitor that is in good condition and can display reasonable color.

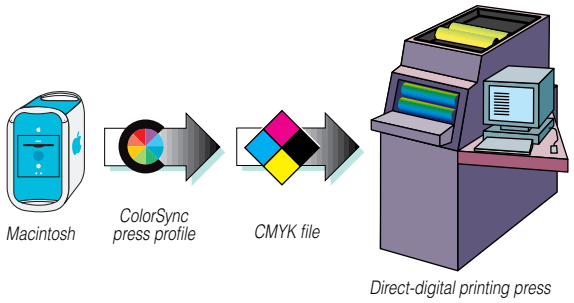


When preparing projects for multimedia publishing on CD-ROM, an RGB monitor profile is set as the destination profile. Work destined for the World Wide Web, below, also requires an RGB profile for the colors of the multiplatform web.





Film recorders require accurate color files in RGB mode. With the appropriate ColorSync profile, the film recorder can produce excellent color consistently.



Direct-digital printing presses, such as the Heidelberg QuickMaster DI shown here, require a color management system to work most profitably. Since there is no film, and no conventional proof, the monitor and the electronically generated proof must be trustworthy.

The color management commitment

Color management has a reputation for being a domain limited to "rocket scientists," but in fact it's a lot easier than that. Companies that take the necessary time and commit the needed resources to implement color management gain the advantage of managed color.

The time necessary to establish color management standards in any shop depends on the complexity of the operation. To calibrate and profile a computer monitor takes just a few minutes, for example. To calibrate and profile a scanner requires about two hours. This procedure need not be repeated often; most scanners are stable.

Printing presses and proof printers require more time, as the number of color spot readings needed to build a profile is high. Changes in paper (type, finish, grade, color) or pigments (or toner, dyes, inks) require new measurements and a new profile.

Several of the available color measurement instruments are semi-automated or fully automated, which makes them capable of making hundreds of readings in just a few minutes. For larger printing operations, these automated and semi-automated instruments are critical to success. The time saved in making the periodic color test target readings will pay for such devices quickly.

Tip to printers: Treat the test targets like any high-quality printing project
In numerous printing operations where tests of ColorSync profiling software have been made, the test target sheet was printed without the commitment to quality that a commercial job would get. It's easy for production people to cast "experiments" like these aside, or to run them without bringing the press up to speed or to full ink density.

These target tests must be printed to the same level of quality as the best commercial printing done on each press. Only then will the color, densities, and dot gain characteristics be valid for commercial application. Expect to spend two or three days of intermittent testing to profile a four-color press, followed by a lifetime of successful color printing.

Making Managed Color Fit Production

The world of artwork production today is abuzz with the expression "workflow." The reason this term is so common is that people have discovered that the greatest advantage technology brings to graphic arts is *productivity.* It means getting more work done in a shift, making fewer reruns, and getting quality output whenever the print button is pushed. Workflow describes how technology is applied in real production.

Color management enhances productivity. When ColorSync profiles are applied in a quality-assured system, the percentage of successful work goes up. When color is reliable and consistent, profits go up and job completion times go down.

It's possible to employ managed color at any level, and those who use ColorSync to its fullest can reap the benefits. Organizations large and small are discovering the financial and production benefits of using ColorSync in print production.

Litho-Krome Company

Litho-Krome Company, located in Columbus, Georgia, has been developing a managed-color production process for several years. The firm specializes in printing fine art reproductions of original artwork that are sold in galleries and by fine art publishers.

Litho-Krome photographs the originals—oils, acrylics, and watercolors—with a digital camera, and converts them to CMYK with ColorSync directly from the camera file.

Dave Reynolds, Litho-Krome's technical development manager, claims to have more "mileage" on the company's spectrophotometer than on his car. The firm's full-time profile builder/manager monitors the output of the presses constantly, and builds profiles for all the various substrates used, including paper—both uncoated and coated—and sheets of canvas specially prepared for offset printing.

For proofing, Litho-Krome uses an Iris ink-jet proof printer, and with ColorSync profiles applied, the proofs from that machine are exceptionally accurate. Says Reynolds of the firm's successes, "We have been able to achieve near-perfect matches proof-to-press that are so close that you cannot tell which is which."

When Reynolds was asked about the tangible benefits of using managed color at Litho-Krome, his response was immediate and confident: "Elated customers are the benefit. They saw the benefit immediately. I attribute this to color management." Now that's success.

People magazine

Time Warner's *People* magazine is discovering the benefits of using managed color in its editorial processes. The publication handles more than 5,000 editorial pages each year working from a wide variety of images—high-quality fashion photos to dupes, and dupes of dupes.

Says Betsy Castillo, imaging manager for *People,* "We decided to try ColorSync for the 25th anniversary edition of *People* because we were treating it as a separate publication. It gave us a chance to set the production procedures aside from everyday methods and try something new.

"With this edition, we're getting more V-1 approvals than ever before.* We're getting much better shadow detail and visibly better skin tones. Since our magazines are basically about people and celebrities in the news, skin tones are really important to us."

"Apple says, 'Think different,' and believe me we had to learn how on this project. Our imaging specialists have spent their entire careers working in CMYK. It has required us to learn how to work in a new color space. But the results are worth the effort."

In summary, Castillo describes the benefits of using ColorSync: "We're getting better quality from lesser originals. We're getting more V-1 approvals. Whenever we are more efficient and can cut waste, that's a good thing."

PhotoDisc

Seattle-based PhotoDisc, a subsidiary of Getty Images, Inc., is another example of a firm that has rolled ColorSync into its daily routine. The firm's stock photographs are being scanned and saved with source ColorSync profiles so that buyers can apply the company's ColorSync profile to images purchased from the firm.

To get people started with color management, the firm shipped a limited-edition ColorGuide, which included a visual software tool for calibrating the computer monitor, and an instruction booklet to explain how to use color management profiles on a computer. The test worked well, and has spurred PhotoDisc to develop a new web-based toolkit to assist customers in getting their monitors calibrated and the profiles to work with PhotoDisc's images.

Says Gary Hawkey, director of PhotoDisc's Imaging Studio, "Our customers never see originals. We want to communicate to them the look we want to achieve in the image and allow them to get similar results, whether they are viewing from our discs, our web site, or our printed material. We want to ensure absolute truth in advertising."

"ColorSync had to work for us before we would recommend it to our clients. We wanted to 'walk the walk before we talked the talk.' If we were successful, we could then recommend it to our customers."

"So far we have produced eight Photo Resource Books, tons of collateral material, direct-mail pieces, and even our trade show signage using ColorSync. When a customer buys images from PhotoDisc, the images they get will look like the images they saw in the book if they use color management and our profile."

*V-1 means "Version One" in *People* magazine's internal terminology. It means that the first scan is approved without additional work needed.

PhotoDisc's images are scanned on Hell drum scanners, then retouched on Macintosh computers using ColorSync profiles for various original film and photo stocks. The images are then saved in a calibrated RGB color space, for which the firm has a master source profile, and in this format they are shipped to customers.

Continues Hawkey, "ColorSync has cut our time to market and improved our customer satisfaction. We have saved considerable time and money, and our customers have experienced the same."

PhotoDisc also uses custom AppleScript scripts to embed ColorSync profiles into batches of images. The firm's standing archive of images is being converted as quickly as possible to include the master source profile. After the images are color-corrected on the firm's reference monitors, the finished images are dropped into a folder. At night, the contents of the folder are automatically processed by the AppleScript script to include the source profile.

Letterpress printing is printing from metal or plastic relief plates.

Flexography, a form of letterpress printing, is printing from polymer or rubber printing plates. It is very common in the newspaper and food packaging industries.

Offset printing uses a metal or plastic printing plate that has no relief, and transfers its image from the plate to a blanket cylinder that prints on the paper.

Gravure printing uses a copper-plated cylinder as its plate, with the image engraved into the cylinder. This method of printing is common in packaging and in publications with very long print runs.

Screen printing is done by exposing an emulsion coating on a fabric screen. When processed, the emulsion is removed from the image areas, allowing ink to pass through the screen onto a substrate. Screen printing is commonly used for printing garments and other irregular surfaces.

Turning color management into profits

Once the reliability of color can be ensured, printers and prepress operators can promote new business by leveraging ColorSync profiles and processes.

Using the supplied color profiles, design clients can preview the effect of a printing press on a job. They can build their color palettes so that spot colors chosen for the design will print correctly on the press, paper, and ink combinations available from their favorite printer.

Software products such as Pantone's ColorDrive and Praxisoft's ColorCompass will assist designers in the selection of printable color palettes that take the guesswork out of the selection of colors for printing.

Color management can help build customer loyalty. When a printer delivers consistent, reliable color, customers come back for more. When prepress suppliers show how they can deliver consistent color for all printing processes—including gravure, flexography, and screen printing—clients can rely on a single prepress supplier for all their film needs regardless of the printing process.

How does ColorSync fit into a quality prepress operation?

There is often resistance to change in our business. That resistance is frequently found in the scanning, retouching, and film assembly areas of quality-conscious prepress operations. This is traditionally where quality is built into printing jobs. Image preparation processes need not be compromised by color management. To the contrary, ColorSync provides a path that can be followed readily by color professionals.

If using ColorSync profiles on a conventional scanner is not workable in the production workflow of a shop, then color management can begin with the calibrated monitor. If the scanner operator or color retouching specialist is satisfied with the image as it appears on a calibrated monitor, then the monitor's profile can substitute for the scanner's as the source profile.

No compromise of quality is necessary in using ColorSync. In fact, ColorSync fits snugly into total-quality* systems because it relies on and introduces consistency and repeatability into the process of image management. Firms that pride themselves on color quality will find improved marketability of their work with ColorSync.

Add up the benefits of managed color

First you get great color, consistency, and repeatability. Then you get the confidence that your color will work on the web, in multimedia, and in print. You'll have fewer losses from color error. Color changes made on the monitor will result in the same change occurring in the final product.

Customers are happier with the finished printing when ColorSync is used to manage color in production. It's easier to match the original by using ColorSync in the production process.

Color business grows because the cost of good color is lower with ColorSync, and also because it's easier to get color into print successfully. And color images can be used for a variety of publishing tasks.

* W. Edwards Deming would be proud. ColorSync fits into total quality management (TQM) processes because it is a process based on consistency, repeatability, and supplier standards. It makes business sense to introduce ColorSync into any quality-managed process.

The Macintosh Color Advantage

Color management is a fundamental part of the Mac OS. It is similarly a big part of Apple's evolving operating system strategy. As Apple makes the transition from its current operating system to its new operating system, Mac OS X, ColorSync will remain a key feature of the operating system, offering customers the flexibility of using applications that support managed color.

Macintosh is preferred by content creators

We think there is a simple reason for this popularity: People get more work accomplished on Macintosh computers. Even in companies that are otherwise all Windows-based, you'll often find that for the origination of artwork for publishing, and for the development of multimedia titles, the Macintosh is the preferred platform.

Cross-platform development is easier

Firms that develop materials for distribution in electronic form use the Macintosh because it is more flexible for cross-platform development. The Macintosh is used for about half the content creation on the World Wide Web, despite the fact that other computer platforms dominate the Internet.

Microsoft's support for the same CMM that is used by ColorSync makes cross-platform workflows more effective, since files prepared using Windows will complement Apple's system of color management as Microsoft ships its future operating systems with support for color management.

Clearly the Macintosh represents a critical component in the world of artwork creation—for print, multimedia, the World Wide Web, videotape, everywhere.

I'll match your color—and raise your productivity

In the last year, Apple engineers have worked to add speed and functionality to ColorSync that give the engine new fuel. Their first job was to make ColorSync run more efficiently on the PowerPC processors in the latest Macintosh computers. The latest release of ColorSync is significantly faster than its predecessors. This means that color space changes—like a conversion from RGB to CMYK—take much less time. Extended AppleScript support within ColorSync adds even more utility.

When applications such as Adobe PageMaker, QuarkXPress, or Multi-Ad Creator2 print a job using ColorSync, it happens now, not later. Adobe Photoshop 5.0 and later versions optionally process every image through ColorSync, and with the speed requirements of that powerful application, it's important for ColorSync to do its job quickly.

Added monitor calibration

One of the greatest problems with color management is buying the tools to put it to work. The cost of color measurement instruments is too great for many customers whose needs for good on-screen color are real, but whose budgets are not adequate to acquire an external monitor calibration instrument.

To solve that problem, Apple ColorSync engineers have built a clever new monitor calibration and profiling application that ships with every copy of the Mac OS.

As part of the Monitors & Sound control panel, this new calibration software walks the user through a visual calibration and profiling process. This software simply asks for input, and then shows response. When the operator is finished with the visual settings, a ColorSync profile can be built by the calibration software.

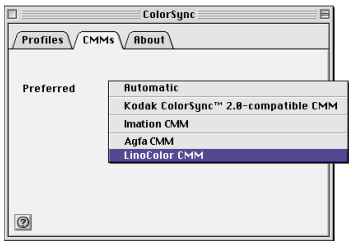
This profile is then automatically stored in a ColorSync Profiles folder within the System Folder. For entry-level color management, this new ColorSync software is just right. It provides everyone with an entry into the world of color management.

With color management emerging in web browser software, the ability to make and apply monitor profiles will give even the most basic user an opportunity to view images on the World Wide Web with better color accuracy.

As Internet commerce grows and electronic online shopping becomes commonplace, the need for more accurate on-screen color becomes critical. Apple's new monitor calibration software goes a long way to making on-screen color perfect for electronic commerce.

Multiple CMMs help when matching color cross-platform

Another improvement in ColorSync is the ability to choose Color Management Modules (CMMs). The latest ColorSync version adds a menu from which any of several CMMs can be chosen.



The reason for this change is to accommodate those users whose work environments include both Macintosh computers running system-level color management and Windows-based computers running application-level color management. In most cases the application-level color management engine in Windows applications is the Kodak CMM.

To do color management on Macintosh and Windows-based computers and have the color transformations come out similarly, the same CMM must be used for both systems.

It is now possible to choose a CMM from Agfa, Kodak, Apple/LinoColor (the default CMM), and soon Imation—all of which can be accessed from the ColorSync control panel. ColorSync also offers an option to set CMM choice automatically, which will arbitrate whenever necessary to provide the correct CMM for color management, based on the CMM settings found in files as they are encountered in a document.

ColorSync and AppleScript

Another major feature of ColorSync is its ability to be programmed with AppleScript, or any other Apple event–aware programming language.* AppleScript is a plain-language programming tool that anyone can learn to use. Its advantages include the ability to cause almost any Macintosh application to run and interact with other applications.

ColorSync is a system-level extension and a fully scriptable application. It has no interface, but runs as a faceless application driven by scripts that are written by users to enhance productivity in any color production operation. Scripts that launch when files are dropped onto them are called *droplets.*

```
tell application "ColorSync Extension" to match _FiletoMatch into (_FinishedFolder as alias) ¬
        quality best profile _SourceProfile intent perceptual with replacing
```

Shown above is a line from an AppleScript program that embeds a profile in a TIFF file. Terms such as "_FileToMatch" are variable names assigned by the programmer. The ¬ character shows a "soft return," which is ignored by AppleScript.

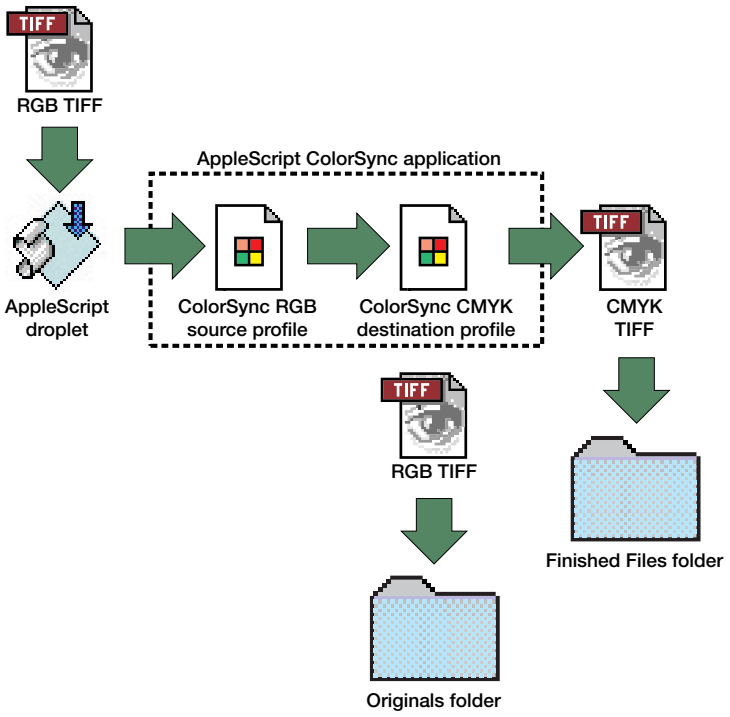
The diagram at right shows how an AppleScript droplet can activate ColorSync to convert an RGB TIFF file into CMYK, putting the finished CMYK file into one folder while putting the original RGB file into another folder.

Such scripts can be written to replace the original file, or to duplicate it and keep the original untouched.

AppleScript is an easy-to-learn programming language used to automate applications and workflows on Macintosh computers. The skills needed to write basic ColorSync applications and droplets with AppleScript can be learned by most Macintosh users in a matter of days.

The benefits of learning AppleScript can include not only building ColorSync applications, but other time- and labor-saving applications that are useful in everyday work. Examples include automatic backup applications, startup scripts, and e-mail automation scripts.

Demonstration scripts for ColorSync can be downloaded from the Apple web site at www.apple.com/colorsync.



*Apple events are internal programming "calls" that let the operating system know what is going on. ColorSync has a number of Apple events that can be activated by AppleScript, Frontier Scripts, and other programs.

Hot-folder AppleScript applications

With ColorSync and AppleScript you can build your own hot-folder applications that perform color management tasks automatically or semi-automatically.

For example, you could write a script that watches a folder on the Mac OS desktop. The arrival of a TIFF file in that folder activates the script, causing the TIFF file to be converted to a different color space, and, when finished, moved to another folder. This same script can act as a batch processor when a folder full of TIFF images is copied to the hot folder.

Another option is not to convert the file, but to embed a source profile it, so that ColorSync-savvy applications such as Adobe Photoshop or PageMaker or QuarkXPress recognize its profile and later convert it to another color space when printing.

Hot Folder Convert ColorSync

A hot-folder AppleScript application is similar in function to a Folder Action script except that it polls a "watched folder" every few seconds to determine whether anything has been added to the folder. If yes, it runs the script.

Folder Action AppleScript

New to Mac OS 8.5 is an AppleScript feature called *Folder Actions.* This capability allows any folder to activate a script when something related to the folder changes. For example, a Folder Action can be set to activate an AppleScript script when a new file arrives in the folder. The script can check to see what type of file has arrived, and then process the file accordingly.

The hot-folder scripts described in the previous section can easily be converted to Folder Action scripts. This results in less idle-time processing by scripts waiting—and taking processor time—for a file to arrive in a watched folder.

Convert ColorSync

This is the icon of a Folder Action script. When the folder is open and a file is added, it activates a script that converts the color of the file added to the folder.

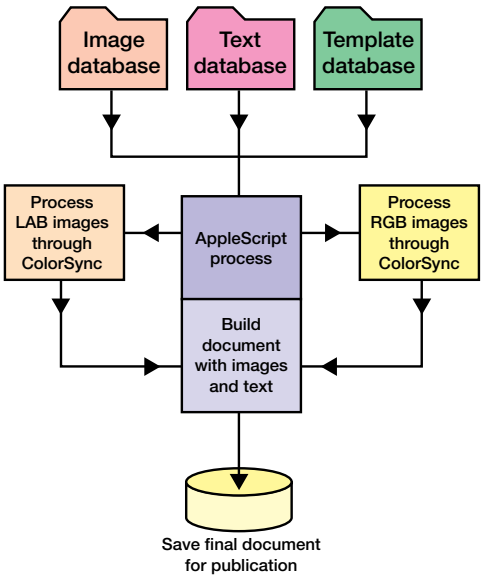
AppleScript droplets

Another option is to use AppleScript to build script droplets, whose function is similar to the hot-folder and Folder Action scripts described, but which are activated by dropping a TIFF file on the droplet. This drag-and-drop action causes the droplet to be run, converting, embedding, or otherwise modifying the file with ColorSync.

ColorSync and AppleScript are a winning combination. With these tools, graphic arts professionals are able to develop systems for improved workflows—methods for getting more work done than ever before.

Embed with System Profile

An AppleScript droplet requires that a file or selection of files be dropped onto the icon. When a file is dropped, the script is activated.



Automated database publishing is a field that is growing in many markets. Direct-digital printing systems, combined with image databases and powered by AppleScript scripts, can feed the systems that deliver such publishing. The best part is that scripts can be developed in-house, improving the quality of the process and ensuring that the product meets your needs exactly.

In the flowchart at right, three databases are merged by an AppleScript program, which then processes RGB or LAB photo files through ColorSync to produce image files that are ready to print.

AppleScript productivity applications

As AppleScript developers discover the opportunities that exist for automating file preparation tasks, they see the benefits of expanded AppleScript applications that process complete publications and business documents.

When companies discover that the same images and text can be processed through multiple publishing AppleScript applications, the process of re-expressing data is also enhanced.

A tremendous amount of information on AppleScript and its use in building productivity applications is available at www.apple.com/applescript. At this web site you can find an Apple Guide that will instruct you on all things AppleScript-related, and a large number of sample scripts. In addition, the site has links to other sites that support AppleScript.

AppleScript specifics for ColorSync

Get familiar with what you can do with AppleScript. Use the Script Editor application that is included in the Apple Extras folder to open the ColorSync script dictionary. From the File menu, select the Open Dictionary item. When prompted, find the ColorSync extension in the System Folder. A window appears, showing exactly what can be scripted in ColorSync. The dictionary has grown to be more extensible than ever.

The new Profile class contains several attributes of profiles that can be referred to and modified. The sample scripts *Show Profile Info* and *Set Profile Info* are good examples of using these. Keep in mind that a profile can be an installed ColorSync profile or a profile embedded in an image. Installed profiles can be referred to by name, by index, or by evaluating a conditional such as “every profile whose color space is RGB.” Remember that if you’re working with a profile embedded in an image, the image must first be opened.

The new Image class contains several image attributes, including color space and profile, as in embedded profile. Images can be opened, saved, and closed. Saving an image is necessary if you’ve modified any attributes of a profile the image contains.

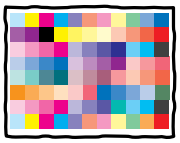
The new Display class contains attributes related to the user’s display environment. If only one monitor is present, it will be referred to as “display 1.” If more than one is present, each will be referred to by index in the same way that the Monitors & Sound control panel indexes multiple monitors. Monitors can also be referred to by name, with older monitors returning a generic display name and newer monitors returning a more specific description.

To help you get started, the latest release of ColorSync includes many sample scripts. You can copy code from these scripts or modify them for your own use. Remember, these scripts are not the final word in ColorSync scripting—they’re just a starting place.

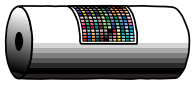
Recommended ColorSync Work Methods

Below and on the following pages are recommended production workflows for using ColorSync and a variety of software and hardware tools to manage color for graphic arts applications. The fundamentals of profiling are covered, as are the methods for image manipulation and page layout with color management. These are certainly not the only possibilities for production with ColorSync; other work methods can be developed for unique situations. In general, to work with color management in production, three types of profiles are needed: input profiles, monitor profiles, and printer profiles. Combining these profiles in a color managed workflow will produce reliable and predictable color.

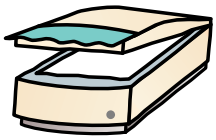
Creating input profiles for Apple ColorSync



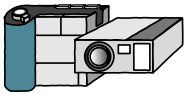
A standardized color target is used to test the performance of color scanners. This target is available as either a transparency or a reflective print of the color samples.



The target is scanned on a drum scanner.



Or the target is scanned on a flat-bed scanner.



Or the target is photographed by a digital camera.

Color scan information is transferred to the Macintosh for processing the color profile.

ColorSync profiling software on the Macintosh compares the known values of the original color target with the values actually scanned, and uses these values to create an input profile.

The profile data is saved in the ColorSync Profiles folder in the System Folder on the Macintosh.

Software appropriate for scanner profile creation:

- ColorBlind Professional
- Agfa ColorTune
- ColorBlind Matchbox
- Logo ProfileMaker Pro
- LinoColor ScanOpen
- Candela Color Synergy
- Praxisoft Compass Profile
- Kodak Color Flow
- Monaco Profiler

Creating monitor profiles for Apple ColorSync

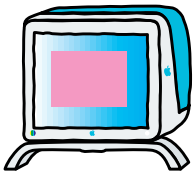
A monitor calibration instrument is affixed to the monitor face. These instruments are either spectrophotometers or colorimeters. Both deliver color data to the computer.

Calibration software is run. It displays a number of colors on the monitor. The instrument reads the color as spectral or colorimetric values, and sends the results to the Macintosh.

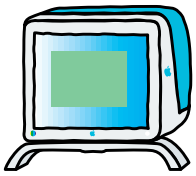
The calibration software running on the Macintosh compares the performance of the monitor with expected results, and builds a ColorSync profile and optionally adjusts the behavior of the monitor.

ColorSync

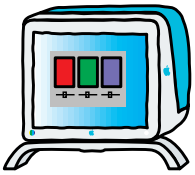
The resulting profile is stored in the ColorSync Profiles folder in the System Folder. From there it can be accessed by applications that use color management.



The 21-inch Apple Studio Display has a unique internal calibration system. Clicking an on-screen button causes the monitor to run through a series of color patterns whose current draw is analyzed by internal circuits.



Apple Studio Displays are factory-set to an industry standard for color. Over their lifetimes, the monitors will adjust to accommodate for the natural decay of the picture tube.



Included with ColorSync is visual calibration software. It allows the user to make visual comparisons of tones and colors, and then builds a profile from the resulting input.

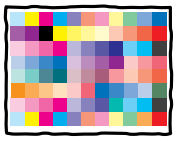
Calibration software steps the user through adjusting brightness, contrast, and visual color balance before a profile is created.

Software appropriate for monitor profile creation:

- ColorBlind Professional
- Agfa ColorTune
- ColorBlind Matchbox
- Logo ProfileMaker Pro
- Heidelberg CPS ViewOpen
- Candela Color Synergy
- Monaco Profiler
- Kodak Color Flow
- Color Partnership OptiCal

It's best to work with only one solution to avoid the possibility of multiple color corrections.

Creating printer profiles for Apple ColorSync



A color target is prepared for print using any of several ColorSync profiling software tools. These targets vary from several hundred to more than 1,000 color patches.

The target is printed on a printing press, a proof printer, or other output device.

The resulting printed patterns are measured on a fully automated spectrophotometer. Shown is the GretagMacbeth Spectroscan.

Or the resulting printed patterns are measured on a semi-automated spectrophotometer. Shown is the X-Rite DTP-41, which is hand-fed with strips of color patches.

Or the resulting printed patterns are measured on a hand-operated spectrophotometer. Shown is the X-Rite Colortron II, an inexpensive measurement instrument.

Profiling software on the Macintosh analyzes the measured colors from the spectrophotometer, and uses them to build a ColorSync profile.

The profile is stored in the ColorSync Profiles folder in the System Folder. ColorSync-savvy applications query this folder to get a list of available ColorSync profiles.

Software appropriate for printer profile creation:

- ColorBlind Professional
- ColorBlind Matchbox
- Heidelberg CPS PrintOpen
- Logo ProfileMaker Pro
- Agfa ColorTune
- Candela Color Synergy
- Praxisoft Compass Profile
- Kodak Color Flow
- Monaco Profiler

Working with Apple ColorSync

Original film transparencies and color negatives can be scanned on high-quality drum scanners or on CCD film scanners for excellent results.

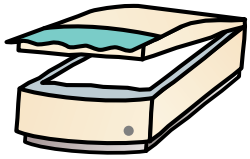
In this example, a drum scanner is used to scan a transparency.

The file is saved to the Macintosh in the scanner's RGB color space.

The Macintosh can store and subsequently convert the RGB color from the scanner color space to the monitor color space.

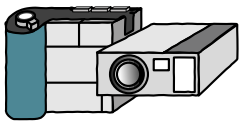
Profiles for scanner and monitor are called into action with system and application software so that the image displayed on screen is the best possible rendition of the original.

Original artwork and reflective photographs can be scanned on flat-bed color scanners or on drum scanners.

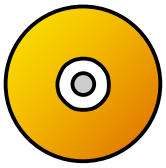


This flat-bed scanner has been profiled, so the Macintosh can process files originating here with more accuracy.

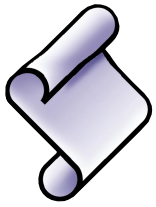
Applications such as Adobe Photoshop 5.0, LinoColor, and ColorBlind Edit can apply ColorSync profiles to images, converting them from RGB to CMYK or other color spaces. (Converting to the final color space at this stage limits alternative uses of these images.)



Digital cameras are getting better all the time; many produce highly professional results. It is now possible to make ColorSync profiles for most digital cameras.



Digital image sources include stock photo discs and stock photo web sites. The best of these services provide ColorSync source profiles with their images.



AppleScript

AppleScript applications can use ColorSync to make color conversions of TIFF, JPEG, and GIF files. In this example, the script will convert images from RGB to CMYK for the printed page using a specific profile or set of profiles.

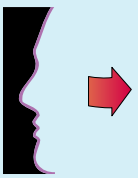
With a calibrated and profiled monitor, the color on screen can be extraordinarily close to the color of the original.

Files scanned in RGB can be saved with embedded profiles, where no change is made to the color, but the source device is identified by the embedded profile.

The document is built with a page layout application using unconverted color images. (In a preseparated workflow, the CMYK files are used here.)

The finished document can contain images in their original color spaces, identified by source profiles. (Preseparated files are identified as CMYK at this point.)

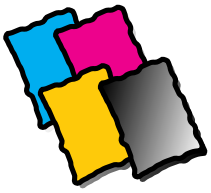
Optional remote viewing with ColorSync profiles is possible with ImageExpo software from Group Logic. This software allows collaborative work over the phone—or across the Internet.



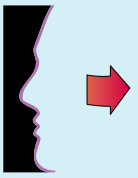
Distilling the document to Adobe Acrobat PDF format allows it to be transferred to other computers and delivered to remote publishing systems. RGB or preseparated files are appropriate to PDF workflows.

Future versions of Acrobat Distiller will include the ability to apply ColorSync profiles to PDF documents for advertising or distribution as PDF files.

These applications can apply ColorSync profiles to an image in the process of conversion. When making conversions for proofing, an additional proofer profile can be applied to these files.



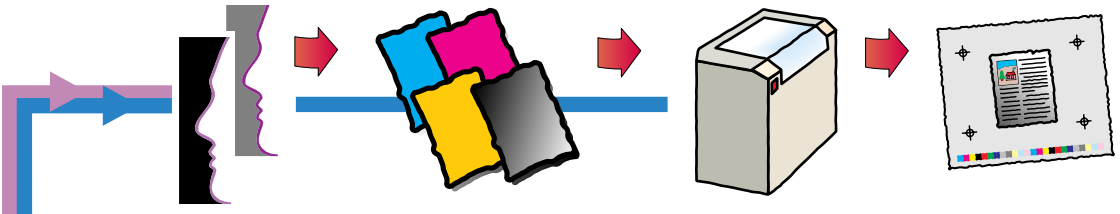
The results file is preseparated and ready for page layout. Color spaces include monochrome, RGB, CMYK, Hexachrome, and others—up to eight colors.



The page layout application can optionally convert the document for inclusion in a web site. Files for the web are kept in RGB format.

The World Wide Web is quickly becoming color aware. Electronic commerce relies on products displayed correctly on screen with colors that are predictable and repeatable.

ELECTRONIC DELIVERY

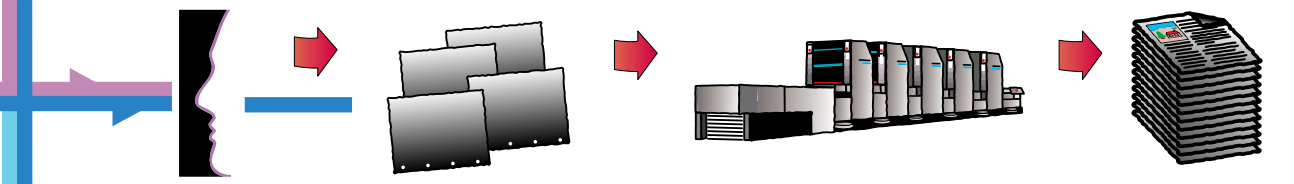


ColorSync profiles can be applied that correct color for the proofing device and proof medium, while simulating the printing press with an additional profile. (Preseparated files are not modified at this stage.)

The page layout application converts the file to either composite color or separated color for proof printing with profiles applied on the fly.

A variety of digital proof printers are in use today. Many use ink-jet technology, while others use dye-sublimation or hybrid marking technologies. Conventional photomechanical proofs can be made just as effectively.

The proof represents the document as it will be printed. When both press and proof printer profiles are applied, the color capabilities of both machines are taken into account in the proof.

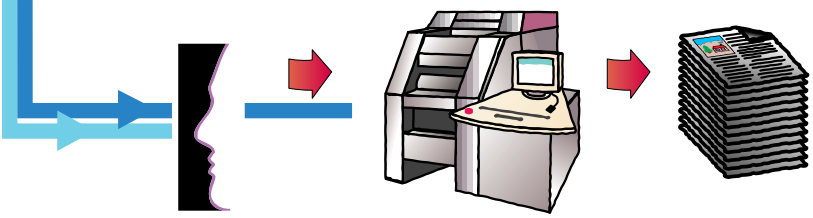


A different ColorSync profile made for the offset press is applied to the document as it is prepared for output to a platesetter or imagesetter. (Preseparated files are not modified at this stage.)

Printing plates are prepared, with ColorSync applied by the page layout application. Plates are made with conventional imagesetter film or on the latest computer-to-plate systems.

The document is printed on a high-speed offset press. Since the trend in quality graphic arts printing is toward high-quality color, ColorSync can provide color files in four-color, as well as other color systems like Pantone Hexachrome.

Finished printing is ready for delivery to the client.



A separate ColorSync profile will characterize the color in the document for the digital printing press. (Preseparated files are not modified at this stage.)

The job is printed on a composite color printing device. In this example, the press is a Heidelberg QuickMaster DI, a digital printing press. Other digital presses and toner-based printers are also good output devices.

The finished printing is ready for delivery to the client.

Primary color-managed production flow
Alternate color-managed production flows
Preseparated production flows

For More Information

Visit the ColorSync web site at www.apple.com/colorsync.
Visit the AppleScript web site at www.apple.com/applescript or Apple Computer's home page at www.apple.com.

To purchase additional copies of this paper, contact Apple StartingLine at 1-800-825-2145 and request part number L03627A or send an e-mail to s.line.order@apple.com.

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