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Construction of the Characterization Data Sets (Fogra 51 and 52 Beta, March 2014)

Documentation for the ECI FRED15 Project

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The Foundation: Spot-On PCx Characterization Data

- Created by Dr. Bestmann, Heidelberger Druckmaschinen AG, for all 8 new paper categories
- based on new colorant descriptions from ISO 12647-2:2013 (meaning: the old colorants printed on the updated papers)
- and standard tone value curves for AM screen
- and averaged existing spectral measurement data which have been tuned to match these.

- The PC1–PC8 data sets are said to be device-independent
- but nevertheless carry their history of creation.

Derived Data Sets for Practical Use

- Created by Dr. Hoffstadt, GMG GmbH & Co. KG, for typical woodfree coated and uncoated papers
- based on PC1 and PC5 spectral data sets
- interpreted as M0 data
- converted from GMDI to XRGA with X-Rite technology
- applied Annex B method to adjust paper white
- then applied CMYK-based OBA correction from M0 to M1

- to end up at a chosen representative CIELAB paper white (PW).

CMYK-Based LAB correction from M0 to M1

- Average based on M0,M1,M2 measurements
  (Konica Minolta FD-7, Techkon SpectroDens, X-Rite i1pro2 and eXact)
- on up to 23 CMYK target data sets for different papers and inks
- good agreement between devices and across papers
- normalized to Δb*=-1 (e. g. M0-M1) and scaled as needed
- CMYK-based multilinear interpolation in 2×2×2×2 table
- after dot gain adjustment by +10% (result of optimization)
  (adjust tone value t by: $x = (t - 50)/50$; $x = 1 - x^2$; $t = t + gain \cdot x$)

- tested successfully by predicting M1 from corresponding M0 target data sets.

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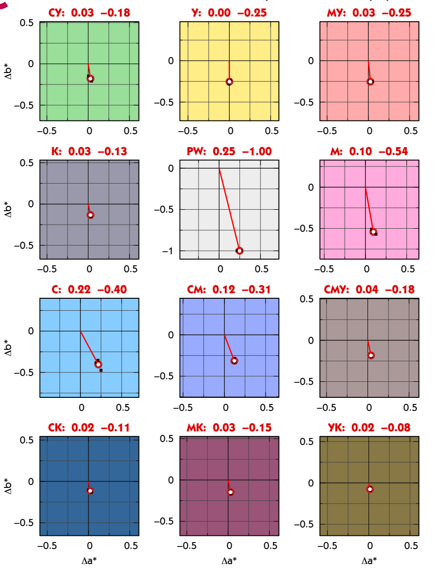
CMYK-based correction table

ΔL*	Δa*	Δb*	Corner
0.0574	0.2475	-1.0000	PW
0.0326	0.2170	-0.4044	C
0.0083	0.0952	-0.5417	M
0.0118	0.0010	-0.2538	Y
-0.0125	0.0269	-0.1334	K
0.0104	0.1213	-0.3139	CM
0.0087	0.0277	-0.1788	CY
-0.0003	0.0250	-0.2534	MY
-0.0161	0.0208	-0.1138	CK
-0.0172	0.0301	-0.1483	MK
-0.0127	0.0158	-0.0773	YK
-0.0034	0.0390	-0.1825	CMY
-0.0182	0.0247	-0.1228	CMK
-0.0127	0.0134	-0.0719	CYK
-0.0131	0.0187	-0.0849	MYK
-0.0116	0.0176	-0.0772	CMYK

PC5: OBA excitation ΔCIELAB shift per Δb*=−1 on paper

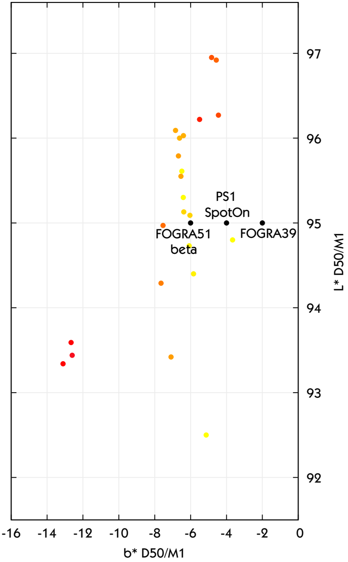


Choosing the Paper White from Market Survey

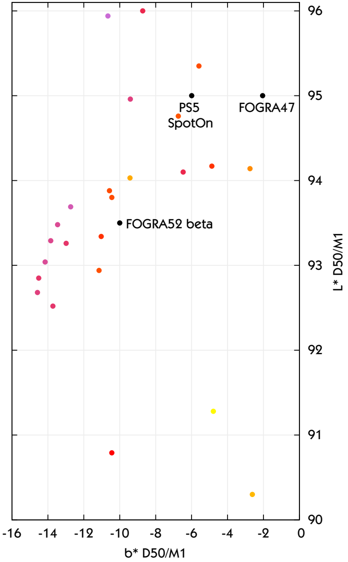
- Market Survey of WFC and WFU Papers
- M1 measurements (FD-7, SpectroDens, i1pro2, eXact)
- WFC choice: CIELAB 95.0 1.5 -6, Δb* (M2-M1) = -6
- WFU choice: CIELAB 93.5 2.5 -10, Δb* (M2-M1) = -8
- WFC papers vary mainly in L*, so the paper tint is representative.
- WFU papers vary strongly in b*, -10 is a conservative estimate.
- Lower L* also to alleviate gamut restrictions in proofing

- Much positive feedback during the field test.

Woodfree Coated Paper



Woodfree Uncoated Paper



Detailed Procedure for FOGRA51 beta

Calculating backwards from the M1 paper white (PW) aim value.

- WFC choice: M1 Lab 95.0 1.5 -6, assumed Δb (M0-M1) = -2
  (confirmed by some of the underlying WFC data sets re-measured with FD-7)
- Use this Δb = -2 to scale OBA correction table
  (The OBA correction for PW is therefore ΔLab 0.11 0.50 -2.00)
- Subtracting from M1 PW yields M0 aim: Lab 94.89 1.00 -4.00
- Now we can use Annex B to adjust the PC1 XRGA data to this
  (with PW Lab 95.00 1.16 -3.84 and black XYZ offset chosen as Lab 10 0 0)
- Apply first Annex B, then OBA correction to all patches.

The spectral PC1 XRGA data set can be provided upon request.
Note that the same CMYK OBA correction table is used for PC1 and PC5.

Detailed Procedure for FOGRA52 beta

Calculating backwards from the M1 paper white (PW) aim value.

- WFU choice: M1 Lab 93.5 2.5 -10, assumed Δb (M0-M1) = -2.5
  (confirmed by some of the underlying WFU data sets re-measured with FD-7)
- Use this Δb = -2.5 to scale OBA correction table
  (The OBA correction for PW is therefore ΔLab 0.14 0.62 -2.50)
- Subtracting from M1 PW yields M0 aim: Lab 93.36 1.88 -7.50
- Now we can use Annex B to adjust the PC5 XRGA data to this
  (with PW Lab 95.00 1.18 -3.85 and black XYZ offset chosen as Lab 26 0 0)
- Apply first Annex B, then OBA correction to all patches.

The spectral PC5 XRGA data set can be provided upon request.
Note that the same CMYK OBA correction table is used for PC1 and PC5.

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Why all this effort?

Advantages of the derived data sets, which:

- Provide the printer with M1 aim values for process control which are better achievable with today's M1 instruments (both due to OBA correction and XRGA conversion)
- Provide the print buyer with a practical standard what to expect by realistic proof and soft-proof simulation
- Avoid the required individual paper adjustments according to ISO 12647-2:2013 Annex B for most WFU papers

Otherwise, most notably changes in Cyan inking would result when aiming for the M0 GMDI based values with M1 XRGA devices.

Detailed explanations are given on the following slides.

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The History of the New Colorants

In particular, how CD1 and CD5 have been created.

- Find representative offset characterization data (any screen)
- Use only the corners: C,M,Y,K solids and their overprints
- Decide on CIELAB for paper white
- Normalize corner CIELAB values of data sets to this white
  (XYZ-scaling method with offset, now in various ISO standards)

At that time, these available data sets have been used:

1. Previous FOGRA## sets, especially the newer 43, 44, 47 (2009)
2. Fogra research project 10.054 on backing (2009–2010)
3. A few other test prints e. g. by Heidelberger

Facts to Consider

Measurement data are from real-life devices:

- FOGRA## data sets: based on Gretag Macbeth SpectroScan
- Fogra backing project: SpectroScan and Barbieri Spectro LFP
- Heidelberg data for Maxi Offset (uncoated): Image Control
- SpectroScan and Spectro LFP are M0 devices
- The Image Control measurement device is close to M2

No M1 device available at that time.

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Consequences Related to OBAs in Paper

Due to lack of existing M1 technology in the past:

- The standard advocates M1 but the basic data aren't.
- Also paper white CIELAB values are at best M0
  (but more like an international compromise)
- No problem for OBA-free or -poor substrates
- No problem for PC2 (LWC+), still low fluorescence
  (FOGRA45/ECI WOWG data are M0, paper is representative)

- Small problem for PC1, bigger problem for PC5
- Almost all uncoated papers are outside of PS5
  (M1-CIELAB 95 1 -4 $\pm$ 2)

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What ISO 12647-2:2013 Suggests

If your paper is different, simply adjust CD aim values.

- Informative Annex B describes one method
  (again, XYZ-scaling method with offset)
- which is appropriate for small differences in white
- but not appropriate for OBAs, biggest error in solids

- Error makes process control aims harder to achieve
  (especially in Cyan: 1 ΔE)
- Cumbersome to do for each M1 paper white
  but required for most WFU papers!

Practical Considerations

M1-capable devices are a new group not only regarding M1.

- Gretag Macbeth SpectroScan is BAM-traceable
- X-Rite has switched to XRGA (partially NIST-traceable)
- Biggest difference to SpectroScan: in high chroma (solids)
- Konica Minolta FD-7 is also NIST-traceable
- Techkon SpectroDens is also in good agreement
- In total, better agreement than among old M0 devices
  but also shifted with respect to legacy M0 (and thus PC*)

- Even more problems for process control, also for PC1
  (Cyan: additional 1.5 ΔE)
- Solution: conversion to XRGA reflects cross-vendor traceability

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Comparing Media-relative Aim Value Corrections

- Annex B: informative, McDowell method
  - exchanges the color of the substrate
  - useful as correction in L* and/or a*b*
  - but neglects color effect of OBAs
- Accounting for different OBA excitation
  - measured L*a*b* shift
  - scales well with UV content of light source (M0 to M1 or to M2)

By combination of both methods it is currently planned to address also yellowish WFU papers (no OBAs, different paper tint, the former PT5).

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Adjusting OBA excitation (M0, M1, M2)

- Incoming UV and outgoing blue fluorescence are filtered differently by C, M, Y, K inks and overprints
- measured CIELAB shifts are better suited than XYZ scaling
- Can also be used to approximate different levels of OBA content in paper
  (as opposed to different levels of UV content in light source)

However, the CIELAB shifts are characteristic for CMYK inks. They cannot be used for different inks, and the method cannot yet be applied in a spectral way.

Thank you for your attention.