ISO 2846-1
Press Color
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Executive Summary

It was requested by Press Color that PIA/GATF test submitted samples of “Super-X” 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 six. 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 controlled conditions, at varying ink film thickness, using a laboratory printability tester. The prints that are 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. Most of the inks qualified at multiple ink film thicknesses.
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 six. Prior to printing, the L*a*b* values of the black strips were measured using an X-Rite 530 spectrophotometer with 0°/45° geometry and standard illuminant D50. A series of prints were produced at an ink film thickness range of 0.7-1.3 microns for yellow, magenta, and cyan. Black was printed at a range of 0.9-1.3 microns, as specified in the standard. 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 fifteen 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:

\[
\text{Ink film thickness} = \frac{\text{mass}}{(\text{mass density} \times \text{area})}
\]

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 a period of at least twenty-four 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:
The color difference before and after printing was calculated for each sample and plotted as a function of ink film thickness.

![Graph showing Transparency vs Delta E with the equation y = 0.2324x - 0.2216 and R² = 0.876]

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.

<table>
<thead>
<tr>
<th>Ink</th>
<th>Minimum T-value</th>
<th>Actual T-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yellow</td>
<td>0.08</td>
<td>0.31</td>
</tr>
<tr>
<td>Magenta</td>
<td>0.12</td>
<td>0.28</td>
</tr>
<tr>
<td>Cyan</td>
<td>0.20</td>
<td>0.31</td>
</tr>
</tbody>
</table>

Table 1: Transparency requirements

Results and Conclusions

All of the 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.
CIELAB Colorimetric Evaluation

Background

The colorimetric evaluation involved generating a series of prints, under specific conditions, on a very specific substrate, using the IGT C-1 printability tester. The prints were produced on a gloss-coated, wood-free paper that contained 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 fifteen 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 0.7-1.3 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 being allowed to dry for twenty-four hours. 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.

<table>
<thead>
<tr>
<th>Ink</th>
<th>L*</th>
<th>a*</th>
<th>b*</th>
<th>ΔE</th>
<th>ΔL*</th>
<th>Δa*</th>
<th>Δb*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yellow</td>
<td>91.00</td>
<td>-5.08</td>
<td>94.97</td>
<td>4</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Magenta</td>
<td>49.98</td>
<td>76.02</td>
<td>-3.01</td>
<td>5</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Cyan</td>
<td>56.99</td>
<td>-39.16</td>
<td>-45.99</td>
<td>3</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Black</td>
<td>18.01</td>
<td>0.80</td>
<td>-0.56</td>
<td>---</td>
<td>±1.5</td>
<td>±3.0</td>
<td>≤18.0</td>
</tr>
</tbody>
</table>

Table 1: CIELAB specifications

Results and Conclusions

All of the 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.

NOTICE: The conclusions drawn in this report are based on the facts and conditions that were observed by and / or reported to us. They include PIA/GATF test results and / or information believed to be reliable. Since there are so many variables in the process, these conclusions might not remain valid if the information given to us was incorrect and / or incomplete. We do not assume any responsibility for the use of this report. This report is confidential to the customer. It is not to be altered in any manner. PIA/GATF does not endorse any products or equipment described within the report.
Table 2: CIELab measurements of qualifying prints

<table>
<thead>
<tr>
<th>Ink Film Thickness (µm)</th>
<th>L*</th>
<th>a*</th>
<th>b*</th>
<th>∆E from specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black</td>
<td>1.29</td>
<td>12.64</td>
<td>0.22</td>
<td>0.11</td>
</tr>
<tr>
<td>Cyan</td>
<td>0.76</td>
<td>55.62</td>
<td>-39.86</td>
<td>-47.49</td>
</tr>
<tr>
<td>Magenta</td>
<td>0.71</td>
<td>50.51</td>
<td>76.22</td>
<td>1.78</td>
</tr>
<tr>
<td>Yellow</td>
<td>0.75</td>
<td>91.51</td>
<td>-5.23</td>
<td>95.57</td>
</tr>
</tbody>
</table>

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 inks tested conform to the transparency and color requirements and subsequently this ink set is ISO 2846-1 compliant.