

UPDIG

Universal Photographic Digital Imaging Guidelines



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The Universal Photographic Digital Imaging Guidelines

These 15 guidelines—along with the accompanying Best Practices documents—aim to clarify issues affecting accurate reproduction and management of digital image files. Although they largely reflect a photographer’s perspective, anyone working with digital images should find them useful. The guidelines have three primary goals:

- ◆ Digital images look the same as they transfer between devices, platforms and vendors.
- ◆ Digital images are prepared in the correct resolution, at the correct size, for the device(s) on which they will be viewed or printed.
- ◆ Digital images have metadata embedded that conforms to the IPTC standards, making the images searchable, providing usage and contact information, and stating their creators or copyright owners.

The Guidelines

1. **Manage the color.** ICC profile-based color management is the standard. *ICC website: www.color.org*
2. **Calibrate the monitor.** Monitors should be calibrated and profiled with a hardware device. *Further discussion of monitor calibration is on page 4.*
3. **Choose a wide gamut.** Use a wide-gamut RGB color space for capturing and editing RGB master files. We recommend Adobe RGB (1998) or ProPhoto RGB. *See also the discussion of camera color spaces on page 4.*
4. **Capture the raw data.** For best quality, digital cameras should be set to record RAW files. *See also discussion of RAW files on page 5.*
5. **Embed the profiles.** All digital files should have embedded profiles (should be “tagged”), unless otherwise noted. Photoshop’s Color Management should be set to “always preserve embedded profiles,” and the “ask when opening” boxes should be checked to alert you to profile mismatches and missing profiles. When profile mismatches occur, you should elect to preserve the embedded profile.
6. **Color space recommendations:**
 - a. For **the web**, convert images to sRGB and embed sRGB profile before delivery.
 - b. For **display prints** from professional digital color labs, if a custom profile is available, use it for soft proofing. Then submit either sRGB or (more rarely) Adobe RGB with embedded profiles, as specified by the lab. If a lab does not have a custom profile, it’s usually best to use the sRGB color space with that profile embedded. *More depth on this is in the discussion of Professional Digital Color Labs on page 5.*
 - c. For **display prints** from many consumer digital-print vendors, a database of custom profiles is available. Otherwise, deliver files in the sRGB color space with embedded profile. *The database source is Dry Creek Photo; see page 5.*
 - d. For **offset printing**, it’s always best to begin by asking the printer or the client’s production expert what file format, resolution and color space they require. RGB files contain many colors that cannot be reproduced by conventional CMYK printing. This has often led to a situation where the final result looks nothing like the screen version of the file, or the inkjet print of the file. There are two ways to avoid this confusion:
 - ◇ Files can be delivered as CMYK files. This is the “safe” way to go, because the image itself will contain no colors that can’t be reproduced by the CMYK process.

- ✧ Files delivered as RGB files can be accompanied by a cross-rendered guide print that includes only colors reproducible in CMYK. *See page 7 for a more thorough discussion.*
- ✧ Files can also be delivered in both CMYK and RGB. This allows the photographer to make the artistic decisions about color rendering, and gives the printer more tools to recover from mistakes the photographer may have made in converting RGB to CMYK.

Ideally, CMYK image files should be converted from RGB using the printer's CMYK profile with that profile embedded in the file. It is not always possible to get the printer's profile, either because the printer does not have one or the client does not know who will print the images. In such cases, it's often best to deliver an RGB master file, with an embedded profile and a ReadMe file that explains that "for accurate color, the embedded RGB profile should be preserved" when opening the file. *CMYK profiles and the RGB alternative are discussed on page 6.*

- e. For **inkjet and dye-sub printers**, use a wide-gamut color space, such as Adobe RGB, for the source space. Use a custom profile for the printer-paper combination in the print space to get the best quality and the best match to a profiled monitor. *Details are on page 7.*

7. Formats and names. File formats should always be denoted by standard, three-letter file extensions.

- a. For **the web**, use JPEG files.
- b. For **print**, uncompressed TIFFs are best. Use JPEG only when bandwidth or storage constraints require it. Use the highest JPEG quality setting possible. We recommend not using less than "8" quality.

To avoid problems with files that will be transferred across computing platforms, name files with only the letters of the alphabet and the numerals 0 through 9. Avoid punctuation marks (other than hyphen and underscore), accented vowels and other special characters. Keep the full name (including extension) to 31 characters or less for files on a network or removable media, and to 11 characters or less (including the three-letter file extension) when burning to CDR, in case a recipient's computers don't support long filenames. For the complete guide to file naming protocol, see the Controlled Vocabulary website.

www.controlledvocabulary.com/imagedatabases/filename_limits.html

8. Appropriate resolution. Resolution of digital images is described by three numbers: height, width and ppi (pixels per inch). *Beware:* It's easy to confuse ppi with dpi (dots per inch), which refers to the resolution of a printing device, or with lpi (lines per inch), which describes a halftone grid or screen used for printing images on a press.

The following target resolutions are meaningful only when paired with the height and width at which an image will appear in the final form:

- a. Low (monitor or "screen") resolution is defined as less than 100 ppi.
- b. Inkjet prints normally need resolutions of 180 ppi to 360 ppi.
- c. Continuous-tone printing requires resolutions of 250 ppi to 400 ppi.
- d. The offset-printing standard is often considered 300 ppi. But resolutions of 1.3–2 times the halftone screen for the project are considered safe. If the images will be printed at 150 lpi, the appropriate image file resolution range would be 195 ppi to 300 ppi.

9. **Sharpen last.** All digital images require sharpening, during capture or after, and the correct amount to apply depends on the type of use and size of the final output. For most uses, it's best to sharpen little or none during capture with a camera or scanner. Sharpening is an art, and requires study and practice. There are several schools of thought regarding proper sharpening. One recommended method is to remove capture softness using a gentle sharpening pass followed by local sharpening and/or output sharpening. Sharpening should be the final step in reproduction, because resizing and contrast adjustment affect an image's sharpness. Sharpening is best evaluated at 100 percent and 50 percent views on your monitor, or by making a print. The most common sharpening method is to apply an "unsharp mask" filter (higher settings for higher-resolution files) to images, but other sharpening methods and Photoshop plug-in programs can be useful, too. Oversharpening creates obvious halos around edges within images.
10. **Delivery.** Digital image files may be delivered on removable media (removable hard drive, CD-Rs or DVD-Rs), or via FTP or e-mail. If files are delivered on CD-R, the standard disc formatting is ISO 9660 or "Mac OS extended and PC (Hybrid) CD." When delivering images on a DVD-R, make sure the recipient can read the chosen format, since there are multiple standards. Often speed and convenience require delivery by File Transfer Protocol (FTP). Although not a preferred method, e-mail delivery usually works if image files are small in number and size, and both sender's and recipient's internet service providers permit large attachments. E-mail delivery sometimes works better if the image files are first compressed using RLE compression software such as WinZip or Stuffit. Check to make sure the recipient can access your specific version of compressed files. Delivery by FTP or e-mail usually precludes delivery of a "guide print" (discussed below), so a disclaimer should always be included that states accurate viewing and reproduction depend on the recipient properly applying ICC color management. *A more detailed discussion is at www.riecks.com/digitalinfo.html*
11. **File info.** All digital image files should have embedded metadata—including copyright, usage license and contact information—that conforms to the IPTC or the newer IPTC Core standards. Photoshop users can input and edit this information by choosing "File Info" under the File menu. Adding caption, title, origin and keyword data enhances searches and organization with digital asset management applications. *Metadata and the IPTC standards are discussed in detail at www.controlledvocabulary.com/imagetdatabases/*
12. **Describe what's there.** Provide a ReadMe file in either .PDF, .HTML, or .TXT format with all files delivered for output. Such files should specify image size(s), color space(s) and any licenses granted, the copyright owner's contact information and, if certain rights are being withheld, the words "other uses, reproduction or distribution are specifically prohibited." The ReadMe file should also include disclaimers noting recipients are responsible for following an ICC-based color management workflow.
13. **Send a guide.** Whenever possible, include a guide print with digital image files. A guide print is typically an inkjet print that serves as a color reference for reproduction of a digital image file. *Details on guide prints are on page 7.*
14. **Disk labels.** Do not use adhesive labels on optical media, since they may separate and damage an optical drive. Printing directly on inkjet-writable CDRs or DVDRs is a good way to provide information such as your copyright, usage license, file lists and disclaimers.
15. **Long term.** Archiving responsibilities should be clearly stated in writing for everyone involved. Photographers should note that charging for archiving means assuming liability for maintaining such archives. Prudent photographers keep back-ups on external magnetic drives, as well as on optical media and, if possible, also keep duplicate back-ups offsite. *A fuller discussion of archiving techniques, and archival file formats, begins on page 8.*

Best Practices: Tools and Methods for Applying Guidelines

The material below expands on the 15 guidelines that UPDIG has recommended to assure optimum reproduction of digital photos in various commercial environments. The following topics are discussed:

- ◆ monitors
- ◆ cameras
- ◆ scanners
- ◆ viewing area for prints or proofs
- ◆ professional digital color labs
- ◆ consumer photo lab digital printers
- ◆ offset printing
- ◆ RGB master files
- ◆ inkjet and dye-sub printers
- ◆ guide prints
- ◆ archiving
- ◆ archival image formats

Monitors

Computer monitors must be calibrated and profiled before they can be part of a professional workflow. The tone-curve standard is a gamma of 2.2 for both Macintosh and Windows, with a color temperature between 5000K and 6500K. Usually, 6000K or 6500K will offer the closest match to actual print output viewed under daylight. Although the Macintosh default has long been gamma 1.8, tests show that all monitors give smoother gradations, with less chance of banding or posterization, at gamma 2.2.

LCD monitors with 8-bit or 10-bit gamma correction are increasingly common in professional workflows. In order to achieve the best performance from an LCD, it should be profiled at a gamma of 2.2 and the native white point. Most high quality LCDs have native white points close to 6500K.

Luminance values can vary from 85–140 candelas per square meter, depending on how bright the working environment is. You want to be able to match what you see on screen to prints viewed in your D50 (simulated daylight) viewing area.

Accurate monitor calibration requires a hardware device, such as the Gretag-Macbeth Eye-One, Color Vision Spyder2, or Monaco Optix XR. Another useful tool is a Profile Verification Kit. This is a digital file with an accompanying proof or print. After profiling your monitor, you view a comparison between the digital file displayed in Photoshop (or other professional imaging software), and the proof print, as viewed under D50 lighting, to indicate whether your monitor profile is accurate. *More information is available at:* www.gretagmacbeth.com/index/products/products_color-mgmt-spec.htm, www.colorvision.com/profis/profis_view.jsp?id=10, www.xrite.com/product_overview.aspx?Line=32 and www.pixl.dk/Download_documents/Profile_verification_UK2003.pdf.

Cameras

Professional digital cameras have selectable color spaces. Photographs intended for print should be captured in a wide-gamut space, such as Adobe RGB (1998). Photographs intended only for the web can be captured in the narrower-gamut sRGB color space. It is possible, but not strictly necessary, to create custom camera profiles. When such profiles work, they can speed workflow and yield more accurate colors. Adobe's Camera Raw program allows for calibration of a digital camera, creating in effect a custom profile. *Info on Adobe's Camera Raw software is at* www.adobe.com/products/photoshop/cameraraw.html. *Instructions on calibrating a digital camera are at* http://visual-vacations.com/ColorManagement/cm_101/04camera.htm.

It's essential that a photographer choose the correct color profile when capturing JPEGs or TIFFs, because the camera will process images into these formats using the specified profile.

Capturing images in a RAW file format offers post-production flexibility to create the best quality images. Photographers capturing RAW files can choose color space, white balance and, to some extent, exposure value (ISO speed setting) *after* the capture via the image-processing software. In addition, many RAW processors have sizing algorithms that (some say) are superior to interpolation in Photoshop, since they are working with the RAW data—the actual pixel data captured by the camera’s imaging sensor. RAW files also offer more bit depth than JPEG files, allowing more aggressive editing, both in the RAW software and when imported as 16-bit files in Photoshop.

Many camera manufacturers have created proprietary, undocumented RAW file formats. Adobe has offered an open-source RAW file format called Digital Negative or DNG. If adopted by camera makers, it would create a standard RAW format that would simplify access to older RAW files as we move into a future of changing software and filing systems. A good first step would be for camera makers to provide open documentation of their RAW file formats. In the meantime, many photographers are converting proprietary RAW files to DNG format before archiving. *Info on DNG is available from www.adobe.com/products/dng/main.html. Among the groups pressing for open documentation of RAW files is www.openraw.org.*

Digital cameras and digital imaging software programs are evolving rapidly. Signal-to-noise ratios continue to decrease, yielding cleaner, higher-quality files at a given megapixel rating. Interpolation algorithms are improving. This makes it unreasonable to specify a certain megapixel rating as a minimum standard tied to any given file size or printed output size.

Scanners

Scanning software, like digital cameras, allows a choice of color space for the resulting files. A wide-gamut space for print (such as Adobe RGB) and the smaller sRGB color space for web are the standards. In addition, a scanner should be profiled for maximum color accuracy.

Print or Proof Viewing Area

The ideal standard is a viewing booth with a dimmable D50 light source. Alternatives to a viewing booth are halogen lights rated at 4700K or 5000K, or full-spectrum fluorescent lights rated at 5000K. A Profile Verification Kit includes a print that incorporates a GATF RHEM light indicator, which indicates whether your viewing area is D50. The inside-back cover of *Real World Color Management* by Bruce Fraser, Chris Murphy and Fred Bunting (Peach Pit Press) also has a GATF RHEM light indicator. *You can order the book from www.peachpit.com/title/0321267222. You can obtain the RHEM indicator from the Graphic Arts Information Network (GAIN), www.gain.net/store/item.cfm?productid=648.*

Professional Digital Color Labs

Most professional digital color labs that do have an ICC workflow usually require sRGB as the color space to send to their RIP or other printer software. A few labs will work from Adobe RGB files, so it is best to ask before submitting files. Those labs that offer custom profiles provide them as “soft proofing” profiles only, since they update their actual profiles on a regular basis, when they change chemistry, paper batches or software versions.

Consumer Photo Lab Digital Printers

There is a free database of ICC printer profiles for digital labs worldwide at the Dry Creek Photo site (www.drycreekphoto.com). The printers covered include Fuji Frontier, Noritsu, Agfa D-Lab, LightJet, Durst and Chromira printers, among others. Because these printers do not recognize embedded profiles, it is necessary to convert your files to their profiles, then save them with the profile embedded. Converting to these profiles will give

you the best color fidelity and allow you to soft-proof your digital files before committing them to print. Labs that don't use profiles usually require that submitted files be converted to sRGB. To avoid confusion on your end, it's still best to include the embedded profile, even if the lab will ignore it. Using the sRGB color space instead of a custom profile may yield less accurate color that doesn't take advantage of the full gamut such printers can produce.

Offset Printing

We strongly recommend that all offset printers adopt the ICC standards. Currently, there is tremendous variation among offset printers, and nothing can be taken for granted. For many years, offset printers used a "closed loop" color-management approach. They scanned film on drum scanners with software that output directly to CMYK. The CMYK was targeted to a proofing device, the customer approved the proof and the press was adjusted until its output matched the proof. Color profiles were built into the workflow, not applied to files. This meant printers could not offer custom CMYK profiles for digital files created outside their shops.

Today, with 60 to 80 percent of images intended for print arriving as digital files, offset printers are moving away from the closed-loop workflow. A single printed piece often includes digital image files from many different sources. It is increasingly likely that an offset printer will have a CMYK profile that describes its proofing device's color space. As a general rule, an offset printer can match the output of its proofing device.

Two organizations in the United States have produced standards for the printing industry that would allow for standardized CMYK profiles. They are the SWOP Committee (Specifications for Web Offset Publications), covering web presses, and GRACoL (General Requirements for Applications in Commercial Offset Lithography), which covers sheet-fed printing. The two standards, SWOP TR001, and GRACoL's DTR004, if widely adopted, would do away with the need to worry as much about custom CMYK formulas. *Go to www.swop.org or www.gracol.com for more information.*

Outside of the U.S., organizations such as The European Color Initiative are working to achieve similar standards. *Go to www.eci.org/eci/en/041_offset.php for more information.*

When a photographer has the expertise, it's best to provide the printer with CMYK image files embedded with the printer's custom CMYK profile. If the printer does not have a custom profile, it's best to consult with the printer or the client's production expert to determine the best color space for the delivered files. A standard Photoshop CMYK profile that matches the general press conditions—sheetfed coated or uncoated, or web coated or uncoated—may suffice, particularly if the printer adheres to SWOP or GRACoL specifications. In this period of flux, communication is key.

Many times, digital image files must go to several different printers, or a project is photographed and delivered before a printer has been chosen. In such cases, it may be best to deliver RGB master files. These should *always* have an embedded RGB profile to ensure accurate color when they are converted to each printer's specific CMYK profile.

Send RGB image files (especially Adobe RGB) to a printer only if the shop has experience converting RGB files to CMYK—and then only if the printer will provide a random or contract proof. If a printer has a clear understanding of ICC profiles and requests RGB, it's best to submit files in Adobe RGB or, possibly, the narrower-gamut ColorMatch RGB. If a printer cannot ensure preservation of the embedded profile before converting to CMYK, it is better to provide files converted to a general purpose CMYK or RGB profile such as SWOP Coated V2 CMYK, ColorMatch RGB or sRGB with the appropriate profile embedded in the file.

Besides color profile issues, perhaps the biggest stumbling block to quality reproduction is inappropriate file resolution. Some digital cameras produce a native file at x-inches high by x-inches wide at 72 ppi. This sometimes results in printers receiving files of the correct height and width, but at 72 ppi. This mistake is so common that

printers have a mantra that all files need to be 300 ppi when the image is sized to the final height and width to be printed. This can be used as a rule of thumb, although if you have good communication with a knowledgeable printer, you can use the more sophisticated standard of 1.3 to 2.0 times the halftone-screen ruling (lpi) for the job.

RGB Master Files

RGB master files are Photoshop (.PSD) or TIFF files, optimized in a wide-gamut color space (such as Adobe RGB or ProPhoto RGB), at either at the digital camera's native file size or interpolated to a larger size (consistent with any possible future use) by a RAW file conversion program. They should be left unsharpened or sharpened only on a removable layer, since resizing for future uses is likely. Master files should be archived along with the RAW files for a project.

Inkjet and Dye-sub Printers

You can easily bring desktop and wide-format printers into a color-managed environment with the help of profiles. If working with the manufacturer's printer driver, turn off all color management and print a copy of the color target file. Next, measure the printed target with a spectrophotometer to generate a profile for accurate output on a particular paper or other medium. Repeat this process for each paper stock you use. Most RIP (Raster Imaging Processor) software offers profiles for a wide variety of papers. Many RIPs will also allow use of custom profiles.

Guide Prints

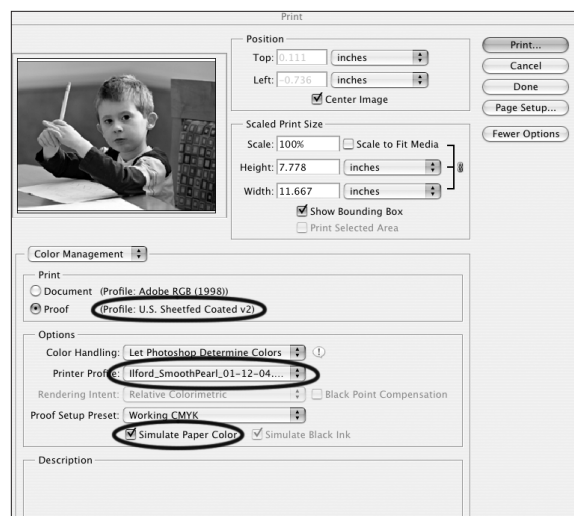
Profiling a desktop printer is critical for photographers who include digital guide prints with their digital files—a key part of these guidelines. This is particularly true with CMYK files submitted to an offset printer. Unless using a SWOP-certified proofing system, photographers should include disclaimers stating that guide prints are for color reference only and are not “contract” proofs.

Since inkjet guide prints made from RGB editing spaces may have wider color gamuts than available from an offset press, a guide print will more accurately reflect what is possible to achieve on an offset press if it is “cross rendered.” Cross rendering involves printing from your current output color space through an intermediate output color space to simulate the appearance of the final output space. For example, in the print dialogue, the “source” space would be either the CMYK file or the CMYK proof space. Choosing Relative Colorimetric as the rendering intent will limit a desktop printer's color gamut to the gamut of the CMYK file. If you use Absolute Colorimetric (or check the “simulate paper color” box in Photoshop CS2), you may more closely simulate the

actual press sheet, since the whites will more closely match the duller white of the actual press stock.

A guide print should not be confused with, or referred to, as a “proof.” That term refers to a “random” or a “contract” proof, provided by an offset printer or prepress house, and created from the actual films or plates used for press output. Direct-to-plate workflows create proofs with special printers, calibrated RIPs and special proofing media to closely simulate the actual press conditions. “Contract proofs” are considered guarantees by printers (or prepress houses) that press sheets will match the proofs.

Photoshop's settings for cross-rendering a print can be found in the Print With Preview dialog. Note that Photoshop CS1 does not have the “simulate paper color” checkbox.



A SWOP-certified proof provides additional precision when indicating the color of digital files delivered to an offset printer. SWOP-certified systems combine RIP software driving special proof printers. *More information on SWOP-certified systems is available from www.swop.org/certification/certmfg.asp.*

Archiving

Digital files accumulate. Without careful filing, it can be hard to find a specific image. However, most image file formats (including all of those that we recommend here) include space for metadata that facilitate cataloging and searching with a digital asset management programs (such as Extensis Portfolio or iView MediaPro). Embedding IPTC metadata in image files early in a workflow, paired with logical file numbering and naming conventions, speeds up cataloging and facilitates searching. *Go to www.extensis.com/en/products/asset_management.jsp or www.iview-multimedia.com for more information.*

Storing multiple copies of image files on redundant hard drives is arguably the most convenient and least expensive solution to guard against data loss. Additional back-ups to CD-R or DVD-R media may be prudent. Note, however, that different brands and batches of CD-R and DVD-R media have different archival qualities. Use only media with high archival ratings; burn discs at lower speeds; do not use adhesive labels on discs; and write on discs only with non-solvent markers designed specifically for inscribing CDs and DVDs. A prudent practice is to maintain a complete copy of your photo archive off-site.

Over time, as operating systems change and new storage media emerge, it will likely be necessary to migrate your digital image files. Most businesses and institutions have been slow to recognize the need for digital asset management, so it generally falls to photographers to maintain digital image archives. It's wise to discuss archiving responsibilities with clients to avoid losing image files.

Archival Image Formats

RAW file archiving for DSLR users is likely to be one of the greatest challenges in the long-term maintenance of a digital archive. Because each camera model creates a unique file-type, the likelihood of files becoming unreadable at some time in the future is high. Photographers must develop a comprehensive strategy to use when confronting this issue: one that takes into account the probable obsolescence of file formats and the necessity of file format migration.

File format migration refers to the practice of conversion of image files to a different storage format. This can come in the form of conversion to TIFF files, conversion to DNG files, or conversion to some future format not even in existence today. Each of these choices holds certain advantages and disadvantages regarding image quality, storage needs, and workflow requirements. Some of these concerns are outlined below.

Conversion to TIFF files

By converting images to TIFF format, the photographer is storing the images in the most accessible file format. Because TIFF is an open standard, it is likely to be readable for a very long time. TIFF also offers a workflow advantage: By converting to TIFF, you probably eliminate the need to reconvert the files again for many years, perhaps even for your lifetime. So images can be converted and archived with confidence that they are safely accessible long into the future.

There is a downside, however. TIFF files are much larger than RAW files. Converting image files to 16-bit TIFFs can make the files up to 10 times larger than RAW files, and 15 times larger than DNG. This will clearly increase the cost of file storage. The other downside to conversion to TIFF is that it precludes the use of better RAW converters that are surely coming in the future. Just as Photoshop CS2 does a better conversion than Photoshop CS does, it is likely that the RAW file conversion programs available in several years will do an even better job than our current tools.

Archiving RAW files

If a photographer chooses to archive the RAW file, then he will be preserving the largest number of options for future conversion of the files. As conversion software improves, new versions of the file can be made that will have better color fidelity, or better noise reduction, or better upsizing interpolation. By keeping the RAW file intact, the largest number of future conversion options is preserved.

This, too, has its downside. RAW files will likely have to be converted to a more universal file format at some time in the future. This may involve the conversion and re-cataloging of hundreds of thousands of image files. If this conversion is not accomplished before that particular format becomes generally unreadable, then the conversion may simply never happen, and those images may be lost.

Additionally, since RAW files are proprietary, it is not safe practice to alter these files. This means that any work you do to these files, such as the addition of metadata, or adjustments to the image, cannot be stored in the file itself. This is typically accomplished by the use of either “sidecar” files, or the storage of these adjustments in some kind of larger database. The splitting of this information makes for a file-management challenge that may present a serious roadblock in the future, as you try to include this work in a conversion file.

Archiving DNG files

RAW files can be converted to DNG files, which is an open format that can store the RAW image data, metadata, and a color-corrected JPEG preview of the image. The DNG file format provides a common platform for information about the file and adjustments to the image. Because of this, cataloging applications like iView MediaPro and Extensis Portfolio can see metadata that has been entered in Photoshop, and these programs can see the image adjustments made in Photoshop. DNG files can be re-opened in Photoshop as though they were RAW files, and offer the full range of conversion options in Photoshop that the original RAW file offered.

DNG is likely to be readable long after the original RAW format becomes obsolete, simply because there will be so many more of them than any particular RAW file format. Additionally, the DNG offers significant file-size savings through a lossless compression that can reduce the file size by up to one third. Also, by converting to DNG at the time of archiving, you are likely to forestall further file format migration for a very long time. DNG also offers the possibility of embedding the RAW file itself, so that it can be re-converted later if desired. Of course, this particular option makes the DNG almost double the size of the original RAW file.

There’s a downside to DNG, of course. Conversion to DNG requires an extra step at the time of RAW file processing; it does not take terribly long, but it is an extra process. Also, by converting a RAW file to DNG, you preclude the manufacturer’s software for converting this file. If you like the conversions you get from the manufacturer’s software more than the conversions you get from Photoshop, then DNG may be unacceptable.

The DNG converter attempts to copy “Undocumented Maker Notes” to the metadata of the DNG file. These maker notes might include information that could be useful in converting the file at a later date (such as “dust reference” information, or information helpful in correcting for chromatic aberration). By converting to DNG today, you may lose this data, since it is currently undocumented and it may not be copied correctly.



This analysis of archival image formats was prepared by Peter Krogh. A more in-depth discussion of these issues, as well as all issues related to the creation and maintenance of a digital archive, can be found in his book, *The DAM Book, Digital Asset Management for Photographers* (www.theDAMbook.com), to be published this fall by O’Reilly.

Best Practices: Applying Digital Guidelines to Your Workflow

No single workflow suits all photographers or all clients. The ideal workflow should provide the best combination of quality and services to fit a client's budget and needs. Because digital photographic imaging is relatively new, photographers must regularly explain to clients the trade-offs between quality and cost in different workflows.

A film-based workflow is simple. Photographers deliver film, designers or art directors decide how pictures will be used, and offset printers and prepress houses handle conversion of the film to printing plates.

Digital cameras, along with scans from film by photographers and agencies, are now replacing film workflows. While clients have been quick to embrace the speed and convenience of digital capture and delivery, they do not universally understand what is required to achieve the same quality levels that they used to expect from film. With the exception of those involved in high-volume, quick-turnaround workflows, most photographers must decide how to handle file preparation. Some photographers want to avoid the distraction of file preparation. Others have embraced it, because it allows powerful control over the reproduction of their images. Profiles and soft proofing allow photographers to see how their files will look as display or press prints. Looking at soft proofs on their calibrated monitors, those who embrace file preparation can deliver to printers files that will accurately (if not precisely) reproduce on paper the optimized image files the photographers see on their monitors.

With some photographers embracing and others avoiding the details of file preparation, clients are understandably confused about who does this work and how much it costs. Many have tried preparing image files without first calibrating their monitors, yielding disastrous results. Some assume printers are accustomed to working with RGB files. However, a survey released in February 2005 by *Printing Color Digest* found that, of some 800 offset printers queried, only four accepted RGB files in their workflow. When you send an RGB file to an offset printer, the biggest risk is that a pre-press worker will open it in the wrong RGB color space, altering the color, then lock in the mistake by immediately converting the file to CMYK. If the printer receives an untagged RGB file, and there has been neither communication with the printer nor the inclusion of a ReadMe file that indicates the color space of the files, prepress will probably open the file in the shop's default RGB space, which may or may not be the space in which the file was optimized. Even when an image file is correctly tagged and its profile preserved when it's opened, there may be problems if a printer uses a RIP for CMYK conversion. Most RIP software does not use black-point compensation, and without it, some conversions can appear flat and unsaturated (muddy).

The workflows below are general in nature. They aim to illuminate options and possibilities rather than offer step-by-step guides. The ideal workflow is a moving target. It varies based on the nature of the project, the photographer's capabilities, the client's needs, and perhaps most importantly, the overall budget and time constraints. Photographers should adopt and adapt workflows to fit project parameters.

- ◆ High volume, quick turnaround workflow
- ◆ High volume, moderately quick turnaround workflow
- ◆ Low volume, high quality workflow
- ◆ High volume, high quality workflow

High-Volume, Quick-Turnaround Workflow

Examples: most photojournalism, sports for newspapers and magazines, events, most public relations.

The focus is on speed. There is a calculated trade off between ultimate quality and speed of delivery. Consequently, such workflows were the first to replace film with quick digital capture. Some issues and solutions include:

- ◆ High quality JPEGs, captured in either Adobe RGB for print or sRGB for web, are suitable in many situations.
- ◆ Professional digital SLR cameras offer white balance controls (with surprisingly accurate auto settings), in-camera sharpening and custom tone curves that can be applied at capture to generate JPEGs that are often adequate—if not optimal—for reproduction.
- ◆ Sometimes JPEGs must be reduced or compressed in the camera or afterward to meet transmission limits of bandwidth and time.
- ◆ It is expected that news organizations and printers have staff trained to receive transmitted photos and prepare them for either print, broadcast or web.
- ◆ Software such as PhotoMechanic allows embedding IPTC data on-the-fly as image files transfer from memory card to computer, saving time and ensuring file recipients have captioning, cataloging and crediting information. *Go to <http://camerabits.com> for more information.*

High-Volume, Moderately Quick-Turnaround Workflow

Examples: monthly magazines, institutional brochures, annual reports, web sites, theater and dance performances, some types of advertising.

There is more focus on balancing competing needs for speed, quality and cost. This leads to many questions about who should do what. Some approaches and concerns include:

- ◆ Whether to capture RAW files or high-quality JPEGs. A single assignment can generate thousands of images that could take many hours to process from RAW files. If the photography is straightforward, the lighting is good, or at least not mixed, and the intended use is web, broadcast, newspapers or magazines printed on web presses, then JPEG capture may be fine. If the intended use is higher-quality, sheet-fed printing, if the lighting is mixed or requires a high ISO setting, the final output will be full page or larger, or there is a strong chance for higher-quality uses later, then capturing RAW files provides the best quality.
- ◆ How to present images to the client, art director or editor. Although there are several good image file browsers, including one built into Photoshop, speed and convenience often require posting a web gallery for editing. If not captured in sRGB, which is the default color space for most web browsers, copies of image files should be converted to that narrow-gamut space before posting to a web site. Usually, it's also best to reduce the resolution and compress the files to fit the viewer's screen and load quickly. Typically, proof images should be 500 to 1,200 pixels at their largest dimension (width or height), unless an editor or designer needs to see minute details.
- ◆ How to deliver files for reproduction. Clients have two basic choices: 1) order optimized image files from the photographer; or 2) receive camera files and take responsibility for optimizing their reproduction. Either way, if good reproduction is the goal, someone who understands color correction, contrast enhancement and sharpening techniques will need to optimize the files. Some formats for file delivery include:
 - ◆ Photographer delivers uncorrected, high-resolution JPEGs or TIFFs. At the very least, the photographer should embed and note the color space of the files, unless instructed otherwise by the

printer. If the delivery method (bandwidth, size of media) can accommodate large files and the client has the needed software, hardware and expertise to deal with them, then 16-bit (48-bit RGB) TIFF files are probably best.

- ✧ Photographer delivers RAW files. Although not recommended, this is now an option, since Photoshop's Adobe Camera RAW supports most camera RAW formats. However, unless the photographer includes .xmp files, (small text files that describe how the RAW file will be processed), the client won't likely know the photographer's intentions for color and tone. Working with RAW files also requires high-end computer equipment, recent software, a color-managed workflow and a good understanding of digital photographic processing.
- ✧ Photographer delivers optimized, high-resolution TIFFs or JPEGs in an agreed RGB color space tagged with the appropriate color profile. Budget requirements—along with the variance of exposure, contrast and color between images—dictate whether and how much the photographer optimizes each file, or whether he or she batch processes them. Tradeoffs between cost and quality, along with the client's responsibility for adjusting final output must be clearly understood by all. Some issues to consider include:
 - a. Whether to deliver 16-bit TIFFs to allow the widest possible adjustment by others further along the workflow. Client must have storage space, knowledge and processing power for such files.
 - b. Whether to sharpen the image before delivery. Sharpening is only appropriate for images delivered at final reproduction size and when the photographer fully understands the sharpening needs for the final use. If an image file is sharpened, this should be noted in an accompanying "ReadMe" file, on the delivery medium (e.g., CD-R), on the delivery memo or on the border of the image. Sharpening a duplicated, composite layer within an image file (TIFF or PSD only) allows a client better resizing options.
 - c. Whether, how much and when to compress images as JPEGs. JPEG files are handy when many images must be delivered or delivery must take place with limited bandwidth or storage. But each time a file is saved as a JPEG, it loses image data and gains digital artifacts. The more a file is compressed, the more damage is done. When editing a JPEG file (created either by the camera or scanner, or in post processing), it's best to save the changed image as a TIFF or PSD (native Photoshop) file. Ideally, a photographer should only deliver JPEG files that are compressed slightly (10, 11 or 12 quality), optimized and sized precisely for output.
- ✧ Photographer delivers RGB master file. If the final use is offset printing, consider creating and archiving RGB master files. An RGB master file is used to create targeted CMYK files, which are sized, sharpened and profiled for the intended offset printer or press. The photographer can help ensure things go smoothly by delivering a "cross-rendered" guide print. *See discussion on page 7.*

Low-Volume, High-Quality Workflow

Examples: High-end advertising, photo-illustration, portraits, high-end editorial, architecture.

High-resolution cameras capturing RAW files or high-quality film scans (usually from medium- or large-format film) are standard. Retouching, blending images and other special Photoshop procedures are common. Some photographers perform this work themselves, while others hire digital assistants or retouchers. Time and effort invested in postproduction often equals or exceeds that spent on image capture. Generally, post-production work

yields an RGB master file. How such files are prepared for final uses depends on clients' production needs, as discussed above. In some cases, it's best to deliver several different file versions derived from an RGB master file, such as a high-resolution Adobe RGB file, a screen-resolution sRGB file and an CMYK file optimized for the expected press conditions, possibly sized and sharpened.

High-Volume, High-Quality Workflow

Examples: Product and catalog photography.

Methods are often similar to low-volume, high-quality photography. However, to speed production, the large number of image files often requires help from a digital service bureau or pre-press house. Some studio workflows—particularly for catalogs—where all conditions can be carefully controlled, can benefit from a JPEG workflow.

This document, prepared by the UPDIG working group, represents the industry consensus as of September 2005. Because digital production standards and best practices are continuing to evolve, we recommend checking the UPDIG web site, www.updig.org, for updates and supplements.

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