September 2018 · No. 5

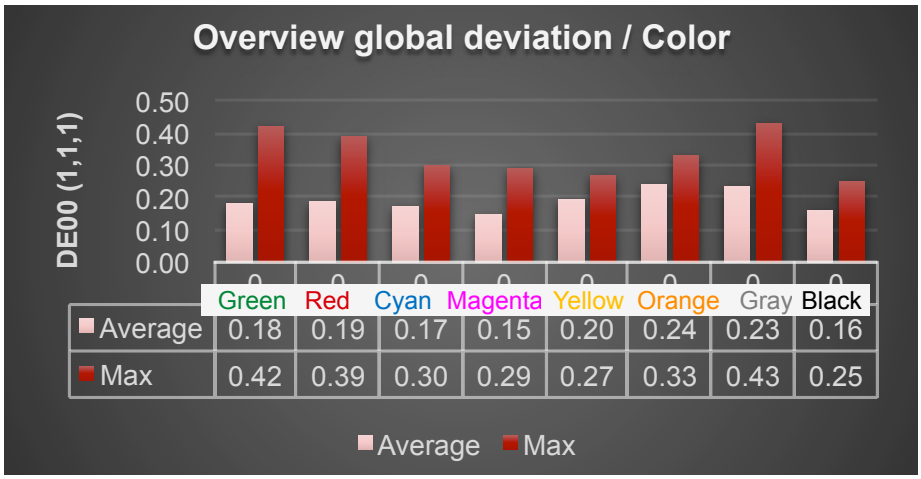
SIEGWERK

COLOR NEWS

Business Unit Sheetfed

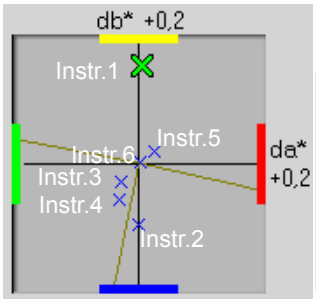
Inter-Instrument Agreement and real deviation

The exchange of reflectance data among all actors of the graphic chain has increased substantially over the past years. From «electronic colors», users are supposed to speak the same language on all continents. Nevertheless, spectro manufacturers are not able to guarantee «0» deviation between two identical instruments. The inter-instrument deviation is a question that concerns all of us: we, as ink manufacturers, and you, printers who are equipped with several spectrophotometers (color laboratory, QC, on press or in your multiple sites). What are the differences and the impact on electronic exchanges?



Average deviation (DE00) ≤ 0,20 all colors and instruments combined

We wanted to check the real drifts between identical instruments (Inter-Instrument Agreement IIA). To realize the experiment, 6 instruments (same model & generation, certified compliant with original standard of the company) have been selected. Measurements were realized under the same protocol, conditions (D50, 2°, M0 filter) and in the same environment (23°C ± 1°C). 8 color patches were measured. The average of all instruments was defined as the target value for each color. Each instrument was compared to this target in order to evaluate the potential deviation.



Name	L*	a*	b*	dL*	da*	db*	dE 2000
GRAY	52,65	1,28	6,22				
1	52,81	1,28	6,37	0,16	0,01	0,15	0,20
2	52,54	1,28	6,13	-0,11	-0,00	-0,10	0,13
3	52,46	1,25	6,19	-0,19	-0,03	-0,03	0,19
4	53,09	1,24	6,16	0,44	-0,03	-0,06	0,43
5	52,95	1,30	6,24	0,30	0,03	0,02	0,30
6	52,80	1,28	6,23	0,15	0,01	0,01	0,15

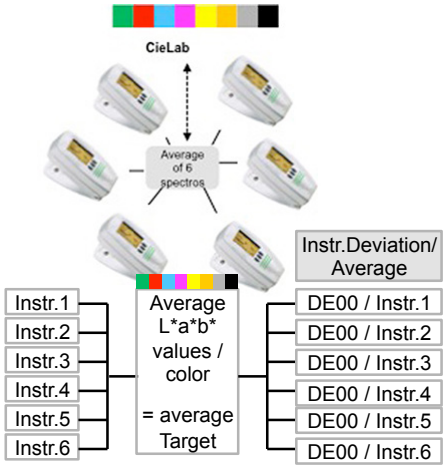
Instruments

Example of disparity of instruments/gray color D50, 2°, M0

	Average DE00 (1,1,1)	Max DE00 (1,1,1)
Instr.1	0,24	0,39
Instr.2	0,12	0,25
Instr.3	0,15	0,25
Instr.4	0,21	0,43
Instr.5	0,29	0,42
Instr.6	0,13	0,21

Average deviation/ Instrument – all colors combined

From the detailed measurement above, we notice that the instrument with the max of divergence (Instr.4/ max DE = 0,43) mostly deviates on the lightness axis (dL = 0,44)*



The global average deviation is consistent with the manufacturer's specifications. Usual tolerances applied for color matching (DE00 ≤ 1) are 5 times wider than average inter-instrument deviations. This guarantees a good level of security.

However, keep in mind that if you use multiple devices (1 for target recording, another for sample printing control), even if models are strictly the same, the global deviation DE is partly due to inter-instrument drifts.

IIA depends on the geometry and model of instrument, and of course on the supplier. This information is available on the technical data sheet of the product.

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Don’t forget to control your spectrophotometer

Due to aging, wear and environmental conditions, spectrophotometers deviate with time. Each user can be faced with variances. To check if the device is still compliant with the original specifications, some solutions exist.

1– EasyChecker is a software proposed by Konica Minolta, allowing to check the reliability and to measure the stability of their own spectros at any time. The software uses a stable green ceramic tile and automatically sets the conditions and factory tolerances for the corresponding instrument model. The system can warn the operator when the instrument is at its limit or out of specifications and requires service or calibration.

2– Netprofiler supplied by X-Rite is used to evaluate the deviations over the time, and also to reduce variances between several measurement devices from X-Rite origin. Based on a common licence and unique tile set, many instruments of the supply chain, that encompass multiple departments and geographies can be controlled and profiled between them. Through this profiling, color measurement results are more consistent. The Netprofiler licence allows to carry out about 25 controls, but must be renewed every year.

Both solutions are interesting to check the reliability and regularity of the instruments over time.

Netprofiler equipment with tile set for CI6x control – XRite

The instrument follow-up mustn’t be neglected. The drifts due to aging and IIA can add up and quickly become a significant source of error on measurement and electronic exchanges, involving several spectrophotometers.

Suppliers recommend to check the conformity of the instruments on an annual basis.
When the instrument is no longer compliant, it is advised to contact a certified/authorized maintenance center for re-certification.

Suppliers propose many preventive «maintenance contracts», on site or return the spectro to the work-shop, with various options such as device loan and/or troubleshooting and repair. Basic contracts include:
Cleaning of the instrument, verification of compliance (calibration), adjustment if necessary, printed certificate detailing the traceability of the calibration.

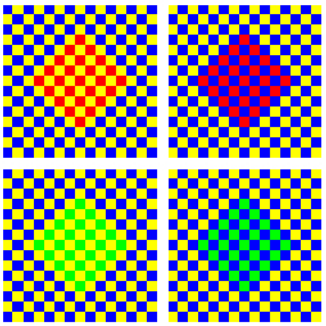
Did you know?

How do you perceive these 2 horses?

The horse on the right side looks darker, more red. But in reality, it is not so! Both are of the same color.

If you see 2 horses of different colors, it’s due to the chromatic assimilation: the variation of colors in the background can make us believe that the color of the horse in the foreground is sometimes strong orange-red, and sometimes warm yellow.

Our visual system plays us tricks! Instead of seeing the colors as they are, our brain takes shortcuts and averages hues and brightness according to the context.



The checkers beside also illustrate the same phenomenon of the chromatic assimilation. Here, we must know that there are only four colors of tiles: yellow, blue, red and green. If red seems orange on the left and magenta on the right, it’s simply a matter of context.

In this figure, as in the pointillist painting, the colors of the 4 diamonds mingle in our eye. (yellow + red = perception of orange ...)

Our visual interpretation is once again fooled!

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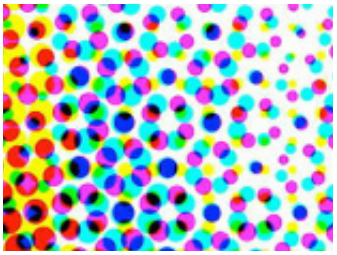
Process color vs. Pantone or Spot color

In printing shops, the four process colors and Pantone colors are the two main methods to print colors. Another process: the extended gamut printing has been explained already in the previous issue of Color News.

What are the differences between process color printing and the Pantone Matching System (PMS) in terms of results, costs and constraints?

When you look at a magazine photo very closely (with a magnifying glass if necessary), you can distinguish a multitude of tiny dots.

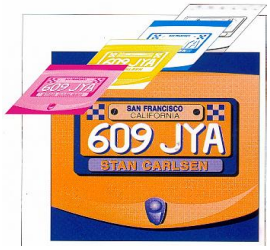
This is called a four-color image (or CMYK system) where the four main colors (CYAN, MAGENTA, YELLOW, BLACK) are juxtaposed in tiny dots to give the impression of a solid color.



Juxtaposition of dots – process colors

The three primary colors come from the subtractive synthesis. When these colors are superimposed in full tone, theoretically we expect to see a Black, but in reality, the result is a dark brown. The 4th component Black is used to obtain neutral grays (which is difficult to obtain from three primary colors), and to strengthen the image. Sometimes, the P. Black is nuanced with an additional pigment (blue) to deepen it and bring more contrast and sharpness to the image. From the 4-colors combination (dot percentage, and size), we can obtain a multitude of colors.

Despite this diversity of colors, some specific shades cannot be reproduced through this process. Especially bright colors are difficult to reproduce and seem faded. CMYK process would reproduce 50 % of the colors referred in the Pantone Guide.



PMS printing in full tone color matching beforehand

Same job printed in CMYK: Orange and R. Blue appear dull

For the rest of the colors, it is essential to work with the PMS (Pantone Matching System). Unlike the four-color process, which is an optical blend of colors (subtractive synthesis), the Pantone System is a physical mixture of colors (additive synthesis), that is, the inks are mixed together before being printed in full tone. Currently, the PMS therefore not relied on 4, but on 18 basic colors plus Transparent White, allowing to reach more than 1800 colors referenced in the Pantone Guide.

	+	–
Process Colors	– Cheap – Easy to use in prepress – Fast printing	– Not all colors are achievable (only 50 % of PMS) – Bright colors seem faded on press – Be vigilant regarding fastness
Extended gamut printing	– Larger color panel achievable in higher quality than in 4-colors process – Ink cost saving and higher productivity than Pantone System	– Not all PMS/spot colors are achievable (60–85 % of PMS)
Pantone Colors	– Higher color quality – Printed colors more in line with our expectations	– High cost for consumables – Variations between physical Pantone Guides

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Siegwerk Basic Ink System and process colors

The Siegwerk ink mixing systems were developed to allow printers to produce themselves specific colors by blending. Dedicated color ink assortments are realized for each ink range and are proposed as tools for color matching jobs. They are composed of 15–20 basic colors and Transparent White to adjust the intensity of the mixture.

TEMPO Nutripack 2 Color Ink assortment

We strive to offer optimal pigment selection, based on a wide gamut, and as possible in ad equation with the Pantone referential. The basic colors selection is varied to meet the multiple technical requirements.
Each pigment has its own specificity in terms of resistance (light, varnishing, laminating, sterilization, solvent, lactic acid and so on…). According to the application and the technical constraints, the pigment selection is limited. In general, our ink assortments are more exhaustive than the PMS book, since they include fast or thermo-fast pigments.

Fanal and low resistance pigments are also available in some ink assortments, but must be used with care. Indeed, they are not or very weakly solid to the light, alcohol and alkalis. Colors made of these pigments may turn in contact with certain adhesives or varnishes (acrylic or UV) or under light exposure. For the touchy applications, we recommend the use of fast pigments. (Please find more information on this topic in Color News N° 2).

Process colors (CMYK) are voluntary excluded from the ink assortments. Their intensity is much lower than equivalent basic inks (P. Blue, Rubine, Yellow and Neutral Black) as you can see below through the optical density measurement.

	OD (Status E)
Process CYAN	1,45
P.BLUE	1,53
Process MAGENTA	1,38
RUBINE	1,45
Process YELLOW	1,1
YELLOW	1,39
Process BLACK	1,42
Neutral BLACK	1,55

Moreover, in terms of colorimetry, process and basic inks can be rather different. The pigment composition is not always the same; P. Magenta for example is more bluish than Rubine, P. Yellow is more reddish than standard Yellow since a small amount of orange pigment could be added in the composition. The shading of certain process bases is necessary to prettify the printed image. Of course, a face printed from «warm» yellow is more flattering than a greenish face obtained from a cold yellow.

Process Blacks are also nuanced with Reflex Blue and Violet or P. Blue and P. Magenta. In solid tone printing, the bluish shading brings a certain depth, unexampled with a Neutral Black, which is more brownish. However, the process bases may sometimes be nuanced from non-solid pigments. This has no influence on the printing of multichromy, half tone or solid dark shades.

On the other hand, when blended in very light colors, such as a light gray, the process bases can quickly « turn » (change color) at light exposure. For illustration, there are two light greys below (10 % Black/90 % Transparent White), respectively made from Neutral Black and Process Black, in order to compare their light fastness. The P. Black is made of P. Blue and P. Magenta (non-fast). Neutral Black is naturally « warm » without toning, only formulated with black pigments (fast). After 1 day of exposure, the grey realized from Process Black has already turned (lightfastness 3). The light grey formulated from Neutral Black is much more resistant; its lightfastness was evaluated at 7. The components used for shading the P. Black are degrading under light. Used as a mixture in very small quantities, the solidity is even lower, implying inescapably a shade deviation after some hours of light exposure, as you can see below.

Neutral Black 10 % **Process Black 10 %**

Exposed side, during **15 days**

No visible change

Exposed side, during **1 day**

Visible shade deviation

Due to their low intensity and their toning (which doesn't resist to light), we strongly discourage to use the process colors in mixing systems. That is why the process colors are not proposed in the color ink assortments, dedicated to color mixing formulation.