Data used for
ISO 12647 – 6: Process control for the manufacture of half-tone colour separations, proof and production prints
Part 6: Flexographic printing

Tim Claypole and Mark Bohan

Client: Flexographic Printing Technology Group

Revision: 0.

Document History:

Revised *Notes:*

Content

1. Introduction

When producing a half-tone colour reproduction it is important that the colour separator, proofer and printer have previously specified a minimum set of parameters that uniquely define the visual characteristics and other technical properties of the planned print product. Such an agreement enables the correct production of suitable separations (without recourse to "trial-and-error") and subsequent production of off-press or on-press proof prints from these separations whose purpose is to simulate the visual characteristics of the finished print product as closely as possible. While the ISO 12647 series of standard are intended specifically for four colour process printing, the generic principles can be applied to any half toned flexographic image.

ISO 12647 – 6 lists suggested values or sets of values of the primary parameters and related technical properties of a half-tone flexographic print produced from a set of halftone colour separation films. Primary parameters are defined as having a direct bearing on the visual characteristics of the image, while secondary parameters only influence the image indirectly by changing the values of primary parameters. Secondary parameters are also recommended for specification where deemed useful.

This report collates the data supplied by the International experts as part of the development of ISO 12647 – 6 for four colour flexographic printing. Any differences have to be resolved to ensure the standard meets the requirements of the international community. The source of each piece of data is recorded and, where appropriate, notes on how it was obtained. The report highlights the differences and how these where resolved. This is a working document, i.e. it will continue to be updated until the standard is published. The gaps in the data indicate where a need for information has been identified, but has yet to be supplied.

This document is not a substitute for the ISO standard as it concentrates on the technical issues and does not include whether the values are prescriptive or merely for guidance. It also does not include the body of the text of the standard, which addresses the scope and contains notes for guidance.

2. Substrates

The resolution and image quality is strongly influenced by the choice of substrate. This choice is frequently dictated by the application. There range of applications for which flexo is used, led to a large number of different substrate types being defined. The data has been kept segregated by substrate, even though the number of substrate categories may be reduced later, retaining this original data allows the option of increasing the number of substrate categories if deemed necessary at a later stage.

The proposed categories of substrate are shown in Table 1.

Table 1
Substrate Types

Substrate Type	Description	Source	Comments
1	Wide Web/sheet Preprint Liner Board - SBS Board	FIRST	
2	Wide Web/sheet Combined Corrugated - Bleached White	FIRST	
3	Wide Web/sheet Combined Corrugated - Coated paper	FIRST	
4	Wide Web/sheet Folding Carton - SBS Board	FIRST	Folding box board
5	Wide Web/sheet Folding Carton - CRB Board	FIRST	Folding box board
6	Wide Web/sheet Multiwall Bag - Coated paper	FIRST	
7	Wide Web/sheet Multiwall Bag - Uncoated paper	FIRST	
8	Wide Web/sheet - Film	FIRST	
9	Narrow Web - Film /Coated paper	FIRST	Label
10	Narrow Web - Uncoated paper	FIRST	Label
11	Publication	FPTG	

3. Screen ruling

The screen ruling (screen frequency) shall be within the range:

Table 2 Screen Ruling (lines/cm)					
Substrate Type		Minimum	Maximum	Source	Note Number
1	Wide Web/sheet Preprint Liner Board -SBS	45	50	FIRST	
		33	60	FPTG	
		34	48	FTAJ	
2	Wide Web/sheet Combined Corrugated Bleached White	20	30	FIRST	
		18	33	FPTG	
		14	34	FTAJ	
3	Wide Web/sheet Combined Corrugated Coated paper	30	40	FIRST	
		18	40	FPTG	
		14	34	FTAJ	
4	Wide Web/sheet Folding Carton SBS Board	48	60	FIRST	
		45	60	FPTG	
		34	48	FTAJ	
5	Wide Web/sheet Folding Carton CRB Board	44	50	FIRST	
		45	60	FPTG	
		34	48	FTAJ	
6	Wide Web/sheet Multiwall Bag Coated paper	30	40	FIRST	
		33	48	FPTG	
		34	48	FTAJ	
7	Wide Web/sheet Multiwall Bag Uncoated paper	25	34	FIRST	
		33	48	FPTG	
		34	48	FTAJ	
8	Wide Web/sheet - Film	44	50	FIRST	
		33	70	FPTG	
		25	48	FTAJ	
9	Narrow Web Film / Coated paper	50	70	FIRST	
		52	70	FPTG	
		40	70	FTAJ	
10	Narrow Web Uncoated paper	44	50	FIRST	
		52	70	FPTG	
				FTAJ	
11	Publication	33	52	FPTG	

4. Screen angle

There is general international agreement that for half-tone dots without a principal axis, the nominal difference between the screen angles for cyan, magenta and black should be 30°, with the screen angle for yellow separated by 15° from another colour. No colour should align with engraving on the anilox. This is achieved by rotating one colour by 7.5^0 with respect to the engraving. These values refer to the films; right reading emulsion up, when viewed at an angle of 45° to the direction of print.

Are elliptical half-tone dots are used in flexographic printing? It is suggested that for half-tone dots with a preferential axis, the nominal difference between the screen angles for cyan, magenta and black shall be 60°, with the screen angle for yellow separated by 15^0 from another colour.

5. **Dot shape and its relationship to tone value**

Are elliptical half-tone dots are used in flexographic printing? If so, should the first link-up occur no lower than at 35 % tone value and the second linkup no higher than at 60 % tone value?

6. **Image size tolerance**

Both the FTAJese and the FPTG agree that for a set of colour separation films in common environmental equilibrium, the lengths of the diagonals shall not differ by more than 0,02%.

7. Tone value sum

The maximum Tone value sums, which can be achieved, are shown in table 3.

Table 3
Tone Value Sum

Generic Substrate	Substrate	Maximum (%)	Source
Corrugated	2, 3	300	FIRST
		400	FPTG
		300	FTAJ
Paper	1, 4, 5, 6, 7, 9, 10, 11	320	FIRST
		400	FPTG
		330	FTAJ
Film	8	340	FIRST
		320	FPTG
		300	FTAJ

8. **Grey balance**

Grey balance, unless otherwise specified, should be given by the tone value combinations specified in table 4.

Table 4
Grey Balance (%)

	Cyan	Magenta	Yellow	Source	Comments
10% tone	10				
25% tone	25	15	15	FPTG	
		20	20	FTAJ	
50% tone	50	40	40	FPTG	
		40	40	FTAJ	
75% tone	75	64	64	FPTG	
		65	65	FTAJ	

9. **Print substrate colour**

The print substrates are essentially white in colour. The colorimetric properties for the different substrate types are shown in table 5.

Table 5
Print substrate colour restrictions

	L^*	$\lvert a^* \rvert$	$\lvert b^* \rvert$	Source	Comments
All Print substrates	≥ 90	≤3	≤5	FPTG	
Corrugated	≥ 90	≤1	≤3	FTAJ	
Paper	≥ 92	≤0	≤1	FTAJ	
Film	≥ 84	≤2	≤4	FTAJ	
Label	≥ 92	≤1	≤0	FTAJ	

10. Ink set colours

Using the process inks, the colours of the process colour solid tones on the proof are given in Table 6. The colour co-ordinates of the two-colour overprints without black should be as given in Table 6.

Table 6
Co-ordinates of solid colours on the proof

Substrate	**Ink**	**L^***	**a^***	**b^***	**Source**	**Comments**
Corrugated	Cyan	50	-28	-50	FTAJ	
	Magenta	50	68	11	FTAJ	
	Yellow	90	-6	71	FTAJ	
	Black	20	1	3	FTAJ	
	Red[1]					
	Green[1]					
	Blue[1]					
Paper	Cyan	52	-30	-51	FTAJ	
	Magenta	51	63	-7	FTAJ	
	Yellow	88	-7	1	FTAJ	
	Black	22	1	2	FTAJ	
	Red[1]					
	Green[1]					
	Blue[1]					
Film	Cyan	51	-32	-46	FTAJ	
	Magenta	45	62	-4	FTAJ	
	Yellow	79	-5	76	FTAJ	
	Black	25	1	3	FTAJ	
	Red[1]					
	Green[1]					
	Blue[1]					
Label	Cyan	60	-33	-46	FTAJ	
	Magenta	54	60	10	FTAJ	
	Yellow	88	-7	79	FTAJ	
	Black	25	1	2	FTAJ	
	Red[1]					
	Green[1]					
	Blue[1]					

1 Printed in the sequence yellow-cyan-magenta

The tolerance values represent the deviation between the proof and the OK copy and the variation tolerance represents the standard deviation of the production. The distribution of ΔE*ab values is not gaussian but skewed. For reasons of consistency, the variation tolerance is defined here as the upper limit for 68 % of the production copies. This is in analogy with a gaussian distribution where 68 % are within plus or minus one standard deviation of the mean.

Table 6
CIELAB ΔE^*_{ab} tolerances for the solids of the process colours

	Substrate	black	cyan	magenta	yellow	Source
Deviation tolerance	Corrugated	6	8	12	9	FTAJ
	Paper	6	8	12	9	FTAJ
	Film	4	5	8	6	FTAJ
	Label	4	5	8	6	FTAJ
Variation tolerance	Corrugated	3	4	6	4.5	FTAJ
	Paper	3	4	6	4.5	FTAJ
	Film	2	2.5	4	3	FTAJ
	Label	2	2.5	4	3	FTAJ

11. **Tone value reproduction limits**

This is to give guidance to the reprography of the limit to which the process can reproduce highlights and shadows. No significant image parts shall rely on tone values outside of these ranges on the colour separation film.

Table 7
Tone Value Ranges (on the film)

Substrate	**Minimum (%)**	**Maximum (%)**	**Source**	**Comments**
Corrugated	8	75	FTAJ	
Paper	3	85	FTAJ	
Film	3	85	FTAJ	
Label	3	90	FTAJ	

12. **Tolerance for image positioning**

The maximum deviation between the image centres of any two printed colours shall not be more than 0,02% of the print form diagonal.

13. **Tone value increase**

The target values for tone gain, which can be used to correct the scanned image are shown in table 8. The acceptable deviation of the tone gain from the proof to the OK print, is shown in table 9, while the tolerance of the production prints is shown in table 10. *Is this sufficient to define the tolerances or is there a need to define the mid tone spread, i.e. the maximum difference in tone gain between the CMY colours?*

Table 8 Tone value increase characteristic for production printing									
	Tone Value Increase on Print (%)								
Tone Value on Film (%) **Substrate**	**10**	**15**	**25**	**40**	**50**	**60**	**75**	**85**	**Source**
Corrugated				30					FTAJ
Paper				28					FTAJ
Film				28					FTAJ
Label				25					FTAJ

Table 9 Production tolerances proof to OK sheet									
Tone Value on Film (%) **Substrate**	**10**	**15**	**25**	**40**	**50**	**60**	**75**	**85**	**Source**
Corrugated				6					FTAJ
Paper				5					FTAJ
Film				5					FTAJ
Label				4					FTAJ

Table 10 Production Tolerances Process variation									
Tone Value on Film (%) **Substrate**	**10**	**15**	**25**	**40**	**50**	**60**	**75**	**85**	**Source**
Corrugated				8					FTAJ
Paper				6					FTAJ
Film				6					FTAJ
Label				5					FTAJ

14. Reflection densities of the process colour solids

These are included in the standard for information only. They are intended as a guide to enable the printer who only has access to a densitometer to successfully operate process control without the need to buy a spectrophotometer.

Gamut	1		2		3	
Polarisation	w/o	w	w/o	w	w/o	W
DIN E reflection densities[1]						
Ink – Cyan						
Paper – Cyan						
Ink – Magenta						
Paper – Magenta						
Ink – Yellow						
Paper – Yellow						
ISO Status T reflection densities[2]						
Ink – Cyan						
Paper – Cyan						
Ink – Magenta						
Paper – Magenta						
Ink – Yellow						
Paper – Yellow						
ISO visual reflection densities						
Black						
Paper						

Notes:
1. DIN E refers to the wider of the two sets of responses specified in DIN 16536-2:1995
2. Responses according to ISO 5-3:1995

References:

1. "FIRST, second edition" , FTA, 1999
2. Private Communication 16.9.99