IDEAlliance Substrate Relativity Calculator:
Users Guide

Substrate Relativity Overview

Substrates used in todays printing industry can vary widely in terms of color of the substrate.   The color of the substrate can affect the printed result when targeting standard characterization data sets. Many print buyers are specifying print based on GRACoL and SWOP characterization data sets but have specified a printing substrate that does not have the same colorants as the characterization data sets. When the substrate color shows a great enough difference from the substrate in the dataset a color-matching problem occurs. Finding a substrate whose CIELAB values are within tolerance of the substrate aims according to ISO 12647-2 for example, is exceedingly difficult. The Substrate Relativity Spreadsheet and related documentation was created to offer a solution to those who wish to aim at industry standards/specifications, but utilize substrates atypical from that defined by current ISO standards.

The Substrate Relativity Calculator allows the user to recalculate industry standard or custom characterization data sets based on the CIELAB values of a given substrate. The procedure utilizes the tristimulus correction methodology defined in ISO 13655 Annex A for correcting measurements based on two backing materials. Once the data is modified relative to the new CIELAB values, the user is provided an idea on how the substrates color will affect the final printed result. The recalculated data can be used to generate profiles for more accurate proofing/converting, and the reported CMYK, RGB and Gray patches can be used for new process control aims when on press with the new substrate.

When a data set has been calculated it may refer to as a 'Relative' data set. For example the GRACoL or SWOP datasets calculated on a new substrate may be referred to as GRACoL Relative (Paper Definition attached) or SWOP 3 Relative (Paper Definition attached.)

Instructions for use:

Determining if a Substrate Is Out of Spec

Each IDEAlliance dataset contains a substrate definition. These definitions are expressed in CIELAB. CIELAB values can be obtained with a spectrophotometer (0/45, D50, 2degree observer)

IDEAlliance is currently researching tolerances for substrate variation to provide a more accurate idea of when the substrate should be recalculated. Currently the tolerance is 5 ΔE^*_{ab}

The Reference Data Worksheet:

This kit includes a spreadsheet named <u>SubstrateRElCalcv4.xls</u> that can be used to recalculate the dataset for a new substrate.

In the User Input area, three standard characterization data sets are preloaded and can be selected. The preloaded data sets are:

- **TR006: GracolCoated1**
- **TR003: SWOP Coated3**
- **TR005: SWOP Coated5**

(Customer characterization data sets can also be calculated by loading custom data. This will be covered in another part of this document.)

Calculating Data

1. Before recalculating data the user must select the reference data from the drop down menu titled 'Select Reference Data to Modify' in the upper left hand corner.

User Input
Select Reference Data to modify:
CGATS TR006 (GRACoLCoated1)
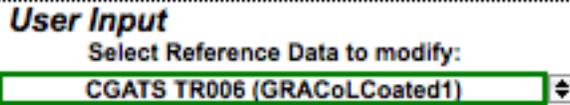
2. The user then needs to enter the new substrate white point in CIELAB values. CIELAB values can be obtained with a spectrophotometer (0/45, D50, 2degree observer).

Enter New Paper White Value

L*	a*	b*
95	-0.02	-1.96
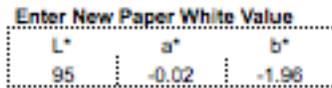
3. The Analysis area shows typical process control patches both before and after modification. This displays new colorimetric aim targets based on the change in paper color. The most common use of this information would be to provide new solid and overprint targets for the substrate being calculated. For example, a press operator might utilize this modified data to set colorimetric targets for solids and overprints when operating a printing device. The Deltas Column on the right side of the 'Analysis' display shows the deviation of the characterization data sets after substrate relative modification. This gives the user a gauge as to how much effect the paper color will have on these patches.

Analysis

	Before: CGATS TR006 (GRACoLCoated1)			After			Deltas			
	L*	a*	b*	L*	a*	b*	dL*	da*	db*	dE76
Cyan	54.96	-37.12	-50	54.96	-37.12	-50	7.1E-15	1.4E-14	0	1.6E-14
Magenta	47.93	74.11	-3.01	47.93	74.11	-3.01	7.1E-15	4.3E-14	2E-14	4.8E-14
Yellow	88.94	-5.02	93.17	88.94	-5.02	93.17	0	2.5E-14	1.4E-14	2.9E-14
Black	14.95	0.19	-0.14	14.95	0.19	-0.14	0	4.3E-15	6.8E-15	8E-15
Red	47.37	68.25	48.79	47.37	68.25	48.79	0	2.8E-14	7.1E-15	2.9E-14
Green	50.12	-68.43	25	50.12	-68.43	25	7.1E-15	1.4E-14	0	1.6E-14
Blue	24.13	17.2	-46.14	24.13	17.2	-46.14	3.6E-15	3.6E-14	0	3.6E-14
Gray (HR)	57.54	-0.12	-1.44	57.54	-0.12	-1.44	7.1E-15	9E-15	3.1E-15	1.2E-14
White	95	-0.02	-1.96	95	-0.02	-1.96	0	2E-14	6.2E-15	2.1E-14

4. Once the user input data is entered/selected, the entire data set's recalculated XYZ and CIELAB values are immediately available under the "Substrate Modified Data" heading. This data can be copied and pasted into a CGATS format text file for profile creation. A sample CGATS file titled 'Custom_Dataset.txt' has been supplied in this kit. To move the calculated data into the supplied file you would copy rows 25-O-1641-T and paste this data into 17-G in the supplied CGATS file titled 'Custom_Dataset.txt. This

calculated dataset could be used with various color management applications and RIPs to create profiles for use in proofing and color management. A common use for this data file would be to create an ICC profile.

Substrate Modified Data

X	Y	Z	L*	a*	b*
84.4728	87.6183	74.5478	95.00	-0.02	-1.96
76.8488	76.3898	66.5345	90.04	6.51	-3.32
69.8422	66.2229	59.0295	85.11	13.22	-4.54
63.1892	56.7344	51.5045	80.03	20.38	-5.35
57.2651	48.4374	44.6056	75.10	27.61	-5.85
49.5289	37.688	35.2018	67.79	39.27	-6.09
42.6703	28.5137	26.7031	60.35	51.93	-5.67
36.9489	21.2758	19.5894	53.25	64.88	-4.44
32.9794	16.7394	14.9764	47.93	74.11	-3.01
73.5905	77.9564	72.496	90.76	-3.24	-7.48
66.9853	68.0871	64.7184	86.05	2.96	-8.49
60.9277	59.1428	57.4807	81.37	9.36	-9.41
55.1316	50.7051	50.2971	76.50	16.29	-10.09
49.9774	43.3176	43.7638	71.77	23.32	-10.56
43.2029	33.7454	34.8006	64.76	34.50	-10.74
37.0486	25.3968	26.5443	57.46	46.86	-10.38
31.9556	18.8574	19.6669	50.52	59.29	-9.31
28.5051	14.8907	15.1053	45.38	68.80	7.99

This profile would be used to predict/simulate printing on this substrate. Applications may include calibrating a proofing system using the profile, soft proofing using the profile, and separation and conversion of images using the profile.

Modifying Custom Data:

Many users of G7 may be working with print methods such as flexo or screen that do not use the GRACoL or SWOP datasets. Because of this there is a need to calculate custom datasets. A tab on this worksheet is available for modifying custom characterization data based on user defined substrate color. This will allow a user to use data sets other that TR006, TR003 or TR005. These can be other standard datasets, or custom data. It should be noted that the worksheet is intended only for up to a patch count of 1617 (the number of patches in the IT8.7/4 target). If users data is more than this amount, the cell formulae will have to be modified.

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GRACoL
General Requirements for Applications
in Commercial Offset Lithography

Calculation of Custom Data Relative to Substrate White Point

User Input

1

Paste CIELab Measurement Data (up to 1617 patches) From Where Indicated.

2

Enter Current Paper White Value

L*	a*	b*
95	-0.02	-1.96

Enter New Paper White Value

L*	a*	b*
95	-0.02	-1.96

3

Min Patch*

L*	a*	b*
10	0	0

Paste Custom Data Here

Substrate Modified Data

X	Y	Z	L*	a*	b*	X	Y	Z	L*	a*	b*
0	0	0				0	0	0	0.00	0.00	0.00
0	0	0				0	0	0	0.00	0.00	0.00
0	0	0				0	0	0	0.00	0.00	0.00
0	0	0				0	0	0	0.00	0.00	0.00
0	0	0				0	0	0	0.00	0.00	0.00
0	0	0				0	0	0	0.00	0.00	0.00
0	0	0				0	0	0	0.00	0.00	0.00
0	0	0				0	0	0	0.00	0.00	0.00

Please Provide Feedback

This spreadsheet is based on the Tristimulus Linear Correction method as specified in ISO DIS 15339-1. Though this spreadsheet is provided freely and without support, questions, comments and suggestions about the methodology and its implementation can be directed to the GRACoL Committee. Please send comments to ron@ronellis.us or jfazzi@idealliance.org

Legal Disclaimer

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