L*a*b* values of process inks for commercial printing

When it comes to colour management, one question that crops up again and again relates to the correct L*a*b* values of the process colours. These values have been defined and described in the international standards DIN ISO 12 647 and DIN ISO 2846.

DIN ISO 2846

DIN ISO 2846 Parts 1 and 2 define the process colours for the four-colour offset process. DIN ISO 2846-1 specifies the colour values for sheet-fed offset and web-offset heatset inks and DIN ISO 2846-2 specifies the colour values for web-offset newspaper inks, which must be obtained under defined conditions using a printability tester and on specific test stock. These two standards therefore form the basis upon which printing ink manufacturers work, but actually relate solely to proofing in the laboratory.

Colorimetric values per DIN ISO 2846-1
(standard illuminant D50, standard observer 2°)

Ink	CIELAB value **L***	**a***	**b***	**Colour tolerances ΔE_{ab}***
Yellow	91.00	-5.10	95.00	4.0
Magenta	50.00	76.00	-3.00	4.0
Cyan	57.00	-39.20	-46.00	4.0
Black	18.00[1]	0.80	-0.00	-

[1] no tolerance band for L*, rather an upper limit

DIN ISO 12 647

DIN ISO 12 647-2 (sheet-fed offset and web-offset heatset) and DIN ISO 12 647-3 (web-offset newsprinting) define the parameters and the test methods and conditions required for proofing and the production run. Accordingly, these standards contain not only the colour values to be aimed for on 5 different classes of substrates but also specifications regarding inking of the stocks, dot gain, screen ruling and other parameters. The colour values on the 5 standardised stocks are obtained by making printshop prints with inks that conform to DIN ISO 2846.

COMMENT

The data listed below refer to the amended ISO/CD 12 647-2.2 or the values of the Altona Test Suite.

Colour values of the commercially available stocks

Black backing

Paper grade	L[1]	a[1]	b[1]	Gloss	Grammage g/m²
1. glossy coated wood-free	93	0	-3	65	115
2. matt coated wood-free	92	0	-3	38	115
3. glossy LWC	87	-1	3	55	70
4. uncoated white	92	0	-3	6	115
5. uncoated yellowish	88	0	6	6	115
Tolerance	±3	±2	±2	±5	

[1] Specifies values per ISO/CD 12 647 - 2.2: D50, 2°, 0/45 or 45/0

White backing

Paper grade	L[1]	a[1]	b[1]	Gloss	Grammage g/m²
1. glossy coated wood-free	95	0	-2	65	115
2. matt coated wood-free	94	0	-2	38	115
3. glossy LWC	92	0	5	55	70
4. uncoated white	95	0	-2	6	115
5. uncoated yellowish	90	0	9	6	115
Tolerance	±3	±2	±2	±5	

[1] Specifies values per ISO/CD 12 647 - 2.2: D50, 2°, 0/45 or 45/0

Inks in accordance with DIN ISO 2846 produced, under printshop conditions, the following CIELAB coordinates (colour sequence: cyan, magenta, yellow) on the stocks stipulated:

L*a*b* values[1]

Paper grade	1+2			3			4			5		
	L*	a*	b*	L*	a*	b*	L*	a*	b*	L*	a*	b*
black backing												
Black	16	0	0	20	0	0	31	1	1	31	1	2
Cyan	54	-36	-49	55	-36	-44	58	-25	-43	59	-27	-36
Magenta	46	72	-5	46	70	-3	54	58	-2	52	57	2
Yellow	87	-6	90	84	-5	88	86	-4	75	86	-3	77
Red (M+Y)	46	67	47	45	62	39	52	53	25	51	55	34
Green (C+Y)	49	-66	24	47	-60	25	53	-42	13	49	-44	16
Blue (C+M)	20	25	-48	21	22	-46	36	12	-32	33	12	-29
Cyan (M+Y)	22	0	0	22	0	0	32	0	0	31	0	0
white backing												
Black	16	0	0	20	0	0	31	1	1	31	1	3
Cyan	55	-37	-50	58	-38	-44	60	-26	-44	60	-28	-36
Magenta	48	74	-3	49	75	0	56	61	-1	54	60	4
Yellow	89	-5	93	89	-4	94	89	-4	78	89	-3	81
Red (M+Y)	47	68	48	47	67	43	54	55	26	53	58	37
Green (C+Y)	50	-68	25	50	-64	27	54	-44	14	50	-46	17
Blue (C+M)	24	17	-46	25	20	-44	38	8	-31	34	12	-29
Cyan (M+Y)	23	0	0	23	0	0	33	0	0	32	0	0

[1] Specifies values per ISO/CD 12 647 - 2.2: D50, 2°, 0/45 or 45/0

Cielab-ΔE tolerances for the primary colour solids

	Black	Cyan	Magenta	Yellow
Variation	5	5	5	5
Fluctuation	4	4	4	5

Preliminary tests

The ink that is checked by the ink supplier in accordance with DIN 2846-1 is now proofprinted on one of the paper grades listed above in accordance with the procedure described below in order to determine its press characteristics, the „best“ specified chromaticity points and the dot gain in the printing process. Priority is given here to the chromaticity point.

Procedure

Here is the procedure as described in the **Altona Test Suite - Application Kit:**

- Preparation of a test form containing the control resources to test the even ink duct zone setting, the variation of density along the printing direction, and halftone patches.
- The printing plates are exposed in the RIP without a correction table. Machine printing begins on the basis of a significant underinking of the primary colours and is continued in small steps up to significant overinking.
- At the point at which the desired coloration is achieved, the variation of density along the printing direction is again checked.
- Variation of density along the printing direction: Here, the difference in the density between the largest and the smallest value should not exceed 10 %, if not, the onset of the reciprocating distributor roller had to be corrected.
- During the inking series, all L*a*b* values (ISO 13 655 conditions: 0/45, D50, 2°, CIELAB) and the corresponding solid tone densities in CMYK are measured in a wet condition (!).
- Inking series: The colour provided by a printing ink and the measurements are continued until the orginally falling DE values (relative to standard CIELAB values, cf. Table 3, section 10) rise significantly again.
- The individual sheets of the inking series are evaluated 20 h later at the earliest because the standard CIELAB values pertain to the colour of the dry sheet.
- For the dry sheet which has the lowest DE values compared with the target values, the wet density values and the wet L*a*b* values recorded for the fresh sheet are determined; these are then used as the target values for all further steps.
- At the same time, this sheet is also used to determine the tone value increase in print and it serves as a basis for any change or adjustment of the LUTs in the RIP for the individual CMYK colours.
- The print forms are exposed again and then printed with the newly defined solid tone densities.
- Now it must be checked whether the changes or adjustments in the RIP LUTs have been desired effect in print. In view of the very high demands placed on the reference prints, further corrections were necessary.
- The individual parameters (CIELAB/density/tone value increase) were recorded again on a data sheet and saved as target values for production printing.
- All adjustments must be repeated for each paper type and individually set because both the colourimetric values and the tone value increase are highly dependent on the material on which the document is printed.

Dot gains

As you see from the above section (Procedure), the dot gains in the print are achieved and controlled primarily by making adjustments in the prepress stages. The ability to influence dot gain by modifying the inks is minimal.

Screen	Paper grade 1				Paper grade 2				Paper grade 3				Paper grade 4				Paper grade 5			
	K	C	M	Y	K	C	M	Y	K	C	M	Y	K	C	M	Y	K	C	M	Y
40 %	16	13	13	13	16	13	13	13	19	16	16	16	22	19	19	19	22	19	19	19
80 %	13	11	11	11	13	11	11	11	13	11	11	11	14	12	12	12	14	12	12	12

Criteria for selecting the good copies

Dot gain in 40 % mid-tone	±4 %
Dot gain in 80 % tone	±3 %
Scatter* in 40 % mid-tone	±5 %
Scatter* in 80 % mid-tone	±5 %
Solid tones per draft standard ISO 12 647-2	±5
Fluctuations in solid-tone density across the sheet	10 %

What is the difference between DIN ISO 2846 and DIN ISO 12 647?

If you compare the colorimetric values, you notice that the values cited in DIN ISO 2846 and DIN ISO 12 647 are not the same. DIN ISO 2846 describes measurement of the colormetric values of laboratory proofs on a defined test stock, while DIN ISO 12 647 defines the chromaticity points of printshop prints on different substrates. According to the standardisation, printing inks that are standardised per DIN ISO 2846-1 and 2 in the laboratory must automatically conform to DIN ISO 12 647-2 and -3 in the printshop print. This, however, is not always the case.

The main reason for this is that the ink system (with the right one for the job being used) is not the only factor that influences the actual production process but other parameters - such as the make, model and configuration of the press, the rubber blankets, substrate, fount solution setting and the colour sequence - also affect the process and therefore the print result.

For this reason, the only option open to the manufacturers of printing inks is to issue their customers with a certificate confirming that specific ink series conform to DIN ISO 2846-1 or -2 but not to DIN ISO 12 647-2 or -3 because the conditions and parameters of relevance to the printing process differ greatly from printshop to printshop.

Summary

The above mentioned standards open up new possibilities for standardisation of the offset process. To what extent customers can and are willing to use the stocks stipulated by this standard - an absolute must if the specifications are to be fulfilled - only the future will tell. Let‘s hope that the standardised offset process doesn‘t soon fall victim to the incessant pressures on costs, especially those relating to the prepress stages.

In principle, all ink series from the hubergroup‘s product portofolio comply with the specifications laid down in DIN ISO 2846-1.

References, sources:
[1] DIN ISO 2846-1,03/2000
[2] ISO 12 647-2, 2004 (not yet published)
[3] DIN ISO 12 647-2, 06/1998
[4] Altona Test Suite, Bundesverband Druck und Medien e.V., December 2003

*Scatter: maximum difference in dot gain between C, M and Y