

## Why do colours sometimes fail to match visually when they match instrumentally?

Andreas Kraushaar

Using the proper calibration, an outstanding colour accuracy, which lies within the measuring accuracy of modern handheld colour measuring devices, can be achieved today with the current generation of proof systems.

It is thus possible, for example, to match an individual offset print with a maxi-

tioner had to accept the promise that the visual match will get increasingly better with smaller CIELAB-colour differences between proof and production print.

Today, with the current generation of proofing systems and with the proper calibration, an accuracy that lies within

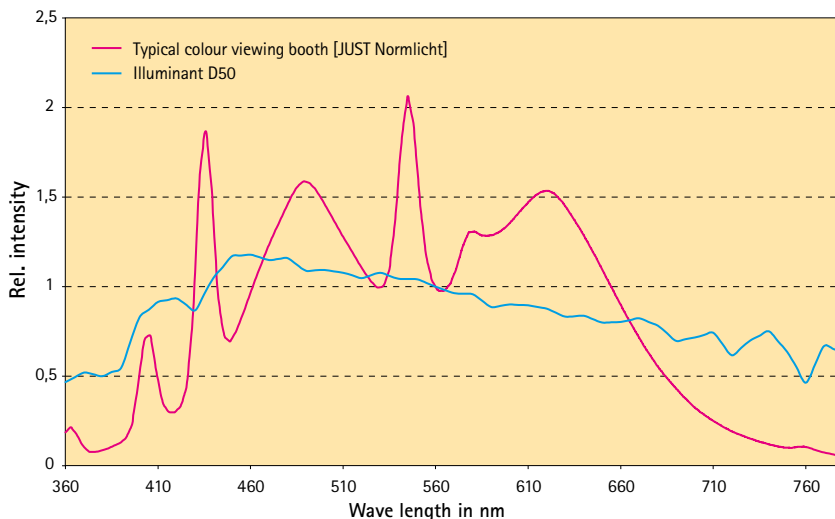


Fig 1: Relative radiant power distribution for illuminant D50 [blue] and a typical colour viewing booth.

mum colour difference of approx.  $\Delta E_{ab}^* = 1$ . The variations of a typical print run are naturally more extensive. In this scenario, the practitioner expects an almost perfect visual match between the proof and the production print. This, unfortunately, is sometimes not achieved in production – proof and production print can often differ distinctly, in spite of minimum  $\Delta E$ s.

### Problem description

For many years, the accuracy with which off-press and on-press proofs were produced was poorer than the accuracy of the colour measuring devices available. A remaining visual difference between proof and press sheet was generally attributed to that inaccuracy. The prac-

the measurement accuracy of modern handheld colour measurement devices can be achieved. The latter was examined in Fogra Research Report [Nr. 52.034]. It displays a CIELAB colour distance  $\Delta E_{ab}^*$  between 0.5 and 1, taking into account the variability of typical offset print samples.

It is possible for high-quality proof printing systems, when using just one measurement device, to attain a colorimetric accuracy that cannot be improved any more measurably. Here is an example: One takes a randomly selected offset print that includes the ECI2002 test chart. This is measured spectro-photometrically. A proof matched to this print can be reproduced with a maximum colour deviation of  $\Delta E_{ab}^* = 1$  using the colour patches of the ECI2002. In other

## It pays to be a member of Fogra

As a member of Fogra, you will be given a 30 % discount on Fogra's hourly rate for consultancy and technical reports.

You can purchase digital and film-based control devices at the Fogra member's price [25 % off regular price].

You will receive all the Fogra publications free of charge [up to 5 copies].

As a Fogra member, the Fogra database offers you a 25 % discount on literature searches and all other literature services, as well as on the review of patents.

All Fogra seminars and symposia are offered to you at a 30 % discount.

### Symposia of Fogra

Colour Management Symp.  
21/22 February 2008

UV Printing User Forum  
29/30 October 2008



words this means that proof and production print do not show significant colour differences. Accordingly, proof and production print should be indistinguishable – when observed by the standard observer and under standard viewing conditions. This is equally valid for two comparable proof prints.

### Colour matching practice

Distinct visual differences are still observed in the colour matching practice: proof prints that are within the pertinent tolerances, such as the Ugra/Fogra media wedge stipulated in the MediaStandard Print 2006, may not perfectly match with the production run. This situation is independent of the used colour difference formulae such as CIELAB, CIEDE94 or CIEDE2000.

Potential buyers of a proofing system primarily evaluate it based on its ability to produce a proof print that simulates the production print accurately, and finally make a decision on the grounds of their visual judgement. Manufacturers of proof printing systems are thus forced to establish a visual correction, which inevitably impairs larger measurable differences. This leads to situations that occur, like for example at the Digitalproof Forum, an event for the comprehensive assessment of proofing systems, organised by the bvdm and ECI. Two proof prints are made on the basis of an offset print; one based on objective colour measurement values, while the other is matched visually. This is most counter-productive for the purpose of a standardised workflow. Printer, proofing system manufacturer and above all, the customers of print products need a simulation or reproduction of the final print whose quality is objectively accessible.

### Cause study- Lighting

The most obvious reason for lacking agreement between the measured and the visual colour difference lies in non-standard lighting. Here the lighting in typical viewing booths used for colour matching and the one used in colour measurement devices differ significantly from the CIE standard illuminant D50.

Various handheld measuring devices measure using filament incandescent [bulb] or LED light that by nature possess a much smaller portion in the blue and UV region of the spectrum than prescribed for standard lighting D50 [5000 K]. The second factor comprises the light present at the time of the colour matching, which as a rule neither concurs with the standard lighting type D50 nor with the lighting used during colour measurement. Standardised light boxes and colour matching cabins are mostly equipped with fluorescent lamps, which have a colour temperature of approx. 5000 K, though they omit another relative spectral power distribution – see fig. 1.

The different percentages of UV in measurement and colour viewing are of great importance, especially in the context of the different amounts of optical brightener in proofing and production papers. The equipment of adjustable UV LEDs in colour measurements devices and colour matching cabins promise interesting potential for improvements in that field.

### Another building block of the solution – "basic colorimetry"?

Firstly, CIE colorimetry as the basis must be explained to be able to analyse further reasons for the disagreement between measurement values and visual judgement. It is of fundamental impor-

tance in, and key for possible solutions for the understanding of this problem.

For decades now, the printing industry has been using the standards of the International Lighting Commission CIE [French: Commission Internationale de l'Eclairage], established in 1931. The CIE system allows the specification of colour matches for a standard observer using colour matching functions. These colour matching functions for normal human observers are the fundamental basis of colorimetry and date back to experiments performed by Wright and Guild. In this experiment, test persons adjusted a non-textured test colour patch against a non-textured adjoining reference colour patch with the help of three controls [for the red, green and blue constituents of the test colour]. The matching field subtending a visual angle of 2°.

The average of all test persons was transformed to the so-called "CIE 1931 2°-normal observer". Though, two colours that have the same CIEXYZ tristimulus value cannot be differentiated from one another under the conditions described above. The similarity of colours with the same colour values is a fundamental basis of the "basic colorimetry". In contrast, "advanced colorimetry" concerns itself with the appearance and/or perception of colours in the human brain where colours are not necessarily identical, if their CIEXYZ values are virtual identical. In fact, further factors like e.g. the ambient lighting and the image structure also contributes to the final judgement. Based on this, it becomes obvious that colour appearance is dependent on many factors.

› To be continued in Fogra News no. 6



Chairman of Executive Committee:  
Stefan Aumüller

Responsible for the content:  
Dr. Eduard Neufeld

Editor:  
Rainer Pietzsch

Address for publisher, print and all responsables:

**Fogra Forschungsgesellschaft Druck e.V.**  
**Graphic Technology Research Association**

Streitfeldstraße 19, 81673 München, Germany

Tel.: +49 89. 431 82 - 0

Fax: +49 89. 431 82 - 100

E-mail: [info@fogra.org](mailto:info@fogra.org)

Internet: [www.fogra.org](http://www.fogra.org)

ISO News

**The latest from international standardisation**

*Dr. Uwe Bertholdt, Andreas Kraushaar*



*Chairman, convenors and secretaries with their gifts.*

ISO TC 130 represents the international standardization body for the printing industry. International experts active in prepress, press, materials and work safety met in Tokyo at the end of September.

**Prepress and data exchange [WG 2]**

One focus of interest was the discussion on the „XML-Paper-Specification“ – XPS, originally developed by Microsoft to be published as an ISO Standard. Therefore a joint working group with Ecma TC46, the responsible committee within the European Computer Manufacturers Association, will be established to be able to ensure an active participation of the printing industry.

In addition new standardised images for colour spaces with an extended gamut were discussed [ISO 12640-4/5]. Part 3 of this Standard defines CIELAB-test images [16-Bit TIFF] and is now available at [www.beuth.de](http://www.beuth.de). Task force 3 [variable data printing] began their deliberations concerning the enhancement of the PDF-Standards [“VPDF”] providing necessary mechanisms for variable data workflows. We expect exciting advances especially for cross-media web2print solutions.

The PDF/X-Standards PDF/X-4 and PDF/X-5 defining blind data exchange are presently under ballot for final publication by the end of this year. Detailed information regarding PDF/X may be found at [www.callas.de](http://www.callas.de).

**Process control and related metrology [WG3]**

ISO 3664: More stringent requirements regarding viewing cabinets have been incorporated into the current draft. An additional annex will be introduced providing a working example including necessary calculations. The publication of the Standard is expected by mid 2008.

**ISO 13655:** Final comments on this draft were resolved, publication as a Draft International Standard is expected soon. Three different measurement conditions are defined:

“M1” – makes provisions for illuminant D50

“M2” – makes provisions for UV-cut measurements

“M3” – extends “M2” by provisions for measurements using polarisation filters.

It is therefore possible to unambiguously identify the correct measurement conditions within any process standard [e.g. ISO 12647-2] in order to facilitate the individual tasks such as the definition of the solid coloration.

**ISO 12647-7:** While the standard is currently under ballot for final publication [end of october] the so called „Design Proof“ has been discussed. It is part of an immediately revision also under balloting as an NWI [new work item]. This is caused and mainly supported by the industry needs to have a defined colour reference in the design process. It was discussed to not call this less stringent category “Proof” rather than “Validation Print”. Final publication of this standard is not expected before 2009.

**ISO 12646:** Final marginal comments have been resolved. This document will be send to ISO for publication as final standard. It will be available early 2008.

**ISO 12647-2:** The pro and cons of a single or a additional TVI-curve [tone value increase] has been discussed elaborately. It was agreed on that a second amendment would be initiate including an additional curve reflecting CtP plate making. The further use of existing and successfully used TVI-curves [e.g. for FOGRA39] could find consensus.

In this light the technical specification TS10128 has been initiated as a working draft. It mainly describe three different

method of process calibration namely the “TVI-method”, a “grey balanced method” and a “method using device link profiling”.

**Paper categorisation:** TaskForce 1 within WG3 is dealing with the paper categorisation. Existing and new work has been discussed. Because of the complex matter of the proof to print match over the entire process control chain it was agreed that further developments needs to be done. It is planed to set up an internet website to serve as a central point for coordination and information.

**Media and Materials [WG4]**

Final consensus could be found in the standard ISO 12635 stipulating dimensional properties of printing plates for offset printing. Critical issues were related to plate thickness, cutting burr, edge waviness and plate edge straightness. Among others these parameter have a fundamental impact on the resulting print quality, a safe handling within the imager as well as the integrity of the blanket.

The committee further discussed improvements concerning the preparation of test prints for screen printing [ISO 2834-3].

The standard's dealing with colour and transparency of printing inks for gravure [ISO 2846-3] as well as the assessment of resistance of prints to various agents [ISO 2836] could be confirmed.

The committee encourages a liaison with ISO TC 6 [Paper, board and pulps] concerning the work on printability testing. Finally a new work item defining test methods on chemical ghosting has been initiated.

**Next Meetings:**

14-19 April 2008 [Paris]

22-27 September 2008 [Amsterdam] ↴



### Science meets colour

In light of the 15th anniversary of the International Color Consortium [ICC] Fogra organizes this Colour Management Symposium. The ICC colour management is the well known de-facto standard in the graphic arts industry.

New technologies, such as media-independent workflows, throw new challenges in the direction of future ICC colour management. This Fogra symposium will establish a platform to address these and forthcoming challenges.

### Don't miss it!

Info online: [www.fogra.org](http://www.fogra.org) → Events

**The updated and printed programme is now available!**

Yes, send me ...

the detailed printed programme of the Fogra Colour Management Symposium to the following address:

Fogra-Fax: +49 89. 431 82 - 100

### The Working Committee for UV Printing

## A Practical Guide for Beginners and Experts in UV Technology

The founding of the working committee for UV printing is an initiative of the »Berufsgenossenschaft Druck und Papierverarbeitung« and presently has 49 enterprises involved in the supply industry, the printing industry, research, education and various associations. The Practical Guide to UV Technology is the result of this committee's work.

The Practical Guide is intended for both beginners and experts in the UV field. The printer will be able to find his particular situation in the representation of every aspect of UV printing processes. Examples taken from practice give him an overview of the UV components and useful combinations that are available today. The Practical Guide is not a conventional reference or text book. In passing on their practical experience and know-how, their particular views when evaluating various stages of the process and not least, in presenting a profile of their companies, the authors invite users of UV technology to a dialogue with them. In doing so, they enable the UV printer to ask specific questions and have specific requirements of the supply industry.

Section 2 offers comprehensive knowledge of the basic principles of health and safety, care of the environment and the technological requirements for the planning, design and securing of a stable UV printing process. Sections 3 to 7 show that UV printing is now possible in every process – despite the differences in development and the range of applications. Quality and profitability, as well as the degree of standardization, show diversity which is typical for this field. It becomes apparent, however, that UV technology is no longer an isolated application.



Fogra focused on the following topics in this practical guide to UV printing:

- Guidelines for the technical application of UV curing
- Testing curing taken place by radical UV radiation curing
- Offset standard permeating all stages of the process

- Moves to standardize testing procedures for hybrid inks
- Standardized workflows in UV screen printing
- Industry initiative to reduce solvent emissions
- Avoiding corrosion damage to UV presses
- European project for health and safety in the workplace.

The Practical Guide to UV Technology is divided into seven sections.

Section 1 gives an introduction to UV radiation curing. Here it is clarified which particular problems, related to the UV process, effect all manufacturers of lamps, what specific developments there have been, which solutions companies are choosing, where the strengths of the systems are, and what the emphasis will be on in the future.

Distributor: Berufsgenossenschaft Druck und Papierverarbeitung  
D-65185 Wiesbaden  
Dr Bernhard Küter and Dr Axel Mayer  
phone ++49 [0]611-131-326  
fax ++49 [0]611-131-319  
e-mail: [chemie@bgdp.de](mailto:chemie@bgdp.de)  
Volume: 372 pages [with 400 coloured illustrations], price: 89 Euro