Digitization Procedures Guideline: Color Management

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Taiwan e-Learning and Digital Archives Program
Taiwan Digital Archives Expansion Project

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Publisher's Preface

After the "National Digital Archives Program" was initiated in 2002, members of numerous institutional projects and request-for-proposals projects joined our team to engage in digital work that covered countless categories and massive amounts of content. The first phase of the five year project was successfully completed in 2006. The following year, the "National Digital Archives Program" and "National Science and Technology Program for e-Learning" were integrated into the "Taiwan e-Learning and Digital Archives Program (TELDAP, http://teldap.tw/)", striving to achieve the ultimate goal of "presenting Taiwan's cultural and natural diversity" as it continued to expand digital resources in various fields, and systemically promoted digital achievements in education, research and industries. TELDAP is preparing to actively collaborate with the private sector to drive growth in related industries, not only preserving important cultural assets, but also accelerating the development of a new culture in the digital age of today.

Originally named the "Content Development Division" during the first phase, we were renamed "Taiwan Digital Archives Expansion Project" (http://content.teldap.tw) as a subproject of TELDAP, and took more active measures to expand the sources of digital content, extending our reach to the collections of private institutions and even individuals. We have widely requested proposals for digitization projects related to archives, archeology, philology, geography, ethnicity, art, daily life, animals and plants, and hope to better integrate digital content with different characteristics, to develop them into fun and inspiring digital materials, and to provide them free of charge to the public for education and research; this will also help firms and public or private holding institutions to find cooperation opportunities in value-added applications. Collaboration between the "Taiwan Digital Archives Expansion Project" and other projects under the "Taiwan e-Learning and Digital Archives Program" will help speed up development of educational, research and commercial value-added applications of digital content, which will benefit the presentation of Taiwan's cultural and natural diversity, and allow people everywhere around to understand and appreciate the richness of our history and culture, as well as the beauty of our natural ecology.

While collecting and developing value-added applications of digital content, whether it may be during the "Content Development Division" or "Taiwan Digital Archives Expansion Project" period, members of this project have continuously followed up on digital workflow related technologies used by public and private institutions and open request-for-proposals projects, and compiled a series of "Digitization Procedures Guideline Books" that introduce various international standards and provide information on digitization technologies and workflows. Since 2005, we have written 21 digitization procedures guidelines on different themes (the full text of all of the 21 books can be downloaded from the “Taiwan Digital Archives Expansion Project” website under “Virtual Library: Digitization Books”), selecting exquisite digital objects, such as ceramics, paintings, calligraphy, and string-bound books, combining the experiences of different institutional projects, and supporting them with domestic and foreign theories and practice results.

Since 2008, we have continuously revised and expanded our “Digitization Procedures Guideline” book series, hoping to expand distribution channels so that they may be provided to even more museums, libraries, institutions and individuals for reference. Our preparations are mainly divided into revising existing guidelines for “selected objects” and compiling new guidelines on “common principles”. The former refers to revising the existing 21 guidelines with a focus on introducing new digitization technologies and specifications, more practical software and hardware, and digital content protection mechanisms; we expect to revise seven books per year and complete all 21 books within three years. As for compiling guidelines on “common principles,” our emphasis will be on the introduction of key concepts, such as the “life cycle” of digital information and quality control, studying multiple types of objects instead of a single type of object, and adopting common principles as the guideline framework. The so called common principles refer to project planning, integrated workflow, audiovisual data, text data, color management, outsourcing management, and digital content protection and authorization. These eight common principles are topics of which we will investigate, study and write guidelines for; we expect to publish eight guidelines in three years.

Guidelines for selected objects and guidelines on common principles in fact complement each another. Guidelines on common principles emphasize on the analysis of important topics in digitization work, guiding readers to thoroughly consider the advantages and disadvantages of digitization. Guidelines on selected objects describe practices and techniques for digitizing specific objects, helping readers to select the most suitable, most effective digitization workflow. By publishing this “Digitization Procedures Guideline” book series, we believe that we are providing institutions and individuals with the intention to engage in digitization work with a series of practical guidelines that provide an overall view, while guiding them step by step through the digital workflow. Here we must stress that the theoretical foundation of this book series is the precious experiences of institutional and request-for-proposal project teams accumulated throughout the years. These experiences allow higher quality digital content to be produced, presented and maintained with less cost, further enriching our digital archives and e-learning content. As we continue to publish our "Digitization Procedures Guideline" book series, we must give special thanks to working partners who were interviewed and colleagues who were a part of writing the guidelines, and are grateful to the scholars and specialists that reviewed and provided their advice on the book series. Finally, we hope that readers will not be reluctant to correct any mistakes or make recommendations that will help us be even better.

Taiwan e-Learning and Digital Archives Program
Taiwan Digital Archives Expansion Project
Digital Archives Sub-project of Project Integration

Project Director
February 10th, 2010

Editor's Preface

Visual perception is an important part of communication and learning to human beings. By recording and reading images, people are not only able to learn about the past, but also preserve a moment in the form of an image that can become a part of the future. These images are essential to the preservation of cultural assets and natural landscapes, and also an important link of work in the Taiwan e-Learning and Digital Archives Program. Therefore, good image digitization procedures are required for the implemention of digital archive projects, especially color management of digital images.

The interpretation and utilization of color vocabulary is a human instinct for perceiving the outer world, and also a medium for artists to render images. Therefore, it is necessary to correctly record and present original colors of collections, especially paintings and antiquities. However, different colors may be displayed as a result of color characteristics of digital image equipment (e.g. cameras of different brands produce film with different colors), and it is the goal of this guideline to explain how color management procedures can be used to duplicate original colors of objects in different media.

Variation of image color is affected by numerous factors; in the case of digital photography, these factors can be categorized under input, processing and output. Characteristics of the light source, scanner and digital camera can be listed as input factors; characteristics of the display monitor, printer ink and printing paper belong as output factors. Color management controls the process of corresponding input device colors to output device colors; in short, color management measures color shift on different devices and records them in a color profile, so that different computer operating systems can access compatible color values, convert the colors into values that compensate the color shift of devices, and then output the correct color signal. This is the fundamental operation principle of color management systems, and is also the structure and order of which chapters in this guideline are arranged.

Although color rendering is affected by ethnic or regional preferences, this guideline uses international color standards as a basis for digital color signals, in which the definition of color space can be traced back to the International Commission on Illumination (CIE), which is situated in Vienna, Austria, and the file format of color profiles can be traced by to the International Color Consortium (ICC). Therefore, digital images produced following procedures of this guideline will conform to international standards on color management, and allow digital archiving results of Taiwan to extend its reach into the world.

Color management is not omnipotent; proceed with caution because opposite results might be produced by using faded color charts, the wrong color profile, or even incorrect calibration procedures. Since all digital image files are merely a string of values, there is not way to know the actual colors that will be output unless special software tools are used. Therefore, it is recommended to first complete the entire digitization process for only a few samples to confirm the results, before implementing the process on a mass scale. In addition, the maintenance and calibration of measurement instruments is also a link that should not be overlooked.

Technology advances along with time, but current color management systems are designed under the premise that fixed light sources are used, meaning that the visual effects of objects under specific lighting conditions are recorded, and not the color texture of the physical object. Therefore, operations should be limited under the same light source. Yet, there are some special materials, e.g. fluorescent, that is beyond the recordable signal range of hardware equipment (also known as out of gamut) and can’t be accurately recorded. This is an imaging technology that is still being developed, so alternative methods must be adopted. In addition, in recent years institutes around the world have been developing multi-spectrum color duplication technology, which might be able to remove numerous limitations in the future. For those who are interested, read “Billmeyer and Saltzman's Principles of Color Technology” 3rd Edition by Dr. Roy Berns or “Introduction Multi-spectral Image Processing” by Dr. Yoichi Miyake.

Human beings’ ability to sense color is extremely profound, and the process of converting an abstract sense of color into computer controlled values can be somewhat confusing. Western scientists established a unified color measurement standard as early as 1931, which is also known as colorimetry, and it has long been applied by the domestic printing industry; however, colorimetry wasn’t systematically taught or promoted by scholars until the past fifteen years. From the perspective of color management, colorimetry can only be successfully implemented by information technology specialists. Digital archives involve a great number of topics, and require sufficient knowledge and proficiency in a field to determine whether or not images meet requirements of the respective field for application. In general, color management in the “Taiwan e-Learning and Digital Archives Program” is a task that requires joint efforts and years of experience, it is extremely important and should not be neglected. Seeing the digital archiving experiences of the Executive Yuan Government Information Office, Council for Cultural Affairs, National Taiwan Museum of Fine Arts, National Palace Museum, Taipei Fine Arts Museum, and Juming Museum, this guideline aims to mainly provide descriptions of operation procedures, and support them with easy to understand background knowledge, hoping to help domestic institutions that are engaged in digital archiving. Finally, I give my regards to the workers that actually participated in the compilation of this guideline; it isn't easy to complete such a well arranged book covering such extensive contents in so little time. I hope that this guideline will benefit the readers that are engaged in digital archiving, and that they acknowledge the good intentions for planning this guideline, as well as the endeavors of project members.

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April 8th, 2009

PREFACE

I. Definition of Color

Human beings have tried different methods to preserve the colorful world they see, one of the methods being photography, from mechanical cameras in the past to the digital cameras and color reproduction equipment of today. Its purpose is to preserve or recreate a specific time and space, just like “the decisive moment” proposed by Henri Cartier-Bresson, who believed that photography is in the millisecond, showing the contents of objects and merging them into our lives.

But how exactly do people sense color? Scientifically, through their visual nerves, which is when the human eye comes in contact with electromagnetic waves with wavelength between 400 to 700 nanometers, also known as “light” or “visible light”. The sun is the main light source of visible light, and colors are the different intervals of wavelengths that comprise visible light, as shown in the Table below[0-1]

Table 1 Wavelengths of visible light

Color	Wavelength
Purple	380~450 nm
Blue	450~495 nm
Green	495~570 nm
Yellow	570~590 nm
Orange	590~620 nm
Red	620~750 nm

Source: Wikipedia

Fig 1 Rainbows are the most common visible spectrum[①]

The human eye is roughly 2.5 centimeters in length and weighs about 7 grams[0-2], in which light passes through the cornea, pupil and crystalline to reach the retina. The iris is the muscle that controls the size of the pupil, also controlling the amount of light that enters the eye. The iris also decides the color of your eyes. The vitreous body or vitreous humour is a clear gel substance that provides a constant pressure to maintain the shape of the eye, while providing refractive power at the same time. The retina consists of eye receptors (rod cell and cone cell areas) that react to light and form images. The receptors react to light by generating electric pulses that pass through the visual nerves and into the visual center in the brain, allowing us to recognize colors, outlines, distance and other details.

The human eye senses light sources and the different colors caused by them; for example, the naked eye cannot detect light directly produced by the sun, and can only see “light source color” that reflect off a triangular prism or result from natural refraction. A light source with color itself is called “transmitted color”, e.g. a lamp covered with colored paper that has a light source inside produces light with the color of the paper. As a matter of fact most object don’t emit light, and their color is the product of light reflecting of them, such colors are “surface colors” or “refractive color” and the most common type of color we come in contact with in life; objects absorb parts of light and the remaining wavelengths enter our eyes.0-3 However, environmental light sources affect “refractive light” to a certain extent, causing people to see different colors, e.g. the same color can be significantly different when under the sun or in a shadow.

Fig 2 Color performance of the same color under the sun and under a shadow.②

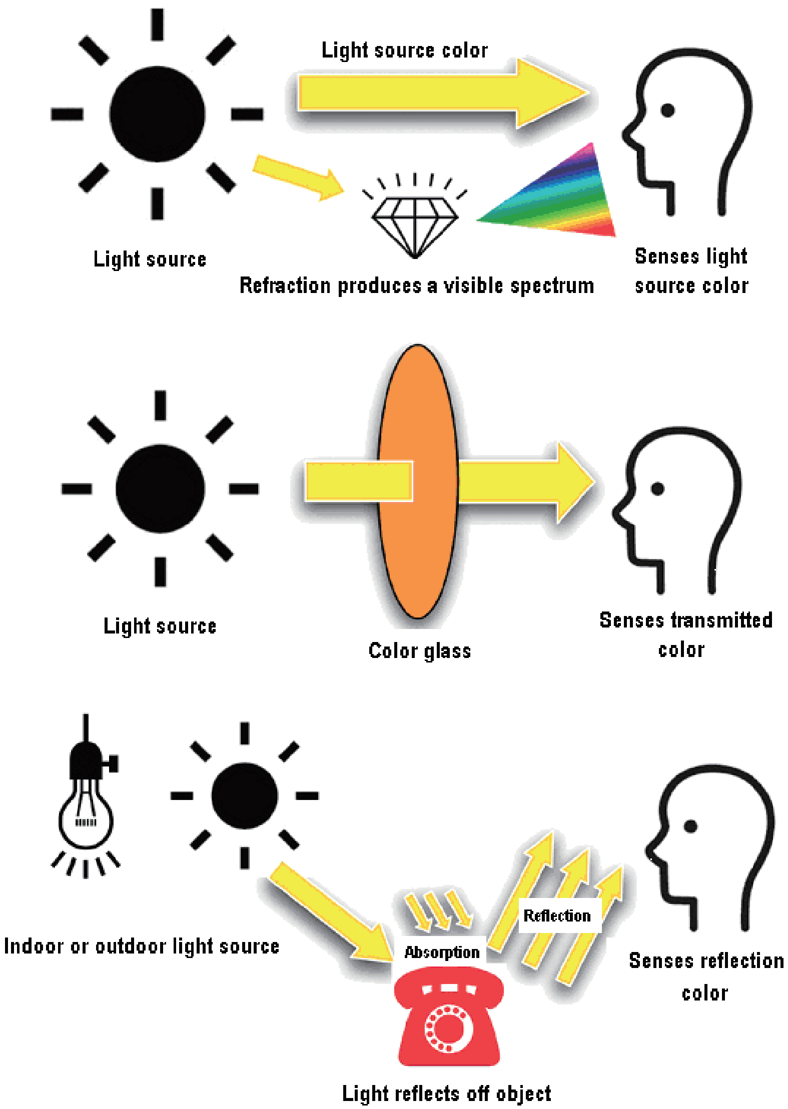


Fig 3 Path of how human beings sense light sources.[3]

II. Primary Colors

The three primary colors are divided into two types, "primary colors of light" and "primary colors of dye"　The three primary colors of light are RGB (R=red, G=green, B=blue); these colors are transmitted colors and used for additive combination of color; white light results when all colors are added together. Colors displayed by a monitor are projected from behind, so they are actually small dots of RGB light.

The three primary colors of dye are CMY (C=cyan, M=magenta, Y=yellow); in dye colors of light are absorbed, they are a subtractive combination, light that is not absorbed is reflected and seen as the color of the object. When mixed together, these three colors become black; under a magnifying glass there will be dots of CMYK.

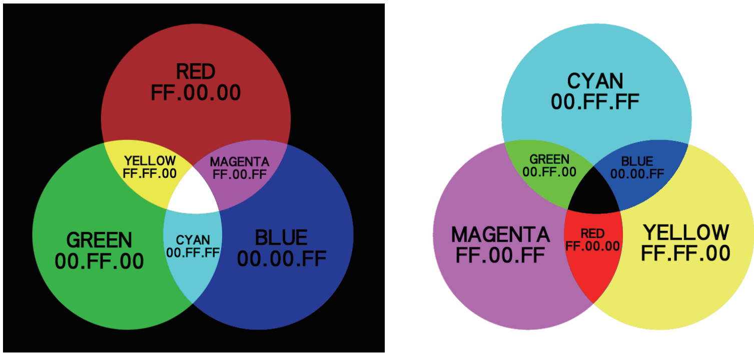


Fig 4 RGB (left) and CMYK (right) and values they represent.[4]

People generally use computers for graphics design, but before an image is printed, we cannot know the exact color it will be. Therefore, a color chart is usually used for confirmation. Currently, the most popular color charts are the Pantone GeoTM product series manufactured by Pantone . Besides using color charts, users can also download Digital Libraries that can be used by Adobe Photoshop / Adobe Indesign / Adobe Illustrator and QuarkXPress, which is an easy way for colors to be more accurately represented.

Fig 5 Pantone Geo^{TM} Guide coated color chart (left) and downloadable Digital Libraries.[5]

III. What is color management? Why is it necessary?

According to unconfirmed claims, a person without any professional color training can identify somewhere between 3,000 to 5,000 colors; however, each individual perceives color differently and has different explanations and understanding of color. For example, the same red could be described as apple red, rose red or blood red, the same blue could be described as ocean blue, sky blue, indigo or Klein Blue; therefore, from different perspectives, even the same color might have significantly different descriptions. A similar situation occurs for color devices, each speaks its own language, but lack a common perception when communicating, resulting in color shift when reproducing colors. This is when color profiles show its importance, allowing different devices to speak the same language and maintain color consistency; color management is a branch of knowledge developed for this situation.

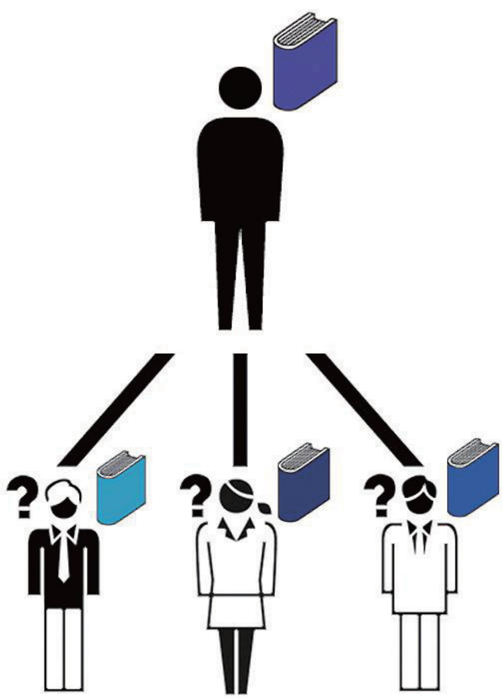


Fig 6 The same blue produces different results due to perception variation.[6]

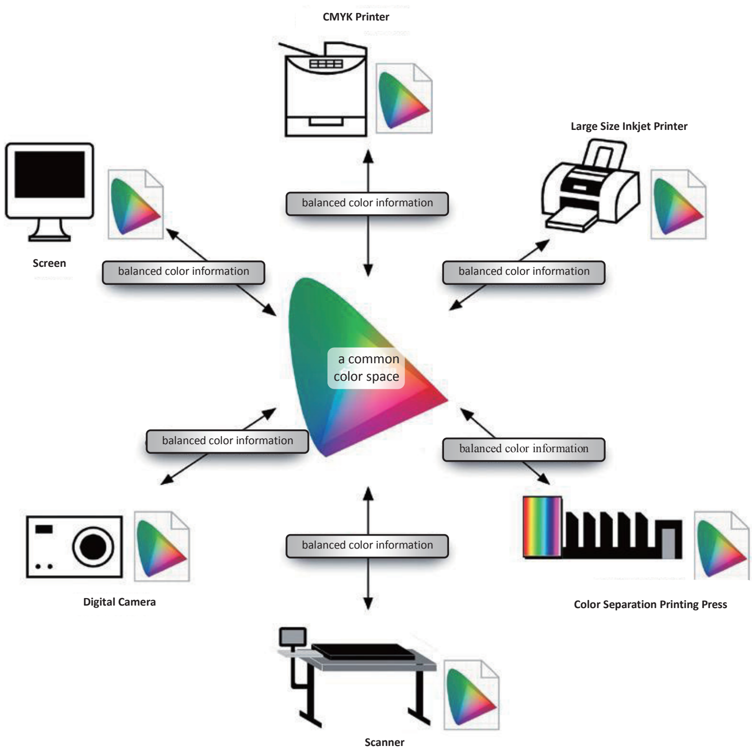


Fig 7 Different devices require balanced color information to provide stable operation procedures and reduce error margins.⑦

IV. Purpose of this Book

"Digitization Procedures Guideline: Color Management" hopes to provide clear digitization procedures and an overall concept to institutions or individual collectors, to enhance digitization work efficiency via easy to understand standard operation procedures, and to reduce the time for becoming familiar with digitization procedures, allowing institutions or individuals to more effectively control time and manpower spent on training and learning, as well as more efficiently carry out digitization. This book "Digitization Procedures Guideline: Color Management" hopes to achieve the following benefits:

1. Understand basic concepts of color.
2. Gain general and fundamental knowledge of color management.
3. Lower the threshold for digital archiving and increase work efficiency.
4. Provide a digitization procedures guideline for training purpose.
5. Provide a comparison and analysis of digitization hardware equipment.

V. Chapters of this Book

1. Chapter One. Basic Concepts: Explains basic concepts of color management, including color space, image file format, which formats support embedded profiles, and the difference between Device-Dependent Color Spaces and Device-Independent Color Spaces, which is required for understanding color management, allowing readers to understand color and values, and further understand what is an ICC Profile and related Know-how.

2. Chapter Two. Cameras: Describes color calibration for 2D photography, including photography procedures and using software to set the camera's ICC profile. This chapter allows readers to understand image file formats that are suitable for photography and other processing details. In addition, this chapter also introduces the latest 3D photography technology.

3. Chapter Three. Scanners: This chapter invites two specialists who are familiar with scanning procedures, Mr. Chang Hsi-Pen and Mr. Li Su, to explain color management procedures for scanners, as well as key points to creating an ICC profile.

4. Chapter Four. Monitors: Introduces common high-end professional monitors, monitor calibration software that come with the monitor, operation methods, and related principles.

5. Chapter Five. Printing: This chapter explains international printing standards, and invites Mr. Chang Shih-Chang of the Printing Technology Research Institute, who specializes in printing operations and certifications, to explain Taiwan's current status in adopting ISO standards and acquiring FOGRA certification.

6. Chapter Six. Color Management in Image Editing Software: Explains environment settings of Adobe Photoshop.

7. INDEX – GLOSSARY: This part explains the technical terms related to color management mentioned in this book for readers to use as reference.

Image notes:

② Source: Taiwan Digital Archives Expansion Project

② Source: Taiwan Digital Archives Expansion Project

③ Source: Taiwan Digital Archives Expansion Project, drawn by: Li Pei-Ying

④ Same as ③

⑤ Source: http://www.pantone.com/

⑥ Same as ③

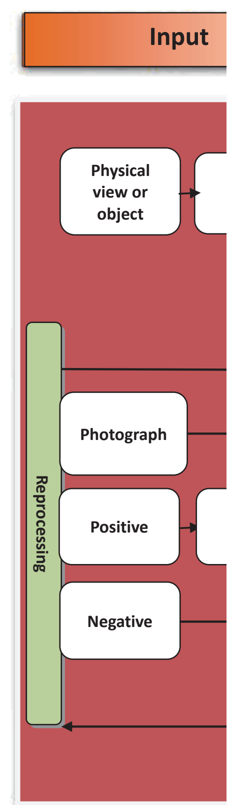
⑦ Same as ③

ONE. Basic Concepts

I. Color Management

Most people wake up everyday and open their eyes to a colorful world. The eye relies on "light" to see all things on earth. Whether its natural light (sunlight) or artificial light (light bulbs), light that is directly or reflected into the eye stimulates the brain and causes visual nerves to interpret electric waves into the perception of color. The definition of color is the visual sensation produced by the stimulation of light to the eye (visual nerves) 1-1. However, color information determined by visual senses can be affected by the surrounding environment, light source, and physical state, and result in different color descriptions (please refer to Fig.3 of the Introduction, the process of how human beings sense light). Therefore, how can we gain correct color? How do we manage color? The establishment of color description and conversion standards via instruments and color values, which are defined by standard procedures, plays an important role in digital archiving work.

Color management of digital images is divided into three principal stages: image input, image processing, and image output. Each stage involves several different kinds of media, e.g. image capture: digital camera, scanner, etc.; image processing: Adobe Photoshop; image output: monitor, ink jet printer, photo paper output device, printing factory, etc. These media all have different color characteristics, and in order for color management to truly be carried out, each stage needs to be included into a complete system of procedures.



Color management comprises three main stages, each stage with three important steps – Calibration, Characterization, and Conversion, the so called 3C principle. Different devices have different calibration methods, for example, scanners and digital cameras require gray scale calibration, and printers have ink volume and density settings. For monitors, color temperature and gamma values need to be adjusted, and color management software and a spectrophotometer are used to calibrate the difference between colors displayed on the monitor and standard colors. Differences calibrated in these devices are stored in color management software, each with its own ICC Profile. When ICC Profiles have bee created for all equipment in the digitization process, the color values of source images can be converted via a table into values of its destination, which is called color conversion.

By implementing each step of color management, we ensure that color quality is accurate to a certain extent, benefiting file output, printing, and value-added applications. Under limited funds and manpower, some holding institutions choose outsource digitization work. In such conditions, color management concepts and basic requirements should be specified in the tender form to help both parties gain the best product quality.

II. Color Space

Color models are abstract mathematical models that use a set of numbers (normally three, four values or color components) to represent colors, such as the three primary

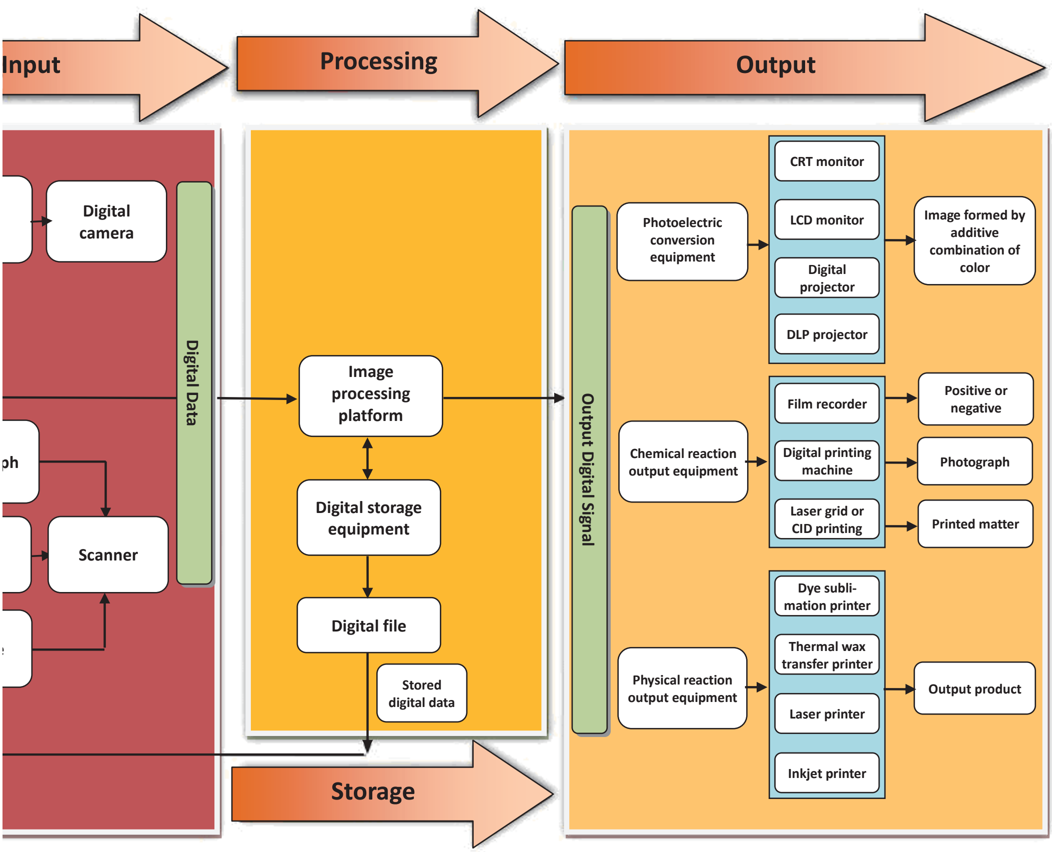


Fig. 1-1 The three principal stages of digital image color management[1]

colors of light – the RGB color model and the four printing colors – the CMYK color model. Color Space is a mechanism that uses numbers to describe colors. It combines color models with color mapping functions to form different color spaces. For instance, Adobe RGB and sRGB are two different color spaces based on the RGB color model.

The standards usually adopted for color spaces are CIELAB or CIEXYZ. These color spaces were designed to cover all colors visible to a normal human being. Since every color space uses the function of absolute reference framework to define color, color space and equipment profiles can reproduce color via simulation and numerical values.

The Commission Internationale de l'Eclairage (CIE) in 1931 for the first time attempted to describe color spaces using numerical values based on the human eye's perception of color and established CIEXYZ, which later became the foundation of other color spaces. CIELAB, AdobeRGB, sRGB, SWOP and CMYK are all color spaces under different models. The main color spaces are described below.

1. CIE LAB[1-2]

(1) CIE LAB, or LAB for short, is the color space recommended by CIE in 1976. It coordinates, luminance (L*) and visual complementary colors (a*) and (b*), form a three dimensional space, and further form qualities of hue and saturation. Therefore, the color coordinates in this three dimensional space achieves color that is perceptually uniform to human beings. This color space is frequently used as a standard for quantifying color signals, and is the foundation for the concept of color management systems.

(2) L represents brightness and has a value between 0 (darkest) to 100 (brightest); A represents the red/green axes; B represents the yellow/blue axes.

(3) The LAB color space is the largest color space that is closest to all colors visible to the human eye, and includes most colors in the RGB and CMYK color gamut.

(4) LAB is not attached to any specific device, ink or printing process. Therefore, LAB can be used as a common color definition.

(5) Due to the immense range of LAB, distortion or posterization will easily occur when working. Moreover, most devices don't support the entire range of LAB, so the true results of editing cannot be presented on the monitor.

1-2 Page 26 of "Digital Photography Technology" by Hsu Ming-Ching, Taipei City: Garden City Publishing, October 2001.

2. RGB

(1) The RGB color space is based on the "RGB color model," which is the color perception of Red (R), Green (G), and Blue (B).

(2) The working space of RGB covers almost the entire color gamut of typical CMYK devices, but is smaller than the LAB color space.

(3) RGB color space is a type of "device related" (device dependent) color space, the colors that you gain at the end depends on the device used.

(4) RGB color space is the default color space of most scanners and digital cameras (all scanners scan images using either RGB or CMYK).

3. sRGB1-3

sRGB is a color space jointly established by HP and Microsoft. Its purpose is for computer peripherals to have a unified color specification, allowing digital images to have consistent color performance on difference devices. However, in terms of photography, sRGB is a relatively small color space, and somewhat insufficient in color performance; it cannot truly reproduce colors of the shooting scene.

4. Adobe RGB

This is the color space used by the image processing software Photoshop. It has a wider color space and is better able to reproduce colors of the shooting scene. Its performance in photo output and printing is significantly better than sRGB. Most picture browsing software use sRGB, posterization occurs when browsing Adobe RGB photos, so the color space must be reconfigured.

5. CMYK

(1) CMYK stands for Cyan, Magenta, Yellow, and Black, four subtractive color system printing ink.

(2) CMYK color space is a type of "device related" (device dependent) color space, the colors that you gain at the end depends on the device used.

(3) Digital printing operations all use the CMYK color model at the end.

III. ICC Profile

To solve the issue of image conversion between different devices, the International Color Consortium (ICC) established a standard format for device profiles –ICC profile.

[1-3] Source of reference: Wikipedia.

After going through a series of standard calibration procedures, ICC profiles are generated for different input devices, including digital camera, scanner, monitor, and printer. Conversion of color spaces between different devices are based on ICC profiles to reproduce the original colors, and achieve the purpose of color management.

The International Color Consortium was founded in 1993. It was first established by several color related companies, including Adobe, Apple, Agfa, Kodak, and Sun. Its purpose is to set up a cross-platform color management system; its main mission is to establish ICC specifications.

Two profiles are required for color conversion: the source device's profile and the destination device's profile. The profile of the source device tells the color management system exactly what colors are contained in the file, and the profile of the destination device tells the color management how to produce the actual colors in the destination device.1-4

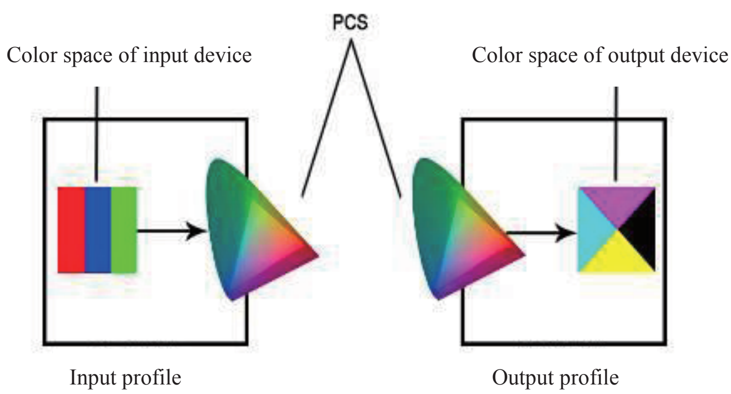


Fig.1-2 One ICC profile comprises of two sets of RGB or CMYK device control values, and the corresponding CIE XYZ or CIE LAB values.②

Most applications with color management functions allow images and other color objects to select an ICC profile. For example, Photoshop allows you to choose an ICC profile for any given image. By selecting an ICC profile for an image, you define the accurate meaning of RGB or CMYK color values and describe its source. For example, the definition of a color in an image was extracted from a scanner or digital camera. Most applications with color management functions allow you to embed ICC profiles in files, e.g. embedding ICC profiles into image files when saving them. This way you

[1-4] Page 76 of "Real World Color Management" by Bruce Fraser, Chris Murphy, and Fred Bunting; translated by Liu Hao Hsiao, Liang Chiung, Wu Ping, Taipei City: Chuan Hwa, 2006.

won't list the meaning of RGB or CMYK values when transferring files between the application and your computer. In the figure below, the software used is Photoshop; the color management system has default options for users to choose the ICC profile: Adobe RGB (1998).[1-5]

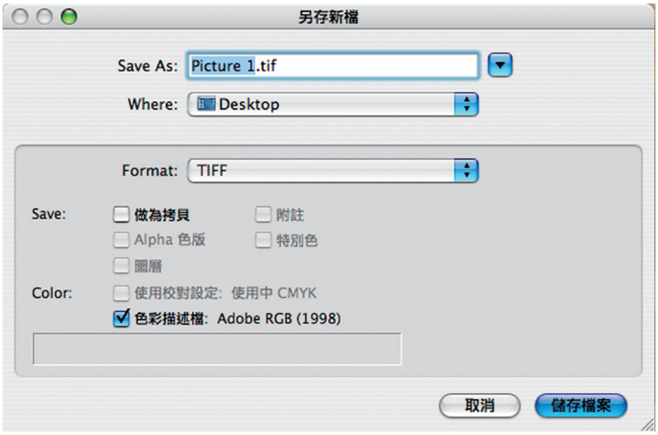


Fig.1-3 Embedding the ICC profile into the image file.[③]

Table 1-1 Image format that support embedded ICC profiles

File extension	Format
psd	Photoshop
eps	Photoshop EPS
pdf	Photoshop PDF
jpg	JPEG
tif	TIFF
pct	PICT file
rsr	PICT resource

Data organized by: Taiwan Digital Archives Expansion Project

[1-5] Color management in Photoshop: Select "Edit" > "Color Settings" (Windows) or Photoshop > "Color Settings" (Mac OS), and configure the color management settings. You can choose a default preset in the "Settings" option in the "Color Settings" dialog box, or customize your own settings. However, you must choose at least one "pre-press" setting, and make it designate Adobe RGB (1998) as the RGB color space. Adobe RGB (1998) is a color space large enough to cover printing colors. Generally, we do not recommend sRGB because it is a relatively small color space and might not contain important colors.

Table 1-2. Commonly used ICC profile software tools.

Developer	Product	Measure	Create profiles	Edit profiles	Assess profiles	Convert using profile	v4 support	Link profile support
Adobe Systems	Adobe Photoshop		Y	Y		Y	Y	Y
Heidelberg	Prinect Color Toolbox	Y	Y	Y	Y	Y	Y	Y
HP	HP Designjet Z2100 / Z3100 / Z3100ps GP / Z6100 / Z6100ps	Y	Y					
PANTONE	huey(TM) / huey(TM) PRO	Y	Y				Y	
	ColorMunki(TM) Create / ColorMunki(TM) Design	Y	Y				Y	
X-Rite	i1DisplayLT / i1Display2	Y	Y				Y	
	i1Basic	Y	Y				Y	
	ProfileMaker 5 Publish / Publish Plus / Photostudio / Packaging	Y	Y	Y	Y		Y	

Source: http://www.color.org/profilingtools.xalter

In the colors of various devices, standards used for exchanging color information can be divided into two types: one is device independent color, which uses CIEXYZ, LAB and LUV to represent color; the other is device dependent color, which uses RGB or CMYK to represent color. "Device independent color spaces" (e.g. CIEXYZ and CIELAB) are color coordinate systems established by the CIE, image color values do not change along with the device used. "Device dependent color spaces" (e.g. monitor, scanner, printer, and printing machine) change along with the device and brand, because difference devices and brands have their own unique color characteristics and color spaces.

Color space conversion is the process of using numerical data in device profiles to translate image color data from a device dependent color space to a device independent color space.[1-6]

n other words, there is no simple formula for conversion between RGB or CMYK values and LAB because RGB and CMYK color spaces are device dependent. RGB or CMYK values must first be converted into an absolute color space, such as sRGB or Adobe RGB. This conversion is device dependent, but the results are device independent, allowing them to be converted into the CIE1931 color space and further into LAB.

IV. Image File Formats

As computer software changes with each passing day, new digital image file formats appear along with advancements in technology. Each file format has functional considerations. Commonly used file formats are described below.

1. RAW

RAW is a primitive image file format that stores only stage image data, which is why it is sometimes referred to as an unprocessed format; dynamic data is not stored in such files. Since dynamic data, such as the size of the image, is not stored, the user must enter the dimensions of the file when opening a RAW file. When opening a RAW file, the software guesses the dimensions of the file, and initially uses the previously used value. To prevent the software from guessing the wrong dimensions, the dimensions of the image can be used as a part of the file name, e.g. a file name of rgb100x75.raw indicates a length of 100 pixels and width of 75 pixels.

2. JPEG

JPEG (Joint Photographic Experts Group) is a commission of experts devoted to the establishment of international image compression standards. They received the ISO 10918-1 certification in 1994. The JPEG file format that we use is a standard lossy compression method widely used for images.

JPEG is a distorted file format because of its compression method. JPEG usually uses lossy compression, which means that image quality sustains visible damage during the compression process, information of the original image is changed and the original image can not be reproduced through decompression. JPEG files offer a variety of compression rates for users to choose from based on quality requirements;

[1-6] "Implementation and Assessment of Color Management Technology" by Chang Shih-Chang, http://www.ptri.org.tw/seminars/S88/s880304c.htm, April 2009.

high compression rates will result in smaller file size but poorer image quality; low compression rates will result in larger file size but better quality.

Fig.1-4 JPEG files can choose compression rates to gain different quality. A large compression rate will result in a smaller file but poor image quality; a small compression rate will result in a larger file but better image quality.[4]

3. JPEG2000

JPEG2000 is officially known as “ISO 15444”, and was established in March 2000 by JPEG the Joint Photographic Experts Group). JPEG2000 has a compression rate roughly 30% higher than JPEG, and supports both lossless and lossy compression (JPEG only support lossy compression). In addition, JPEG2000 supports “area of interest,” and allows the compression or decompression of any give area in an image. However, applications that currently support JPEG2000 are not common, software developed by LuraTech are more complete in this aspect and they have thus signed an agreement with ACD Systems, providing a JPEG2000 LWF format add-on for ACDSee, one of the most popular image management software in the market. This way users may view and produce LWF files by simply installing an add-on.

4.TIFF

The first version of TIFF (Tag Image File Format) was created by ALDUS in 1986. It used tags to compose its basic framework and possessed immense expandability. Each TIFF file can be single or multiple pages, image information is not distorted during the editing process, and has therefore been used by most software. TIFF files are bit-mapped images with lossless compression characteristics. The TIFF file format not only supports black and white and RGB full color models, but also supports CMYK professional models, including the linear image compression function LZW (Lempel-Ziv -Welch Encoding), as well as variable length encoding methods, which reduces file size but doesn't distort the image. Users can use suitable compression strategies based on their requirements. TIFF supports professional functions like printing output, and is the easiest image file format for circulation. However, TIFF files are usually larger than JPEG or GIF files. Although TIFF files are relatively larger and take more storage space, its images are without distortion and closest to the appearance of the original object. TIFF is an important format to digital archives.

Fig.1-5 TIFF files can choose to store data using PC or Mac arrays, increasing compatibility and access speed. In addition, it can choose whether or not to use the LZW mode for image compression.[5]

5. GIF

GIF (Graphics Interchange Format) is an image file format often used on websites. It achieves data compression using index colors, and can be used to create animations. Its color depth is only 8 bits, so colors of such files are sometimes distorted when printed. GIF files are normally only used in a webpage environment.

6. BMP

BMP (Bitmap) is one of the main image formats used by Microsoft Windows. It does not support the CMYK color model; hence it is largely used in non-printing areas, or as an internal working format in a window operating environment.

7. PNG

PNG (Portable Network Graphics) is a relatively new file format that was designed by W3C for webpage display. Its main advantage is that achieves lossless compression using wavelets, and support transparent images. However, currently not all applications support this file format, so compatibility is still an issue.

Table 1-3 Comparison of different file formats

File format	File type	Color model	Compression	Characteristics
RAW	Bit-mapped	Full color	Lossless	Larger file size
JPEG	Bit-mapped	Full color	Lossy	Small file size, but images will be somewhat distorted
JPEG2000	Bit-mapped	Full color	Lossless or lossy	Different filters allow lossless or lossy compression; can correct noise
TIFF	Bit-mapped	Full color	Lossless	Suitable for printing
GIF	Bit-mapped	256 colors		Supports transparent colors and animations
BMP	Bit-mapped	Full color		Standard image format of Windows, suitable for use as original image files
PNG	Bit-mapped	Full color		Supports transparent colors, but doesn't support animations

Source: "Introduction to Digital Archive Technology" by Tsai Yung-Cheng, Huang Kuo-Lun, Chiu Chih-I, Taipei: NTU Press, November 2007.

Image Notes:

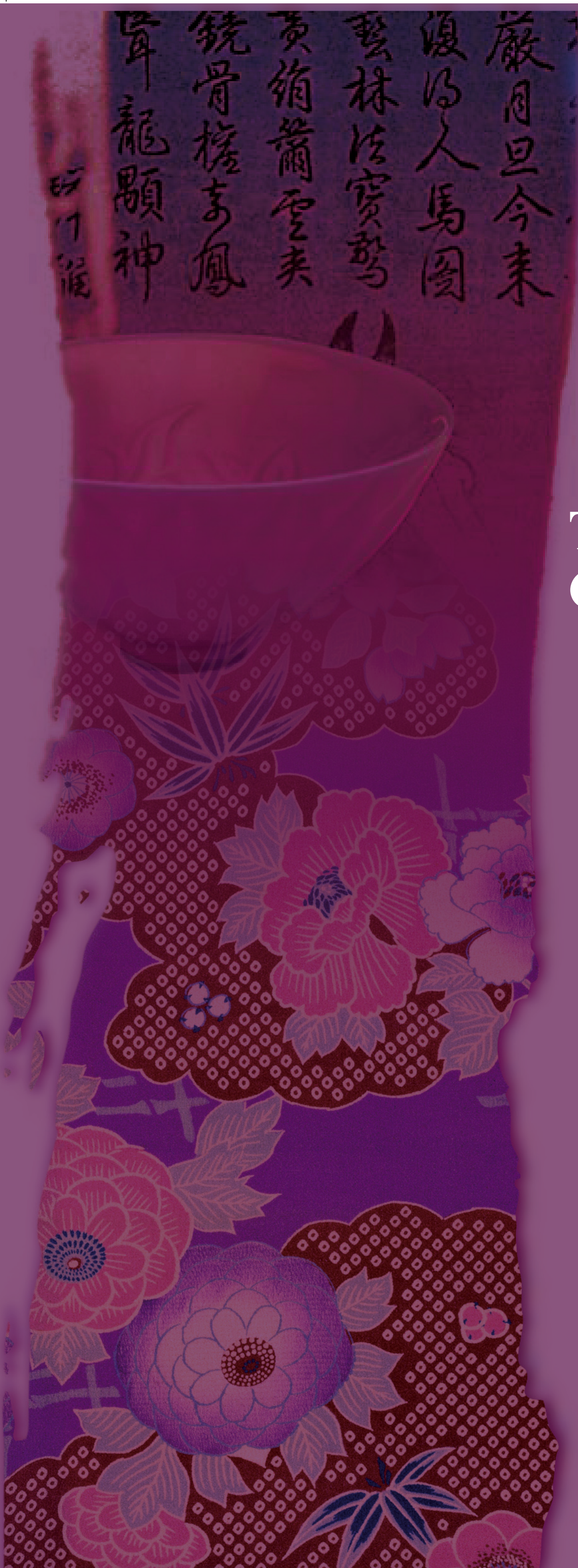
① Image source: Taiwan Digital Archives Expansion Project, drawn by Li Pei-Ying

② Same as ①

③ Image extracted from Adobe Photoshop® CS

④ Same as ③.

⑤ Same as ③.



TWO. Digital Cameras

Sony in 1981 released the world’s first electronic static object camera that adopts a magnetic recording method – MAVICA. It was the world’s first digital camera. From the early cameras that used negative films to the digital cameras of today, their different recording methods all use similar concepts.

The concept of photography is to record images formed by light on mediums, and to reproduce the images in the form of light to viewers. For common mediums, such as negatives and photographic paper, images are recorded on negatives, which then go through development and fixing procedures. When the need arises, the image is projected in the form of light on the audience’s visual system; the best example of such mediums is filmslides.

Digital cameras function in a similar way, only that the chemical processes are replaced with optoelectronic processes. In short, the negatives are replaced by light sensing electronic devices. At present, the most common device in digital cameras is CCD, but a small portion of digital cameras uses CMOS; the size and density of these light sensing devices to a certain extent determines the size of the image. For example, cameras have negatives with the dimensions of 135, 120 and 4×5. 2-1

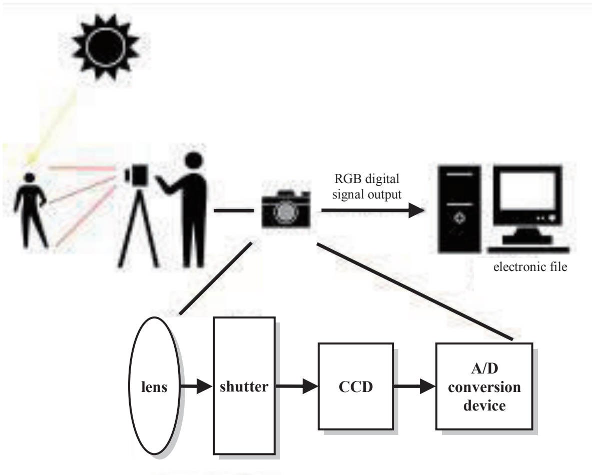


Fig.2-1 The forming of digital images starts from light that is reflected off an object and into the digital camera. After light passes through the lens and shutter, it reaches the light sensing device, which stores image signals in the form of an electronic file.①

the process of digitization, color management at the input and output end is extremely important because each color has values that can be calibrated, and these values affect the quality of the image. In which digital cameras are powerful tools for calibrating color data at the input end. If preliminary procedures can calibrate a camera’s

[2-1] Pages 64-65 of “Digital Photography Technology” by Hsu Ming-Ching, Taipei City: Garden City Publishing, October 2001.

resolution, white balance, exposure mode, light source, color correction and the shooting environment to an optimal state, then the truest colors of an object can be recreated for viewers, significantly reducing color difference between the original object and the image.

I. 2D Photography

Like the proverb "one must have good tools in order to do a good job," before we start taking pictures, we must first make sure that all equipment is ready. In digital camera color management, besides the basic camera calibration, stable light source and good shooting environment, the most important tools are the "color chart: ColorChecker" and "color management software."

Color charts are divided into two types, one for color calibration before taking pictures, and the other for being photographed along with objects. Below is a simple introduction to common color charts:

1. Color calibration before picture taking

(1) GretagMacbeth ColorChecker (24 colors): Standard color chart, but has relatively poor accuracy.

(2) GretagMacbeth DC (237 colors): Out of production; the predecessor of SG.

(3) GretagMacbeth Semi-Gloss (140 colors): Semi glaze design; create ICC profile.

(4) GretagMacbeth 3-S and Gray Scale (3 color gray scale): Black, gray, white calibration.

(5) GretagMacbeth Custom White Balance (White): White balance calibration.

2. Photographed along with objects

(1) Kodak Q13 (6X22cm): Out of production; used as a scale and for color calibration when taking pictures.

(2) Kodak Q14 (7X35.5cm): Used as a scale and for color calibration when taking pictures.

(3) GretagMacbeth ColorChecker mini (Full series mini version): For macro photography.

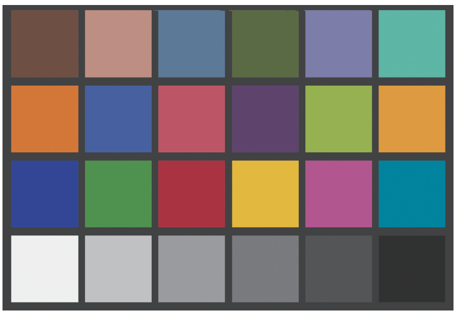


Fig.2-2 GretagMacbeth ColorChecker ②

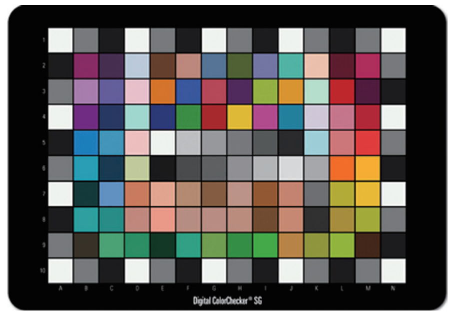


Fig.2-3 GretagMacbeth Semi-Gloss③

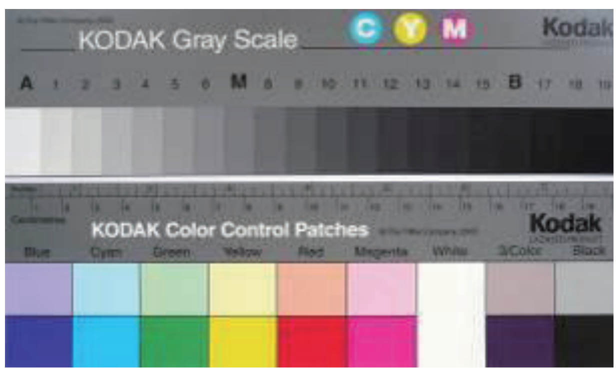


Fig.2-4 Kodak Q13④

Prices of camera color management software on the market vary widely. Common software includes ProfileMaker, MonocoProfile, Eye-One Match and Adobe Photoshop. ProfileMaker is a professional application that allows the production of extremely precise camera ICC profiles, but is quite expensive. Although Photoshop can not create profiles for the shooting environment, and can only use profiles like Adobe RGB (1998), but at least it can control color standards. When choosing color management software, it is best to base your decision on usage requirements and cost.

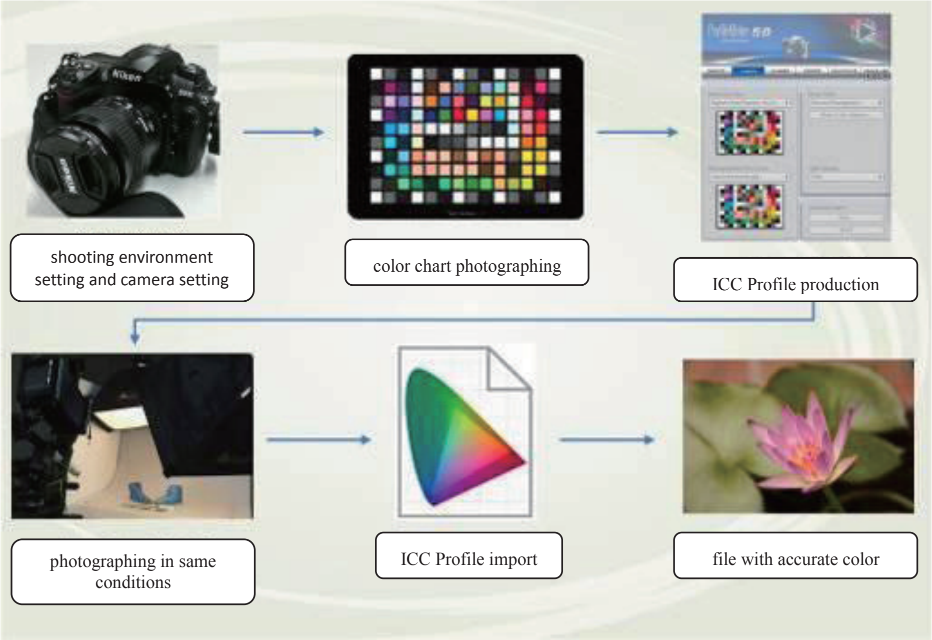


Fig.2-5 Camera color management flowchart⑤

3. Procedures

The flowchart above will give you a general idea of the necessary procedures of color management for digital cameras. Below is an explanation of specific procedures.

(1) Equipment preparation: Digital single lens reflex (DSLR) camera, three color charts (e.g. SG, white balance, and Q13), several fill lights (must be the same model and have the same power), color management software (e.g. ProfileMaker), light meter, and a computer for image processing.

(2) Shooting environment settings 2-2: A good shooting environment is the first step to color management. The best color for the wallpaper in the photography studio is gray close to Kodak 18% gray, followed by white or black. This is to prevent color management from being affected by color staining, which will occur when light reflects off the wall. In addition, other things that might affect picture taking should also be avoided, such as stray light from windows and moving light sources.

(3) Light set up: Different light sources affect the color information of objects. Before taking pictures, warm up the lights to natural temperature 5,300k~5,500k, and use a light meter to measure light at the four corners of the room. Try to make the light as uniform as possible.

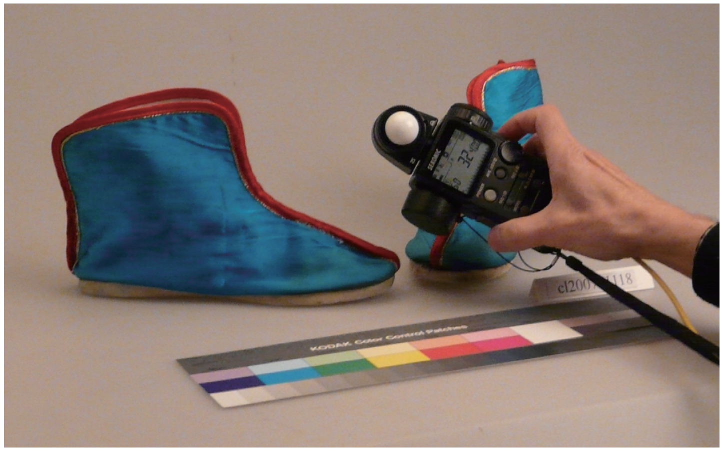


Fig.2-6 Shooting environment light detection®

(4) Exposure mode settings: This is a necessary procedure every time you photograph an object. Generally speaking, the exposure values are set at 0 EV, but find the best exposure value based on the value shown in the light meter. In the color management software, the whitest part should have a value in the range 210~245, while the darkest part should have a value under 20.

(5) White balance settings: The default white balance setting in digital cameras is “auto”; however, change it to “manual” for best hue performance. To make adjustments, place the white balance card under the shooting light, let the white balance card fill the viewfinder, and let the camera read the light source state to complete white balance settings.

(6) Resolution settings: Different output devices have different resolution requirements. Online images viewed on a computer monitor have a resolution of 72dpi; an output resolution of 300~350dpi in digital printing already produces good results. Therefore, before photographing an object, first consider what media the image will be displayed on. If you are uncertain, choose higher resolution settings to ensure the file’s usability.

(7) File format selection: For the convenience of importing the image file of SG color chart into ProfileMaker for making an ICC Profile, it is best to choose TIFF as the camera’s file format because it is uncompressed and has good circulation; set color depth at 16bit. The main reason why RAW isn’t used is to avoid potential loss of color information during conversion from RAW to TIFF, which can only be done by software of the camera’s manufacturer; a 16bit color depth prevents harsh color gradation.

(8) Color chart photographing: Place the SG card under a controllable light source; position the SG card at a 45 degree angle with the light source to reduce reflection. Finally, use ProfileMaker to make an ICC Profile for the photographed picture.

(9) ICC Profile production and storage: Use ProfileMaker to extract CIE Lab values, and then import the photographed SG card for correspondence analysis to complete the ICC profile. Then, save the ICC profile according to the operating system. If you are working in Windows XP, save the ICC profile under C:\WINDOWS\system32\spool\drivers\color, so that Photoshop can import the profile.

(10) Object photographing: When photographing objects, place a Kodak Q13 color chart (color patches and gray scale chart) next to the object, and photograph the color chart along with the object for future calibration. Import the ICC profile and calibrate colors of the image file to best match the object's original colors.

4. Precautions

(1) Light set up: Once cold light bulbs are used for a long time, their color temperature become unstable. So warm the lights up thirty minutes before photographing objects, and let them rest after taking pictures for several hours to maintain light source stability. Furthermore, the shooting lights should be placed on the left and right sides of the object, forming a 45 degree angle with the object for light to be even, and adjust the distance so that the illuminated area is 2~3 times larger than the object. Prevent shadows at all costs.[2-3]

[2-3] Pages 86-87 of "Digital Archive Book Series Painting and Calligraphy Digitization Procedures – Painting and Calligraphy Thematic Group", Taipei: National Digital Archives Program Content Development Division, December 2003, First Edition.

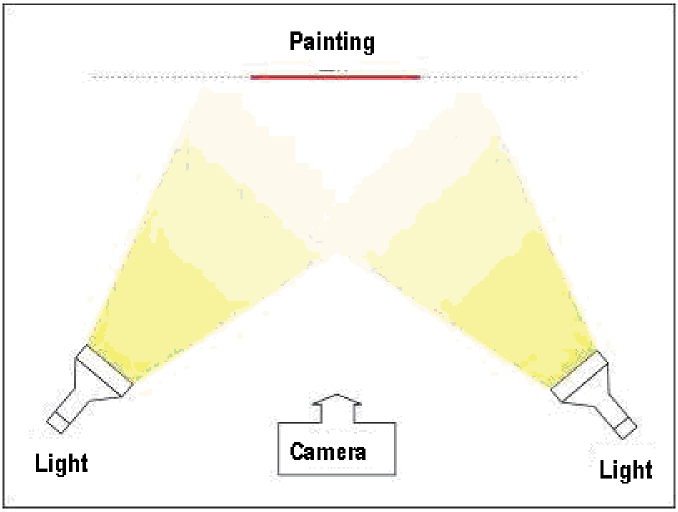


Fig.2-7 Position of shooting light⑦

(2) Exposure mode settings: If white areas have a value over 245, white areas will become pure white in the conversion from RGB to CMYK, and the result will be no color tones. If this step is not handled properly, the quality of the ICC profile will be affected.

(3) White balance settings: Unlike the visual system of human beings, light sensing devices in digital cameras are unable to immediately adapt to colors. Therefore, the color temperature of light sources require additional adjustment to make white objects appear white under light sources of different color temperature[2-4]. By using a white balance card you can neutralize the white, gray and black of a camera under any lighting conditions, and also resolve the color shift issue of CCD[2-5]. Light sources set up for tests must be the same as those that will be used in the shooting environment, because if white balance is not properly calibrated it will affect the accuracy of its ICC profile.

[2-4] Pages 121-123 of “Digital Photography Technology” by Hsu Ming-Ching, Taipei City: Garden City Publishing, October 2001.
[2-5] Pages 121-123 of “Digital Photography Technology” by Hsu Ming-Ching, Taipei City: Garden City Publishing, October 2001.

Fig.2-8 Camera's white balance set at auto[8]

Fig.2-9 Camera's white balance set at daylight[9]

Fig.2-10 Camera's white balance set at fluorescent light[10]

Fig.2-11 Camera's white balance set at tungsten filament light[11]

(4) Resolution settings: When outputting a digital image, the number of pixels on the image will affect the quality of the product. If there are two few pixels, then the edges will be shaped like saw tooth when the image is enlarged, which is the so called "Mosaic". Higher resolution can ensure better image quality, and although pixel interpolation can be used for images with low resolution, it is a last measure.

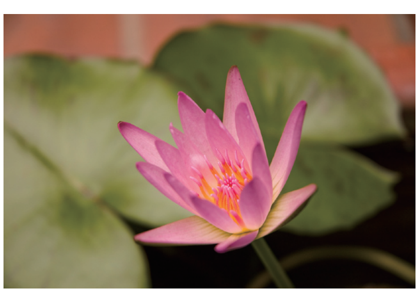


Fig.2-12 Photo with normal resolution[12]

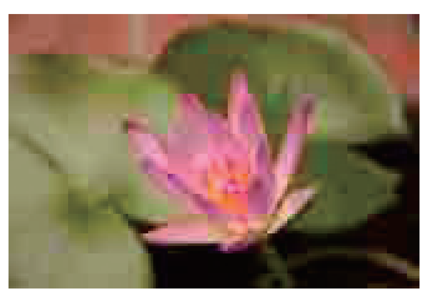


Fig.2-13 Mosaic effect – Low resolution[13]

(5) File format selection principles: Based on its brand and model, DSLR cameras

can choose to save images as RAW, TIFF or JPEG files. However, JPEG files are already compressed by the camera, so JPEG is not considered. RAW and TIFF files both store an abundance of color information, but the best results of reading RAW files can only be obtained from software provided by the camera manufacturer, and the color management software ProfileMaker is currently only able to process TIFF files, so in order to avoid potential loss of color information when converting RAW files, TIFF is the recommended file format for photographing color charts. However, RAW is still recommended for photographing objects because RAW files store an abundance of color information, color calibration is easier, and ICC profiles can be completed by using Adobe Photoshop.

(6) Photographing color charts: SG color charts are semi glazed, so without controllable lighting equipment, the accuracy of color information will be affected by reflection.

(7) ICC Profile production (using Profile Maker as an example):2-6

i. Import the photographed image of the SG color chart into Profile Maker. A warning message telling you that a correct ICC profile cannot be made for the image will appear if the shooting light was too dark or other factors caused an error in colors. If this occurs, it is recommended to photograph the SG chart again to avoid using an incorrect ICC profile.

ii. After importing the file, first select the model of the color chart to be analyzed for Profile Maker to execute correspondence analysis○1. Next, position the color chart○2 and choose the parts of the color chart to be analyzed; continue with further operations after positioning is complete.

[2-4] Pages 121-123 of “Digital Photography Technology” by Hsu Ming-Ching, Taipei City: Garden City Publishing, October 2001

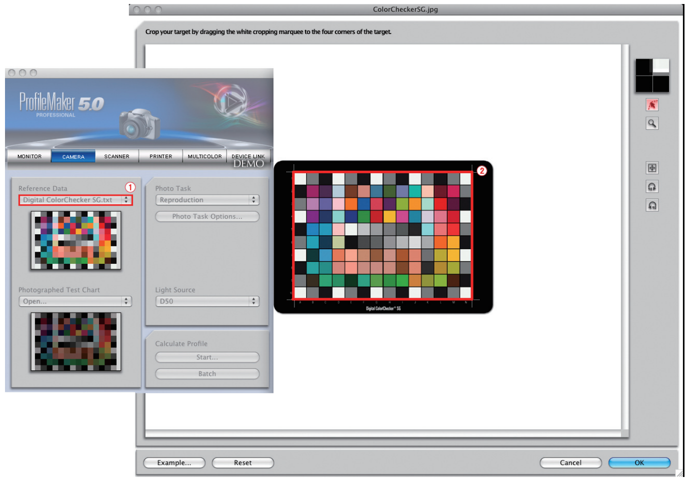


Fig2-14[14]

iii. For the purpose select “Reproduction” because the option better achieves the original colors of the photographed object.

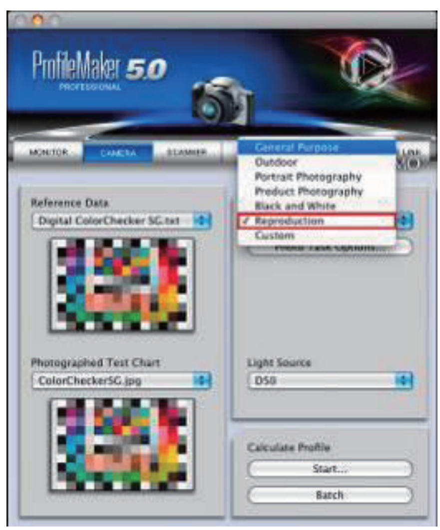


Fig2-15[15]

iv. For the light source select D50○1 because the D50 light source has a color temperature of 5000K, which is the setting normally used for 2D photography. After setting the light source, press “Start”○2 to start ICC Profile correspondence analysis and production.

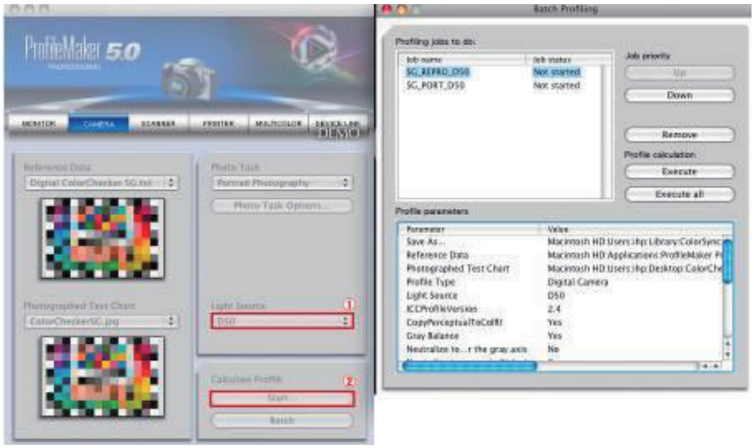


Fig2-16[16]

v. The ICC profile created will be automatically stored in the default folder of the operating system. This is for the convenience of future use by color management software. The default folders for storing ICC profiles in different operation systems are as follows:

Microsoft 98/98se/me: C:\WINDOWS\system\color

Microsoft NT: C:\winNT\system32\color

Microsoft 2000/xp/Vista: C:\WINDOWS\system32\spool\drivers\color

Mac OS9 or earlier versions: system\colorsync

Mac OSX: Library\colorsync\profiles

(8) ICC Profile import and application (using Photoshop as an example)

i. Open the digital image photographed under the same conditions with Adobe Photoshop. Do not manage the colors on this file to avoid losing color information in the next step, which is to specify an ICC profile; editing this file will result to two conversions. If the digital image opened already has default settings, all you need to do is choose “Edit” → “Assign Profile”.

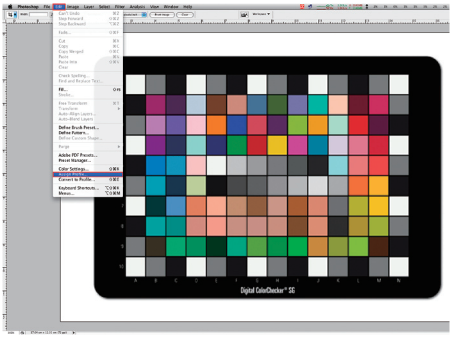


Fig.2-17[17]

ii. Choose the ICC profile and import it into the image file to acquire colors of the shooting environment. In the future, images photographed in the same environment can directly import this ICC Profile. The two color charts below are before and after the ICC profile was imported.

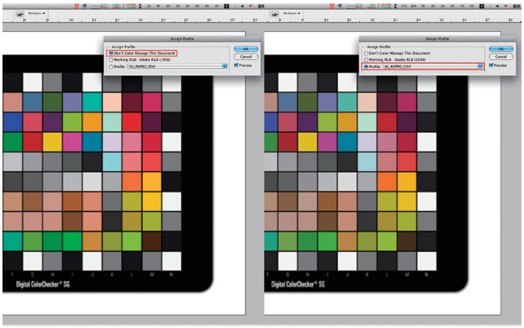


Fig.2-18[18]

5. Techniques and tips

(1) Low cost ICC profile production

Like mentioned before, general color management software in the market are extremely expensive, in the below two alternative approaches are provided. Color management is extremely important, but can also be intimidating.

(2) Directly apply Adobe RGB (1998)

Adobe Photoshop as a matter of fact has Adobe RGB built-in, when other calibration tools are not available, you can directly apply Adobe RGB to the photographed image for color control.

Even though the color performance of Adobe RGB may be somewhat different from the colors at the shooting environment, by applying the large color gamut

Adobe RGB you can ensure that color shift won't be too serious. However, you must make sure that the color space setting on your camera is also set at Adobe RGB.

Therefore, when you adopt this approach, make sure that color space settings are consistent throughout the digitization process. As described in the previous section, it is recommended to use RAW for photographing objects. Unlike TIFF and JPEG files, the camera will not apply its built-in profile on RAW digital images. This way you avoid losing color information when applying Adobe RGB, which will then be the second conversion.

(3) Outsource ICC profile production

If you have access to color charts, but don't have the software and hardware to make ICC Profiles, you can photograph and save the color chart before photographing objects, and outsource ICC profile production to a service provider or agency with the required technology and equipment. After receiving the completed ICC Profile, import it into your image editing software and apply it to images photographed under the same conditions, and you will gain an image file with correct colors.

(4) Considerations of digital camera selection[2-7]

The most important equipment in 2D photography is without doubt the camera. Base your decision of what camera to use on the following five considerations:

i. Image quality

A. Resolution

a Are there enough pixels?

b Are the three colors RGB accurate?

c What is the output color depth?

d Do dark patches still have enough detail?

e Does light in bright areas blur or spread?

B. Color capacity

a Does automatic white balance perform well?

b Does it support enough white balance (color temperature) types?

c Can you manually set white balance (color temperature)

d How accurate are the colors?

C. File characteristics

[2-7] Pages 74-77 of "Digital Photography Technology" by Hsu Ming-Ching, Taipei City: Garden City Publishing, October 2001.

a Can you select different file sizes?
b Can you select different compression rates?
c What file formats does it support?
ii. Lens characteristics
A. How is the optical quality?
a Is it made of optical glass or resin-modified glass?
b What is the largest aperture?
B. Is the focal distance suitable?
a Can it change focus?
b Does it support macro photography?
c Can you manually change the focus?
C. Can the lens be changed?
a Does it have focal length ratio characteristics?
b Does it support a wide variety of lenses?
iii. Photography functions
A. Does it have a LCD to immediately view or delete images?
B. Is the camera shutter's response time fast or slow?
C. What is the continued shooting speed?
D. Exposure functions
a Can you choose an ISO value?
b Is the manual exposure mode adequate?
c Is it evaluative or spot?
d Does it have exposure compensation function?
e Can the flash light be used with a fill light?
E. Can the lens cube be rotated?
iv. System compatibility
A. Memory card format and popularity
a Can you access the card using an external device?
b Does it have enough memory?
c Durability
B. Data transfer
a Is the transfer speed fast enough?
b Can it be connected with an image processing platform?
c Is the interface serial, parallel, USB, SCSI, IEEE1394, infrared or blue tooth?

C. Power supply

a Is power consumption too fast?

b Does it have a power save mode?

c Can you turn on/off the LCD to save power?

d Can you use rechargeable batteries?

e Does the camera come with rechargeable batteries and a recharger?

f Can you plug-in the camera to recharge the battery?

D. Flash synchronization

a Does it have a hot shoe for the flash light?

b Does it have a synchronization point for external flash lights?

c Is the synchronization point of a standard specification?

v. Other functions

A. Does the camera come with complete software?

B. Can you record sounds?

C. Can you record videos?

D. Does it support fast continuous shooting?

E. Does it support remote controlled picture taking?

F. Is self shooting convenient?

G. Does it have a timer for picture taking?

H. Can it be directly linked to the internet?

I. Can you preview videos?

J. Does it come with accessories?

For digital camera selection, consider the camera's characteristics and functions based on your purpose. Consider the camera an option if both its characteristics and functions satisfy your requirements. Although there are numerous factors to consider when buying a camera, the most important factor is still your own requirements. This way you can buy a good camera and take good pictures.

II. 3D Photography

3D photography in domestic digital archive projects is carried out in roughly two ways. One is to use 2D photography techniques to photograph an object's 360 or 720 degree digital images, and then sew them together using software. The other is to use 3D laser scanning technology, first use a scanner to construct a virtual model of the object, and then use 2D photography techniques to photography different angles of the object; finally software is used to paste the digital images on to the virtual model.

The main difference of 3D photography and 2D photography is in the light source. Current color management technology emphasizes on controlling the light source so that light is evenly distributed, whereas 3D visual effects is the result of dark and light colors on an object. However, further study and practice is required to determine whether this dark and light color change is the result of the object's position or the light source's position.

Color management in current digital archive projects focuses on colors that result from light reflecting off the object being photographed. Furthermore, different research teams around the world are using multispectral capture technology to capture the frequency of reflected light under different spectrums. We have high expectations for future developments and breakthroughs in this area.

Image Notes:

① Image source: Taiwan Digital Archives Expansion Project, drawn by Li Pei-Ying
② Image source: http://www.edmundoptics.com/onlinecatalog/displayproduct.cfm?productid=1815, March 2009
③ Same as ②.
④ Image source: Taiwan Digital Archives Expansion Project Photographer: Chen Hsiu-Hua
⑤ Image source: Taiwan Digital Archives Expansion Project Drawn by: Kao Lang-Hsuan
⑥ Image source: National Taiwan University of Arts Department of Graphic Communication Arts folk dance costumes – Taiwan Folk Arts Digital Cultural Village Project.
⑦ Image source: China University of Technology Department of Visual Communication and Design – Li Shih-Chiao Art Museum Project.
⑧ Image source: Taiwan Digital Archives Expansion Project Photographer: Lin Fang-Chih
⑨ Same as ⑧
⑩ Same as ⑧
⑪ Same as ⑧.
⑫ Image source: Taiwan Digital Archives Expansion Project Photographer: Kao Lang-Hsuan
⑬ Same as ⑫
⑭ Image extracted from ProfileMaker®.
⑮ Same as ⑭
⑯ Same as ⑭
⑰ Image extracted from PHOTOSHOP®.
⑱ Same as above

THREE. Scanners

To control colors you must first turn them into numerical values, photoelectric conversion carried out by scanners are able to turn colors of an image into digital signals. However, due to numerous factors, e.g. the light source's brightness, color temperature, CRI, the color filter's quality, and CCD, PMT error margins, images often are not perfectly recorded. This is where color management comes in and returns the object to its true colors. Bruce Fraser in the book Real World Color Management once said that ICC profiles do not automatically give excellent color effects, they cannot replace color shift calibration and tone adjustment, ICC profiles merely tell the color management system how to sense the colors it samples, meaning that it attempts to recreate colors of the original object.

The most important part of a scanner to color stability is the light source; the light source needs to be replaced on a regular basis to maintain color quality. In the color management process, scanners are located at the input end. Besides specialized CMYK scanners, most scanners use the RGB color model for scanning. All color management settings of the scanner's software must be turned off, such as Auto Color Balance, Black-and-White Point control, and all intelligent functions, scan images in the most primitive state and make sure all future scans use the same settings. This is to prevent the scanner software's intelligent functions from modifying an image's colors, after all, the purpose of color management is to reproduce the original colors and not make the image prettier.

Based on the master copy, scanners can be divided into two categories: reflection and transmission. The master copy of reflection type scanners are photos, light reflects off the photo to form a visual image; black and white photos, color photos, newspapers, advertisement paper, paintings and calligraphy can all be used as the master copy. For transmission type scanners, besides the common colorful positives, as a matter of fact, negatives can also be directly scanned, and doesn't necessarily need to go through an additional procedure that will distort light signals. However, in the scanning process, specialized software is required to convert negative colors and the orange film base into positive colors. In addition, transmission type scanners place the light source and target on opposite sides, increasing the complexity and manufacturing cost of the machine.[3-1]

[3-1] Pages 81-82 of "Digital Photography Technology" by Hsu Ming-Ching, Taipei City: Garden City Publishing, October 2001.

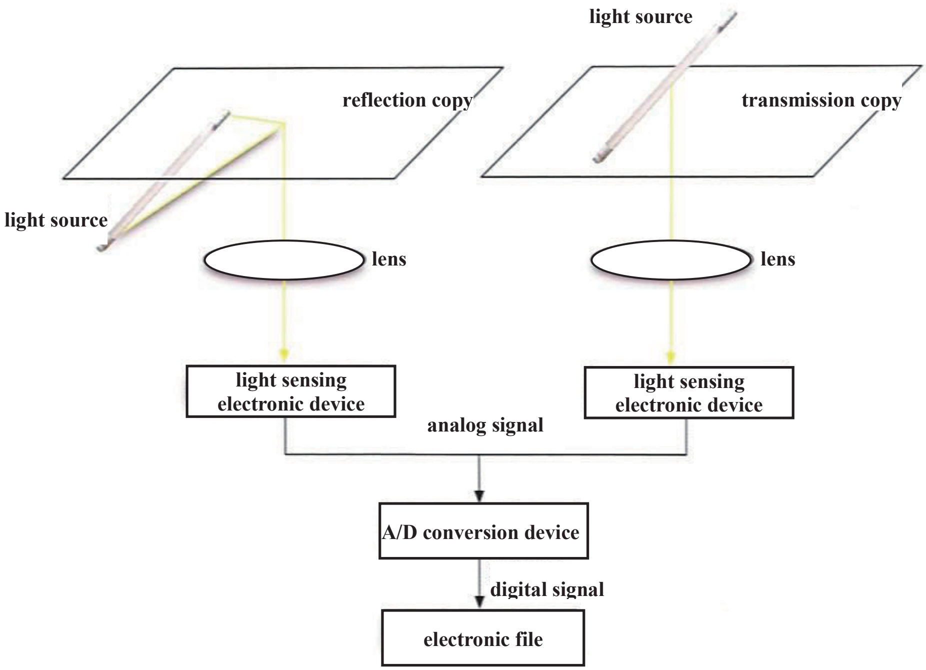


Fig.3-1 Scanners can be divided into reflection and transmission scanners.①

I. Scanner Types

The drum scanner was popular for nearly two decades before the twentieth century ended. From the early image setter connected to a film printer, to independent machines, the quality produced was extremely high but not affordable to all. For this reason, the flatbed scanner was developed, using linear CCD (Charge Coupled Devices) to capture image signals. At first, three filters were used to capture R, G, and B, later on, CCD that could capture three colors RGB at the same time were developed. Prices dropped, and now scanners are very popular. However, drum scanners are still the best if quality is your main concern. In addition, there are large scanners that employ digital cameras to scan objects larger than A2 size, making it suitable for scanning large sheets of paper or books; such scanners also allow color management. All scanners in the market can be roughly divided into the following categories:

1. Pen scanner: Combined with OCR (optical character recognition), this scanner can convert images into text, or read special dots to learn how to speak. Mini ScanEYE is an example of this scanner type.
2. Hand-held scanner: This scanner is held by hand and moved over document, generally has a scanning width of 105mm, and is easy to carry. Mustek's GS-780 (800dpi) is an example of this scanner type.
3. Sheet-fed scanner: Automatically pulls documents sheet by sheet into the scanner, stable and fast. For example, HP Scanjet N6010 18ppm (36ipm) is often used for creating files of official documents.
4. Flat-bed scanner: This scanner uses a wide-angle lens and reflection mirror to rapidly capture the image with its CCD; its resolution can range from 600dpi to 5000dpi. Some scanners can scan transmission copies with its built-in mask or by installing one, such as EPSON Expression 10000XL, which can even be used to scan x-ray film or old glass photo-mask. High-end flat-bed scanners have developed movable X-Y axes, and their lenses are always perpendicular to the scanning area to avoid image distortion, producing quality close to that of a drum scanner; some scanners can even scan 3D objects, e.g. Fuji Lanovia C-550 and Finescan 2750 XL.
5. Slide specific scanner: This scanner is specially designed for slides, scanning width is generally, 120/220 cartridges and optical resolution can reach 2000dpi or even 4000dpi. Nikon Super COOLSCAN 9000 ED, which uses four color LEDs (R, G, B, IR) as its light source, is an example of this type of scanner.
6. Drum scanner: High luminance halogen light source is directed toward a reflection or transmission copy, three PMTs (Photo Multiplier Tube) collect signals, the lens can be adjusted to change the focal distance, the aperture's size can be adjusted, and resolution can reach up to 5000dpi or higher. FFEI (FujiFilm Electronic Imaging) Celsis 6250 is an example of this type of scanner.
7. Book scanner: This scanner has a special platform that can be adjusted according to the book's thickness, and flatten both sides of the book. i2S DL 3000 and Bookeye3 A1 Overhand Scanners are examples of this type of scanner.

II. Color Chart

An important in color management of scanners is the color chart. Scanners generally use the color calibration charts defined by ANSI for color management, three charts in total. Using IT8 as an example, it is a committee founded by ANSI in 1987 to expedite the standardization of digital data exchange formats. In which the IT8.7 standard is for computer color calibration, IT8.7/1 is for transmission copies, IT8.7/2 is for reflection copies, and IT8.7/3 is for printings, all of which are now ISO standards.

Color chart manufacturers include Kodak, AGFA, and FujiFilm. Each color chart has attachments that provide data on measurements of each color patch, whether they may by spectrums, XYZ, or Lab. Below is an example of a color chart manufactured by Kodak.

The IT8.7 color chart is divided into several areas, as shown in Fig.3-2, the lower left corner show the Batch ID; a certain quantity is manufactured and then sampled to measure color patches. The C area is based on chrominance, the L area is based on luminance; each area includes tone performance for the main colors C, M, Y, K, R, G, and B. The lower area is gray scale performance with chrominance of 0. Normally, scanners should be able to identify the maximum density.

Color charts deteriorate as time passes and should be replaced every 2~3 years. However, in recent years spectrophotometers have more elaborate designs and lower prices; hence, they can be used to re-measure the color charts and used as reference data. For instance, X-rite SpectroScanT can measure IT8.7/1 4x5”, SpectroScan can measure IT8.7/2 5x7”, but problems occur when using EyeOne i0 to measure IT8.7/1 and 2, shifting one patch to the right, so EyeOne Pro must be used to manually measure individual patches one at a time.

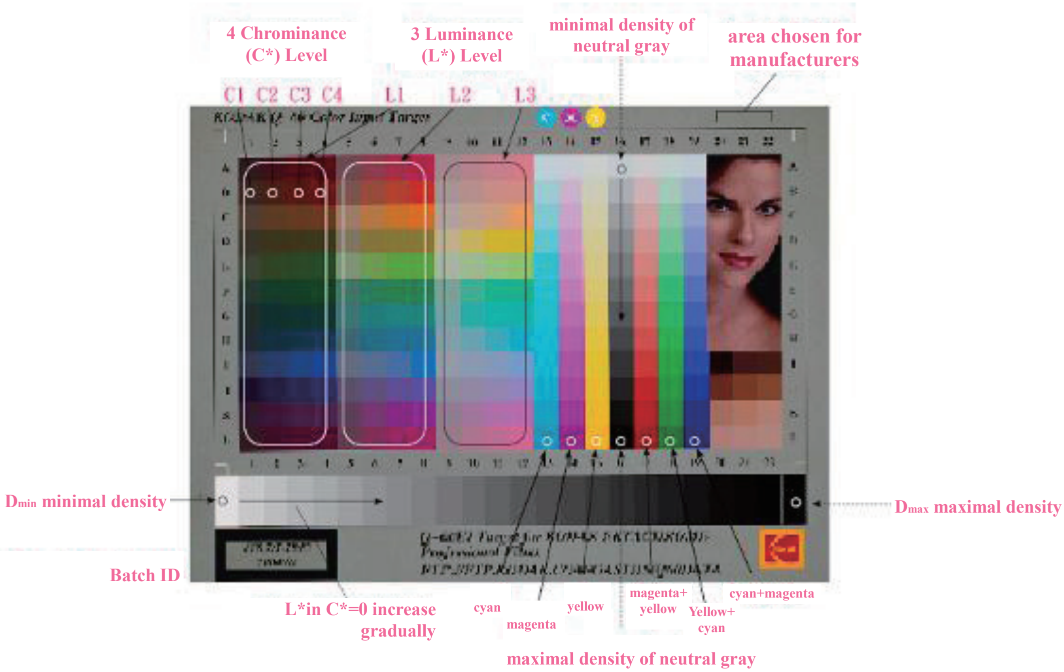


Fig.3-2 IT8.7/1 chart structure②

1. IT8.7/1 Type3:35mm transmission copy. Used for the calibration of transmission scanners and slide scanners, as shown in Fig.3-3.
2. IT8.7/1 Type1: 4x5 inches. Used for the calibration of transmission scanners and slide scanners, as shown in Fig.3-4.
3. IT8.7/2 5x7 inch reflection copy. Used for the calibration of reflection scanner, as shown in Fig.3-5.

Fig.3-3 IT8.7/1 Type3:35mm transmission copy ③

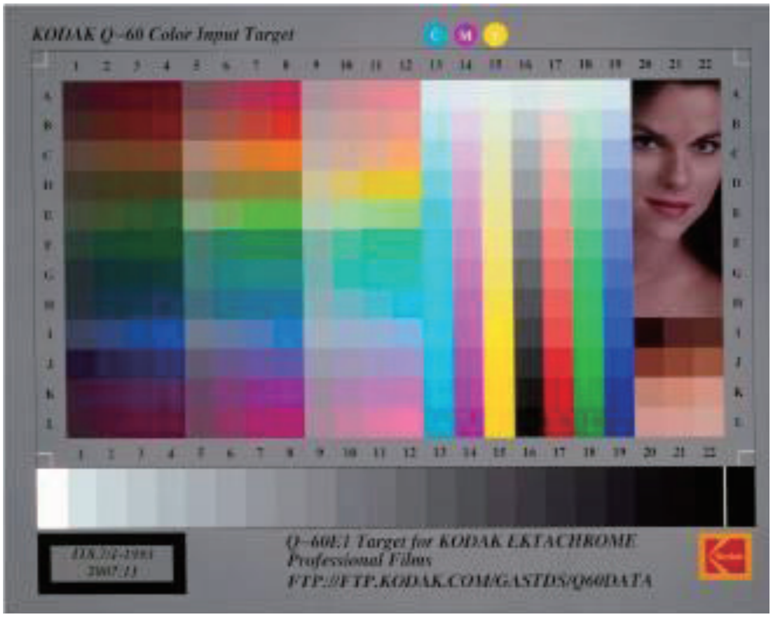


Fig.3-4 IT8.7/1 Type1:4x5 inch transmission copy[4]

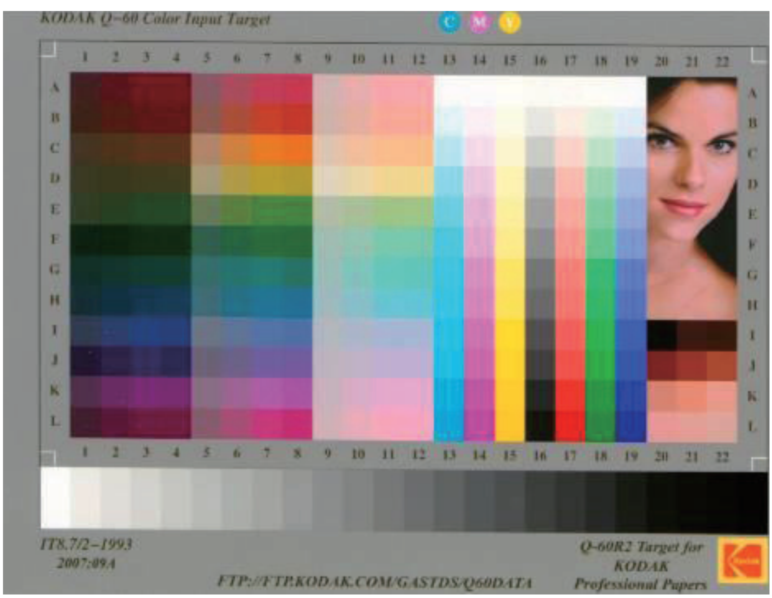


Fig.3-5 IT8.7/2: 5x7 inch reflection copy[5]

III. Scanner Color Management Process

Among the multitude of scanners introduced above, flatbed scanners and drum scanners are the most commonly used scanners in digital archive projects. Below we will further introduce color management procedures and key points for these two scanner types.

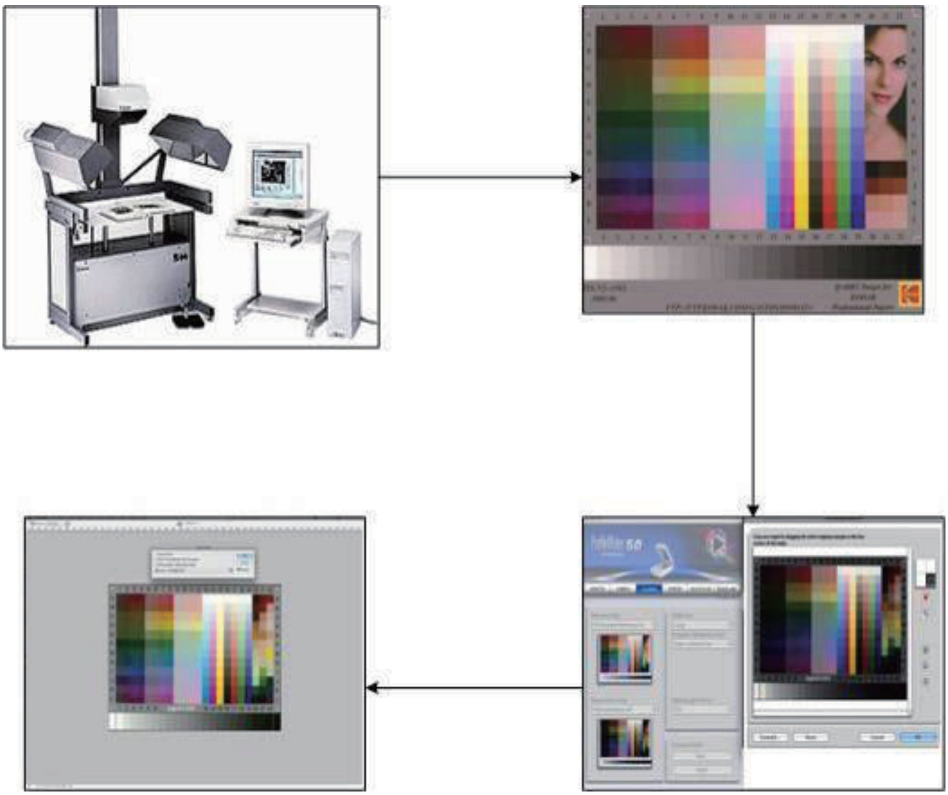


Fig.3-6 Making an ICC profile for a scanner ⑥

1. Flatbed Scanner

(1) Equipment preparation:

The first task is to select a computer and monitor that supports color calibration. Modern operating systems, graphics cards or graphics chips generally support color calibration. When selecting a monitor, make sure that it supports color temperature of 5000K, and whether or not it provides wide-angle view; 5000K is the base for monitor calibration; wide-angle is to avoid seeing different colors due to different viewing angles when examining image files, which will affect your judgment of color. Of course, it is best to keep the light source in the scanning environment at a color temperature of 5000K, this way your vision is not affected by the surrounding light.

(2) Monitor calibration:

Use a color calibrator (e.g. Xrite's MONACO optix and i1) for monitor calibration. After calibration is complete, the color management software will generate a monitor profile based on the surrounding light, so that every time you turn on the computer the system will adjust the monitor to display standard colors. After applying the monitor profile, do not make any adjustments to the monitor, including its brightness. The frequency you calibrate your monitor depends of the quality of the monitor and the frequency it is used. It is recommended to calibrate your monitor everyday, once a week, or once a month to keep it in a stable state.

(3)Scanner color calibration:

Here we will explain how scanner color calibration is carried out using the large upward facing scanner of i2S as an example. Digitization equipment based on CCD or CMOS all use the RGB color model. Therefore, white balance is the basis of color calibration. The purpose of white balance is to achieve consistency of RGB color lights, so first use a piece of white paper (normally white paper you can purchase at your regular book store) for white balance calibration, and adjust the scanner so that maintains consistent RGB signals when capturing information. Then, use black paper for black balance calibration; adjust the scanner until it recognizes what values of RGB are black. The gray scale will be automatically generated at this time.

(4) Determine the brightness based on the gray scale of the Q13 color card:

Scan the Q13 color card and adjust the scanner's brightness until you can see all gray scales on the monitor. The right end of the color will be hard to determine, so enlarge the image to verify.

(5) Scan the IT8 color into a TIFF file:

Use MONACO DC COLOR or ProfileMaker to produce the ICC profile of your scanner. All scanned images afterwards will be able to choose to be saved along with the profile or separately. Of course, creating an ICC profile is not something you will only do once; based on the stability of your scanner and user requirements, you will have to create new ICC profiles on a regular basis. (Production of an ICC profile will be introduced in the following section.)

2. Drum scanner

(1) Scanning principle:

In drum scanners, the master copy is stuck onto a transparent drum, the drum rotates at high speeds, and pixel data is read one at a time via PMT. Preliminary procedures and scanning of such scanners are more time consuming, but scanning quality is better because PMT has higher dynamic threshold (density threshold) and higher stability; such scanners are mainly for professional purposes. Drum scanners are able to scan both reflection and transmission copies, while flatbed scanners can only scan reflection copies, unless they are of special models for professional purpose.[3-2]

(2) Basic color calibration:

Before scanning objects, first complete basic color calibrations, such as linear calibration and gray balance calibration, and then produce an ICC profile for the scanner and scanning conditions. When creating the ICC profile, it is recommended to use an IT8 chart (use IT8.7/1 for transmission copies and IT8.7/2 for reflection copies) or similar chart, stick the chart onto the drum and scan it into a digital image file, compare the image file with parameters of the profile production software and produce the ICC profile, then use color management procedures to control color performance.

(3) ICC Profile production (using ProfileMaker as an example):

i. Import the scanned IT8 chart into ProfileMaker. A warning message will appear telling you that a correct ICC profile cannot be created if the scanning process caused an error in colors. If this occurs, it is recommended to rescan the IT8 chart to avoid producing an incorrect ICC profile.

ii. Paper gray scale settings, on the light source menu select D50. This is because D50 has a color temperature of 5000K, which is the standard setting for general color calibrations. Press “Start” after setting the light source to start correspondence analysis and production of the ICC profile.

[3-2] Pages 81-82 of “Digital Photography Technology” by Hsu Ming-Ching, Taipei City: Garden City Publishing, October 2001.

iii. After file import is complete, choose the type of the color chart you wish to analyze for ProfileMaker to carry out correspondence analysis. Then, position the color chart and select the range of the color chart to be analyzed. Continue with further operations after positioning the color chart. (As shown in Fig.3-7)

iv. When naming the ICC profile, it is best to include the scanner model and related information, such as settings and color chart format, making it easier to find in the future. (In Fig.3-8, the file shown is only a default file; you should put as much information as possible in the file name of an actual ICC profile.)

v. Press "Start" after configuring related settings and begin correspondence analysis and production of the ICC profile.

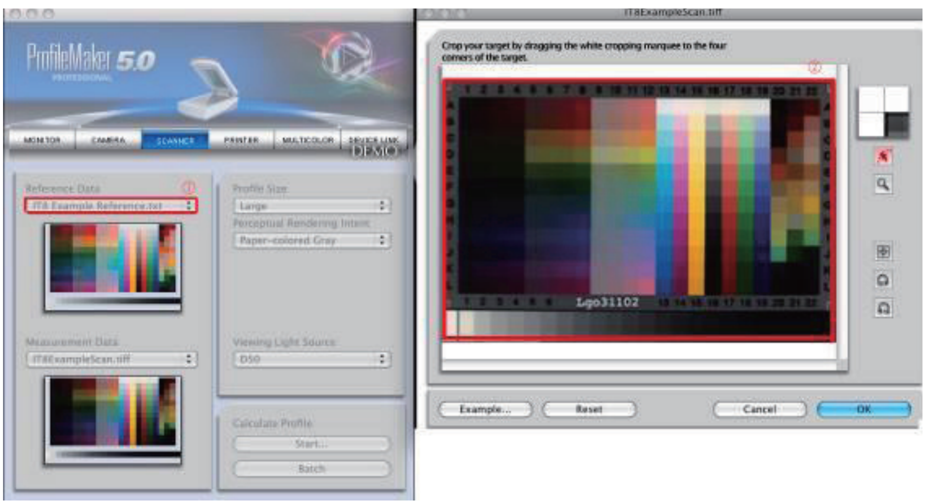


Fig.3-7 [7]

vi. The new ICC profile will be automatically stored in the default folder based on the operating system used. This makes it easier to find when you import it into your color management software in the future.

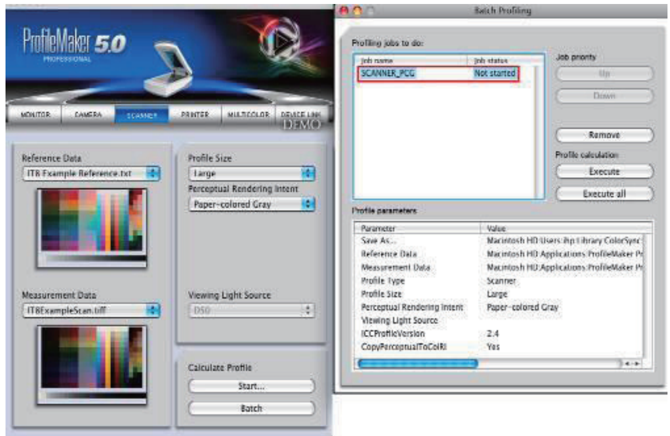


Fig.3-8 File naming⑧

(4) ICC Profile import and application (using Adobe Photoshop as an example)

i. Open the digital image photographed under the same conditions with Adobe

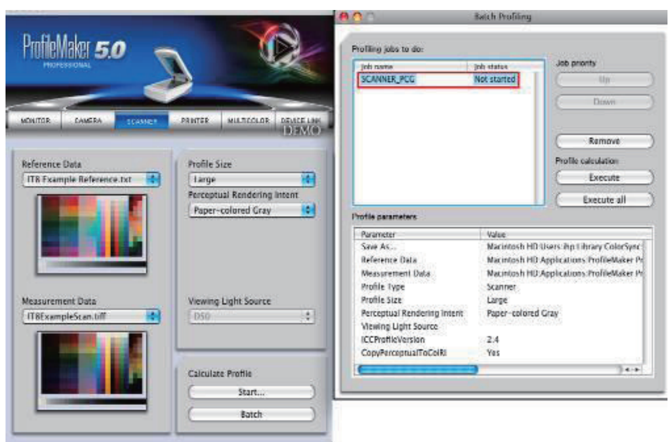


Fig.3-9 Correspondence analysis and production of ICC Profiles⑨

Photoshop. Do not manage the colors on this file to avoid losing color information in the next step, which is to specify an ICC profile; editing this file will result to two conversions. If the digital image opened already has default settings, all you need to do is choose “Edit” → “Assign Profile”.

ii. Choose the ICC profile and import it into the image file to acquire colors of the shooting environment. In the future, images photographed in the same environment can directly import this ICC Profile. The two color charts below are before and after the ICC profile was imported.

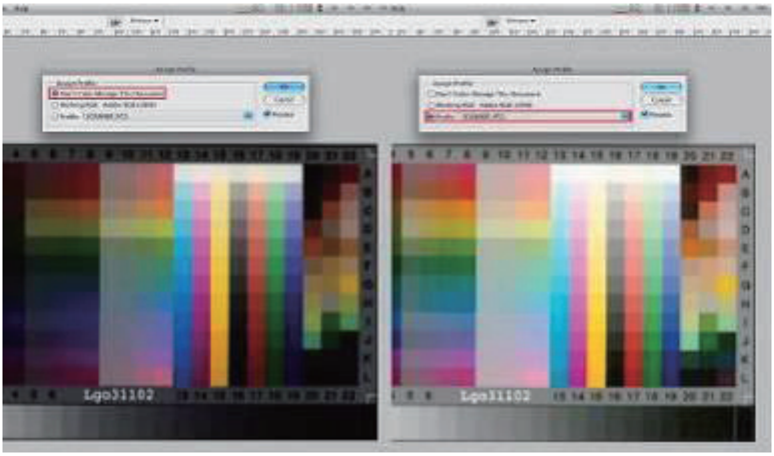


Fig.3-10 Comparison of colors before (left) and after (right) applying the ICC profile⑩

Image Notes:

① Source: Taiwan Digital Archives Expansion Project　Drawn by Lei Pei-Ying

② Source: Richard M. Adams I I and Joshua B. Weisberg (1998) The GATF Practical Guide to Color Management, page 64.

③ Source: “Canon CanoScan 8400F Flatbed Scanner: One Level Up”, http://www.xbitlabs.com/articles/other/display/canoscan-8400f_10.html, March 2009.

④ Same as ③.

⑤ Same as ③

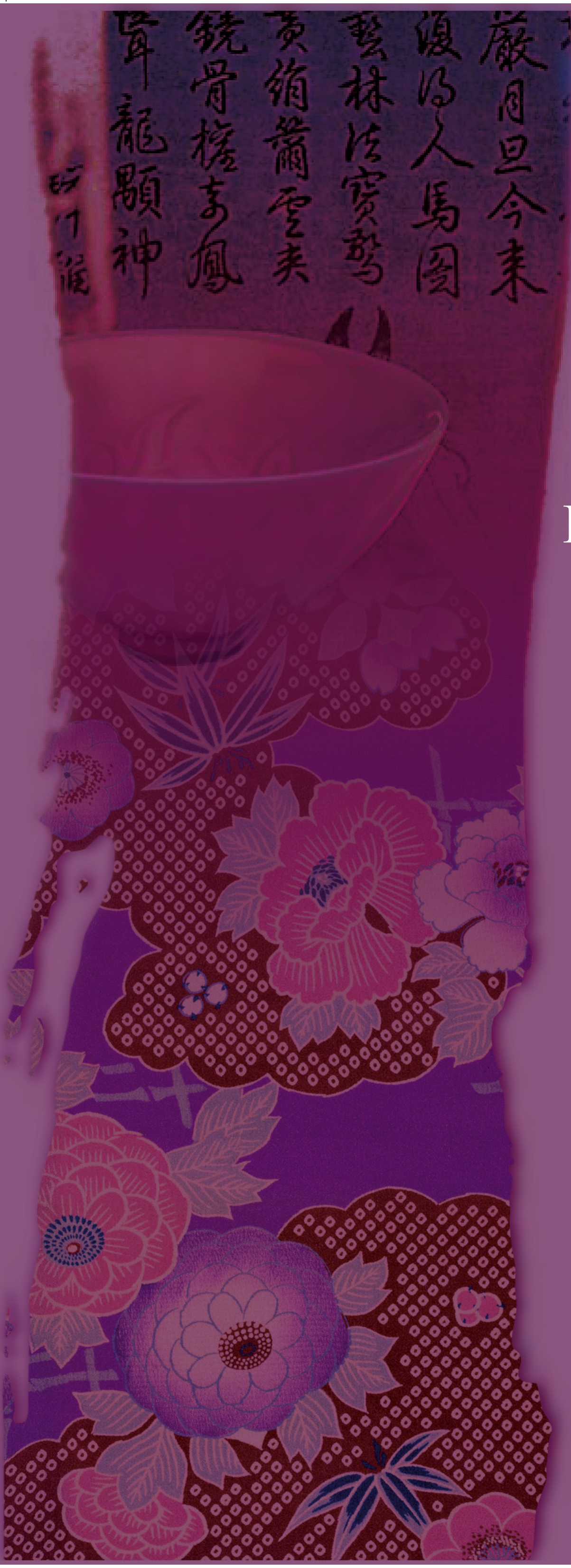
⑥ Source: Taiwan Digital Archives Expansion Project　Drawn by Wang Ya-Ping

⑦ Image captured from ProfileMaker®

⑧ Same as ⑦.

⑨ Same as ⑦.

⑩ Image captured from PHOTOSHOP®



FOUR. Monitors

Monitors play a significant role whether it may be on the input end or output end. Developing from CRT to LCD, monitor colors often determine the life and sustainability of images. Therefore, when professional graphics artists, photographers, designers, or printing companies are processing images, they all consider professional monitors to be a link in quality management. To digital archive workers, ensuring that image colors match the original is of utmost importance. From the perspective of color management, monitor requirements include: smooth and even color tones, wide color gamut, stable and continuous brightness, accuracy of colors and color blending, and less distorted viewing angles; for high-end monitors, requirements include built-in software calibration functions. Considering that high-end professional monitors are mainly used for color management, below we will introduce popular professional monitors in the market:

I APPLE

1. Background

Apple Inc., originally Apple Computer Inc., removed the word "Computer" in the Macworld Expo on January 9th, 2007. Its headquarters is situated in Cupertino, California (County of Santa Clara, CA), and mainly designs and markets electronic products4-1. Development of Apple II in the 1970s led to the PC revolution, and Macintosh, one of Apple's most famous products, took its place in the 1980s to further developments. Besides personal computers and computer software, Apple has also expanded into mobile devices[4-2].

Table 4-1 Developments of Apple Inc.

Year	Events
1976	Steve Jobs and Steve Wozniak (Woz) founded Apple Computer Inc. Developed
	and began sales of Apple I the same year.
1977	Sold the earliest personal computer Apple II.
1984	Released the revolutionary Macintosh computer.
1997	Steve Jobs returned to Apple.
1998	Released the first generation iMac.

Notes:

[4-1] Article on Apple Inc. [G/OL] from Wikipedia, the free encyclopedia, March 22nd, 2009 12:03 [March 27th, 2009 02:48]. http://zh.wikipedia.org/w/index.php?title=%E8%98%8B%E6%9E%9C%E5%85%AC%E5%8F%B8&oldid=9626096.

[4-2] For list of Apple products please visit: http://www.tofslie.com/hey/2009/01/27/apple-evolution-poster-now-updated-for-2009/

Year	Events
2001	Released the digital music player iPod.
2003	Released the earliest 64 bit personal computer Apple PowerMac G5.
2005	Steve Jobs announced that Apple will begin using Intel processors the following year.
2006	Steve Jobs announced the first desktop computer and laptop computer using Intel
	Processors – iMac and MacBook Pro.
2007	Steve Jobs announced iPhone.
2008	Steve Jobs announced MacBook Air, the thinnest laptop computer today.

Source: Same as[4-1]

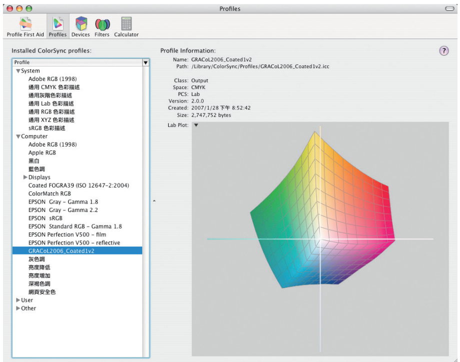
2. Product technology

Apple on October 15th, 2008 released the newly designed Apple LED Cinema Display, the first monitor developed by Apple that entirely used LED backlight display; combined with a glass texture Multi-Touch panel, it was a specialized monitor for Macbook. For instance, the 30 inch Apple Cinema HD Display provides an astonishing 2560 x 1600 pixel resolution. Because it was designed for creative professionals, this monitor provides more space for users to place ongoing work, format settings, and all tools and control panels required for synthetic work.

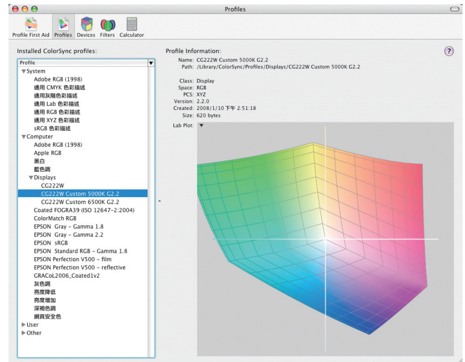
The new Apple Cinema HD Display is equipped with an active matrix LCD display, its images don't bounce or flash, and compared with typical CRT monitors, it can provide higher brightness, higher definition, and higher contrast rate. Unlike analog LCD monitors, it uses a pure digital interface to provide images without distortion, requiring minimal adjustments. Since it provides over four million digital pixels, this monitor is especially suitable for processing technical or structural analysis data. LED technology became more and more popular because it was extremely difficult for conventional light bulb backlight to display true black; monitors using LED light sources are better able to show more detail in dark areas because the monitor consists of independent LED.

Fig.4-1 Apple Cinema Display (uses LED backlight display).[1]

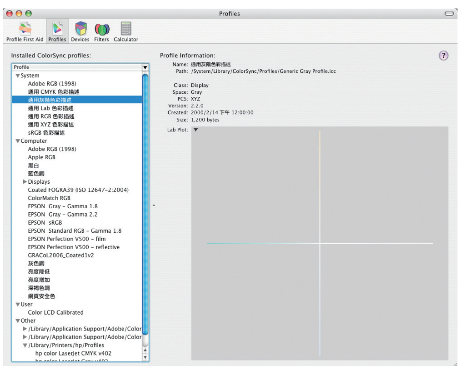
The 30 inch Apple Cinema HD Display has a wide color gamut of up to 16.7 million colors. It can display soft colors to bright colors with a precision that allows users to identify even the minutest difference between colors. It has a wide viewing angle, and colors are not distorted at different angles. The built-in ColorSync technology of Apply computers allow users to customize their own color profiles, and maintain consistency between colors displayed on the monitor and colors output. Using MAC OS X as an example, ColorSync is at Application\Utilities\ColorSync.app. Users can calibrate the monitor using built-in or downloaded profiles, e.g. different profiles can be selected for different printing standards, and the monitor will display the color gamut of the selected profile. As shown in the figure below, this convenient built-in software displays the color gamut for users to make detailed adjustments, allowing objects to accurately display the colors they should. In addition, ColorSync can detect external devices and select suitable profiles; for output devices, ColorSync also provides multiple environment settings for users to configure, making the output object more consistent with its display on the monitor. Apple products have always served as a benchmark in the industry, and whether or not this LED backlight technology will turn into another trend is something that we are all observing.



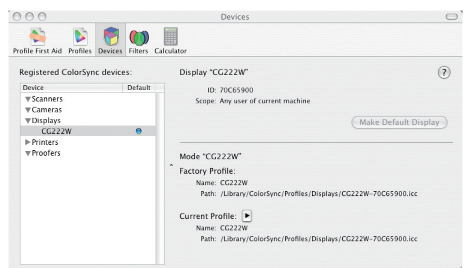
Profile can be selected for printing (e.g. GRACoL).



Profile for monitors (separate download required).

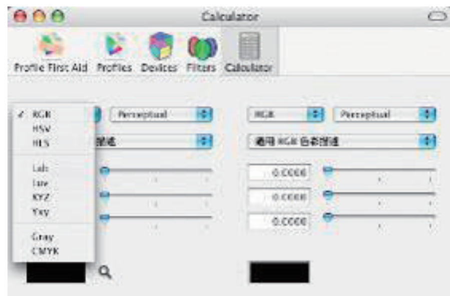


ColorSync gray scale settings for monitors.



Profiles can be embedded into external monitors that are detected

Colors of the output device can be adjusted.



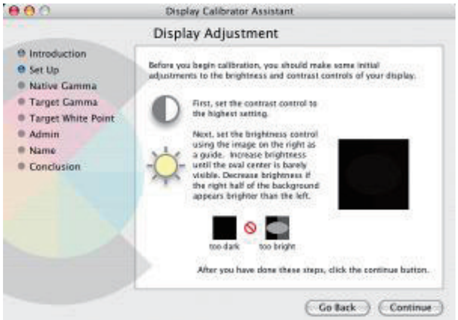
Monitor color values can be detected and compared.

Fig.4-2 Profile related options and micro adjustments in ColorSync.②

Besides the ColorSync Utility of MAC OS, users can also configure monitor related options in System Preference to set their monitor environment. By taking a few simple steps, users can ensure the monitor is within a certain range.

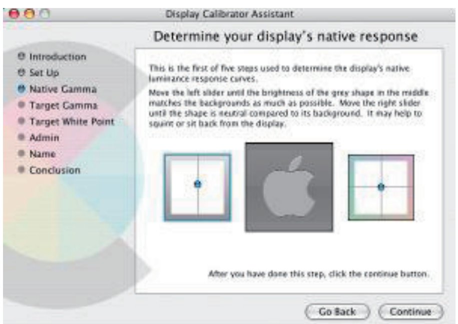
Step 1

Open to the page Apple Display Calibrator Assistant. There are two modes to choose from: simple and expert; in this example expert mode is selected.



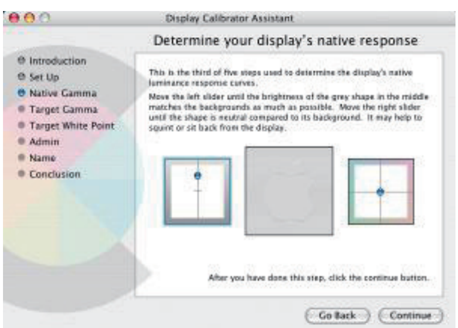
Step 2

Next, adjust the contrast of your monitor. The explanation below will show you what normal contrast should look like. At the same time, it shows you the current state of your monitor.



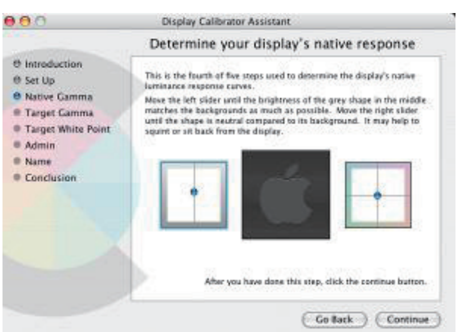
Step 3

Adjust the brightness of your monitor. Adjust the blue point on the left up or down so that the gray shape in the middle matches the background as much as possible. Then move the blue point on the right until the shape is neutral compared to the background.



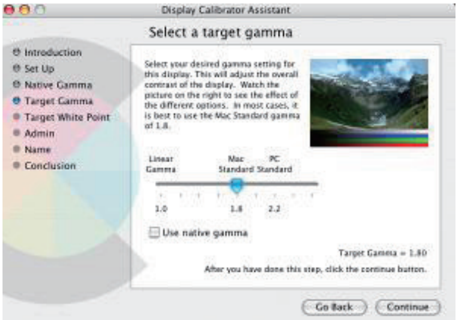
Step4

Move the blue point of the left up and down until the gray shape in the middle matches the background as much as possible. Then move the blue point on the right until the shape is neutral compared to the background.



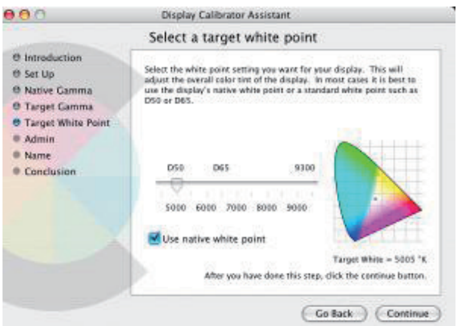
Step5

This step adjusts your monitor's gamma value. Move the blue point on the left up and down until the brightness of the gray shade in the middle matches the background as much as possible. Then adjust the right coordinate system until the shape is neutral compared to its background.



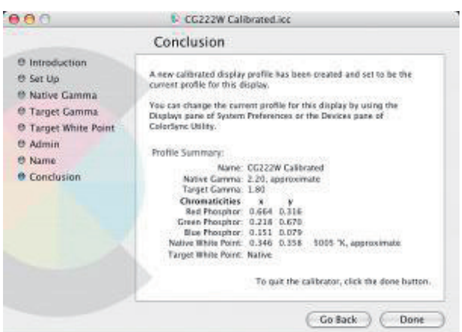
Step6

This step adjusts the target gamma value. The system recommends MAC operating systems to select a gamma of 1.8; for PC operating systems it recommends a gamma of 2.2; micro adjustments can be made via the image on the upper right.



Step7

Select the color temperature displayed by your monitor. D50 is generally selected when processing images for printing; select D56 if you will be processing photos.



Step8

Users can name and save the profile. In the future users can use the same options to access the ICC profile.

II. BENQ/Qisda—R series FP91R

1. Background

Taiwan has long been a global leader in terms of monitor production capacity. However, the brands produced are mainly for the general public, and very few monitor products are for professionals. Continental Systems Inc. was established in 1984. It released its self-owned brand – BenQ in 2001, and officially renamed itself BenQ Corporation. In the following year (2002), BenQ in a regular shareholder's meeting changed its Chinese name from “明碁電通” to “明基電通”, and began actively expanding its global market. In 2007, the BenQ’s brand and OEM businesses were separated, and the OEM business was named Qisda (Quality Innovation Speed Driving and Achievements). BenQ’s products focus on wide screen monitors, high-end LCD monitors, and consumer LCD monitors.

2. Product technology

BenQ in July 2006 released its professional LCD monitor R series, featuring the – BenQ FP91R monitor, and won the 2007 Red Dot award. The model was designed for professional photographers, image post production and dynamic image workers, architecture designers, printing companies, and web designers.

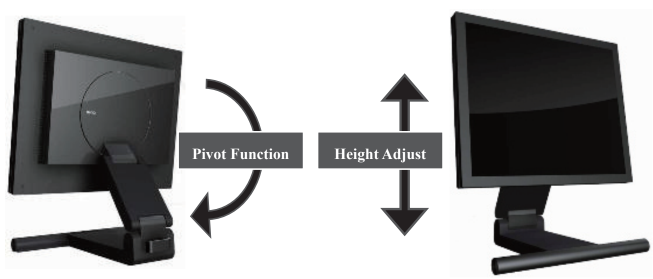


Fig.4-3 BenQ FP91R Monitor, (left) 90 degree pivot function; (right) flexible height adjust[3]

Fig.4-4 BenQ FP91R Monitor has elegant simple lines, and has an exclusive color calibration tool (left).[4]

Features of the IPS panel of BenQ FP91R are as follows:

(1) Completely supports sRGB standard colors.

(2) Allows independent six-color adjustment (Red, Green, Blue, Cyan, Magenta, and Yellow), possesses color stability, gray scale color saturation…etc.

(3) Built-in luminance compensation, and automatically reminds users to calibrate their monitors if decay occurs.

(4) The first domestic LCD to be attached with a control device for users to change between different modes, enter the main menu, and configure hot keys; the control device has an On-Screen-Display interface and can be used for light measurement.

(5) Pivot function and height adjust, as well as USB port.

What makes the BenQ FP91R monitor extraordinary is its exclusive Senseye technology. Development of Senseye began in 2004, and was employed in high-end monitor products starting in 2006; photo and dynamic image technology was developed the same year. Senseye technology is divided into three main functions: color management, contrast enhancement, and sharpness enhancement. The purpose of these functions is to make images richer and clearer so that they satisfy various user requirements.

Fig.4-5 Development of Senseye technology [5]

In the past, when the brightness of monitors was increased, chroma would decrease and colors would fade. This is because typical monitors didn’t separate brightness from saturation, meaning that when RGB brightness signals were adjusted color saturation was affected as well, and the result was posterization.

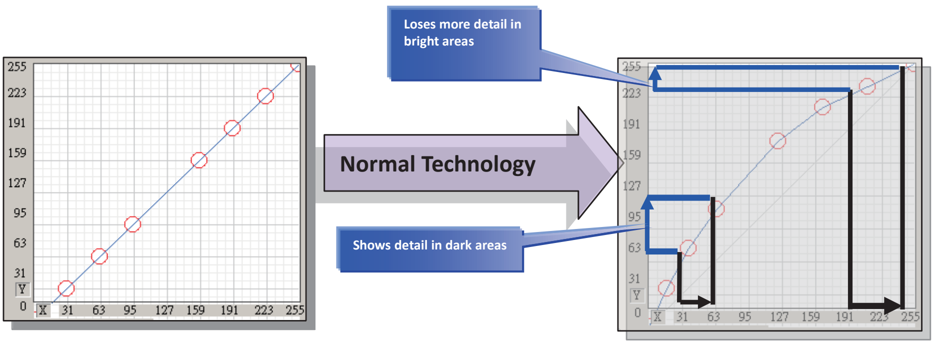


Fig.4-6 Comparison of Senseye with typical monitor⑥

In the contrast enhancement function of Senseye, it automatically detects image signals and divides them into three regions for micro adjustments, allowing more detail to be displayed in bright and dark areas.

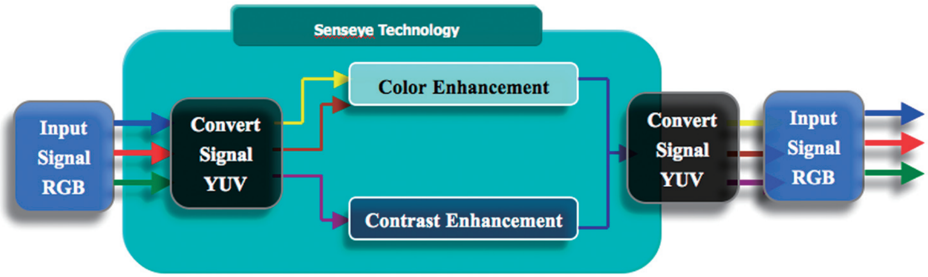


Fig.4-7 Senseye possesses contrast enhancement function⑦

Senseye's color management function allows independent three-color (RGB) adjustment, and enhances color signals with low color saturation without affecting the performance of other colors.

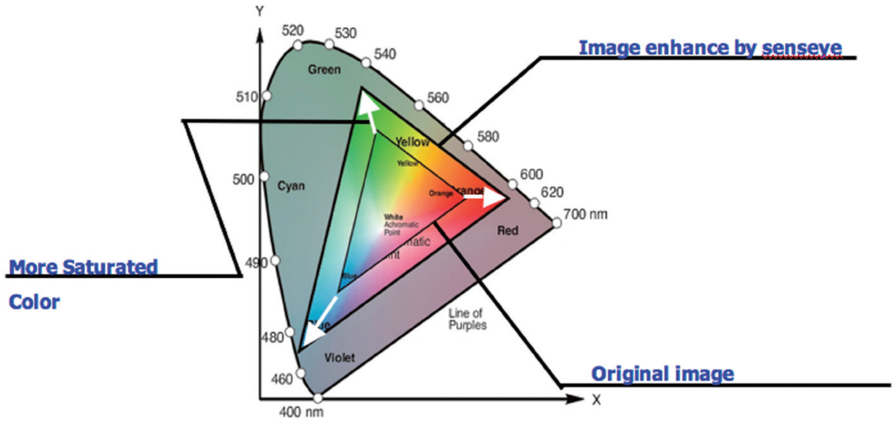


Fig.4-8 Color performance of image enhanced by Senseye[8]

BenQ's Senseye technology guarantees that products will be configured to meet professional requirements before they are delivered. Therefore, users can easily maintain colors to meet professional requirements under any circumstances. Whether it is a flat plane image or dynamic image, Senseye technology can fully support operations and maintain the display in a stable detailed state.

3. Monitor color calibration

BenQ FP91R made a ground breaking development in its design. On the front side of the controlling device are buttons that allow users to easily adjust the monitor's angle; on the back side of the controlling device is a sensor for simple monitor color calibration.

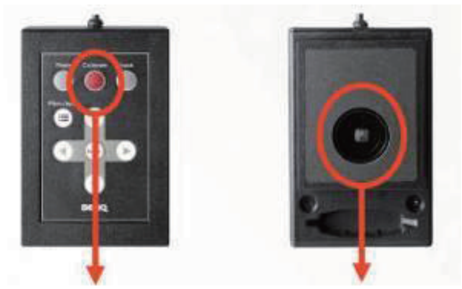


Fig.4-9 Front and back of the external controller.[9]

Fig.4-10 The controller is simply placed in front of the monitor for calibration.[10]

Fig.4-11 Monitor calibration menu.①

After panel technology grew more mature, monitor prices dropped, but the quality and specifications of monitors remained at their original levels. Instead, manufacturers began introducing technology of high-end products into consumer products, and differentiated their products based on different requirements, giving consumers more space to choose monitors that best meet their requirements and budget. Still, no matter what type of monitor you use, basic maintenance is extremely important; for example, regularly cleaning the screen with specialized products, and executing monitor calibration on a regular basis; not only will this extend the lifespan of your monitor, but also reduce stress on your eyes. It is also important that the monitor be at a certain height so that the viewing angle is desirable.

III. EIZO-NANAO

1. Background

Founded in Ishikawa, Japan on March 6th, 1968, EIZO-NANAO was originally an electronics product manufacturer. The company began manufacturing CRT computer monitors in 1985, and established the brand "NANAO" for sales in North America; sales in Japan began 1991, and it expanded its market to Europe and other countries. In 1992, the company began producing large LCD monitors for use in amusement parks. After re-structuring its two brands "EIZO" and "NANAO" in 1996, the company began developing and selling computer LCD monitors in 1997, and gradually expanded to medical imaging. The company was officially listed in the Tokyo Stock Exchange in 2002 and 2003, and currently has offices in the U.S., Sweden, Germany, and Switzerland.

2. Product technology

EIZO-NANAO's ColorEdge series (CG series)4-3 is a series of professional monitors designed for photography, design and printing; the CG series is well known among professionals. The earliest ColorEdge products were the 21 inch CG21 and 18 inch CG18 released in 2003. In 2004, "CG19" was released and the earliest monitor to use AdobeRGB – CG220 was released immediately after, creating a bustle in the field of graphics design; developed from CG21, CG210 appeared in the market in 2005. The next year as technology matured, CG221 and CG211, which allowed correspondence with sRGB, was released into the market; the earliest appearance of the company's new technology DUE was in these two models. EIZO-NANAO has been actively acquire certifications for its CG series, considering that the series is mainly used for commercial printing and design; for example, in 2008 CG241W and CG301W received the "IDEAlliance (SWOP · GRACoL) Proofing Systems Certification" from the non-profit

[4-3] "カラーマネージメント液晶モニターColorEdgeとは？", http://www.genkosha.com/eizo/coloredge/page1.html, March 2009.

organization IDEAlliance (International Digital Enterprise Alliance), securing the CG series' position in proofing systems; these two models could become standard models in the industry[4-4]. In the future, EIZO-NANAO will continue to apply for certification of other models.

Table 4-2 EIZO ColorEdge series monitors

Year	Model
2003	CG18 / CG21
2004	CG19* / CG220
2005	CG210
2006	CE240W / CE210W / CG221♦o / CG211*
2007	CG241Wo / CG301Wo
2008	CG222Wo
2009	CG 242Wo

♦High-end oWide color gamut *General

Source: http://www.genkosha.com/eizo/coloredge/page1.html

Fig.4-12 CG241W and CG301W certified proofing systems.[12]

EIZO-NANAO attaches great importance to product technology development. Take its CG series for example, its main feature is the integrated operation of hardware and software, e.g. image display control technology and DUE technology (Digital Uniformity Equalizer) are core technologies that maintain the monitor's brightness and color balance; LED monitors are different from CRT monitors in that the larger the size, the harder it is to control the brightness of the corners, which is why color balance is extremely important to high-end professional monitors. The main function of DUE

4-4 “モニター色校正の新規格をColorEdgeシリーズが取得”, http://www.genkosha.com/eizo/news/index.html#2931, March 2009.

technology is to detect the distribution of pixels displayed and to balance them[4-5], ensuring color display, which is extremely to professionals working with colors.

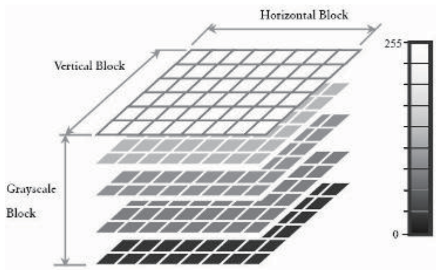


Fig.4-13 Drawing of a monitor's composition, each block is one pixel.[13]

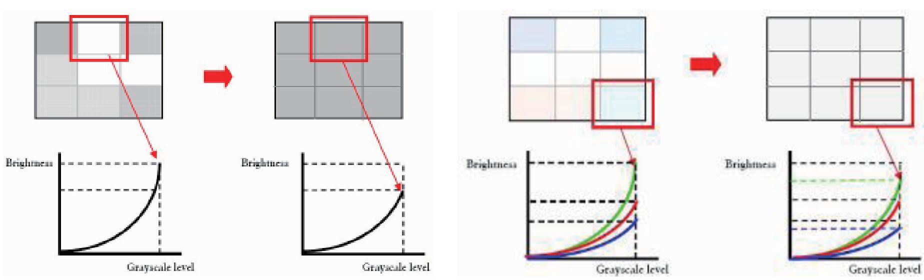
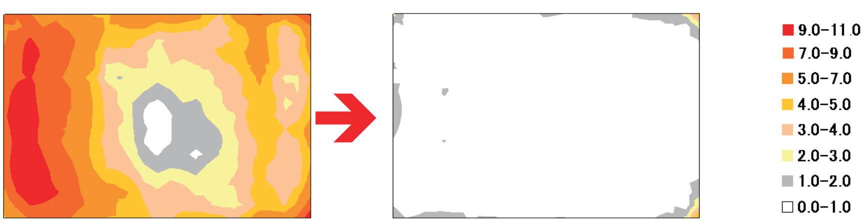


Fig.4-14 (Left) Measuring the grayscale level of pixels when they are bright and dark; (Right) using the same principles, adjust RGB as separate variables to achieve color balance.[14]



Before monitor calibration After monitor calibration ΔE*ab values

Fig.4-15 The monitor displays an even brightness after being calibrated with DUE technology; ΔE*ab values have also dropped.[15]

Next is its backlight technology. For the typical monitor, brightness is controlled by light tubes on the bottom layer, only a few LED light sources are used. EIZO CG

[4-5] 33 pixels × 25 pixels × 9 levels (32 levels each) 7425 pixels.

monitors have an exclusively designed sensor embedded in the back. Depending on how bright the surrounding is, the sensor adjusts the monitor's brightness to reduce pressure on users' eyes. This is why CG monitors are able to achieve display stability in a shorter amount of time compared with other monitors, and colors are not easily distorted.

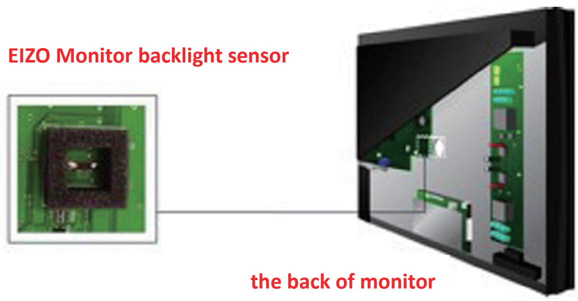


Fig.4-16 EIZO Monitor backlight sensor.⑯

Viewing angle also determines how professional a monitor is, and for CG monitors colors are consistent no matter what angle you look at it from. Each EZIO LCD monitor is calibrated, RGB and gray scale values, using a CCD lens before it is delivered, so that color tones are smooth and difference between individual monitors is minimized. The gamma value on ColorEdge can also be changed using their exclusive calibration software – ColorNavigator[4-6].

Fig.4-17 Before EIZO monitors are delivered, each one is calibrated in a darkroom to ensure quality.⑰

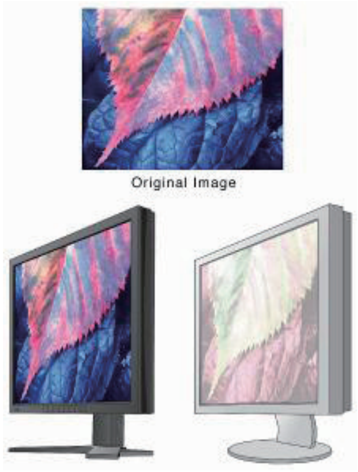


Fig.4-18 EIZO Monitors have a wide viewing angle⑱

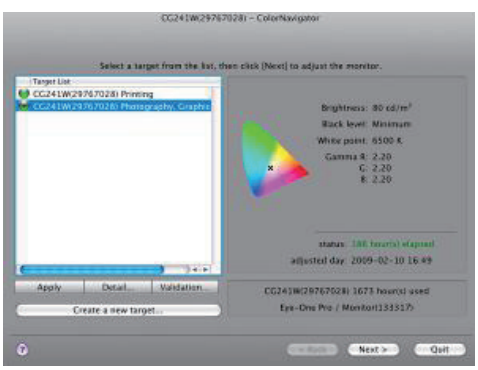
[4-6] ColorEdgeCG220 White Paper, Eizo-Nanao Corporation, December 2004.

Although EIZO monitors are relatively expensive, the extra cost is well spent on quality. Besides a few specific parts that are imported from other countries (e.g. Taiwan), the entire monitor, including ICs, has exclusive specifications and is assembled, tested, and calibrated in its factor in Ishikawa, Japan. The factory's operating environment has strict requirements on humidity to prevent static electricity, and workers responsible for assembly are monitor specialists. Although the output quantity each day is not large, the entire production process holds a careful attitude to produce high quality products. For example, comparing CG222 with their Flexscan series, due to the high precision of the CG series, the assembly time of CG222 can be up to twice the amount of time required for the Flexscan series. When products are delivered, each monitor comes with a manual explaining values adjusted by DUE for customers to keep as reference. The company's emphasis on quality is not only seen in its products; seeing that products are shipped over long distances, EIZO established a shock laboratory in its factory to test products after they are packaged, ensuring that long shipment distances will not affect product quality. It is not hard to tell why professionals have favored ColorEdge monitors for such a long time; the brand is almost synonymous with quality 4-7.

3. EIZO CG series monitor calibration

In the past, CG monitors usually came with Gretag Macbeth i1 color calibrators. However, in response to the trend of simplified color calibration, EIZO developed its own EasyPIX color calibrator. Differences in using these two color calibrators are briefly described below.

(1) EIZO CG series monitors and Gretag Macbeth i1 series color calibrators

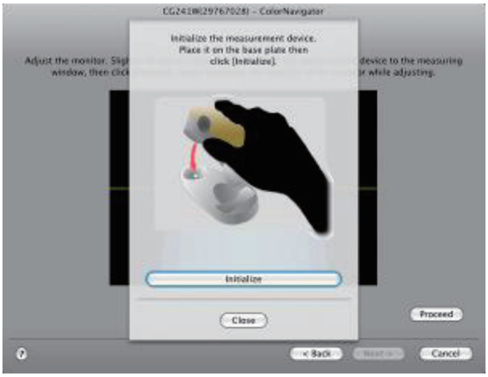


Step1

After connecting the Macbeth i1 color calibrator, execute the built-in color calibration program of CG series monitors – ColorNavigator (you can download this program at the EIZO official website, the latest version is 5.7).

Next, select the mode – printing or photography. In this example the mode selected is photography.

[4-7] 大浦タケシ, "ColorEdgeを生み出す「ナナオ本社工場」訪問記", 2008.4.24, http://www.genkosha.com/eizo/feature/factory/page1.htm



Step2

Wait for the color calibrator's white point to start up. ColorNavigator will show a dialogue box indicating the next step; prepare to place the color calibrator on the monitor.

Note: The reference white point under each i1 color calibrator has different values, and corresponds to only one color calibrator. Therefore, with consideration to the accuracy of values, it is recommended to replace it with a new one if it wears away.

Step3

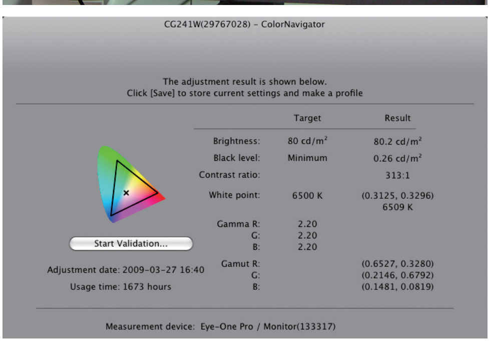
Follow the instructions in the dialogue box and place the color calibrator in the blue area on the monitor; prepare for color calibration.

Step4

After the color calibrator is placed in the correct position; the next step will be automatically initiated.

Step5

When calibration initiates, the area under the color calibrator will change into different colors for it to measure; on the lower right of your monitor, you can see the execution time and current progress.



Step6

This screen will appear after calibration is completed, showing the values after calibration, date, and number of times the monitor has been used. Users can save results of each calibration for reference.

The entire calibration process takes very little time; it is extremely convenient and fast. In this example less than 15 minutes was used.

(2) EIZO EasyPIX color calibrator

Fig. Appearance of EIZO EasyPIX.

Source: EIZO-NANAO

Step1

Enter the menu, you can choose photography, online usage, or typical purpose (matching mode)

Note: The Matching Mode is for more accurate colors on your photos. The Matching Mode allows users to adjust the colors and brightness of their monitor based on the photo paper.

Step2

Use EasyPIX to adjust colors and brightness based on to the color white of the paper used.

Step3

Use the EX1 sensor to measure and adjust monitor settings, and create a color profile.

Step4

By configuring your printer, colors of the printed photo will be similar to colors of the image on your monitor

Image Notes:

① Source: www.apple.com
② Image captured from Apple® ColorSync version4.4.5
③ Source: BenQ / Qisda Corporation
④ Same as ③.
⑤ Same as ③.
⑥ Same as ③.
⑦ Same as ③.
⑧ Same as ③.
⑨ Same as ③.
⑩ Same as ③.
⑪ Same as ③.
⑫ Source: http://www.genkosha.com/eizo/news/index.html#2931
⑬ Source: EIZO-NANAO
⑭ Same as ⑬
⑮ Same as ⑬
⑯ Same as ⑬
⑰ Same as ⑬
⑱ Same as ⑬

FIVE. Printing

I. International Printing Standards

1. SWOP (The Specifications for Web Offset Publications)

(1) Background[5-1]

The Specifications for Web Offset Publications (SWOP) are specifications of the publication printing industry in the United States, defining color profiles and printing developments. In the late 1960s and early 1970s, as web offset printing of publications started to become popular and then predominate, it became obvious that the supplied input materials (proofs and film) were difficult for printers to match on press. Under these circumstances, prepress service providers did their best, but without any specifications they merely were guessing at what the printer required. The situation was chaotic and getting worse. Printers were unable to run advertisements supplied from various sources in line with each other on the same press form and found it difficult to satisfy the advertiser's quality requirements.

In late 1974 a group of concerned industry experts met informally to explore the possibility of forming a committee to write specifications for material supplied to web offset publications. These specifications were initiated after the joining of other graphics designers and specialists in 1975, announcing the first version of SWOP that year and revising it for the first time in the following year. The first revision in 1976 officially named the specifications SWOP. In 1986 the SWOP Specifications booklet included guidelines for web printing of publications. In the 1993 edition of the booklet, SWOP addressed specifications for electronic file preparation and transfer of graphic arts data in a digital workflow. In 1997 and 1998 SWOP addressed the emergence of computer-to-plate as an important production method for publication printers across the country. This was addressed in the booklet's eighth edition and in a subsequent brochure, "Digital Specifications and Requirements." Here the issues of standardizing file formats and digital proofing were first introduced. Throughout its history, SWOP has played a key role in helping the printing industry adapt to new technologies while continuing to ensure quality SWOP.

The SWOP industry review committee irregularly publishes technical specifications that help print high quality and high efficiency publications. The SWOP operation booklet comprises a number of aspects of color reproduction, output and text printing. For example, the booklet states that the error margin from film to printing output should be within 17% +/- 4%. The SWOP industry review committee also encourages its members to self-monitor their workflow and products, and collaborates with quality specification organizations that insist on SWOP

Notes:

[4-7] 大浦タケシ, "ColorEdgeを生み出す「ナナオ本社工場」訪問記", 2008.4.24, http://www.genkosha.com/eizo/feature/factory/page1.htm

settings. Information on the SWOP operation booklet can be acquired from the American Association of Advertising Agencies (AAAA) and the American Business Media, ABM, (formerly the American Business Press).

(2) SWOP as a part of IDEAlliance

In 2004, SWOP and IDEAlliance formed a coalition to support print media through the coordinated development of standardized specifications and guidelines, certification programs, software tools, educational seminars, and peer support networks. In 2005, SWOP, Inc. merged with IDEAlliance. The merger provided new resources to support SWOP modernization.

In Feburary 2006, IDEAlliance announced that SWOP would adopt the new G7™ calibration, printing and proofing process control methods. The G7™ methodology grew out of the recent research and development efforts of the IDEAlliance GRACoL Committee. It defines gray balance and target neutral print density curves for three-color gray and black as the primary method for color control as opposed to the current SWOP methods that focus on ink density and TVI (Tone Value Increase) on a prescribed paper stock. This shift in digital calibration methodology represents a significant step toward SWOP modernization because it establishes a new foundation upon which to update the specification. The mission of SWOP is to continually raise the leve of quality of publication printing by setting forth specifications, tolerances and functional, experienced-based compliance procedures. In order to compete and create value for print media, as of 2006, SWOP will concentrate on business and education dynamics rather than technical to advance the transition of the print media industry to any new mode of content creation and dissemination.

2. IDEAlliance / GRACoL (the General Requirements for Applications in Commercial Offset Lithography)

(1) Background[5-2]

In 1996, 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 quality color printing. Since that time, the GRACoL Working Group has developed, maintained and published printing guidelines that have since become de facto standards on many pressrooms. The mission of GRACoL is to improve

[5-2] http://www.idealliance.org/about_u

communications and education in the graphic arts by developing best practices that reflect the influence and impact of new technologies in the workflow of commercial offset lithography. GRACoL is a registered trademark of IDEAlliance.

IDEAlliance (International Digital Enterprise Alliance) is a not-for-profit membership organization that has been a leader in information technology and publishing since 1966.IDEAlliance advances core technology to develop standards and best practices to enhance efficiency and speed information across the end-to-end digital media supply chain - creation, production, management, and delivery of knowledge-based multimedia content - digitally and in print.

IDEAlliance members represent a unique convergence of the leading brand owners, agencies, publishers, printers, materials suppliers and solution providers. IDEAlliance provides a user-driven, cross-industry, and open environment in which its members can strategize, innovate, standardize, and implement solutions to real business challenges in eMedia-based publishing.

(2) GRACoL 7.0 (G7)

G7™ is as specification that defines the factors that can be used to provide consistent gray scale reproduction across multiple devices, processes and media[5-3].

GRACoL Chart

PAPER / SUBSTRATE	LINE SCREEN	TOTAL AREA COVERAGE %	SOLID INK DENSITY				TOTAL % DOT GAIN				PRINT CONTRAST			
			K	C	M	Y	K	C	M	Y	K	C	M	Y
Grades #1 & #2 Premium Gloss / Dull Coated	175	320%	1.70	1.40	1.50	1.05	22	20	20	18	40-45	35-40	35-40	30-35
Grades #1 & #2 Premium Matt Coated	150-175	300-320%	1.60	1.30	1.40	1.00	24	22	22	20	40-45	35-40	35-40	30-35
Premium Text & Cover Smooth	150-175	260%	1.30	1.15	1.15	0.90	26	22	22	20	35-45	30-40	30-40	25-35
Grades #3 Coated	150	310%	1.65	1.35	1.45	1.02	22	21	22	18	45	40	40	35
Grades #5 ** Coated	133	300%	1.60	1.30	1.40	1.00	22	20	20	18	35-45	30-40	30-40	25-35
Supercal SCA+	133	280%	1.50	1.25	1.35	1.00	28	26	26	24	23	21	21	20
Supercal SCA	120	260-280%	1.40	1.15	1.20	0.95	28	26	26	24	23	21	21	20
Supercal SCB	120	240-260%	1.35	1.10	1.15	0.95	28	26	26	24	23	21	21	20
Uncoated	110	240-260%	1.25	1.00	1.12	0.95	28	26	26	24	20	17	16	17
Newsprint ***	85	240%	1.05	0.90	0.90	0.85	30	30	30	30	16	13	12	15
Newsprint (heatset) & Supercal SCC	100	240%	1.20	1.08	1.15	0.95	32	32	32	32	16	13	12	15
** Same as SWOP *** Same as SNAP	Dots per inch	YMCK Screen Total %	+ / - .10 Density				Measured at 50% + / - 3%				Density of Solid / Density of 75% Patch (+/- 5%)			

www.lithoclubofbaltimore.org/images/GRACOL.PDF

Fig.5-1 GRACoL specifications of paper/substrate.[①]

The main innovation of G7TM is NPDC (Neutral Print Density Curve). NPDC achieves better consistency of color effects compared with only TVI (Tone Value Increase) or dot gain. NPDC comprises of directly measuring the density of a gray chart and dot gain. Like HR (Highlight Range), NPDC also needs to produce two types of gray, CMY three-color gray and K single-color gray. This allows the well-proven photographic principles of gray balance and exposure control to be applied to CMYK printing, ensuring a close visual match between printed images no matter where or how they are produced[5-4].

Although developed initially for commercial offset proofing, G7TM has been applied successfully to a wide range of processes, including coated and uncoated offset, newsprint, gravure, flexography, ink-jet, electro-photography and others. By directly controlling the density, contrast and balance of a neutral gray scale, G7TM brings the goal of "printing to the numbers" one step closer to reality.

G7™ has enjoyed major adoption in two distinct areas. Firstly, the gray balance an neutral tone scales defined within the G7TM specification have been used as the basis for developing standardized characterization datasets, including TR003 and TR005 (SWOP), TR006 (GRACoL) and TR007 (FIRST/FLexo). These and any other printing specifications that are based on G7TM exhibit a "shared appearance" that makes the exchange of image files and proofs between different imaging processes easier and more predictable. Secondly, the principles of G7TM are also being used to calibrate presses and proofing systems worldwide. G7TM documents mainly present techniques for calibrating a device to the G7TM values and principles.

3. FOGRA

(1) Fogra Graphic Technology Research Association

FOGRA was established in 1951 to promote print engineering and its future-oriented technologies in the fields of research and development, and to enable the printing industry to utilize the results of this activity. To this end the association maintains its own institute, with about 50 staff members, including engineers, chemists and physicists. FOGRA has over 600 members. About two thirds of them are graphic art businesses operating in fields ranging from prepress to bookbinding, while the remaining third are suppliers. A third of the members are based outside Germany.

The eight technical committees, responsible for various specialist topics, are a

[5-3] IDEAlliace, "The G7 Specification 2008- Final Working Draft", 2008/09/12.

[5-4] Chiang Jui Chang, "GRACoL 7.0 – One step closer to printing", http://www.deepblue.com.tw/article.php?articleid=133, March 2009.

central part of FOGRA. In these committees, specialists from printing businesses and FOGRA staff define industry problems which are to be studied. The progress and results of work are discussed at the Committee meetings. Thus, the Committees fulfill creative and monitoring functions. At the same time they characterize the work style of a collective research institute which meets the needs of the printing industry. Product certifications provided by FOGRA include CTP technology, printers and auxiliary equipment, printing plate lubrication, IC card, printing plate lubrication measurement, in which printing plate lubrication measurement is a service for members only. In general, FOGRA fulfills its creative and monitoring functions, and its research institute satisfies printing business that have a need for such certifications and services.

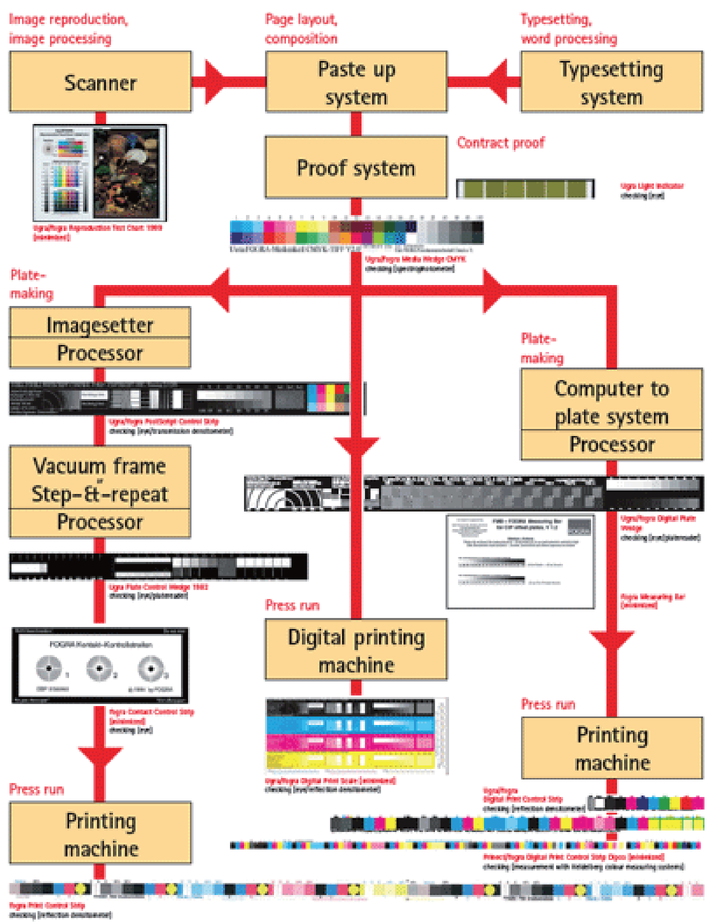


Fig.5-2 FOGRA Digital control aids in the workflow②

4. Japan Color Standard

(1) Composition

i. Japan Color standard ink

Between 1990 and 1992, the Japan National Committee for ISO/TC130 authorized the Japan Printing Ink Manufacturers' Association to establish standard ink. Ink manufacturers from around Japan provided their most commonly used four color inks, and the Association began research on the color characteristics. The inks provided by eight ink manufacturers were used to make samples; the spectral reflectance of each sample was measured to obtain an average spectral reflectance curve, which was used as the spectral reflectance curve of the standard ink. The Japan National Committee for ISO/TC130 authorized the Japan Printing Ink Manufacturers' Association to produce inks of the standard spectral reflectance curves, and named the ink "Japan Color ink SF-90". The four color inks used in Japan have standard CMYK hues, and were provided to ISO as Japan's standard inks. Using these inks as a basis, ISO then analyzed standard inks of European and American countries to establish the printing ink standard ISO2846-1.

ii. apan Color standard paper

Japan Paper Association was asked to conduct an investigation on coated paper, which was most commonly used for offset printing, with the premise condition of continuously providing paper. The association conducted optical measurements of coated paper manufactured by six companies. The Japan National Committee for ISO/IC130 then adopted the coated paper of two companies with close average values as the standard coated paper. The four types of paper adopted by "JAPAN COLOR 2001 Coated" are recommended by three manufacturers to become products that conform to ISO standards.

iii. Japan Color solid value

Japan Color Solid Value is a standard for indicating solid values. With assistance from the Japan Federation of Printing Industries, 21 of Japan's top printing companies used their coated paper and inks to make solid colors; the solid value

(CIELAB value) of solid colors from each company was then averaged; this value can be considered as a reflection on the level of solid colors on printed matter in Japan. Japan Color ink SF-90 and the standard paper were then used to make solid colors; the minimum color difference ΔE of these solid colors with the solid colors above were then found, and used as the solid value for the eight colors mentioned above.

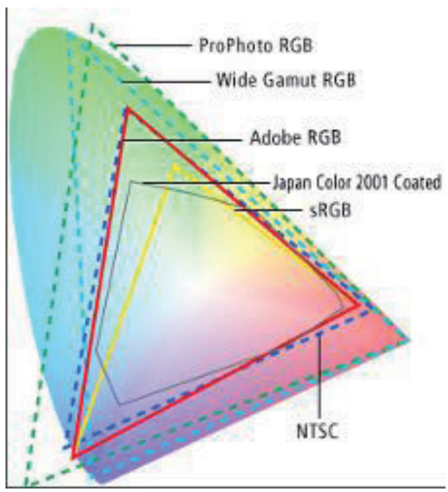


Fig.5-3 Comparison of Japan Color 2001 Coated with other color spaces.[3]

iv. Japan Color solid color sample

"Japan Color solid color sample" is a solid color sample that was made using standard ink and standard paper with difference between Japan Color 2000 solid values and ISO standards of ΔE Δ6 (the production conditions were to achieve ΔE Δ3). The sample shows solid colors of coated paper that conforms to ISO 12647-2.

v. Japan Color 2001 Coated

Japan Color 2001 Coated adopts four types of paper under ISO12647-2, Japan Color solid color samples that were produced for Japan's market, and curve data, including printed images used for subjective evaluation. It includes an instructions manual, standard solid color samples on four types of paper, each of which has ISO12647 output targets, values of 982 solid colors - L*a*b* values and XYZ values, and a DVD that contains ICC profiles used for printing each of the 4 samples.

Fig.5-4 Japan Color 2001 Coated[④]

(2) Organization

i. Japan Printing Machinery Association

The Japan Printing Machinery Association was established by the "Tokyo Printing Organization," and became a national organization in 1963. In November 1975 the association was incorporated with approval from the Ministry of International Trade, Japan, and officially became a judicial person; it revised its company constitution in December 1989.

The members of the association are mainly the manufacturers and vendors of printing machinery, bookbinding machinery, paper converting machinery and its peripheral equipment. The purpose of the association is to contribute to the development of the Japanese economy by promoting the development of the related industries through research studies, information gathering and promotion of standardization regarding the production, distribution and technical development of machinery for printing industry.

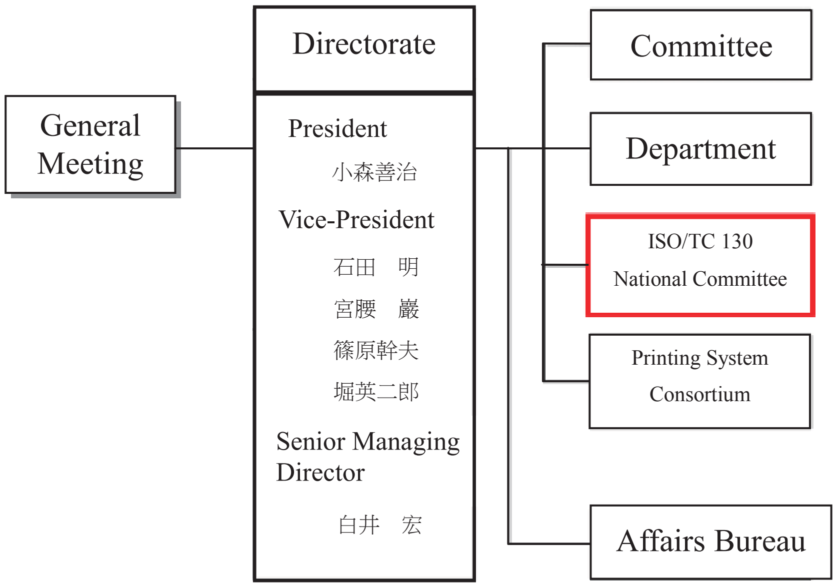


Fig.5-5 Organization chart of the ISO/TC130 Committee and Japan Printing Machinery Association⑤

Main affairs of the Japan Printing Machinery Association are as follows:

A. To develop technologies.

B. To develop and popularize standard specifications.

C. To enhance the safety and reliability of products.

D. To protect and promote intellectual property.

E. To solve environmental issues.

F. To boost product circulation and sales.

G. To make surveys and conduct investigations.

H. To hold various presentations.

I. To engage in exchanges with overseas industry groups.

"Japan Printing Machinery Association" is Japan's largest organization of printing machinery manufacturers, merging together three associations for printing plate, printing machinery and post processing equipment. JPMA also participates with the Importers' Association for Graphic Arts Machinery & Material, Printing Ink Manufacturers Association and Graphic Arts Suppliers Committee in jointly holding IGAS (once every four year) and JGAS.

ii. ISO/TC 130 Committee

The International Organization of Standardization (ISO) maintains a vast number of international standards, including standards for color management, photography, printing, and many many others. Its Technical Committees (TC) are each responsible for specific fields, in which TC 130 is responsible for color management and printing standards. TC 130 maintains the following ISO standards[5-5]:

A. ISO 12640 Input data for characterization of 4-colour process printing
B. ISO 12642 SCID images
C. ISO 12647 process control for the manufacture of halftone color separations, proof and production prints
D. ISO 13655 spectral measurement and colorimetric computation for graphic arts images
E. ISO 15076 ICC color management
F. ISO 15930 Prepress data exchange PDF/X

II. Domestic Standards and ISO Certification

1. ISO color standards

ISO announced its 12647 series color standards, in which ISO 12647-2:2004 is for offset printing. Tables 5-1, 2 and 3 are standards defined by ISO 12647-2:2004. This standard is5-6:

(1) directly applicable to proofing and printing processes that use color separation films as input.
(2) directly applicable to proofing and printing from printing forms produced by filmless methods as long as direct analogies to film production systems are maintained.
(3) applicable to proofing and printing with more than four process colors as long as direct analogies to four-color printing are maintained, such as for data and screening, for print substrates and printing parameters.
(4) applicable by analogy to line screens and non-periodic screens.

[5-5] "ISO TC130" , ColorWiki, http://www.colorwiki.com/wiki/ISO_TC_130, March 2009.
[5-6] Source: http://www.iso.ch/iso/en.

Table 5-1 Gray scale color patch combinations

	Cyan	Magenta	Yellow
Highlights	25%	19%	19%
Middle tones	50%	40%	40%
Shadows	75%	64%	64%

Source: Brainnew

Table 5-2 Position of four-color primary colors and superimposition in the CIELAB color space

Paper type	1	2	3	4	5
	L*/a*/b*	L*/a*/b*	L*/a*/b*	L*/a*/b*	L*/a*/b*
Black	18/0/-1	18/1/1	20/0/0	35/2/1	35/1/2
Cyan	54/-37/-50	54/-33/-49	54/-37/-42	62/-23/-39	58/-25/-35
Magenta	47/75/-6	47/72/-3	45/71/-2	53/56/-2	53/55/1
Yellow	88/-6/95	88/-5/90	82/-6/86	86/-4/68	84/-2/70
	48/65/45	47/63/42	46/61/42	51/53/22	50/50/26
	49/-65/30	47/-60/26	50/-62/26	52/-38/17	52/-38/17
	26/22/-45	26/24/-43	26/20/-41	38/12/-28	38/14/-28
	Black	Cyan	Magenta	Yellow	
Tolerance	2	2.5	4	3	
Total color difference	4	5	8	6	

* See the numbers below for paper type (Paper specifications)
  1. Coated paper 2. Matte coated paper 3. Commercial coated paper 4. Uncoated printing & writing paper (white) 5. Uncoated printing & writing paper (yellow).
* L*a*b* color algorithm is based on ISO 2846-1. L*a*b* measurement standards are based on ISO 12647-1:1996. 5.6: black material positioned behind the object being measured, D50, 2° viewing angle, and instrument geometries are 45/0 or 0/45.

Source: Brainnew

Table 5-3 Paper specifications

Paper type	L*	a*	b*	Gloss %	Brightness %	Mass per area %
1.Gloss-coated wood-free	93	0	-3	65	85	115
2.Matt-coated wood-free	92	0	-3	38	83	115
3.Gloss-coated web	87	-1	3	55	70	70
4.Uncoated white	92	0	-3	6	85	115
5.Uncoated yellowish	88	0	6	6	85	115
Comparison paper	95	0	5	70-80	80	150

1). L*a*b* are measured according to ISO 12647-1:1996. 5.6: black material positioned behind the object being measured, D50, 2° viewing angle, and instrument geometries are 45/0 or 0/45.
2). Gloss is measured according to ISO 8254-1; the angle used for measurement is 75 degrees.
3). Whiteness is measured under single wavelength of 460nm.
4). The paper for comparison is according to the ink testing standard ISO 2846-1.

Source: http://www.iso.ch/iso/en

In the past, Taiwan's printing market didn't have a common color standard, printing quality was often hard to control and there wasn't a basis for communication, which resulted in poor efficiency and waste. In order to enhance the quality of the domestic printing industry, establishing color standards for the industry is a matter of urgency. The Printing Technology Research Institute[5-7] (PTRI) invited major enterprises in the industry to join together and help Taiwan implement ISO color standard certifications, using ISO profile to unify color profiles of input, display and output devices. The objective is to help users directly use the color profile for their printer when engaged in color management, which not only meets the public's expectations and reduces dispute, but also allows papers and printers to reach standards. CSC (Color Standard Certification) work of PRTI is a set of certification procedures based on ISO 12647-2 and CNS-15025 (See Fig.2), providing certification services for digital proofing and printing in a open, fair way. CSC services to provide the printing industry with a consistent color standard, in hopes of establishing standard operating procedures for printing, elevating quality and international competitiveness, and increasing the output value of Taiwan's printing industry.

[5-7] The Printing Technology Research Insitute was established with donations from the Ministry of Economic Affairs Industrial Development Bureau and the Taiwan Printing Industry Association. Its board of directors was formed in September 1992, and was formally established on March 2nd, 1993.

By adopting ISO color standard certifications, the chaotic state between driver, photography, advertisement, publishing and printing industries will no longer exist. Collaboration in the supply chain of Taiwan's printing industry will increase, and pointless waste of efficiency and cost will be effectively reduced, causing quality and levels of the domestic printing industry to become in-line with international standards, and truly achieve industrial upgrade.

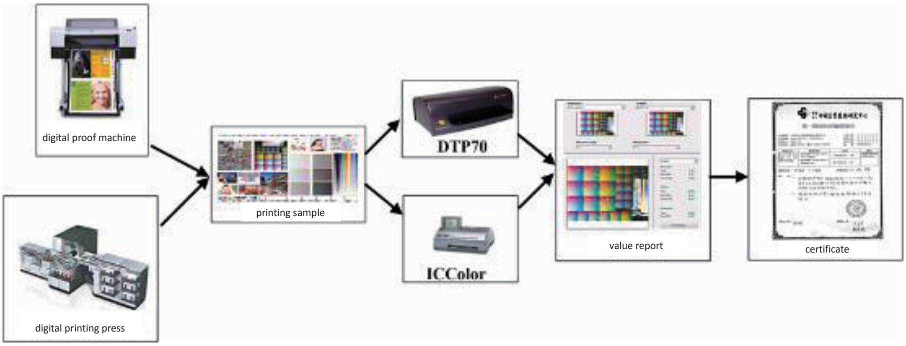


Fig.5-6 Color certification flowchart of the Printing Technology Research Institute©

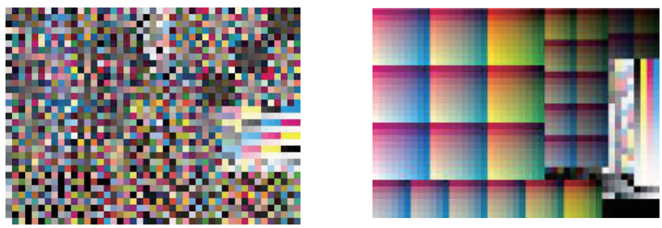
2. Fogra Certification

Fogra Forschungsgesellschaft Druck e.V. (Fogra) is a German printing technology research institute that enjoys international prestige; it is also highly praised by the domestic printing industry and research institutes. Services provided by Fogra include consultation, publication printing, material testing, machine inspection, and workflow testing and certification. There is a specific certification under the workflow testing and certification category named FograCert, which comprises Proof Creation, Proof Substrate, Proof System and Blanket; in which the scope of the Blanket certification is still being established. Additionally, Offset printing Process Standard is another type of certification provided by Fogra, and targets offset printing processes.

According to Fogra's official website, Fogra's proof color certification is based on ISO 12647 standards, which uses a standard certification sample with 46 color patches; certification results are notified within one week and valid for one year. Furthermore, measurement results of Fogra's ECI 2002 standard chart are based on the ISO 12642-2 standard; gloss is measured according to ISO 8254-1 (TAPPI). Fogra Proof Creation requires two documents, one is the ECI 2002 standard testing chart, and the other is Ugra/Fogra Media Wedge CMYK 2.1; the purpose of ECI2002 is to test for the maximum color gamut, while the purpose of Media Wedge is to test for color accuracy.

The ECI2002 standard testing chart is divided into two color patch distributions, Visual layout and Random layout (as shown in Fig.3). Color patches include all of those in IT8 with additional dark colors, totaling to 1,485 color patches. Each color patch has a standard CIELAB value; by using a colorimeter the difference between the proofing sample and ISO standards can be told. Studies generally choose the ECI2002 random layout chart as their proofing sample.

The Ugra/Fogra Media Wedge CMYK 2.1 testing chart (please refer to Fig.4)



ECI2002 VisualLayoutCmyk1485-LZW ECI2002 RandomLayoutCmyk1485-LZW

Fig. 5-7 ECI2002 standard testing chart[7]

is sold in the form of DVD with authorization from Fogra, and has 46 color patches as testing targets. The DVD contains 8 files, “MKV21AT”, “MKV21GIT”, “MKV21GT”, “MKV21-T”, “MKV21XAT”, “MKV21XDT”, “MKV21XPT”, and “MKV21XT”. Each file listed above is suitable for one colorimeter. Its purpose is for applicants to conduct tests for themselves before applying for certification, this way they are fully prepared.

Fogra Proof Creation is based on FOGRA39, establishing proofing colors of

Fig.5-8 The Ugra/Fogra Media Wedge CMYK 2.1 MKV21XDT chart authorized by Fogra[8]

coated paper and offset printing according to ISOCoated.icc in ISO 12647-7. Hence, the standard CIELAB values of its 1,485 color patches are the same as ISOCoated specifications. FOGRA39 settings are as follows:

(1) Standard light source: D50

(2) Viewing angle: 2 degrees

(3) Measurement angle: 45˚ / 0˚

(4) Measurement background: White backing

(5) Printing conditions:

i. Lithography (according to ISO / DIS 12647-2: 2004)

ii. Paper: Type 1 or 2 (Coated paper), basic weight 115 g/m2

PTRI in 2006 began implementing color standard certification (CSC) for digital proofing (printing), taking a large step forward for domestic printing quality. Furthermore, seeing the importance of internationalization to the domestic printing market, at the end of 2006 PTRI organized a “Fogra International Digital Proofing Certification Task Force” with support from the Ministry of Economic Affairs Department of Industrial Technology. The Task Force began actively preparing for Fogra digital proofing certifications, and received Fogra Proof Creation in January 2007. PTRI is the first institute in Asia to receive Fogra Proof Creation; related information can be found on Fogra’s official website. This certification furthered the internationalization of the domestic printing industry and established a foundation for printing color control technology, using advanced methods to strengthen the competitiveness of Taiwan’s printing industry.

Image notes:

① Source: www.lithoclubofbaltimore.org/images/GRACOL.PDF

② Source: http://www.fogra.org/, March 2009.

③ Source: “Understanding color space”, http://www.canon.co.jp/imaging/picturestyle/editor/matters04.html, March 2009.

④ Source: “Japan color 2001 coated”, http://blog.graphic.jp/2007/01/japan_color_2001_coated_1.html, March 2009.

⑤ Source: Japan Printing Machinery Association 2007 business report.

⑥ Source: Printing Technology Research Institute

⑦ Source: World Wide Web: http://www.eci.org/eci/en/060_downloads.php

1. 2. Ugra/Fogra Media Wedge CMYK 2.1

⑧ Source: Ugra/Fogra Media Wedge CMYK v2.1TIFF/WIN/Standard

SIX. Color Management in Image Editing Software

Adobe Photoshop is an application frequently used for editing images. If the input end is a camera, after acquiring an image from the camera, the next step is usually to display the image on your computer monitor and then engage in post production. At this time, besides calibrating the monitor to display correct colors, Adobe Photoshop also requires some basic configurations. After users complete installation of Adobe Photoshop, it is recommended to first adjust its color settings and preferences before using its editing functions to process images, this way it better matches the user's purpose and requirements. If colors are stable and adjusted according to user requirements, they will be closer to the original at the output end; this is also an important link in image quality control.

Configuring color settings is a basic step before using Adobe Photoshop. Using the MAC version of Adobe Photoshop CS as an example, select Photoshop>Color settings (as shown below) to enter the color settings menu; for the PC version of Adobe Photoshop CS3, select Edit>Color settings.

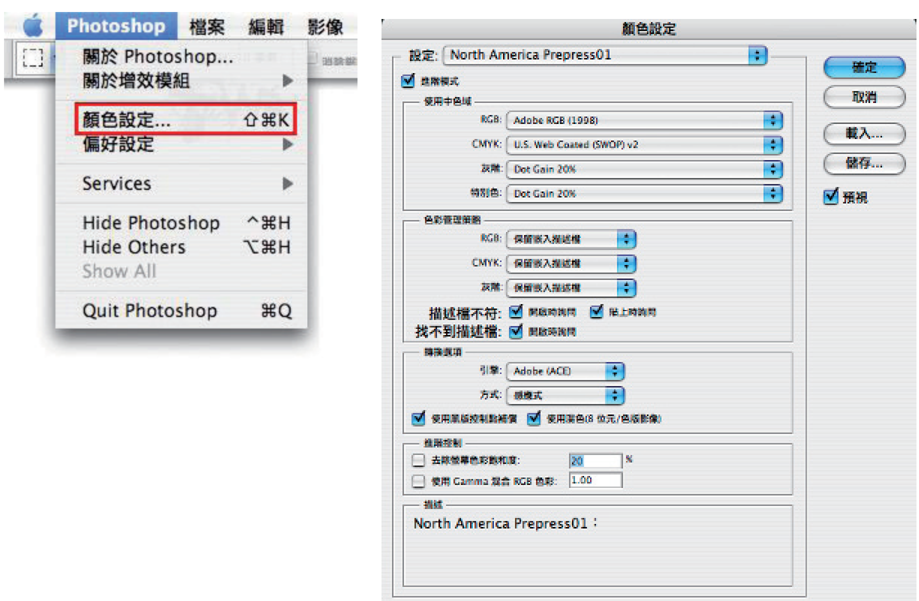


Fig.6-1 Adobe Photoshop CS color settings①

First click on the "Settings" option on the top of the color settings menu, this will show a list of default settings that Adobe Photoshop has already configured for users. For example, if the image file is for printing purpose, there are different printing standards to choose from, and the working space below will change to match the settings. In addition, users can also save customized settings that best meet their requirements (the figure below shows a customized mode); select Adobe RGB for the RGB setting to gain a wider color gamut that better meets the purpose of printing; for images that will be mostly edited by users and not for printing, choose sRGB because it betters serves the purpose of PC monitor display. For the CMYK setting, if users have already created a profile with i1 (eyeone), this is where they can load their profile, or select the general purpose SWOP. For the gray scale and special color settings, Dot Gain 20% is a suitable option for printing purpose.

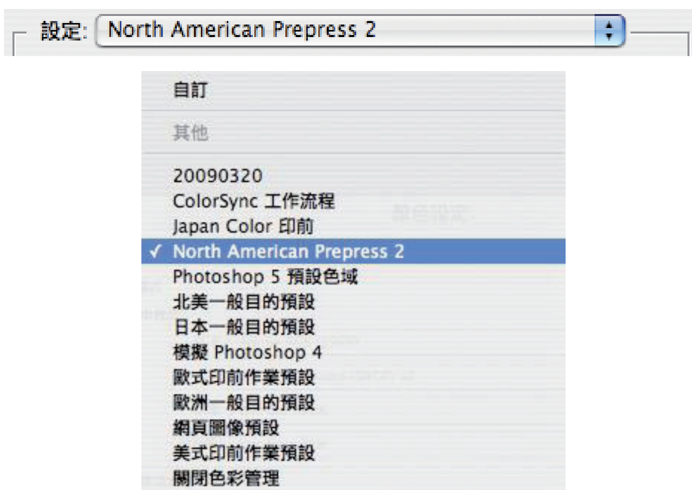


Fig.6-2 Adobe Photoshop CS color settings[2]

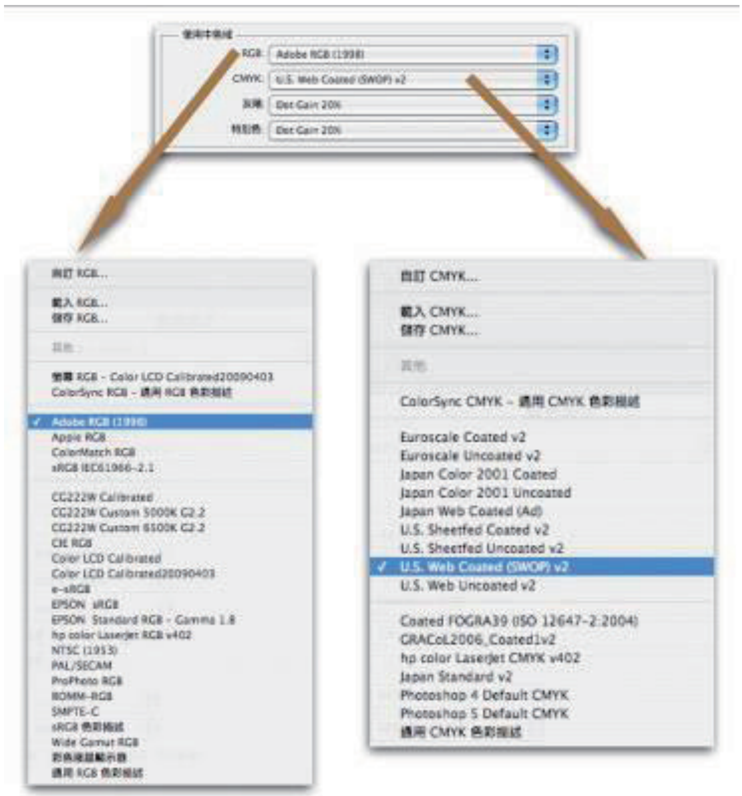


Fig.6-3 Adobe Photoshop CS color settings RGB/CMYK color space options[③]

After selecting the color gamut for the basic environment, proceed to color management settings. Of course, if users choose to disable color management in the procedures above, then this area will automatically be disabled. However, of the color management option is enabled, settings in this area are usually to retain the embedded profile. Before image files are loaded into the application for processing, if the system detects that the profile does not match the image file, then a warning message will appear and ask users if they want to maintain the original settings or switch. For example, if the color setting is set at Adobe RGB, but the image files is already using sRGB, then a warning message will appear before the image is loaded onto the application; if at this time users choose to switch working spaces, then the image file that was encoded with sRGB will be converted to Adobe RGB. However, if the image file did not embed the color profile, then users can choose to save new file and embed another color profile.

Fig.6-4 A warning message will appear if the embedded profile does not match settings.④

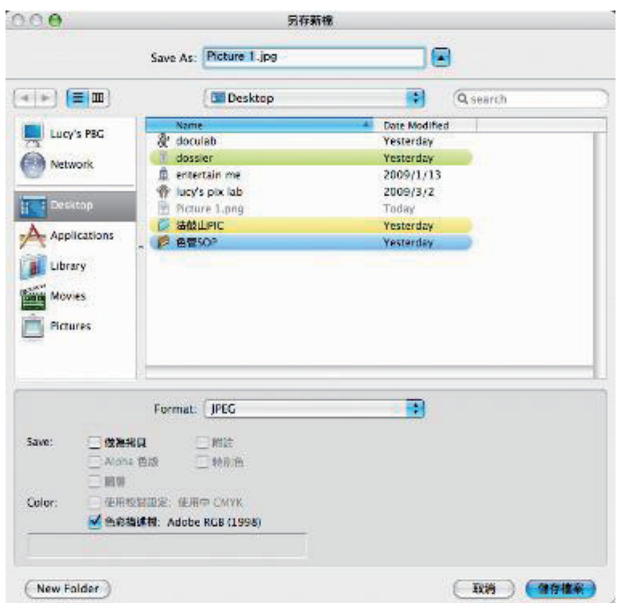


Fig.6-5 Image files that undergo color space conversion can choose to embed the ICC profile.⑤

If an image file did not go through color management procedures, or is an edited image file, then it can execute color calibration in the calibration settings menu; in Adobe Photoshop CS you can find this menu at View>Calibration settings. If the output device profile has already been loaded, users can choose a suitable profile for the printer in this menu, and colors will be changed to the printer's default colors.[6]

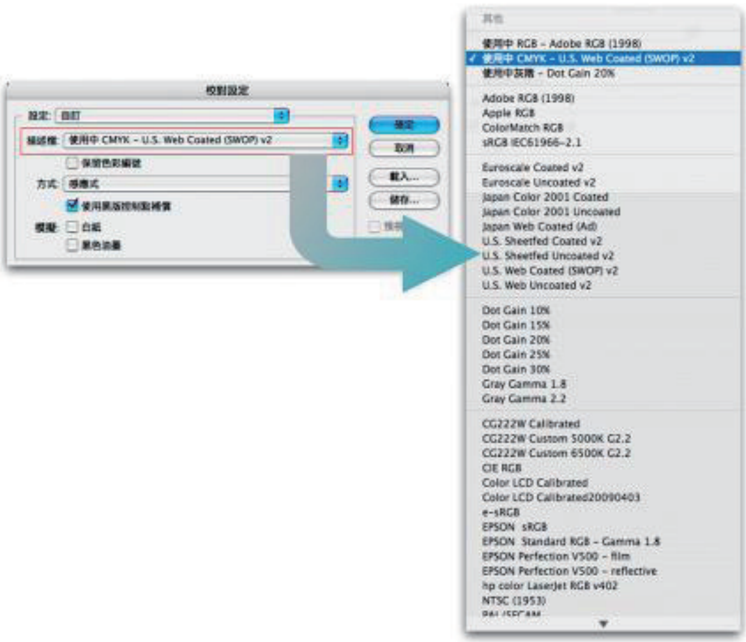


Fig.6-6 A warning message will appear if the embedded profile does not match settings.[6]

Like the proverb "one must have good tools in order to do a good job," if users understand basic operating principles of Adobe®Photoshop, and learn to flexibly use ICC profiles, then Adobe Photoshop can be an extremely convenient color management tool for users of typical monitors. Besides its editing functions, as long as users properly configure environment settings, they will be able to achieve twice as much with half the effort. For example, when using a camera, besides using the camera's original profile, users can also use applications described in chapter two to create a profile for the camera, or take pictures in the form of RAW files, and then use image editing software to apply a profile; the same method applies to scanners and even printers, users can use different procedures to enable color management in their image editing software, by applying a suitable monitor profile to display accurate colors, the software will serve as a platform for displaying colors that best meet expectations.

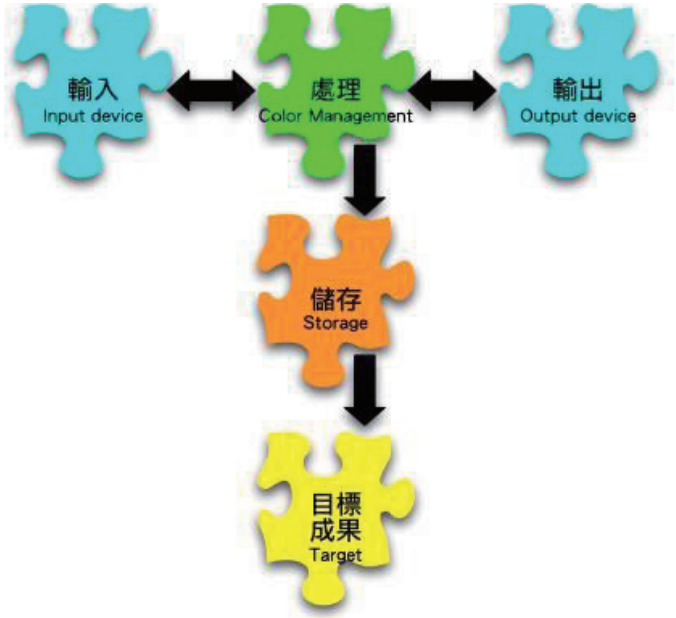


Fig.6-7 Flowchart of image editing software.⑦

Image notes:
① Image captured from Adobe®Photoshop CS
② Same as ①
③ Same as ①.
④ Same as ①
⑤ Same as ①.
⑥ Same as ①.
⑦ Image source: Taiwan Digital Archives Expansion Project Drawn by Li Pei-Ying

EPILOGUE

“Digitization Procedures Guideline: Color Management” is arranged in a way that readers will be able to understand how the bright and dazzling colors we see on computer monitors, printed matter, and other mediums are formed – light that reflects off objects and captured by light sensing devices is converted into digital signals, which can be processed by different devices to recreate the beautiful colors of nature.

Although color management seems to be minute and complicated work, it is merely the use of common specifications to recreate colors of the natural world. ICC profiles that correspond to LAB are created for devices at the input end (cameras and scanners) and the output end (monitors and printers), and are used as a basis for converting color information on one device into the equivalent on another. However, color management procedures are still somewhat inadequate. Considering that digitization work strives to make images as real as possible, and to ensure that the product can satisfy requirements of value-added applications in the future, quality management is also an extremely important task.

Besides establishing standard operating procedures, quality management also includes testing and acceptance and long term preservation strategies for digital objects. To ensure color accuracy and image quality, color management products must go through a testing and acceptance process; at the input end, this refers to digital images, at the output end, this refers to digital printing and output.

Quality tests related digital images can include color model, color depth, image size, and image format tests; scanned images can be tested for flaws, such as stains, hairs, and tilt angle; for color performance, test items can include hue, chroma, luminance, clarity and gradation. In digital printing and output, images can be tested for stains and scratches not from the original object, whether or not the ink spread, signs of ink cutting, whether or not the image size matches specifications, image clarity, color saturation, chroma, and performance of highlights, middle tones and shadows.

Both color management and quality management play an important role in digital archiving work. Creating digital archives is a one time task, so each procedure should be carried out with extreme care, this way digital output can be maintained at a certain quality, and achieves the purpose of facilitating knowledge exchange and elevating academic research.

Finally, implementation of color management around the world can roughly be divided into two approaches, one is the “RGB” approach introduced in this book, and the other is “multispectral capture,” which can be seen as the new generation color management, recording the color response of objects after spectral analysis. Although multispectral capture is still in an experimental stage, it is gradually being adopted by large museums in Europe. However, from the perspective of TELDAP, the properties of future objects to be digitized and suitable color management methods remain unknown. But no matter what method is used, the ultimate objective of color management is to reproduce an object’s truest colors before the viewer’s eyes.

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BenQ belongs to BenQ (subordinate to the BenQ Group)

EIZO and EIZO EasyPIX belong to NANAO (General agency in Taiwan is Grandwave International Corporation)

FOGRA belongs to Fogra Graphic Technology Research Association

GRACoL belongs to IDEAlliance

i1 (eyeone) belongs to X-Rite

JAPAN COLOR 2001 Coated belongs to Japan Printing Machinery Association

Kodak belongs to Kodak Company

Pantone belongs to X-Rite Inc.

Photoshop belongs to Adobe Systems Incorporated

ProfileMaker originally belonged to GretagMacbeth, which merged with X-Rite in 2006

Qisda belongs to Qisda Corporation (subordinate to the BenQ Group)

SWOP belongs to IDEAlliance

GLOSSARY

Adobe RBG	The monitor color display specification established by Adobe, colors are specified as (R, G, B) triplets, Gamma is set at 2.2, and color temperature is set at 6500 degrees.
Apple RBG	The monitor color display specification established by Apple for Macintosh computers, and is a standard setting for a Macintosh environment, in which Gamma is set at 1.8 and color temperature is set at 6500 degrees; this has always been the standard specification for 2D drawings and pre-press design.
Backlight	Backlight is a type of lighting used by LCD monitors. The difference between backlight and front light is that backlight refers to lighting from the back or side, while front light refers to lighting from the front. Light is produced in a way similar to that of a CRT monitor, increasing the brightness of monitors in a low lighting environment; light sources can be ELP, LED, or CCFL.
Bit	A Bit is the smallest unit of computer memory and records values of 0 or 1; 8 bits form 1 Byte.
Bitmap	Bitmap is a map of pixels or bits that form a digital image; pixels are independent and have different color depths.
Black point	A black point is the darkest color that a piece of equipment can produce. To a printer, a black point is the darkest color that can be produced by its ink; to a monitor, it is the color black displayed after adjustments to the black level or brightness level.
BMP	This is the extension of an image file format. It is a built-in image format of PC systems, and is the abbreviation of Bitmap.
Brightness	Brightness is an important parameter in all display equipment. Brightness is measured in candela, represented with cd. The brightness of a single LED is usually measured with millicandelas (MCD), which is a thousandth of a CD. The brightness of a square meter of LED combined is the brightness of a unit area, which represented with NITS; 1 NITS = 1 cd/m2.
Byte	A byte it the unit of memory formed by 8 bits, one byte can be used to form 2 to the power of 8 combinations, and is usually used to record numbers between 0 and 255.
Calibration	To calibrate, modify, or adjust certain equipment (such as color duplication equipment or measurement instruments) is to put them in an ideal state. Many scanners, monitors, and digital printers all come with calibration systems provided by its hardware manufacturer.

CCD	Charge Couple Device (CCD) is a light detection chip used in most digital cameras. It is able to sense the intensity of light and transform them into electrical charges.
Channel	Channels are the base of colors. RGB full color comprises three primary channels red, green, and blue. Each channel represents an axis in the color space coordinate system. When you adjust a specific channel, you only change the intensity of that single color, without changing any other colors. Colors used for printing comprise four channels: C, M, Y, and K.
CIE	CIE is the abbreviation of Commission Internationalede l'Eclairage, which is an international organization for establishing color measurement standards; the Commission's headquarters is in Vienna, Austria.
CIELAB	This is the color space recommended by the CIE in 1976. Its three dimensional coordinate system achieves colors that are perceptually uniform to human beings. This color space is often used as the standard for quantifying color signals, and is the basis of color management systems.
CMS	CMS is the acronym of Color Management System. It utilizes the principle of a perceptually uniform color space to establish an absolute color coordinate system for the human beings. This allows color signals on different devices to be matched to achieve consistency of colors. A CMS is usually software combined with a measurement instrument applied to an environment in which colors are reproduced.
CMOS	CMOS stands for Complementary Metal Oxide Semiconductor, and is a relatively new light sensing device that can be used in digital cameras. Compared with CCD, it is less power consuming and cheaper to manufacture; its image quality is gradually catching up with CCD.
CMYK	CMYK is the abbreviation of the four colors of printing, C for Cyan, M for Magenta, Y for Yellow, and K for Skeleton or Black, which are the primary colors of the four channels.
ColorMatch RGB	This is the computer monitor display specification established by Color Match; its Gamma value is 1.8 and color temperature is 5000.
Color mode	A color mode is a typical way of expressing colors as a set of numerical values. For example, the RGB color mode uses three values to represent colors; the first value is the content of Red (R), the second value is the content of Green (G), and the third value is the content of Blue (B).
Color space	Color space is a mechanism that uses numbers to define the relationship between two color spaces, using a color mapping function to map color signals to different positions in color spaces that have the same color

	perceptions. For example, Adobe RGB and sRGB are two absolute color spaces based on the RGB color model.
ColorSync	This is the name of the color management system developed by Apple, and is the built-in CMS of Macintosh operating systems (OS8 or later versions).
ColorNavigator	This is the monitor calibration software of EIZO CG monitors; requires the use of a color calibrator.
Contrast	Contrast refers to the visual effect of difference between highlights and shadows on the monitor.
Curve	A color calibration tool of Adobe Photoshop, utilizes principles of color reproduction curve to directly control colors of any channel.
D50	A standard CIE light source that has a color temperature of 5000K.
Device dependent	Device dependency refers to whether or not color models are specific to a device. Each device has its own color characteristics, and different brands have different color gamuts.
Device independent	Color coordinate systems established by the CIE are device independent color models. Image color data does not change along with different devices.
DOT	A dot is a controllable hardware unit. Images compose of dots, such as ink dots of a printed image.
DPI	DPI stands for Dot Per Inch and is a unit of resolution, indicating how many dots is in an inch; dpi is usually used when outputting an image.
Digital Proofing	Digital proofing obtains a printed output directly from digital files for the purpose of predicting the appearance of printed matter. Digital proofing systems include thermal transfer wax inks systems, thermal transfer printing systems, inkjet printing systems, and laser printing systems.
Display profile	Also known as monitor profile, it describes the device used for displaying images, such as a computer monitor.
Dot gain	Half tone dots expand during the printing process mainly because ink spreads when it comes in contact with paper. Dots on film have also been seen to spread, but it is because of the combination of mechanical pressure and physical properties.
EPS	EPS, which stands for Encapsulated PostScript, is a web description file format proposed by Adobe. It can accept data in the form of bitmaps and vector maps, and is mostly used for printing applications.
Firewire	This is the interface that links computers to peripheral devices. It has a data speed of 400MBits and support's plug and play; it is suitable for transferring large amounts of data. IEEE1394 uses this specification.

Gamma	Gamma is characteristic function in computer monitors that define color scale change; for Macintosh computers this value is set at 1.8 and for PC it is set at 2.2; Gamma values affect the image display.
GIF	GIF is the bitmap file format established by Compuserve, and stands for Graphics Interchange Format. Its color model uses index colors, has file compression ability, and supports Flash, so it is often adopted for webpage design.
Gray scale	Gray scale ranges from light gray (1% dots) to black (100% dots), increasing the density of dots based on the percentage.
ICC	The International Color Consortium is an industrial alliance formed by the industrial sector and color related enterprises. With the objective is to facilitate compatibility of color signals between computers, it established specifications for color profiles that are used across color management systems.
IEEE1394	This is the name of the specification of the Firewire interface, and is suitable for transferring large amounts of data.
Indexed Color	This is a color model that creates indexes for colors, reducing the color depth required for representing full color. The GIF file format uses this color model.
IPS	IPS is a uniquely designed panel with electrodes located on the same side, significantly increasing viewing angel, but also resulting in slower response time. This technology was developed by Hitachi when it sought to improve the poor viewing angle and color performance of the TN panel.
ISO	The International Organization for Standardization, established in 1947, is an international organization that sets forth standards for industries and technologies. ISO is not an acronym, but originated from the Greek work isos, which means equal.
IT8	IT8 is a committee organized by ANSI in 1987 for the purpose of facilitating the standardization of digital data exchange formats. In which the IT8.7 standard is for computer color calibration, IT8.7/1 is for transmission copies, IT8.7/2 is for reflection copies, and IT8.7/3 is for printings, all of which are now ISO standards.
JPEG	JPEG is an image file compression method proposed by the Joint Photographic Experts Group. It encodes 8x8 blocks for image compression. JPG files are directly produced by this compression method. Jpg is an image compression format commonly used on the internet. Other files formats, such as EPS, also include options to compress files using the JPEG compression method.

Layer	A layer is an independent image. When several layers are overlapped using mathematical principles, they can form a three dimensional relationship; this is an important concept of image synthesis.
LED	LED stands for Light Emitting Diode. Some semiconductors emit light of specific wavelengths when electricity passes through; this conversion from electricity to light is extremely efficient. By using different chemical processes for semiconducting material, we can obtain LEDs of different brightness and color. LCD monitors control LEDs to display text, icons, images, animations, etc.
Level	This is a command of Adobe Photoshop for adjusting color signals, and can directly define values for the highest, lowest and middle levels.
LPI	LPI stands for Line Per Inch and is a resolution unit based on the number of gridlines in an inch; this unit is usually used in printing output.
LZW	LZW is a compression method jointly developed by three scientists, Lempel, Ziv and Welch. Its compression range is horizontal lines. LZW is a compression option adopted by the TIFF file format.
MASK	A mask defines the working area of a bit map, setting which areas are covered and which areas are transparent. When used in overlapping images, masks are extremely handy tools for image synthesis.
Palette	Palette, or color table, is used by computers for selecting color combinations.
Path	A path is a line linked together by multiple control points, changing the position of any control point will change the shape of the path; lines linking any two control points are calculated from mathematical formulas. Therefore, all members on a path are related.
PICT	This a built-in bitmap file format of Macintosh computers; images captured from the monitor are displayed in this file format.
Pixel	Pixel, originating from the words Picture Element, is the smallest unit of a digital image. Pixels are independent units sampled from images.
Plug-in	Plug-ins are additional programs that can be installed in an application to enhance the application's functions.
PMT	Photomultiplier Tube (PMT) is an electronic device used to convert light signals into electronic signals. The sensing area of PMT can only sense single dots, unlike the lines or areas of CCD, but the signals of these dots are extremely precise, which is why drum scanners use this device to produce high quality images.
PNG	PNG stands for Portable Network Graphics, which is an image file format established by W3C. PNG files are able to use wavelet compression

	without causing image distortion, and can be used on webpage; it has immense development potential.
PPI	PPI, Pixel Per Inch, is a resolution unit used represent the number of pixels in an inch; this is usually the resolution setting at the input end.
Profile	In color management, each device (e.g. printer or scanner) has its own color characteristics, and color profiles serve as records of such characteristics.
RAM	Random Access Memory is storage space for computer processing data. Sufficient RAM can enhance efficiency. However, RAM cannot be used for permanent storage because its data will disappear when the power is turned off.
RAW	This is the most primitive file format, all data are stored according to byte sequence; no dynamic data of any form is recorded.
Resolution	Resolution is a term often mentioned in digital display equipment and indicates the total number of pixels; resolution is generally written in the form of width × height, e.g. 1024×768. The table below shows common monitor sizes and their relationship with resolution.
RGB	This is the most commonly used full color model, comprising of three primary colors, Red, Green and Blue.
SCSI	SCSI, Small Computer System Interface, is an interface for connecting computers with peripheral equipment. It has high data speed and is often used by high-end scanners. However, it doesn't support plug and play, so the power has to be turned off when linking devices together.

Size	Resolution	DPI (Dots Per Inch)
15”	1024 X 768	85
17”	1280 X 1024	96
19”	1280 X 1024	86
20.1”	1600 x 1200	100
21.1” (Widescreen)	1680 x 1050	94
21.3”	1600 x 1200	94
22”	1680 x 1050	90
24.1” (Widescreen)	1920 x 1200	94
27” (Widescreen)	1920 x 1200	84
29.8” (Widescreen)	2560 x 1600	101

Senseye	This is the exclusive display technology developed by BenQ that can carry out detailed display adjustments.
Soft-proofing	This method simulates printing effects on your monitor, meaning that you can the appearance of printed matter on your monitor before actually printing it.
sRGB	sRGB is a monitor color space jointly established by HP and Microsoft. It has a gamma value of 2.2 and color temperature of 6500K. The s in sRGB stands for "Standard", but there have been other sayings that it stands for the last name of its original designer Mike Stokes. sRGB is now widely applied to personal computers.
TIFF	TIFF stands for Tag Image File Format. It was established by Aldus (later on acquired by Adobe) in 1986. Due to its tag file structure, it can record dynamic data of numerous files, thus has extremely high compatibility; it is an ideal image file storage format.
USB	USB is the acronym for Universal Serial Bus and is an interface used to connect computers with peripheral devices. Its data speed is slower than IEEE1394 and SCSI, but it supports plug and play, making it an extremely popular and convenient interface.
Vector	A vector is a line linking two points together that has a direction. Inside computers, control points can define lines, mathematical formulas are used to calculate the position of control points on a line, each point on the line is not independent, and changing one control point will affect all other points on the line. The concept of vectors is often used in computer graphics, and is used in contrast with bitmap images.
Viewing Angle	The monitor is brightest when viewers are directly facing it, brightness decreases when viewers move to the left or right, viewing angle is defined as the angle between two sides when brightness decreases to its original half; vertical viewing angle is measured in the same way.
Web Offset printing	Web offset printing is a type of high speed printing, large rolls of paper rotate and output paper that is printed and then cut into appropriate sizes. Web offset printing is mostly used for mass publications, such as books, magazines, newspapers, etc.
White point	White point refers to the brightest color a device can produce. To a printer, white point is the color and luminance of the paper itself; to a monitor, it is the color temperature and brightness of the color white, and it can be adjusted. White point is also the color for observing light sources, and is often represented with color temperature.

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Japan Printing Machinery Association: http://www.jpma-net.or.jp/

Japan Color Research Institute: http://www.jcri.jp/

Avision: http://www.avision.com.tw/

BenQ: http://corp.benq.com.tw/

Colortrac: http://www.colortrac.com/

CONTEX: http://www.contex.com/default.htm
EPSON: http://w3.epson.com.tw/ett/index.asp
EIZO 株式会社ナナオ: http://www.eizo.co.jp/
FFEI: http://www.ffei.co.uk/
Fogra Forschungsgesellschaft Druck e.V.: http://www.fogra.org/
FUJITSU: http://www.fujitsu.com/tw/
IDEAlliance: http://www.idealliance.org/
International Color Consortium: http://www.color.org/index.xalter
Japanese Standards Association: http://www.jsa.or.jp/default_english.asp
Microtek: http://www.adara.com.tw/
Mustek: http://www.mustek.com.tw/Taiwan/
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APPENDIX

Appendix 1. List of ICC profile software tools

Developer	Product	Measure	Create profiles	Edit profiles	Assess profiles	Convert using profile	v4 support	Link profile support
Adobe Systems	Adobe Photoshop		Y	Y		Y	Y	Y
Alwan Color Expertise	CMYK Optimizer		Y	Y		Y	Y	Y
	LinkProfiler		Y				Y	
	ColorPursuit				Y		Y	
Barbieri Electronic	Spectro LFP / Swing	Y						
	Profile-Xpert		Y				Y	Y
Color Solutionss	basICColor catch pro / control / certify	Y					Y	
	basICColor input		Y					
	basICColor display 4	Y	Y		Y		Y	
	basICColor dropRGB / CMYKick / print3		Y				Y	
	basICColor DeviL		Y	Y		Y	Y	Y
	basICColor demon					Y		Y
	basICColor photo server (pro)					Y		
	basICCoolTool WPEdit / Shadow Match			Y				
	basICCoolTool The Missing Link		Y		Y			Y
	basICCoolTool spoTTuner					Y		

Developer	Product	Measure	Create profiles	Edit profiles	Assess profiles	Convert using profile	v4 support	Link profile support
	basICColor Profile's Secret				Y			
	basICCoolTool SpaceLab		Y					
	basICCoolTool MatchPatch			Y	Y			
Fujifilm	ColourKit Profiler Suite		Y	Y	Y		Y	
Heidelberg	Prinect Color Toolbox	Y	Y	Y	Y	Y	Y	Y
	Prinect Printready System				Y	Y	Y	Y
	Prinect MetaDimension				Y	Y	Y	Y
	Prinect MetaDimension 52i				Y	Y	Y	Y
	Prinect PDF Toolbox				Y	Y	Y	Y
HP	HP Designjet Z2100 / Z3100 / Z3100ps GP / Z6100 / Z6100ps	Y	Y					
HP	HP Advanced Profiler Solution		Y					
ICS	Remote Director	Y	Y		Y		Y	
The MathWorks	MATLAB Image Processing Toolbox		Y	Y	Y	Y	Y	Y
Onyx Graphics	RipQueue					Y	Y	Y
	PosterShop				Y	Y	Y	Y

Developer	Product	Measure	Create profiles	Edit profiles	Assess profiles	Convert using profile	v4 support	Link profile support
	ProductionHouse	Y	Y		Y	Y	Y	Y
	GamaPrint					Y	Y	Y
PANTONE	huey(TM) / huey(TM) PRO	Y	Y				Y	
	ColorMunki(TM) Create /	Y	Y				Y	
	ColorMunki(TM) Design	Y	Y				Y	
X-Rite	huey(TM)	Y	Y				Y	
	ColorMunki(TM) Photo	Y	Y				Y	
	i1DisplayLT / i1Display2	Y	Y				Y	
	i1Basic	Y	Y				Y	
	i1Extreme	Y	Y	Y	Y			
	i1Pro + i1iO	Y					Y	
	i1iSis / i1iSis XL	Y					Y	
	MonacoEZcolor	Y	Y	Y				
	MonacoPROFILER Gold / Platinum	Y	Y	Y	Y		Y	Y
	ProfileMaker 5 Publish / Publish Plus / Photostudio / Packaging	Y	Y	Y	Y		Y	

SOURCE: ICC profile tools http://www.color.org/profilingtools.xalter

Appendix 2. Business Plan of ISO/TC 130 - Graphic technology

ISO	ISO/TC 130 N 1094 Business Plan of ISO/TC 130 Date: 2006-12-12 Version: Final

Introduction

▪ ISO Technical Committees and Business Planning

The extension of formal business planning to ISO Technical Committees (ISO/TCs) is an important measure which forms part of a major review of business. The aim is to align the ISO work programme with expressed market needs and to allow ISO/TCs to prioritize between different projects, to identify the benefits expected from the availability of International Standards, and to ensure the adequate resourcing of projects through their development stages in the ISO/TCs. Your role in the implementation of the Business Planning concept will contribute significantly to the overall effectiveness of international standardization.

We express our sincere appreciation and thanks for your time in reviewing this Business Plan.

▪ International standardization and the role of ISO

The foremost aim of international standardization is to facilitate the exchange of goods and services through the elimination of technical barriers to trade.

Three bodies are responsible for the planning, development and adoption of International Standards: ISO (International Organization for Standardization) is responsible for all sectors excluding electrotechnical, which is the responsibility of IEC (International Electrotechnical Committee), and most of the Telecommunications Technologies, which are largely the responsibility of ITU (International Telecommunication Union).

ISO is a legal association, the members of which are the National Standards Bodies (NSBs) of some 130 countries (organizations representing social and economic interests at international level), supported by a Central Secretariat based in Geneva, Switzerland.

The principal deliverable of ISO is the International Standard.

An International Standard embodies the essential principles of global openness and transparency, consensus and technical coherence. These are safeguarded through its development in an ISO Technical Committee (ISO/TC), representative of all interested parties, supported by a public comment phase (the ISO Technical Enquiry). ISO and its Technical Committees are also able to offer the ISO Technical Specification (ISO/TS), the ISO Public Available Specification (ISO/PAS) and the ISO Technical Report (ISO/TR) as solutions to market needs. These ISO products represent lower levels of consensus and have therefore not the same status as an International Standard.

ISO offers also the Industry Technical Agreement (ITA) as a deliverable which aims to bridge the gap between the activities of consortia and the formal process of standardization represented by ISO and its national members. An important distinction is that the ITA is developed by ISO workshops and fora, comprising only participants with direct interest, and so it is not accorded the status of an International Standard.

▪ Scope of ISO/TC 130

Standardization of terminology, test methods and specifications in the field of printing and graphic technology from the originals provided to finished products. The scope includes in particular: composition; colour separation, colour management; storage of digital image data on electronic data carriers, display of graphical data on monitors and by projection, printing processes; finishing (for example binding); suitability of inks, substrates and other materials used in graphic technology. Printing is defined here as a process of repetitive reproduction involving the transfer of a usually coloured substance (ink, etc.) to a substrate, using relief, planographic, intaglio, stencil or other printing forms or without a permanent printing forme by so-called non-impact printing methods.

▪ Market Envirnment and Objectives of ISO/TC 130

This section establishes a sequential development of thoughts regarding the market for which the ISO/TC aims to fulfil the needs. Details in relation to the market analysis are given in the Guidance document on ISO Business Planning. The sequence of thoughts starts from a description of the current market situation relevant to the product or product grouping under consideration by the ISO/TC, continues on to an analysis of the different factors motivating/influencing the activities of the ISO/TC, to come to clear description of objectives and expected benefits resulting from the work of the ISO/TC, together with an accompanying strategy how to reach those objectives. Finally, a general 'risk analysis' is included highlighting issues that may delay or stop the ISO/TC achieving its set objectives.

▪ Market Environment0

Political, economical, social, technical, legal and international factors that either directly require some or all of the standardization activities proposed by the ISO/TC, or significantly influence the way these activities are carried out are the following:

1. General description of the market

ISO/TC 130 addresses the business community engaged in print media production and its suppliers of

• materials,
• computer hard- and software,
• proofing soft-, firm- and hardware,
• printing, converting, finishing and other related machinery,
• optical measuring instruments,
• laboratory apparatus.

ISO/TC130 presently serves this market by providing a framework of standards on terminology, pre-press digital data exchange, process control, metrology, printing materials, ergonomics and safety.

2. Description of the total market

Total sales in graphic arts over the last 3 years: 483 billion EURO in the developed world

Total employment world-wide: roughly 2 million people

With the exception of the digital media, graphic products like newspapers and brochures are mainly being produced close to the consumer. Therefore, graphic production requires the free flow of information and image material on a global scale, from the source to the final printing site. Traditionally, work is split up between several enterprises: The creative side, the pre-press service provider, the printer and the print finisher. In this environment, consistent work is only possible, if a minimum set of recognized International Standards exist that define the interfaces between co-operating enterprises.

3. Description of the market structure and the major market players

3.1 Structure of the market: Suppliers/Manufacturers

Software providers	10 %
Printing	30 %
Converting	5 %
Paper	40 %
Digital media and pre-press	15 %

3.2 Major factors which may have an impact on the development of the markets

Paper suppliers are concentrating into large and very large operations, Scandinavia still is a focal point. Printing and pre-press equipment suppliers tend to globalise, too, there are only half a dozen global players left over. On the side of non-paper materials, concentration is also in full swing, there are not more than 5 global players.

With the exception of very few printers tend to be middle to small-sized. Over 95 % of the print shops have less than 100 employees.

With the on-going digital revolution, demand and revenue for pre-press work decline, while the pre-press industry struggles to realise new opportunities with the new digital media like Internet and other electronically-based media.

Contrary to many predictions, newspapers consumption and advertisement revenues are not declining in favour of television.

The short-run colour market does not grow as fast as often predicted.

Social change:
With the growth of literacy and per-capita-income in the developing countries, a vast potential of reader-consumers is yet to be realised.
Because of the decentralised nature of the print media production, legal, customs and other barriers do not normally hamper the production.

The environmental impact of printed products on paper is minimal - if not only visual - because the mainly consumed item newsprint can be recycled (the figure is 90 % in Central Europe), if not , it decomposes natural by action. Of concern are printed plastic packagings which can be recycled if collected properly. Production can be affected here by local restrictions or legislation.

In the developed countries cropped forests are being replanted, so cropping will not normally impact the environment.

4. Benefits expected from the work of ISO/TC 130

The provision of standards aids the free flow of text and image information which is a prerequisite for newspaper and print production in general.

Traditionally, graphic arts work is split up between several enterprises: The creative side, the pre-press service provider, the printer and the print finisher. In this environment, consistent work is only possible, if a minimum set of recognised International Standards exist that define, in a technical way, the interfaces between co-operating enterprises.

5. Representation of major players in ISO/TC 130

The nations represented in the TC work groups more or less coincide with the major producers and consumers of the graphic arts industry.

The major groups represented in the working groups are

USA	approx. 33 experts
Japan	approx. 20 experts
Great Britain	approx. 6 experts
Brazil	approx. 12 experts
Germany	approx. 6 experts
Others	approx. 16 experts

▪ Objectives of ISO/TC 130 and Strategies for their Achievement

Based on the considerations above, the ISO/TC proposes the following objectives and strategic directions for its future work:

▪ Objectives of ISO/TC 130

Elaboration of standards on the subject of graphic technology, i. e. data exchange process control, measurement methods, materials, terminology, ergonomics and safety.

▪ Strategies adopted to reach the Objectives

Development of Prepress data exchange, conduction of physical meetings and telephone conferences using the English language and a simple organisational structure based on Working Groups. The secretariat for the TC as well as WG 1, WG 3, WG 4, JWG 6 is managed by DIN while the remaining WG 2 and WG 5 are managed by NPES/US.

The work on colour requires liaison to CIE and ISO/TC 42. The work on colour management and office machines provided for colour work requires liaison to ISO/TC 42, IEC/TC 100 , ICC and ISO/IEC JTC 1/SC 28.

The work on data exchange process control requires liaison to CIP 3/CIP 4 and the JDF consortia. Since printing is mainly on paper, liaison to TC 6 is essential.

▪ Risk analysis

Advance of standards work in ISO/TC 130 heavily depends on the work of a dozen key players whose workload endangers timely delivery of documents. In some areas, progress is slowed down by powerful industrial associations who view the standards process as a threat to their status as the sole source of enlightenment.

▪ Work Programme

This section gives an overview of existing and planned standardization projects, called Work Items (WI). The aim of this listing is to demonstrate the adequacy of the proposed

programme of work with the actual market or stakeholders' needs. More comprehensive information regarding the ISO/TC structure can be found under the next section 'ISO/TC Structure and Resources'.

Note that the information provided below is accurate as of 2006-12-12. A list of ISO/TC 130 Work Items which is continually updated can be found on the Web site of ISO.

Work Programme of ISO/TC 130 on ISO Web site

ISO/TC 130 - Graphic technology

Reference : ISO/DIS 2834-2
Graphic technology -- Laboratory preparation test prints -- Part 2: Liquid printing inks
Current stage: 40.20
Stage date: 2006-11-17

Reference : ISO/DIS 2846-2
Graphic technology -- Colour and transparency of printing ink sets for four-colour printing -- Part 2: Coldset offset lithographic printing
Current stage: 40.20
Stage date: 2006-12-07
Publication target date: 2008-01-21
Reference : ISO/AWI 5776
Graphic technology -- Symbols for text correction
Current stage: 20.00
Stage date: 2006-09-26

Reference : ISO/NP 12635
Graphic technology -- Plates for offset printing -- Dimensions
Current stage: 10.99
Stage date: 2005-08-01
Publication target date: 2009-02-01

Reference : ISO/CD 12637-2
Graphic technology -- Vocabulary -- Part 2: Prepress terms
Current stage: 30.20
Stage date: 2006-05-24
Reference : ISO/CD 12637-3
Graphic technology -- Vocabulary -- Part 3: Printing terms
Current stage: 30.20
Stage date: 2006-08-30

Reference : ISO/DIS 12637-4
Graphic technology -- Vocabulary -- Part 4: Postpress terms
Current stage: 40.20
Stage date: 2006-10-19

Reference : ISO 12639:2004/PRF Amd 1
Use of JBIG2-Amd2 compression in TIFF/IT
Current stage: 50.20
Stage date: 2006-11-24

Reference : ISO/DIS 12640-3
Graphic technology -- Prepress digital data exchange -- Part 3: CIELAB standard colour image data (CIELAB/SCID)
Current stage: 40.60
Stage date: 2006-03-15

Reference : ISO/FDIS 12643-1
Graphic technology -- Safety requirements for graphic technology equipment and systems -- Part 1: General requirements
Current stage: 50.20
Stage date: 2006-11-15

Reference : ISO/FDIS 12643-2
Graphic technology -- Safety requirements for graphic technology equipment and systems -- Part 2: Press equipment and systems
Current stage: 50.00
Stage date: 2006-09-19

Reference : ISO/DIS 12643-3
Graphic technology -- Safety requirements for graphic technology equipment and systems -- Part 3: Binding and finishing equipment
Current stage: 40.20
Stage date: 2006-10-03

Reference : ISO/DIS 12646
Graphic technology -- Displays for colour proofing -- Characteristics and viewing conditions
Current stage: 40.20
Stage date: 2006-07-21

Reference : ISO 12647-2:2004/FDAmd 1

Graphic technology -- Process control for the production of half-tone colour separations, proof and production prints -- Part 2: Offset lithographic processes
Amendment 1
Current stage: 50.00
Stage date: 2006-11-24

Reference : ISO/DIS 12647-7
Graphic technology -- Process control for the manufacture of half-tone colour separations, proof and productions prints -- Part 7: Off-press proofing process working directly from digital data
Current stage: 40.20
Stage date: 2006-10-19
Publication target date: 2008-08-26

Reference : ISO/CD 13655
Graphic technology -- Spectral measurement and colorimetric computation for graphic arts images
Current stage: 30.20
Stage date: 2006-08-16

Reference : ISO/NP TR 15847
Graphic technology --Graphical symbols for printing press systems and finishing systems, including related auxiliary equipment
Current stage: 10.99
Stage date: 2006-05-23

Reference : ISO/DIS 15930-7
Graphic technology -- Prepress digital data exchange using PDF -- Part 7: Complete exchange of printing data (PDF/X-4) and partial exchange of printing data with external profile reference (PDF/X-4p) using PDF 1.6
Current stage: 40.20
Stage date: 2006-07-24

Reference : ISO/DIS 15930-8
Graphic technology -- Prepress digital data exchange using PDF -- Part 8: Partial exchange of printing data using PDF 1.6 (PDF/X-5)
Current stage: 40.20
Stage date: 2006-07-26

Reference : ISO/DIS 28178
Graphic technology -- Exchange format for colour and process control data using XML or ASCII text
Current stage: 40.20
Stage date: 2006-10-24

▪ International Standards and other publications of ISO/TC 130

This section gives an overview of existing and planned standardization projects, called This section gives a list of International Standards that have been published by the ISO/TC.

Please note that the information provided below is accurate as of 2006-12-12. A list of published ISO/TC 130 Standards which is continually updated can be found on the Web site of ISO.

Published Standards of ISO/TC 130 on ISO Web site

ISO 2834:1999
Graphic technology -- Test print preparation for offset and letterpress inks

ISO 2834:1999/Cor 1:2003

ISO 2834-1:2006
Graphic technology -- Laboratory preparation of test prints -- Part 1: Paste inks

ISO 2835:1974
Prints and printing inks -- Assessment of light fastness

ISO 2836:2004
Graphic technology -- Prints and printing inks -- Assessment of resistance of prints to various agents

ISO 2846-1:2006
Graphic technology -- Colour and transparency of printing ink sets for four-colour printing -- Part 1: Sheet-fed and heat-set web offset lithographic printing

ISO 2846-2:2000
Graphic technology -- Colour and transparency of printing ink sets for four-colour-printing -- Part 2: Coldset offset lithographic printing

ISO 2846-3:2002
Graphic technology -- Colour and transparency of printing ink sets for four-colour-printing -- Part 3: Publication gravure printing

ISO 2846-4:2000
Graphic technology -- Colour and transparency of printing ink sets for four-colour-printing -- Part 4: Screen printing

ISO 2846-5:2005
Graphic technology -- Colour and transparency of printing ink sets for four-colour printing -- Part 5: Flexographic printing

ISO 5776:1983
Graphic technology -- Symbols for text correction

ISO 11084-1:1993
Graphic technology -- Register systems for photographic materials, foils and paper -- Part 1: Three-pin systems

ISO 11084-2:2006
Graphic technology -- Register systems for photographic materials, foils and paper -- Part 2: Register pin systems for plate making

ISO 12040:1997
Graphic technology -- Prints and printing inks -- Assessment of light fastness using filtered xenon arc light

ISO 12218:1997
Graphic technology -- Process control -- Offset platemaking

ISO 12634:1996
Graphic technology -- Determination of tack of paste inks and vehicles by a rotary tackmeter

ISO 12635:1996
Graphic technology -- Plates for offset printing -- Dimensions

ISO 12636:1998
Graphic technology -- Blankets for offset printing

ISO 12637-1:2006
Graphic technology -- Vocabulary -- Part 1: Fundamental terms

ISO 12637-5:2001
Graphic technology -- Multilingual terminology of printing arts -- Part 5: Screen printing terms

ISO 12639:2004
Graphic technology -- Prepress digital data exchange -- Tag image file format for image technology (TIFF/IT)

ISO 12640-1:1997/Cor 1:2004

ISO 12640-1:1997
Graphic technology -- Prepress digital data exchange -- Part 1: CMYK standard colour image data (CMYK/SCID)

ISO 12640-2:2004
Graphic technology -- Prepress digital data exchange -- Part 2: XYZ/sRGB encoded standard colour image data (XYZ/SCID)

ISO 12641:1997
Graphic technology -- Prepress digital data exchange -- Colour targets for input scanner calibration

ISO 12642-1:1996/Cor 1:2005

ISO 12642-1:1996
Graphic technology -- Input data for characterization of 4-colour process printing -- Part 1: Initial data set

ISO 12642-2:2006
Graphic technology -- Input data for characterization of 4-colour process printing -- Part 2: Expanded data set

ISO 12644:1996
Graphic technology -- Determination of rheological properties of paste inks and vehicles by the falling rod viscometer

ISO 12645:1998
Graphic technology -- Process control -- Certified reference material for opaque area calibration of transmission densitometers

ISO 12646:2004
Graphic technology -- Displays for colour proofing -- Characteristics and viewing conditions

ISO 12647-1:2004
Graphic technology -- Process control for the production of half-tone colour separations, proof and production prints -- Part 1: Parameters and measurement methods

ISO 12647-2:2004
Graphic technology -- Process control for the production of half-tone colour separations, proof and production prints -- Part 2: Offset lithographic processes

ISO 12647-3:2005
Graphic technology -- Process control for the production of half-tone colour separations, proofs and production prints -- Part 3: Coldset offset lithography on newsprint

ISO 12647-4:2005
Graphic technology -- Process control for the production of half-tone colour separations, proofs and production prints -- Part 4: Publication gravure printing

ISO 12647-5:2001
Graphic technology -- Process control for the manufacture of half-tone colour separations, proof and production prints -- Part 5: Screen printing

ISO 12647-6:2006
Graphic technology -- Process control for the production of half-tone colour separations,

proofs and production prints -- Part 6: Flexographic printing

ISO 12648:2006
Graphic technology -- Safety requirements for printing press systems

ISO 12649:2004
Graphic technology -- Safety requirements for binding and finishing systems and equipment

ISO 13655:1996
Graphic technology -- Spectral measurement and colorimetric computation for graphic arts images

ISO 13656:2000
Graphic technology -- Application of reflection densitometry and colorimetry to process control or evaluation of prints and proofs

ISO/TR 14672:2000
Graphic technology -- Statistics of the natural SCID images defined in ISO 12640

ISO 14981:2000
Graphic technology -- Process control -- Optical, geometrical and metrological requirements for reflection densitometers for graphic arts use

ISO 15076-1:2005
Image technology colour management -- Architecture, profile format and data structure -- Part 1: Based on ICC.1:2004-10

ISO 15790:2004
Graphic technology and photography -- Certified reference materials for reflection and transmission metrology -- Documentation and procedures for use, including determination of combined standard uncertainty

ISO 15929:2002
Graphic technology -- Prepress digital data exchange -- Guidelines and principles for the development of PDF/X standards

ISO 15930-1:2001
Graphic technology -- Prepress digital data exchange -- Use of PDF -- Part 1: Complete exchange using CMYK data (PDF/X-1 and PDF/X-1a)

ISO 15930-3:2002
Graphic technology -- Prepress digital data exchange -- Use of PDF -- Part 3: Complete exchange suitable for colour-managed workflows (PDF/X-3)

ISO 15930-4:2003
Graphic technology -- Prepress digital data exchange using PDF -- Part 4: Complete exchange of CMYK and spot colour printing data using PDF 1.4 (PDF/X-1a)

ISO 15930-5:2003
Graphic technology -- Prepress digital data exchange using PDF -- Part 5: Partial exchange of printing data using PDF 1.4 (PDF/X-2)

ISO 15930-6:2003
Graphic technology -- Prepress digital data exchange using PDF -- Part 6: Complete exchange of printing data suitable for colour-managed workflows using PDF 1.4 (PDF/X-3)

ISO 15994:2005
Graphic technology -- Testing of prints -- Visual lustre

ISO/TR 16044:2004
Graphic technology -- Database architecture model and control parameter coding for process control and workflow (Database AMPAC)

ISO/TR 16066:2003
Graphic technology -- Standard object colour spectra database for colour reproduction evaluation (SOCS)

ISO 16612-1:2005
Graphic technology -- Variable printing data exchange -- Part 1: Using PPML 2.1 and PDF 1.4 (PPML/VDX-2005)

▪ ISO/TC 130 Structure and Resources

This section gives an overview of existing and planned standardization projects, called This section gives an overview of the existing and planned standardization structure for this ISO/TC and its resources, which are required to be able to elaborate the above listed projects. Only structures directly responsible for standardization projects (WIs) are listed. Therefore, no co-ordination or advisory groups are included. Again, the aim of this listing is to demonstrate the adequacy of available resources with regard to the anticipated workload.

ISO/TC 130 - Graphic technology

ISO/TC 130 Graphic technology
Contact through: DIN

TC 130/WG 1 Terminology
Contact through: BSI

TC 130/WG 2 Prepress data exchange
Contact through: ANSI

TC 130/WG 3 Process control and related metrology
Contact through: DIN

TC 130/WG 4 Media and materials
Contact through: DIN

TC 130/WG 5 Ergonomics - Safety
Contact through: ANSI

TC 130/WG 6 Joint TC 130-TC 42 WG: Certified reference materials (WG on stand by)
Contact through: DIN

TC 130/WG 7 Colour management (JWG ISO/TC 130 and ICC)
Contact through: ANSI

TC 130/JWG 8 Joint TC 130-TC 42 WG: Revision of ISO 13655
Contact through: DIN

Membership:
Countries/ISO member bodies that are P and O members of the ISO committee

Personnel:
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ISO/TC 130 Secretary : Mr. Cord Wischhöfer
ISO Member responsible : DIN German Institute for Standardization

▪ Annex: Glossary of terms and abbreviations for the ISO/TC Business Plan

NB: This glossary gives the full name and status of terms used, in abbreviated form or in full, in the above "Business Plan for ISO/TCs". The glossary also gives the source of the information provided. Glossary intends to help with the understanding of the terms used. Whenever any of these terms are used by contributors to this Business Plan, they are requested to use them coherently as foreseen in the glossary.

Term	Abbrev	Definition
standardization	---	Activity of establishing, with regard to actual or potential problems, provisions for common and repeated use, aimed at the achievement of the optimum degree of order in a given context. NOTES 1 In particular, the activity consists of the processes of formulating, issuing and implementing standards. 2 Important benefits of standardization are improvement of the suitability of products, processes and services for their intended purposes, prevention of barriers to trade and facilitation of technological cooperation.
standard	---	Document, established by consensus and approved by a recognized body, that provides, for common and repeated use, rules guidelines or characteristics for activities or their results, aimed at the achievement of the optimum degree of order in a given context. NOTE Standards should be based on the consolidated results of science, technology and experience, and aimed at the promotion of optimum community benefits.
package of standards	---	A group, as small as possible, of inter-related standards in the scope of one or more ISO/TCs which are usually developed simultaneously to one another as parts of one standard, or standards that must be developed simultaneously.
consensus	---	General agreement, characterized by the absence of sustained opposition to substantial issues by any important part of the concerned interests and by a process that involves seeking to take into account the views of all parties concerned and to reconcile any conflicting arguments. NOTE - Consensus need not imply unanimity

Term	Abbrev	Definition
ISO/TC International Standardization Deliverables:		
International Standard	IS	A normative document, developed according to consensus procedures, which has been approved by the ISO membership and P-members of the responsible committee in accordance with Part 1 of the ISO/IEC Directives as a draft International Standard and/or as a final draft International Standard and which has been published by the ISO Central Secretariat.
ISO Technical Specification	ISO/TS	A normative document representing the technical consensus within an ISO committee, approved by 2/3 of the P-members of the ISO/TC or SC.
ISO Public Available Specification	ISO/PAS	A normative document representing the consensus within a working group, approved by a simple majority of the P-members of the TC/SC under which the working group operates.
ISO Technical Report	ISO/TR	An informative document containing information of a different form from that of normally published in a normative document.
Amendment	Amd	An amendment alters and/or adds to previously agreed technical provisions in an existing standard.
Technical Committee	ISO/TC	A technical body responsible for the programming and planning of technical work and the monitoring and execution of this technical work. The ISO/TC is also responsible for the consensus building process among its members for individual work items.
Subcommittee	SC	A technical body reporting to an ISO/TC which, within its scope which is covered by the scope of its parent ISO/TC, is responsible for the monitoring and execution of the technical work. The SC is also responsible for the approval and consensus building process among its members for individual work items.
ISO/TC Working group and ISO/SC Working group	WG	A technical body, appointed by the ISO/TC or ISO/SC and composed of experts, responsible for the drafting of standards, in accordance to the ISO rules and the clear specifications set by the ISO/TC or ISO/SC.
Editing Committee	---	A committee set up by a technical body (ISO/TC or SC) at the beginning of its work, which represents the three official languages of ISO. It is responsible for the correct formulation and presentation of the standard(s) prepared by the technical body (ISO/TC or SC) and the equivalence of the texts in the three official languages.

Term	Abbrev	Definition
Participating member	P-member	A member body participating actively in the work of a TC or SC, with an obligation to vote on all questions formally submitted for voting within the TC or SC on enquiry drafts and final draft international standards and, wherever possible, to participate in meetings.
Work Item number	WI	The identification number given to a standards project in a standards work programme. It is intended that the standards project leads to the issue of a new, amended or revised standard, an ISO/PAS, ISO/TS or other ISO product.
Vienna Agreement	VA	Agreement on technical cooperation between ISO and CEN.
VA ISO lead (5.1)	---	Technical cooperation between ISO and CEN under the VA, where the work is done by the ISO/TC, where a formal notification of interest was received by ISO from CEN, and where parallel synchronized procedures are applied in ISO and CEN for the approval processes.
VA CEN lead (5.2)	---	Technical cooperation between ISO and CEN under the VA, where the work is done by the CEN/TC or SC, where a formal notification of interest was received by CEN from ISO, and where parallel synchronized procedures are applied in ISO and CEN for the approval processes.
ISO stakeholders	---	Individuals, institutions, organizations or enterprises who have a direct or indirect interest in the ISO System, its activities and products and who have a specific interest in the effective programming of ISO work items and their adequate resourcing.

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