COLORSOURCE

Colour Management:

Technical point about Colour Proofing,

Design of adequate Control Bars,

Certification of colour proofing systems,

New trends in colour proofing.

Colour proofing is by far the easiest of colour management applications. A Colour Proofing system is quite simply a printer that simulates another printer. In addition, because modern print engines easily offer a wider Colour Gamut than the simulated printer does, it is easy to obtain perfect Proofs without any human interpretation. Of course, I speak about common colour proofing applications: CMYK pages simulation, with possibly some special tints, which will be published with additional Inks or by CMYK simulation, at User's choice. The applications involving numerous special tints with screening and overprints are essentially much more delicate, at stage of files interpretation by the RIPS, and at stage of colour management: let us not forget a Proofing printer is a multicolour printer, while an image-setter - or a CTP - is a monochromic printer.

However, "traditional" Proof probably concerns about 95 % of which is published in colour: Then why devote an article to such an easy topic? Because we almost daily note that delirious statements on this topic do not cease, and are only the tree hiding the forest: a majority of the actors concerned by colour proofing still do not know colour management and modern production methods, which daily penalises their quality and their productivity.

Many pre press or advertising companies still invest in colour proofing systems apart from any rational technical and economic consideration, but only to reassure their Customers. Some would even want to check the Colour Proofs by using Control Bars designed for offset or analogue proofs, which are unsuited, inter alia, to digital proofs control.

Lastly, colour management being redefining the whole contractual relations on the graphic art process, it requires a complete redefinition of Proofing concepts and it becomes urgent to make a serious technical point on these issues. The aim of this paper is therefore to expose a number of technical obviousness that appears very healthy to keep in mind.

Used Vocabulary:

·**Proofing printer:** any print engine accepting C' M' Y' K' input expressed in % to print with its C', M', Y', K' inks.

·**Calibration curves:** 4 arbitrary independent curves each fixing the density rise of each printer C', M', Y', K' primary ink in function of each C1, M1, Y1, K1 entry data.

·**Calibration:** setting a peripheral in conformity with its calibration curves, or other arbitrarily chosen and fixed adjustments, as a preliminary.

·**Calibration process:** overall process allowing achieving the colours we look for.

·**Output profile:** I.C.C. profile [Lab <-> C1 M1 Y1 K1] characterising the calibrated Proofing printer (C ', M ', Y ', K' inks)

·**Input profile:** I.C.C. profile [Lab <-> CMYK] characterising the printing device to be simulated (CMYK inks)

·**Special tint:** named colour defined by the User as CMYK values, or Pantone tint or other special tint formulated on demand to match an arbitrary reflection spectrum, to be later published with additional special Ink or by CMYK simulation.

·**Traditional Proof:** analogue Proofing system such as Eurosprint cromalin or LDG Match Print, or any digital colour proofing system simulating the colours of a market acknowledged analogue proofing system.

·**I.C.C. Workflow Tool**: software carrying out the colour space changes of mounted pages containing a priori text, line work and bitmap images coded in RGB, La*b*, CMYK, or black %, plus named special tints.

·**Grey Balance of a printer:** Set of C', M', Y' mixtures allowing printing a D50 neutral grey

·**Pure-grey Vs trichromatic grey balance of a printer:** Set of C', M', Y' mixtures making it possible to obtain the same colour as a screened pure black K' % in D50 lighting. The screened pure black not being a D50 neutral grey, the pure-grey Vs trichromatic grey balance is slightly different from printer's grey balance.

A) "Traditional" digital colour proofing:

A1) How colours are simulated:

"Traditional" colour proofing is intended to simulate an acknowledged analogue Proof: for example the Eurosprint cromalin or LDG (Low Dot Gain) Match Print. The interest of this simulation for the quality of final printed document becomes more and more questionable - prepress is made to get a beautiful Proof and not a beautiful print! - But studying the operation of these digital Proofing systems remains very current and useful for purpose of understanding:

Colour Management modern tools bring an obvious technical solution to Digital Colour Proofing, illustrated by **figure 1**:

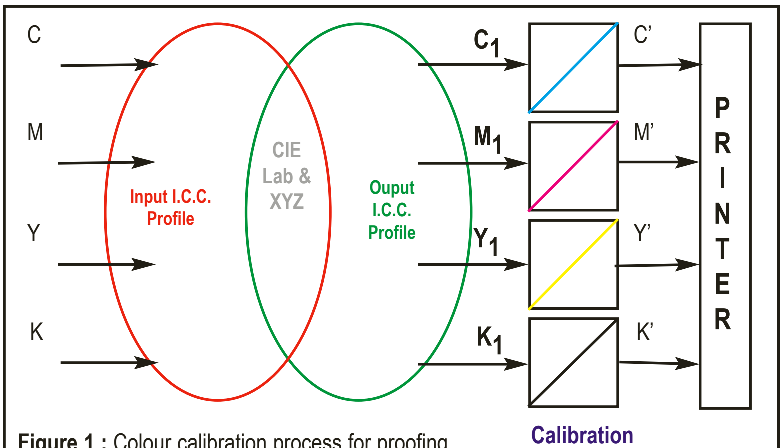

Figure 1 : Colour calibration process for proofing

Calibration of the printer: The role of the Look Up tables located exactly upstream from the printing heads is to allow print engine stabilisation, so that for a same C1M1Y1K1 file it daily prints the same colours. One chooses the density rise for each C', M', Y', K' primary ink, then one brings back there at the time of calibration by modifying these curves according to measures of the C', M', Y', K' inks in steps. The density curve rise for each C', M', Y', K' primary ink can be selected more or less astutely according to the characteristics of the considered print engine and consumable. (Printers and RIPS manufacturers do not always help us on this issue). This primary ink calibration is wholly comparable with density calibration of an image-setter or a printing press. Usual contrast and print ability considerations should prevail for fixing each primary colour reference densities.

Output I.C.C. profile: Output I.C.C. profile makes it possible to determine the adequate C1M1Y1K1 inks quantities to reproduce on calibrated printer any input colour specified in CIE La*b* or XYZ. This I.C.C. profile is computed after calibration of the printer. It will remain valid as long as one does not change the batch of paper or inks, and as long as one will regularly calibrate the printer by using a spectrophotometer or a densitometer, to match the 4 density rise reference curves, chosen and fixed a reference curves beforehand.

Output I.C.C. profile is therefore quite simply a profile, which characterises the printer for an arbitrarily chosen calibration. Of course, it is calculated with ink parameters well suited to print technology, and allows a rational and economic use of Inks.

Input I.C.C. profile: Input I.C.C. profile characterises the "colours target" of the Digital Colour Proofing system: if one chooses the I.C.C. profile of a Eurosprint cromalin, it makes it possible to compute the CIE La*b* and XYZ colour which one would be obtained on a cromalin for any CMYK data of the input file. This colour will be accurately reproduced thanks to Output I.C.C. profile. The "colour target" being such as "cromalin Eurosprint" or "Match Print LDG" - or other - is by definition an arbitrary reference CMYK frame profile, which does not drift. Role from both I.C.C. profiles is therefore to daily obtain not only the same colours (this is the role of calibration), but also the "good colours".

Important note: When one uses constant quality inks and papers, the short-term drifts of the Proofing printer only come from the variations of C', M', Y', K' primary inks quantities transferred on paper per unit of area, according to the same C1, M1, Y1, K1 instructions. These densities are simple and fast to restore by densiometric re calibration of the printer.

When the printer driver or the RIP does not allow any calibration process, it remains possible making a printer I.C.C. profile "without calibration", and then to regularly update this Output I.C.C. profile. It is possible do so by re measuring only the C' M' Y' K' primary inks in steps of 5 or 10 %. Modern software such as GretagMacbeth ProfileMaker allows updating the printer I.C.C. profile by this fast method. The Output I.C.C. Profile offers internal Look up Tables similar to calibration Look up Tables **(see Figure 8)**, which software can edit and update. The most rustic printers can be re characterised without spending the time to remake a complete I.C.C. profile, by simple edition of these tables from the densitometric or colorimetric measures of primaries. However, will see that this method prohibits the use of a powerful Control Bar: for professional use, the RIP or the printer imperatively has to provide separated calibration Look Up Tables, downstream from the Output I.C.C. profile.

A2) The proprietary systems:

Some dedicated Colour Proofing printers replace the use of both I.C.C. profiles per one a proprietary conversion file "CMYK to C1M1Y1K1" (I.C.C. remains the best tool to compute in factory the data of this file!). This is very valid if provided consumable are of perfectly constant quality and a calibration mechanism of the printer by a densitometer is provided downstream from this proprietary conversion table. But this makes it impossible for the User to choose and compute himself its own "colour target" I.C.C. profiles, with all flexibility desirable today, neither to choose his inks neither his paper, nor to even design intelligent, useful and effective Control Bars.

The dye sublimation SEIKO Instruments Colour Proofing printers used this design, 5 years ago. Less known than other long standing proprietary systems on the Market, they were however the first Colour Proofing printers that could be fixed... with a simple and cheap densitometer, and which no longer confused printer drift correction with target colour edition!

The same densitometer was used if necessary to take account of real target press Dot Gain, or even... for well simulating the bad cromalins of our customers at the time of our demonstrations, which did not respect the "official" cromalin Dot Gain curves! (70% of the cromalins we used to receive for demos were wrong…)

Such a colour calibration mechanism present the merit of great simplicity and low investment in measuring instrument, but today only interest small companies: any other company has to be equipped with sophisticated tools to manage the whole of its colours peripherals from the printing press to the Digital or analogue cameras. In addition, when they do not invest in this field, it is never of a budget problem, but only a training problem. It becomes impossible to optimise productivity without using I.C.C. technology, and this, from the stage of document conception. In this prospect, the colour proofing systems - or any other printer - will be fixed using the general-purpose I.C.C. calibration tools, which every modern company have to control from now on. Spectrophotometers are less expensive today than densitometers 5 years ago, and the latter are gradually replaced by more flexible, accurate and reliable spectrodensitometers.

A-3) Print Technologies for digital colour proofing printers:

The vast majority of market modern print engines offer a suitable Colour Gamut for simulation of analogue Proofs

The majority of C', M', Y', K' on-demand ink-jet printers - small and large format - are OK, whether the ink jet is thermal or piezoelectric. For simulation of the very low densities of analogue Proofs, the use of two Cyan inks (dense Cyan and light Cyan) and of two Magenta inks (dense Magenta and light Magenta) can be useful, because - on productive hardware - the inks drops projected on paper are not as small as with the very expensive continuous ink-jet printers. Generally the transition between dense and light ink on a primary colour gradation, is dealt with by the printer, which thus remains, seen from outside, a traditional C', M', Y', K' printer easily manageable by standard four colours I.C.C. Profiles.

The majority of colour copiers are OK as well, but of course, they require more frequent calibrations than Ink Jet, by nature of their electrostatic impression mechanism: densities of the primaries transferred on paper (quantities of C', M', Y', K' toner per area unit for the various specified C1, M1, Y1, K1 input percentages) are less stable than with ink-jet printers. However, the Colour Proofs production costs are very much lower than costs of Ink Jet and with a higher productivity, (at least for some time yet…). Colour copiers therefore remain a good choice for colour proofing, provided well designed Control Bars allow an effective and very quick control of each produced Proof.

There are very important precaution however to be taken when a printer is bought: Far too many printers, even so called "professional" models, offer unnecessarily complex drivers perfectly unsuited to a healthy Colour Management:

Printers accepting only RGB files: RGB does not measure nor specify a colour, and internal printer's transform of RGB data into C', M', Y', K' leads to waste of ink, to bad print quality on many media, and to less accurate I.C.C. Colour Management upstream. (One can produce by I.C.C. the "good RGB data" that will optimise the printed C', M', Y', K' colours, but this is a turn around). The internal RGB conversion by the printer or driver moreover limits the Colour Gamut. Unlike RGB, sRGB is a known colour but within the colour gamut of a monitor: you can not make Graphic Arts but only RGB monitor softcopy, as in the past you did with PhotoShop 3.x and 4.x. In addition, this does not allow ensuring good print ability on various media, neither to use a decent Control bar.

Printers with fake C'M'Y'K' driver transforming input C'M'Y'K' file into RGB, by some undocumented bad recipe, when you start printing (see above subparagraph therefore!).

Printers "polluting" C1, M1, Y1 or K1 data: Some printer drivers replace pure Yellow Ink per a magenta and yellow mixture, and/or pollute the same way the cyan and magenta data. This involves waste of ink and sometimes a catastrophic restriction of colour gamut.

Some drivers print a C', M', Y' mixture at the room of black Ink when pure black is asked for! This with the only aim to empty your Chanel N°5 priced ink cartridges as quickly as possible. This carefully designed waste of ink should undoubtedly interest the trade press or consumers institutes who test printers: as good pro testers, since so many years, they did not even notice the trick!

But the largest induced problem is that it is difficult to establish a correct I.C.C. profile for these printers: The replacement of black Ink by C', M', Y' greys is particularly penalising: in this case it is better to generate a C1 M1 Y1 K1 I.C.C. profile without black, or to use the printer in RGB mode with an RGB I.C.C. profile. In both cases, Ink will be wasted and print ability not optimised for each media. This also prevents any use of an effective Control bar allowing a visual warning of printer drifts.

Quite simply check with a microscope that the driver allows printing pure C' M' Y' K' primaries without any "pollution", for all specified input densities.

A professional print engine using C', M', Y', K' inks should never accept RGB files, but only C1 M1 Y1 K1 files, and should keep these four channels perfectly separated. The role of I.C.C. profile is to proportion perfectly and individually each C', M', Y', K' ink for a good respect of upstream specified colours, while ensuring good print quality and economy of the inks. Print options menus offer to Users a large choice of useless options and multiply risks of configuration error, while the few essential options and the calibration of the printer by Look up Tables are often absent. Let us add that the majority of printers drivers - PostScript or not - are unable to use properly the I.C.C. profile of the printer. Software applications bugs add even more problems on PostScript 3 printers. I.C.C. is a buzzword, therefore much botched.

But all above problems can be avoided by the User, provided he is able address to the printer the right C', M', Y', K' data which will give the good colours, and these values are not distorted by the driver or the RIP. It is better, in a first step, not to use the "I.C.C." menus of the printer driver, which are often bugged. Professional colour management asks for printers, monitors and scanners, ultra simple drivers, which do not try - badly - to manage colours.

With above precautions it is possible to produce superb and reliable Proofs on supermarket printers. (For example: production of a CMYK PDF, transformation into C', M', Y', K' PDF with generation of suitable Control bar by using GretagMacbeth I.C.C. Workflow software IQueue 140, then print from Acrobat to a non PostScript supermarket printer: Colour wise this is much more reliable than a 100 000 $ Proofing system used without any measuring instrument!

B) How to design adequate control bar for Digital Colour Proofs:

The inept marketing made around some well-known Control Bars testifies to the disastrous state of quality assurance in Graphic Industries.

B-1) Useful Control Bars for colour proofing printers:

Let us remind a printer can be used of several separate manners. Hereafter a partial list of possible uses:

· Simulation of an opaque original: This is a "Scan to Print" application.

· Simulation of an RGB monitor: This is a monitor Softcopy application, useful for 3D Design and CAD CAM.

· Simulation of an Analogue proof or printing press: This is ColourProofing, subject of this paper

In each of above three applications, the carried out print can only be good if the printer remained well calibrated at the time of printing. In professional use, a Control Bar is therefore essential on any printer, for all printing applications, and not only for Colour Proofing.

Consequently, the Control bars of a Proofing Printer should ONLY depend on the characteristics of the printer in its state of good calibration, and will therefore have neither the grey balance data, nor the colours or the densities of cromalin or simulated offset press Control bars! One wants checking the printer at printing stage: not the simulated cromalin, which is supposed to be perfect (cromalin I.C.C. profile does not move).

Therefore, we recommend the following Control bar, comprising three types of elements:

Elements allowing fast visual checking of any drift of the pure-grey Vs trichromatic grey balance (C'M'Y') in D50 lighting (Fig. 2):

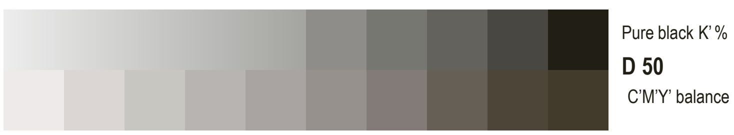

Figure 2 : Pure grey Vs trichromatic grey balance in D50 viewing conditions.

This part of the Control bar, specified in K1 % values and their respective C1M1Y1 D50 equivalents is valuable for the immediate visual detection of any serious drift of printer, which modifies its grey balance.

The C1M1Y1K1 I.C.C. profile of the calibrated printer allows to very easily design these elements, which immediately warn the User of any serious drift.

It is enough, for example, to make under PhotoShop a range of pure greys K1% in steps of 5 or 10 %, and to convert it by using printer C1M1Y1K1 I.C.C. profile as input, and a second C1M1Y1K1 I.C.C. profile as output, calculated without black (maximum K = 0 %, Maximal

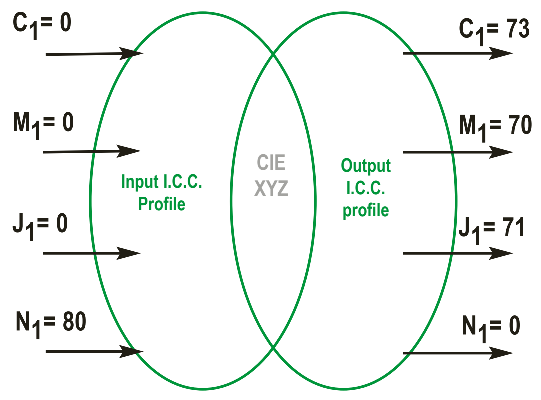

Figure 2bis : Computing Pure grey Vs trichromatic grey balance

inking = 300 %). **(Figure 2bis)**

This trichromatic I.C.C. profile can easily be computed from the C1M1Y1K1 printer I.C.C. Profile, by using ProfileMaker. Absolute rendering intent has to be used with of course no "black point projection", a strange useless misleading feature of this software). The C1M1Y1 % printed patches will visually match with K1 % patches on a D50 viewing booth, as long as the printer keeps calibrated.

Elements for visual monitoring of very high and very low C' M' Y' K' densities:

The 100 % RGB patches allow visual detection of densities variations on C', M' or Y' solid densities **(Figure 3):**

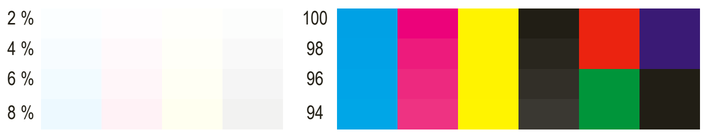

Figure 3 : control of very high and very low densities.

It is easier to see a colour anomaly on these RGB squares than to perceive density anomalies on 100% solid C', M' or Y' primaries.

Elements intended to check the good calibration of printer C ', M ', J ', K' primary inks (Figure 4):

This part of the Control bar is the only essential one. It makes it possible at the same time to check the Proof by measures, and if needed to re calibrate the printer, from the measured values.

Our recommended Control Bar makes it possible to check the good calibration of printer on every copy; regardless you are producing a Proof... or a Monitor Softcopy, or the copy of an opaque or transparent original.

The cromalin profile used for input is constant by definition, and therefore, mathematically, the printer will accurately simulate cromalin as long as our Control bar shows the printer keeps calibrated. Tints of our Control bar are very different from traditional cromalin Control bars. In addition, C1M1Y1 values providing the visual balance with black K1% in D50 lighting have nothing to do with traditional pure-grey Vs trichromatic grey balance on cromalin Control bars. Indeed the colours of C' M' Y' primary inks are much purer and saturated, which allows them a larger colour gamut than simulated cromalin, and leads to a grey balance different from cromalin or offset!

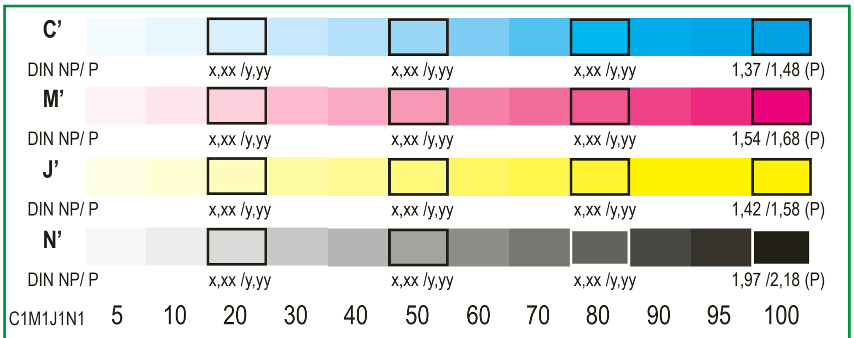

Figure 4 : for control of the proof by measures, plus proofer re calibration

Their pure grey Vs grey trichromatic balance is provided by cromalin I.C.C. profile by the same method as described for colour printers. Let us point out the patented elements of some Control bars for checking high resolution line work are useless for Colour Proofing and therefore nothing useful for Digital Proofs is patented. Then why pay for the invention of tepid water, especially when tepid water is of no use?

If the RIP or the I.C.C. Workflow software only allow printing one Control Bar, our recommended Control bar is to be used.

B-2) Useless "marketing" Control Bars:

As long as our Control Bar prints in conformity with its specifications (density values determined by the User will be printed aside the Control bar patches), any cromalin colour will be simulated well, as long as we use a good I.C.C. cromalin input profile.

Under above condition colours of a "Traditional Control Bar" such as Fogra, Brunner, or other, are of course accurately simulated in D50 lighting.

Therefore, including in the input CMYK data one of these "Traditional Control Bar ", so that it prints on the Digital Proof, can flatter an ignorant customer, but can be dangerous, because when simulated colours are correct, density measures are essentially different from cromalin reference densities.

Even more dangerous: the visual matching of pure greys Vs trichromatic greys (K Vs CMY) on these simulated Control bars will always look good, even if the printer have drifted and no longer respect its own grey balance (K' Vs C' M' Y'). Sole interest of simulating a Control Bar such as Fogra, Brunner or other is at most, and to large maximum, a visual checking when setting the printing press... However, can a printing press be set visually today?

B-3) Conclusions about Control Bars for Digital Colour Proofs:

To satisfy the largest number (let us be generous!), a Colour Proofing system will therefore be able to print two separate Control Bars:

a) The Control Bar which we recommend:

It is specific to the printer, for a specific arbitrary calibration: this Control Bar is specified in C1M1Y1K1 inks and its colours are not transformed by the profiles but only by the calibration Look Up Tables. It remains valid and precious even when the printer is not used for proofing applications.

It belongs to the printer's User to design his own Control bar according to the simple method described above, because the values of C1M1Y1 Vs K1 balance and the reference densities of primary C' M' Y' and K' Inks, depend on the 4 arbitrarily chosen calibration reference curves.

To allow Proof checking by any customer, these reference densities have to be printed aside the Control Bar.

Let us recommend for Europe indicating these densities in status DIN (E) with polarised filter and in status DIN (E) without polarised filter, which correspond to most widespread densitometers in Europe. This double marking is therefore desirable.

b) "Marketing" Control Bar (Figure 5):

This is the simulation of an analogue proof Control Bar such as DuPont, Brunner Fogra or GretagMacbeth. These Control Bars are designed according to cromalin CMYK profile, and their colours will be simulated by processing via the two I.C.C. profiles and the calibration Look Up Tables.

Usual checkpoint of CMYK primary inks are: 100%, 75%, 50%, 25% (Brunner checkpoints) and 40%, 80 % (GretagMacbeth checkpoints).

C) Certification of colour proofing systems:

The only intelligent, open, and constructive initiative in France as regards certification of colour proofing systems was that of Mr Michel BABSKY on behalf of the ATEP (FEDEC today).

The FEDEC therefore publishes reference densities of approved systems - not for Control bars specific to the printer, but for "marketing" Control bars (simulation analogue proofs Control bars). This reduces controls accuracy, but this initiative was excellent, making it possible to stop many sterile debates, in a not so remote time where digital colour proofing was accused of all evils. This approach had the merit of not disturbing too much the many Users accustomed to the apparent colours of traditional Control bars on analogue proofs.

Today, any trained customer is in a position to self-certify his Colour Proofing system by conceiving and printing his own Control Bar with his reference densities and viewing Light temperature (ANSI and ISO tolerate D65 but recommend D50). An important advantage is that Users remain free to choose their inks and papers, hence their suppliers. In front of the multiplication of valid technical solutions for production of "Traditional" Digital Colour Proofs, auto-certification appears to be the best solution, and the only applicable one in practice.

THETA Scan, in future, will self-certify Proofing systems of their catalogue, which are marketed with all tools making it possible to colour calibrate them and check every produced proof.

D) About productivity and page description languages:

For the efficient production of colour proofs, a tool is needed to allow automatic transformation of print ready CMYK pages into C' M' Y' K' pages for the proofing print engine.

There would be very long to say on this subject: colour management can be - largely - independent of the page description language. (PostScript or else).

PostScript confuses two quite distinct technical fields: the description of pages and the colour management. I.C.C. makes null and void the interest of colour management by the page description language: I.C.C. can work with all page description languages. The multiplication of print options in PostScript drivers unnecessarily increases printer's using complexity and the risks of configuration mistakes. All this requires being re-examined, purified and simplified. I.C.C. would be much easier to use if each manufacturer of peripherals, drivers, or page description language would suppress the fossils and rubble of his proprietary developments as regards Colour Management. They no longer interest Professionals, neither the even more easily mislead amateurs.

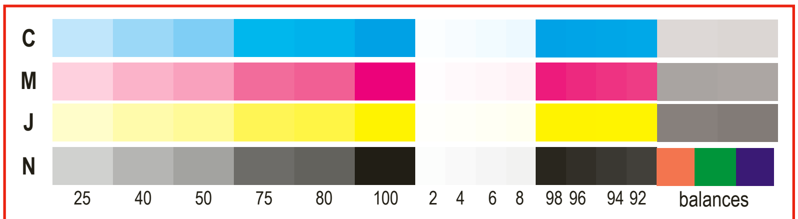

Figure 5 : "marketing" Control bar for traditional digital colour proofing

For good productivity the colour space changes can be carried out at the level of the RIP ("I.C.C." compatible RIP), or upstream from the RIP, by I.C.C. Workflow software on print servers **(Figure 6)**. This software applies the colour transformations to PostScript or PDF format pages.

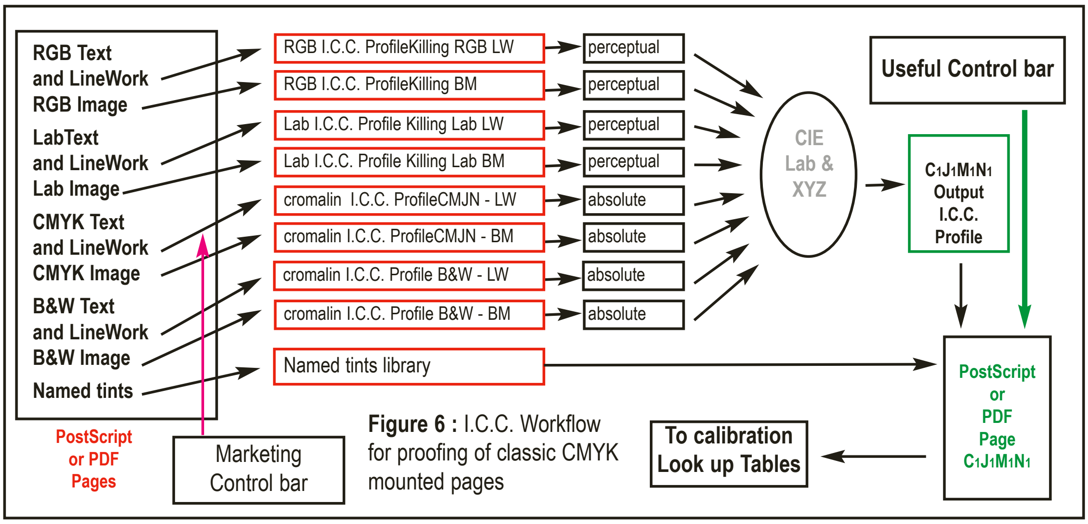

Figure 6 : I.C.C. Workflow for proofing of classic CMYK mounted pages

Under old production Workflow (CMYK mounted pages…), any RGB element present by mistake in the pages can be converted into monochromic or into negative or flat image per one a suitable RGB I.C.C. input profile, which allows easy visual detection of these mistakes.

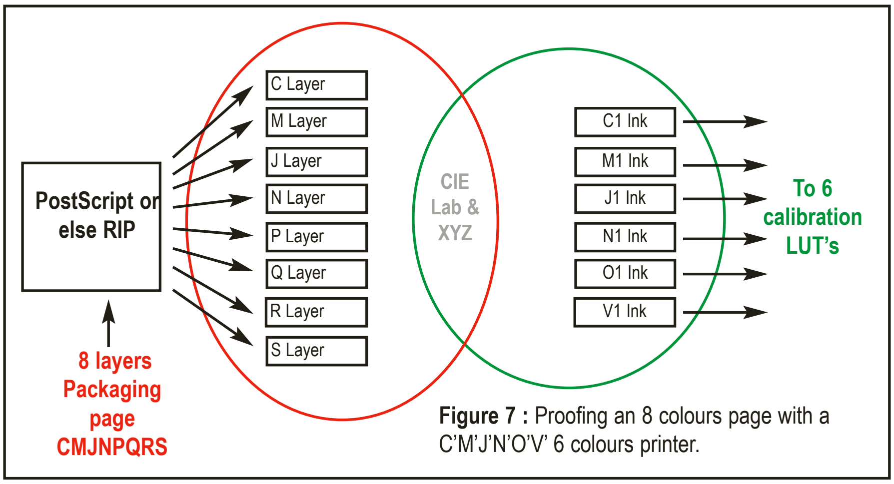

Figure 7 : Proofing an 8 colours page with a C'M'J'N'O'V' 6 colours printer.

Special tints ask for special processing by the CMS: for example black texts should not be turned into C'M'Y'K'.

A well-known proprietary Colour Proofers manufacturer claims to have developed special I.C.C. profiles for good monochromic reproduction of black texts.

He may not have read I.C.C. specifications: one sometimes also wants a K100C40, a M100Y100 or a 50 % black text not to be converted into C'M'Y'K'! I.C.C. Profiles should not be modified to address these issues, but a good RIP or a good I.C.C. Workflow tool will. I.C.C. did well envisage all these issues and clearly stated the CMS to process them. Special I.C.C. profiles of this manufacturer are just not in conformity with I.C.C. specifications, while a vast majority of Market Vendors does respect I.C.C. specifications (Graphic Arts Industries are really progressing on standardisation).

User will often have to manage his colours by using an I.C.C. Workflow tool operating on PostScript or PDF pages upstream from the RIP, and will disable all colour management on the RIP, except calibration when it is available. The Workflow tool can drive the printer automatically, avoiding the use of applications print menus and their ambiguous print options on the pre press Workstations. This is more productive and eliminates all printers' configuration mistakes.

Above modus operandi is satisfactory for 95% of standard CMYK work with some named tints.

However, an elementary reflection shows that for packaging applications with numerous special tints with trapping, screening and overprints, an effective and simple colour management could only be obtained by using I.C.C. on bitmap-converted layers downstream from the RIP! **(Figure 7)**

This completes to demonstrate the enormous interest of uncoupling the page description language and the colour management process as much as possible, in order to make everybody's life much easier.

E) Technical details about printer calibration process:

E-1) Use of Control bar for re calibrating the printer:

Measuring densities of our C', M', Y', K' Control bar elements on any produced Proof allows not only checking the Proof, but also re calibrating the printer if needed. This re calibration have imperatively to be done by amendment of calibration Look Up Tables downstream from Output I.C.C. profile, and not by edition of Output I.C.C. profile internal Look Up Tables **(Figure 8).** Indeed if we would update Output I.C.C. profile rather than printer calibration LUT's, we would then need to change all grey balance specifications and reference densities of our Control bar, which would be tedious! A densitometer or spectrodensitometer built into the printer could make these adjustments while printing. In addition, Grey balance data could be computed automatically for automated Control bar generation, by using the calibrated printer I.C.C. Profile.

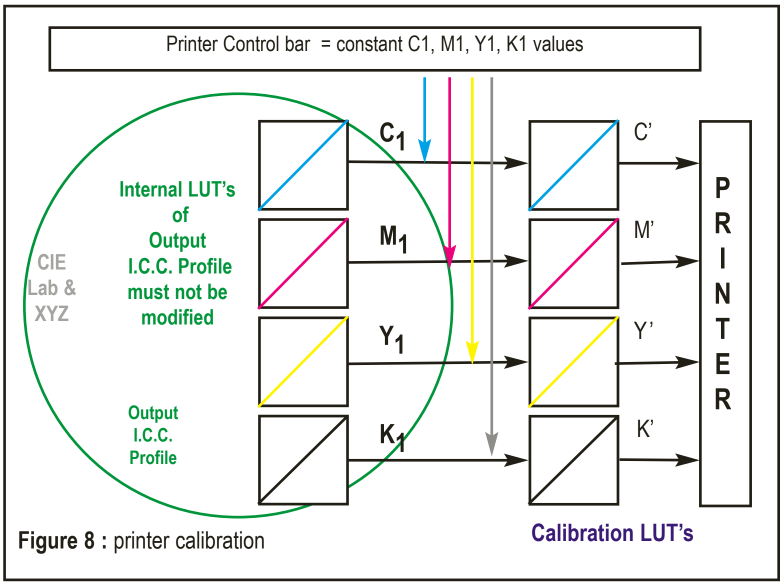

Figure 8 : printer calibration

E-2) Adaptation of densitometer spectral response for printer calibration:

Measuring C' M' Y' K' densities for printer calibration have not optimal accuracy by using a standardised densitometric spectral response of type DIN (E), T, or other. Usual standardised spectral responses (E, T, A etc.) were established for the specific control of European offset printing primary inks (E), American SWOP inks (T) or positive photographic material pigments (A), which are not the specific C ', M ', Y', K' inks of our printer. Modern spectrodensitometers such as GretagMacbeth SpectroEye make it possible to carry out the densitometric measures with a filtering adapting automatically to the spectrum of the measured primary ink, which allows a more accurate and sensitive density measure, as well as the colorimetric control of these supplies. This spectrodensitometers type can carry out in the same way the densitometric control of the orange and green inks of hexachromic processes. Moreover, they are often essential for accurate control of drum web yellows, very different from offset yellows. Of course they also allow performing the status E (DIN) measures (Polarised and non polarised) that will be printed along the Control bar, allowing easy control of the proof by Customers with their ordinary densitometers.

E-3) Adaptation of the RIP to print engine (Fig. 9):

Majority of RIPS - when they have the good taste to allow printer calibration by densitometric measures - impose four arbitrary calibration reference curves. These imposed curves are not always ideal, and the software imposes using a standard densitometric spectral response (E or T), which is not optimised for our specific C ', M ', Y', K' printer's primary colours. This can harm the calibration accuracy. It would be much better that Rips would allow Users to freely define in a first step their own density rise reference calibration curves, and with the measurement spectral response of their choice.

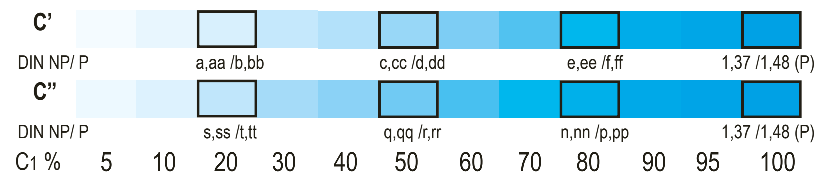

Figure 9 : Two arbitrary calibration references for cyan C' Ink.

E-4) Adaptation of the print engine:

Last important point: an intelligent fixing of C ', M ', Y', K' density rise curves by the play of the 4 Look Up Tables will not be of any help for accuracy and stability, if native C ', M ', Y', K' densities rises, in absence of any calibration, are aberrant owing to a bad design of the print engine.

On this issue, scarce are the print engines where the hardware allows setting the printed solid ink densities for good use of media and print engine chosen resolution. Some well-known Ink Jet printers are advertised to print 720 x 720 dpi (and even more), and prospects say: "Yes 720 dpi it is much better than 360 dpi mode..." Simply they just do not realise that these printers put adequate solid ink densities on paper in their 720 dpi mode, but not enough ink (4 times less?) in their 360 dpi mode! In addition, they never use a microscope to measure the real size of the ink drops on the paper. Nevertheless, in their mind, 720 dpi is always better than 600 dpi! Moreover, scanners are not tested more seriously...

F) Pleasant and convenient conclusions about colour proofing:

F-1) Making reliable "traditional" Digital Colour Proofs is very simple and inexpensive:

The vast majority of Ink Jet Printers (small and large format) today allow the production of perfectly reliable Proof, since they are managed with modern colour management tools, provided their driver do not pollute the C', M', Y', K' primaries.

Colour copiers also allow production of Proof but their instability is such that our Control bar with pure grey Vs trichromatic grey balance is essential, for fast visual checking of each copy on a D50 light booth. Complementary Densitometric control of the C', M', Y', K' bars have to be carried out if in doubt.

F-2) We need to agree on "colours target" I.C.C. profile:

The only possible reason why two print engines used with competence can produce two abnormally different "digital cromalins", is that both Users chose for Input I.C.C. profile (colours to be simulated), two different cromalin I.C.C. profiles. Of which one, at least, was established from a badly made Eurosprint cromalin (badly calibrated image-setter, bad film development, bad registration, bad exposition of the layers etc. ...Digital proofing is so much easier!).

Even when correctly making two cromalins out of the same films, one obtains two slightly different results: no analogue proofing or print process is perfectly repetitive.

Under these conditions, it is essential that promoters of "standard" CMYK reference frames such as cromalin, Match Print or else, publish the specifications of their claimed standard in the form of a reference I.C.C. profile.

On this issue, Graphic Industries are still the only ones I know today where some Vendors can claim standards without publishing any technical specifications! Professional organisation have to impose their suppliers, whoever they are, to supply complete exhaustive and free of rights documentation, about any claimed standard, as it is done in any other Industry. A much better initiative from relevant organisations would be to establish new CMYK standard reference frames matching to major types of commercial print works better than Analogue Proof does. Good idea when these ones are bound to disappear soon with the advent of Computer to Plate!

In absence of any published specification, THETA Scan offer a free of charge cromalin Eurosprint I.C.C. profile on their www.thetascan.fr Web site, suited for use as colour target I.C.C. profile. (we can claim it is the market standard!)

Of course, the obtained Proofs are identical in D50 lighting with Ink Jet printers and with colour copiers, since the latter are calibrated, and use a good I.C.C. profile describing them well in this state of good calibration.

On colour copiers and Ink Jet printers, the viable solution consists to carry out oneself these profiles or to have them carried out per one a relevant person. An I.C.C. Workflow tool on a print server can be used if the existing RIP is not I.C.C. compatible.

Indeed, on a dedicated proofing system, inks and papers production can be sufficiently well checked, so that simple printer re calibrations are enough. However, with "ordinary" printers and copiers, it will sometimes be necessary to remake a complete I.C.C. profile and not a simple calibration.

F-3) Easy to design Control bar:

The prestigious named Control bar are perfectly unsuited for easy, accurate and fast control of Digital Proofs. The world is full of simple, brilliant and false ideas. This paper contains the instructions to design Control bar worthy of this name: It checks the printer according to its own ink densities and own grey balance.

Well-known Control bars, designed for offset or gravure, are often technically out of date, and a trained User will do well to re-examine the way he drives his presses and design his own bars. These Control bars once had the merit of dragging Professionals interest to a densitometric control their presses, at a prehistoric time of digital age.

Any trained and equipped customer can today design his own Proofing system and Control bar, according to our very simple instructions described upstream. He is able to colour calibrate and self-certify this system. Whether he chooses an I.C.C. compatible RIP, or I.C.C. Workflow software upstream from the existing RIP, the software has to allow automatic addition of this Control bar on each copy.

G) Less pleasant conclusions about "traditional" colour proofing:

Simulating a cromalin is OK, but to our knowledge, a cromalin never simulated well a drum-offset press with recycled paper. Making pre press to get a beautiful cromalin will then lead to a quality very far from optimum. Traditional Proof is becoming a major source of non-quality, and traditional Digital colour proofing therefore presents little interest.

More serious case: Dot gain of analogue Proofs, of mainly optical origin, are fixed - for a given screening - and very different from Dot Gains of most real presses with optimised Ink settings.

But the long standing co-marketing of some Control bars, and Analogue - then Digital - proofing systems Vendors, have widespread the stupid fairy tale according to which ALL printing presses with ALL inks, ALL papers and ALL screen rulings, have the same ideal primary density curve, which precisely gives - by some miraculous chance! - the optical dot gains curves imposed by traditional analogue proofs...

This wonderful marketing loop was therefore finalised: Messrs. the Printers, please hold twisted well, and your costume will fall quite straight!

The result is that Print Houses have to always set their press inking curves endeavouring to respect the compulsory figures of the "official" Control bars, and these forceps like settings are a major additional source of non-quality: Print houses can seldom use their presses with optimal Ink settings.

Let us add that these prestigious Control bars are not generated by the image-setter, thus make it impossible to detect calibration defects of the image-setter, and therefore cannot validate the CMYK proofed files! In addition, these CMYK page elements proofed with bad films will often be reused as they are - via film or CTP.

When technical reality is denied and disguised by the "bullshit marketing" speech of so many Vendors, it is not astonishing that numerous Graphic Industries companies pain to make judicious investment and profits. In truth, the majority of Vendors preaching without cease for quality became, in digital age, the largest promoters of ignorance and non-quality. The speech of these professional Predicators once had the merit of simplicity - in the absence of exactitude -, but becomes far too simplistic with respect to the enormous progresses of digital Imaging.

Professional Users have to get trained and to forge their technical opinions far from marketing bullshit! Our experience with training shows us they will not have any evil with becoming much better experts than most of their suppliers, and we have numerous evidences.

This paper can moreover be useful to a number of printers, page description language and RIP manufacturers, since it details many technical aspects that they obviously do not understand... or pretend not to.

In these conditions, since a Proofing system is a printer simulating another printer, and given that, most of the times, we know at pre press stage, nor where, nor how the final document will be printed, the good solution consists into the printing press simulating the Proof, and not the reverse.

My paper remains valid if you replace the words "calibrated printer" by the words "Ink Set printing press"

Print Houses can now ensure that their presses fixed beforehand on intelligently optimised density curves - far from official dogmas -, will well simulate... cromalin, Match Print, or any Digital Colour Proof. (This is moreover necessary when cromalin and Match Print have quite different CMYK colour spaces!)

This while awaiting the establishment of more realistic CMYK reference frames: Some integrated French Companies have defined their own internal CMYK reference frames for their prepress and proofs, which match better their major types of commercial works. In addition, this allows them much better aesthetic choices for the image reproduction at pre press stage!

Proof simulation by printing presses will undoubtedly lead to best quality, and to best productivity. Because only in this logic can much more productive new pre press methods be set up, from the stage of documents design.

We will return there in a forthcoming paper.

Wilfrid MEFFRE - COLORSOURCE - wme@color-source.net

27 rue Pierre-Brossolette

91430 IGNY FRANCE

Tel & Fax. + 33 1 69 41 01 62

http://www.color-source.net/en/Colorsource_news.htm