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As organizations of competitors, non-profits must be vigilant to ensure that state and federal antitrust laws are respected. The general improvement of the industry benefits the public. This is why Congress granted the privilege of taxexempt status to non-profit organizations. Our focus must be the general improvement of our industry. We must refrain from actions, which either may suppress competition among members or give members a competitive advantage over non-members.

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HERE'S WHAT'S NEW IN V20

FROM IDEALLIANCE CEO, TIMOTHY BAECHLE

"The mission of Idealliance is to create immense efficiencies and enormous profitability from content creation through printing and packaging and electronic distribution through the work we produce from specifications to global standards to the world's leading certifications and supply chain audits. We work tirelessly around the world to LEARN, LEAD and SERVE, so that others globally can carry the same torch and share knowledge with the world in order to further our great industry. We believe that everyone is welcome in Idealliance, serving others is where you find purpose and meaning and that anyone and any company that seeks to transform their business, change, grow and transform themselves into the very best they are capable of becoming, we will go to the ends of this great Earth to walk hand-in-hand in the service to others. Our work is done by not only our incredible staff around the world in our (12 offices), but through the industry changing committees and Working Groups, such as the Idealliance Print Properties & Colorimetric Council, which is made up of members from around the world, who give their brilliant minds, their most nonrenewable resource (time), and set aside industry competition all to build the future of our incredible industry. What has come out of this global collaboration through the years has literally changed the industry from: GRACoL®, SWOP®, G7°, BrandQ° (ISO 19303-1), IT8.7/4, IT8.7/5, SCTV (ISO 20654), PRX, PQX (ISO 20616-1 and ISO 20616-2), countless other ISO standards and contributions to creating, writing and revising 12647-(2-9), the world's 1st Global Characterization Target and Kit for ECG (CMYK+OGV), TR016, printing and proofing guidelines, lighting and proof-to-press matching, Large Format-Industrial-Textile Printing Control Wedge, the Universal Digital Data Print Space (largest color space in the world), and countless other standards, specifications and globally leading practices. Without the collaboration of the world, none of this would be possible and we thank everyone for their incredible contribution to not only Idealliance, but the indelible impact they have made on our industry."

ABOUT THIS GUIDE

Version 20.1 Guide to Print Production is an insight to our work, free to the world, about design-printing-packaging and leading practices and techniques for reproducing a creative concept, image, on a targeted output media. Idealliance shares our work with the world in order to make it accessible to everyone. We believe that sharing knowledge is "seed planting" and this not only builds the industry, but sustains the industry by designing workflows, standards, specifications and leading practices that are far ahead of the global markets. Much of what we do at Idealliance is free to the world, but membership most certainly has its extraordinary privileges, as we serve thousands and thousands of members around the world. Idealliance has a weekly podcast called GAMUT, which averages an audience of 23,000+ from (6) continents around the world.

We also host a monthly BrandQ* Webinar Series, where experts' panelists in the world of packaging share knowledge of the most intriguing matters in the global packaging supply chain, among other countless programs, offerings, certifications, tools, solutions and services we provide around the world. Idealliance knows who we are and most certainly knows who we serve. We are a laser focused organization on a mission to serve the world. You can always find out more about us at www.idealliance.org or follow us on LinkedIn at https://www.linkedin.com/company/idealliance.

This Guide V20.1 provides incredible education into all aspects of the supply chain from design-through-production. For example, G7* is far more than the world's leading color specification used by tens of thousands around the world. It is far more than a certification or a qualification for a facility or a technology. It has proven to be the most innovative, efficiency driving, and profitability increaser across a supply chain as its focus is: one file, one separation, one target, one calibration all of which result in one remarkably similar visual appearance-regardless of the technology, substrate or inks. Serve the World-This is not just the focus of Idealliance, but the ability of everyone who chooses to maintain a process control driven culture and supply chain. Own your market, limit the noise you're taking in and know that there is a difference between being in business and driving a business. One can "run" a business or "ruin" it. Only one letter standards in the way, "I".

WHAT'S NEW IN V20

The Guide to Print Production is a living, breathing document of our work that we continually update. We run 24-7; we travel the world, meet who we serve in-person, listen to the heartbeat of the industry, look for the gaps and search for solutions and build workflows, standards, and specifications that advance the industry. Version 20.0 of the Guide to Print Production addresses new ISO standards, new characterization datasets, and new specifications in printing, lighting, viewing and measurement and a tremendous amount of new leading practices. We define the importance of process control and a standards driven supply chain. We extrapolate on the fact that everything begins at design and design intent. We work with and reach up and down the supply chain to engage and work with everyone that manages quality in printing and packaging. V20.1 includes Leading Standards in Lighting. This Guide to Print Production is not just for those who work in color quality and supply chain management, but for everyone seeking to further themselves and their business. It can, in part, help people see that technology will not replace humans; rather, technology in the hands of brilliant minds can be transformational. Without a never-stop-learning mentality, there can be no innovation. Your curiosity will lead you to your answers if you seek them.

The Essentials:

WHATITALL

DISCLAIMER

Although this guide is designed to help the user understand and implement leading practices and procedures, it is impossible to cover all of the possible combinations of systems, software programs and workflows. As with any other document that provides general guidelines, asking for assistance from your print provider or other trained individuals and seeking additional educational training is encouraged.

WHO SHOULD USE THIS SECTION?

This section provides essential guidelines for people who are new to production/prepress processes or those who want to review the essentials.

WHY THIS SECTION IS IMPORTANT

Following these guidelines helps reduce errors and mistakes once files are in the hands of your publisher or print vendor. Understanding a bit about their needs and the limitations of the printing process goes a long way in building a good relationship with a publisher or print vendor. Plus it can reduce costly fixes.

CREATING, PROOFING, AND DELIVERING FILES

The points listed here are just some of the steps that we believe to be fundamental and necessary for anyone responsible for creating, proofing and delivering files intended for any commercial printing process. More detailed information is available at www.swop.org and www.gracol.org, or at www.idealliance.org.

- Let us always helpful to visit the publisher or printer's website for additional technical information and guidance about how to facilitate and more efficiently create and deliver materials. A phone call doesn't hurt either, especially if the website information isn't understood.
- Beginning the creative process with proper resolution and image format in a document that accommodates the correct size and layout requirements is critical. If you're not sure, ask your print vendor for help as early in the creative process as possible. This can save a lot of time and frustration in rework if files are not created and assembled to the printer's requirements.
- C. Viewing proofs, whether on a monitor or in hard copy, is essential for good color communication during both the creative and production processes. The successful communication of color expectations can only be achieved if all participants "see the same color." This requires all participants to adhere to monitor proofing and hard copy proofing standards, along with standard viewing conditions as specified by the International Organization for Standards. While this might sometimes be difficult to achieve, everyone from creative to print production should understand that the visual communication of color breaks down without adhering to these standards. (See Guidelines and Leading Practices.)
- D. Saving and delivering files should be done according to the publisher or printer's requirements. Problems can be avoided by communicating with your publisher or print vendor. Generally, all advertising files should be saved as PDF/X-4. This often holds true for commercial print as well. Always check with the publisher and/or printer for exact submission criteria.
- Final proofs should always be made from the final file that is delivered to the publisher or printer. If proofs are not required then a PDF is typically used as the digital proof. Make sure that the file is properly created to accurately represent the printed color expectation per the publisher or printer's requirements.
- are being submitted in accordance to the publisher or printer's needs. Preflighting files can catch images that are the wrong resolution, wrong color space (RGB instead of CMYK) or not included.

IMAGES: BOTH RASTER AND VECTOR

Both raster and vector images can be saved in several different color modes. In most cases CMYK is the color mode all images should be converted to prior to sending to the publisher or print vendor. What CMYK "flavor" to choose is just as important. For global sheet fed printing, convert images to GRACoL 2006 or GRACoL 2013 for coated or uncoated stock. Web publications use SWOP3 2006 or SWOP 2013. It's important to make sure all images have been converted to the same CMYK print condition prior to submitting files to publishers or print vendors. Some printers and print workflows can use RGB colorspaces and convert to CMYK at a late stage in the process. Check with your printer if you would like to use RGB images.

This is common in dual use situations where images may be used on the web or in ebooks, as well as print. Vector images are resolution independent. They can be sized up or down with no quality sacrifice. Raster images, on the other hand, are resolution dependent. This means the quality changes if an image is enlarged to the point where the resolution (dpi) gets too low. Also if an image has been saved, for example, as a 72dpi image, the resolution is too low for quality print reproduction. When saving raster images, ensure they are saved with the correct resolution for quality reproduction. If you're unsure, consult the publisher or the print vendor. When you change the sizes of raster images in page layout programs, the final print resolution will also change, so ensure that the image is saved with enough resolution to handle any enlargements.

TECHKON Erfolg ist messbar

G7[®] evaluation – all results in one scan ...



PLAIN BLACK VS. RICH BLACK

Black ink can be printed as black only or a mixture of CMY and black, called rich black. It's important to know when and why to use black only vs. rich black, and how to set each of these up in frontend applications.

Plain black (100% black) should always be used for printing black text. The reason is that it is difficult to register rich black well enough to be legible when used in small text. Plain black by itself can look dull and sometimes a bit gray when compared to rich black, so adding other inks to black creates a "richer" looking black. Rich black is used as a way to increase the saturation and gloss of large black areas in a printed piece. It can also be a mistake as the result of delivering RGB files to the printer that include RGB text. An example would be a Microsoft Word document. The printer might not catch this and the resulting printed piece will have black text that is made of CMY and K inks, causing the text to look fuzzy due to any slight misregistration. It also causes the press operator problems, as it is difficult to perfectly register a large press sheet from edge to edge and corner to corner.

Bottom line: know when to use black and rich black, and how to create both in front-end applications. If you're using a product that produces only RGB results, let the print vendor know what application created the file, so the printer can adjust the output at their end.

BLEEDS

If any object in a project goes all the way to the edge of the final cut sheet, it needs to "bleed" off the sheet.

This is required so that the print vendor has a little wiggle room for the bindery process, where the sheets are folded and cut down into the finished product. The standard amount is 1/8", but it's best to check with your print vendor to ensure they don't require more. Less, they can adjust for, but more requires extra work with the original files, not the PDF that was sent to the print vendor. Make sure any object that goes to the edge goes past the edge by the appropriate bleed amount.



FONTS

Font omission is the single most frequent issue when files are received at the printer. When generating PDF files, ensure that the settings include embedding the fonts into the PDF file. When sending files in their original format, ensure that the fonts have either been outlined or have been included along with the file. Another often overlooked design error is using the application style menu to change font attributes. Many fonts don't have all of the styles that are available from the style menu, which can cause unexpected results in the printing process. Always choose a font's style from the font menu to ensure that you actually have that particular style available with that chosen font.

IMAGES & GRAPHICS

Make sure to include all images and graphics with your publication file. Resolution is important, and a rule of thumb is that images should be 2x the resolution of the line screen. So for a 150-line screen print, the images should be 300 dots per inch. Your preflight should include checking for image resolution and type. When you're packaging a file or making a PDF, check to be sure that all images are linked and updated.

PREFLIGHT

Invest in a preflight program and learn how to use it. Learning to preflight files can go a long way in understanding the ins and outs of file preparation for the printing process. The preflight program will flag common, and not so common file issues, so that they can be corrected prior to submission to the print vendor. Preflight programs are also very good time savers when set up and used properly. Many printers use them to ensure that they catch as many file issues as possible before the files gets on press. Preflight programs actually pay for themselves rather quickly.

COMMUNICATION

This section touched on the basics of file prep for print. It also highlighted many of the common file errors that are seen at print shops. What's important is communication. Ask questions of the print vendor when unclear how to prepare files for print. If communication starts in the early stages of a project, there will be fewer unforeseen issues and and it will be a more pleasant experience. Keep those communication channels open and working well. It can save headaches and money in the long run.

G7:WHAT IS G7?

G7 is an Idealliance specification and the #1 color specification, certification and standard in the world that defines a universal appearance for B&W imagery (or a printed gray-scale), as well show how to calibrate and control any printing or proofing system to achieve that appearance. It is also the basis of GRACoL and SWOP, the CGATS.21 suite of Characterized Reference Print Conditions and is currently being revised into ISO 12647-2.

G7 uses the same CMYK calibration curves as traditional TVI-based calibration, but with much more valuable and incredibly consistent results. Unlike TVI calibration, which is unrelated to human vision, G7 is based on visual appearance, achieving the same pictorial qualities of tonality and gray balance across all print technologies. By controlling grays, color images also look as "pleasing" as possible without ICC profiles. For even more accuracy, and color-critical work, G7 should be combined with ICC color management. In addition to being a specification, G7 also defines a simple method for calibrating CMYK printing devices. Part of the success of G7 is related to the ease of calibration.

G7 IN PICTURES

The illustration to the right shows what G7 can—and cannot—do. The top three images were produced without any calibration using three different printing

technologies: dryink digital, ink jet and offset lithography. The images show that G7 calibration has corrected gray tones and improved colored areas. Saturated colors are still affected by ink differences (which G7 cannot adjust), but without a reference proof, all three bottom images are "nearly identical visually" and it is hard to say which is "correct".

G7 BENEFITS

By focusing on visual appearance rather than mechanical variables like TVI, G7 offers many benefits.

- G7 helps offset, digital (EP, LEP, inkjet), flexo, gravure, screen, and wide format printers simulate a GRACoL or SWOP proof without a custom press profile. The addition of ISO-standard inks and paper also play a significant role in results (i.e. offset printing).
- An ICC profile made after G7 calibration can have a longer life and achieve higher accuracy than one made without G7.

• All G7 printing systems have "shared neutral appearance," meaning that files prepared for any G7 printer should look pleasing on any other. This has profoundly simplified and improved CMYK file exchange.

BRINGING RGB BENEFITS TO CMYK

Exchanging RGB files has always been easier than exchanging CMYK files. Whether it's a TV signal, a web image or a video, an RGB image that looks good on one display (monitor or projector) usually looks pleasing (if not exactly the same) on any other. This is because all video display devices produce the color "gray" from equal RGB values, and typically share a common 2.2 gamma. So black-and-white images appear very similar, no matter where they are displayed.



The above set of pictures shows how G7 calibration provides common appearance across multiple print processes.

G7 is the first "universal standard" for how to print gray in CMYK. Before G7, tonality (lightness and contrast) and gray balance varied widely on different presses and printing technologies.

One perfectly good press might be very dark while another was very light. One might have a natural bluish cast while another had a natural reddish cast, etc. Every printing process needed its own custom CMYK files, and sharing files between printers often required extensive (and expensive) prepress corrections.

To address the differences between presses, G7 established a carefully researched definition of gray balance and neutral tonality, based on typical offset printing, and instituted a simple method of calibrating any printing system to match that definition.

G7 TONALITY (NPDC)

G7 tonality is the relationship between the dot percentage and printed neutral density of two neutral gray scales, one printed in black only, the other printed with "balanced cmy" percentages. The G7 neutral density values of these gray scales were determined by testing the natural performance of multiple offset presses using ISOstandard ink and paper. The results were averaged into a set of "neutral print density" curves (NPDC). A formula adapts the NPDC curve shape to any available maximum ink density, maintaining highlight contrast but compressing or expanding the curve in darker tones, as shown in the G7 NPDC FanGraph.

G7 GRAY BALANCE

G7 defines gray balance in two parts:

- A standardized scale of cmy percentages that should appear neutral to the eye, and
- The a* and b* values for each scale step.

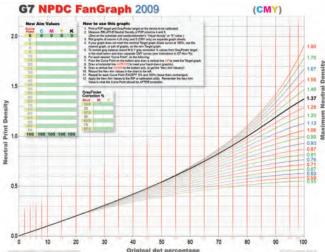
The grayscale cmy percentages were derived using a formula based on the traditional 50c, 40m, 40y gray balance ratio. Exact values appear in the "G7 How-To" booklet and in Column 5 of the P2P51x target.

The a* and b* values for any step of the gray scale vary according to paper color and can be calculated by these simple formula: through which the eye uses the surrounding white paper as reference.

FLEXIBILITY

The key to G7's widespread adoption is that it works with any technology. Any stable, repeatable printing system can simulate G7, using either simple one-dimensional calibration LUTs or more sophisticated color management. The same rules apply to all printing processes, regardless of substrate (paper), colorants (inks), tone modulation (screening) or basic technology. G7 has been globally adopted and implemented to offset, flexography, gravure, electrophotography, inkjet, LEP (liquid electrophotography)screen printing, RGB photographic paper,

monochrome (blackand-white) and more.



The G7 Fangraph shows how multiple devices can achieve common tonality and gray

 $a^* = paper_a^* \times (1 - C/100) b^* = paper_b^* \times (1 - C/100)$

G7 gray balance is "paper-relative," meaning that images printed on different colored substrates appear slightly different when viewed side by side. When viewed individually, however, each appears neutral to the eye, thanks to a process known as "visual adaptation,"

LEARNING MORE

For more information, attend a G7 Expert Certification Training, read more at www.idealliance.org, watch videos at our site, listen to our webinars, podcasts, view the tools, resources and downloads we have available, ask a G7 Expert or contact Idealliance around the world and let us know how we can serve you.

GRACOL AND SWOP:

CHARACTERIZED REFERENCE PRINTING CONDITIONS

Over the past 40 years the evolution of electronic systems in the graphic arts industry, from capture to print, has progressed to a point where all segments of the industry are now dependent on digital technology. The efficiency of operations and the quality of products have reached unprecedented heights, thanks not only to these technologies, but also to the efforts of industry organizations and think tanks, such as Idealliance in applying specifications, standards and process control to the complex operations involved in color communication and reproduction. The historical background of this effort is briefly reviewed in this introduction.

The history of print specifications in the U.S. began in 1975, when a group of industry leaders from printing, prepress, advertising and publishing gathered to address the problem of inconsistent color reproduction in publications. They assembled a set of leading practices that were to become the specifications for web offset publication, or SWOP. These became guidelines across the industry for the preparation of print ready materials, selection of inks, protocols for proofing and parameters for printing. SWOP's efforts are credited with stabilizing color reproduction across an industry where image quality was critical. The basic concepts of SWOP are acknowledged by many other segments of the printing industry to the point where it became a widely emulated, though often misunderstood, brand. Most of the specifications and guidelines in this document have roots in the original work of SWOP.

However, as advances in digital technology began to explode in the late '80s and early '90s, it became clear that the basic approach of SWOP had to be taken to a new level. Partnering with CGATS, the ANSI Committee for Graphic Arts Technical Standards, SWOP began to update and revitalize the meaning of its specifications. Press tests were performed and spectrophotometric measurements were made to "characterize" SWOP printing. The result was the first widely used reference print characterization, which was designated ANSI- CGATS-TR001:1995.

Profiles made from this characterization data were used in popular desktop applications and in digital proofing systems, which for the first time enabled accurate simulation of actual press behavior. This success ushered in a new era of accurate color proofing and of the reliable exchange of color information. SWOP became a specification and working group of Idealliance in 2005.

GRACoL, founded in 1996 as an outgrowth of the Graphics Communication Association, which became wholly owned by Idealliance, began to take up a similar banner for general practices in the commercial offset industry. The intent was to do for sheetfed printing what SWOP had done for the web offset publications. Over the next few years, it developed requirements for prepress and print production and conducted research projects aimed at furthering standards in the graphics arts. GRACoL guidelines

were published yearly from 1997-2002. Then in 2006, in conjunction with SWOP and under the auspices of Idealliance, three new reference characterizations were developed for GRACoL and SWOP. The design of these new datasets incorporated an innovative new calibration methodology, termed G7, which provided a defined neutral scale for common neutral appearance. These datasets, and the G7 calibration method they complemented, were extremely successful in creating a new framework for consistent color communication and reproduction from design to print.

With the continued success of reference characterizations and color managed workflows in the graphic arts, it became clear that adding a few additional datasets could provide a framework that would accommodate essentially all commercial print processes. The development of CGATS-21 in the U.S. and ISO 15339 internationally has resulted in a family of characterized reference print conditions (CRPCs) that form a "process agnostic" basis for color preparations, exchange and reproduction across the industry. These characterizations simplify the work of originators, buyers, preparers and manufacturers by enabling accurate previewing, communication, reproduction and verification of desired color content. The following sections of this chapter discuss details of GRACoL, SWOP and the characterized reference print conditions that are now the foundations of reliable color reproduction based on standards.

GRACoL: The Preferred Reference for Commercial Printing

GRACoL is the most prominent of the Idealliance datasets and is widely used for print production across many formats. In 1996, following the success of SWOP, a graphics arts task force was formed by the Graphic Communications Association (now Idealliance) to develop a document containing general guidelines and recommendations that could be used as a reference source across the industry for commercial sheetfed, four-color, offset printing.

The goal of GRACoL was to formalize a general approach for everyone—from experienced to novice print buyers, designers and specifiers—to work more effectively with their print suppliers. This was successfully accomplished, and the GRACoL Characterization Dataset has since been revised several times. The ongoing mission of GRACoL has been to improve communication and education in the graphic arts by maintaining and updating these guidelines for commercial printing and documenting the impact of new technologies in the commercial offset lithography workflow.

Since 1996, the GRACoL Committee has:

- Established subcommittees in many countries around the world;
- Worked closely with the Idealliance Print Properties Colorimetric Council to develop and support the G7 specification as a functional international process control tool, based on shared visual appearance

- Continually supported CGATS in the U.S. and ISO internationally to develop a comprehensive list of printrelated standards;
- Been more closely aligned with SWOP to produce a comprehensive proofing certification process;
- Developed and refined a family of characterization datasets based on G7 to give "shared appearance" to all forms of printing, from full range commercial printing to newspaper reproduction;
- Developed the G7 Master, G7 Experts and G7 Certification programs for effective implementation of process control;
- Supported the development of GRACoL 2013 and M1 color management workflows; and
- Initiated the G7 Process Control training and qualification program.

KEY COMPONENTS OF GRACOL

GRACoL (General Requirements for Applications in Commercial Offset Lithography-which today is a misnomer because it is used in every type of printing.) is one of the reference print conditions based on G7 NPDC aims. As a reference print condition, GRACoL can be fully represented via standard ICC profiles. The GRACoL 2006 ICC Profile, like the GRACoL 2006 Dataset, is based on G7 calibration along with solid colorimetry of ISO 12647-2:2004.

This version of GRACoL is based on grade 1 paper types that do not contain optical brighteners (OBAs). The GRACoL 2013 ICC Profile was created using the CRPC6 Dataset of CGATS 21-2. This GRACoL 2013 Dataset, like all CGATS 21-2 CRPC's, is based on G7 calibration and solid colorimetery from ISO 12647-2. The GRACoL 2013 revision is based on M1 measurement and on a grade 1 paper type that contains a specific amount of optical brighteners. In 2010, FTA

(Flexographic Technical Association) recommended GRACol 2013 for narrow web flexography. In addition, there is a GRACoL 2013 UNC ICC Profile, as well as the GRACoL 2013 UNC Dataset

(CRPC3 of CGATS 21).

This is the first official GRACoL uncoated profile, and it is based on M1 measurements and an uncoated paper stock that contains OBAs. All three of these GRACoL profiles and their corresponding datasets are available from Idealliance (www. gracol.org). Though GRACoL was created as a representation of G7 on a sheetfed offset press, the GRACoL color space is used as the reference for many non-sheetfed commercial print applications, such as web, flexo, gravure, screen and wide-format printing. The GRACoL working group is continuously working on tools, guides and leading practices to help GRACoL users.

DIFFERENCES BETWEEN GRACOL 2006 AND GRACOL 2013

Since 2006, the GRACoL Dataset has been the defacto standard reference print condition for commercial printing and proofing in North America and other regions around the world. To keep up with industry trends, the GRACoL Committee introduced an updated version called GRACoL 2013, which is nearly identical to GRACoL 2006. The few changes are barely visible in most subject matter and should not significantly affect printers, designers or print buyers.

The main difference between GRACoL 2006 and the new GRACoL 2013 Dataset is the white point. The target white point for GRACoL 2006 (95 L*, 0 a*, -2

b*) was based on the legacy ISO 12647-2 standard, which in turn was based on typical commercial printing stocks available in 1994. The GRACoL 2013 white point (95, 1, -4) is slightly bluer, in line with today's typical commercial stocks. Because the two datasets are nearly identical, most print buyers and designers should see little visible difference. In fact, the differences are smaller than the typical variation between two good offset press runs. To see how small the difference is, open a CMYK image in Photoshop and assign a GRACoL2006-based profile (e.g. GRACoL_Coated1.v2), then toggle back and forth between a profile based on GRACoL 2013, (e.g. GRACoL2013_ CRPC6.icc).

ALIGNMENT WITH STANDARDS

In 2013, both international (ISO) and U.S. (CGATS) printing standards were updated in response to industry trends.





Figure 1. Comparison of GRACoL 2006 (left) and GRACoL 2013 (right)

CGATS 21-2 is a new ANSI (American National Standards Institute) standard, approved in 2013, containing seven "Characterized Reference Print Conditions" (CRPCs) representing seven different printing processes. Because all seven are based on G7 and common ink hues, maximum "shared appearance" is achieved when a common file is printed on a system calibrated to any of the seven RPCs. In CGATS 21-2, GRACoL 2013 is known as "CGATS 21-2, RPC-6," while the old 2006 SWOP 3 and SWOP 5 datasets have been combined into a single RPC called "SWOP 2013" or "CGATS.21-2 RPC-5." This reflects the trend of the two legacy SWOP papers merging into a single generic paper type. (Idealliance has published an updated SWOP 2013 C5 Profile, which is available on the Idealliance website.)

GRACoL 2013 (CGATS 21-2, CRPC-6) was originally intended to align exactly with the solid colorimetric values and TVI (tone value increase) values of ISO12647-2 Print Condition 1 (PC1). However, ISO12647-2 was not finalized until

- after CGATS 21-2 was approved, and as a consequence there are very minor differences:
- All measurements used in GRACoL 2013 are specified in M1. This means that GRACoL 2013 calibration and assessment is to be done with M1 instruments. (Note that if substrates do not contain optical brighteners, the M0 and M1 readings are the same.)
- The Cyan, Red and Green solid colorimetric values are slightly different, but the differences (~1dE) are virtually impossible to see in a visual comparison between GRACoL2013 and PC1 of ISO12647-2.
- In the finalized ISO12647-2, black TVI was lowered for simplicity reasons to equal the CMY TVI values of 16%. This change was not incorporated into CGATS.21, partly because it deviates from the natural behavior of typical offset lithography and partly to maintain compliance with the G7 tonal curves in CGATS TR015. Consequently, the black TVI in GRACoL 2013 remains at 19%, as it was in GRACoL 2006. This difference, while modest, will make some image areas containing black tonal values slightly darker than ISO12647-2.

WHATTHIS MEANS FOR GRACOL USERS

GRACoL 2013 is very similar to GRACoL 2006, so most users will barely see a difference. Because GRACoL 2013 is better aligned with today's premium commercial stocks, printers should find it easier to simulate proofs based on GRACoL 2013 than on GRACoL 2006. The really good news is that except in rare situations, legacy image files and proofs produced using GRACoL 2006 should not need to be adjusted or converted for printing or proofing to GRACoL 2013 (and vice-versa).

Calibration and verification of GRACoL 2013 requires the use of M1-capable instruments when in the presence of OBA substrates. This means that using GRACoL 2013 in production cannot be done unless you have M1 capable instruments for these situations. Idealliance recommends the following transition:

- If you only have M0 measurement devices, continue using GRACoL 2006.
- If you have M1 instruments, you may choose to move to GRACoL 2013. In the GRACoL 2013 workflow, M1 instruments are to be used for calibration and verification. (M0 instruments can still be used for process control.)

Idealliance expects that there will be a period of several years during which printers and premedia providers migrate to new GRACoL 2013-based profiles, while continuing to use the legacy 2006 profiles as needed.

OBTAINING NEW PROFILES

Profiles for GRACoL 2013 (and the other CGATS21-2 reference print conditions) can be downloaded from either www.gracol.org, or the ICC profile registry at www.color.org.

GRACOL AND PROOFING

GRACoL characterization data or profile provide complete information on the reference print condition needed for proofing. A proofing RIP can be used to accurately render the color space based on this data.

GRACOL AND PRESS CALIBRATION

The GRACoL reference print condition is based on using G7 on a sheetfed press with a #1 coated substrate. Other print methods might not match the GRACoL aims as accurately. On a sheetfed press, important GRACoL aims are discussed below and summarized in the chart.

• Paper color: GRACoL datasets are based on a specific paper color. If a paper is more than 3 Δ E76 from the GRACoL aim, the paper is considered out of tolerance. (In this case the GRACoL dataset can be recalculated using substrate correction, as defined in CGATS 21, based on the paper color.) The resulting aims and dataset are called GRACoL Relative. GRACoL Relative is possible because G7 automatically scales its aims based on the paper color and the maximum density. A GRACoL Relative dataset will have different aims based on the color shift caused by the paper color.

- Solids: GRACoL aims for solids are specified in LAB and are based on values from the GRACoL Reference Characterization Dataset. The aims are to control the color of the solid ink. The tolerances for these aims are also specified in ISO 12647-2:2004 for GRACoL 2006, and CGATS 21 for GRACoL 2013.
- Overprints: GRACoL aims for overprints are specified in LAB and are based on the respective GRACoL datasets for GRACoL 2006 or GRACoL 2013. These aims specify the color of the overprints. GRACoL requires that the overprints be within a tolerance of 6 Δ E76.
- NPDC curve: The Neutral Print Density Curve specifies the weight of the G7 curve. Patches such as the HC (Highlight Range, 25. 19, 19), HR (50, 40, 40) and SC (75, 66, 66) are measured to ensure that the neutral print density for both the CMY and K channels is correct.
- Gray balance: Gray balance for GRACoL specifies the color of the gray along the G7 curve. Patches such as the HC (Highlight Range, 25. 19, 19), HR (50, 40, 40) and SC (75, 66, 66) can be measured to ensure that the neutral print density for both the CMY and K channels is correct.
- G7 metrics change based on the color of the paper. The values for both the gray balance and NPDC are calculated based on the substrate and the maximum neutral density on that print combination.

GRACoL is based on colorimetric measurements rather than mechanical press attributes. Simply printing to G7 on a sheetfed press is not considered GRACoL. GRACoL is based on the above colorimetric values being met.

LOCATION OF PROFILES

ICC profiles for GRACoL can be found here, on the Idealliance website (http://www.gracol.org) as well as at http://www.color.org.

WORKING SPACE

The G7 Color Settings for Adobe® Creative Suite® can be downloaded from www.gracol.org.

ADOBE COLOR SET-

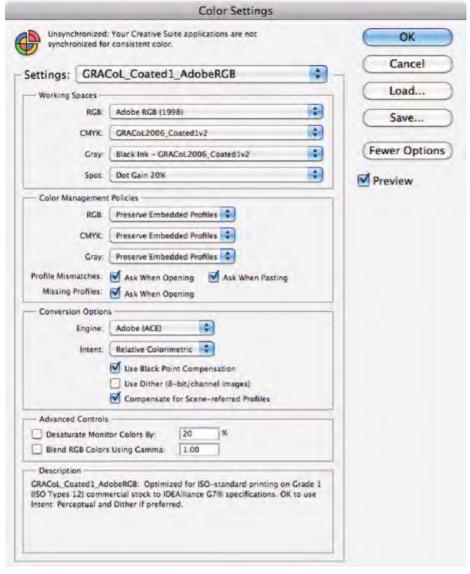
TINGS FILES

Idealliance provides several pre-set Adobe® Color Settings Files (.csf) for use when viewing or preparing images for G7 printing. These .csf files will automatically set Adobe Creative Suite® applications (Photoshop, InDesign, Illustrator and Acrobat) to the ideal settings for a G7 workflow. These directions can also be found online at Adobe Color Suite Settings on the GRACoL page.

DOWNLOADING AND

SAVING

For the GRACoL profiles, go to



Above: An examples of Adobe Creative Suite settings

www.gracol.org and download CSF files for either the GRACoL 2006 or GRACoL 2013 profiles. After downloading the G7 .csf files, drag them into the Adobe Custom Color Settings folder as follows.

DEFAULT MAC OSX LOCATION:

Users/ [Username]/ Library/ Application Support/ Adobe/ Color/ Settings.

DEFAULT WINDOWS LOCATION:

Documents and Settings/ [Username]/ Application Data/ Adobe/ Color/ Settings.

(This might vary based on operating system version. If you cannot find it, you can use your workstation's existing custom location.) Click the Load button in Photoshop's Edit – Color Settings... window, note the path to the custom folder, and then click Cancel.

CUSTOM LOCATION

On some workstations, custom .csf files might be in a custom location. If so, you can either move all of your custom .csf files back to the default locations shown above, or you can save the G7 .csf files in the existing custom location.

To find your workstation's existing custom location, click the Load button in Photoshop's Edit –Color Settings... window, note the path to the custom folder, and then click Cancel.

SELECTION IN CREATIVE SUITE: GRACOL 2006

Once the files are placed in the correct location, select the appropriate color settings file in your Creative Suite application(s) as follows. Photoshop, InDesign or Illustrator

- Go to Edit Color Settings...
- In the dropdown menu, select the appropriate color settings file according to the type of printing by which your work is most often printed.
- If your work is mostly for commercial printing on highquality Grade 1 or 2 paper, select: GRACoL_Coated1_AdobeRGB.
- If your work is mostly for publication (magazine) printing on good quality Grade 3 paper, select: SWOP_Coated3_AdobeRGB.
- If your work is mostly for publication (magazine) printing on lower-quality Grade 5 paper, select: SWOP_Coated5 be RGB.
- If your work often varies between publication and commercial printing, either change the color settings for each job or keep the settings you most frequently use but change the CMYK output profile as needed when converting images into CMYK.

SELECTION IN CREATIVE SUITE: GRACOL 2013

Once the files are placed in the correct location, select the appropriate color settings file in your Creative Suite application(s) as follows.

- Go to Edit Color Settings...
- In the drop down menu, select the appropriate color settings file according to the type of printing by which your work is most often printed.
- If your work is mostly for commercial printing on high quality Grade 1 or 2 paper, select: GRACoL_Coated1_AdobeRGB.
- If your work is mostly for publication
- (magazine) printing on good quality Grade 3 paper, select: SWOP_Coated 3_AdobeRGB.



Example of the Adobe Bridge Color Settings, which can be used to synchronize across Adobe applications.

If your work often varies between publication and commercial printing, either change the color settings for each job or keep the settings you most frequently use but change the CMYK output profile as needed when converting images into CMYK.

SYNCHRONIZING VIA BRIDGE

If you have installed the whole Creative Suite, you can use Bridge to quickly "synchronize" all Adobe applications to use the same color settings, as follows:

- Launch Bridge from the File menu of any Creative Suite application.
- Go to Edit Creative Suite Color Settings...
- Select whichever G7 Color Settings file is appropriate (see above).

USING G7 COLOR SETTINGS

Selecting the most appropriate .csf file for your type of work will automatically ensure that:

- A CMYK file displayed on your monitor looks as close as possible to a proof or final printed piece produced to the same specification.
- An RGB image displayed as CMYK looks as close as possible to a proof or final printed piece produced to the same specification.

(Note: Accurate color display requires an accurate custom monitor profile. Even then a profiled display will only simulate an actual proof or print under carefully controlled lighting conditions.)

- When you convert an image from any color space (RGB, CMYK, LAB, gray scale, etc.) into CMYK, the resulting file will be optimized for the specified type of G7 printing in terms of GCR, TAC, gamut mapping, etc.
- When you convert an image into grayscale mode, the resulting file will be optimized for printing with the black ink alone

of the specified printing specification in terms of tonality (darkness/lightness and contrast).

CHANGING THE RGB WORKING SPACE

If your preferred RGB working space is not Adobe RGB (1998), you can change the RGB working space and save a modified Color Settings File as follows:

- Select the G7 Color Settings file in the Edit – Color Settings...window.
- Enable the More Options button.
- In Working Spaces RGB, select your preferred RGB space.
- Click Save...
- Save your custom Color Settings with a new name, such as "SWOP_Coated3_ [RGB Space]".
- Distribute this new Color Settings File among all of your peers who use the same RGB space.

SWOP 2013 Introduction

SWOP: The Preferred Reference for Publication

Printing

For more than 30 years SWOP has been the default standard for publication printing.

SWOP was started in late 1974 by a group of concerned industry experts who formed a committee to write specifications for material supplied to web offset publications. This is where the initial set of specifications that would become specifications for web offset publications (and its acronym, SWOP) were first envisioned. Many versions of SWOP were published over the years. Since 2006, the SWOP 2006 profiles have been the standard reference print condition for publication printing and proofing in North America and other world regions. To keep up with industry trends, Idealliance has introduced an updated version, called SWOP 2013, which is nearly identical to SWOP 2006. The few minor changes are barely visible in most subject matter and should not significantly affect printers, designers or print buyers.

Differences Between SWOP 2006 and SWOP 2013 Paper Type 3

There is very little difference between SWOP 2006 and SWOP 2013 for paper type 3. The paper white points are identical and the solid and overprint values are very close. Because the two datasets for paper type 3 are nearly identical, most print buyers and designers should see little visible difference. In fact, the differences are smaller than the typical variation between two good offset press runs. To see for yourself how small the difference is, open a CMYK image in Photoshop and assign a SWOP2006based profile (SWOP2006 Coated3.v2), then toggle back and forth between a profile based on SWOP 2013.

Differences Between SWOP 2006 Paper Type 5 and SWOP 2013

One difference between SWOP 2006 and SWOP 2013 is that there is no longer a separate characterization dataset for SWOP 2013 paper type 5. The only characterization data supplied is for SWOP 2013 paper type 3. SWOP 2013 paper type 3 is part of a series of seven common appearance data sets, provided in CGATS.21 (see below), which range from wide gamut printing and offset coated (GRACoL) all the way down to newsprint. CGATS.21 provides a method of calculating characterization data for additional paper types. For legacy users of SWOP 2006 paper type 5, Idealliance has provided a legacy profile (SWOP2013C5.icc) calculated using this method, which is available on the Idealliance website.

Alignment with Standards

In 2013, both international (ISO) and U.S. (CGATS) printing standards were updated in response to industry trends. CGATS.21 is a new ANSI (American National Standards Institute) standard, approved in 2013, that contains seven reference print conditions (RPCs) representing seven different printing processes. Because all seven are based on G7 and common ink hues, maximum "shared appearance" is achieved when a common CMYK file is printed on all seven. In CGATS 21, SWOP 2013 is known as CGATS 21-2, RPC5, where the old 2006 SWOP 3 and SWOP 5 conditions are represented by a single CRPC, reflecting the trend to use substrate correction for papers that are similar in general characteristics but have a moderately different white point.

CGATS 21-CRPC5 and ISO-12647-2.

CGATS.21-CRPC5, on which SWOP 2013 is based, aligns closely with the updated version of ISO12647-2, Print Condition 2, which specifies traditional aim values for solid colorimetry and TVI (tone value increase) for improved lightweight coated publication printing.

All measurements used in SWOP 2013 are specified in M1. This means that SWOP 2013 calibration and assessment is to be done with M1 instruments.

What This Means for SWOP Users

SWOP 2013 is very similar to SWOP 2006, so most users will not see much difference. Calibration and verification of SWOP 2013 requires the use of M1-capable instruments. This means that SWOP 2013 cannot be used in production where substrates contain OBAs unless you have M1-capable instruments. Idealliance recommends the following transition:

• If you have M1 instruments, you may choose to move to SWOP 2013. In the SWOP 2013 workflow, M1 instruments are to be used for calibration and verification.(M0 instruments can still be used for process control.)

Idealliance expects that printers and premedia providers will migrate to new GRACoL 2013-based profiles over a period of several years, during which they will continue to use the legacy 2006 profiles as needed.

Obtaining New Profiles

Profiles for SWOP 2013 (and the other CGATS21-2 reference print conditions) can be downloaded from either the Idealliance website or the ICC profile registry at

Idealliance 2013

Common Datasets

While GRACoL and SWOP are the best-known G7-based reference print conditions, these two datasets do not represent the full range of printing color spaces used throughout the industry.

Idealliance has been working on a family of G7 characterization datasets that represent G7 printing across a range of common substrates and print conditions. As a result of these efforts, a new standard was introduced in 2013. CGATS 21 provides a set of G7-based reference printing characterizations that represent the seven most common printing conditions. The new standards also provide a method of adjusting these datasets to accommodate actual paper colors encountered in real-world production. Because all seven reference print conditions are based on G7 and use common ink hues, maximum "shared appearance" is achieved when a common CMYK file is printed on all seven reference print conditions.

Alignment with

Standards

ISO 15339 is similar to CGATS 21 and is based on near neutral calibration and common hue angles. By using CGATS 21, users can be assured of compliance with standards. All measurements used in these new datasets are specified in M1. This means that calibration and assessment of these new datasets is to be done with M1 instruments.

What This Means for Users Users who typically print on non-GRACoL or SWOP applications may find this to be a more accurate G7 reference print condition for use in their workflow. The new standards also provide a method for adjusting these datasets based on substrate color. These new standards are designed to help designers and printers better match and produce color to G7 reference print conditions.

- CRPC1: gamut size and substrate of Cold-set News.
- CRPC2: gamut size and substrate of commercial newsprint, flexo on porous substrate.



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Leading Practices: FOR CREATIVES

INTRO

Creatives are faced with many new challenges as they create and work on projects. The path from initial design to final

output has many steps and many pitfalls.

- New versions of software and tools allow greater design freedom but can also hinder the print process.
- Advances in printing technologies enable higher quality output and expanded color gamut, as well as a multitude of special effects, but increase complexity.
- Changing roles in the production workflow, as well as staff reductions due to automation, have blurred the traditional separation between designers and production, prepress and printers.
- A creative workflow today must be a fluid and flexible multipath guide that takes into account all of these factors to deliver a consistent quality product.

COMMUNICATION

IS KEY

The single most important factor contributing to a successful project completion is communication. Most projects today are complicated affairs that address not only a printed campaign but also a multimedia one that encompasses social media and digital media as well. Since so many parties are involved, file delivery and preparation specifications need to be discussed and agreed on from project inception in order to ensure a smooth hand off between parties.

A good workflow with standard operating procedures will eliminate errors and delays, but since every vendor is unique, good communication upfront ensures that all parties are working toward the same outcome.

WHAT ARE

CREATIVES' ROLES?

Who are creatives and what are their roles? Creatives are the people responsible for the design aspects of a project, including art directors and designers. However, as the pressure to deliver projects on budget and on time increases, many creatives are tasked with production as well as prepress functions. As such they must be aware of the technologies and standards used in manufacturing and color reproduction in addition to their own design tools. Some processes, such as color management, need to be applied throughout the entire workflow from creation to print in order to be effective.

GUIDELINES FOR CREATIVES: FILE CREATION

Design Tools

Use the right tool for the job. Coordinating design and print is a complicated task. Not all applications support the file formats, functions and features needed to create a successful print file. It is vital to use industry standard software, tools and

procedures in the design process. This ensures that vendors can handle the files appropriately and make changes when necessary.

This applies regardless of the file format. For example, although PDF is a universal file format used for file submission, not all PDFs are created equal. A brochure laid out in a word processing program and then converted into a PDF may have type reflow issues, low-resolution imagery and mismatched color spaces. It will not support spot colors and other print specific functions. It will not pass most preflighting systems and most often will require recreation in a more standard page layout program. It could add delays and additional costs to the project.

Design Features

Designers can select many design capabilities in their applications that printers cannot easily print and convert. Transparency is a great application feature that allows more innovative designs, but it can create headaches downstream. When the design is ready for press, a raster image processor (RIP) converts the design to a machine language suitable for a particular print process. Different RIPs handle transparencies differently, and unexpected print results may occur. Prior discussions with print partners about which settings to use, as well as how to prepare the file, can eliminate these surprises. In general, when using a feature for the first time, consider how it will affect the print process and communicate accordingly. A quick email or telephone call to your printer

can preempt many headaches later on, where mistakes can have costly penalties.

Multimedia, RGB and CMYK

Today, a project might not only be printed, but it may have digital distribution as well. An efficient workflow allows you to use assets for multiple purposes while creating a cohesive design that maintains a tight aesthetic between the multimedia output and the printed product.

To this end, design files should begin in an RGB color space. This allows the greatest color gamut and can then be repurposed for different intents later in the design process. Communicate with print partners to determine if and when CMYK conversion should take place, and what reference print condition the CMYK conversion should target. In the case of point of sale (PoS), trade show graphics and other wide format uses, print partners may prefer the RGB files so that they can take advantage of the expanded gamuts of digital printers. For online web and tablet applications, RGB is mandatory for the best visuals.

Color Management

Use color management when available in the design tools. At the most basic level this means choosing the proper colorspace profiles for creation, as well as final printed output. Design suites such as the Adobe Creative Cloud even allow synchronizing color management preferences across the entire suite from a single easy-to-use interface within Adobe Bridge. If you are unsure of which settings to use, contact your print provider. Just as important is to synchronize those same settings among the entire creative team. That way file exchange can happen seamlessly and color fidelity is maintained between not only applications but also different

designers. The minimum settings are the selection of appropriate RGB and CMYK profiles, and how to handle color mismatches. Idealliance has kits and Adobe Color Settings Files available at www.Idealliance.org/ specifications/gracol, as well as instructions on how to use these settings and profiles. In general, use embedded profiles when available. RGB should be set to the most common denominator profile among your assets. This is often sRGB (though it does not contain the largest gamut), especially if the project will have a multimedia component. AdobeRGB is also common, especially in commercial photography. CMYK should be the dominant print condition, and the most common CMYK profile used is GRACoL 2006 or GRACoL 2013. GRACoL is a good choice because it can easily be converted to smaller gamut colorspaces if needed. These settings are defaults and serve as a starting point for all new files. Individual files can have separate preferences as well that can tailor each project to the intended output. For example, although most projects may be targeting Gracol 2006, an individual file may be targeted to SWOP.

Paper

When creating designs, paper choice as well as specialty inks should be considered at the beginning of the creative process. Paper choices along with the print process determine the color gamut as well as image quality of your project. For example, coated premium papers printed offset will have a much larger color gamut and higher image quality than newsprint. If the design calls for bold, vibrant colors, then a coated sheet is needed. If a muted, warm, urban, tactile aesthetic is desired, then a recycled matte stock may be chosen.

When developing the design, take care to account for the paper and print process limitations. Large inked areas or small reverse type do not work well on matte and uncoated stocks. Rules below a certain point size may disappear altogether while others may expand more than expected. Again, communicate with print partners to get design limitations specific to the paper type. Paper may not even be paper. Commonly used print processes such as flexo and offset lithography, along with newcomers in the digital press arena, can now print on a wider variety of substrates, including board, plastics and metals. In these cases, the color of the material is not white and can treated as another color in the design process. Successful designs incorporate the substrate color as an integral part of the design itself.

Specialty Inks

Specialty inks can include not only popular spot color systems, but also custom mixes as well as non-inks such as aqueous coatings. Preparing files using these spot colors is relatively easy, but sometimes that ease creates complications since it is also easy to make mistakes as well. Determine the exact inks that will be used and how they will be named. A project can have multiple files but should not use multiple names to refer to the same ink! Again, communicating with the entire design team, as well as the print partner, to come up with a common palette will avoid later complications. Making sure that everyone is using the same system and the same version/release of each system will avoid color mismatches. Using CxFX4 in your workflow will provide all the data needed for your supply chain partners to align with your aims and their deliverables.

GUIDELINES FOR CREATIVES: FILE PROOFING

Monitors

Humans are visual people. Our sight is our most import sense, and it is how we interact most with our surroundings. We make choices based on what we see. So for color evaluation, an accurate monitor is vital in the design process.

In a creative environment, color evaluation and editing are performed by multiple people. Calibrated and profiled monitors ensure that everyone views the files the same way and that colors are consistent. Most professional graphics monitors sold today meet these needs. These monitors, coupled with inexpensive monitor profiling hardware, ensure accurate on-screen presentation of the file's color. Monitors should be recalibrated and verified periodically to maintain color accuracy as part of an overall process control strategy. Monitors with built in sensors make this a painless process.

Viewing Environment

Critical color evaluation benefits from a stable and standardized lighting environment. Most creative environments are chaotic workspaces with mixed lighting that varies throughout the day. Monitor hoods and dim lighting are preferred, but dedicated viewing workspaces are often necessary for truly critical color evaluation.

When evaluating hard copy, a dedicated viewing station ensures the truest perception of the color. Color correct lights at the proper illumination and color temperature ensure that proofs do not shift color due to non-standard light sources. ISO 3664:2009 specifies the current standard viewing conditions, and many professional graphic arts viewing stations meet these requirements.

Hard Copy Proofing

Proofs may be provided by prepress and print partners, but they can also be produced in house. These in house proofs allow for greater project flexibility, permitting creatives to make better color decisions earlier during the design process. If properly prepared and verified, these proofs can also be used as the final proofs and a color target for print partners as well. Inkjet printers, coupled with color managed RIPs and appropriate proofing stock, can produce proofs that match the print conditions required by the project. Just like profiling monitors regularly, these inkjets need to be recalibrated to maintain their color accuracy. Paper is also a color and needs to be taken into account when proofing. If the final product is printed on a paper that is significantly different from the proofing medium, create proofs that include paper simulation in order to mimic the final output. We are very sensitive to paper white, as our color perception of the rest of the proof is scaled to the white of the paper. Aside from inkjets, color lasers are often used in creative workflows. Although a rigorous schedule of calibration and profiling can produce an acceptable proof, these devices tend to be quite variable over a short time period. Although they are great for looking at design layouts and FPOs, as a proofer they require constant maintenance.

GUIDELINES FOR CREATIVES: FILE PRE-FLIGHT AND PREPARATION AND SUBMISSION

Preflight

Most standardized graphic arts software includes a preflighting function.

Preflight allows you to check the fidelity of your file and determine if it is appropriate for its intended application. For example, if your file is intended for an offset print process, preflight will check for image resolution and flag any images considered low resolution. This allows you to correct for most common problems before the file is sent to your print partner or before you create your press PDF.

PDF

PDF is the most common file format for file submission. PDFX4 files contain fonts, images and color information for output. Properly prepared, a PDF should print with minimal issues. Just submitting a PDF, however, does not ensure that it is printable. PDF encompasses a wide range of features, and some of them may not be compatible with all RIPs. So preflighting the PDF for your particular print process before submission to a print partner is important. The Ghent Workgroup, www.gwg.org, (an industry association of graphic arts users, associations and developers) establishes leading practices for creating, processing and exchanging files for the graphics arts industry. These industry wide recommendations, along with the specific parameters specified by the print partner, will ensure a hassle-free RIP process.

Color Conversion

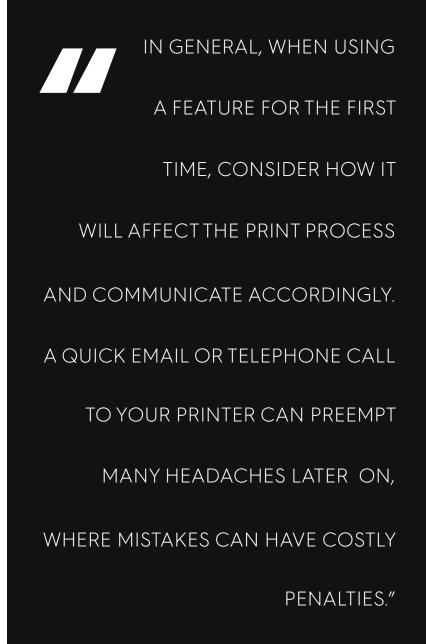
Here, communication is key. Depending on the print partner, CMYK or RGB files are preferred. And if CMYK is needed, which CMYK color profile should RGB data be converted to?

In the case of digital printing, most print partners prefer RGB data. CMYK conversion is done at the RIP stage and most often targets the

wider color gamut available on most digital printers. For more traditional print processes, CMYK is needed. However, some print partners may prefer to do the conversions internally. As long as the file has been prepared properly with embedded RGB profiles, the conversion is fairly straight forward. Other print partners prefer receiving converted files. In this case, print partners should specify the CMYK profile to be used: either a custom one for that print facility or a standardized reference print condition such as GRACoL. Conversion can be done during the PDF creation process, manually or through automation.

GUIDELINES FOR DESIGN: CONCLUSION

Creatives' roles have expanded over the years. The advent of new tools and technologies means a more holistic approach is necessary in order to complete any project. The designer's skillset must now also include a smattering of process control, color management and prepress duties. Communicating with all parties before, during and after a project is critical to success. Industry standard procedures and specifications, when implemented and regularly verified, contribute to this success.



Leading Practices FOR PRODUCTION

Much of the contemporary print process involves digital processing, file conversion and file preparation. Despite the complexity of the prepress workflow, prepress is the easiest process to validate and verify. Audit files can be run through the workflow to make sure files are processed correctly. Plates can be measured and checked for proper values, and proofs can be measured and validated.

A prepress workflow needs to be designed to ingest customer/internally created files and prepare them properly for the given output condition that the job will be imaged to. It is not the customer's responsibility to know what device the job will be imaged on, but it is the customer's responsibility to select and communicate the printing aim. (The printing aim is a reference print condition, most commonly expressed as an ICC profile). The printing aim is greatly affected by the substrate, which is one of the most important cost considerations related to print reproduction. The printing aim is process independent, but it is contingent upon the appropriate substrate, which must be considered in any color reproduction scenario since substrate is the fifth color in any four-color printing condition.

The prepress workflow should be defined to work with specific parameters such as file formats, and requirements for elements for the files to image correctly. This needs to be clearly communicated to the clients by the premedia or print facility to ensure that the clients submit suitable files for any given prepress workflow.

Each file will be preflighted when received to ensure that the supplied file has the required elements necessary for proper color reproduction. The prepress department needs to be very precise in defining which file formats are accepted and, when necessary, detail the parameters related to version number, image resolution, embedded ICC Profile handling, spot color handling, transparency handling and font handling. For instance, a good workflow today should be able to handle a PDF/X4 file that allows for transparencies and RGB elements within the PDF. From a customer viewpoint, this allows for a truly device independent PDF that can be used for multiple purposes, including a website, mobile and tablet, and virtually any kind of print based on the printing aim defined by the customer.

In order for color to be properly reproduced on an output device, the output device needs to be calibrated and properly color managed to hit the printing aim gamut within the given tolerance. Equally important, the source files (such as images and pages) must be separated into that same printing aim condition.

Most prepress workflows today assume that the files are separated in the correct printing aim gamut, but in many cases they are not. Some PDF files have images that have mixed gamuts and colorspaces that are impossible to fix on press. Most press operators have experienced this. They have a press form with one fleshtone image rendering perfectly and a second fleshtone in line imaging too yellow. Both images were in CMYK color space but not the same CMYK color space. Therefore, they print differently. This is a problem that occurs with most prepress workflows used in production today. You can test if your workflow fixes this issue by using an audit PDF file.

It is much easier for the prepress department to handle client files if they are already separated into the correct printing aim, though many clients are not capable of doing this properly in which case it may be safer to submit RGB files and let the printer or prepress make the conversion to CMYK. In the same way that an ideal prepress workflow applies different plate curves for different presses and substrates, an ideal prepress workflow should also be able to "reseparate" customer files into the proper "printing aim" based on the intended print condition. During this same step, the file can be optimized (replacing CMY with K) for the given printing condition to greatly improve the make ready times, stability, drying time and ink consumption. This will greatly improve the accuracy of the job when printed as well.

PLATESETTER

The platesetter should be maintained based on manufacturer recommendations

to ensure repeatable results. Plates should be measured with a suitable measurement device to ensure the desired values are being met on the press. The plate values should be recorded for the raw/na-ked condition and recorded for each desired plate curve. This will help troubleshoot the problem should one or both of the values not be correct. It is critical that the plates are measured to ensure that the plate setter does not become a variable when ensuring that the press is printing correctly.

DIGITAL FRONT END (DFE)

When imaging on a digital press, it is critical to know what the value is of the tone reproduction curve (TRC) on the digital front end (DFE) in order to properly influence the color on a given device. These curves should be managed and tracked just like a conventional plate curve on a plate setter. The TRC in a calibrated condition should be documented, and the curve in a color managed condition should be documented if it is different from the calibrated state. The DFE version will control how complex elements such as transparency, blends and other elements are rendered. With a current RIP, these elements will render correctly. An older RIP may encounter errors and issues.

PROOFING

The prepress service supplier is responsible for proofing to the client the agreed upon printing aim condition (this could be one of the seven CGATS.21 printing conditions, including both SWOP and GRACoL) for color matching according to the manufacturer's application data sheet (ADS). (See the proofing section for more information on proof verification.)





Leading Practices: IN HARD & SOFT PROOFING

THE IMPORTANCE OF PROOFING

The color proof is an important component of an accurate color reproduction workflow. The proof should adhere to the print standard appropriate for the print production process and be within defined tolerances. The proof is the reference to which all stakeholders refer to determine correct color. Because proofs are normally much more stable than many printing processes, the proof is also an indicator of print or press accuracy. Inability to match a verified contract proof often indicates problems within the printing process. GRACoL 2006 or SWOP 2006 have been the predominant target color spaces for proofing, regardless of simulated print process. Most digital front ends (DFE) that drive today's proofers have GRACoL and SWOP profiles preinstalled so that users can easily calibrate to these reference print conditions. In addition, many papers are produced that specifically meet the white points of reference print conditions such as GRACoL and SWOP. Proofs are easy and inexpensive to make. The most important consideration is to make sure that a proof is an accurate and valid proof upon creation of the proof.

Every Proof Needs a Control Strip!

Every proof must have an Idealliance ISO 12647-7 Control Wedge 2009 or 2013 on it. Failure to include a control strip could result in rejection of the proof by other involved parties. The control strip lets all parties involved verify that the proof is valid and the print condition is achievable. In addition, the proof also lists the reference print condition, as well as other settings and information that are valuable to all parties. Most proof producers use an application and measurement device to measure and verify that the proof is valid. Many proof providers print and affix a label demonstrating that the proof was measured and passed the proofing tolerances. The Idealliance website also includes a spreadsheet and colorbar that can be used for proof verification. The spreadsheet and colorbar can be downloaded from www.gracol.org.

Changes to Proofing

Over the past several years there have been several changes to standards and processes, and to Idealliance's recommendations that improve proofing in general. The most important result of current developments is that Idealliance has created a series of G7-derived

reference printing conditions (CRPCs) with gamut and white points adjusted to encompass nearly all print processes. These CRPCs are now in corporated into CGATS 21. Additionally, measurement and lighting standards are now closely correlated with the updates to ISO 3664 (lighting) and ISO 13655 (spectral measurement). When properly implemented, proofs are more accurate, realistic tolerances can be made, and the challenges of OBAs can be better managed. To help with these changes, Idealliance is developing a workflow that allows for more accurate and predictable proofing for all print processes. This publication is intended to be a reference for current developments and to provide leading practices for proofing. Beyond this publication are some useful references:

- 1. Idealliance Guide to M1 Workflow
- 2. Idealliance M1 Kit

Both of these are available from www.gracol.org.

Proofing System Certification

In the past, Idealliance has maintained a certification process for both hardcopy and soft-proofsystems. Prior recommendations were that a certified system must be used. While these programs continue to be valid, they are currently being updated.

PROOFING GUIDELINES

Hard-Copy Proofing

Hard-copy proofs typically are created with some form of inkjet proofing. A RIP is commonly used with a printer capable of rendering the desired CRPC. A wide-format inkjet printer is an ideal tool for proofing, since the gamut generally encompasses all CRPC datasets, while a RIP enables the color control necessary to achieve and maintain the CRPC.

The following guidelines have been developed to use current standards, including the use of the ISO 3664 lighting and ISO 13655 M1 instrumentation. If you are matching an M1 CRPC, more details can be found by referencing the

Idealliance Guide to M1 Workflow available at www.gracol.org.

The proofing system should be characterized using an IT8.7/4 target, comparing it to the reference print condition and should meet the following conditions according to ISO 12647-7.

- **A.** White point \leq 3.0 Δ E(00)
- **B.** Average over IT7.4/8 <=2.0 $\Delta E(00)$
- **C.** 95% over IT7.4/8 <=4.0 Δ E(00)



The Idealliance ISO 12647-7 2009 Color Control Wedge

Every proof should include an Idealliance ISO 12647-7 compliant, three-row digital control wedge 2013, and each proof should be verified to meet these tolerances defined in ISO 12647-7.

- **A.** White point \leq 3.0 Δ E (00)
- **B**. Average over the control wedge $\leq 2.0 \Delta E00$
- **C.** Maximum over the control wedge \leq =4.0 Δ E00
- **D.** Average over 3-color gray patches <= 1.5 Ch
- **E.** Maximum over 3-color gray patches <= 3.0 Ch

Soft Proofing

Soft proofing is an important part of graphic communication. Designers, prepress staff and even consumers spend more time than ever looking at information on screen. Often, particularly in the case of print designers, there is the expectation that what they see on the screen should match the printed result. Many large national brands and publications no longer even use hard copy proofs, but rely exclusively on soft proofing. Soft proofing consists of three major components that work together to deliver the soft proof.

The first of these is calibration. The calibration state typically consists of adjusting the monitor so that the gamma, whitepoint, brightness and contrast are in an optimal and repeatable state.

In this process the monitor is very important. Many inexpensive LCD monitors are rarely usable for soft proofing. The number one obstacle to soft proofing in most shops is a lack of a suitable monitor. As a rule of thumb, any monitor more than a few years old may not be appropriate, and most monitors that are not professional graphics monitors also may not work. Performing soft proofing requires a good monitor, software and a measurement instrument. In preparation for calibration, gamma and the white point are selected. Both Apple and Windows systems have a recommended gamma of 2.2 (Apple for many years was 1.8). Gamma is the contrast of the display. Selecting an ideal white point may depend on ambient conditions, but in general D50 is a good starting point in order to be aligned with standard lighting. However, one may want to make adjustments to the white point to better simulate a desired stock in a custom viewing environment. Once these are picked, the monitor is calibrated by following procedures provided by the monitor vendor or the calibration software.

The next step is profiling or characterization. In this step the software captures a bunch of color patches and then creates a profile characterizing the display at the calibrated state. When complete, most software installs the profile in the operating system.

The final step is configuring the software. Desktop software such as Adobe Creative Cloud supports soft proofing, as do many other professional dedicated software applications. One thing to keep in mind when profiling monitors and setting up soft proofing is that there are always two profiles involved. The first is for the display system, which, along with the OS, makes the monitor display as accurately as possible. The second is for the color space you want to simulate. This is normally used by the application that will be performing the soft proofing.

Once you have completed the profiling, if you are in Adobe Creative Suite you will configure your working space.

If working in RGB, you will use the proof simulation (command-y) to simulate final CMYK output. If you're already in CMYK you can also use the proof simulation function to simulate other CMYK working spaces.

The soft proofing match can then be tested by using a calibrated proof and comparing it to an image on the screen. If it does not match, often the monitor is the problem. If you do have a good graphics display, you can then review your settings and make sure they are correct. Also make sure to adjust and check the application settings.

There are new ISO standards for display proofing such as ISO 12646 and ISO 14861. A new Idealliance Soft Proofing Certification program, based on these standards, is in development and can be used to assess the quality of soft proofing systems. See the Idealliance website for more information about this program.

STANDARDS IN LIGHTING

Summary

Viewing conditions are an important part of any print workflow. Recent changes to the ISO standard for viewing conditions have prompted changes to the lamps used in most print viewing booths. This section briefly outlines the changes and possible issues, as well as ways to work with the new standards. It is provided with no guarantees or support and is for informational purposes only.

ISO 3664:2009 AND CHANGES TO LAMPS FOR VIEWING BOOTHS

The ISO Standard for viewing conditions was changed in 2009. The new standard includes many improvements, including being a closer match to real daylight, as well as being in closer agreement with CIE specifications for illuminant D50. To meet the new specifications, most standard lighting lamps needed to increase their UV content. All lamps shipped after 2011 were modified to meet these specifications, and lamps for most standard viewing equipment now meet the new specifications. This means that new lamps now generally contain more UV content. What are the implications of the UV content contained in the new lamps? They illuminate the brighteners in the substrates just like typical viewing conditions.

For more than six years, proof-topress color matching has been done in viewing booths with lighting that contained lower UV content. Proofing papers also contained few optical brightening agents (OBAs), allowing measurements to be taken from these papers for ICC color management purposes. When placed in a viewing booth where the lighting has little UV content, a typical press sheet with OBAs and a proof on paper with no OBAs would provide a good color match. Not so with the new lighting sold today that meets the new ISO standards.

POTENTIAL ISSUES

Although many users might not encounter any issues with the new lighting, some might find that they can no longer obtain a proof-topress match using the new lighting because the UV content of the new lights is exciting the OBAs in the press sheet, but the proofing paper they are using does not contain brighteners. Most paper manufacturers provide alternative papers with various levels of OBAs. Using a modern spectrophotometer in M1 mode will align proof to print. If you print with paper containing OBAs and your proofing paper has a coating to block OBAs, the press sheet will look bright white and the proof will appear yellow. It is often important to obtain a quick visual match from a proof-to-press sheet. This visual mismatch can be a deal-breaker for many printers and their customers.

There are currently two practical approaches to providing a good proof-to-press match when using brightened printing stock. We outline them here.

M1 (2013) Workflow:

Use an M1 workflow and reference print condition such as GRACol 2013, SWOP 2013, ISO 12647-2:2013, or CGATS 21 if there are optical brighteners in any substrate. Maintain and replace your lamps with new ISO 3664:2009-compliant lamps. If you need help determining whether your lamps are compliant, contact your manufacturer. There is also information on ISO 3664-2009 lamps at www.gracol.org. Note that it is important that everyone in your production workflow (customers and printers) use the same lamps. This approach will work best with M1 workflows containing updated lamps and measuring devices capable of reading M1.

M0 (2006) Workflow:

If you are using an M0 workflow and reference print condition such as GRACoL 2006 and SWOP 2006, you may notice visual inconsistencies between white points of proof stock and paper stock.

press stock appearing blue or bright white. If you encounter problems like this, you may choose to use a UV filtering lens in your viewing booth. Both JUST Normlicht and GTI include or make UV filtering lenses for their viewing booths. A UV filtering lens will block the UV light from passing through, effectively making the new lights act like the previous lamps, which had minimal UV content. This will allow you to have the same proof-to-press match that was possible prior to the introduction of the new standard and newer lamps.

If you use a UV filtering lens, it is important that everyone in your production workflows (customers and printers) also use a UV filtering lens so they have the same viewing condition. You can use the UV filtering lenses and still be compliant with 3664:2009. The ISO 3664:2009 standard allows for the use of a custom standard (such as 3664:2009 using UV lenses) as long as it is used in the entire production workflow. UV filtering lenses also degrade over time, so they will need to be replaced periodically. Remember everyone in your workflow needs to be aware of your choice if you chose to use these lenses.

To meet the newer viewing and measurement standard, the emerging process is to match the amount of apparent OBAs between the proofing stock and the printing stock. This, in combination with an M1 measuring workflow, should allow good proof-to-press matches and also meet current reporting requirements.

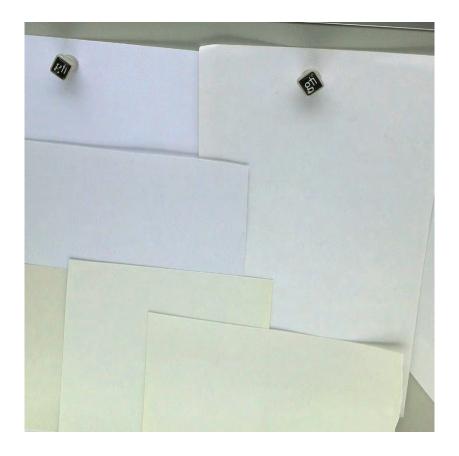
To help with these changes, Idealliance is developing a

workflow that allows for more accurate and predictable proofing for all print processes. This publication is intended to be a reference for current developments and provide best practices for proofing. Beyond this publication are some useful references:

- 1. Idealliance Guide to M1
 Workflow
- 2. Idealliance M1 Kit

Both of these are available from https://www.idealliance.org/gracol

THE ISO STANDARD
FOR VIEWING
CONDITIONS WAS
CHANGED IN 2009.
THE NEW STANDARD
INCLUDES MANY
IMPROVEMENTS,
INCLUDING BEING A
CLOSER MATCH TO
REAL DAYLIGHT, AS
WELL AS BEING IN
CLOSER AGREEMENT
WITH CIE
SPECIFICATIONS FOR
ILLUMINANT D50."



The picture above shows the effects of updated lighting on various papers. The bottom three papers are two proofing papers and one press sheet with no OBAs. The sheets above are press sheets with varying levels of OBAs. Under previous viewing conditions these may all have looked similar.

PROCESS CONTROL IN

PRINT PRODUCTION

For some time, printing has been making a transition from a craftbased industry to a manufacturing process. Economic pressures and competition have continued to push printers to become more efficient, which requires more process control tools. Idealliance's online G7 Process Control program is intended to help printers make process control an integral part of their manufacturing operation. Many industries invest heavily in making sure that every single manufactured item is identical. But because of the large number of variables in the printing process, making every single press sheet an identical match is almost impossible. The goal for most printing plants is repeatability: the idea that the same printed piece can be reproduced over and over. To achieve this, printers must be able to predict the final outcome of the printed condition and identify and verify each step in the process for conformance. This is the essence of process control and printing to a specification or standard.

RECORD ALL THE

METRICS

The key to controlling all of the parts of the process is to record all of the metrics, from file creation to proofing to press. This entails building a file to an industry specification or standard and recording data from the proof condition, the plate condition and the press condition. Without recording our benchmarked condition, we have

no way of telling if printing will be consistent. Starting with the file, the output intent must be identified by choosing a printing aim such as GRACoL or SWOP, which clearly sets the expectation for the finished product.

For the proof condition, we want to record lab data from our properly calibrated G7/GRACoL/SWOP proof. This lab data can be compared against data on a proof to ascertain that the proof is compliant with the specified aim. This data is typically recorded from a color control wedge on the proof. The tolerance can vary from less than 1 ΔE to as much as 2 ΔE or more, depending on how tightly you are monitoring your proofing system. While this can be accomplished at no cost using spreadsheets, it is more often done using dedicated quality control software. Software can give you a pass or fail condition on the proof and will typically allow you to print a label indicating the proof compliance status for inclusion on the proof. The key idea here is to read the proof and make

sure it has not changed and therefore is compliant with industry specifications and standards.

PROOFING

While inkjet proofing systems are typically stable, simple issues such as a clogged nozzle can cause a proof to become invalid. How many proofs need to be read? Shops that are meticulous about maintaining high quality read every single proof, while shops that are less willing to maintain these standards might read a proof daily to verify that the proofing condition has not changed. Identifying and establishing best practices for maintaining your proofing equipment is essential for successful, trouble-free proofing.

PLATE

The next area to record is the printing plate. We typically want to record dot gain on the plate.

Because all plates can vary by color, it is important to pick a specific plate color as the benchmark value. For example, always reading the 50% on the black plate can tell us if the plate is changing.

| Paper | max ∆Em ≤ 3.0 | 0.0 | ✓ HEATSET NEWS PROOF |
|------------|----------------|-----|---|
| Delegacion | max AEm = 5X | 0.0 | ✓ CGATS21 CRPC2 |
| Primaries | max 4H 5 25 | 0.0 | ✓ M1 - SCCA OFF |
| | | | ISO12647-7:2013 |
| Overprints | max ∆End ≤ 61 | 0.0 | - / |
| Conso | avg wachs 15 | 0.0 | Passed V |
| Grays | max wACH & 3.0 | 0.0 | |
| NPDC | avg wal.'s 1.1 | 0.0 | 8/26/14 22:41 |
| NPDC | max wal." = 31 | 0.0 | This software is provided free of charge as |
| Overall | avg AEm ≤ 31 | 0.0 | a demonstration tool only. Its use does not constitute a warranty or certification by |
| Overall | max AEm s 81 | 0.0 | IDEAlliance as to the accuracy or quality of a proof |

Example of a proof pass/fail label

Many high quality shops read each plate as it comes out as part of their quality-control procedure. Shops that are less stringent will read a plate every day to make sure they are not having any consistency problems with their plates.

PRESS

The press is the most complicated and mechanical part of the process and because of this, it is the part of our manufacturing process that deserves the most attention. In most printing plants, press conditions are constantly changing. If it's not the season and the weather, then it's wear and tear on machines and the differences among operators. Since the presses are the most expensive pieces of equipment in the plant, as well as the key moneymakers, it should come as no surprise to learn that the press deserves a lot of attention. Recording data on the press is very important because if the press is drifting or has changed, matching the proof can become virtually impossible.

Several easy-to-record indicators can show if the press is changing. Besides the actual color of the ink, the simplest item to record is the dot gain at a specific density for each cylinder. Changes in the amount of dot gain from the recorded dot gain over a number of jobs on the same substrate indicate that something has changed on press and you need to take corrective action. For example, if you suddenly have problems matching proofs, you can read the proof to determine whether the proof has changed and read the plate to see if the plate has changed. If you stop to read the press gains and notice that the yellow gain has gone up 10%, you will suspect that something is wrong with the yellow unit.

Typically a press operator can use this type of information to check the press and make sure there is not a problem on the cylinder in question. Of course, even an expensive press has some variation, so one job being out of spec does not necessarily indicate a problem on the press.

A number of variables can cause a press to print out of spec, so you need to see the same behavior on multiple jobs to determine whether there is actually an issue or trend. Measuring such things as LAB values for solids and trap information can also be valuable in determining if there is an issue on press. The key point here is that unless you are recording this information, you won't know if you are printing correctly or not.

A number of tools and procedures are available to monitor the printing process and turn printing from a crafty, emotional game into a well controlled manufacturing process. To learn more about process control, consider the G7 Process Control Program, which can provide you with training and resources so that you can take control of your print process workflow.

HOW DIFFERENT MEASUREMENTS CAN HELP YOU

G7 measurements of printed material have become more important than ever. By defining targets, G7 specifications make it easier than ever to tell if you are "there" yet. Instead of wondering if it is "good printing," we can use measurements and standards to know if the process is under control.

Comparing these measurements to our target values can produce key indicators to show whether we can print predictably or, conversely, if something has gone terribly wrong with the print process. What numbers should we learn and know about for pressroom measurement? Depending on what we are doing, these are often the same metrics we have always used, such as density and dot gain. Contemporary color measurement in the pressroom does not rely exclusively on the oldschool metrics, although those indicators are still important. Because much of color measurement today is based on measuring color itself rather than just density, new measurements can tell us what is happening on our press and proof. The following basic metrics for G7 Process Control can be used in daily production. They can usually be found on a standard color bar and normally do not require separate press runs.

· LAB Values for Ink Solids.

Even though they are not used for daily production, LAB measurements of solid ink values are very helpful for troubleshooting. First, they indicate whether we have achieved ISO compliance with our ink set and corresponding density. Second, these values can tell us if our ink is changing. If the LAB value between the current ink and the reference measurements is great enough, it means that the ink might have changed. This could indicate a pressside problem, such as contamination, or it could indicate consistency problems from the manufacturer.

An easy way to tell if the ink has changed is if the press and proof are not matching a simple LAB measurement of the inks. This test will also indicate whether the ink is ISO-compliant at the densities being run. The same ink at the same density on the same paper should be relatively consistent and should not change by more than a few ΔE .

• LAB Values for c50/m40/y40.

The lab values for the neutral patch are often a great overall indicator of the calibration state of the press. While using gray balance as a metric for daily operation can be difficult, it can be helpful in seeing exactly where the press is and whether the press can maintain the ideal calibration condition. In daily production you will probably have to nudge your solid ink densities to achieve these values. But if the calibration conditions have stayed the same, you should be able to come close to this. A quick glance at this patch can tell you where your system is, as well as confirm any color bias you are seeing. (Once you are familiar with LAB readings, any deviation from the above will tell you exactly where the color is headed.)

• LAB Values for Overprints.

LAB solids for overprints are often overlooked, but can be valuable tools. When operating to a specification such as GRACoL or SWOP, the overprint values can be used to tweak the ink aim points so that you achieve the best possible ink film thickness, as well as overprint colors (such as blue sky instead of purple sky). In daily production, a large deviation can indicate that press conditions have changed and need to be inspected. While there is no official ISO tolerance for LAB measurements of overprints, a tolerance of 6 ΔE is used for G7 Targeted.

• Density Values for Ink Solids. Although density for ink solids is a tried-and-true measurement, once we have determined our proper ink densities, it is important that we maintain them. Accurate printing and the value of LAB and other measurements are closely tied to the press operator being able to get to the same point (usually) through density. Tolerance for this on a specific media and print condition is generally 0.05.

• TVI (a.k.a. Dot Gain).

Dot gain is another old-school metric that is very important for diagnostic purposes. A large fluctuation of dot gain of the same density on the same paper indicates a potential problem with the press or platemaking. For example, if the reference dot gain is 16% and after learning that proofs are not matching we see that one cylinder is now gaining 27%, we will know exactly where to look and why we can no longer matcha proof. Tolerance for this varies depending on the printing process, but generally can start at +/- 4% and can be loosened from there if necessary for daily production.

• LAB Values for Substrates. LAB

values for paper are valuable as a reference point. When using tight process control, the above values are valid when run in the same conditions, meaning the same paper and ink. Of course, many papers can be made to work by simply adjusting the solid ink densities as printers have done for decades. For all of the other values to be useful for troubleshooting, you will need to be on the same or similar paper. The LAB reading will tell you if that paper has changed or if it is a completely different paper. Even if you are checking this during runs, you can detect a change in paper if an operator throws in a supposedly similar paper because they have run out of the original paper.

HOW MUCH TO

MEASURE?

The above measurements are very helpful in maintaining good process control. Obviously not every sheet can be measured, nor would this be desirable due to the wide variety of stocks used. There are several aspects of process control. The first is daily process control: how you run. In general, you should attempt to run your jobs to the reference densities. (Keep in mind that with out-of-spec papers, your densities will change slightly.) The idea is to start at these target densities and make whatever adjustments are necessary to match the proof. At the same time, operators should be comfortable checking the dot gain or NPDC curves when at density to make sure everything is running as required and that no major mechanical issues have occurred. The second is longterm process control: the ability to check and adjust for the inevitable changes that occur in press rooms before they become a crisis. While it would be great if every sheet could be read, this is not practical, either. By reading sheets throughout the run, as the press falls out of spec you can take note of the new condition and make corrections as soon as possible via mechanical adjustments on press or gain curves. The big issue is not how much you are measuring, but simply to be measuring and monitoring your printing conditions. To learn more about process control, consider the G7 PC Program, which can provide you with training and resources to take control of your print process. Details at www. idealliance.org/ g7pc.

STANDARDIZED PRINTING GUIDELINES

USAGE CHART (MOSTLY FOR CREATIVE, PRE-PRESS AND PROOFING PERSONNEL)

| REFERENCE PRINT CONDITION (RPC) | PRINTING METHOD/ SUBSTRATE | ICC PROFILES | PROFILE USE | TAC | MAXK | ОВА |
|---|--|-------------------------------|----------------|------|------|----------|
| CRPC-1 2013 (SNAP2008) | Coldset / Newsprint | CRPC-1.icc | OF | 240% | 90% | Unlikely |
| CRPC-2 2013 | Heatset / Improved Newsprint | CRPC-2.icc | OFD | 260% | 95% | Unlikely |
| CRPC-3 2013 | Sheetfed-Web / Premium uncoated | CRPC-3.icc, GRACoL UNC.icc | OGFD | 270% | 100% | Likely |
| CRPC-4 2013 | Web / Supercalendar | CRPC-4.icc | OGFD | 270% | 100% | Unlikely |
| CRPC-5 2013 (SWOP2006/Flexo Wide Web) | Web / Pub coated / White Poly /Corrugated Coated Liner | CRPC-5.icc, SWOP 2013.icc | OGFD | 270% | 100% | Likely |
| CRPC-6 2013 (GRACoL2006, SWOP CoatedV2) | Sheetfed-web / Premium coated | CRPC-6.icc, GRACoL2013 | OGFD | 300% | 100% | Likely |
| CRPC-7 2013 | Sheetfed-Digital / Premium stocks | CRPC-7.icc | OGD | 340% | 100% | Likely |

Legacy notes: SNAP-2008 identical to CRPC-1 gamut, with slightly higher TVI SWOP2006_Coated3 neary identical to CRPC-5 GRACoL2006_Coated1 nearly identical to CRPC-6

| DOT VALUES | | | | | | | | | | |
|------------|----|----|----|----|--|--|--|--|--|--|
| PATCH | С | М | Υ | K | | | | | | |
| HC_cmy | 25 | 19 | 19 | 0 | | | | | | |
| HR_cmy | 50 | 40 | 40 | 0 | | | | | | |
| SC_cmy | 75 | 66 | 66 | 0 | | | | | | |
| HC_k | 0 | 0 | 0 | 25 | | | | | | |
| HR_k | 0 | 0 | 0 | 50 | | | | | | |
| SC k | 0 | 0 | 0 | 75 | | | | | | |

Legacy Profiles: Profile Use Legend SNAP2008.icc O - Offset SWOP2006_Coated3, G - Gravure SWOP2006_Coated5 F - Flexo GRACoL2006_Coated1 D - Digital

Just look up your printing method and substrate combination to find the correct CRPC and/or free ICC profile to use in CMYK conversions, soft and hard proofing.

Using the correct profile when converting to CMYK will help the final printed work match what you see in Photoshop (within the limits of the printing system) assuming you have a high quality monitor with a custom ICC profile and proper color management settings.

Using the same profile as the "source" profile in a proofing workflow will help the proof match the final printed sheet, assuming the printing system is properly calibrated and controlled.

Note that higher CRPC numbers have wider color gamut and greater print quality, assuming the correct substrate and inks are used and the nominal printing aims are achieved.

Expert users can create their own ICC profiles from the appropriate characterization dataset, e.g., GRACoL2006_Coated1 to alter GCR, TAC, black printer strength, etc.

Medium GCR is built into the default IDEAlliance profiles. Higher GCR levels and longer-range blacks will improve dark colors and press stability, especially in neutral tones.

METRICS CHART (MOSTLY FOR PRODUCTION PRINT, PROCESS CONTROL AND QC PERSONNEL)

| CRPC | Р | ape | er | | | | Solid Primaries | | | | | | | | |
|---------------|----|-----|----|----|----|----|-----------------|-----|-----|----|----|-----|----|----|-----|
| | | | | | K | | | С | | | М | | | Υ | |
| Ref Char Data | L* | a* | b* | L* | a* | b* | L* | a* | b* | L* | a* | b* | L* | a* | b* |
| CRPC-1 2013 | 85 | 1 | 5 | 37 | 1 | -4 | 59 | -24 | -26 | 56 | 48 | -0 | 80 | -2 | 60 |
| CRPC-2 2013 | 87 | -0 | 3 | 30 | 1 | 2 | 57 | -28 | -34 | 52 | 58 | -2 | 82 | -2 | 72 |
| CRPC-3 2013 | 95 | 1 | -4 | 32 | 1 | 1 | 60 | -26 | -44 | 56 | 61 | -2 | 89 | -3 | 76 |
| CRPC-4 2013 | 89 | 0 | 3 | 23 | 1 | 2 | 55 | -36 | -38 | 47 | 66 | -3 | 83 | -3 | 83 |
| CRPC-5 2013 | 92 | -0 | -0 | 19 | 0 | 1 | 57 | -37 | -44 | 48 | 71 | -4 | 87 | -4 | 88 |
| CRPC-6 2013 | 95 | 1 | -4 | 16 | 0 | 0 | 56 | -37 | -50 | 48 | 75 | -4 | 89 | -4 | 93 |
| CRPC-7 2013 | 97 | 1 | -4 | 14 | 0 | -0 | 54 | -42 | -54 | 47 | 78 | -10 | 90 | -4 | 103 |
| XCMYK | 95 | 1 | -4 | 16 | 8 | 0 | 41 | -32 | -61 | 46 | 80 | 5 | 90 | -3 | 105 |
| GRACoL 2006 | 95 | 0 | -2 | 15 | 0 | 0 | 55 | -37 | -50 | 48 | 74 | -3 | 89 | -5 | 93 |
| SWOP 3 2006 | 93 | 0 | 0 | 10 | 0 | 0 | 57 | -37 | -45 | 48 | 72 | -3 | 88 | -5 | 88 |
| SWOP 5 2006 | 90 | 0 | 4 | 19 | 1 | 0 | 57 | -38 | -41 | 48 | 70 | -4 | 86 | -6 | 85 |

The Metrics Chart lists the nominal target values for G7 press control. Achieving the correct solid ink CIELAB values, relative ND and gray balance values on press helps simulate a properly made proof and reduces the need for custom press profiles.

- * Densitometer zeroed on paper
- * Nominal values: actual gray aims depend on substrate color.

Note: Relative ND and Gray Balance may differ slightly from available profiles due to software characteristics.

| CRPC | Solid Overprints | | | | | | | | | | Re | elativ | ve N | D* | |
|---------------|------------------|----|----|----|-----|----|----|----|-----|------|------|--------|------|------|------|
| | R | | | G | | | В | | | НС | | HR | | SC | |
| Ref Char Data | L* | a* | b* | L* | a* | b* | L* | a* | b* | CMY | K | CMY | K | CMY | K |
| CRPC-1 2013 | 54 | 44 | 25 | 55 | -35 | 17 | 42 | 7 | -22 | 0.24 | 0.22 | 0.46 | 0.44 | 0.64 | 0.65 |
| CRPC-2 2013 | 51 | 55 | 32 | 51 | -44 | 19 | 35 | 9 | -32 | 0.25 | 0.22 | 0.50 | 0.47 | 0.77 | 0.75 |
| CRPC-3 2013 | 54 | 56 | 28 | 54 | -43 | 15 | 38 | 10 | -31 | 0.25 | 0.22 | 0.51 | 0.47 | 0.79 | 0.77 |
| CRPC-4 2013 | 46 | 62 | 39 | 49 | -54 | 24 | 28 | 14 | -39 | 0.25 | 0.22 | 0.52 | 0.48 | 0.84 | 0.83 |
| CRPC-5 2013 | 48 | 65 | 45 | 51 | -62 | 26 | 27 | 17 | -44 | 0.25 | 0.22 | 0.53 | 0.49 | 0.88 | 0.86 |
| CRPC-6 2013 | 47 | 68 | 48 | 50 | -66 | 26 | 25 | 20 | -46 | 0.25 | 0.22 | 0.54 | 0.49 | 0.91 | 0.89 |
| CRPC-7 2013 | 48 | 75 | 54 | 50 | -72 | 29 | 20 | 26 | -53 | 0.25 | 0.22 | 0.55 | 0.50 | 0.97 | 0.90 |
| XCMYK | 46 | 73 | 56 | 42 | -72 | 24 | 19 | 19 | -51 | 0.25 | 0.22 | 0.55 | 0.50 | 0.97 | 0.90 |
| GRACoL 2006 | 47 | 68 | 48 | 50 | -68 | 25 | 24 | 17 | -46 | 0.25 | 0.22 | 0.54 | 0.50 | 0.90 | 0.90 |
| SWOP 3 2006 | 47 | 66 | 45 | 52 | -65 | 25 | 26 | 18 | -44 | 0.25 | 0.22 | 0.54 | 0.50 | 0.90 | 0.90 |
| SWOP 5 2006 | 47 | 64 | 43 | 52 | -62 | 27 | 27 | 19 | -42 | 0.25 | 0.22 | 0.54 | 0.50 | 0.90 | 0.90 |

| CRPC | Gray Balance | | | | | | | | | | | |
|---------------|--------------|------|------|------|-------|------|--|--|--|--|--|--|
| | HC_ | cmy | HR_ | cmy | SC_cm | | | | | | | |
| Ref Char Data | a* | b | a* | b | a* | b | | | | | | |
| CRPC-1 2013 | 0.7 | 3.7 | 0.5 | 2.5 | 0.2 | 1.2 | | | | | | |
| CRPC-2 2013 | -0.0 | 2.2 | -0.0 | 1.5 | -0.0 | 0.7 | | | | | | |
| CRPC-3 2013 | 0.7 | -3.0 | 0.5 | -2.0 | 0.2 | -1.0 | | | | | | |
| CRPC-4 2013 | 0.0 | 2.2 | 0.0 | 1.5 | 0.0 | 0.7 | | | | | | |
| CRPC-5 2013 | -0.0 | -0.0 | -0.0 | -0.0 | -0.0 | -0.0 | | | | | | |
| CRPC-6 2013 | 0.7 | -3.0 | 0.5 | -2.0 | 0.2 | -1.0 | | | | | | |
| CRPC-7 2013 | 0.7 | -3.0 | 0.5 | -2.0 | 0.2 | -1.0 | | | | | | |
| XCMYK | 0.7 | -3.0 | 0.5 | -2.0 | 0.2 | -1.0 | | | | | | |
| GRACoL 2006 | 0.0 | -1.5 | 0.0 | -1.0 | 0.0 | -0.5 | | | | | | |
| SWOP 3 2006 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | | | | |
| SWOP 5 2006 | 0.0 | 3.0 | 0.0 | 2.0 | 0.0 | 1.0 | | | | | | |

G7® PRESS CONTROL

G7 press control maintains tonality, gray balance and color reproduction by aiming for the solid ink CIELAB, ND (neutral density) and gray balance values listed in the Metrics Chart. G7 press control is more effective than older TVI-based methods because it directly controls photographic appearance and applies equally to all printing technologies.

Measuring G7 Tonality

G7 Tonality is controlled by measuring the ND (neutral density) values in the "HC" (Highlight Contrast), "HR" (Highlight Range) and "SC" (Shadow Contrast) patches. The HR_k patch has the most effect in controlling black-ink tonality. The HR_cmy patch has most effect in controlling tonality of the CMY plates, and also controls gray balance.

G7 Gray Balance

G7 gray balance is achieved when the HR_cmy patch measures half of the a^\star , b^\star values of the substrate. If the production

substrate color is different from the standard CRPC substrate, it may be necessary to deviate from the a^* b^* values in the Metrics Chart for optimal G7 compliance.

 $Likewise, to \ match \ an \ actual \ proof \ it \ is \ often \ easier \ to \ aim \ for \ the \ a^* \ b^* \ values \ measured \ in \ the \ HR_cmy \ patch \ of \ the \ actual \ proof.$

Controlling Gray Balance by Densitometry

Although G7 gray balance is defined in a*, b*, it is often easier to control a press using custom cmy gray balance densities determined by measuring the individual C, M and Y densities of a properly balanced HR_cmy patch. Any change in these CMY densities on the HR_cmy patch will show which ink(s) need adjusting.

Using Solid Ink Densities for Press Control

Although standard ink colors are published in CIELAB units, it is still possible to control a production press by measuring CMYK density values. To determine your own "custom press densities" for any press/ substrate / ink / combination, first achieve the correct CIELAB values with a hand-held spectrodensitometer, then measure the CMYK solid patches with the press control system. Note that densities found for one ink/ substrate/ densitometer combination may not work for another.



G7° Process Control Certification & Training is for elite suppliers & personnel from the global print & packaging supply chain.

G7 Process Control Master Facilities are independently audited & verified leading print providers who meet the most stringent requirements & implement Process Control throughout their entire print production.

G7 Process Control & Implementation Certification & Training for G7 Process Control Experts is an entirely hands-on focused training for individuals who are licensed to train, audit, & implement G7 Process Control Facilities & their entire print & packaging supply chain.

CROSS MEDIA: SIX STAGES OF AN INTEGRATED WORKFLOW

To adapt to the changing market environment, successful print providers are diversifying their offerings beyond print into crossmedia channels. Increasingly, non print related services and products account for a growing proportion of revenues. An opportunity exists for print providers that learn how to grow new revenues by adopting integrated media workflows.

TODAY'S PRINT WORKFLOW

If your business is print-based today, you are likely using a linear print workflow. The three basic stages in this workflow are:

- Capture & Create assets that make up the product to be printed. This includes the print design, (photographs, graphics or logos) and capturing additional content for the project.
- Edit & Produce the print product. This includes layout, proofing, preflighting, approvals, PDF generation and sending the file through a RIP so that it can be printed.
- Fulfill & Distribute. This includes printing, binding and distributing by the USPS or other physical method.

EMERGING REVENUE OPPORTUNITIES

Printers continue to own the primary business relationship with their print customers. Often these relationships have been forged over decades. With some updates in the products and services they offer, each printer can leverage its existing

business relationships to create new revenue streams by offering enhanced services beyond print. For example, printers often begin by offering upstream services such as design and prepress services. Fresh revenue streams can come from offering new services that can help make print more powerful. Printers have added services to personalize print by employing variable data printing techniques. Similarly, printers are growing revenues by offering services based on such technologies as QR codes and augmented reality to enable their printed product to become a more interactive means of communication. Now printers can offer services for the production of rich media or products delivered to digital channels. Examples of diversified service offerings that printers can offer include:

- Producing tablet or mobile apps in addition to print products already produced
- Integrating print with website/ online/e-mail services;
- Providing customer relationship management (CRM) services;
- Providing database list management services;
- Developing online marketing automation and management systems;
- Combining print and Internet solutions to build and deliver integrated marketing campaigns;
- Developing websites, online database applications, personalized URLs and QR codes;
- Developing an augmented reality marketing campaign;

- Printing on a wide variety of papers and substrates, including plastic, lenticular, styrene and cling;
- Printing for large format and signage;
- Editing, producing and streaming short-form video;
- Managing imagery, video and other rich media assets;
- Providing customized or generic marketing collateral on demand across media channels; and
- Printing and delivering personalized marketing collateral, including variable data.

THE INTEGRATED MEDIA WORKFLOW

Providing new services to existing customers results in a more complex workflow. Clearly, repurposing content and media assets for all media channels is a must. Ideally, this implies utilizing a central asset management repository. Early efforts to deliver products across media channels were realized by developing a parallel workflow for each media channel.

WHAT IS THE INTEGRATED MEDIA WORKFLOW MODEL?

To make a meaningful workflow transition, one must understand the concept of the "Integrated Media Workflow" (or IMW) model. The goal of the IMW is to be able to efficiently produce output to a wide variety of distribution channels from a single workflow. Rather than

using a linear process or a series of separate linear processes, the goal is to integrate media production centrally and to output to any distribution channel from that central system.

Note that in addition to moving from a straightforward linear model, the hub-and-spoke IMW model has several additional stages that are critical to the success of the IMW model.

UNDERLYING

TECHNOLOGIES

At the heart of an IMW is the "hub." One thing that distinguishes many current print workflows from an integrated media workflow is that in all likelihood, not all of the functions will be performed by hardware, software and staff at your physical location. Today you can add remote cloud services to enhance workflows without the level of investment or expertise formerly required by each individual printer. Additionally, underlying technologies enable printers to bring their customers into the loop remotely at any time. Certain technologies that underlie each stage of an integrated media workflow play a key role in ensuring media integration. These technologies can include:

Color Management: techniques and technologies for managing the color intent across devices throughout the integrated media workflow.

Metadata: descriptive digital asset labels that facilitate automation and contain critical asset information across an integrated media workflow (PDFx4).

Workflow and Asset Management Technologies:

technologies that manage and move content and media assets from

one process to the next, across an integrated media workflow.

Cloud Services: computer resources (including both hardware and software applications) that are accessed in real time to ensure that only the most current content and media assets are used throughout the workflow.

Security: technologies that ensure that your media assets are protected against loss, damage or theft.

Analytics: software and cloudbased technologies that track the output and measures the results.

THE ROLE

OF STANDARDS

Certain standards and specifications play an important role in a linear print workflow. For example, GRACoL, SWOP and G7 should be used to ensure color integrity from production to proofing and on the press. Using a PDF/X file format as the deliverable to a press is also critical in ensuring color and content integrity.

As we move to an integrated media workflow, many other standards and specifications come into play. These standards are critical to ensuring that tools can interact throughout the workflow. When all tools and the content and media assets themselves operate using the same underlying standards, they can be easily and completely integrated so automation can occur. Key standards and specifications should be noted in each IMW stage.

SIX STAGES TO AN IMW

One way to understand an integrated media workflow is to partition the functions into steps or stages. Some stages exist in current print based workflows, but others are new functions that are required to integrate with cross channel

media production. Some stages are at the "spokes" of the workflow while others are centralized. IMW stages include:

Create & Capture (create: to bring into existence; capture: to acquire)

Ingest & Manage (ingest: to bring into, to upload; manage: to organize, store and retrieve)

Edit & Produce (edit: to correct or modify; produce: to combine components into a product)

Transform & Publish (transform: to change from one format to another; publish: to finalize for fulfillment)

Fulfill & Distribute (fulfill: to package or print; distribute: to deliver or supply)

Report & Engage (report: detailed accounting; engage: to involve)



INDIVIDUAL CERTIFICATIONS - PERSONAL SKILLS TRAINING & RECOGNITION

An individual may become a Certified G7 Expert or G7 Professional, upon successful completion of the 3 day classroom-based training, and a certification exam.



G7° EXPERT: Certified in the field of color management, process and quality control for proofing and printing equipment, and is authorized by Idealliance to train in the areas of color and print related issues.



G7® PROFESSIONAL: Generally an in-house quality/technical professional who has attended and passed the in-person Idealliance G7 Expert/Professional training course with a minimum 80% course proficiency. Certification is valid for two years.



G7º PROCESS CONTROL EXPERT: Proven leader in the field of color management, process and quality control for the entire print production supply chain.



PRINT PLANNING & ESTIMATING MASTER: cover core planning and estimating concepts applicable to any print service provider environment, as well as specific instruction related to devices in digital, offset, large-format, and flexographic printing.



PRINT PLANNING & ESTIMATING OFFSET: The preeminent certification course for those involved in the offset firint filanning and estimating firocess.



PRINT PLANNING & ESTIMATING FLEXO: The preeminent certification course for those involved in the flexographic print planning and estimating process.



PRINT PLANNING & ESTIMATING DIGITAL: The preeminent certification course for those involved in the digital print planning and estimating process.



PRINT PLANNING & ESTIMATING WIDE-FORMAT: The preeminent certification course for those involved in the wide-format print planning and estimating process.



INTEGRATED MEDIA WORKFLOW (IMW) PROFESSIONAL CERTIFICATION: Demonstrated an understanding of the technology and workflow fundamentals essential to effective multi-channel, cross-media publishing (formerly Emedia Pro).



MAIL PROFESSIONAL CERTIFICATION: Equips those involved in the extended printing and mailing supply chain with a complete understanding of the postal-facing aspects of mailing.



MAILPRO© FUNDAMENTALS: MailPro Fundamentals teaches the primary principles of mail supply.



MAILPRO© ADVANCED: Advanced knowledge in the extended printing and mailing supply chain with a complete understanding of the postal-facing aspects of mailing. MailPro Advanced provides deep knowledge critical to the postal supply chain.



BRANDQ® CERTIFIED SUPPLY CHAIN EXPERT: BrandQ training is aimed at color management/process control epperts and focuses on required knowledge that is required to teach the BrandQ program and how to conduct location audits as a certiped BrandQ Certiped Supply Chain papert.



BRANDQ® MANAGER: BrandQ helps brand managers communicate eppectations and requirements and then c arefully monitor and measure these throughout their supply chain.



COLOR MANAGEMENT PROFESSIONAL® MASTER: Proven p rop cient in the p rincip les and best p ractices associated with color management imp lementation in a grap hic communications p roduction environment.CMP Masters are trained and certiped in Color Management Fundamentals, Premedia, and Print - Digital and/or Offset.



CMP FUNDAMENTALS: Offers the latest in color theory and applications in color, providing a strong educational foundation for color managing a graphics workflow.



CMP DIGITAL PRINT: Designed for operators of digital press equipment, and is an easy-to-understand instructional guide to color management principles in the digital pressroom.



CMP OFFSET: Designed for operators of conventional press equipment and is an easy-to-understand instructional guide to color management principles in the pressroom.



CMP PREMEDIA: Focused on strategies to control color for premedia and prepress departments responsible for reproducing files for output.



CMP CREATIVE: Examines issues critical to the process of ensuring content output meets the intended design and corporate brand objectives.

SYSTEM CERTIFICATIONS - SUBMITTED BY SYSTEM MANUFACTURERS



DIGITAL PRESS CERTIFICATION – ELECTROPHOTOGRAPHIC: Certifies the capabilities of commercial production electrophotographic devices to meet specific print standards. The program consists of testing and certification in areas of color, print properties, and print production.



DIGITAL PRESS CERTIFICATION – INKJET / LEP – HIGH SPEED, CUT SHEET & WEB: Certifies the capabilities of commercial production inkjet, high speed, cut sheet and web, devices to meet specific print standards. The program consists of testing in areas of color, print properties, and print production.



ISO/PAS 15339 DIGITAL PRESS CERTIFICATION: The program is an expanded compliance program to the Idealliance Digital Press Certification for digital printing press manufacturers and evaluates colorimetric accuracy and conformance referencing global specifications for electrophotographic, production inkjet / LEP – high speed, cut sheet and web devices. Released 2018.



G7 SYSTEM CERTIFICATION: The G7 System Certification Program evaluates the ability of a software system to calibrate a printing device to meet the G7 grayscale definition using four 1-D Curves.



G7 PRESS CONTROL SYSTEM CERTIFICATION: G7 Press Control Certification validates a press control system's ability to monitor and control G7 gray balance and tonality, supporting print service providers' ability to realize the full benefits of the G7 methodology.



G7 AI MASTER CALIBRATION SYSTEM CERTIFICATION: The recent advancements in artificial intelligence (AI), in-line color measurement devices, and cloud-based technology make possible the implementation of achieving the G7 calibration condition as an integral part of the digital presses with full automation and without human intervention.



HARD PROOFING SYSTEM CERTIFICATION: The Hard Proofing System Certification program conveys a proofing systems capability associated with GRACoL® and SWOP® specifications, and compliance with ISO 12647-7.



SOFT PROOFING AND DISPLAY SYSTEM CERTIFICATION: A soft proofing system consists of a display, software, measurement equipment, and a host computer that adjusts incoming data so that a displayed image simulates the appearance of a hard copy proof calibrated to a chosen reference print characterization and viewed under standard lighting.



WIDE/GRAND FORMAT INKJET SYSTEM CERTIFICATION: The Wide/Grand Format Inkjet System Certification Program evaluates original equipment manufacturers' roll-fed and flatbed large format printing systems. Systems are evaluated for printing, production, and application qualities for a specific ink and media combination.

FACILITY QUALIFICATIONS & CERTIFICATIONS - AWARDED TO FACILITIES



G7 MASTER QUALIFICATION: Granted to a physical facility, equipment, or systems. Qualification is valid for one calendar year and must be renewed annually. There are three levels of compliance for G7 Master Qualification: G7 Grayscale, G7 Targeted, and G7 Colorspace. These levels demonstrate G7 Master capabilities by specified print condition and offer new levels of distinction for G7 Master Printers. G7 Master Qualification status indicates that the facility has calibrated certain equipment and systems to G7 gray balance and neutral tone curves and is capable of delivering G7 proofs and print products. While many G7 Masters are printing companies, other graphic solutions providers such as creative and premedia providers may also be qualified as G7 Masters.



G7 PROCESS CONTROL MASTER CERTIFIED FACILITY: is a print service provider that has demonstrated through the use of process control and leading practices designed for print supply chain efficiencies and productivity. The program is designed to help optimize the printing process through on-site training, development of custom standard operating procedures, and periodic assessment. Completion of the program provides the user with a list of productivity deliverables, reference materials, and quarterly reports on print quality. G7 Process Control provides print service providers with more efficient production methods, education, and industry recognition in the form of an annual certificate with quarterly verification.



BRANDQ CERTIFIED SUPPLY CHAIN FACILITY ISO PROCESS STANDARDS: BrandQ Facility ISO Process Standards certification enables communication between brand owners and suppliers, so it is clear on brand owner's expectations, evaluation methodology, aims and tolerances, and validation process. BrandQ Supply Chain Certification ISO Process Standards assesses key aspects such as process capability, performance, process control, color management, ISO Standards implementation, proof and press alignment, spot color rendering, pre-media capabilities, G7 calibration, and includes detailed reports and analysis. In addition to enabling brand communication, BrandQ provides a comprehensive evaluation of the suppliers and how they are meeting brand expectations and needs.



IDEALLIANCE TAIWAN

ECG: IDEALLIANCE ECG PROGRAM OVERVIEW

In the same way that the CMYK process printing has become standardized, the Idealliance Print Properties Council is working to standardize expanded gamut printing. Expanded gamut printing is defined as printing in a gamut that is larger than standard CMYK printing (such as GRACoL 2013). There are currently a number of digital devices that can print in a colorspace larger than standard printing. For the lithographic, flexographic, and gravure processes, expanded gamut is most often done by adding additional colors such as Orange, Green, and Violet. Currently much of the ECG printing is performed through the use of custom and proprietary calibration and methods. The goal of the Idealliance ECG project is to standardize ECG printing much in the same way CMYK print was standardized by use of the GRACoL specification and the G7 method.

The components of the Idealliance ECG program are an industry standard test chart, methods for calibrating, a proofing control strip, and a sample target characterization data set and aims for ECG (Extended Color Gamut) printing. The Print Properties Council is currently conducting test runs. Test forms and documentation, including how to perform the test runs are available on the Idealliance web site. The method combines G7 methods for CMYK and SCTV (Spot Color Tone Value) for the Orange, Green and Violet colors. Below are some of the guidelines and information about the test forms and methods.

Test Form

The ECG test form is designed for use with offset and flexographic printing. The form consists of 1 - 4 test charts that can be used to calibrate and characterize an ECG test run. While using more test charts provides more information, the charts are designed so that in many cases 2 charts can be used, and in some cases even 1 chart can be used. The full set of all 4 charts and reference files can be downloaded from the Idealliance website: www.idealliance.org

Paper

Litho: Because ECG is primarily for high - end packaging, best results require a high quality SBS type board. For flexo the whitepoint should be similar for flexo.

Target white point: 95 L*, 0 a*, 1 b*. Tolerance: < 2.0 dE00

Note: The ECG process can be applied to other applications that are not currently in scope. Other applications may include non - standard substrates, fine art or photo book printing and packaging applications. For these applications, differences in substrate white point (brightness, color, and OBA), hardness and/or absorption may result in decreased accuracy in relation to the standard target characterization data set that is being developed at this time.

Screening

Printers may user either AM or FM screening to produce the test form, however, FM or Ring AM is suggested for two reasons:

- 1. FM and Ring AM screening can help solve screen angle conflicts which result from using conventional AM screening.
- 2. FM and Ring AM screening, or any other non traditional screening that uses very small ink receptive sites (e.g. 20 micron) can help expand color gamut in quarter to mid tone tinted areas on most offset and flexo presses.

For AM screen systems where the screen rulings are similar to one another, placing the OGV colors at the same angles as their complementary colors with Orange at the Cyan angle, Green at the Magenta angle, and Violet at the Black angle. It is recommended to use FM or Ring AM screening when running Violet rather than attempting to run Violet at the Black angle. The rationale is that it is rare to have color overprint combinations including significant combinations of complementary colors, so it is somewhat safe to use the same screen angles and hence the same screen patterns for these compliments. Violet is chosen to screen at the same angle as Black because there are no other good choices available for the overprint. Generally, in offset printing, this will result in V/K at 45°, O/C at 15° or 75°, and G/M at 75° or 15° (different than O/C). Y is allowed to be screened at 0° because Yellow is a fairly light color, so the resulting moiré is usually not very noticeable.

In other printing processes such as flexo, 7.5° rotated versions of these same constellations of screen systems are also possible, following the same basic principle of screening complementary chromatic colors with the same screen angle. Stochastic or FM screening of OGV or all units also may be used to prevent moiré. FM screening all 7 units makes it possible to use 7 independent screen patterns, which prevents moiré altogether.

Note: When characterizing FM, it is usually recommended to apply a cutback curve rather than start with linear plates to reduce the increased dot gain/TVI that typical of FM printing. Doing so results in a printed characterization chart which has greater separation between the measured values for the different patches comprising the chart, and thus gives better results. Note that the need for an arbitrary cut-back curve is largely eliminated by proper G7 ° and SCTV calibration, however a cut back curve applied to the first calibration run can reduce the number of iterations required to achieve accurate G7 ° or SCTV calibration.

Recommended screening options:

- FM/CMYKOGV
- AM/CMYKOG + FM/V
- AM/CMYK + FM/OGV

Other screening configurations may be used. However, note that some alternative screening configurations may introduce moiré and other artifacts. In addition, note that mixing screening types may cause different print characteristics on differently screened units.

RECOMMENDED COLOR PIGMENT AND HUE ANGLE CMYK

| Name | Recommended Pigment | Hue Angle |
|---------|---------------------|-----------|
| Cyan | Blue 15:3 | 233.5° |
| Magenta | Red 57:1 | 356.9° |
| Yellow | Yellow 14 | 92.5° |
| Black | Black 7 | 0.0° |

Inks

CMYK Inks

ECG is compatible with any ISO 12647-2 CMYK compatible ink set currently used for commercial (e.g. GRACoL) printing. High-chroma inks may help improve gamut at lower ink film but are not recommended for this test.

OGV Inks

Standard Orange, Green and Violet inks should be used for the OGV inks using the hue angles below.

RECOMMENDED COLOR PIGMENT AND HUE ANGLE OGV

| Name | Recommended Pigment | Reco | mmended Va | Derived from LAB | | | | |
|--------|------------------------|------|------------|------------------|------|--------|--|--|
| | | L | А | В | С | н | | |
| Orange | Orange 16 or 64 | 70.0 | 55.0 | 82.0 | 98.7 | 56.1° | | |
| Green | Green 7 | 66.0 | 73.0 | -1.0 | 73.0 | 180.8° | | |
| Violet | Pigment 23 | 24.0 | 46.0 | 57.0 | 73.2 | 308.9° | | |

Print Rotation

The test chart should be printed with the recommended print sequence of KCMYVGO. Alternative rotations are permitted, if justified, but may conflict with characterization data from other test runs, and from the standard data set produced by this research program.

Calibration

Before working with ECG, the CMYK plates must be calibrated to G7 using the consumables and settings suggested below. Run the press to the above aims for inks, using 12647-2:2013 for CMYK and table above for OGV. Once the ink is within 3.5 delta E/2° Hue of above perform the following calibrations:

- For CMYK perform a G7 calibration
- For OGV perform a linear SCTV calibration Both the G7 and SCTV calibrations should be as accurate as possible but note that small deviations will be corrected later in software as part of this project.

Confirmation Run

Perform a confirmation run with the new plates at the same ink levels determined in the first run. Run enough sheets to reach press stability and pull 20 sheets from the last set.

XCMYK+OGV Test Run

Run one last set of sheets with CMYK inks increased to XCMYK levels and pull the last set. Recalibration to compensate for the impact of higher XCMYK ink levels on G7 is optional, but not essential. Post-recalibration will be applied to the measured data later if needed. This run is being used to evaluate whether XCMYK combined with OGV yields additional gamut expansion.

Partial versus Complete Calibration

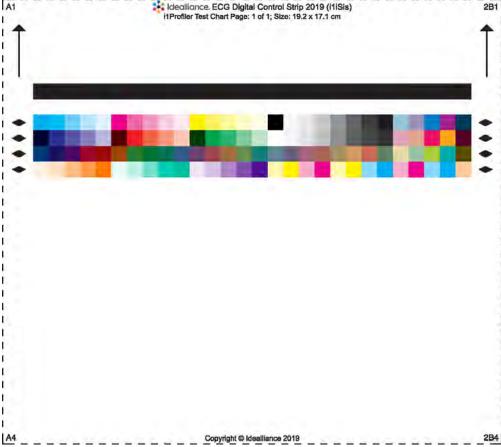
If for some reason the second run does not exactly meet calibration targets for G7 and SCTV, sheets may still have value, as long as they meet the correct target ink aims and are relatively even across the print area. In some cases, measurement data from these sheets may be realigned to the target characterization data using mathematical functions. In these cases, data from these sheets is usable and valuable for this project. The recommendation is to pull 20 sheets, with the closest ink aims, from the entire press run set.

In the CxF workflow fragile printed samples are no longer used but instead, the CxF file is communicated to the supply chain.

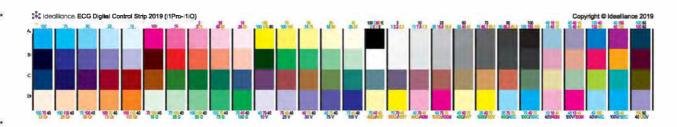
Ink companies can use the CxF to make the ink and make sure it is correct on the job substrate. Creatives and designers can use the CxF file when proofing to make sure the color is correct as well. Print assessment can be done based on the CxF to make sure that the plant and customer are assessing the correct color. While communicating color sounds like it should be simple, CxF is helpful because it removes the multiple versions, faded prints, questionable viewers, and the uncertainty that has often been an issue when working across a print supply chain.

CxF can be found in the software you use to measure, check and work with color.





Idealliance ECG Digital Control Strip 2019 r2 (iSis)



Idealliance ECG Digital Control Strip 2019 r2 (i1Pro-i1iO)

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CRF: Putting Numbers to the Visual Match

Cumulative Relative Frequency using delta E00, at the 95th Percentile

The business of print manufacturing is related to ensuring printed colors will meet customer expectations. Printing to customer expectations relates to product conformance and it is very different from process control. Customers and print buyers care about product conformance but generally do not care about process control.

Cumulative Relative Frequency at the 95th percentile delta E00 has proven to be an excellent metric, which can be used to assess customer expectations, and product conformance. If the CRF 95th percentile value of the output device is equal to or less than the CRF 95th percentile of the customer expectations, then the product will meet or exceed customer's expectations.

Precision (consistency) and accuracy (hitting the correct printing aim) are product conformance attributes that define output devices characteristics. How does the industry quantify precision and accuracy? What metric is in use? ANSI/CGATS TR016-2014 provides a tolerance schema for 4 levels of acceptance that can be used by customers today. TR016 assesses both precision and accuracy requirements and quantifies the differences using Cumulative

Relative Frequency (CRF) of delta E00, at the 95th percentile. This metric has proven to be very reliable when assigning a single number to describe how different two images

or two pages look from one another. (TAGA, CRF 2001 and CRF 2017). Now when presented with multiple proofs or prints, no one knows which is most accurate, but using CRF, everyone will know which is most accurate, and precise.

The difference between delta E00 and CRF delta E00 at the 95th percentile

Delta E00 is a mathematical equation that defines the difference between two colors. It is a reliable means to bridge the gap between human vision and instrument metrology. Delta E00 works great when comparing two colors to one another. However, when comparing two different pages with thousands of colors containing multiple images and graphics, there hasn't been a simple metric to quantify the difference. But wouldn't it be great if we could? CRF delta E00 at the 95th percentile meets this industry need.

What is Cumulative Relative Frequency (CRF), and how is it calculated?

CRF delta E00 at the 95th percentile is a distribution, of all compared

colors, sorted from lowest delta E00 to highest delta E00. It provides a stack ranked cumulative distribution of colors. This arranged distribution depicts each percentile from 0 to 100. The 95th percentile delta E00 represents the 95% of the highest Delta E00 and thus rejecting outliers. Different people have different expectations as to what constitutes an "acceptable" versus "not acceptable" match. Establishing an "expectation", based on CRF at 95th percentile, enables the quantification of expectations/biases on a per individual basis.



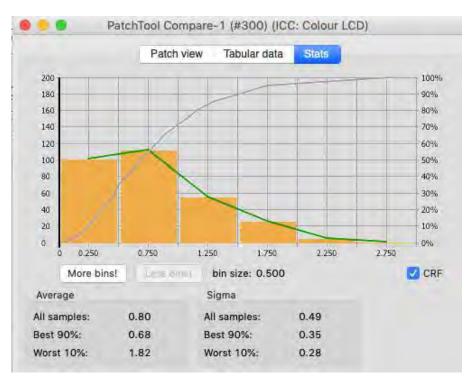
Examples of multiple 'passing' prints with visual differences. CRF can be used to identify which prints are correct.

How to use CRF to increase productivity and profitability

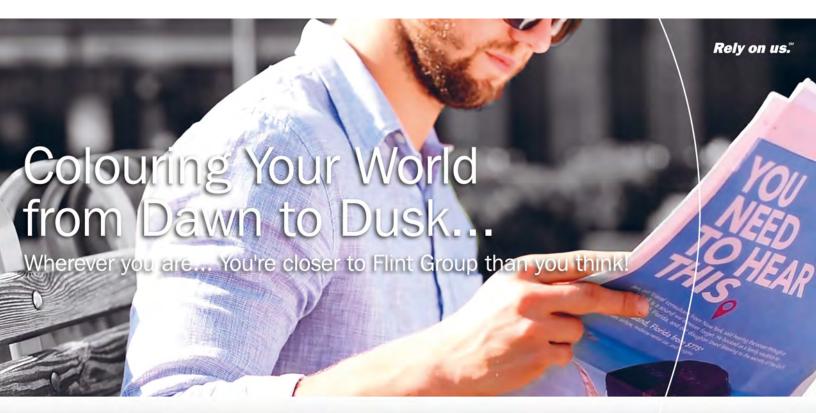
Migrating to a print manufacturing process, requires each company to understand their own upper and lower limits. This is the same concept as when you played sand lot football, or other games as a kid. Before you could successfully play the game, the field sidelines and end lines (boundaries) needed to be defined. CRF at the 95th percentile, provides the framework to define the field you play on. This helps establish your business tolerance for what is obtainable, as well as acceptable, and what is not. It is properly setting your bar for manufacturing printed goods within your production capabilities and

your profitability guidelines. If the output devices CRF at the 95th percentile is equal to or less than your desired (customers) CRF at the 95th percentile, then expectations will be met, and customer needs to pay. If the output device is higher than customer expectations, then the printer has a problem.

Too loose of tolerance, a printer loses customers; too tight of tolerance, a printer loses money. It is a fine line between profitability and rejected goods (waste). Using CRF at the 95th percentile, and TR016 allows a company to establish its quality framework. These guidelines empower all print manufacturing personnel with the capability to know they are producing color that meets their customers' as well as their company's expectations. In other words, they know how to "manufacture within the boundaries".



Visual of CRF showing the distribution of delta in the measured sample



NEW INITIATIVES IN PRINT: THE WORK OF IDEALLIANCE

Collaborative Efforts Yield New Specifications, Standards, and Leading Practices

In 2006, G7° and GRACoL° and SWOP° 2006 were introduced, both causing a revolution in how we print. In 2013, GRACoL and SWOP were updated and additional G7 datasets were released and detailed in the Idealliance Guide to Print Production 13.

These major innovations—
providing important guidelines and specifications centered around how we calibrate, print, and communicate in the industry—were produced by the Idealliance Print Properties Colorimetric and GRACoL Working Groups, which continue to create new specifications, standards, and best practices, some of which are again completely changing the way we print.

Since the Idealliance Guide to Print Production 13 was first published there have been a number of new initiatives, including new print conditions, ways to calibrate and specify spot colors, and better ways to communicate print data between print quality systems. Here are some of the current projects the Idealliance Print Properties Council is working on:

Expanded Gamut Printing. The ECG project has been working on standardizing expanded gamut printing. The project includes a universal 7 color characterization target, a 7 color proofing control strip, 7 color datasets, and a guide to 7 color calibration.

G7 and ICC Profiling. A research project to document whether or not G7 improves ICC profiling results is being conducted by the Print Properties Council and Ryerson University. It has been believed that doing G7 before profiling results in better ICC profiles. This research project is conducting research at Ryerson with a testing plan and a variety of print devices, as well as analyzing live data provided by a number of large printers who use multiple calibration and profiling techniques.

Working with Spot Colors. The Print Properties Council is also looking at better ways to work with spot colors. These projects involve looking at further improvement in ways to specify and communicate spot colors as well as tints of spot colors.

Tools to work with the IT8.7/5 (TC1617). IT8.7/5 (TC1617) of datasets The Print Properties Council has recently released new IT8.7/5 (TC1617)

versions of the datasets to accompany CGATS 21. While not an official addition to the CGATS 21 standard these provide complimentary data for those creating and editing profiles

Updated Paper Calculation
Spreadsheet
In addition to updating the datasets, the Print Properties Council has also updated the M1 Substrate Relative Correction spreadsheet to contain the full IT8.7/5 (TC1617) datasets.
This will allow users to work with the full IT8.7/5 (TC1617) datasets, as well as produce profiles and data that will provide necessary data for quality applications, as well as improved profiling.

New CRPC's including Universal Digital Dataset The Print Properties Council is also looking at future datasets to better meet the needs of the print community. Although the XCMYK and ECG datasets (including a CMYK version for digital print) provide some larger spaces for wide gamut digital use, many users still want a wider gamut CMYK profile and translation space. Idealliance is working on a larger gamut print and translation space based on the widest known print devices.

The Idealliance Print Properties
Council holds live meetings several
times a year, and during the
upcoming year, these meetings will
be streamed live with both video and
audio, as well as topics timed so
members can call in for pertinent
topics. In addition the Print
Properties Council holds
teleconferences every month and will
be recording event video as well as
posting documents, research and
standards as they have done for
decades.

Here are some of the more recent projects the Idealliance Print Properties Council has completed:

XCMYK

XCMYK is a color space representing CMYK Expanded Gamut printing that can be achieved on offset and digital devices. Many digital devices now can print gamuts larger than traditional print standards such as GRACoL. For these devices simply using XCMYK can produce color that is much more vibrant and appealing. For offset print, XCMYK involves running inks at higher densities, and is considered specialty printing. XCMYK provides a significant gamut increase over GRACoL and Fogra—while GRACoL can reproduce about 67% of the Pantone + library, XCMYK can reproduce about 85%.

The project was conducted by the GRACoL Committee over a 15-month period in 2015-2016, and involved 26 test runs from all over the world, using offset presses running with FM screening at high densities. In addition to XCMYK, the Idealliance Expanded Gamut Project is exploring traditional multicolor expanded color gamut.

Adoption of XCMYK has been high in the digital print segment, where it is used by many printers to achieve more pleasing results. There is lower adoption in traditional print, with lithographic printers typically using it for high-end catalog and print products. To learn more about XCMYK and download profiles, datasets, and other information, go to www.gracol.org.

IT8.7/5 (TC1617)– Characterization Chart

In 2016 Idealliance introduced a new characterization chart, the TC1617, for use in G7 color characterization and compliance checking. This chart has since become an ISO standard and is now called the IT8.7/5. Print characterization is typically done using an IT8.7/4 chart with 1617 patches, but the patches used do not contain most of the key patches for G7 calibration or compliance checking. (The IT8.7/4 contains a 50/40/40 patch but does not contain an HC/25, 19, 19 or SC/75, 66,66, or other G7 grayscale patches.) The IT8.7/4 is used for communication by ISO and many software programs and contains a number of duplicate patches for consistency checking.

Because the IT8.7/4 does not contain critical G7 grayscale information it is not an optimal target for use with G7. The charts contain all patches in the IT8.7/4, plus the complete set of gray and black patches from rows 4 and 5 of the P2P51—redundant patches from the IT8.7/4 were replacing by P2P rows 4 and 5. As a result, the complete IT8.7/4 is contained in the TC1617, as well as the important rows of the P2P.

One important benefit of the TC1617 is that it can be used to perform a much better check against a G7 dataset. Because it contains the IT8.7/4 and the gray patches it can be used to check characterization compliance, as well as G7 compliance. Another benefit is that for small format devices this single target can be used to assess both colorspace and gray balance, rather the old method of using a P2P and an IT8.7/4. A third benefit is better results when profiling. Because of the 29 gray patches the profiles may produce better results than a traditional IT8.7/4 profile due to the IT8.7/4's lack of patches in the highlight areas.

There are three versions of the TC1617. The first two are X-Rite i1 iSis formated targets—the only difference is the arrangement of the P2P patches in portrait or landscape mode; the third is formatted for X-Rite i1 IO table. The TC1617 target images can be measured on the Konica Minolta FD9, X-Rite, i1 iSis or i1 iSis XL (1 or 2) and the X-Rite i1iO (1 or 2).

CxF (ISO 17972)

Communicating color can be a difficult task, that's where ISO 17972, also known as CxF, comes in. CxF is an exchange format designed to let users communicate color between each other. Originally developed by X-Rite, CxF is now widely used for color communication, both for spot and process colors. The CxF format is based on XML and can contain creator, reference, and other descriptive information. More importantly, it can contain detailed measurement information, including measurement parameters, references, and data on tints and solid colors, including spot colors.

There are four different ISO 17972 documents: CxF3 (ISO 17972-1) provides prepress digital data exchange and verification for fourcolor process printing, CxF/X2 (ISO 17972-2) defines the Custom Resource within the CxF/X structure for the creation of scanner target data, CxF/X3 (ISO 17972-3) defines the output target data within the CxF/X structure for the creation of output printer target data, and CxF/ X4 (ISO 17972-4) defines the exchanging spot color characterization data within the CxF/X structure.

With CxF spot colors can be recorded and shared with others. It can provide an unambiguous way to communicate spot color values, references between members of a print supply chain, and information to be used by software, such as ink formulations systems to create a new ink matching the properties supplied in the CxF file.

PQX/PRX (ISO 20616-1 and ISO 20616-2)

PQX is designed as an interchange format that allows printers, buyers, and others in the supply chain to exchange data between systems without needing to use multiple programs, redundant software, and measurement. By establishing a standard print quality exchange specification for printers to report print quality to the print buyer, tools or plugins can be developed to streamline print quality reporting and analysis. The work to develop PQX, the Print Quality eXchange, began as an initiative of the Idealliance Print Properties and Colorimetric Council (PPC) in June of 2015. A subcommittee of PPC began this effort using an agile software development methodology, and developed a standard XML message.

As the project developed Idealliance began to move PQX into the global ISO standards development process. Today, what began as the Idealliance PQX Specification is now ISO 20616 – Part #2. PQX can be purchased from anyone selling ISO Specifications. As PQX nears completion software and tool manufacturers are beginning to build it into their tools.

CGATS TR016-2017

CGATS TR016 was originally released in 2014 as a methodology for tolerance and conformity assessment. The TR016 report outlines methods for using a fourtiered tolerance approach, ranging from 2 to 6 delta E for various print attributes ranging from solids, overprints, and tints to gray balance. It also provides a scheme for evaluating within sheet variation, as well as production color variation, and offers weighting and scoring recommendations, as well as ways to assess instrument repeatability and inter-instrument agreement.

Designed to be modified, TR016 is offered as a basic schema and guidance for use in print quality and is set up to be modified by the user to fit specific needs. It differs in several ways from the basic tolerances in typical ISO documents. It is, for example, designed for production print evaluation, and offers scoring and other methodologies typically not found in ISO documents. TR016 also uses characterization data and reference print conditions as aims, allows substrate corrected data, and provides a scoring system. It is available from CGATS/NPES at www.npes.org.

CRF – Cumulative Relative Frequency

If you have ever been given two proofs or print samples that 'passed' but look visually different, you will be interested in CRF (Cumulative Relative Frequency). CRF first appeared in "Quantitative Analysis of Pictorial Color Image Difference," a TAGA paper by Robert Chung and Yoshikazu Shimamura. The idea of CRF is that the visual match can be better assessed by looking at the distribution of delta E rather than simply looking at the delta E average. From this a visual curve can be general, showing the likelihood of a good visual match, as well as a view of the distribution of delta E across the colorspace. When using CRF, the 95th percentile is applied (the worst 5% of all patches are discarded, and the remaining patches are stacked in order of distribution). The resulting curve and distribution helps determine whether a print is likely to be a good visual match. Several programs, such as BabelColor PatchTool, Chromachecker, and SpotOn! Verify, have incorporated iterations of CRF into their evaluation toolset. Many users report CRF as a much better way to assess a likely visual match than just using delta E.

G7 Master Pass/ Fail Document 2019

The G7 Master Pass/Fail document, updated in 2015, contains detailed information on the requirements for the G7 Master program submission. Major updates included a change to delta E 2000, improved tolerances, and the addition of delta Ch as well as delta L. A new simplified and streamlined version was released this year, with additional updates and tightening of some of the looser tolerances in areas such as proofing.

SCTV: Spot Color Standard (ISO 20654)

In 2013, the Idealliance Print Properties Colorimetric Council began to work on a project to predictably define spot color tone value. The result was a formula called SCTV (Spot Color Tone Value), which provides a more accurate match to spot color halftones, and was recently adopted as ISO 20654. Many software programs used throughout the print industry for calibration and quality control now support SCTV, which gives us a consistent method of reproducing spot colors across multiple devices. SCTV allows us to come much closer to the designer's initial intent—which is what matters.

BrandQ: Communicating Quality

Idealliance's BrandQ[™] program provides education and tools to help brands and consumer packaged goods (CPGs) create and communicate standards, check the capabilities of print suppliers, and monitor print quality.

It focuses both on the building blocks of communication and assessment, based on Idealliance's experience with CMYK print standards and innovative spot color calibration. BrandQ is scalable and can be used simply to improve basic communication and assess suppliers or for ongoing print quality assessment and auditing. It also provides a brand/CPG online forum and community to allow members to share problems and solutions directly. It was released early 2017 with online and live training sessions.

CGATS 21: Dataset Access and updated IT8.7/5 (TC1617) Datasets

Since its completion in 2013, CGATS 21 has been added as an ISO Publically Available Specification, titled ISO PAS 15539. The ISO specification is similar to CGATS 21, with only a few minor changes. It allows users needing the ISO imprint to have internationally recognized access to these seven datasets. The Print Properties Council has recently released new IT8.7/5 (TC1617) versions of the datasets to accompany CGATS 21.

While not an official addition to the CGATS 21 standard these provide complementary data for those creating and editing profiles.

Updated Paper Calculation Spreadsheets

In addition to updating the datasets, the Print Properties Council has also updated the M1 Substrate Relative Correction spreadsheet to contain the full IT8.7/5 (TC1617) datasets. This will allow users to work with the full IT8.7/5 (TC1617) datasets, as well as produce profiles and data that will provide necessary data for quality applications, as well as improved profiling.

178.7/5 (TC1617x): A BETTER TARGET FOR PROFILING AND CHARACTERIZATION

The IT8.7/5 (TC1617x) target better aligns with G7 gray scale calibration, and also provides better patch selection for improved profiling. The target is supported by most profiling applications, as well as RIPs and calibration software. Idealliance also supports the target and the IT8.7/5 (TC1617x) is the preferred target for G7 Master Qualification auditing.

Here's what you need to know about the target:

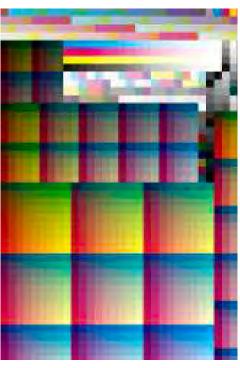
The IT8.7/5 (TC1617x) CMYK target combines the unique patch values in the standard IT8.7/4 target with all the patch values in columns 4 and 5 of the P2P51 target. The letter "x" distinguishes the final version from earlier prototype versions circulated during development.

The TC1617x maintains the same patch count as the IT8.7/4 (1,617 - hence the name) by removing 2 duplicate patches from the IT8.7/4 and replacing them with the 28 patches in columns 4 and 5 of the P2P51 that were absent in the IT8.7/4.

BENEFITS FOR THE G7 MASTER SUBMISSION PROCESS

The initial purpose of the IT8.7/5 (TC1617x) was to reduce the time and cost of verifying G7 Colorspace compliance, by eliminating the need





IT8.7/5(TC1617) on left. Note the gray ramp. The older IT8.7/4 on the right does not have many G7 gray patches.

to print and measure two separate targets (the IT8.7/4 and the P2P51). This is especially helpful for proofing and digital printing applications.

EVEN MORE IMPORTANT - BENEFITS FOR ICC PROFILING

An important side benefit of the TC1617x compared to the IT8.7/4 is that it improves the characterization accuracy of a printing system, thanks to the addition of 29 new gray patches.

Under certain circumstances, this can produce more accurate ICC profiles and less chance of unwanted color artifacts in neutral gray image areas, but the difference may be difficult to detect except on extremely stable printing systems.

DESIGN

Unlike the IT8.7/4, the TC1617x is only available in randomized layouts (there is no "visual" version), however, the CMY and K-only gray patches are not randomized, but rather arranged as two contiguous gray ramps along the edge of the target. This helps reduce small tonality or color variations throughout the gray ramps due

to in-line ink starvation effects or uneven inking that would be magnified if the gray patches were randomized throughout the target. You could also load the IT8.7/5 (TC1617x) target reference file and then create your own randomized or other sized versions for your own use.

WHAT DOES "X" MEAN?

During development of the 6, several prototype versions were distributed for beta testing. To avoid confusion, the final official version has the letter "x" after the name. Other versions should be discarded as they may not work correctly and will not be accepted for G7 master submissions.

STANDARD TC1617x IMAGE FILES

Three versions of the TC1617x are available from the Idealliance website — two for the i1iSis and one for the i1iO. The two i1iSis targets are designed for either vertical or horizontal gray ramp alignment, and are marked accordingly with "V" or "H" in their names.

The i1iO target contains two pages in one image, with the gray scales in line with each other. Before measuring, cut the pages apart so the top of each page is closest to the i1iO armature.

On printing systems subject to uneven inking or directional ink exhaustion, align the TC1617x so the gray ramps point in the direction of paper travel (e.g. around an offset press cylinder) or parallel to ink variation lines. This minimizes the chance of color anomalies within each gray ramp and can yield smoother curves and better G7 w Ch and w L* scores.

16-bit Target Precision

The supplied 8-bit TIFF CMYK target images were produced using LSB error diffusion, giving each patch effectively 16 bit precision when integrated by a spectrophotometer aperture. This extra precision can be important in very light gray patches between 0 and 20%.

User-created targets (from the supplied CGATS text files) may not have the same accuracy but should be adequate for most purposes. CAUTION: Lossy (e.g. JPEG) compression or re-sizing will eliminate most of the extra precision contained in the supplied 8 bit dithered targets.

Instrument compatibility

The supplied TC1617x target images can be measured on the Konica Minolta FD9, X-Rite iliSis or iliSis XL (1 or 2) and the X-Rite iliO (1 or 2).

Software compatibility

The TC1617x can be measured by any software that drives the above instruments and accepts X-Rite .pwxf or .rwxf workflow files, or standard CGATS .txt files. Before measuring, copy the supplied .pwxf, .rwxf or .txt files into a location where the software can easily find them.

Custom TC1617x target images can be created and measured on other software or devices using the supplied CGATS .txt files, but may not be so accurate (see 16 bit target precision).

ICC profiles can be created from TC1617x data in base ICColor print, X-Rite i1Profiler, or any software that accepts (and uses all the patches of) customer-generated CMYK target designs.

Impact on Idealliance press forms

The IT8.7/4 will be replaced by the TC1617x in all press forms and G7 Master kits on the Idealliance website.

Impact on the P2P target

The TC1617x eliminates the need for a separate P2P51 target for G7 Master Colorspace submissions, but the P2P51 is still recommended for G7 Grayscale or G7 Targeted submissions, and is still required by certain G7 calibration or verification software.

Impact on present and future CRPC data sets

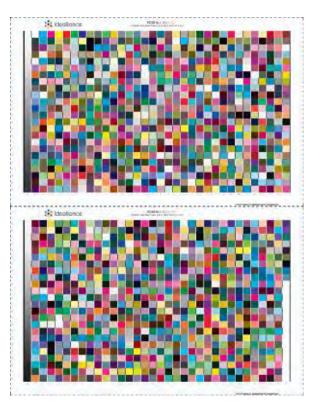
Present (and future) CRPC data sets that have been (and will be) issued by CGATS or ISO in standard IT8.7/4 format will also be distributed by Idealliance in the G7-friendly TC1617x format. This is being done because of the following advantages:

- The TC1617x contains real data for 25 G7 CMY gray samples compared to only 3 real G7 CMY gray samples in the IT8.7/4
- The TC1617x contains real data for 25 G7 K-only samples compared to only 17 real G7 K-only samples in the IT8.7/4
- Due to the lack of 29 real G7 gray samples, IT8.7/4-based profiles may not be as accurate in G7 gray areas as TC1617x-based profiles
- • Prints based on TC1617x profiles may achieve better scores for w Δ Ch and w Δ L*
- TC1617x-based prints may have better accuracy or stability in gray image areas
- Profiles made from IT8.7/4 and TC1617x datasets should be visually identical

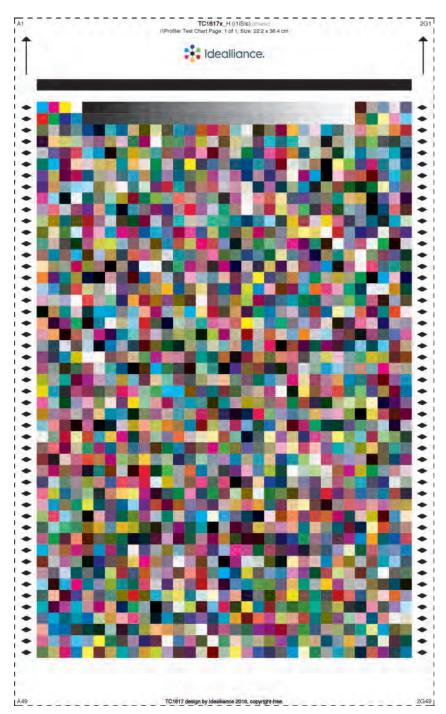
Note that for practical purposes, each pair of data sets will be interchangeable, however the IT8 version will continue to be the only official "standard" data until further notice.

Comparing TC1617x data to legacy IT8.7/4 data

The 29 new gray patches added to TC1617x data sets will be synthesized to perfectly meet the G7 neutral gray definitions in ANSI CGATS TR015. Some legacy-data patches (e.g. white, gray or black) may also have to be adjusted slightly to align with the new G7-perfect patches, but these changes should be very small and invisible to the eye.



The TC1617 target, for the I1 IO



The TC1617 target formatted for the iSis

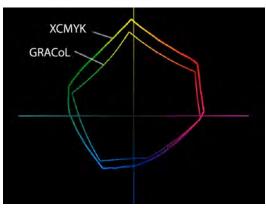
XCMYK: MAKING THE MOST OF CMYK

XCMYK is an expanded-gamut color space designed for use in digital print, wide format print, and highquality sheet-fed printing. The colorspace is larger than standard CMYK based color spaces, but can still be printed on traditional CMYK lithographic and flexographic presses. One primary advantage is the color space can provide a G7 profile that can take full advantage of higher gamut digital print methods, while still providing continuity to GRACoL and other CRPCs. XCMYK is based on high-quality sheet-fed offset printing using standard ISO 12647-2 compliant CMYK inks (run to higher than normal levels), with non-traditional screening. The XCMYK color space can be reasonably approximated on any suitably-adjusted offset press without a custom ICC profile, and can be simulated on other digital printing systems with equal or greater native color gamut, by ICC methods. XCMYK is part of Idealliance's Expanded Gamut Project. The XCMYK research was conducted by the GRACoL Committee over a 15month period in 2015-2016, and involved 26 test runs.

How to Use the Supplied Profile and Datasets

The XCMYK profile and datasets provided by Idealliance can be installed directly in most Digital Front Ends (DFEs) or RIPs, as well as ICC-aware software like Adobe Photoshop, Illustrator, InDesign, and other publishing applications.

(Note that the profile is ICC version 4, and may not work in older RIPs. You can create a version 2 ICC profile from the XCMYKdataset.) The XCMYK datasets come in both TC1617 and IT8.7/4 formats. TC1617 is a more recent Idealliance characterization target which contains all the unique patch values of the IT8.7/4, as well as the full gray and black ramps from columns 5 and 6 of the P2P51 target, using the same number of patches as the original IT8.7/4. The TC1617 results in better profile accuracy and reduces the effort needed to test for G7 Colorspace compliance.



Gamut map showing how XCMYK has a larger gamut than a standard print condition such as GRACoL.

How the XCMYK Dataset and Profile Were Made

The XCMYK characterization data set was produced by analyzing selected press sheets taken from 26 experimental press runs performed in 2015 and 2016 at volunteer printing sites around the world, including Hong Kong, China, Singapore, Malaysia, Pakistan, Canada, and the US.

• Individual IT8 data sets were white point adjusted, G7-optimized and averaged.

- The averaged dataset was smoothed to remove noise and TVI artifacts.
- The averaged and smoothed dataset was formatted to the TC1617 patch set, iSis-Vertical layout, and the IT8.7/4 format.
- The final datasets were inspected and verified to have desired TVI and G7 target metrics.
- The XCMYK_2017 profile was created from the TC1617 dataset using 300 TAC, black start 15, heavy black generation, maximum GCR.

Printing to XCMYK on a Digital Print Device such as Proofers, Wide Format, Digital Production

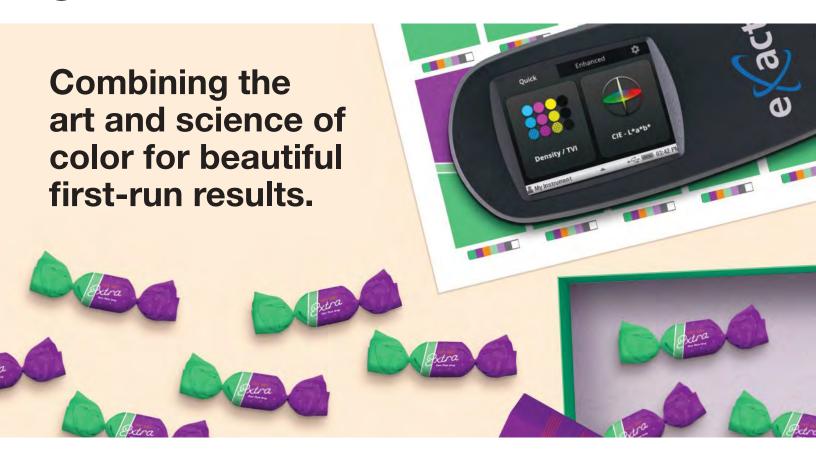
Any high gamut ink-jet system should be capable of simulating the XCMYK 2017 color space, simply by replacing the current "simulation profile" (e.g. GRACoL) with the XCMYK 2017 profile. Before setting up an XCMYK print system, make sure the basic printing device (without profiles applied) has a color gamut equal to or greater than XCMYK.

Checking the Proofer Color Space

Note that the color gamut of some inkjet proofing systems may have been artificially constrained during the "ink limiting" or "ink restriction" stage. This can be determined as follows:

- Software like CHROMIX ColorThink Pro, load the digital printer's output profile and the XCMYK 2017 profile.
- Rotate the two profiles in 3D, checking to see that the XCMYK 2017 profile remains inside the volume of the digital printer profile.
- If the volume of the XCMYK 2017 profile extends outside the proofer profile, the digital printer has insufficient gamut for a perfect match.





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- Create accurate ICC profiles
- Optimize jobs to run on press
- Deliver consistent color across substrates
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Expanding the Digital Printer's Color Space

It may be possible to expand the digital printer's native gamut by repeating the "ink limiting" or "ink restriction" procedures, then building a new proofer profile. If you don't know how to do this, consult your print system manufacturer or color management specialist.

PRINTING XCMYK

ON AN OFFSET PRESS

Before working with XCMYK, an offset press must be calibrated to G7 using the consumables and settings suggested below. If you have never calibrated a press to G7, hire a G7 Expert.

A custom XCMYK test form (see below) is free to Idealliance members at www.Idealliance.org.

Paper

Best results require a high-quality grade 1 coated commercial stock (80-100+ lb.). The white point in the XCMYK data is based on ISO 12647-2:2013, namely, L* 95, a* 1, b* -4 (all +/- 1)

For custom applications, the XCMYK process can theoretically be applied to any substrate color or brightness, but the final color space will be significantly affected by substrate brightness, hardness, and absorption characteristics. More absorbent substrates will typically produce less gamut improvement.

Screening

XCMYK printing works best with FM screening (typically 20 micron) or any other non-traditional screening that uses very small ink-receptive sites, such as ESKO's concentric dot screening. AM screening will tend to produce a smaller gamut improvement in light pastel, tinted colors.

Inks

XCMYK is compatible with any good ink set currently used for commercial (e.g. GRACoL) printing. High-Chroma inks may help improve gamut at lower ink film thicknesses, but are not mandatory.

Initial Ink Settings

(Approximate)

Aim to achieve solid ink Lab measurements as close as possible to the values listed below, which are taken from the XCMY 2017 data set. Don't worry if you can't achieve these numbers exactly. The individual press sheets from which they were averaged varied considerably from each other, yet

still looked very similar to the eye.

| W: | 95 | L^* | 1 | a* | -4 | b* |
|----|----|-------|-----|----|-----|----|
| C: | 49 | L^* | -32 | a* | -61 | b* |
| M: | 46 | L^* | 80 | a* | 5 | b* |
| Y: | 90 | L^* | -3 | a* | 105 | b* |
| K: | 8 | L^* | 0 | a* | 0 | b* |
| R: | 46 | L^* | 73 | a* | 56 | b* |
| G: | 42 | L^* | -72 | a* | 24 | b* |
| B: | 19 | L^* | 19 | a* | -51 | b* |

Status-T Densities

(Approximate)

The following densities may be used as a rough guide to setting ink levels, but remember Lab values are more exact.

C: 1.85

M: 1.85

Y: 1.20

K: 2.0

300% Neutrality

It is just as important that the 300% CMY overprint patch remains as neutral as possible (close to zero a*, b*) as it is to achieve the perfect CMY solid LAB values. If possible, adjust the yellow ink more than C or M to neutralize the 300% patch.

G7 Calibration

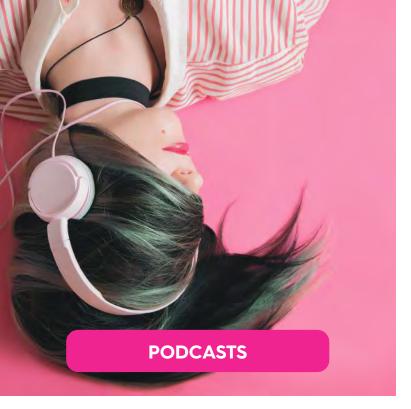
Run enough sheets to reach press stability, then calculate G7 correction curves and create new plates.

XCMYK Confirmation Run

Perform a G7 confirmation run with the new plates at the same ink levels determined in the first run. Run enough sheets to reach press stability.

Validation and Optional Custom XCMYK Press Profile If

the appearance of the confirmation sheet does not closely match a proof made from the supplied XCMYK 2017 profile, either adjust the press for a better match, or build a custom XCMYK profile for your press from the characterization target on the confirmation sheets. This profile can be used to convert standard XCMYK files for your press, and/or to create a custom proof setup that more closely matches your press.

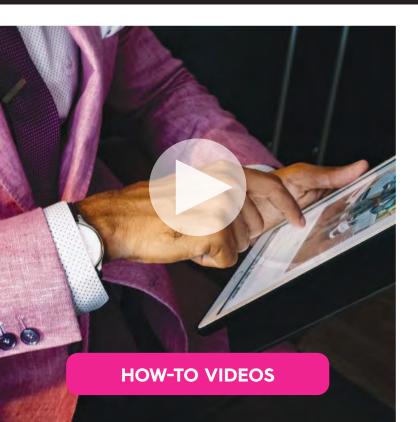




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TR016: QUALITY MANAGEMENT FOR TODAY

CGATS TR016 is a standard used to ensure print quality. Many previous standards used solid ink color and TVI to specify print quality, but these metrics have little to do with the actual visual appearance of the print. CGATS TR016 is different because it uses a reference characterization data set to define the printing aims. The aims for process control are derived from characterization data and calculated using the Cumulative Relative Frequency (CRF) at the 65th percentile delta E 2000. The CRF at the 65th percentile has proven to be a very good metric to quantify the quality of color match. (TAGA 2017 Color Matching using CRF)

TR016 provides an easy way to assess the level of color match. There are four levels of color matching. These four levels allow a company to customize and define how close is close enough for their needs.

Using the TR016 methodology and a single number for CRF conformance, it is clear which printed sheet is closest to the Printing aim, eliminating "guesses" from interested people.

Legacy standards of tolerances on these aims take a one-size-fits-all approach. None of the existing standards, with the exception of CGATS TR015 provide any metrics which can be combined together to provide an indication of visual match.

This lack of relevant standards makes it hard to judge if multiple prints on multiple substrates have a shared appearance, which is the goal when printing on different substrates across a supply chain.

The goal of TR016 is to provide a test method that is process agnostic, and contains sampling, measurement procedures, and tolerances, to evaluate deviation, within-sheet variation, and production variation regardless of printing processes.

TR016 provides information on deviation, within sheet variation and within job variation. This provides the operator the immediate feedback they need to fix the aforementioned problem.

TR016 aid in assessment and certification activities. It does not specify the scope of a print production workflow nor specific conformity testing conditions for pass/fail decisions. This allows the user to customize the metrics that are most important for the printers and their customers in order to complete the framework for a tolerance framework for their organization.

Spectral Measurement Conditions Defined: The "M" Factor

There are many choices allowed when making spectral measurements and performing colorimetric computations. The specific choices made can result in different numerical values for the same property for the same sample. Thus, it might not be possible to make valid comparisons unless the data being compared are all based on the same set of measurement and computational choices. The purpose of this document is to specify a limited number of such choices for the measurement and computation of the colorimetric characteristics of graphic arts images and specimens, such as test charts, to allow valid and comparable data to be obtained. While this document references ISO 3664, the International Standard established for viewing conditions in graphic arts and photography, it is not expected that measured colorimetric data will provide an absolute correlation with visual colour appearance.

When the prior revision of this document was started, it was observed that almost all graphic arts specimens exhibited fluorescence. In most cases, this was due to optical brightening agents (OBA) contained in the paper substrates. In rare cases, the printing inks were fluorescent.

According to the recommendations of the 1996 version of this document, this would have meant that the source used for the measurements (i.e. the spectral power distribution of the specimen illumination) was required to closely match CIE illuminant D50. Yet when the 2009 revision was started. not a single colour-measuring instrument sold for the graphic arts market provided an illumination system that closely matched CIE illuminant D50. Instead, most instruments used incandescent lamps for light sources. The spectral power distributions of such lamps have varying amounts of UV content. The variation in UV content between instruments could easily amount to a colour difference of 5 Δb^* when measuring substrates with a high level of optical brightening agents. Consequently, the measurement results for unprinted paper substrates and lighter colours differed appreciably between different instrument models. For a thorough study of fluorescence effects, see CIE Publication 163.

It had also been observed that graphic arts viewing booths vary with respect to UV content, even those that comply with the 1996 version of ISO 3664.

In the 2009 revision, four measurement choices were defined for reflective measurements. Measurement condition M0 requires the source illumination to closely match that of illuminant A; this provides consistency with existing instrumentation and ISO 5-3. Measurement condition M1 requires the colorimetry of the specimen illumination to closely match CIE illuminant D50. Measurement condition M2 only requires that the spectral power distribution of the specimen illumination be provided in the wavelength range from 400 nm to at least 700 nm and have no substantial radiation power in the wavelength range below 400 nm (often referred to as "UV-Cut"). Measurement condition M3 has the same sample illumination requirements as M2 and includes a linear polarizer in the influx and efflux portions of the optical path with their principal axes of polarization in the orthogonal or "crossed" orientation. For specimens in which the fluorescence is primarily that of a UV activated blue emission, it is possible to use the method of a virtual fluorescent standard reported by Imura of Konica Minolta[24][25] to determine the total radiance factors for M0, M1 and M2 conditions.

In this revision, Annex A has been revised providing a slightly narrower and more realistic set of spectral tolerances on the white backing materials. The properties of the white backing material are critical to reproducibility of readings of packaging printing on clear or translucent films.

Finally, as the CIE has been recommending the use of 5 nm intervals for practical tristimulus integration since the second revision of CIE Publication 15 and as graphic images can be composed of colour stimulus functions with very narrow transitions from the low values to the high values, this revision recommends that tristimulus values be based on spectral data collected with a 5 nm interval and a 5 nm bandpass. Since many of the instruments now in use in the field are equipped with 10 nm vi © ISO 2017 - All rights reserved ISO 13655:2017(E) intervals and 10 nm bandpass spectrometers, such readings are allowed with the recommendation that tristimulus calculations be preceded by applying bandpass correction to the spectral data as specified in ASTM E2729.

The use of instruments with wider sampling intervals and bandpass has been deprecated with the exception of the use of such non-standard instruments to monitor the state of previously characterized materials or objects. The requirements of this document are focused on colorimetric measurement equipment intended for use in the graphic arts environment.

Helpful information on issues such as substrate backing materials, reporting, standardization, standard and improved colour difference metrics, fluorescence and ways to improve the inter-instrument agreement are included. These will be useful to technical advisors of graphic arts associations, specialized graphic arts research institutes, and practitioners with an interest in the basics of measurement and process control.

M - Factors Defined

M0

M0 delineates that the measurement was made using "illuminant A" which is the traditional unfiltered tungsten light. Most older measurement instruments would have this kind of light. This also designates that there is no UV filtering and no polarizing in the process.

M1

M1 labels the measurement light as conforming to CIE D50, that is - normal daylight. This would include UV light, and not be polarized

M2

M2 describes any nonpolarized light that has UV filtered out. This would include measurements made by a UV-cut.

M3

M3 describes a measurement that is polarized and has UV filtered out.

| | МО | M1 ₁ | M1 ₂ | M2 | М3 |
|---|------------|-----------------|------------------------------------|----|------------|
| Measure effect of OBAs | | | | | |
| Measure ink fluorescence | | • | | | |
| Measure non-OBA stock | | | | | |
| Cut the effect of OBAs | | | | • | |
| Cut first surface reflections | | | | | |
| Agree on M Standard for use in exchanging data prior to measurement | When using | | o exchange data andard before m | | o agree on |

CGATS21/ISO PAS 15339: G7 Datasets with Paper Adjustment Methodology

A Family of G7-based datasets

Since 2006 the GRACoL and SWOP datasets have been the defacto-standard reference print conditions for printing and proofing in North America and other world regions. The primary difference between GRACoL and SWOP is the paper white point, also known as paper color. While these two datasets have been very successful, they do not represent the full range or printing colorspaces used throughout the industry.

In 2013 Idealliance developed G7 characterization datasets that represent G7 printing across a range of common substrates and print conditions. As a result of these efforts in 2013 CGATS 21 was introduced. CGATS 21 provides a set of G7 based profiles that represent 7 common reference printing conditions across a variety of substrates. The CGATS 21 standards also provide a method of adjusting these reference printing conditions based on modest paper changes. Because all seven reference print conditions are based on G7 and use common ink hues, maximum "shared appearance" is achieved when a common CMYK file is printed on all seven reference print conditions. The print conditions include: 1- cold web, 2 - heatset web, 3 - premium uncoated, 4 – super calendared, 5 - SWOP (web publication) 6 – GRACoL, 7 - Generic wide gamut.

Alignment with International Standards

In 2013 ISO Publicly Available Specification (PAS) 15339 was approved. ISO PAS 15339 is similar to CGATS 21, and is based on near neutral calibration and common hue angles. By using CGATS 21 or ISO PAS 15339 users can be assured of compliance with internationally recognized specifications. The chart below illustrates compatibility with current and legacy print conditions when using ISO PAS 15339 or CGATS 21. All measurements used in these new datasets are specified in M1. This means calibration and assessment of these new datasets is to be done with M1 instruments.

Figure 1. 7 Common Universal Print Conditions based on G7 and Common Hue Angles

| Reference Print Condition | | *a*h | | | | | | | | | | | | | | | | Solid Overpint L*a*b* | | | | | | | | | | | | | | ND (excludi | ng paper) | Gray Balance (nominal) | | | |
|---------------------------|----|------|-----|-------|----|----|----|----|-----|-----|-----|----|-----|----|----|-----|-----|-----------------------|-------------|----------------|-----|----|----|----|-----|----|-----|-----|------|------|--------|-------------|-------------|------------------------|--------------|-------------|--|
| restrance i fine contamon | (n | omin | al) | Black | | K | | 10 | C | | | M | | | Y | | н | | | G | | | В | | | 9 | CMP | r . | CMYK | | HC | HR | SC | HC | HR | SC | |
| | L* | a* | b* | L* | L | a* | þ* | L* | a* | b* | 1.* | 3* | bs | La | a* | b* | 1.4 | 2* | b^{\star} | \mathbf{L}^* | 3* | b* | L* | a* | be | L | n* | b* | L* | CM | IY/K | CMY/K | CMY/K | a*/b* | a*/b* | a*/b* | |
| CGATS.21-2_CRPC1.icc | 85 | 1 | 5 | 32 | 37 | 1 | 4 | 59 | -24 | -26 | 56 | 48 | 0 | 80 | -2 | 60 | 34 | 44 | 25 | 55 | -35 | 17 | 42 | 7 | -22 | 40 | 0 | 0 | 32 | 0.24 | / 0.22 | 0.46 / 0.44 | 0.64 / 0.65 | 0.75 / 3.75 | 0.50 / 2.50 | 0.25 / 1.25 | |
| CGATS.21-2_CRPC2.icc | 87 | 0 | 3 | 22 | 30 | 1 | 2 | 57 | -28 | -34 | 52 | 58 | -2 | 82 | -2 | 72 | 51 | 55 | 32 | 51 | -44 | 19 | 35 | 9 | -32 | 32 | 0 | 0 | 22 | 0.25 | /0.22 | 0.50 / 0.47 | 0.77 / 0.75 | 0.0 / 2.25 | 0.0 / 1.50 | 0.0 / 0.75 | |
| GRACoL2013UNC_CRPC3.icc | 95 | 1 | -4 | 27 | 32 | 1 | 1 | 60 | -26 | -44 | 56 | 61 | -2 | 89 | -3 | 76 | 54 | 56 | 28 | 54 | -43 | 15 | 38 | 10 | -31 | 34 | 0 | 0 | 27 | 0.25 | / 0.22 | 0.51 / 0.47 | 0.79 / 0.76 | 0.75 / -3.0 | 0.50 / -2.0 | 0.25 / -1.0 | |
| CGATS.21-2_CRPC4.icc | 89 | 0 | 3 | 15 | 23 | 1 | 2 | 55 | -36 | -38 | 47 | 66 | -3 | 83 | -3 | 83 | 46 | 62 | 39 | 49 | -54 | 24 | 28 | 14 | -39 | 27 | 0 | 0 | 15 | 0,25 | / 0.22 | 0.52 / 0.48 | 0.84 / 0.83 | 0.0 / 2.25 | 0.0./ 1.50 | 0.0 / 0.75 | |
| SWOP2013C3_CRPC5.icc | 92 | 0 | 0 | 9 | 15 | 0 | 1 | 57 | -37 | -44 | 48 | 71 | -4 | 87 | 4 | 88 | 48 | 65 | 45 | 51 | -62 | 26 | 27 | 17 | -44 | 25 | 0. | 0 | 9 | 0.25 | / 0.22 | 0.53 / 0.49 | 0.88 / 0.86 | 0.0 / 0.0 | 0.0 / 0.0 | 0.0 / 0.0 | |
| SWOP2013C5.icc | 90 | 0 | 4 | 9 | 19 | 0 | 2 | 56 | -36 | -40 | 47 | 70 | -2 | 85 | 4 | 88 | 47 | 64 | 45 | 50 | -61 | 27 | 26 | 17 | -41 | 24 | 0 | 0 | 9. | 0.25 | / 0.22 | 0.53 / 0.49 | 0.87 / 0.86 | 0.0 / 3.0 | 0.0 / 2.0 | 0.0 / 1.0 | |
| GRACoL2013_CRPC6.icc | 95 | 1. | -4 | 9 | 16 | 0 | 0 | 56 | -37 | -50 | 48 | 75 | -4 | 89 | 4 | 93 | 47 | 68 | 48 | 50 | -66 | 26 | 25 | 20 | -46 | 23 | 0 | .0. | 9 | 0.25 | / 0.22 | 0.54 / 0.49 | 0.91 / 0.89 | 0.75 / -3.0 | .0.50 / -2.0 | 0.25 / -1.0 | |
| CGATS.21-2 CRPC7.icc | 97 | 1 | -4 | 4 | 14 | 0 | 0 | 54 | -42 | -54 | 47 | 78 | -10 | 90 | 4 | 103 | 47 | 75 | 54 | 50 | -72 | 29 | 20 | 26 | -53 | 14 | 0 | 0 | 4 | 0.25 | / 0.22 | 0.55 / 0.50 | 0.97 / 0.90 | 0.75 / -3.0 | 0.50 / -2.0 | 0.25 / -1.0 | |

Figure 2. 7 Common Universal Print Conditions based on G7 and Common Hue Angles – Visual Representation (see figure 1 to identify reference print conditions).



What this means for users

For users that normally print on applications that are not supported by GRACoL or SWOP (such as uncoated, or other substrate types) it means there may be a more accurate G7 reference print condition for use in your workflow. One of the most powerful features of CGATS 21 is the ability to adapt the supplied datasets to different substrate colors. CGATS 21 provides a well-tested method of adjusting these datasets based on actual substrate color, called SCCA. More information on SCCA is supplied in the sidebar. These new standards are designed to help designers and printers better match and produce color to G7 reference print conditions.

What this means for GRACoL and SWOP users

Reference Print condition 6 (GRACoL 2013) is very similar to GRACoL 2006, so most users will barely see a difference.

Because GRACoL 2013 is better aligned with today's premium commercial stocks, printers using optically brightened stocks should find it easier to simulate proofs based on GRACoL 2013 than on GRACoL 2006. If a user's whitepoint is significantly different than the standard print condition, the user can use substrate adjustment to modify the dataset's whitepoint for an improved prediction and process control data.

The really good news is that *legacy image files and proofs produced using GRACoL* 2006 should not need to be adjusted or converted for printing or proofing to GRACoL 2013 (and vice-versa), except in rare situations.

Reference Print Condition 5 (SWOP 2013) is very similar to SWOP 2006, so most users will not see much difference.

Calibration and verification of GRACoL 2013 and SWOP 2013 requires use of M1 capable instruments. This means that use of GRACoL 2013 and SWOP 2013 in production cannot be done unless you have M1 capable instruments.

Obtaining CGATS 21 profiles

Profiles for GRACoL 2013 (and the other CGATS21-2 reference print conditions) can be downloaded from the Idealliance web site (http://www.ldealliance.org).

Updating your pre-press workflow

To up-date a pre-press workflow to use the new 2013 profiles:

- (a.) Change the CMYK Working Space in the Color Settings window of Adobe Creative Suite to the CGATS 21-2 profile equivalent to your legacy CMYK Working Space, e.g. GRACoL2013_CRPC6.icc or SWOP2013C3_CRPC5.icc
- (b.) Change the source profile in your proofing RIP to the CGATS 21-2 profile equivalent to your legacy CMYK source profile, as in (a) above.
- (c.) Inform any workflow partners (vendors or clients) of the change and encourage them to do the same.

Sidebar-

Adapting CGATS 21 datasets using substrate correction:

One of the most powerful things about the CGATS 21 datasets is they are meant to adapted to whatever substrate you are using. This makes if very easy to adapt the substrate to whatever substrate color you are actually printing on, often resulting in an improved press to proof match. This substrate adjustment is used often in the print industry. Examples of this are packaging, where the substrates are often more neutral than GRACoL 2006 or 20013, as well as with uncoated and commercial where the standard substrate is too neutral compared the supplied datasets. Here are two examples: For a yellowish packaging board, or even a recycled board, it is common to take the GRACoL 2006 dataset and substrate correct it to the actual color being used. For uncoated board it is common to take and use dataset CRPC-3 (uncoated), and correct it to the actual uncoated stock, which is normally brighter than CRPC-3. The same is common for digital print substrates and GRACoL 2013. The substrate correction is easily accomplished using Substrate Corrected Colorimetric Aims. This can be done using an Idealliance spreadsheet available at the gracol.org website (as well as with some commercial programs). The spreadsheet is used to create an adjusted dataset which can then be used to create profiles or loaded directly into software and process control applications. This same method is built into many measurement devices and quality and process control tools. This method can also be used with other G7 datasets such as GRACoL and SWOP 2006, and XCMYK.

ISO STANDARD 20654

(SCTV)

SCTV, Specifying Spot Color Across the Supply Chain

In printing, "tone value" is a term (expressed as a percentage) that is used to indicate the visual weight of a "tint," relative to both the substrate and the solid ink value. The tone value of substrate is always zero (0 = no tone) and the tone value of a solid is always 100 (100 = full tone).

hen we think of tone for historical CMYK process, we expect the tone percentage to be higher than the input value. For example, a Cyan 50% might have a tone value (TV) of 72%, or 22%

TVI. Intuitively, this make sense as we know that printing dots spread out or "gain" when they are transferred to a substrate. Historically, these measures have been called "dot area" and "dot gain," which are equivalent to tone value (TV) and tone value increase (TVI).

Tone value is useful for setting a printing machine to a specific printing condition. Once the measured tone value at the 50 (and other tints if desired) is established, the printing machine can be measured during production to both gauge the machine stability and also estimate the variability of the printed product.

ISO 12647 parts 1-4 specifies recommended target TVI values that printers should calibrate to when setting up their presses, which are commonly expressed in the form of ISO curves (a curve not only expresses the TVI at the 50, but across the entire range of tints).

Historically, industry specifications for print have been "density based." In other words, those specifications prescribed that solid ink film thickness be run to specific target densities. It makes sense that, historically, density was also used as the basis for calculating tone value. In fact, most tools today use the Murray-Davies equation (introduced in 1936), which produces a tone value based on the density of the solid, substrate and tint.

Use of density for the management of solid ink and tone value has been viable for 4-color process printing, largely because the density filters used to measure print have been built to correspond with standard CMY print colors. However, when it comes to spot colors that fall in between the standard CMY printing colors, density-based strategies are less reliable. This is the reason that print buyers are increasingly specifying equity spot color inks using color (L*a*b*) and not density.

How It Works

While L*a*b* (and more preferably, spectral data) has become popular for specifying and managing spot color solids, there has been no industry-standard color-based approach to tone. This is the foundation of why ISO 20654 was written. ISO 20654 brings the same color-based approach used to specify and manage solid color to tone value.

Spot Color Tone Value (SCTV) is a ratio of the colorimetric difference between the tint, the substrate, and the solid. It works the same way the standard Murray Davies equation does, except that it uses color, versus density.

The key to SCTV is the use of three tri-stimulus functions for XYZ instead of density. These functions are outlined in the section below. The difference in each of the three functions are added together to create a value that represents the colorimetric difference between two measurements. Like Murray Davies, the formula computes the difference between the substrate and tone, and then divides that between the difference between the substrate and the solid. The final output of the formula, like Murray Davies, is a single percentage number that expresses the tone value.

SCTV FOR MULA

With Ite emergence of this new standard, software and hardware manufacturers are expected to implement this new method in their tools. The formula for SCTV is as follows.

$$t = \sqrt{\frac{(f_{x_{t}} - f_{x_{p}})^{2} + (f_{y_{t}} - f_{y_{p}})^{2} + (f_{z_{t}} - f_{z_{p}})^{2}}{(f_{x_{s}} - f_{x_{p}})^{2} + (f_{y_{s}} - f_{y_{p}})^{2} + (f_{z_{s}} - f_{z_{p}})^{2}}}$$

Where

- t is the tone value of the patch measured
- s is the solid
- p is the paper (substrate)

The particular functions (f) can be calculated either from $L^*a^*b^*$ values

$$f_x = (L+16)/116 + \frac{a}{500}$$

$$f_y = (L+16)/116$$

$$f_z = (L + 16)/116 - \frac{b}{200}$$

ortri-stimulus values

$$f_x = f\left(\frac{X}{X_n}\right)$$

$$f = f\left(\frac{Y}{Y_n}\right)$$

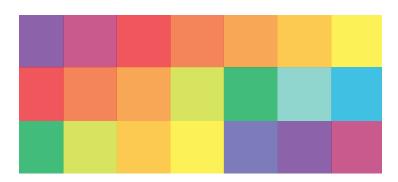
$$f_z = f\left(\frac{Z}{Z_n}\right)$$

So...what's different?

Because SCTV is based on L*a*b* best derived from spectral data, it works equally well on all colorants, substrates, and print processes. That means, when working with spot colors on a variety of substrates, SCTV produces a consistent result. When calibrating different spot colors across a variety of hues, substrates, and print processes, SCTV reliably produces a visual result where the 50% tint of the color approximates the expected 50% appearance.

Clarification

SCTV is a method for calculating tone value. Using a set of target values, SCTV can be used to measure the current behavior of the print process, create a correction curve, and then determine if the corrected process has achieved the target or intended behavior. SCTV is not a predictive algorithm that estimates what the target L*a*b* of an ink should be at a given percentage. SCTV is not a strategy for making the 50% tint of one printing machine match the 50% tint of another printing machine. Like Murray-Davies, it's a formula that calculates tone value. It just works much better for spot colors than density-based formulas.



What's the target?

Historically, specifications have offered target numbers for tone value based on print process and substrate type. ISO 12647-2:2015 prescribes 16% TVI when printing on a #1 coated sheet using standard CMYK inks. The same standard prescribes 22% when printing CMYK on uncoated materials. Generally speaking, specifying TVI depends on the process, the ink, and the substrate

SCTV is different. The recommended target for SCTV is always the same as the tint value. A 50% tint should have a measured tone value of "50." A 75% tint should have a target of "75" and a 2% should be a "2." Although these targets are recommended for use with SCTV, ISO 20654 does not explicitly prescribe a specification target. ISO 20654 provides a formula, which can be used effectively to calibrate and manage the printed tone behavior of printed spot colors. However, it is up to the appropriate print specification documents to officially prescribe use of SCTV, including the targets for use with the SCTV method. This is a communication between all parties in the supply chain and a calibration between the design intent, graphic target (proof), and the print reproduction.

Why it's better for spot colors.

SCTV in practice (vs Spectral Density)

Spectrum 1 is an image of 54 color ramps. This visual was created by collecting color ramp data across several different pressruns, spanning multiple print processes, substrates, and colors. The spectral data, in 10% increments, was then corrected so that the 50% tint would produce a 50% tone value, using spectral density. Spectral density is based on the highest-absorption wavelength, so it is essentially a customized density measure for each color. It should have worked. However, it is easy to see how inconsistent the corrected data is. Even in the black colors, behaviors are very different. This is a clear indicator that density measurement does not provide a reliable, consistent correction.

Spectrum 2 is what designers would see in Adobe Creative Suite if they defined these same exact spot color solids and then reduced the coverage by 10% increments using their application tools. It's easy to see that, no matter what the color, the ramps are smooth and consistent.

Spectrum 3 is the same data used for the top example (correction using spectral density), but corrected using the SCTV formula. Note that all the ramps develop evenly from top to bottom, just like the ramps that the prepress/design user would see. Note, too, that these 54 color ramps have 54 different white points whereas the prepress image is normalized to a "white." As a result,

SPECTRUMS



you can see differences in the top row, which is a function of the substrate differences and not the SCTV calculation.

By normalizing each color strip to white, versus the measured color of the substrate, you can see exceptional correlation between the SCTV result and the Photoshop color preview underneath it (Spectrums 4 and 5).

Long story short, calibrating a press with SCTV, making the 50% tone a "50," produces a printing behavior that better mirrors the expected printing behavior... no matter what the process, substrate, or ink hue.

Can SCTV be used for CMYK colors, too?

SCTV has clear benefits for use with spot colors. From a technical perspective, it is possible to use this method for calibration and management of CMYK colors. However, because the industry has already adopted many different specifications related to CMYK printing, which include both use of single-ink calibration and near-neutral calibration (CMY composited), the proposed scope of ISO 20654 is spot colors only







G7° Master Pass/Fail Requirements For the G7 Master Program





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Scope:

This document specifies the criteria for assessing printed samples submitted under the G7[®] Master program for G7[®] Grayscale, G7[®] Targeted and G7[®] Colorspace compliance.

1.0 Conformance Introduction

- 1.1 Idealliance Certified G7 Experts submit an application and supporting data to the program auditor as specified in the procedural document:
 "G7 Master Qualification Submission Procedures"
- 1.2 The G7 Expert supervises preparation of the print samples to be submitted by the Master site candidate. The Expert then uploads the relevant files as specified in 3.0.
- 1.3 The sample prints, proofs or press sheets are shipped to the Idealliance auditor for analysis.
- 1.4 The samples are analyzed to determine if they are within tolerance using the criteria outlines in this document.
- 1.5 For G7 Targeted or Colorspace submissions, the measurement data must correspond to the G7-based CRPC selected by the applicant within tolerances specified herein.
- 1.6 For G7 Grayscale submissions, the printed samples must conform to the G7 gray requirements. The printed samples must meet the G7 tonality and gray balance tolerances contained herein.
- 1.7 The colorimetric values or specifications used in this document are based on ISO 13655 'Spectral measurement and colorimetric computation for graphic arts images'. All auditor measurements are taken using the M0 or M1 measurement mode, unless otherwise requested¹.

¹ Regarding measurement modes:

G7 Grayscale is substrate-relative and therefore not dependent on the measurement mode. G7 Grayscale submissions may be measured in M0, M1, or M2.





2.0 Regarding Non-Standard Substrates (SCCA)

- 2.1 Where the printing substrate to be used has a color that differs from the CRPC by more than 2 but less than 5 ΔE_{00} , the CRPC data may be adapted using the SCCA (Substrate-Corrected Characterization Aims) method², which is defined in the downloadable SCCA kit: 'Substrate Relativity Calculator 20120606.zip'.
- 2.2 This creates a new sub-category of qualified conditions known, for example, as "GRACoL Targeted Relative" or "GRACoL Colorspace relative".³

GRACOL 2006 was based on M0, but can also be measured in M1 or M2 mode if submitted as a "relative" match, i.e. with SCCA (Substrate-corrected Colorimetric Aims) on.

GRACoL 2013 and the other six CGATS.21 / ISO 15339 CRPCs were based on M1, but can also be measured in M0 or M2 mode if submitted with SCCA on.

For best results, submissions that do not use SCCA should be measured in the M mode on which the target CRPC was based.

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² See ISO 15339 for more information.

³ Note that a "Relative" reproduction will look different to the eye from an "Absolute" reproduction, but is still valid for qualification purposes.





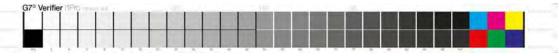
3.0 Sample Submission Requirements

3.1 Basic Target Submission Requirements

The G7 Expert must ensure the candidate G7 Master site produces valid print samples, which are measured by the Idealliance designated auditor as shown below:

| Condition | Charts ⁴ | |
|---------------|---|--|
| G7 Grayscale | G7 Verifier ⁵ , P2P25 or P2P51 | |
| G7 Targeted | G7 Verifier ⁵ , P2P25 or P2P51 | |
| | P2P25 or P2P51 and IT8.7/4 | |
| G7 Colorspace | or TC1617 (no P2P needed) | |
| | (TC1617 has been updated to IT8.7/5) | |

Example of the G7 Verifier chart:



- 3.2 Additional Target Submission Requirements Colorspace
 - 3.2.1 Smallest possible target: IT8.7/5 (TC1617)
 - 3.2.2 Alternate target combinations: IT8.7/4 plus P2P25 or P2P51

Note: Duplicate patches in the IT8.7/4 (or a combination of IT8.7/4 plus P2P) submitted for Colorspace will always be averaged; however, if an IT8.7/5 (TC1617) is submitted, there is no need for averaging because there are no duplicate patches.

⁴ Never reduce or enlarge the standard target images.

⁵ The G7 Verifier is a new CMYK target designed for evaluating G7 Grayscale and G7 Targeted compliance levels. It contains the minimum patches required for G7 Grayscale or Targeted compliance testing. The G7 Verifier is not a calibration target and does not replace a P2P target.





4.0 G7 Grayscale Pass/Fail Requirements

"G7 Grayscale Compliance" is achieved when a device or process is calibrated to the basic G7 definition of constant neutral Grayscale appearance as defined in ANSI/CGATS TR015, but does not necessarily use standard colorants or match a standard CRPC.

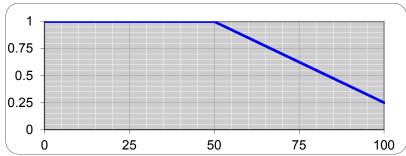
Remember that G7 Grayscale compliance provides no assurance of accuracy in colored image areas.

4.1 NPDC (CMY and K-only scales) and Gray Balance (CMY scale only)

| Target | Press Tolerance |
|--|---|
| Weighted ΔL^* (w ΔL^*) ⁷ CMY and K-only scales | Average $w\Delta L^* \le 1.5$ Maximum $w\Delta L^* \le 3.0$ |
| Weighted $\Delta C_h (w\Delta C_h)^8$ CMY scale | $\begin{array}{c} Average \ w\Delta C_h \leq 1.5 \\ Maximum \ w\Delta C_h \leq 3.0 \end{array}$ |

⁷ Where; $\Delta L^* = \sqrt{(L^*_{sample} - L^*_{target})^2}$ and; $w\Delta L^* = \Delta L^* * (1 - \max(0, \frac{\% - 50}{50} * 0.75))$

The w ΔL^* formula reduces the significance of the ΔL^* measurement above a Grayscale percentage (%) value of 50% on a linear scale beginning at 100% significance when % = 0 through 50 and terminating at 25% significance when % = 100.



The goal of the weighting function is to minimize the significance of hard-to-control lightness errors in very dark grays, which are usually less noticeable to the eye than L^* errors in lighter tones. $W\Delta L^*$ can be calculated using various software solutions available in the marketplace.

⁸ Where
$$\Delta C_h = \sqrt{(a^*_{sample} - a^*_{target})^2 + (b^*_{sample} - b^*_{target})^2}$$
; and; $w\Delta C_h = \Delta C_h * (1 - \max\left(0, \frac{c\% - 50}{50} * 0.75\right))$

The $w\Delta C_h$ formula is similar to the $w\Delta L^*$ function, reducing the significance of the ΔC_h measurement above a cyan percentage (c%) value of 50% on a linear scale beginning at 100% significance when c% = 0 through 50 and terminating at 25% significance when c% = 100. The goal of the weighting function is to minimize the significance of hard-to-control gray balance errors in very dark CMY grays that are usually covered by black ink. $W\Delta C_h$ can be calculated using various software solutions available in the marketplace.





4.2 Spatial Uniformity Informative (Not required)

If the sheet has two (2) measureable targets, then the CMYK solids on all targets *should pass*. Idealliance International Affiliates can modify this clause based on their region/market.

4.3 A Caution About Tolerances

The above tolerances are the bare minimum needed to pass G7 Grayscale compliance and do not necessarily reflect excellent printing. Serious print providers should aim for tolerances about half of the permitted values, i.e. weighted average 0.75 (vs. 1.5) and maximum 1.5 (vs. 3.0).

4.4 Exceptions Based on Print Process

Idealliance provides certain exceptions when qualifying printing processes whose inherent characteristics may cause them to fail normal G7 compliance tests. These print processes include flexo, screen printing, and any system that cannot achieve a near-neutral 300% CMY patch due to unusual colorants or process limitations. These exceptions are covered in the Annex to this document.

5.0 G7 Targeted Pass/Fail Requirements

"G7 Targeted Compliance" is achieved when a printing process passes G7 Grayscale compliance and the CIELab values on the primary (CMYK), secondary (RGB) solid ink patches and substrate match a selected CRPC within tolerances contained herein. For example, a commercial sheetfed offset press is in "G7 GRACoL Targeted Compliance" when it passes G7 Grayscale compliance and its seven ink solid patches and substrate meet the specified colorimetric aims for GRACoL.

- 5.1 Must meet G7 Grayscale requirements (see above section 4.0).
- 5.2 Must identify a G7-based CRPC, either in the public domain or custom (See Section 3.4: Custom Target Submission Requirements).





5.3 Solids, Overprints and Substrate⁹

| Target | Press Tolerance |
|----------------------|--------------------------|
| Substrate | $\Delta E_{00} \leq 3.0$ |
| CMY Solids | $\Delta E_{00} \le 3.5$ |
| K Solids | $\Delta E_{00} \le 5.0$ |
| RGB Overprint Solids | $\Delta E_{00} \le 4.2$ |

5.4 G7 Targeted Relative

If the substrate is significantly different from the defined CRPC, the sample may pass "G7 Targeted Relative Compliance", if selected in the application. For more details, see section 2.0 – Non-Standard Substrates.

6.0 G7 Colorspace Pass/Fail Requirements

"G7 Colorspace Compliance" is achieved when a device or process passes G7 Targeted Compliance and the CIELab values in an IT8.7/4 target match those in the selected CRPC within the following tolerances. 10

6.1 **Proof and Press Tolerances**

| Target | Proof Tolerance | Press Tolerance |
|----------------|---|---|
| Substrate | $\Delta E_{00} \le 1.5$ | $\Delta E_{00} \le 3.0$ |
| CMY Solids | $\Delta E_{00} \leq 3.5$ | $\Delta E_{00} \le 3.5$ |
| K Solids | $\Delta E_{00} \le 5.0$ | $\Delta E_{00} \le 5.0$ |
| RGB Solids | $\Delta E_{00} \le 4.2$ | $\Delta E_{00} \le 4.2$ |
| All patches of | Average $\Delta E_{00} \le 1.5$ | Average $\Delta E_{00} \leq 3.5$ |
| IT8.7/4 | 95 th percentile $\Delta E_{00} \le 3.0$ | 95 th percentile $\Delta E_{00} \le 5.0$ |
| | Maximum $\Delta E_{00} \leq 5.0$ | |

6.2 G7 Colorspace Relative

If the substrate is significantly different from that of the defined CRPC, the sample may pass "G7 Colorspace Relative Compliance", if selected in the application. For more details, see section 2.0 – Non-Standard Substrates.

⁹ The solid and 2-color overprint CIELab target values can be either the absolute values from the reference data set or the substrate-relative versions of the aims

¹⁰ These tolerances are relative to the absolute or substrate-relative aim CIELab values.





7.0 Pre-Verification of Print or Proof Samples

The G7 Expert should verify the print samples will pass the selected G7 Master compliance level by one or more of the following methods:

- 7.1 Use of a certified G7 System software that can verify the above conditions.

 Click Here for a list of G7 Certified Systems
- 7.2 Manual measurement analysis by other software applications (e.g. custom spreadsheet).

8.0 Color Measurement Method

All targets are to be submitted in a layout and size readable by the X-Rite i1iSis 2 or X-Rite i1iO II in i1Profiler. If customer targets are provided, the target and related reference file must be pre-approved¹¹ and readable using an X-Rite i1iSis 2 or X-Rite i1iO II in i1Profiler.

- 8.1 Measurement Mode

 Unless otherwise agreed, all measurements should be made in M1 mode.
- 8.2 Thickness Limitations

 Materials that are too thick to be read by an i1iSis2 will be read using an i1iO II. The Idealliance designated auditor reserves the right to reject these materials if measurement is impractical.
- 8.3 Transparent Samples

 Transparent or translucent samples will be measured on the Barbieri LFP.

 Transparent samples should only be submitted after confirming with the G7

 Master auditor that the actual targets and sample materials are acceptable by the Barbieri LFP and Gateway software.
- 8.4 Sample Size

 All targets must be reproduced at 100% of their original size.

¹¹ Contact Jordan Gorski (jgorski@idealliance.org) at Idealliance for custom chart submission procedure information.





9.0 Affidavit

The G7 Expert is required to provide an affidavit attesting to the completion of the G7 Master candidate's training requirements. The affidavit must be signed by both a designated representative of the G7 Master candidate company and the G7 Expert

- 9.1 Submission will not be analyzed until receipt of a properly completed affidavit.
- 9.2 Penalties for deliberately falsifying an affidavit include suspension of G7 Master status and/or loss of G7 Expert Status.

10.0 Failure of Samples

In the event of failure, the G7 Expert will have 60 days beyond the initial submission to resubmit new samples. An additional charge will apply for resubmission to cover the auditor's additional reading and analysis costs.





Annex A: Screen Printing

Scope

This annex modifies the Pass/Fail requirements for Screen Printing due to the special challenges faced by this process, notably the difficulty in producing consistent results from print-to-print, or prints with even coverage edge-to-edge.

A.1 Introduction

This Annex is necessary because exceptions to the basic G7 compliance levels of offset printing do not apply to screen printing. The key areas include:

- 1.1 Screen Printing compliance for G7 Gray Balance
- 1.2 Lower halftone screening frequencies
- 1.3 Expanded tolerances:
 - 1.3.1 $w\Delta L^*$ and maximum $w\Delta L^*$
 - 1.3.1.1 Minimizes the need for multiple NPDC curves
 - 1.3.1.2 Ink film thickness is not static across the press form
 - 1.3.1.3 Screen Printing has limited print station control points
 - 1.3.2 $w\Delta C_h$ and maximum $w\Delta C_h$
 - 1.3.2.1 The tonal range of the 3 color overprints are not neutral at the suggested G7 (a*, b*) values of (0,0)

A.2 Sample Submission Requirements

The G7 Expert must ensure the candidate G7 Master site provides valid print samples from which measurements can be obtained by an auditor. (See Section A.3).





A.3 Minimum Target Submission Requirements

- 3.1 Submit at least three of each of the following:
 - 3.1.1 Idealliance 12647-5 screen print control wedge and
 - 3.1.2 Either: the standard P2P25 or P2P51 target
 - 3.1.3 Or: a pre-approved custom target containing identical CMY and K patch values to columns 4 and 5 of the P2P51 target as well as solid C, M, Y and K patches. If a custom target is supplied, the original electronic version must also be supplied along with suitable reference files.

A.4 Pre-verifying Submitted Samples

The recommendation is that the G7 Expert analyzes the samples submitted for compliance evaluation, or identical copies, before their submission, using either the candidate site's or the G7 Expert's measuring equipment. (See section 7.0).

A.5 G7 (Grayscale) Pass/Fail Requirements – Screen Printing

All NPDC calculations for screen printing are based on the following seven control points of rows 4 and 5 from the P2P25 target, P2P51 target or a custom target containing identical CMY and K patch values:

0, 10, 25, 50, 75, 90, 100

5.1 NPDC (CMY and K-only scales) and Gray Balance (CMY scale only)¹²

| Target | Tolerance |
|---|-------------------------------|
| Weighted ΔL^* (w ΔL^*) | Average $w\Delta L^* \le 2.5$ |
| CMY and K-only scales | Maximum $w\Delta L^* \le 5.0$ |
| Weighted ΔC_h (w ΔC_h) | Average $w\Delta C_h \le 3.0$ |
| CMY scale | Maximum $w\Delta C_h \le 7.0$ |

¹² These tolerances are extremely generous and represent only a vague visual compliance with the expected "shared neutral appearance" of G7. It is strongly recommended to try and reach tighter tolerances and/or to use maximum GCR in production work to minimize the effects of unstable gray balance.





Annex B: Flexographic Printing

Introduction

This annex modifies the Pass/Fail requirements for Flexographic printing. Flexo presses cannot achieve the smooth continuous tonality in very light tones using traditional platemaking systems that other printing systems, such as lithography, can achieve.

Notes:

Flexo printers using new screening systems or other techniques that effectively solve the above problem need not use this annex.

The averaging of three sheets is allowed for legacy flexographic pri

B.1 Sample Submission Requirements

The G7 Expert must ensure the candidate G7 Master site provides valid print samples from which measurements can be obtained by an auditor. (See Section B.2).

B.2 Minimum Target Submission Requirements

- 2.1 Either: at least three P2P25 or P2P51 targets
- 2.2 Or: at least three customer targets containing identical CMYK patch values to columns 4 and 5 of the P2P25 or P2P51 target including solid C, M, Y and K patches. If a custom target is supplied, the original electronic version must also be supplied along with suitable reference files.
- 2.3 Relative proofs are allowed; however, no longer meet standard datasets and must reflect a named SCCA dataset (i.e., GRACoL 2006 Relative 95 0 -6)
- 2.4 Special cases, such as small web, may contact Idealliance for assistance.

B.3 Pre-verifying Submitted Samples

The recommendation is that the G7 Expert analyzes the samples submitted for compliance evaluation, or identical copies, before their submission, using either the candidate site's or the G7 Expert's own measuring equipment. (See Section 7.0).





- **B.4** G7 Grayscale Pass/Fail Requirements Legacy Flexographic Printing
 If not using modern flexographic platemaking technology, the G7 Grayscale
 evaluation will ignore NPDC and gray balance errors under 20% dot value.
- B.5 G7 Targeted Pass/Fail Requirements Legacy Flexographic Printing Because solid ink areas are unaffected by legacy flexo platemaking, no changes are necessary for G7 Targeted compliance except for the special G7 Grayscale compliance.
- B.6 G7 Colorspace Pass/Fail Requirements Legacy Flexographic Printing
 Because legacy flexo screening may affect many IT8.7/4 patch values, G7
 Colorspace compliance may require submission of a custom G7 dataset to
 Idealliance. Please contact Idealliance for more information.





Annex C: G7 Native CMY

Scope

This annex modifies the G7 Pass/Fail requirements to allow for printing processes that cannot achieve near-neutrality at 300% CMY, which includes most dry-ink electrophotographic (xerographic) printing systems.

C.1 Introduction

Certain printing processes (e.g. dry-ink electro-photography) cannot achieve G7 compliance "natively" (without the help of color management) due to the G7 requirement that 300% CMY must be "neutral" (0.0 a* and b*).

The arbitrary G7 requirement for a neutral 300% CMY point came from G7's origins in photography, where color film and paper always produce a nearly-neutral black with just three CMY dyes. However, in CMYK printing, the black ink largely hides any non-neutral gray balance in darker CMY values, and the 300% CMY value is seldom, if ever printed in actual work. So, the arbitrary insistence on a neutral 300% patch can be safely suspended for certain printing systems without significantly altering the basic concepts, intents, and benefits of G7.

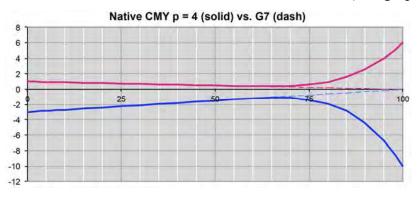
The "G7 Native CMY Annex" by-passes the "neutral 300% CMY" rule for systems that cannot achieve neutral 300% CMY by mechanical means.





C.2 G7 Grayscale Native CMY Compliance

"G7 Native CMY" is similar to G7 Grayscale, except the target a* and b* values for CMY gray levels darker than 50% cyan are adjusted along a trajectory that ends at the native a* and b* values of that device's 300% CMY level. (See graph below.)



2.1 The example graph above depicts:

The "target" a^* (red) and b^* (blue) for a device whose paper is 1 a^* , -3 b^* and the G7 Native CMY gray balance when 300% CMY = 6.0 a^* , -10 b^* .

2.2 Target a*, b* algorithm

Given:
$$a^*_s$$
, b^*_s (s = substrate) and a^*_300 , b^*_300 ;

For index percentage values 0 to 100;

$$a^* tgt = a^* s x (1-C/100) + a^* 300 x if(C < 50, 0, ((C - 50)/50)^4)$$

$$b^* \text{ tgt} = b^* \text{ s x } (1-C/100) + b^* 300 \text{ x if}(C < 50, 0, ((C - 50)/50)^4)$$

2.3 G7 Native CMY maintains G7's original neutrality up to approximately 75% because CMY gray balance only deviates from legacy G7 in tonal areas normally covered by high amounts of black ink.

C.3 Important Notice

3.1 Printing systems that can achieve neutral 300% CMY (e.g. offset) should continue to aim for neutral 300% CMY, especially when the goal is G7 Targeted or G7 Colorspace compliance.





Annex D: Deriving L*a*b* Aims for Neutral Scales from TR015 Equations

D.1 Background

CGATS/Idealliance TR 015:2015 (TR015) was developed to provide a framework for G7 methodology that could be incorporated into standards documents. The equations in TR015 provided a formal representation of Neutral Print Density (NPD) and color (a*, b*) for CMY and K neutral scales that is equivalent to the original G7 formulation. When evaluating neutral scales for G7 compliance, it is often necessary to first calculate L*a*b* aims that correspond to ideal G7 neutral scales. This annex is intended to clarify the derivation of these aims from the equations in TR015.

D.2 Deriving L* Neutral Scale Aims from NPD Equations of TR015

NPD equations for CMY and K neutral scales are found in Sections 5.4 and 5.5 of TR015. When evaluating neutral scales using metrics that depend on L*, it is necessary to first calculate L* values corresponding to NPD aims for a G7 neutral scale. This requires conversion of NPD aims to "absolute" NPD, by adding substrate density, then converting this quantity to L* as follows:

$$\begin{split} NPS_{abs} &= NPD + log 10(1/Y_L) \\ Y_{abs} &= 10^{NPD_{abs}} \\ L^* &= 116 * Y_{abs}^{1/3} - 16 \quad if \quad Y_{abs} > (6/29)^3 \\ &= (841/108) * Y_{abs} \quad if \quad Y_{abs} \le (6/29)^3 \end{split}$$

where Y_L is the luminous reflectance factor of the substrate as defined in TR015.

The following approximation, when L^* is calculated directly from NPD and L^*_s , the substrate lightness can be used when NPD_{abs} < 2, which is true in most applications:

$$L^* = 10^{-NPD/3} * (L_S^* + 16) - 16$$





D.3 Deriving a* and b* Neutral Scale Aims based on TR015

Section 5.3 of TR015 has clarified that for most applications, the a* and b* should use the following equations that represent a linear scaling of substrate a* and b*:

$$a^* = a_s^* \times (1 - TV_C / 100)$$

$$b^* = b_s^* \times (1 - TV_C / 100)$$

Note: The alternative method found in Appendix C or TR015 is intended for calculation of substrate corrected data sets.

D.4 Example

The example chart on page 20 lists aims that have been calculated for a given paper substrate and CMY solid. Tone values for M and Y are calculated according to section 5.2 in TR015. NPD was calculated according to section 5.4 of TR015. NPD_{abs} and L*a*b* aims were calculated according to the equations in D.2 and D.3 above.





Example Chart

| | | L* | a* | b* | | |
|---------------------|----------------------|-------|--------|--------|--------|--------|
| | Paper | 95 | 1 | -4 | | |
| | CMY solid | 23 | 0 | 0 | | |
| | | | | | | |
| TV _C (%) | TV _{MY} (%) | NPD | NPDabs | L* aim | a* aim | b* aim |
| 0.00 | 0.00 | 0.000 | 0.057 | 95.00 | 1.00 | -4.00 |
| 2.00 | 1.49 | 0.019 | 0.077 | 93.37 | 0.98 | -3.92 |
| 4.00 | 2.98 | 0.039 | 0.096 | 91.75 | 0.96 | -3.84 |
| 6.00 | 4.47 | 0.058 | 0.116 | 90.14 | 0.94 | -3.76 |
| 8.00 | 5.96 | 0.078 | 0.135 | 88.55 | 0.92 | -3.68 |
| 10.00 | 7.46 | 0.098 | 0.155 | 86.98 | 0.90 | -3.60 |
| 15.00 | 11.21 | 0.148 | 0.205 | 83.08 | 0.85 | -3.40 |
| 20.00 | 15.01 | 0.199 | 0.257 | 79.27 | 0.80 | -3.20 |
| 25.00 | 18.88 | 0.252 | 0.309 | 75.51 | 0.75 | -3.00 |
| 30.00 | 22.83 | 0.305 | 0.363 | 71.82 | 0.70 | -2.80 |
| 35.00 | 26.90 | 0.361 | 0.418 | 68.17 | 0.65 | -2.60 |
| 40.00 | 31.11 | 0.418 | 0.475 | 64.55 | 0.60 | -2.40 |
| 45.00 | 35.46 | 0.477 | 0.535 | 60.96 | 0.55 | -2.20 |
| 50.00 | 40.00 | 0.539 | 0.596 | 57.39 | 0.50 | -2.00 |
| 55.00 | 44.74 | 0.604 | 0.661 | 53.82 | 0.45 | -1.80 |
| 60.00 | 49.69 | 0.673 | 0.730 | 50.24 | 0.40 | -1.60 |
| 65.00 | 54.90 | 0.745 | 0.803 | 46.65 | 0.35 | -1.40 |
| 70.00 | 60.37 | 0.823 | 0.880 | 43.03 | 0.30 | -1.20 |
| 75.00 | 66.12 | 0.905 | 0.963 | 39.41 | 0.25 | -1.00 |
| 80.00 | 72.19 | 0.993 | 1.051 | 35.79 | 0.20 | -0.80 |
| 85.00 | 78.59 | 1.087 | 1.144 | 32.21 | 0.15 | -0.60 |
| 90.00 | 85.34 | 1.183 | 1.240 | 28.77 | 0.10 | -0.40 |
| 95.00 | 92.47 | 1.278 | 1.336 | 25.62 | 0.05 | -0.20 |
| 98.00 | 96.94 | 1.331 | 1.388 | 23.96 | 0.02 | -0.08 |
| 100.00 | 100.00 | 1.363 | 1.420 | 23.00 | 0.00 | 0.00 |

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BrandQ Experts are individuals who are qualified to train and implement the BrandQ program at brand and supplier facilities. The BrandQ training for experts focuses on what experts need to teach brands, program requirements, and conducting BrandQ audits. Unlike the BrandQ user training which is hands-on and focuses on basics of measurement, assessment, and communication the BrandQ Expert training focuses on program requirements, and the knowledge needed to implement the program as a certified BrandQ Expert.

Upon completion of the program, BrandQ Experts will take an online test, and receive a packet of materials to assess and report on during a live remote session. Upon completion of the test Experts will be listed on the Idealliance BrandQ website as a certified Idealliance BrandQ Expert.

BrandQ Site Certification Idealliance offers a site certification for brands based on the BrandQ program. BrandQ Certification is issued to suppliers and is based on performing to industry standards. Idealliance uses its worldwide network of assessment labs as well as BrandQ Certified experts to assess sites for BrandQ certification. The BrandQ certification is used by







major brands to identify and qualify suppliers. BrandQ Certification can be customized to meet the needs of the brand. Below are standards referenced by the BrandQ program for training and certification:

Applicable Industry Standards The Figure below shows applicable standards in each of the three steps of a packaging color reproduction workflow. This information was published on 12/12/2017 in the ISO/DTR 19303-1 Graphic Technology Guidelines for Schema Writers Part 1: Packaging printing colour reproduction.

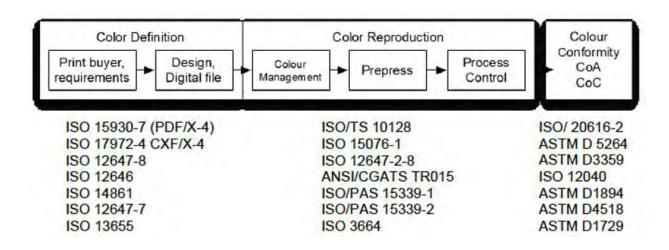
*CoA: Certificate of Analysis CoC: Certificate of Conformance

These international and national standards were referenced in constructing the BrandQ on-site audit process to ensure the practices and results are conformed to the highest standard of the industry. The number and title of each standard are listed below for quick referencing.

| Standard Document Number and Title | | | |
|------------------------------------|---|--|--|
| ISO 5-4:2009 | Photography and graphic technology – Density measurements – Part 4: Geometric conditions for reflection density | | |
| ISO 3664:2009 | Graphic technology and photography – Viewing conditions | | |
| ISO/TS 10128:2009 | Graphic technology — Methods of adjustment of the colour reproduction of a printing system to match a set of characterization data | | |
| ISO/CIE 11664-6: 2014 | (CIE S 014-6/E:2013) Colorimetry – Part 6: CIEDE2000 Colour-difference formula | | |
| ISO 12040:1997 | Graphic technology – Prints and printing inks – Assessment of light fastness using filtered xenon arc light | | |
| ISO 12646:2015 | Graphic technology – Displays for colour proofing – Characteristics | | |
| ISO 12647- 2:2013 | Graphic technology – Process control for the production of half-tone colour separations, proof and production prints – Part 2: Offset lithographic processes | | |
| ISO 12647- 7:2016 | Graphic technology – Process control for the production of halftone colour separations, proof and production prints – Part 7: Proofing processes working directly from digital data | | |

| ISO 12647- 8:2012 | Graphic technology – Process control for the production of half-tone colour separations, proof and production prints – Part 8: Validation print processes working directly from digital data | |
|----------------------|---|--|
| ISO | Graphic technology – Spectral measurement and | |
| 13655:2017 | colorimetric computation for graphic arts images | |
| ISO | Graphic technology – Requirements for colour soft | |
| 14861:2015 | proofing systems | |
| ISO 15076- | Image technology colour management – Architecture, profile | |
| 1:2010 | format and data structure – Part 1: Based on ICC.1:2010 | |
| ISO/PAS | Graphic technology – Printing from digital data | |
| 15339-1: 2015 | across multiple technologies – Part 1: Principles | |
| ICO/DAC | Graphic technology – Printing from digital data across | |
| ISO/PAS | multiple technologies – Part 2: Characterized reference | |
| 15339-2: 2015 | printing conditions, CRPC1-CRPC7 | |
| | Graphic technology – Prepress digital data exchange using | |
| ISO 15930- | PDF — Part 7: Complete exchange of printing data (PDF/X-4) and | |
| 7:2010 | partial exchange of printing data with external profile reference | |
| | (PDF/X-4p) using PDF 1.6 | |
| ISO 17972- | Graphic technology – Colour data exchange format (CxF/ | |
| 4:2015 | X) – Part 4: Spot colour characterisation data (CxF/X-4) | |
| ISO/DIS | Graphic technology – Colour conformity assessment of | |
| 19302 | printed products | |
| 100/075 | Graphic Technology – Guidelines for Schema Writers – | |
| ISO/DTR | Part 1: Packaging | |
| 19303-1 | printing colour reproduction | |
| <u> </u> | | |

| Graphic technology – File format for quality control | |
|---|--|
| and metadata – Part 2: Print quality exchange (PQX) | |
| Graphic technology – Measurement and calculation of spot | |
| colour tone value | |
| Graphic technology – Exchange format for colour | |
| and process control data using XML or ASCII text | |
| Document management – Portable document format – | |
| Part 2: PDF 2.0 | |
| Graphic technology – Methodology for Establishing Printing | |
| Aims Based on a Shared Near-neutral Gray-scale | |
| Standard Practice for Visual Appraisal of Colors and | |
| Color Differences of Diffusely-Illuminated Opaque Materials | |
| Standard Test Method for Static and Kinetic Coefficients | |
| of Friction of Plastic Film and Sheeting | |
| Standard Test Methods for Rating Adhesion by Tape Test | |
| Standard Practice for Abrasion Resistance of | |
| Printed Materials by the Sutherland Rub Tester | |
| | |





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- G7° is designed to align all devices, substrates and inks
- G7° makes it easier to meet and maintain color expectations



Lighting and Proof to Press Matching: Dealing with Metamerism Failures and Substrate Adjusted CRPC Profiles for Non-Standard OBA Levels

This document discusses some common problems often encountered when viewing, measuring or controlling color printing, that can make color management seem to fail, and cause frustration and expense for printers and print buyers alike. Generally classified as "metamerism failure", these problems are caused by a combination of factors including the illuminant in a measuring instrument – especially its UV content, OBAs (Optical Brightening Agents), ink fluorescence or UV absorption, and differences between the official D50 standard and commercially-available "D50" light sources.

Suggestions for minimizing or eliminating these problems are offered along with input on how these problems and solutions can impact process control and successful G7® calibration.

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Metamerism Failure Defined

In the world of printing, "metamerism failure" describes what happens when two different colorant sets (inks) that appear similar under a certain light source, look different under different lighting. The two most common printing industry problems caused by metamerism failure are:

- (1) Unreliable "match" between two printed samples.
- (2) Two printed samples that "match" each other under one light source fail to match under another.

Printed appearance changes under different lighting

A print sample that looks correct under one light source, e.g. ISO Standard 'D50'1, looks incorrect under a different light source, e.g. home, office or retail lighting.

Figure 1 shows that metamerism failure can cause a printed sample that matches in the printer's D50 viewing booth (center) to not match in the client's environment (left and right). This is one of the biggest sources of disagreement between creatives and print providers and can lead to costly remakes when expectations are high.

The good news is that problems caused by metamerism failure can be reduced with proper education and/or custom color management workflows.



Figure 1: The same offset print viewed under F1 (left), D50 (center) F12 (right).

What causes metamerism failure?

The root cause of metamerism failure is the difference in spectral energy curves (a.k.a. 'spectral emission curves' or 'spectrum') between different light sources, and how that difference can change the visual appearance of the inks and/or substrate in a printed sample.

¹ D50 (defined in ISO 3664:2009) is the default standard illuminant for graphic arts use.

For example, the red graph in Figure 2 shows how a "warm-white" (F12) fluorescent tube enhances the saturation of magenta ink while diminishing the saturation of cyan ink, which explains the red cast in the right-hand image in Figure 1. Conversely, the blue graph shows how a "cool-white" (F1) fluorescent tube enhances cyan ink but diminishes magenta, which explains the bluer look and weaker reds in the left-hand image.

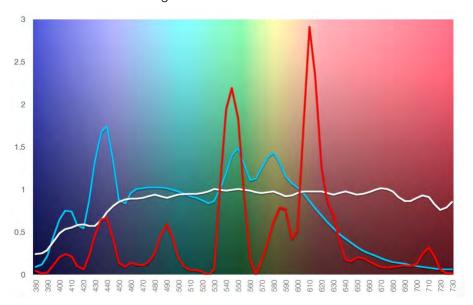


Figure 2: Spectral curves of the three light sources in Figure 1: F1 (blue), F12 (red) and CIED50 (white).

Metamerism failure under D50 lighting

A more subtle metamerism failure can occur when the spectral energy curve of a commercially available D50 light source only approximates the CIE D50 spectral curve, as shown in Figure 3.

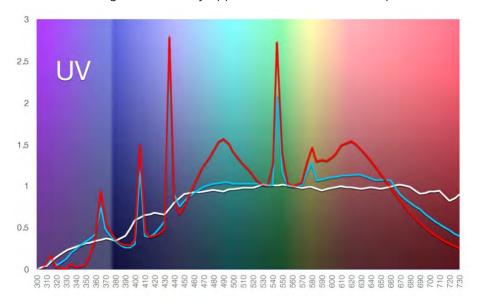


Figure 3: Spectral curves of 'D50' fluorescent tubes from GTI (blue) and JUST Normlicht (red) compared to CIE D50 / M1 (white). Differences in the UV region cause problems when measuring and viewing OBAs.

The ISO 3664:2009 standard requires a D50 light source to achieve a Color Rendering Index (CRI) of 93 or higher, but this is a quite loose tolerance that does not guarantee a perfect visual match in demanding situations. Significant delta E errors can exist between a measured print and how it appears in an actual viewing booth.

High-CRI LED lighting

Recent developments in high-CRI 'white LED' light sources can significantly reduce metamerism failure, as shown in Figure 4, but quite large errors still exist in the blue-UV region.

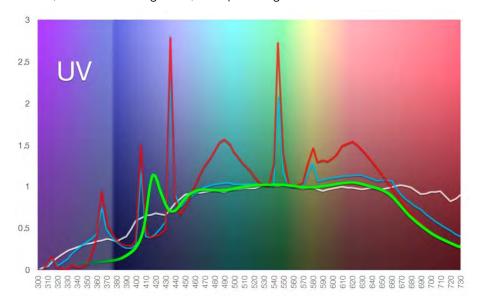


Figure 4: High-CRI D50 LED bulbs (green) are much closer to CIE D50 than D50 fluorescent tubes.

Problems due to fluorescence, OBAs and M1 measurements

The differences in UV spectrum between commercial D50 light sources and M1 (CIE D50) (see figures 3 and 4) can cause problems when measuring, color-managing and viewing fluorescent materials, inks or substrates enhanced with Optical Brightening Additives (OBAs).

The main problem is that the UV spectrum of M1 is not the same as the UV spectrum of a typical D50 booth, so the effect on fluorescing materials (OBAs, dyes, pigments, etc.) can be significantly different in terms of brightness and color. As a result, when M1 measurements are used to make the input and profiles of a proofing system, the press stock may appear bluer or pinker than the proof or vice/versa.

The problem is made worse by the fact that M1 instruments do not contain a true D50 light source, but rather a combination of "white" tungsten or LED reinforced with a separate UV source. The net spectral curve of the instrument illuminant starts out far from CIE D50, but is then modified in software so that (on the instrument's white calibration plaque) the OUTPUT spectral curve matches what would be measured if the light source were true D50. It's a clever trick – but with a fatal flaw.

Why M1 often fails

The M1 measurement standard is meant to solve the problem that M0 and M2 instruments don't "see" what we see in a D50 light booth. The reason M1 doesn't often fails on OBAs and fluorescent inks is that software correction values applied to the output signal at UV wavelengths do not correct light and color emissions generated at visible wavelengths by the UV fluorescence.

Add to this the difference between M1 and a typical D50 viewing booth and the promise of M1 becomes more remote. With apologies to Confucius, at the time of writing, M1 is like the sound of one hand clapping. At best it solves only half the measuring/viewing problem, and even then, only partially.

Light at the end of the tunnel

To be clear, the problems of metamerism failure, M1 and OBAs are not caused by any weakness in ICC theory, they are lighting problems. The good news is that for advanced users, modified ICC profiles can hide or even cancel these problems (see *Solutions and workarounds*.)

Solutions and workarounds

Standard D50 lighting

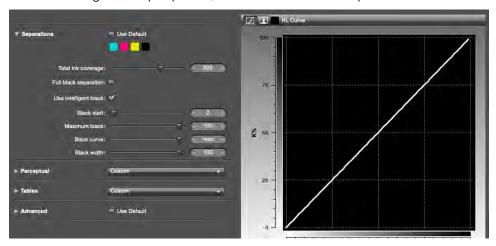
The best way to avoid metamerism failure is to only view printing under ISO Standard D50 lighting, but D50 is usually unavailable in end-user environments. Switching to D50 can be expensive, with high-quality D50 tubes costing around \$30-\$40 compared to around \$3 for typical home or office lights. So-called "5000K₂" or "daylight" tubes may reduce the problem but are seldom true D50.

Reducing metamerism failure with GCR

If the effects of metamerism failure are most visible in neutral gray areas it can be reduced by using a profile with maximum GCR and a full-range black. If the black ink is free from metamerism failure (true for most offset inks but not all ink-jet inks) neutral gray areas should exhibit less metamerism failure.

Creating a high-GCR profile

When creating the output profile, use as much black as possible and maximum GCR, as shown here.



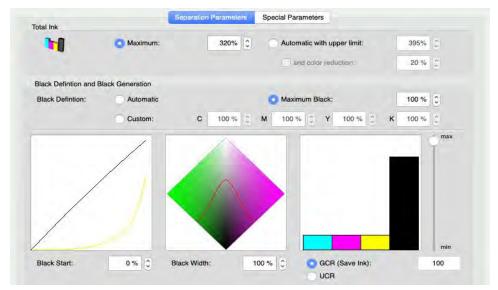


Figure 5: Creating a full-range black profile ini1Profiler (top) and basICColor print (bottom).

² Contrary to common belief, D50 is not the same as "5000°K".

High-GCR profile cautions

- High-GCR profiles can reduce metamerism failure in neutral areas but not in colors. If the problem is in colored areas, try spectral-based profiles as well as, or instead of high-GCR.
- High-GCR or long-range-black profiles make black halftone dots more visible in light areas where they may be objectionable in some applications, especially flesh tones.

Reducing metamerism failure with spectral profiling

When D50 lighting is not the intended viewing environment, metamerism failure can be reduced or eliminated by creating output files with a custom ICC profiles tailored to the spectrum of the specific light source, subject to the limitations discussed under *Cautions When Using Spectral Profiles*.

Creating Spectral Profiles

Most ICC profiling software can build spectral profiles if the characterization data (e.g. from an IT8.7/5 target) include spectral values. (Note that spectral profiles cannot be made from tri-stimulus values like CIELAB or XYZ).

The software usually offers a list of standard CIE₃ illuminants including D50 (default), D65, D75, A, F1, F11, etc. If the desired light source is not in the list, there is usually an option to measure a custom illuminant or load measured data from another program.

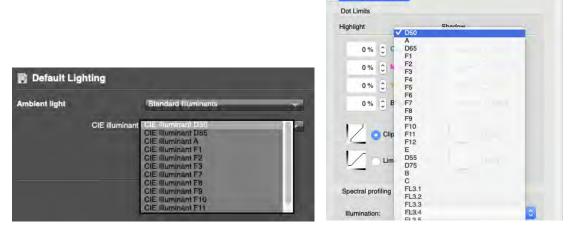


Figure 6: Standard CIE illuminants in i1Profiler (left) and basICColor print (right).

When a custom illuminant is selected, the profiling software interprets the printer's spectral characterization data as they would appear under that illuminant, rather than D50.

Each profiling software is different but the basic procedure for creating a spectral printer profile is as follows:

- Stabilize the printer and calibrate to G7.
- Print a characterization target (e.g. IT8.7/5) through the G7 calibration curves.
- Measure the characterization target (ideally in M1 or M0 mode) and save the measured data as spectral values in the widest available range of spectral values, e.g. from 380 to 730 nm rather than 400 to 700 nm.
- When the software asks for a light source, select the one nearest to your viewing condition. If your viewing condition is not listed, select 'Measure...' and follow the instructions to measure your own light source with an emissive spectrophotometer, e.g. X-Rite i1Pro.

³ Commission Internationale de l'Eclairage (International Commission on Illumination)

- o If there is no 'Measure...' option, measure your light source with a commercially available software application designed for such purposes.
- Save the measurements in a format accepted by the profiling software and name it with your custom source, e.g. 'supermarket 2019'.
- Load the custom measurement in your profiling software with the 'Load...' option.
- Create the profile and include the light source in the name, e.g. 'Press1_supermarket 2019.icc'.

Using spectral profiles

Matching different media under non-standard lighting

One of the most valuable uses for spectral printer profiles is to improve the visual match between different printing systems or ink types under 'real-world' lighting.

For example, packaging, labels, signs and other materials from different printing systems should match each other more closely in a retail store, so long as the image files for each printing system are converted into each printer's own custom-spectral ICC profile made with the spectrum of the store's actual lighting.

Improving proof-to-press match under commercial 'D50' lighting

In a proofing setup, the effect of small differences between CIE D50 and commercially-available "D50" tubes can be reduced or eliminated by using a spectral *press* profile as the 'source profile' and a spectral *proofer* profile as the 'output profile', where both profiles are made using the actual viewing booth illuminant, not the standard CIE D50 setting.

NOTE: If the main difference is in the white areas, OBAs may be the problem – see later section on OBA.

Improving hard-copy to soft-proof match

A related use of spectral profiles is to reduce the small errors sometimes seen between a hard-copy print or proof in a D50 dimmable viewing booth and a soft-proof on an accurately calibrated and profiled computer monitor. These errors can be reduced or eliminated by assigning to the CMYK image a spectral profile based on that specific print media and the spectral curve of that actual dimmable viewing booth.

Cautions when using spectral profiles

Pre-agreement to use the same custom viewing conditions

Everyone who judges color in the workflow should be provided with a custom viewing station equipped with the same custom light source. This can be assured by buying a bulk quantity of the specified tube or bulb and distributing them to all parties. Keep enough in reserve to allow for re-lamping all involved viewing stations for the foreseeable future.

Visual differences under D50 lighting

When using spectral profiles, all parties including printer, pre-press, customer, sales and support must understand that printed materials may not match under different lighting conditions. For example: a substrate that fluoresces under one light source may not do so to the same extent under a different light source; or, two patches of the same color value have visually different appearances under different lighting conditions. In other words, color that does not match under D50 lighting may appear to be 'correct' under other viewing conditions, and vice-versa.

Special proof / print job identification

Proofs made with spectral profiles should be clearly labeled with a notice such as 'Non-standard proof – view only under (light source name)'.

Confirming the effectiveness of spectral profiles

When first using custom spectral profiles, it is important to check the proof to press sheet match under the custom viewing condition. If the press sheet and proof don't match visually, check the measured match, but remember that delta E is normally calculated with reference to D50, so normal delta E numbers may not correlate with what you see. For proper delta E calculations, the instrument or software used to calculate delta E should use the custom light source, not D50.

Calculating delta E for a custom illuminant

Some measuring devices offer a selection of CIE-standard illuminants, including D50, D65, A, F1, etc., however using a user's own custom-measured illuminant may not be supported.

Expert users can convert measured spectral data into custom-spectral CIELAB in a commercially available software application designed for such purposes, then calculate Delta E in a spreadsheet or similar software application.

NOTE: Standard Delta E formulae should work effectively so long as both measurements refer to the same custom illuminant.

If the proof-to-press visual match is acceptable but one or both no longer passes G7 Colorspace, read the section; *Compatibility with the G7 Master Program*.

Compatibility with the G7 Master program

Because standard Delta E calculations are normally specified with an illuminant of D50, if a proofing or printing system uses custom spectral profiles, the printed samples submitted to the G7 Master program may show higher than expected delta E numbers, or even fail G7 Master Colorspace or G7 Targeted tolerances.

In such cases, the G7 Master program allows applications to reference any CIE-standard non-D50 light source such as F1, F2, D50, D65 etc. If the spectral profiles reference a user's custom-measured light source, that can also be used so long as the measured spectral light source data are uploaded with the application. Spectral files must be in CGATS .txt file format, for example created and exported from a commercially available software application designed for such purposes, Note that X-Rite.lxf and .cxf illuminant files must be converted to ANSI CGATS .txt format before uploading.

D50 "visual match" vs. M1 "measured match"

Due to the difference between commercial D50 light sources and true CIE D50, M1 measurements do not exactly correlate with what we see in a standard D50 viewing booth, and Delta E values or G7 Colorspace scores calculated from M1 measurements may not exactly represent the visible relationship between a proof and a press sheet.

The reason for this is that when a spectrophotometer is set to M1 mode, true CIE D50 illumination is simulated by software adjustments to give CIELAB and Delta E values that represent what we would see under perfect CIE D50 lighting (if it were available).

However, because the spectral energy curves of commercial D50 light sources only approximate true D50, small but noticeable disagreement can occur between a "measured match" and a "visual match". This explains why we sometimes see small color differences between two printed samples, even when their measured Delta E differences are effectively zero.

Dealing with OBA-related metamerism failure

Eliminate UV

It is possible to eliminate UV from the viewing area and light sources. This sounds extreme, but a lack of UV was how viewing and evaluation conditions were specified from 1995 until around 2009, when UV specifications were devised in the newer viewing standard, ISO 2664:2009.

This tactic does not eliminate visual mismatches but can hide visual differences caused by different OBA levels in the substrates of the prints being compared. Metameric failure may also be hidden when UV is filtered or masked in the viewing area. That is, colors that are metameric pairs may look similar under non-UV viewing conditions, but visually different under viewing conditions including UV. Note that printed materials and proofs that don't involve OBAs or fluorescent inks should look identical in UV or non-UV environments.

Eliminating UV in the viewing booth

- Most viewing booth manufacturers can provide a UV filter either for the luminaire or wrapped around individual tubes.
- Be sure to modify all equipment and booths at both the printer and print buyer locations.

Eliminating UV in the measuring device and profiles

- Set the spectrophotometer to M2 (or M3) mode. (Note that M0 includes UV.)
- Create profiles as normal from the M2 measurements.
- If the material has OBA content, be sure to include "M2" in the profile name

Limitations and cautions

- Creating a UV-free workflow, profiles or proofing setup will hide the effects of fluorescence that may show in other lighting.
- Be sure all involved parties are aware of and agree to this work-around and are equipped with UV-cut viewing and measuring equipment.
- When submitting samples for G7 Master compliance, be sure to note that all measurements are made in M2 mode.

Generating an OBA-adjusted input (CRPC) profile

The input or source CRPC (Characterized Reference Print Condition) is the profile that the proofer is trying to simulate. The CRPC's nominal white point can be modified by standard SCCA means, using the free Microsoft Excel spreadsheet from Idealliance or commercially available software.

Once the CRPC data has been SCCA-modified, an input profile can be created from the adjusted data.

Generating an OBA-adjusted output (proofer) profile

There is normally no need to create an OBA-adjusted output (proofer) profile, except when the measuring instrument sees the OBAs in the proofing stock differently from how the human eye sees them in the actual viewing booth. Such differences are caused by differences between the UV energy and actual curve shape in the measuring device compared to the viewing booth, as illustrated in Figures 3 and 4.

One way to minimize such differences is to create an output (proofer) profile using the actual spectral energy curve of the viewing booth rather than D50 (see *Reducing metamerism failure with spectral profiling*).

If this doesn't work completely, edit the white point a* or b* values of the spectral profile by the SCCA method using trial and error until the required accuracy is achieved.

Caution when creating OBA-adjusted CRPC profiles

IMPORTANT: Input (CRPC) profiles created from SCCA-modified CRPC data should be notated in the name to make it clear that they are not made from a stand a new data set or profile has been created from modified CRPC data.ard CRPC (ard-analysis ready data). For example, if CRPC6 is modified to have a white point of 95 L*, +1 a*, -9 b*, the profile name should include 'L95, a1, b9 or similar.

Solutions for non-ICC profiling systems

Some proofing systems do not use ICC profiles but instead use a device-link or color table approach. These systems can usually be configured to match their proofing product under spectral lighting conditions. Contact the manufacturer for detailed instructions.

Appendix A: CRPC profiles for non-standard OBA levels

Improving press-to-proof match with non-standard OBA levels

To achieve a better proof to press match with higher OBA press papers it is necessary to match the OBA level of the modified CRPC (see list above) and the proof paper to the OBA level of the press sheet. This can be done by comparing the OBA index of the proof paper to the OBA index of the press paper. (OBA index is function in many spectrophotometers. It can also be calculated manually.)

An alternate solution is to measure your own press stock and create your own modified CRPC with the same white point, using the free SCCA tools available from Idealliance, or one of the many commercial software packages that do the same thing.

Matching proofing stock to press stock OBA level

To create a good proof-to-press match it is important that the OBA level of the proof and press stocks match, but the wide variety of stocks used in most pressrooms makes it difficult to select one standard proofing paper. Most printers match their proofing stock OBA level to a 'house' pressroom stock. Measuring the house stock's OBA Index helps decide the best proofing stock. The OBA Index function will result in a high, low or medium OBA level. (This can be done by hand by measuring M1 and M2 and subtracting the difference.). The proofing paper is then compared to the same OBA Index and the proofing paper with the closest level of OBA's is selected.

It is also helpful to check the M1 measurements of each stock and make sure they are similar. If the two stocks have too great a difference in OBA, a good proof to press match will be impossible. If they have a good measured match both in both M1 and M2 modes and a good visual match in both UV-rich and non-UV lighting, the chance of achieving a good proof to press match becomes much greater.

Many users have a difficult time color-matching or validating a press sheet that contains higher levels of optical brighteners than the nominal CRPC they are using. For example, many commercial offset papers have higher levels of OBAs than GRACoL® 2013 (CRPC-6), which has a nominal b* value of -4. This makes it extremely difficult to create pre-press proofs that visually-match the press paper. It also makes it hard to know when the press is matching the selected CRPC, except by using the SCCA option.

To help alleviate this problem, the Idealliance Print Properties Committee has created SCCA-adjusted versions of GRACoL® 2013 with two higher levels of OBAs, as shown in the following chart. These higher-OBA CRPCs can be used as references when calculating G7 Colorspace compliance in Delta E units, or as source profiles to create simulated proofs on suitably brightened proofing stock.

| GRACoL® 2013 CRPC6 | Low OBA | -4 |
|-------------------------|--------------|-----|
| GRACoL® 2013 96 1.5 -8 | Moderate OBA | -8 |
| GRACoL® 2013 96 2.5 -12 | High OBA | -12 |

To use these profiles as source profiles for modified hard-copy proofs, be sure the proofing paper has at least the same level of OBA, or higher (lower b*, higher L*). Most proofing paper manufacturers now have OBA versions that correlate with the moderate OBA profile (-8 b*) listed above.

Measuring OBA Index

OBA index can be calculated with any device that can measure M1 and M2. Most commonly this is done using a device with built-in OBA Index capabilities such as a Techkon Spectrodens or X-Rite eXact. It can also be done manually with a scanning spectrophotometer such as an X-Rite i1, iSis, Barbieri, or Konica FD-9 or 7, and suitable software.

Calculating OBA Index manually

OBA index can be calculated manually by subtracting the L*, a* and b* measurements taken in M1 and M2 modes, as follows. Measure in M1 mode, then measure in M2 mode and subtract the difference between the two. Correlate the difference to the values below.

- < 1) No OBA
- < 4) OBA faint
- < 8) OBA low
- < 14) OBA moderate
- < 25*) OBA high

Appendix B: Solving Metamerism Failure

Because the use of CMYK inks to simulate an infinite range of naturally occurring colors is only an illusion, there can be no simple solution to the fundamental problem of metamerism failure.

In controlled circumstances (e.g. proof-to-print or press-to-product matching) the theoretically ideal solution is to use inks whose spectral reflectance curves exactly match each other, or the material being reproduced, but this is usually impractical.

Replacing D50 and M1 with a new illumination standard

Because the main problems of metamerism failure are caused by differences between CIE D50, M1, commercial D50 viewing booths and typical end-user environments, the best long-term solution would be a new light source that;

- Matches, or at least approximates, the CIE D50 spectrum
- Can fit in both a spectrophotometer and a viewing booth
- Is economical enough for use in home, office and retail environments.

Once such a light source is available and proven (LEDs may hold the answer) the current D50 spectral energy curve will be altered to match the spectral emission curve of the new source. Then once these new lights become ubiquitous in printing, home, office and retail environments, today's problems with metamerism failure, OBAs and color management in general will be greatly reduced or eliminated.

Universal Digital Print Space

Universal Digital Dataset

The Print Properties and Colorimetric Council have produced many print conditions ranging from newsprint to large gamut color spaces. While newer color spaces such XCMY and ECG are much larger than standard color spaces they are often not large enough for printers that have extremely large gamut. In some cases, standard print conditions such as GRACoL (based on offset) are looked at by those with wide gamut machines as gamut restricting. While it is easy enough to create a custom profile using the full gamut of a printer, these custom profiles have no relation to existing artwork and standard print conditions. In most cases, it is better to have a color space that has some relationship to other standard print conditions, but without clipping the gamut of the device you are printing with.



Printing without Restrictions

The Print Properties and Colorimetric Council is working on a color space that has the largest possible gamut, is also based on common hue angles, and is G7 calibrated. The common hue angles and G7 calibration give this color space common visual appearance and continuity with other G7 color spaces, but will produce no clipping or gamut reduction on the digital printer. This color space can also be used as a translation space, to move files in and out of workflows using any of the G7 color spaces. With the completion of this color space there will be a full set of G7 color spaces available for print and translation, including a G7 color space that will provide common visual appearance without limiting the gamut of a digital printer.

Idealliance Print Properties & Colorimetric Council

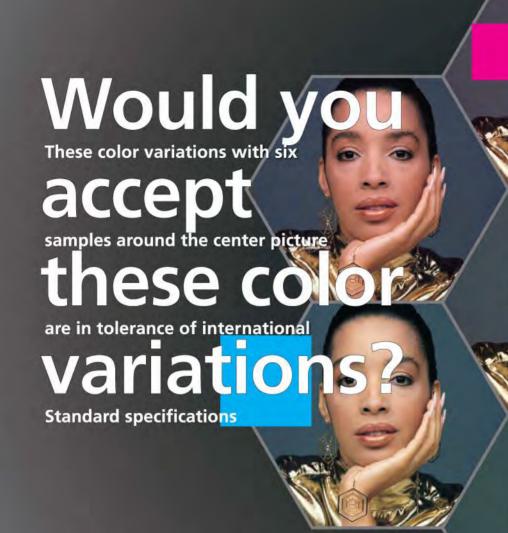


OBJECTIVES

- Perform development projects on new and current industry topics
- Provide the industry with leading practices, guidelines, specifications, standards, tools, information, and methods
- Provide application support for end users including calibration, specification, design, creation and final print.
- Create global standards and work with global standards bodies

The Idealliance Print Properties and Colorimetric Council (PPC) is a global standards and specifications council within the Idealliance think tank and works on projects to propel the global industry forward, focused on efficiency and profitability. It is a group of more than 200 individuals from all aspects of the supply chain. Idealliance PPC meets several times a year in person, as well as monthly via online conference calls. The PPC is a place where all member views and voices are welcome. Many great initiatives have come out of the PPC, including recently the IT8.7/5, SCTV, GRACoL, SWOP 2013, the world's 1st ECG characterization target and dataset that was built to be globally beneficial, PQX, PRX, and many other initiatives and standards. PPC works closely with **CGATS** on print standards and specifications that are used on an international level, feeding into ISO TC130.

All members are welcome to join and take part in the PPC and take part in meetings, subcommittees, and on-line conferences.



If you're only controlling solid densities on press, you might not match and maintain the correct colors of your job. Printed appearance is affected by many more variables than solid ink density alone. Even monitoring TVI doesn't guarantee stable gray balance or tonality. For the shortest make-ready times best proof-to-press match and color stability in print production, you need a press control system that automatically controls the G7® parameters, as well as solid CIELAB values/densities, TVI and more.

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