GRACoL®

- Refers to the IDEAlliance Committee that began in 1996 as a graphics arts task force
- formed to develop a document containing general guidelines and recommendations that could be used as a reference source across the industry for quality color printing

GRACoL 7

- Newest version of the GRACoL Publication
  - will explain the rationale behind the new visual-appearance-based GRACoL press and proofing system, gray balance characterization and calibration methods
  - will specify a definition for gray balance and recommend characterization data for commercial offset printing on a #1 coated sheet
  - final publication is scheduled for fall 2006

G7™

- New IDEAlliance proof-to-print process
- Requires printing with inks defined by ISO 2846 so that the dry solids measure as close as possible to the ISO CIELab values for seven colors
  - the four primary colors and three 2-color overprints specified in ISO 12647
  - focusing on colorimetric data for gray balance in the mid-tones

Ink - ISO 12647-2

<table>
<thead>
<tr>
<th></th>
<th>L*</th>
<th>a*</th>
<th>b*</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>55</td>
<td>-37</td>
<td>-50</td>
</tr>
<tr>
<td>M</td>
<td>48</td>
<td>74</td>
<td>-3</td>
</tr>
<tr>
<td>Y</td>
<td>89</td>
<td>-5</td>
<td>93</td>
</tr>
<tr>
<td>K</td>
<td>16</td>
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</tbody>
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Paper

- Grade #1 gloss coated paper with as little optical brightener as possible
- A nominal white point of
  - $95 L^* (+/- 2), 0.0 a^* (+/- 1), -2 b^* (+/-2)$
  (measured with white backing)
**G7™**

- Major marketing efforts
- Makes extensive use of grey balance (NPDC neutral print density curve)
  - advocates a uniform tone value increase (dot gain) for all printing conditions
  - In reality
    - individual results depend on the inks, paper, press, etc. used

**Calibrating and Printing to GRACoL 7**

Following information taken from CONFIDENTIAL Beta Release Gracol 7 document

**Colorimetric data for grey balance and a standardized “Neutral Print Density Curve” (NPDC), rather than on traditional TVI aims for each ink**

Claims - allows a careful user to:
- achieve a closer visual match from device to device (at least on neutral gray tones)
- maintaining the same overall “appearance” of traditional printing

**Calibrating and Printing to GRACoL 7**

Does NOT guarantee a perfect match in all colors

DOES reduce the need for custom separations for each press
- which is a valuable benefit in today’s ICC workflows (huh?)

**Calibrating and Printing to GRACoL 7**

The degree to which this benefit will be achieved depends on
- the user’s patience and process control tolerances

Reflects the typical performance of today’s commercial printers
- both in the USA and overseas

**Highlight Range (HR)**

- Density of a pre-defined mid-tone gray patch minus the density of the substrate (paper) on which it is printed
- A constant value

**HR = 0.54**
Highlight Range (HR)
- Expressed in neutral density (ND)
  - which can be measured with a densitometer set to the black channel, or the "Visual density" setting
- HR is computed twice, once for the CMY inks and again for black ink

CMY HR
- Computed by measuring the neutral density (ND) of a combined CMY gray patch
  - containing 50% Cyan, 40% Magenta, 40% Yellow
  - and subtracting the neutral density of the background paper

Black HR
- Is computed by measuring the ND of a 50% Black patch and subtracting the neutral density of the background paper
  - If paper ND = 0.09
  - and HR = 0.54
  - Target mid-tone density = 0.63 (for that paper)

Neutral Print Density Curve (NPDC)
- Relationship between measured neutral density and original halftone percentages on a gray scale
- Two Neutral Print Density Curves are specified
  - one for a combined CMY gray scale
  - one for a black-ink gray scale

Neutral Print Density Curve (NPDC)
- NPDC calibration involves:
  - comparing a printed gray scale to a reference scale
  - calculating correction values that give the press the desired curve shape on subsequent prints
  - by plotting two graphs
    - black scale
    - CMY gray scale
Gray Balance
- Defined in colorimetric (CIELab) terms

\[ 50C, 40M, 40Y = a^* \ 0.0, \ b^* \ -2.0 \]

Tolerance: +/- 0.5, +/- 1.0

Simply reading a single gray patch of 50C, 40M, 40Y, should be enough to ensure the device is “in balance” (Huh?)

When to Use TVI (dot gain)
- Although TVI is no longer as important as it used to be, it continues to serve some very important functions in GRACoL 7

When to Use TVI
- After the calibration run reaches nominal densities TVI should be checked to make sure each unit is printing normally
- Production plate control
- Whenever problems occur during a run which cannot be solved by simple SID adjustments
- Individual-ink TVI values should be monitored, as well as gray balance and HR, as part of any thorough process control program

Calibration Summary
- Press Calibration Run
- Compare "Natural NPDC" to reference NPDC
- Calibrate the RIP
- Qualification and Characterization Run
- Calibrating a Proofing System

Press Calibration Run
- Run using a Number 1 sheet and ISO 12647-1 compliant inks
- Provides a snapshot of the natural NPDC and gray balance of that press/ink/paper combination
- Adjust HR density to (0.54 plus paper density)
- Adjust gray balance on press (huh?)
  - tweaking solid ink densities
  - adjusting pressure on one or more units
  - by other means
Using CIELab to Control Gray Balance

When $a^*$ and $b^*$ are both zero, a theoretically perfect "neutral" is measured
- but most people prefer a slightly "bluer" gray, therefore GRACol 7 defines gray as $0 a^*, -2 b^*$, (not $0 a^*, 0 b$
- What to do when $a^*$ or $b^*$ are too high or too low?

Press Calibration Run

If adjust gray balance on press not possible
- press can be left in an "un-balanced" state
  - (so long as it remains consistent over time
  - and gray balance can instead be calibrated via separate C, M and Y CtP curves
- Using "gray finder"

Compare "Natural NPDC" to reference NPDC

- measuring two gray scales
  - one printed in CMY inks only
  - another printed in black ink only
  - then drawing graphs on special GRACol 7 graph paper

Using CIELab to Control Gray Balance

- If $a^*$ is high
  - reduce M or increase C and Y
- If $a^*$ is low
  - increase M or reduce C and Y
- If $b^*$ is high
  - reduce Y or increase C and M
- If $b^*$ is low
  - increase Y or reduce C and M

GrayFinder

G7 Test Target
**Calibrate the RIP**

- Correction values are read from the graph and entered in the CIP calibration software or RIP

**Calibrating a Proofing System**

- Device must be stable and repeatable
- Gray balance would typically be adjusted by separate RIP curves, rather than by physical adjustments to the proofing system (huh?)
  - What about Inks? Paper?

**Qualification and Characterization Run**

- New press run is performed using plates created through the newly-calibrated RIP
- Resulting NPDCs for CMY and black are checked
- If everything is in order, an optional ICC profile can be created from this run
  - if proper GRACoL inks and paper are used, the GRACoL 7
  - characterization data (available elsewhere) should describe the press closely enough to avoid the need for a custom press profile
Steps to compliance

Substrate Selection
- Use a high quality paper
- Don’t use extremely glossy paper
- Make sure $a^*$ is positive
- Minimal optical brighteners
  - examine spectral reflectance curve
- Proofing substrate should meet these criteria
  - close spectral match

Steps to compliance

Ink set Selection
- ISO 2846-1 Ink draw downs
- Wet trap should produce correct secondary colors
- TVI
- Grey Balance
- Ink flow
- Water pickup

Steps to compliance

Plate Calibration
- Should be based on measurement and examination of the plate
- Should be independent of printing conditions
- Should not be based on measurement of printed product
- Should be independent of screening

Steps to compliance

Press Run
- Press is in optimal condition
  - document consumables and settings
- Optimize test form for evenness of ink distribution
- Run enough impressions to stabilize between measurements
- Verify primary and secondary colors, TVI/NPDC, grey balance
- Run enough impressions to stabilize after final approval
- Measure wet and dry (predetermine dry back)