ISO 2846-1
Gans Ink and Supply Company

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Executive Summary

It was requested by Gans Ink and Supply that PIA/GATF test Seaside four-color process inks for ISO 2846-1 conformance.

Testing Performed

ISO 2846-1 is an international standard used to determine color and transparency conformance of four-color lithographic printing inks. The colorimetric portion of the ISO 2846 specification requires that a very specific substrate be used. The only substrate that conforms to all of the substrate specifications is known as Phoenix Imperial APCO II/II. The prints generated for the transparency evaluation are printed on Leneta card over a pre-printed solid black with an L* value less than 6. The black patch on the Leneta card was measured, colorimetrically, before and after printing. The differences in color with respect to ink film thickness were used to determine the transparency of the ink. The sample inks are printed on their respective substrates under very controlled conditions, at varying ink film thickness, using a laboratory printability tester. The prints that fall within the specified ink film thickness range are measured for color (L*a*b*) and transparency using a spectrodensitometer. If any of the prints are within the specified tolerance ranges for color and transparency the ink is said to be ISO 2846-1 compliant.

Results

All of the inks tested for transparency were within the ISO 2846-1 specified tolerances. ISO 2846-1 specifies minimum transparency values for cyan, magenta, and yellow. There is no transparency evaluation for black. All of the inks tested were above the specified values and are subsequently compliant with the transparency portion of ISO 2846-1.

Colorimetric analysis of the prints indicated all of the inks tested were within the colorimetric tolerances provided in the standard. It should be noted that all of the inks, with the exception of black, only qualified for ISO 2846-1 colorimetric standards at the low end tolerance of ink film thickness. The nature of the color variation with each of the primary inks indicates a very strong pigment load. The inks were subsequently examined for tinctorial strength. The yellow, magenta, and cyan inks were found to be stronger than SWOP standard inks with respect to pigment load.

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Transparency

Background

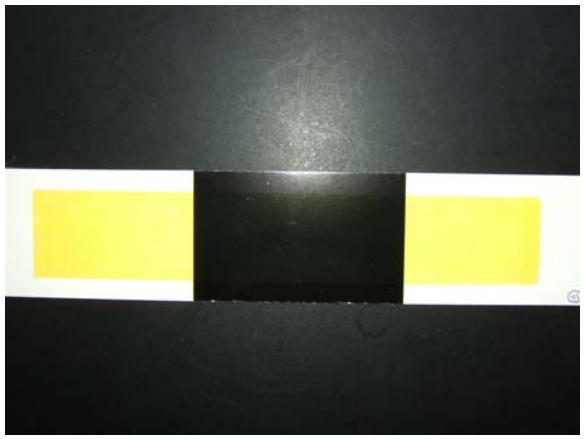
Transparency refers to the ability of an ink film to transmit and absorb light without scattering. The transparency value that is expressed (T value) is a measure of the unwanted light scattering.

Methodology

Transparency was evaluated by printing each of the three primary inks over a pre-printed black ink film. The transparency prints are made on a pre-printed Leneta card as specified by the standard. The pre-printed black strip must have a lightness (L*) less than 6. Prior to printing, the L*a*b* values of the black strips were measured using an X-Rite 530 spectrodensitometer with $0^0/45^0$ geometry and standard illuminant D_{50}. A series of prints were produced at an ink film thickness range of 0.7-1.3 microns. The prints were produced using an IGT C-1 printability tester, with a polyurethane printing form, printing at 250N/cm of force. To achieve these prints an average of 15 prints were generated for each color. The printing form was weighed before and after printing. The mass density of each ink was calculated. The ink film thickness is calculated using the following equation:

$$\text{Ink film thickness} = \text{mass} / (\text{mass density} \times \text{area})$$

For each color, three prints were generated that are representative of the entire ink film thickness range. After being printed the sample prints were allowed to dry for 24 hours. Once dried, the ink film was measured colorimetrically (L*a*b*) where it overprinted the pre-printed black. An example of a yellow test print can be seen below:



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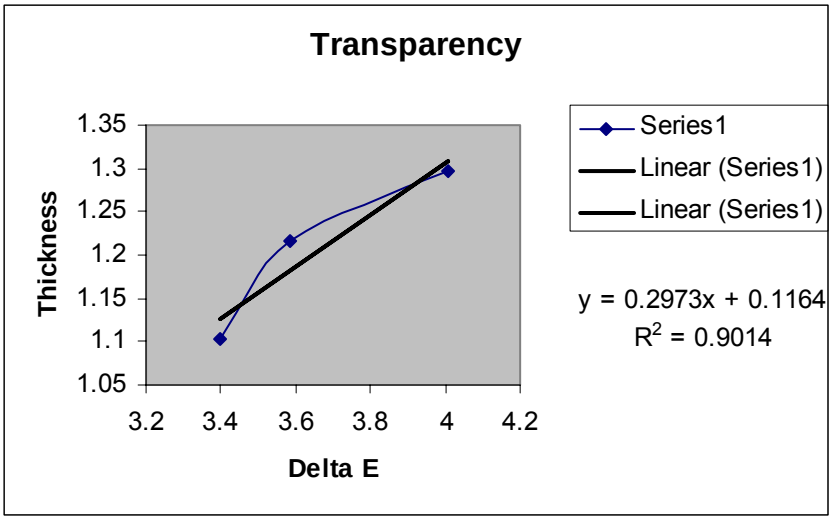
The color difference before and after printing was calculated for each sample and plotted as a function of ink film thickness.



The linear regression coefficient was calculated for each color. If the reciprocal of the coefficient (T-value) is greater than that specified in Table 1, the ink conforms to this portion of ISO 2846-1.

Ink	Minimum T-value	Actual T-value
Seaside Yellow	0.08	0.22
Seaside Magenta	0.12	0.23
Seaside Cyan	0.20	0.35

Table 1: Transparency requirements

Results and Conclusions

All of the Seaside inks tested produced a T-value greater than that specified in the standard, therefore conforming to the transparency portion of the ISO 2846-1 specification.

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CIELAB Colorimetric Evaluation

Background

The colorimetric evaluation involved generating a series of prints, under specific conditions, on very specific substrate, using the IGT C-1 printability tester. The prints were produced on a gloss-coated, wood-free paper that contains no optical brighteners. The only known substrate to conform to the specification is Phoenix Imperial APCO II/II from Scheufelen, and this substrate was used. The same printing form, pressure and printability tester that were used for the transparency evaluation were also used for the colorimetric evaluation. Approximately 30 prints were made with each color to obtain a minimum of three samples printed at the appropriate ink film thickness range. If any of the prints within the ink film thickness range are within the Delta E tolerances provided in the standard, the ink conforms to the colorimetric portion of ISO 2846-1.

Methodology

For each color, a minimum of three prints were generated that were within the specified ink film thickness range. This range is 0.7-1.1 microns for yellow, magenta, and cyan. The ink film thickness range for black is 0.9-1.3 microns. The prints that were representative of the ink film thickness were measured colorimetrically after 24 hours of oxidative drying. The ISO 2846-1 specification provides CIELab values for each color. The Delta E color difference between the prints and the specification can then be calculated. The specified CIELab values can be found in table 2.

Ink	L*	a*	b*	ΔE	ΔL*	Δa*	Δb*
Yellow	91.00	-5.08	94.97	4	---	---	---
Magenta	49.98	76.02	-3.01	5	---	---	---
Cyan	56.99	-39.16	-45.99	3	---	---	---
Black	18.01	0.80	-0.56	---	±1.5	±3.0	≤18.0

Table 1: CIELAB specifications

Results and Conclusions

All of the Seaside inks tested were within the specified tolerances, therefore conforming to the colorimetric portion of the ISO 2846-1 standard. The colorimetric measurements and ink film thicknesses of the qualifying prints can be found in Table 2.

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	IFT (µm)	L*	a*	b*	ΔE from specification
Seaside Black	1.11	8.4	0.21	-0.34	n/a
Seaside Cyan	0.67	57.22	-42.04	-45.88	2.88
Seaside Magenta	0.70	49.21	78.75	0.96	4.88
Seaside Yellow	0.70	93.31	-5.88	97.18	3.3

Table 2: CIELab measurements of qualifying prints

It should be noted that all of the primary inks had to be printed at the low end limit of the ink film thickness range to qualify for the colorimetric portion of ISO 2846-1. The nature of the color variations indicated the sample inks were tinctorially strong. Subsequently the inks were tested for tinctorial strength using the NPIRI bleaching method. The results of the strength testing can be found in Table 3.

Sample	Tinctorial Strength	Shade Difference
Seaside Black	~17% weaker than SWOP	SWOP is more blue
Seaside Cyan	~9% stronger than SWOP	---
Seaside Magenta	~13% stronger than SWOP	---
Seaside Yellow	~17% stronger than SWOP	---

Table 3: Tinctorial strength

In order to conform to the ISO 2846-1 specification an ink must meet the specifications for color at some ink film thickness within the specified range, while also meeting the specification for transparency. All of the Seaside inks tested conform to the transparency and color requirements and subsequently the Seaside ink set is ISO 2846-1 compliant.