

G7 BRIDGING THE GAP ACROSS ALL PRINT MEDIA
DIGITAL, FLEXOGRAPHY, GRAVURE, OFFSET AND SCREEN

IDEA Alliance®

G7®

HOW TO

A STEP-BY-STEP GUIDE TO CALIBRATING,
PRINTING & PROOFING BY THE G7 METHOD

CONTENTS

1 INTRODUCTION	3	5 G7 CALIBRATION FROM ICC PROFILES	27
1.1 About This Document	4	5.1 Heidelberg Gray Balance Optimizer	27
1.2 What is G7?	4	5.2 Manual Method	28
1.3 Key Innovations	4		
1.4 What is G7 Not?	5	APPENDICES	
1.5 Areas of G7 Application	5	A: G7 FANGRAPH	30
1.6 Definitions	6	A.1 Using the FanGraph	30
1.7 New Materials for 2009	6	B: ISO 12647-2 SOLID INK VALUES	34
1.8 G7 Compliance Levels	6	B.1 Measuring With White vs. Black Backing	34
2 G7 CALIBRATION SUMMARY	7	C: INTRODUCTION TO CI ELAB	35
2.1 Basic G7 Grayscale Calibration	7	C.1 Delta E (E)	35
2.2 G7 Targeted Calibration	7	D: G7 FOR PRE-PRESS PROOFING	37
2.3 G7 (Colorspace) Calibration	7	D.1 G7 Compatibility	37
2.4 G7 Extreme Calibration	8	D.2 G7 Proofer Calibration Summary	37
3 G7 CALIBRATION USING THE FANGRAPH	9	D.3 Step-by-Step G7 Proofer Calibration	38
3.1 Requirements for FanGraph Method	9	D.4 Applying Color Management (if Needed)	39
3.2 Assembling the Test Form	11	D.5 Proofing on Non-Standard Substrates	40
3.3 Printing the Test Page	11	D.6 Proofing Systems Without RIP Curves or LUTs	41
3.4 Measuring the P2P Target	11	D.7 Pre-Production Final Color Matching Test	41
3.5 Plotting the Common CMY NPDC Curve	12	D.8 Controlling Production Proof Quality	41
3.6 Finding Nearest Target Graph With Same D-max	13	E: G7 FOR OFFSET LITHOGRAPHY	42
3.7 Repeating for Black	13	E.1 Requirements for G7 Press Calibration	42
3.8 Choosing Optimum Curve Points	13	E.2 G7 Press Test Form	43
3.9 Determining if Gray Balance Needs Correcting	14	E.3 Press Control Bars	43
3.10 Calculating RIP Values <i>Without</i> Gray Balance	14	E.4 Plates, RIP Curves and Screening	45
3.11 Calculating RIP Values <i>With</i> Gray Balance	14	E.5 Press Pre-Qualification	47
3.12 Adjusting for NPDC Error Due to Gray Balance	18	E.6 Calibration Run vs. Confirmation Run Priorities	47
3.13 Applying New Aim Values to the RIP	18	E.7 Calibration Press Run	47
3.14 Evaluating G7 Calibration Accuracy	19	E.8 Creating CtP RIP Curves	50
4 G7 CALIBRATION USING IDEALINK CURVE	20	E.9 Confirmation Press Run	50
4.1 Requirements	20	E.10 Custom Press Profiling	52
4.2 The Test Page	20	E.11 G7 Production Press Control	54
4.3 Printing the Test Page	20	E.12 CI ELab-Based Press Control	56
4.4 Measuring the P2P Target	21	E.13 Density-Based Press Control	58
4.5 Loading Measurement File(s) in IDEALink Curve	21	E.14 Automated Press Control and G7	59
4.6 Choosing the Optimum Curve Points	21	E.15 Production Plate Making Control	60
4.7 Determining if Gray Balance Needs Correcting	22	F: G7 FOR SOFT PROOFING	62
4.8 Correcting Gray Balance in IDEALink Curve	22	F.1 G7 Soft Proofing Requirements	62
4.9 Using IDEALink Curve <i>Without</i> Gray Balance	24	F.2 Local Soft Proofing	62
4.10 Applying the Output Curve Set to the RIP	24	F.3 Remote Soft Proofing	64
4.11 Evaluating G7 Calibration Accuracy	25		

Copyright and Legal Notices see page 64.

Copyright © International Digital Enterprise Alliance, Inc. [IDEAlliance] (2001- 2009). All Rights Reserved.

1 INTRODUCTION



IDEAlliance and *Graphic Arts Monthly* are pleased to present this G7 How-To Guide. Authored by expert Don Hutcheson, it is the eighth in a series of printing specifications we have published jointly over the last 15 years. G7 is a very exciting new path for IDEAlliance, and for the printing and premedia industries. It evolved and was refined as we completed the latest GRACoL 7 and SWOP specifications in 2006. G7 specifies the components of an image that define a similar “visual appearance” to the human eye. G7 grew out of a desire expressed primarily by agencies and print buyers a few years ago, who found that proofs didn’t match the press, and that proofing systems looked different from one another. They wanted to be able to send their files across the country and around the world and get a consistent appearance regardless of where it was printed or who printed it, and regardless of the technology being used.

Since G7’s introduction three years ago, the success stories arrive on a weekly basis from printing firms the world over. One of the biggest advantages for offset printers is faster makeready. Printers who have adopted G7 have reported that their makeready time has been reduced—the single greatest waste factor a press operator encounters.

IDEAlliance has spent more than four decades fostering the development of printing and graphic production specifications for participants all along the printing supply chain, an effort that embraces the work of creative services firms, publishers, printing companies, paper manufacturers, and suppliers of printing systems and equipment. During that time SWOP, GRACoL, PRISM, Papinet, ADsml and other file creation, reproduction and communications formats have evolved, reflecting the growing sophistication of printing production. Our work now touches on many modalities of file and page preparation, transfer, and reproduction, increasingly important factors as the channels carrying graphic communications messages multiply to an ever broader range of traditional and emerging platforms.

Joe Fazzi

Vice President, Print Media

IDEAlliance

1.1 About This Document

This document describes how to calibrate an offset press, digital proofing system, or any other CMYK imaging device using the IDEAlliance G7® method. Step-by-step instructions take the reader through the manual calibration method (using hand-drawn graphs on free G7 FanGraph™ paper) and the automated method using IDEALink Curve™ software. Appendixes explain how to use G7 with a pre-press proofing system, a sheet-fed offset press and soft proofing. Future appendixes detailing how to use G7 with other processes including flexography, screen printing, digital printing presses and gravure will be downloadable from www.g7global.com when available.

1.1.1 Changes to this Version

Compared to the August 2006 edition (Calibrating, Printing and Proofing by the G7® Method version 6) the main changes to this edition include:

- Definitions and theory discussions moved to a new *G7 Specification* document
- Simplified gray balance formula
- G7 calibration from ICC profiles
- New appendixes for device-specific calibration
- Using the new IDEAlliance ISO 12647-7 Control Strip to monitor production proof quality
- Content consolidation, re-arrangement and renumbering

NOTE: The basic principles of the G7 method have not changed significantly since the original document, except for the simplified gray balance formula, which may have a minor effect on substrates with non-standard color shades.

1.1.2 Companion Documents

Theoretical discussions, definitions and formulae from the original How-To have been moved to the companion *G7 Specification* document.

1.2 What is G7?

G7 is...

- An implementation of the new ISO 10128 standard for “Near-Neutral” calibration.
- A specification for consistent gray scale appearance that is universally applicable to all color imaging processes.
- A calibration technique to adjust image values within an imaging system to meet the G7 specification.
- An enhanced basis for process control in any imaging process.
- A basis for “shared appearance” that aligns the appearance of diverse printing methods or classes as closely as possible to each other without additional color management.

Developed originally for halftone laminate proofing systems, G7 has since been applied successfully to a wide range of other processes including offset lithography, gravure, flexography, dye-sublimation, ink-jet, electrophotography, screen printing and photographic printing. Using simple 1-dimensional curves, G7 yields the closest possible visual match between different imaging systems that can be achieved without more complex multi-dimensional systems such as ICC color management.

1.3 Key Innovations

1.3.1 Grayscale Definition

The main innovation of G7 is that it defines how a gray scale should appear to the human eye instead of defining how individual colorant scales should measure in terms of dot size, dot gain (TVI) or other mechanical measurements. Defining the gray scale defines the “backbone” of a color space and allows the critical visual characteristics of gray balance and neutral tonality to be controlled with simple 1-dimensional curves such as the CMYK calibration tables found in most RIPs.

1.3.2 Highlight Preservation

A unique characteristic of G7 is that density and contrast in lighter tones (to which the human eye is highly sensitive) are preserved, regardless of dynamic range, while darker tonal ranges are compressed or expanded to meet the capabilities or limitations of each process. This means that a CMYK image

printed on multiple G7-calibrated devices having widely different tonal range capabilities will exhibit relatively consistent lightness and contrast.

1.3.3 Substrate Relativity

G7's gray balance formula is "substrate relative," automatically adapting to the color of the substrate, rather than being defined in absolute terms. This means that a grayscale image should always appear visually neutral on a G7-calibrated device, when compared to the actual substrate on which it is printed. For a more detailed explanation of this philosophy see the *G7 Specification*.

1.3.4 Contrast Relativity

G7's gray tonality formula (NPDC or Neutral print Density Curve) is "contrast relative," automatically adapting to the substrate brightness and maximum neutral density of a device. This means that a grayscale image always takes advantage of the maximum neutral contrast available on a G7-calibrated device.

1.3.5 Device Independence

A key value of G7 is that its rules are the same for any imaging technology or colorant set, which makes G7 a truly device-independent specification. G7's common gray balance and neutrality rules can be applied to virtually any color imaging method, regardless of mechanics, substrate, colorants, screening technologies, etc.

1.4 What is G7 Not?

A common misunderstanding is that G7 replaces ICC color management. This is not true. No process that controls only 1-dimensional calibration tables can replace the complex multi-dimensional variables solved by ICC color management, however ICC profiles created after first calibrating with G7 are potentially more accurate, and can have longer-lasting value, than profiles made without G7 pre-calibration.

Another misconception is that G7 guarantees an accurate press-to-proof match simply by "printing to the numbers." This is not true. The success of any "print by numbers" system – G7 or otherwise – is limited by the stability of many variables, most of which cannot be controlled at print time. What G7 does offer is a more direct way of measuring print appearance, and a more effective way of deciding how to adjust those variables that can be controlled.

Finally, it is important to note that G7 is not, on its own, an official ISO standard. However G7 is at the heart of four new ANSI standard color spaces (TR006, TR003, TR005 and TR007) and the key innovations employed by G7 – especially the "near neutral" calibration concept, have significantly impacted the way modern printing standards are being written and applied.

1.5 Areas of G7 Application

G7 has experienced major adoption in two main areas - device calibration and the development of printing specifications.

1.5.1 Device Calibration

Any CMYK or CMY imaging process, regardless of colorants, substrate or technology, can be G7-calibrated so long as separate CMYK (or CMY) percentage-based calibration tables are available in the RIP or driver. G7 has even been applied to continuous-tone RGB photographic film recorders.

1.5.2 Developing Standard Print Specifications

The gray balance and neutral tone scales defined within the G7 Specification have been used as the basis for standardized characterization datasets including TR003 and TR005 (SWOP®), TR006 (GRACoL®) and TR007 (FIRST/Flexo). All printing specifications based on G7 exhibit a “shared appearance” that makes the exchange of files and proofs between processes easier, safer and more predictable.

To learn how to develop G7-based characterization data sets, see the *G7 Specification*.

1.6 Definitions

NOTE: Complete theory and math descriptions of each G7 variable are available in the companion *G7 Specification* document, free at www.G7global.org

Prior to using G7 for the first time, you should familiarize yourself with the definitions in the *G7 Specification*. The most important definitions are G7 Gray Balance, G7 Tonality, HR, SC and HC.

1.7 New Materials for 2009

- G7 FanGraph 2009 (cosmetic changes only)
- Press Forms (various sizes)
- GrayFinder22 (Wider gray balance range)
- Sheetfed Press Operators Guide 2008

1.8 G7 Compliance Levels

Depending on how it is applied, G7 can produce several different levels of compliance, as follows.

- G7 Grayscale
- G7 Targeted
- G7 (Colorspace)
- G7 Extreme

1.8.1 G7 Grayscale

A device or process is in “G7 Grayscale compliance” when it is calibrated to the basic G7 definition of constant neutral grayscale appearance, but does not necessarily use standard colorants or match a standard color space.

1.8.2 G7 Targeted

A device or process is in “G7 Targeted compliance” when it is G7 Grayscale calibrated and meets a standard set of colorimetric measurements for substrate and colorants such as those defined in ISO 12647-2.

1.8.3 G7 (Colorspace)

A device or process is in “G7 (Colorspace) compliance” when it is G7 Grayscale calibrated AND controlled (for example with ICC profiles) to match a specific colorspace such as GRACoL or SWOP, in which case the correct naming would be “G7 (GRACoL)” or “G7 (SWOP).”

1.8.4 G7 Extreme

A device or process is in “G7 Extreme compliance” when it is G7 Grayscale calibrated, and has a significantly greater natural color space than any G7 Characterized specification, and can be optionally controlled (for example with ICC profiles) to match any G7 Characterized color space.

For more information about G7 compliance see the *G7 Specification*.

G7 CALIBRATION SUMMARY

2.1 Basic G7 Grayscale Calibration

These basic steps are followed when G7 is applied to any imaging process.

- Prepare the Equipment and Materials
- Print a P2P Target (and GrayFinder for FanGraph method)
- Compare 'Device NPDC' to G7 NPDC and calculate correction values
- Compare 'Device Gray Balance' to G7 Gray Balance and calculate correction values
- Apply correction values to the RIP
- Print a new P2P Target (and GrayFinder for FanGraph method) through the new RIP curves and verify G7 calibration accuracy

2.2 G7 Targeted Calibration

These steps are followed when G7 is applied to a process using standard solid and 2-color overprint CIELab values, such as those defined in ISO 12647.

- Prepare the Equipment and Materials
- Adjust the process until the solid CMYKRGB CIELab values are within the tolerance specified for the applicable print condition
- Print a P2P Target (and GrayFinder for FanGraph method)
- Compare 'Device NPDC' to G7 NPDC and calculate correction values
- Compare 'Device Gray Balance' to G7 Gray Balance and calculate correction values
- Apply correction values to the RIP
- Print a new P2P Target (and GrayFinder for FanGraph method) through the new RIP curves and verify G7 calibration accuracy

2.3 G7 (Colorspace) Calibration

These steps are followed when a G7-calibrated device must closely simulate a specified color space, for example SWOP or GRACoL.

- Prepare the Equipment and Materials
- Adjust the process until the solid CMYKRGB CIELab values equal or exceed the color gamut of the reference data
- Print a P2P Target (and GrayFinder for FanGraph method)
- Compare 'Device NPDC' to G7 NPDC and calculate correction values
- Compare 'Device Gray Balance' to G7 Gray Balance and calculate correction values
- Apply correction values to the RIP
- Print a new P2P Target (and GrayFinder for FanGraph method) and a Characterization Target (e.g. the IT8.7/4) through the new G7 RIP curves
- Verify G7 calibration accuracy
- Verify that the Characterization target matches the target data set within acceptable tolerances
- If necessary, improve the match with a custom ICC profile (or equivalent color management)

2.4 G7 Extreme Calibration

These steps are followed when G7 is applied to an imaging process with a wider than normal color gamut.

- Prepare the Equipment and Materials
- Print a P2P Target (and GrayFinder for FanGraph method)
- Compare 'Device NPDC' to G7 NPDC and calculate correction values
- Compare 'Device Gray Balance' to G7 Gray Balance and calculate correction values
- Apply correction values to the RIP
- Print a new P2P Target (and GrayFinder for FanGraph method) and a Characterization Target (e.g. the IT8.7/4) through the new G7 RIP curves
- Verify G7 calibration accuracy
- From the Characterization target build a custom ICC profile
- Use the ICC profile when specific color matching is required, or use the G7 calibration alone to produce more saturated, but gray-normalized, prints from typical CMYK files

G7 CALIBRATION USING THE FANGRAPH

This section gives a step-by-step guide to the basic G7 Grayscale calibration using the free FanGraph method. These steps are common to all devices and G7 compliance levels.

3.1 Requirements for FanGraph Method

3.1.1 G7 FanGraph 2009 Paper

Print several sheets of blank G7 FanGraph 2009 paper (see appendix) and use a fresh sheet for each calibration.

NOTE: The new FanGraph 2009 charts are functionally identical to earlier versions, but contain a table for conveniently recording M and Y GrayFinder correction percentages.



3.1.2 Colored Pens or Pencils

Drawing and reading the graphs is simplified if color-coded pens are used for the CMY curves.

FIGURE 3.1 FanGraph paper and colored pens



3.1.3 Hand-Held Spectro-Densitometer

Needed for measuring the P2P target and the GrayFinder target.

FIGURE 3.2 Hand-held spectrodensitometers from TECHKON (left) and X-Rite (right)

3.1.4 G7 P2P Target

The most important G7 tool is the P2P target, which is supplied in different layouts to suit different measuring devices. For example, the P2P25X can be read on an X-Rite i1-iSis, while the P2P25 cannot, however so long as the version number is the same (e.g. 25) the patch percentage values remain identical. A change in version number (e.g. 26) implies a change in patch values.

NOTE: In 2009 several new versions of the P2P target are planned. Be sure to use the correct definition file with the *SAME VERSION NUMBER* when measuring any P2P target.

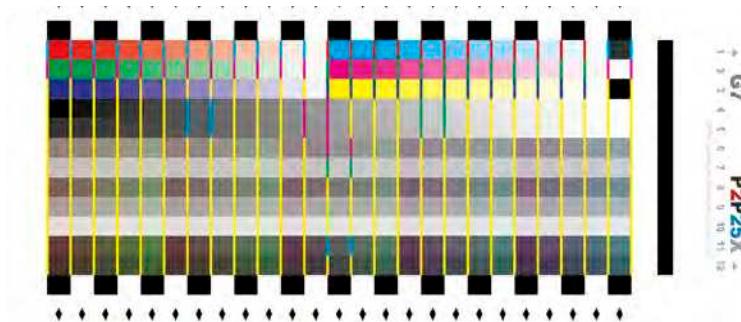


FIGURE 3.3 P2P25x Target

3.1.5 GrayFinder Target

The GrayFinder target is essential for the FanGraph G7 calibration method, but is not needed for the automated software method.



FIGURE 3.4 Original GrayFinder21 Target

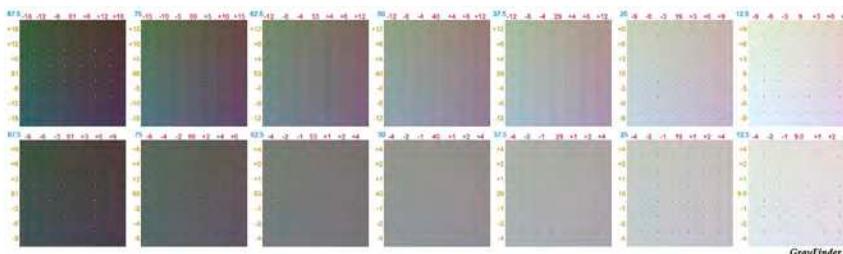


FIGURE 3.5 New GrayFinder22 Target

The new GrayFinder22 target released in 2009 has an extra block at 87.5% for better gray analysis in darker areas, and the 75% and 87.5% blocks have stronger M and Y increments to solve stronger gray balance errors. The target is in two halves, the lower half has “fine” steps for normal devices and the upper half has “coarse” steps to help balance extremely non-neutral processes.

NOTE: The M and Y steps in the lower half of the new GrayFinder22 are NOT THE SAME as in the GrayFinder21. For example in the 12.5, 25, 37.5, 50 and 62.5 blocks, M and Y increment by unequal steps of 1%, 2% and 4%, compared to 1%, 2% and 3% in the older version.

3.1.6 IT8.7/4 Characterization Target (Or Equivalent)

Most proofing systems and some other printing devices require a custom ICC profile as well as, or instead of, G7 calibration. If the need for a custom ICC profile is anticipated the IT8.7/4 target (shown below) or an equivalent characterization target will be needed.

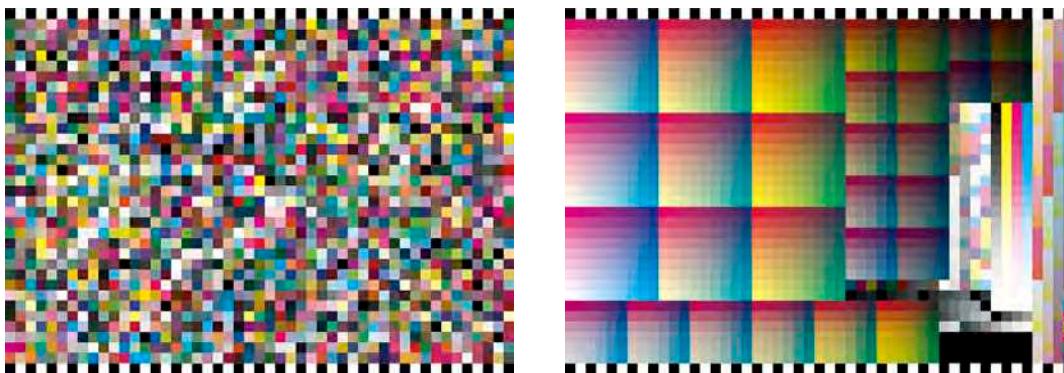


FIGURE 3.6 The IT8.7/4 target, randomized layout (left) and visual layout (right)

3.2 Assembling the Test Form

Test forms at various sizes are can be downloaded free from www.G7global.org, or you can create your own form.



FIGURE 3.7 Typical G7 press form (left) and proofing form (right)

Every G7 test form must contain at least one P2P target, and for the FanGraph method, at least one GrayFinder target. (The GrayFinder is optional with the software method.) If color management will be applied as well as G7 calibration, include a profiling target such as the IT8.7/4.

3.3 Printing the Test Form

- The test page should be printed with exactly the same materials and techniques as live work.
- Be sure the device is properly prepared and in an optimal, stable, repeatable condition.
- Record all printing variables.
- If the device suffers from unevenness, instability or sheet-to-sheet variations, print as many samples as necessary to get a representative average by measuring several targets.

3.4 Measuring the P2P Target

Measure the **ND** (Neutral Density) values of the K-only gray scale (P2P column 4) and the CMY-only gray scale (P2P column 5) and record the values in a list. (25 measurements per list.)

The target can be measured with spot readings using a hand-held densitometer set to the **Black**, or **Visual** channel or with an automated device such as the X-Rite EyeOne Pro, EyeOne iO, EyeOne iSis or DTP70.

For the FanGraph method, CIELab measurements may have to be converted to ND values¹ in software like Microsoft Excel® or X-Rite MeasureTool™. If the whole target was measured, the column 4 and 5 densities will have to be extracted from the list for the FanGraph method.

If more than one physical P2P target sample is measured, average the ND values from each set of measurements, either manually, or in software like Microsoft Excel.

3.4.1 Subtracting Substrate Density

When taking individual spot readings with a hand-held device, first zero the densitometer on the substrate so that the ND values are **minus substrate**. If the device cannot be zeroed on the substrate, record the absolute ND readings then subtract the substrate ND (measured in the lightest step) from all measured values. With substrate subtracted, the ND value for the lightest step of both the CMY and K grayscale should be exactly 0.0.

3.5 Plotting the Common CMY NPDC Curve

For each grayscale step, make a small mark where the ND value on the vertical axis aligns with the C% value on the horizontal axis. The red vertical *assist* lines indicate the C% of each P2P patch.

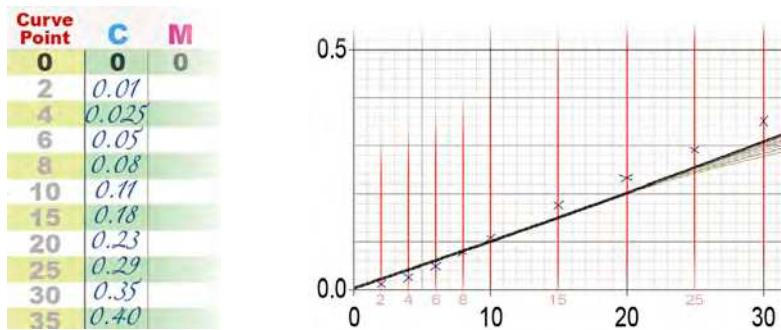


FIGURE 3.8 Left: List of CMY ND values. Right: Marking the ND vs. dot % intersections with crosses.

Connect the marks to draw the CMY *sample graph*. Use blue ink as the initial CMY sample graph becomes the cyan graph when correcting gray balance.

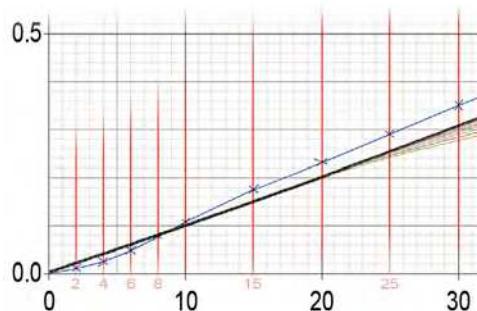


FIGURE 3.9 Connecting the dots creates the CMY sample graph.

¹ Formulae for converting CIELab or CIEXYZ to neutral density are available in the *G7 Specification* and elsewhere.

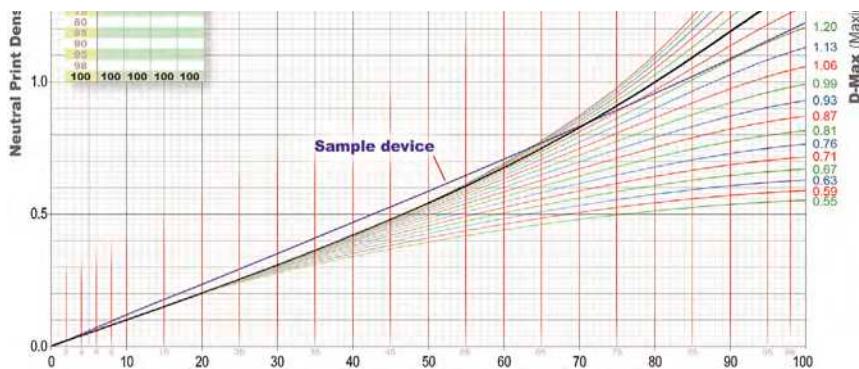


FIGURE 3.10 Typical CMY sample device graph

NOTE: Your graph must begin with a zero density value in the zero percent value (bottom left). If not, subtract the substrate (paper) density from all recorded density values and plot the graph again.

3.6 Finding Nearest Target Graph With Same D-max

Find the two nearest pre-printed target graphs above and below the D-max (maximum Neutral Density) of your sample device graph. Staying between the two pre-printed graphs, draw a new target graph that exactly touches your device curve at 100% (D-max) as illustrated below.



FIGURE 3.11 Left: The nearest two pre-printed graphs above and below the sample graph are 1.20 and 1.13. Right: Drawing a new target graph between the 1.13 and 1.20 graphs.

3.7 Repeating for Black

On a fresh sheet of G7 NPDC FanGraph (K) paper, draw the K NPDC sample graph using the same method as for the CMY graph. Find the nearest two pre-printed target graphs and re-draw the target graph the same as for the CMY graph.

3.8 Choosing Optimum Curve Points

Examine the graphs and decide how many 'curve points' are needed - typically wherever your sample curve bends significantly. For example, the curve in figure 3.12 requires points at 2% and 15%, and ideally at 10% and 20%, for maximum accuracy.

NOTE: For maximum precision in light highlight tones include 2%, 5% and 10% curve points.



FIGURE 3.12 Curve Points placed at bends in the sample curve

3.9 Determining if Gray Balance Needs Correcting

The common CMY graph generated in the previous section generates a common RIP curve for C, M and Y, which will not compensate for gray balance errors. To correct a gray balance error, different C, M and Y RIP curves are needed, which require drawing two new graphs for M and Y on the same FanGraph sheet.

- To correct gray balance errors, proceed to Calculating RIP Values **With** Gray Balance.
- To calculate a single RIP curve without gray balance correction, proceed to Calculating RIP Values **Without** Gray Balance
- If you are not sure whether gray balance needs correcting, continue reading from this point.

3.9.1 When to Correct Gray Balance

On highly stable devices like ink-jet printers or halftone laminate proofers, gray balance errors are usually very consistent and even small gray balance errors should be corrected.

On devices with moderate print-to-print inconsistencies (such as a sheet-fed offset press) gray balance errors should only be corrected if the errors in the P2P sample represent the average gray condition of the device. *Correction curves based on one P2P sample may not be valid for subsequent prints due to daily gray balance variations.*

Very unstable devices should be sampled several times with multiple P2P tests to determine the average gray balance condition.

3.9.2 When NOT to Correct Gray Balance

Gray balance should **NOT** be corrected if;

- The test print is already perfectly gray-balanced.
- The test print is nearly neutral and the error is less than the typical print-to-print deviation.
- The device will be gray-balanced on the next print run by physical adjustments such as modified CMY colorant levels.
- The device is so unstable that average gray balance is impossible to analyze.

3.10 Calculating RIP Values Without Gray Balance

If gray balance does not need adjustment, one common RIP curve can be calculated for all three CMY channels, as follows;

3.10.1 Finding New Aim Value for the 50% Curve Point

- From the 50% point on the X axis draw a vertical line up to meet the TARGET curve.
- From there draw a horizontal line across (left or right) to the SAMPLE curve.
- From there draw a vertical line down to the X axis to get the NEW AIM value.
- Record the new aim value in the chart provided on the FanGraph.

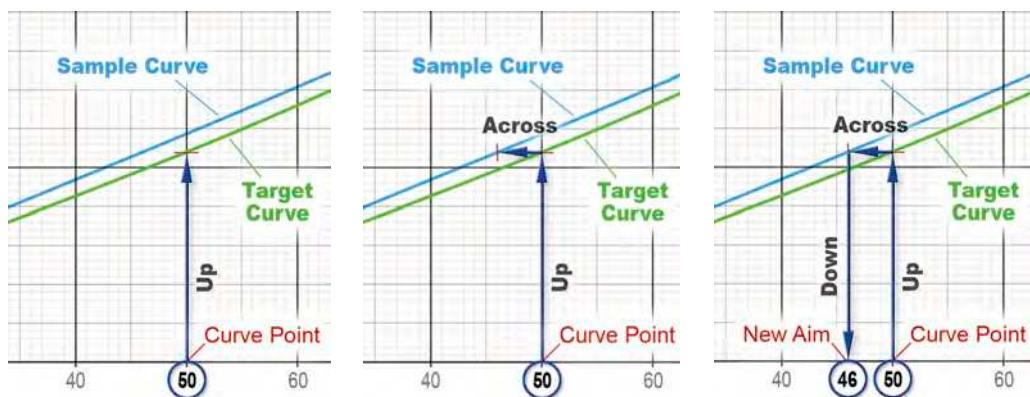


FIGURE 3.13 Finding the New Aim for a 50% Curve Point by the 'Up-Across-Down' method

3.10.2 Finding New Aim Values for the Other Curve Points

- Repeat for each curve point except 0% and 100%, which never change.

3.11 Calculating RIP Values *With Gray Balance*

To solve gray balance errors, separate CMY RIP curves can be calculated as follows;

NOTE: The already-drawn common CMY sample graph becomes the Cyan graph.

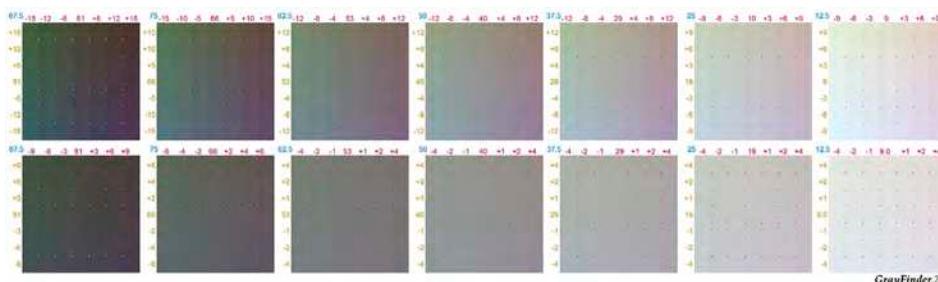
3.11.1 Calculating Wanted Gray Balance for Each GrayFinder Block

- With a spectrophotometer, measure the a^* and b^* values of the substrate on which the P2P and GrayFinder targets were printed.
- Multiply the substrate a^* and b^* values by the gray factors (derived from the C% of each block) to get wanted a^* and wanted b^* for each block, where;

$$\text{Gray factor} = (100 - C\%) / 100;$$

$$\text{Wanted } a^* = a^*_{\text{paper}} * \text{Gray factor};$$

$$\text{Wanted } b^* = b^*_{\text{paper}} * \text{Gray factor};$$



FACTOR: x 0.125 x 0.25 x 0.375 x 0.50 x 0.625 x 0.75 x 0.875

FIGURE 3.14 The GrayFinder22 target with G7 gray factors for each block

3.11.2 Finding the 'Most Neutral' Patch in the 50% Block

In the 50% block of the GrayFinder Target find the patch with the closest a^* and b^* values to the wanted a^* and wanted b^* values calculated in the previous step. Sometimes the closest match will be found by straddling two patches with the spectrophotometer's aperture.

- If the center patch is nearest to wanted gray, no correction is needed at that block.
- If the patch nearest to the wanted a^* b^* values is *not* the center patch, note the Magenta and Yel-

low coordinates of that patch. In the example below the wanted a^* and b^* values are between the +2 and +3 Magenta columns on the -3 Yellow row, so gray balance needs to add +2.5 M and -3 Y gray correction percentages to the calibration curves.

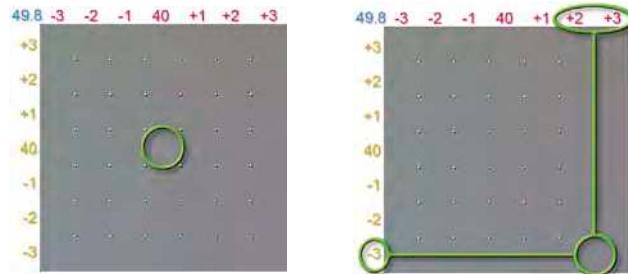


FIGURE 3.15 Good gray balance (left) and bad gray balance (right)

- If the lower half of the GrayFinder target does not contain wanted a^* b^* , use the upper half.

3.11.3 Repeating for Other GrayFinder Blocks

- Repeat the process for the 12.5%, 25%, 37.5%, 62.5%, 75% (and 87.5% if available) blocks.

3.11.4 Listing the M & Y Correction Percentages

- List the M and Y gray correction percentages on the new (2009) G7 NPDC FanGraph.



FIGURE 3.16 Typical list of M and Y gray correction percentages on the new FanGraph paper

3.11.5 Plotting M and Y Correction Percentages for the 50% Block

- At the point where the common CMY sample graph (now the Cyan graph) and the 40% vertical line intersect, count to the left or right by the amount of the M & Y gray correction percentages recorded earlier, and make M & Y colored dots or crosses, as shown below.
- The M and Y dots must be at exactly the same horizontal level as the intersection point of the Cyan graph.

NOTE: The gray correction values for the 50% GrayFinder block are plotted at the 40% intersection, because the M and Y percentages on that block are 40%.

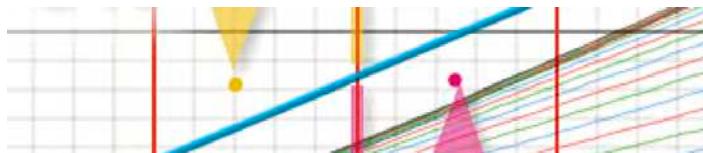


FIGURE 3.17 M and Y gray correction values are plotted at the same horizontal level (height) as the intersection point of the 40% value and the Cyan graph

3.11.6 Plotting M and Y Correction Percentages for Other Blocks

- Repeat for the other GrayFinder blocks, using the following vertical lines for M and Y;

Gray Block	M & Y Vertical Line
12.5	9
25	19
37.5	29
50	40
62.5	53
75	66
87.5	81

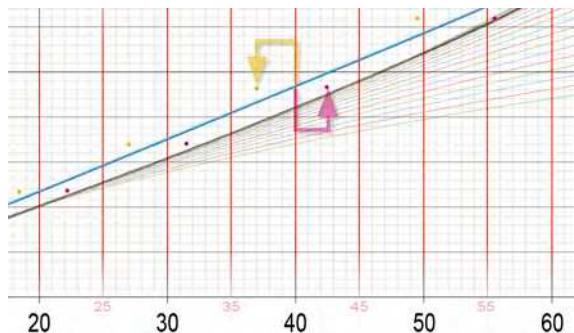


FIGURE 3.18 M and Y dots are plotted for each GrayFinder block

3.11.7 Drawing Curves for Magenta and Yellow

- Connect the magenta and yellow dots to create two new M and Y graphs. (The already-drawn common CMY graph becomes the C graph.)

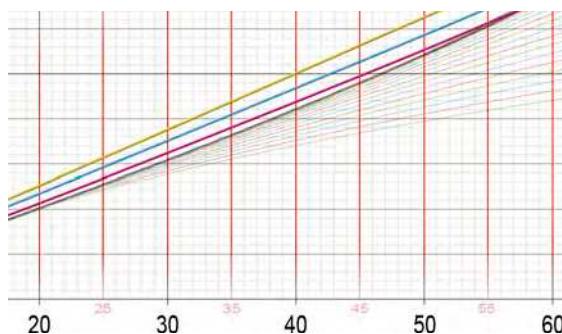


FIGURE 3.19 Connecting the dots to make three separate CMY curves

3.11.8 Finding New CMY Aim Values

- From each curve point on the X axis draw a vertical line UP to meet the target graph.
- Draw a horizontal line ACROSS to intersect the C, M, and Y graphs.
- Draw *separate* vertical lines DOWN to get three ‘new aim values’ for C, M, and Y.
- Record the CMY aims in the **New Aim Values** chart on the FanGraph.

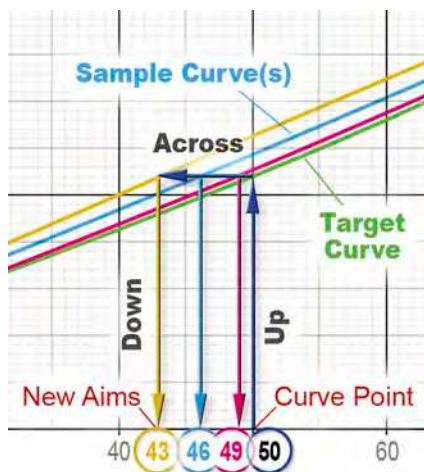


FIGURE 3.20 Finding separate CMY Aim Points.

New Aim Values				
Curve Point	C	M	Y	K
0	0	0	0	0
2				
4				
6				
8				
10	9	8	7.5	
15				
20				
25	23.5	21.5	20	
30				
35				
40				
45				
50	46	49	43	
55				
60				
65				
70				
75	74	72	69	
80				
85				
90	90	91	88	
95				
98				
100	100	100	100	100

FIGURE 3.21 New Aim Values recorded on the G7 FanGraph

3.12 Adjusting for NPDC Error Due to Gray Balance

If separate curves were calculated for C,M and Y, the NPDC curve may be inaccurate due to the M value's ND contribution. This inaccuracy can be minimized by subtracting the M aim from the C aim at each curve point to create an ND correction value, and adding *half* the ND correction value to the C, M and Y aim values, as follows;

$$\begin{aligned} \text{ND_correction} &= (\text{new_aim_C} - \text{new_aim_M}) / 2; \\ \text{corrected aim_C} &= \text{new aim_C} + \text{ND_correction}; \\ \text{corrected aim_M} &= \text{new aim_M} + \text{ND_correction}; \\ \text{corrected aim_Y} &= \text{new aim_Y} + \text{ND_correction}; \end{aligned}$$

3.12.1 Example (using aim values above):

NEW AIMS			ND_CORRECTI ON	CORRECTED AIMS		
C	M	Y		C	M	Y
8	9	7.5	$(8 - 9) / 2 = -0.5$	7.5	8.5	7
21.5	23.5	20	$(21.5 - 23.5) / 2 = -1$	20.5	22.5	19
46	49	43	$(46 - 49) / 2 = -1.5$	44.5	47.5	41.5
72	74	69	$(72 - 74) / 2 = -1$	71	73	68
90	91	88	$(90 - 91) / 2 = -0.5$	89.5	90.5	87.5

NOTE: This formula assumes that magenta and cyan contribute approximately equal neutral density to a CMY gray area, and that yellow contributes little or no neutral density. This correction can be safely ignored if an M value is less than 1-2 % different from its respective C value.

3.13 Applying New Aim Values to the RIP

3.13.1 RIP Interfaces

In a typical RIP interface there are three columns labeled “File Value”, “Measured Value” and “Wanted Value” or words with similar meanings. Refer to your RIP manufacturers instructions.

Initial Value	Current Value	Intended Value
5.00	5.00	5.00
10.00	10.00	10.00
15.00	15.00	15.00
20.00	20.00	20.00
25.00	25.00	25.00
30.00	30.00	30.00
35.00	35.00	35.00
40.00	40.00	40.00
45.00	45.00	45.00
50.00	50.00	50.00
55.00	55.00	55.00
60.00	60.00	60.00
65.00	65.00	65.00
70.00	70.00	70.00
75.00	75.00	75.00
80.00	80.00	80.00
85.00	85.00	85.00
90.00	90.00	90.00
95.00	95.00	95.00
100	100	100

File Value	Measured Value	Wanted Value
5.00	5.00	5.00
10.00	10.00	10.00
15.00	15.00	15.00
20.00	20.00	20.00
25.00	25.00	25.00
30.00	30.00	30.00
35.00	35.00	35.00
40.00	40.00	40.00
45.00	45.00	45.00
50.00	50.00	50.00
55.00	55.00	55.00
60.00	60.00	60.00
65.00	65.00	65.00
70.00	70.00	70.00
75.00	75.00	75.00
80.00	80.00	80.00
85.00	85.00	85.00
90.00	90.00	90.00
95.00	95.00	95.00
100	100	100

Index Value	Actual Value	Desired Value
5.00	5.00	5.00
10.00	10.00	10.00
15.00	15.00	15.00
20.00	20.00	20.00
25.00	25.00	25.00
30.00	30.00	30.00
35.00	35.00	35.00
40.00	40.00	40.00
45.00	45.00	45.00
50.00	50.00	50.00
55.00	55.00	55.00
60.00	60.00	60.00
65.00	65.00	65.00
70.00	70.00	70.00
75.00	75.00	75.00
80.00	80.00	80.00
85.00	85.00	85.00
90.00	90.00	90.00
95.00	95.00	95.00
100	100	100

FIGURE 3.22 Typical CtP RIP user interfaces. (Actual labels and values vary from RIP to RIP.)

- The first column usually represents the dot percentage value sent to the RIP in the initial image file. The number of entries in this column may be fixed or user-editable. If fixed, be sure the Curve

Points on the FanGraph match the fixed RIP values.

- The second column usually receives the dot percentages measured from the media being calibrated. In G7 this column should always contain the same values as the first column.
- The third column usually asks for the value that is wanted in that scale step. This is where the G7 **Aim Values** should be entered.

3.13.2 Finding 'Measured' Values for Reverse-Acting RIP Curves

If the RIP only has two columns asking for **File** values and **Measured** values (or equivalent names), or if there is no column for **Wanted** values, the G7 New Aim values calculated normally may act in reverse, darkening instead of lightening the printed result. To find **Measured** values for a reverse-acting RIP, use the following procedure.

For each curve point:

- Draw a vertical line up to meet the SAMPLE curve.
- From there draw a horizontal line across (left or right) to the TARGET curve.
- From there draw a vertical line down to the bottom axis to get the MEASURED value.
- Record the Measured value in the New Aim column in the FanGraph chart and re-label that column '*Measured*' to avoid confusion.

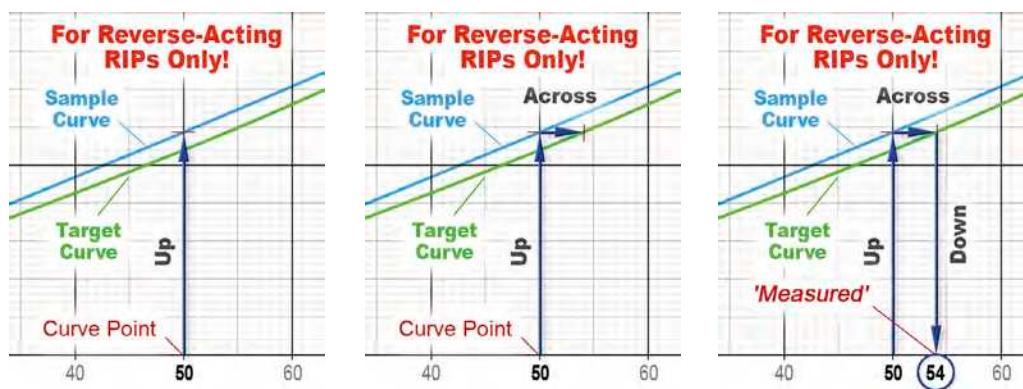


FIGURE 3.23 Modified 'Up-Across-Down' method for use with **Reverse-Acting** RIPs

3.14 Evaluating G7 Calibration Accuracy

- Print a qualifying print of the same form and measure the P2P target.
- Plot the NPDC curves on fresh sheets of FanGraph. Your measured data should overlay the pre-printed lines virtually perfectly from 0% to 50%.
- Check gray balance by measuring the center patches of the GrayFinder target. The center patch in each block should be closest to the wanted a^* and b^* values.

If your qualifying print passes these tests, neutral gray images should closely match another G7-calibrated device, relative to substrate color and brightness. However remember that differences in substrate color may lead to gray balance differences between media, and differences in dynamic range may affect the visual match in darker tones. G7 does not attempt to solve these differences. If a more exact match is required between devices, some form of color management may be needed as well as G7 calibration.

4

CALIBRATION USING IDEALink[®] Curve

This section gives a step-by-step guide to the basic G7 Grayscale calibration using the IDEALink Curve software. For more detailed instructions see the Curve User's Guide.

4.1 Requirements

4.1.1 Curve calculating software

IDEALink Curve software.

4.1.2 Automated software for measuring the P2P target

ONE OF:

- X-Rite MeasureTool - available at www.x-rite.com
- X-Rite ColorPort - available at www.x-rite.com

4.1.2 Automated measuring device

ONE OF:

- X-Rite Spectroscan
- X-Rite EyeOne Pro
- X-Rite EyeOne IO
- X-Rite DTP-70
- X-Rite i1 iSis

4.2 The Test Form

Various-sized test forms can be downloaded free at www.G7global.org. If making your own test form, the P2P target is essential. The IT8.7/4 target (or equivalent) is required if making an ICC profile from the same form. The GrayFinder target is not required by IDEALink Curve.

4.3 Printing the Test Form

- The test form should be printed with exactly the same materials and techniques as live work.
- Be sure the device is properly prepared and in an optimal, stable, repeatable condition.
- Record all printing variables.
- If the device suffers from unevenness, instability or sheet-to-sheet variations, print as many samples as necessary to get a representative average by measuring several targets.

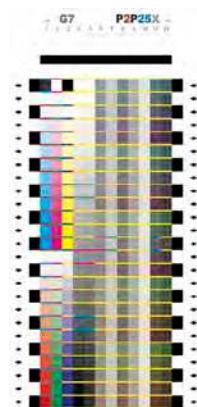


FIGURE 4.1 The minimum G7 test form for IDEALink Curve is the P2P target

4.4 Measuring the P2P Target

- Measure the **whole** P2P target with an automated device such as the X-Rite EyeOne Pro, EyeOne iO, EyeOne iSis, DTP70 or SpectroScan.

4.4.1 Measuring the P2P Target in MeasureTool

- In the Configure tab select the attached measuring device.
- In the Measuring tab select the appropriate reference for the target and device.
- Measure the target and save the file as a '.txt' file.

4.4.2 Measuring the P2P Target in ColorPort

- (Initial installation only) From the File menu, open Target Manager and Import the .xml file(s) supplied with the P2P target.
- Click the Measure Target tab.
- In the Target list select the appropriate .xml file for the target and device in use.
- Measure the target and save the file as a CGATS document

4.5 Loading Measurement File(s) in IDEALink Curve

- In the Gather Measurements tab of IDEALink Curve click Add... and load the saved measurement file. You can also drag and drop files into the measurement sets list.
- New measurement files appear in the Measurement Sets list with a check mark to indicate they are being averaged with other files in the session.
- To disable a measurement file, remove the checkmark alongside it and that file will be removed from the average. To re-enable it, enable the checkmark again.

4.6 Choosing the Optimum Curve Points

- Examine the graphs and decide how many 'curve points' you want. If your RIP needs specific curve points, make sure these match the Entry column of the Output Curve Set. If your RIP lets you choose your own Curve points, add enough to control the curve shape smoothly.



FIGURE 4.2 IDEALink Curve's Output Curve display under the **Create Curves** tab

4.6.1 Adding and Subtracting Curve Points

- To add a curve point click the + (plus) symbol under the **Output Curve Set** and type the value. To delete a curve point, highlight the **Entry** value and click the - (minus) symbol.

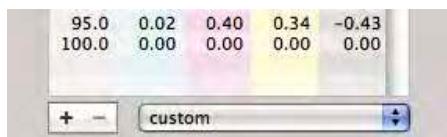


FIGURE 4.3 Plus (+) and minus (-) symbols under the Output Curve Set allow custom curve lists

NOTE: For maximum highlight tone precision always include 2%, 5% and 10% curve points, unless the device you are calibrating cannot hold such small percentages (such as a flexo press).

4.7 Determining if Gray Balance Needs Correcting

When the maximum difference between C, M and Y in any **Output Curve Set** row is equal to or greater than 1%, and the device consistently prints with the same gray balance error, different C, M and Y RIP curves are recommended.

- To correct gray balance errors, proceed to *Correcting Gray Balance in IDEALink Curve*.
- To calculate a common RIP curve for CMY without gray balance correction, proceed to *Using IDEALink Curve Without Gray Balance*.
- If you are not sure whether gray balance needs correcting, continue reading from this point.

4.7.1 When to Correct Gray Balance

On highly stable devices like ink-jet printers or halftone laminate proofers, even small gray balance errors should be corrected. Small gray balance errors are normal and usually very consistent.

On devices with moderate print-to-print inconsistencies gray balance errors should only be corrected if the errors in the P2P sample represent the average gray condition of the device. Very unstable devices should be sampled several times with multiple P2P tests to determine the average gray balance condition.

CAUTION: Correction curves based on one P2P sample may not be valid for subsequent prints due to normal process variations.

4.7.2 When NOT to Correct Gray Balance

Gray balance should **NOT** be corrected if;

- The test print is already perfectly gray-balanced.
- The test print is nearly neutral and the error is less than the typical print-to-print deviation.
- The device will be gray-balanced on the next print run by physical adjustments such as modified CMY colorant levels.
- The device is so unstable that average gray balance is impossible to analyze.

4.8 Correcting Gray Balance in IDEALink Curve

Make sure **Gray Balance** is checked in the **Create Curves** tab.

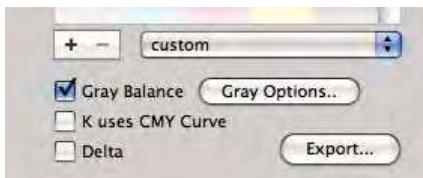


FIGURE 4.4 Gray Balance switched ON in the **Create Curves** tab

4.8.1 Gray Options

Clicking the **Gray Options...** button opens a sub-window with several controls.

4.8.2 Paper White vs. Custom White

When **Paper White** is selected, gray balance is based on the color of the substrate on which the P2P target was printed. To base gray balance on an arbitrary paper color click **Custom White** and enter a* and b* values manually. ILC will attempt to match grays above about 30% to the arbitrary paper color, while fading smoothly towards the substrate color in lighter percentages.

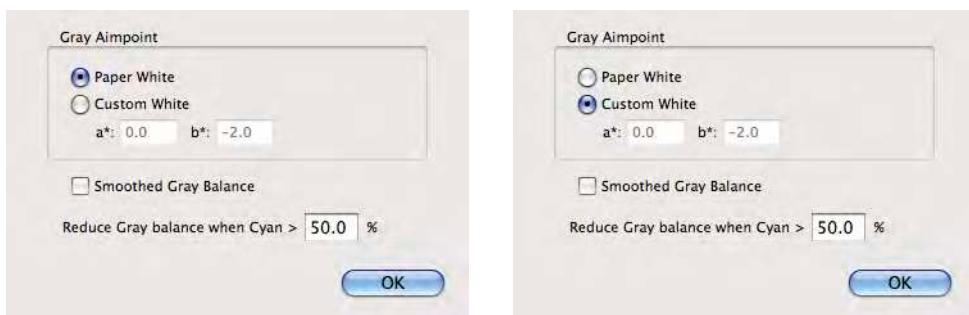


FIGURE 4.5 Switching between Paper White and Custom White

4.8.3 Smoothed Gray Balance

CAUTION: Smoothed Gray Balance should normally be OFF. It is only intended for very unstable gray balance conditions that are hard to analyze, for example web-offset presses on newsprint.

Checking **Smoothed Gray Balance** creates less precise (but smoother) gray balance corrections based on an average of the whole CMY gray scale.

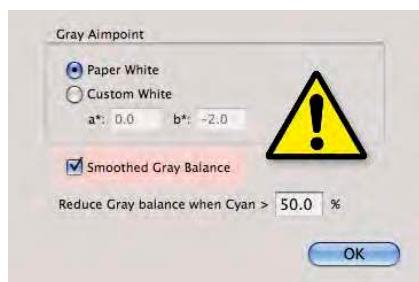


FIGURE 4.6 Smoothed Gray Balance should be OFF except in rare circumstances

A better way to calculate gray balance for unstable devices is to measure several P2P targets from different sheets and from multiple different testing times.

4.8.4 Reduce Gray Balance when Cyan > (...)%

By default, gray balance correction is reduced in darker tones, with none at all at 100%. The **Reduce Gray Balance when Cyan > (...)%** control sets a threshold above which gray balance correction begins reducing. At a setting of 50% grays are fully corrected from 0% to 50%, but only half corrected at 75% as shown below, left. The default setting of 50% is recommended for devices with unstable shadow balance, such as an offset press. Higher percentages extend gray correction further into shadows. The maximum effective setting is 87.5%.

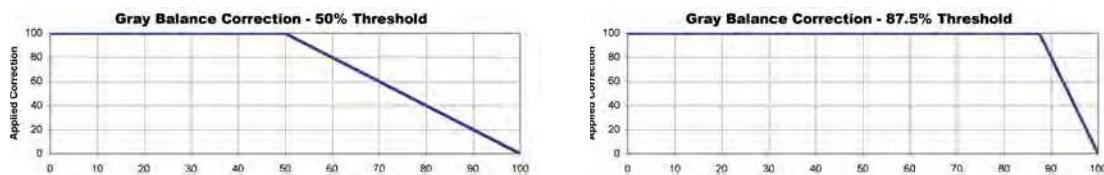


FIGURE 4.7 Gray Balance can be applied to varying extents in darker tones

CAUTION: On an offset press, threshold values over 50% may cause problems in 1- and 2-color ramps and spot colors. If the correction curves show “flats” or “reversals”, reduce the threshold.

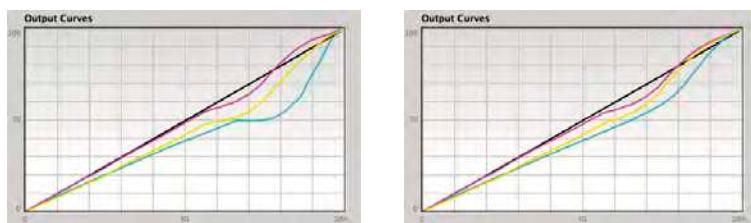


FIGURE 4.8 A threshold of 90 (left) showing curve “flats”. 50 (right) is safer.

4.9 Using IDEALink Curve Without Gray Balance

- Switch off gray balance in the **Create Curves** tab.

When Gray balance is OFF, identical CMY curve values are calculated which will optimize the NPDC curve, but not correct any gray errors.

4.10 Applying the Output Curve Set to the RIP

The **Output Curve Set** values must be transferred to the RIP.

4.10.1 RIP Interfaces

In a typical RIP interface there are three columns labeled **File Value**, **Measured Value** and **Wanted Value** or words with similar meanings.

Initial Value	Current Value	Intended Value
5.00	5.00	5.00
10.00	10.00	10.00
15.00	15.00	15.00
20.00	20.00	20.00
25.00	25.00	25.00
30.00	30.00	30.00
35.00	35.00	35.00
40.00	40.00	40.00
45.00	45.00	45.00
50.00	50.00	50.00
55.00	55.00	55.00
60.00	60.00	60.00
65.00	65.00	65.00
70.00	70.00	70.00
75.00	75.00	75.00
80.00	80.00	80.00
85.00	85.00	85.00
90.00	90.00	90.00
95.00	95.00	95.00
100	100	100

File Value	Measured Value	Wanted Value
5.00	5.00	5.00
10.00	10.00	10.00
15.00	15.00	15.00
20.00	20.00	20.00
25.00	25.00	25.00
30.00	30.00	30.00
35.00	35.00	35.00
40.00	40.00	40.00
45.00	45.00	45.00
50.00	50.00	50.00
55.00	55.00	55.00
60.00	60.00	60.00
65.00	65.00	65.00
70.00	70.00	70.00
75.00	75.00	75.00
80.00	80.00	80.00
85.00	85.00	85.00
90.00	90.00	90.00
95.00	95.00	95.00
100	100	100

Index Value	Actual Value	Desired Value
5.00	5.00	5.00
10.00	10.00	10.00
15.00	15.00	15.00
20.00	20.00	20.00
25.00	25.00	25.00
30.00	30.00	30.00
35.00	35.00	35.00
40.00	40.00	40.00
45.00	45.00	45.00
50.00	50.00	50.00
55.00	55.00	55.00
60.00	60.00	60.00
65.00	65.00	65.00
70.00	70.00	70.00
75.00	75.00	75.00
80.00	80.00	80.00
85.00	85.00	85.00
90.00	90.00	90.00
95.00	95.00	95.00
100	100	100

FIGURE 4.9 Typical CtP RIP user interfaces. Actual labels and values will vary from RIP to RIP

- The first column must contain the same values as the Entry column of the Output Curve Set. The number of RIP entries may be fixed or user-editable. If fixed, change the Entry values in IDEALink Curve to match the fixed RIP values.
- The second column usually receives the dot percentages measured from the media being calibrated. For G7 this column should always contain the same values as the first column.
- The third column usually asks for the value that is wanted in that scale step. This is where the CMYK Percentages in the **Output Curve Set** should be entered.

4.10.2 Output Curve Set Values for Reverse-Acting RIP Curves

If the RIP has no column for **Wanted** values, the **Output Curve Set** may work in reverse, darkening instead of lightening the result. To calculate *approximate Measured* values for a reverse-acting RIP;

- Click the Delta button under the Output Curve Set.
- Subtract the delta percentage values displayed from the Entry values.
- Apply the resulting value to the Measured column of the RIP

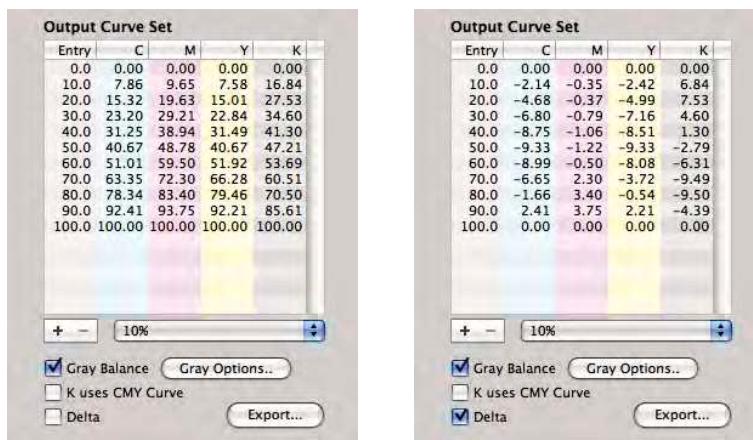


FIGURE 4.10 Output Curve Set with Delta values (right) and normal values (left)

For example, here are the calculations to find the approximate **Measured** magenta values in the Output Curve Set illustrated above:

Entry	Delta_M	Measured_M
10	- (- 0.35)	= 10.35
20	- (- 0.37)	= 20.37
30	- (- 0.79)	= 30.79
40	- (- 1.06)	= 41.06
50	- (- 1.22)	= 51.22
60	- (- 0.50)	= 60.50
70	- 2.30	= 67.70
80	- 3.40	= 76.60
90	- 3.75	= 86.25

NOTE: Subtracting a negative value is the same as changing the sign and adding the number.

4.11 Evaluating G7 Calibration Accuracy

- Make a qualifying print of the same test form through the new RIP curves.
- Measure the P2P target and load the data in IDEALink Curve.

4.11.1 NPDC Curve Visual Analysis

In the **CMY NPDC** and **K NPDC** graphs the green **Wanted** line should almost perfectly cover the red **Measured** line, with slight deviations allowed above 50%.

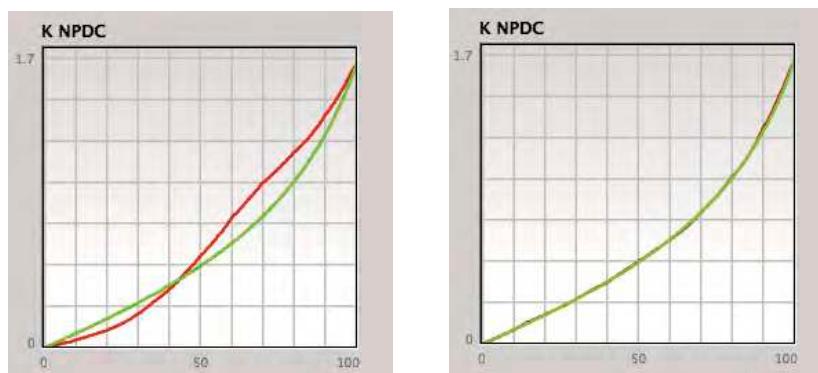


FIGURE 4.11 NPDC curves before (Left) and after (Right) a successful G7 calibration

4.11.2 Gray Balance Visual Analysis

Click on the **Analyze Color** tab and view the **CMY Gray Balance** curves. In a perfect case the **a*** (red) and **b*** (blue) lines would be perfectly straight, starting at 0% with the substrate **a*** and **b*** values and ending at 100% with zero in both cases (touching the middle line of the graph).

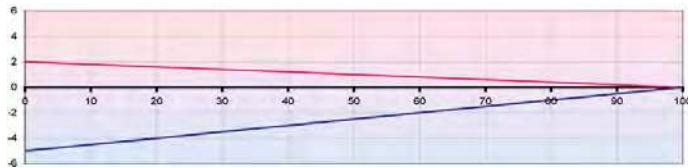


FIGURE 4.12 Theoretically ideal gray balance curves for a^* (red) and b^* (blue)

In practice small deviations from the ideal lines are acceptable, especially at values between 60% and 100%. The lower right illustration (below) represents good typical G7 gray balance.

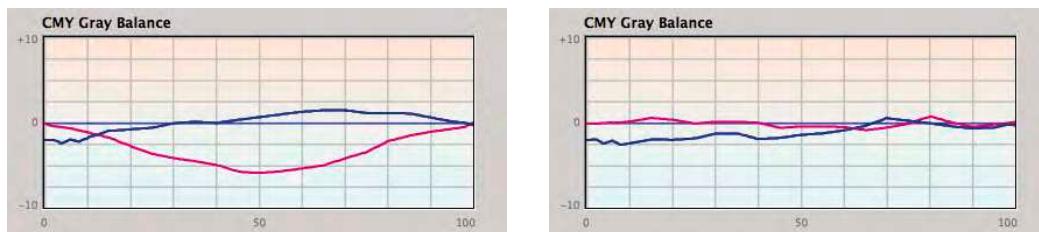


FIGURE 4.13 Gray Balance curves before (Left) and after (Right) successful G7 calibration

4.11.3 Delta % Analysis

For a more rigorous gray balance analysis, click on the **Create Curves** tab and click **Delta**. A good G7 calibration should show no delta values greater than $\pm 1.0\%$ from substrate to 50%, and none greater than $\pm 2\%$ above 50%, however this will depend on the repeatability of the device, the number of control points entered into the RIP, etc.

Output Curve Set				
Entry	C	M	Y	K
0.0	0.00	0.00	0.00	0.00
2.0	0.43	0.11	0.16	-0.02
5.0	0.15	-0.14	-0.01	-0.05
10.0	0.05	-0.46	-0.21	-0.09
20.0	-0.24	-0.75	-0.30	-0.19
30.0	-0.33	-0.63	-0.40	-0.28
40.0	0.52	-0.24	-0.23	-0.33
50.0	0.50	-0.21	0.01	-0.34
60.0	0.80	-0.36	-0.28	-0.40
70.0	0.06	-0.00	-0.02	-0.48
80.0	-0.11	-0.27	-0.28	-0.37
90.0	-0.62	0.11	0.10	-0.28
95.0	0.18	0.41	0.41	-0.13
100.0	0.00	0.00	0.00	0.00

Gray Balance Gray Options...
 K uses CMY Curve
 Delta Export...

If your qualifying print passes these tests, neutral gray images should closely match another G7-calibrated device, relative to substrate color and brightness. However remember that differences in substrate color may lead to gray balance differences between media, and differences in dynamic range may affect the visual match in darker tones. G7 does not attempt to solve these differences. If a more exact match is required between devices, some form of color management may be needed as well as G7 calibration.

FIGURE 4.14 Delta values after a successful G7 calibration

G7 CALIBRATION FROM ICC PROFILES

G7 calibration from ICC profiles is useful when you have an ICC profile of a process but for some reason cannot print a separate P2P target. With an ICC profile, the Lab values that would have been measured in a printed P2P target can be predicted, and the resulting values can be used to calculate G7 calibration curves.

There are at least two ways to calculate G7 calibration curves from an ICC profile. One way uses Heidelberg's Gray Balance Optimizer Utility to automatically generate CMYK RIP tables directly from two profiles of the target condition and the device to be calibrated. If the target profile is G7-based, the RIP curves should result in a good G7 calibration. Another more labor-intensive method uses software like CHROMiX ColorThink™ or X-Rite ColorLab to extract Lab data from a P2P reference file, which is then used by IDE-Link Curve to create G7 correction curves.

In theory, calibrating from an ICC profile may not be as accurate as calibrating from a printed P2P target, because an ICC profile cannot analyze small tonal and gray balance variations as precisely as a printed P2P target. On the other hand, the inherent smoothing action of an ICC profile may actually be an advantage in some cases, especially when the device is somewhat unstable.

5.1 Heidelberg Gray Balance Optimizer

NOTE: This software has not yet been tested by IDEAlliance but the principles are known to be valid. The following overview is taken by permission from the **Heidelberg Gray Balance Optimizer User's Guide**. For more details and technical support please contact the manufacturer directly.

5.1.1 Description of Heidelberg's Near Neutral Utility

Heidelberg's Gray Balance Optimizer Utility is a simple way to accomplish Near Neutral Calibrations and create Reference values for different substrates, inks, or processes. By using a Standard ICC Profile (or a custom profile of your choosing) as a Reference File, and then creating an ICC Profile of the Linear (or Raw) Print Process to be calibrated and inserting it into the Utility, Calibration Data Records are automatically generated.

By using ICC Profiles Heidelberg's Gray Balance Optimizer needs no special Charts and even eliminates the need to print TVI (Dot Gain) scales to perform calibrations. Any ICC Profile Target can be used to generate Calibration Curve Corrections.

5.1.2 Outline For Using Heidelberg's Gray Balance Optimizer:

1. Determine what Print Standard to use for your production.
2. Select Reference Printing Condition and Create ICC Profile or use existing Standard Profile from ECI or GRACoL.

3. Select Color management Target that is applicable to the printing process being calibrated.
4. Print Color Management Target to Standard Inking Values such as detailed in ISO12647-2. Printing can be done with Linearized plates or Raw Plates at the discretion of the user.
5. Create ICC Profile from results of Profiling Target Printed to Standard Inking Values.
6. Calculate Calibration Data by loading the Reference Profile and your Process Profile into the Gray Balance Optimizer.
7. Import results into the Heidelberg Calibration Tool or Calibration Manager to create Calibration Curves. Additionally, results may be entered manually by users of third party software.
8. Output a new set of plates applying the Calibration Curves that were just created
9. Print Calibrated Plates to the same Standard Inking Values as used in step 4.
10. Verify Results.

For more information from Heidelberg about Color & Quality go to http://www.heidelberg.com/www/html/en/content/articles/prinect/topics/color_and_quality

5.2 Manual Method

This method of G7-calibrating from an ICC profile was used by IDEAlliance when developing the 2006 GRACoL and SWOP characterization data sets. For more details of that process see the *G7 Specification*.

CAUTION: This method is NOT recommended for novice users.

5.2.1 Requirements

- An ICC profile of the device to be calibrated.
- Software capable of converting text values into CIE Lab via an ICC profile, e.g. CHROMiX ColorThink™.
- The P2P25.txt reference file supplied in the P2P25 target package.
- IDEALink Curve™.

5.2.2 Extract Lab values From the P2P reference file

- Open the P2P25.txt file in CHROMiX ColorThink or equivalent software.
- Assign the profile of the device you want to calibrate.
- Set the rendering intent to ABSOLUTE.
- Save a list of the CMYK and Lab values as a text file.

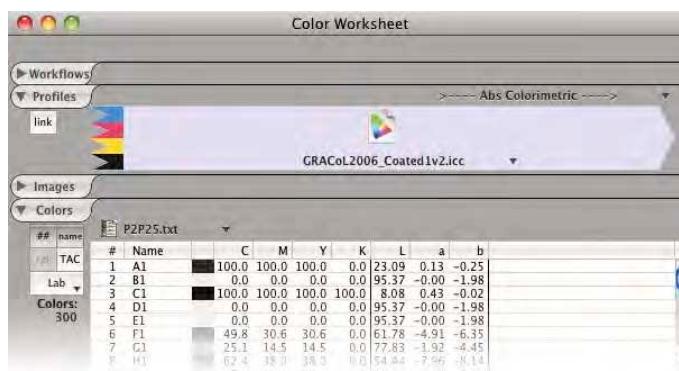


FIGURE 5.1 Assigning the profile to the P2P text file in a ColorThink worksheet

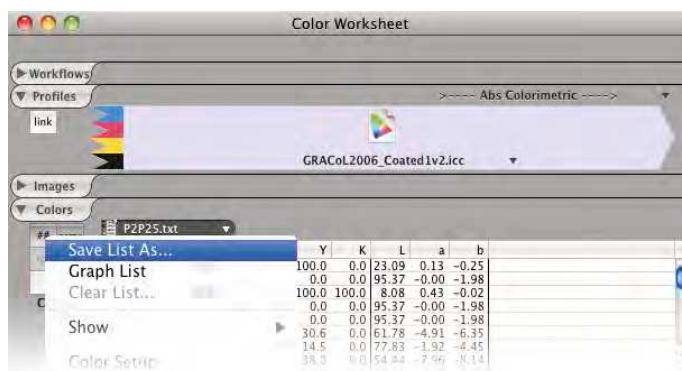


FIGURE 5.2 Saving the list



FIGURE 5.3 Selecting CMYK and Lab in the Save dialog

5.2.3 Calculate G7 Corrections in IDEALink Curve

- Load the text file you just exported into IDEALink Curve, just as you would a normal measurement file.
- Proceed as described in section 4.

A

APPENDIX A: G7 FANGRAPH

This section contains blank G7 “FanGraph” images plus an example graph showing how the graphs are used. These images are also available as separate high-resolution pdf files at www.G7global.org.

NOTE: that the G7 compression formula could possibly change in future, resulting in slight changes to some or all graph shapes shown here. To be sure you are using the latest formula, check for updates and download the latest FanGraph pdf files from www.G7global.org.

A.1 Using the FanGraph

- Detailed instructions are provided in the section “G7 Calibration Using the FanGraph.”
- Print several sheets of each blank graph page prior to calibrating.
- Use a fresh sheet of K and CMY FanGraph for each new calibration exercise.
- Begin by making a small dot or cross where each neutral density value (located on the vertical axis) intersects with its P2P patch dot percentage (located on the horizontal axis).
- The red vertical lines indicate the locations of each P2P patch.
- When plotting the CMY graph, use blue ink as the initial curve becomes the cyan curve when calculating gray balance correction.

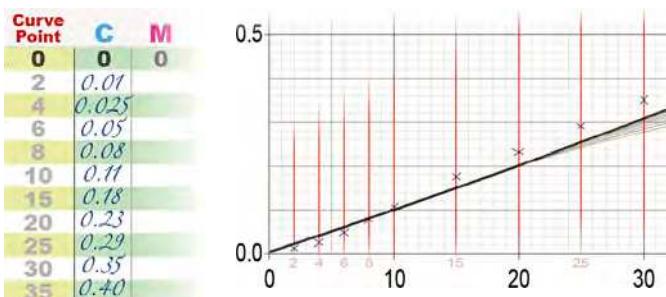


FIGURE A.1 Left: List of CMY ND values. Right: Marking the ND vs. dot % intersections with crosses.

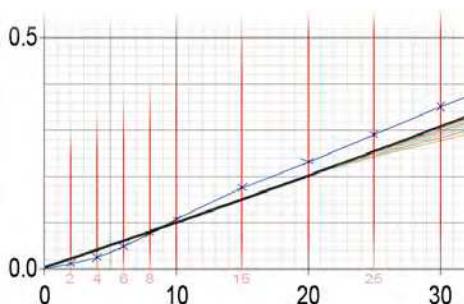
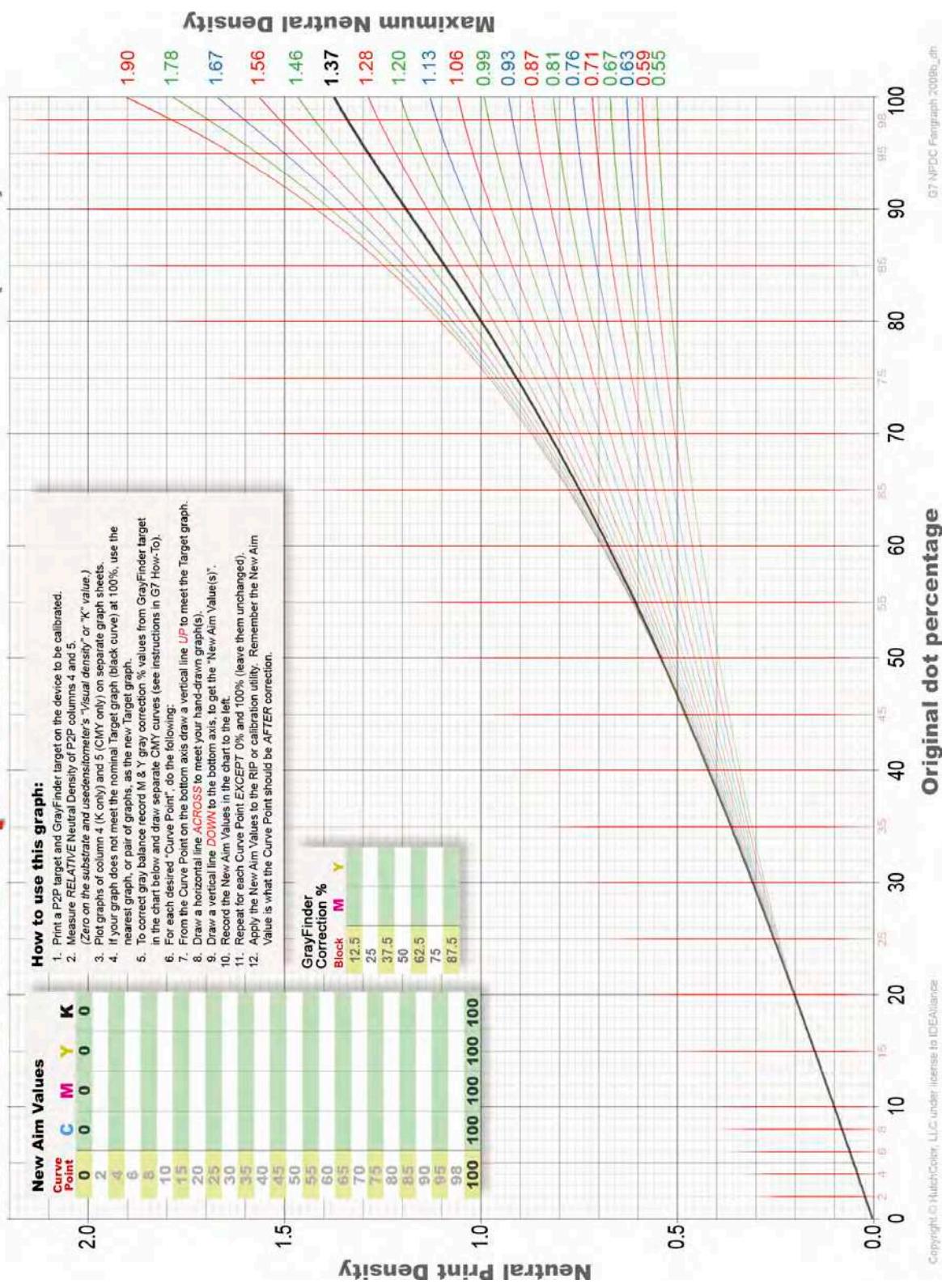


FIGURE A.2 Connecting the dots creates the CMY NPDC curve.

G7 NPDC FanGraph 2009

(CMY)



G7 NPDC FanGraph 2009b.dft

Original dot percentage

Copyright © MunsellColor, LLC under license to iDE Alliance

FIGURE A.3 Blank G7 NPDC FanGraph (CMY)

G7 NPDC FanGraph 2009

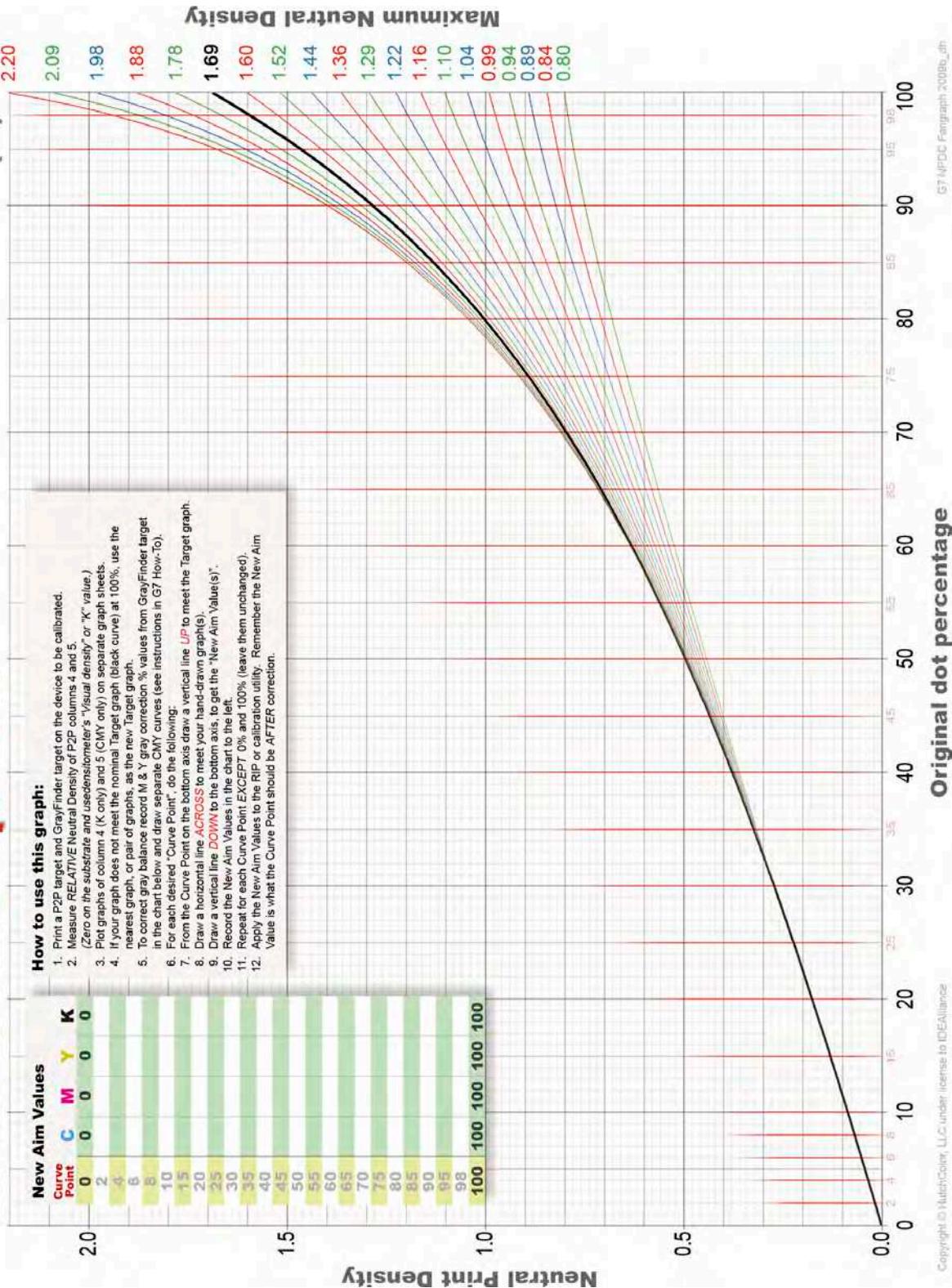
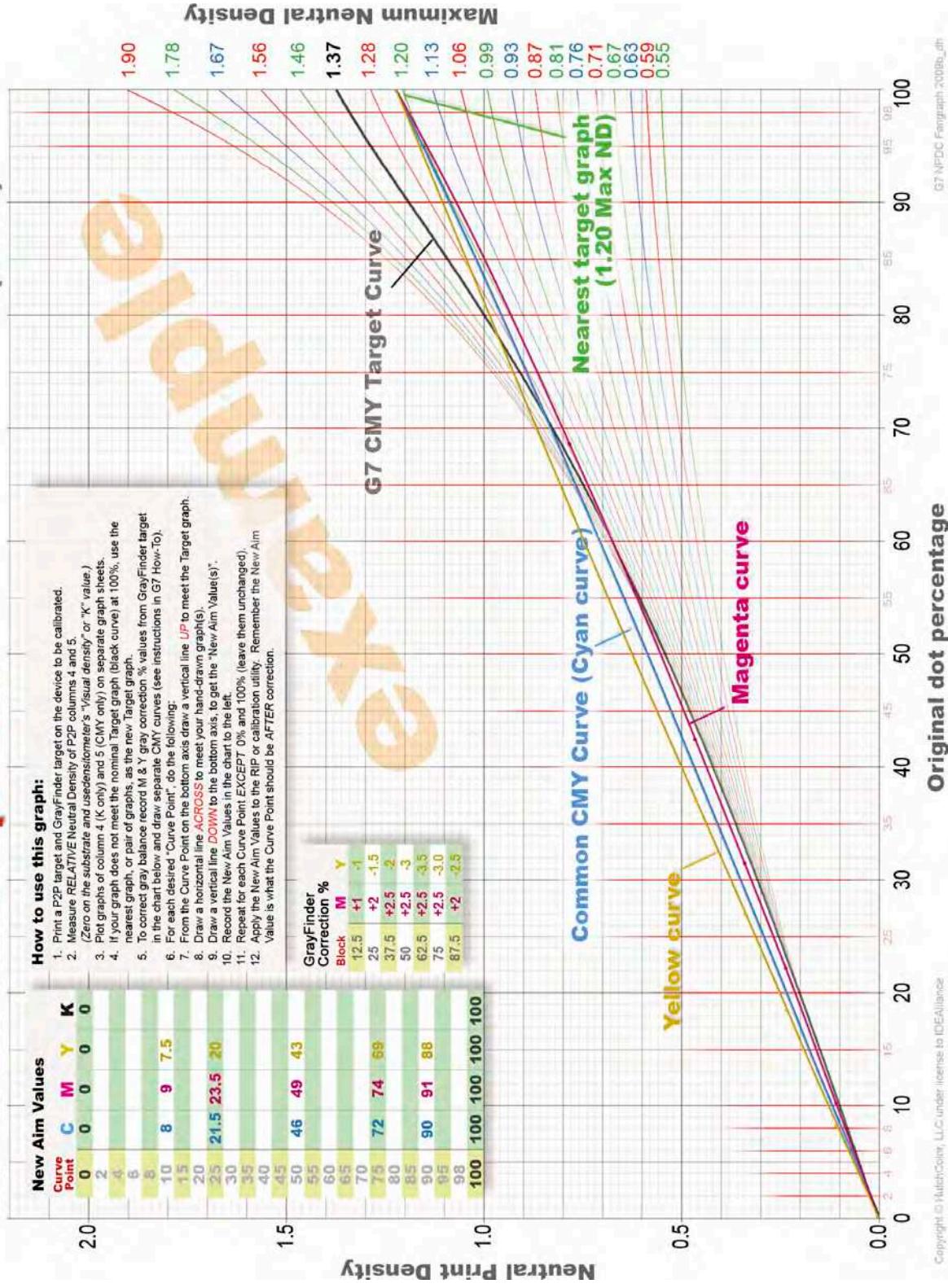


FIGURE A.4 Blank G7 NPDC FanGraph (K)

G7 NPDC FanGraph 2009 (CMY)



Copyright © MunsellColor, LLC under license to IDEAlliance

G7 NPDC FanGraph 2009a_dft

FIGURE A.5 Example of a completed G7 NPDC FanGraph

B

APPENDIX B: ISO 12647-2 SOLID INK VALUES

The following chart lists the CIELab values for solid inks on standard ISO paper types 1, 2, 3, 4 and 5, as listed in ISO 12647-2:2004/Amd.1:2007. Check the ISO website for latest updates.

NOTE: SWOP 3 and 5 aims are not the same as ISO paper type 3 and 5.

Paper type	1 & 2			3			4			5		
	L*	a*	b*	L*	a*	b*	L*	a*	b*	L*	a*	b*
K	16	0	0	20	0	0	31	1	1	31	1	2
	(16)	(0)	(0)	(20)	(0)	(0)	(31)	(1)	(1)	(31)	(1)	(3)
C	54	-36	-49	55	-36	-44	58	-25	-43	59	-27	-36
	(55)	(-37)	(-50)	(58)	(-38)	(-44)	(60)	(-26)	(-44)	(60)	(-28)	(-36)
M	46	72	-5	46	70	-3	54	58	-2	52	57	2
	(48)	(74)	(-3)	(49)	(75)	(0)	(56)	(61)	(-1)	(54)	(60)	(4)
Y	87	-6	90	84	-5	88	86	-4	75	86	-3	77
	(89)	(-5)	(93)	(89)	(-4)	(94)	(89)	(-4)	(78)	(89)	(-3)	(81)
M+Y	46	67	47	45	62	39	52	53	25	51	55	34
	(47)	(68)	(48)	(47)	(67)	(43)	(54)	(55)	(26)	(53)	(58)	(37)
C+Y	49	-66	24	47	-60	25	53	-42	13	49	-44	16
	(50)	(-68)	(25)	(50)	(-64)	(27)	(54)	(-44)	(14)	(50)	(-46)	(17)
C+M	24	16	-45	24	18	-41	37	8	-30	33	12	-29
	(24)	(17)	(-46)	(25)	(20)	(-44)	(38)	(8)	(-31)	(34)	(12)	(-29)
C+M+Y	22	0	0	22	0	0	32	0	0	31	0	0
	(23)	(0)	(0)	(23)	(0)	(0)	(33)	(0)	(0)	(32)	(0)	(0)

FIGURE B.1 Solid ink values for ISO 12647-2 paper types 1 through 5.

Lighter rows show white-backed readings (with numbers in brackets) – reproduced by courtesy of ISO

B.1 Measuring With White vs. Black Backing

The values shown in brackets refer to measurements taken with the sample lying on a white backing material having an approximate CIELab value of L*98, a*0, b*0, as defined in ISO 13655. In practice ‘Self Backing’ with five or more blank sheets of the same substrate is often used when the standard backing material is not available.

CAUTION: White backing is not recommended when printing on both sides of a semi-transparent substrates such as lightweight paper due to “show-through” from the reverse of the sheet. For process control on such substrates, take readings with a black backing material underneath the sheet.

APPENDIX C: INTRODUCTION TO CIELAB

CIELab is the preferred color space for measuring gray balance and ink color, because CIELab is ‘device-independent’, meaning two samples on different materials with the same CIELab value will look identical under standard D50 lighting. CIELab is therefore ideal for matching devices in different locations, or with different inks, to a standard ‘appearance’.

When a^* and b^* are both zero (centered) a neutral color (white, gray or black) is produced.

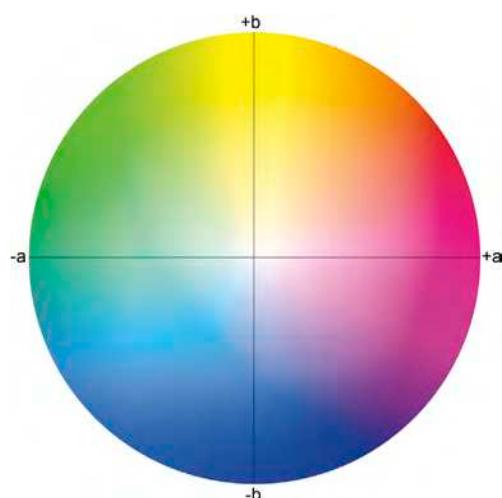


FIGURE C.1 Plan view of the CIELab a^* , b^* color space

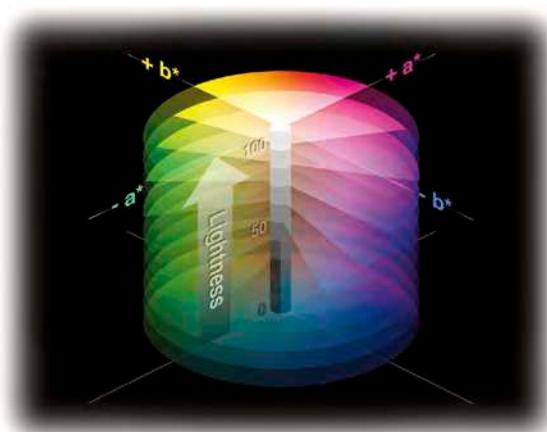


FIGURE C.2 3-D CIELab diagram showing every L^* value has a full range of a^* and b^* values.

C.1 Delta E (ΔE)

Delta E (also written ΔE or ΔE^* , uses the Greek letter Δ (Delta) to stand for “difference.” ΔE is a standardized way of expressing the color difference between two or more CIELab measurements. Several formulae exist, including ΔE^*_{ab} , ΔE^*_{94} , ΔE^*_{CMC} and ΔE^*_{2000} , but the original ΔE^*_{ab} formula is simplest to calculate and adequate for most purposes.

The original ΔE^*_{ab} uses a relatively simple RMS (root-mean-square) formula, where Delta E is equal to the square root of the sum of the squares of the separate L^* , a^* and b^* differences;

$$\Delta E_{ab} = (\Delta L^2 + \Delta a^2 + \Delta b^2)^{0.5}$$

Here is the formula as it would appear in Microsoft Excel™

$$\Delta E_{ab} = ((L1-L2)^2+(a1-a2)^2+(b1-b2)^2)^0.5$$

C.1 Calculating ΔE^*_{ab}

If you are not comfortable with math but would like to calculate ΔE^*_{ab} manually, here is a step-by-step method. A scientific calculator or software like Microsoft Excel simplifies the work.

- If not already known, measure the “target” sample (the sample to be matched) with a spectrophotometer set to D50, 2° and record the L^* , a^* and b^* values.

$$\text{Target_}L^* = L^* \text{ of the sample to be matched}$$

$$\text{Target_}a^* = a^* \text{ of the sample to be matched}$$

$$\text{Target_}b^* = b^* \text{ of the sample to be matched}$$

- Measure the “imitator” sample (the sample being compared) and record the L^* , a^* and b^* values.

$$\text{Imitator_}L^* = L^* \text{ of the sample being compared}$$

$$\text{Imitator_}a^* = a^* \text{ of the sample being compared}$$

$$\text{Imitator_}b^* = b^* \text{ of the sample being compared}$$

- Subtract the Target values from the Imitator values to get ΔL^* , Δa^* and Δb^*

$$\Delta L^* = \text{Imitator_}L^* - \text{Target_}L^*$$

$$\Delta a^* = \text{Imitator_}a^* - \text{Target_}a^*$$

$$\Delta b^* = \text{Imitator_}b^* - \text{Target_}b^*$$

- Square each delta value by multiplying it by itself

$$\Delta L^{*2} = \Delta L^* \times \Delta L^*$$

$$\Delta a^{*2} = \Delta a^* \times \Delta a^*$$

$$\Delta b^{*2} = \Delta b^* \times \Delta b^*$$

- Add the squared delta values together and raise their total sum to the power of 0.5 to get the square root, or ΔE^*_{ab} value.

$$\Delta E^*_{ab} = (\Delta L^{*2} + \Delta a^{*2} + \Delta b^{*2})^{0.5}$$

APPENDIX D: G7 FOR PRE-PRESS PROOFING

This appendix describes how to G7-calibrate a proofing system using either the FanGraph or IDEALink Curve methods (described earlier in this document). Note that G7 calibration alone may not be enough to match a proofing system to a reference print condition like GRACoL or SWOP without additional ICC (or equivalent) color management, but G7 calibration makes an ideal basis for, and can enhance the value of, subsequent color management.

Your proofing system may require some slight modification to these instructions but the basic principles are common to all. If your proofing system is incompatible with these methods, ask your vendor how to match G7 and/or the desired reference print condition.

D.1 G7 Compatibility

G7 can only be applied *directly* to proofing systems that let the user adjust CMY or CMYK **Calibration** curves (a.k.a **RIP** curves or **Tone** curves) by directly entering **wanted** (a.k.a. **Target** or **Aim**) dot percentage values. This includes most halftone laminate proofing systems and some ink-jet systems driven by a conventional RIP. Proofing systems with no user-accessible calibration curves may not accept direct G7 calibration, but can still reproduce G7 via ICC profiles or equivalent color management.

Regardless of how a proofing system is calibrated or color-managed, any proofing system's ability to match the G7 specification can be tested by printing and measuring a P2P target and comparing it to the official G7 NPDC and gray balance curves.

D.2 G7 Proofer Calibration Summary

A full proofer calibration and color management cycle involves some or all of the following steps.

D.2.1 G7 Calibration

- Qualify the proofer (to determine its suitability).
- Optimize the system components to manufacturer specifications.
- Print the P2P target (and GrayFinder target if using the FanGraph method).
- Measure the P2P target.
- Plot the curves manually on FanGraph, or load the data into IDEALink Curve.
- Determine gray balance corrections using the GrayFinder target or IDEALink Curve.
- Apply separate C, M, Y and K correction curves to the RIP.

D.2.2 Confirming G7 Calibration Accuracy

- Re-print and measure the P2P target.
- Plot the curves manually on fresh G7 FanGraph, or load the data into IDEALink Curve.
- Confirm that the NPDC curves and gray balance closely match the G7 targets.

D.2.3 Applying ICC (or Equivalent) Color Management

- Print a characterization target through the new RIP curves.
- Either create an ICC profile or follow the manufacturer's custom color matching process.
- Apply ICC profiles (or custom color matching tables) in the proofing RIP to match the desired reference color space.

D.2.4 Final Color Check

- Confirm color accuracy by printing an IT8.7/4 (or larger) characterization target through the whole system (both curves and color management) and comparing the measured patch values to the reference CIE Lab data.

D.3 Step-by-Step G7 Proofer Calibration

D.3.1 Qualifying the Proofing Device

Make sure the printing system (hardware plus consumables plus software)...

- Is stable and repeatable.
- Prints evenly across the whole image area.
- Is not subject to short-term color changes or fading.
- Uses a white substrate within tolerances of the reference standard.
- Can yield a color gamut equal to or greater than the reference color space.
- Can yield a neutral black value equal to or darker than the reference color space.

D.3.1.1 Gamut Test

A good way to see if the device has sufficient color gamut and dynamic range to match a specification like GRACoL is to measure a characterization target with color management off and compare it to the specification characterization data (or an ICC profile made from it) in a 3-D display utility like CHROMiX ColorThink™.

If the device profile has a smaller volume than the specification space in any region, some of the specification colors will not be rendered accurately. Pay particular attention to the darkest values at the bottom of the color volume.

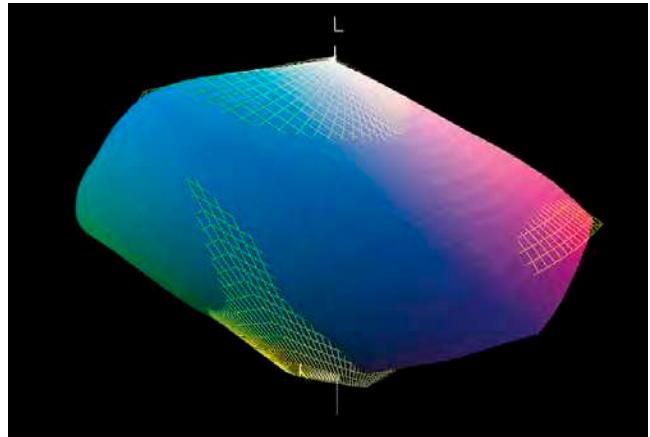


FIGURE D.1 3D view in ColorThink showing a printer space (solid surface) which is not large enough to accurately proof the GRACoL color space (wireframe)

D.3.2 Optimizing the proofing system

Optimize the proofing system following the manufacturer's instructions, with the following exceptions;

- If asked to calibrate individual CMYK curves or LUTs, omit this stage EXCEPT if the manufacturer's calibration is used to create ink-limiting tables.
- If the manufacturer's instructions involve any kind of ICC or custom color management, disable this function until after G7 calibration is completed.

IMPORTANT: If possible, turn OFF any ICC or other color management functions prior to G7 calibration. (These will be re-enabled after the calibration and profiling process is completed.)

D.3.3 Printing the Test Form

Print either a standard G7 Proofing form www.g7global.org or your own version.

D.3.4 Calculating the RIP Curve Correction Values

See instructions for FanGraph or IDEALink Curve method.

D.3.5 Applying New Aim Values to RIP

See instructions for FanGraph or IDEALink Curve method.

D.3.6 Evaluating G7 Calibration Accuracy

See instructions for FanGraph or IDEALink Curve method.

D.3.7 Evaluating Color Matching Accuracy

If the proofer passes the **G7 Calibration Accuracy** tests but its solid colorant CIELab values are significantly different from the reference printing condition (e.g. GRACoL) additional color management will be necessary. Proceed directly to **Apply Color Management (If Needed)**.

If the proofer passes the **G7 Calibration Accuracy** tests and its solid colorant CIELab values are similar to those of the reference color space, its ability to match a G7-based reference color space will depend on how well its colorants simulate the *behavior* of the reference process. For example, even if the solid colorants have the same CIELab values as the reference space, two- and three-color overprints may appear different due to trapping and opacity differences.

One way to test matching accuracy is to compare the characterization target from your test proof with the target characterization data in software like CHROMiX ColorThink or similar, as described in **Qualifying the Proofing Device**.

A more visually-intuitive test is to create a profile of your proofer and assign it to a variety of CMYK images in Photoshop using View - Simulate Paper Color, then switch between the proofer profile and a profile of the target color space. If you can barely detect any difference over a wide range of images, the proofer probably doesn't need any further color management.

D.4 Applying Color Management (if needed)

Most proofing systems require additional color management on top of G7 calibration. The most common approach is to create an ICC profile of the proofer in its G7-calibrated state and use a profile generated from the target color space as the 'source' device in a standard ICC proofing workflow. Some systems use proprietary color management systems while others use standard ICC color management technology.

D.4.1 Custom Color Management Systems

If your proofing system uses proprietary (non-ICC) color management, follow the instructions that came with the system. To match a G7-based print specification like GRACoL or SWOP, choose that color space as the target to match in the custom system.

D.4.2 ICC – Based Systems

If your proofing system uses ICC color management, follow the instructions below. To match a G7-based print specification like GRACoL or SWOP, choose that color space as the target to match when applying the proofer profile.

² Photoshop CS or earlier. In Photoshop CS2 or later use View – Proof Setup – Custom – Simulate Paper Color

D.4.3 Creating an ICC profile

- Measure an IT8.7/4 characterization target (or equivalent) that has been printed through the actual G7 calibration curves produced in the previous steps.
- Load the measurement data into the ICC profiling software of your choice and create an ICC profile.
- Set TAC (Total Area Coverage) to 400%. As this profile will only be used for proofing there is usually no need to restrict TAC (Total Area Coverage) to less than 400%. A lower number may just limit the available dynamic range.
- Set the maximum Black ink value to 100% for the same reasons.
- Set GCR to maximum to maximize the available dark color gamut.
- If there is a choice, generate the largest profile possible.

D.4.4 Setting Up an Automated Proofing RIP

In the proofing RIP there should be some way of automatically matching an incoming CMYK file to a color space or print specification like GRACoL or SWOP. Setting up this automated conversion varies from RIP to RIP, but the main variables to look for are;

D.4.4.1 Source Profile

The Source Profile may also be called the “Input Profile“ or “Target Profile” and is the profile or color space you want to simulate, for example GRACoL.

D.4.4.2 Profile Policies

The RIP should provide options for what to do when an embedded profile is found in an image or page sent to the proofing RIP. Usually the correct answer in a proofing RIP is to “Ignore Embedded Profile,” “Override Embedded Profile” or words to that effect.

D.4.4.3 Proofer or Output Profile

The proofer profile is the profile you just made of the proofing device.

D.4.4.4 Rendering Intent

The rendering intent controls how the profiles will be interpreted or applied and should be set to either **Absolute Colorimetric** or **Relative Colorimetric**. If Relative Colorimetric is selected, make sure to *disable* **Black Point Compensation** if it is offered. Black Point Compensation may falsely reproduce dark colors if the proofer profile has different maximum density than the source profile.

For specific details on how to set up a particular proofing RIP to match a G7-based print specification, see the instructions that came with the proofing system.

D.5 Proofing on Non-Standard Substrates

When a proofing system must match a rigid paper definition it is best to print on a substrate that exactly matches the target substrate. If a proofing substrate of exactly the same color and lightness (same CIELab values) is not available, it may be possible to simulate the target substrate using the Absolute rendering intent. Absolute rendering will attempt to paint the color of the target substrate on the proofing substrate with small percentages of C, M and/or Y.

If the proofing substrate is darker than the target substrate, the absolute intent may call for negative percentages of one or more CMY colorants, and the paper simulation may therefore fail. In this case the *color* of the target substrate may be simulated, even if the lightness is incorrect, by editing the white-

point tag of either the proofer profile or the target profile so they are the same. This requires a profile editing package such as X-Rite ProfileEditor or equivalent.

D.6 Proofing Systems Without RIP Curves or LUTs

Proofing systems with no user-accessible CMYK RIP curves or LUTs should be able to match the G7 neutral condition via ICC or custom color management, so long as the reference ICC profile or data are based on G7.

If your proofing system uses a custom color calibration system that is *incompatible* with ICC profiles, ask your vendor how to make a certified proof for the desired reference condition.

If the vendor cannot help, a ‘last resort’ option is to create an ICC profile of the proofing system in its vendor-approved state, then convert incoming files from a target profile to the proofer profile in a RIP or color conversion software up-stream of the proofing system.

An example of this ‘last resort’ approach for occasional use would be to convert individual CMYK images or rasterized pages from the target profile to your custom proofer profile in Adobe Photoshop, using Absolute Colorimetric Intent, or Relative Intent **without** Black Point Compensation, then send the converted file to the proofer.

D.7 Pre-Production Final Color Matching Test

No matter what calibration or color management methods have (or have not) been used, at this stage your proofing system is probably as good as it’s going to get. Before putting it into production it’s important to see how good it is.

- Print the test form through all curves and color management.
- Measure the P2P target.
- Evaluate G7 calibration accuracy (see 3.14 or 4.11).
- Measure the characterization target.
- Evaluate color matching accuracy (see D.3.7).

D.8 Controlling Production Proof Quality

Having taken the trouble to create the most accurate proofing quality possible, every production proof should be monitored to maintain that quality and detect changes before they become a problem. Here is a suggested method for proof quality control.

- Include the IDEAlliance ISO 12647-7 Digital Control Strip alongside every image or page.
- Measure the strip and save the data.
- Load the data into a comparison software such as IDEALink Verify, MeasureTool, or similar.



FIGURE D.2 IDEAlliance ISO 12647-7 Digital Control Strip 2009

- Compare the measured data to the reference data supplied with the target for the print condition the proof has been set up to match, for example TR006 (GRACoL) or TR003 or TR005 (SWOP).
- For suggested tolerances see Tolerance Notes in the *G7 Specification* document.

E

APPENDIX E: G7 FOR OFFSET LITHOGRAPHY

This section does not attempt to teach offset lithography. It simply focuses on the main issues that arise when calibrating or controlling an offset press by the G7 method.

Before applying G7 in an offset pressroom you should already have a sound understanding of press operation including mechanical, physical, chemical and operating variables. You should also read the **IDEAlliance Press Operator's Guide to G7** (currently in a working draft available at www.g7global.org).

Before attempting to G7-calibrate an offset press any maintenance or repairs necessary to bring it up to optimum condition should be applied.

Amongst other changes since the original G7 How-To v6, this appendix contains;

- Clarified instructions for plate pre-linearization prior to the first press run.
- Improved guidelines for how to use TVI in combination with G7 measurements.
- A change in priorities between the Calibration Run and Confirmation or Production runs.
- Other suggestions gleaned from three years of practical G7 usage in hundreds of offset printing plants world-wide.

E.1 Requirements for G7 Press Calibration

E.1.1 Time

The full press calibration method requires two press runs with a break in between to calculate RIP curves and make new plates. First-time users should allow one to two hours for the first 'analysis' run, about an hour for RIP calibration using IDEALink software (or two hours if using the FanGraph method) and another hour for the second 'confirmation' run.

The process typically goes much faster with practice. Once you become confident in the G7 calibration process, subsequent press calibrations (for example for different papers or screening) can often be reduced to a single run, omitting the second confirmation run.

E.1.2 Paper

Approximately 6,000 to 10,000 sheets of paper will be needed, depending on press efficiency, to allow for both runs. Less paper is typically needed with closed loop ink control. Most of the paper is usually used in the first run to get even ink coverage across the sheet. Waste sheets are often used for this purpose.

Calibration should be with the same kind of paper normally used in production. If a variety of different types of paper of a similar surface character are often used, calibrate with the sheet which best

represents the average of the group. If your goal is to simulate GRACoL as closely as possible, use ISO Paper type 1 with minimal fluorescent brighteners and a nominal white point as close as possible to $95 L^* (\pm 3)$, $0 a^* (\pm 2)$, $-2 b^* (\pm 2)$ (measured with white backing). If your goal is to simulate another specification, use a paper as close as possible to that standard or specification.

E.1.3 Inks

Most industry specifications like GRACoL 2007 or SWOP 2007 are based on inks whose color is defined by the ISO 2846 standard. Of more importance to most users is that the inks used must be capable of achieving a close match to the solid ink CIELab values reported in the respective specification when printed on the actual substrate, within the allowed tolerances of each specification.

A chart of ink colors on a variety of ISO-standard paper types is included in appendix B.

E.1.4 Dot Meter

A video dot meter for measuring plates is desirable, for example the X-Rite PlateScope™ or TECHKON SpectroPlate™.

NOTE: Even the most sophisticated plate readers may not predict the true “printable” dot area due to differences in how the visible plate image relates to the actual printed dot area. This anomaly varies from plate type to plate type.

E.2 G7 Press Test Form

Test forms at various sizes are available for download from www.G7global.com or you can create your own. If creating your own form, be sure to include at least one P2P target. If using the FanGraph method you must also include the GrayFinder target.



FIGURE E.1 A typical 28" x 40" G7 press form

E.3 Press Control Bars

Press control bars fall into three general categories, Non-G7 compliant, Minimum G7-compliant, and Optimum G7-compliant (see below).

Many existing press control bars can be used for G7 press control. The bar you use will depend, amongst other things, on whether your press control system is manual or automatic, how many inks you typically run, the aperture size of the measuring unit, and so on.

If your press control system already has a G7-compliant control bar, use it. If not, either work with the manufacturer to develop a suitable bar, or use the free IDEAlliance G7 Press Control Bar, or modify an existing bar to suit your particular needs.

NOTE: It is NOT essential to use the free IDEAlliance G7 Press Control Bar in order to control a G7-calibrated press.

E.3.1 Non G7-Compliant Control Bars

Many existing press control bars provide only solid (100%) CMYK and two-color RGB patches. Other bars provide solids and 50% CMYK patches for mid-tone dot gain (TVI) measurements but no mid-tone CMY gray patches. Press control bars like these that lack at least one 3-color gray patch are considered “Non G7-Compliant.”



FIGURE E.2 Typical press control bar **not** suitable for G7 press control – (layout may vary)

E.3.2 Minimum G7-Compliant Control Bars

To make a basic press bar G7-compliant, at least one mid-tone gray balance patch (HR patch) of 50c, 40m, 40y should be present, and ideally one for every ink zone. If your press control bar already has gray balance patches with slightly different values (e.g. 50c, 41m, 41y), see *Bars With Non-G7 Gray Patches* (below) for instructions on how to use it for proper G7 press control.



FIGURE E.3 Minimum G7-compliant press control bar – (HR_cmy patches are notched)

NOTE: If your press control system does not control gray balance, ask the supplier how this can be achieved, or measure the gray balance (HR_cmy) patches manually (see E.14 Automated Press Control and G7).

E.3.3 Optimum G7-Compliant Control Bars

For maximum G7 compliance a control bar should have not only the HR patches but also at least one SC (shadow contrast patch) of 75c, 66m, 66y, and at least one HC (Highlight Contrast) patch of 25C, 19M, 19Y. The SC and HC patches can appear less often than the HR patches.

E.3.4 Free IDEAlliance G7 Press Control Bar

The bar shown in figure E.4 is available free at www.g7global.org. It is **NOT** required for G7 press control, but it does contain a suggested minimum set of optimum G7 patches.



FIGURE E.4 The free IDEAlliance G7 Press Control Bar.

Users are encouraged to modify this free bar by rearranging the patches and/or adding other patches as needed, for example to control additional inks.

Patch size in the supplied file is nominally 4mm wide by 7mm high with 8 patches per zone, but the target can be stretched or compressed either in Adobe Illustrator or in a pagination program to produce any desired patch size, or to fit different key zones.

E.3.5 Control Bars With Non-G7 Gray Patches

Some existing color bars already contain gray balance patches with slightly different CMY ratios than specified for G7. For example the Brunner System™ Instrument Flight® Colorbar uses a gray balance ratio of 50c, 41m, 41y, while older bars from Printing Industries of America may contain gray patches with 50c, 39m, 39y. These bars can be used with the G7 method with 100% accuracy so long as the target CIELab values are adjusted to what these patches would produce if a 50c, 40m, 40y patch is in correct G7 gray balance. If these bars are used without changing target values, the resulting error may be smaller than typical press variations, but it is better to eliminate as many errors as possible.

Modified target CIELab values can be determined for a non-standard gray balance either by balancing the press on a true G7 gray patch, then measuring the CIELab values of the non-G7 patch, or by assigning a profile made from the target color space to a CMYK image containing the non-standard patch values in software like Adobe Photoshop or CHROMiX ColorThink Pro, and converting the non-standard patches to CIELab using the Absolute Colorimetric rendering intent.

E.3.6 Applying Calibration Curves to Control Bars

NOTE: G7 CtP curves must be applied to the press control bars as well as to the live image for G7 press control to work correctly. The only elements that should *not* be curved are control devices designed to judge plate exposure and development, which are usually in the grip area.

E.4 Plates, RIP Curves and Screening

E.4.1 Plate-Making System Basic Setup

Check that plate-making hardware, chemistry and RIP are operating within their respective manufacturer's specifications.

E.4.2 Pre-Linearized or Un-Calibrated Plates?

It is important to note that G7 press calibration can either take the place of, or be applied in combination with, conventional plate linearization. If the G7 calibration run uses “un-calibrated” plates, the G7 correction values will take the place of conventional linearization curves. If the calibration run uses “pre-linearized” plates, the G7 correction values must be applied in combination with any linearization curves, with both curves working simultaneously.

Either way, after G7 calibration, plate making performance should be monitored by measuring dot area values directly from the plate. If plate values begin to change significantly, correction values may have to be entered into the RIP, but how and where they are entered will depend on whether the RIP supports separate “Dual-Stage” curves for linearization and editorial tone control, or whether it has only one “Single-Stage” curve.

E.4.3 Identifying Dual-Stage Vs. Single-Stage RIPS

Some RIPS have dual-stage CMYK curves, one for linearizing and another for applying editorial tone adjustment curves. Other RIPS have only single-stage curves exclusively for plate linearization. Some RIPS show two sets of curves at the user-interface, but use a single curve mechanism inside the software, hence a true dual-stage RIP can be difficult to identify. Sometimes even the manufacturer's technical support department may not know with certainty if their RIP is dual-stage or single-stage.

A RIP is *DEFINITELY* single-stage if it only has one user-interface area for adjusting halftone dot curves, typically under the heading “Linearization” or “Calibration,” and with columns for “mea-

sured” and “wanted” values (*or words to that effect - see 4.10.1 RIP Interfaces*).

A RIP *MAY BE* dual-stage if it has two user-interface areas for adjusting halftone dot curves, typically the first area called “Linearization” or “Calibration”, and the second called “Tone Reproduction” or “Dot Gain Adjustment” (actual name may be different).

NOTE: If you are not sure which type of RIP you have, treat it as a Single-Stage RIP.

E.4.4 Setting Up a Single-Stage RIP

On Single-Stage RIPs (with only one set of curves) pre-linearization prior to a G7 press run is optional, but not recommended, as the G7 process will effectively over-ride the linearization values, and the linearization curves may interfere with the G7 process, leading to inaccuracy.

If you choose to pre-linearize, use a maximum of ten curve points (ideally fewer) that are no less than 10% apart from each other. In many cases a single point linearization at 50% will be enough to establish a stable plate condition for process control purposes, even if other parts of the curve are still not perfectly linearized.

NOTE: Narrowly-spaced linearization steps (e.g. 5% or 2% apart) may actually cause linearization or G7 calibration errors due to small errors in even with the most sophisticated plate measurements.

If you choose NOT to pre-linearize, make sure the “measured” and “wanted” columns are both equal to the nominal “File” column values (*see E3.13.1 RIP Interfaces*).

E.4.5 Setting Up A Dual-Stage RIP (Linearization Plus Calibration)

On Dual-Stage RIPs (with separate linearization and editorial tone curves), pre-linearization is still optional, but safer, as it is less likely to affect G7 calibration accuracy.

If you choose to pre-linearize use the RIP’s linearization curves to make the measured plate values equal the nominal file values, then apply the G7 corrections in the editorial tone curves.

If you choose NOT to pre-linearize, make sure the “measured” and “wanted” columns are both equal to the nominal “File” column values (*see E3.13.1 RIP Interfaces*).

E.4.6 Screening

G7 calibration is compatible with any screening system, AM, FM (‘stochastic’) in fact any conceivable type of dot - even “dot-less” (continuous-tone) plates. The same target NPDC curves and gray balance values apply regardless of screening method or frequency.

NOTE: The screen rulings suggested in GRACoL and SWOP documentation are guidelines only and are not mandatory for correct G7 printing. However note that standardized print conditions like GRACoL are somewhat screening-dependent. For example, FM screening is known to yield wider color gamut in pastel colors than regular AM screening, even with identical solid ink values.

E.4.7 Exotic Screening or Continuous-Tone Systems

Exotic screening systems such as stochastic or ‘FM’ screening can be calibrated with the G7 method as easily as traditional AM halftone screening, but remember that color gamut is sometimes affected by screening.

E.4.8 Calibration Run Plates

Produce a set of *un-calibrated* plates (if using a single-stage RIP) or *linearized* plates (if using a dual-stage RIP) of the calibration form using exactly the same workflow as for regular work.

E.4.9 Recording Calibration Plate Curves

Measure dot sizes on the calibration run plates at 5% or 10% intervals to establish the baseline condition of the plate making system. These values can be used to check plate-maker performance any time in the future.

When making *un-calibrated* plates, the measured plate values will usually NOT match the halftone file values. This is normal. When making *linearized* plates, the plate values should be as close as possible to the nominal file values, however note that plate values may vary slightly between colors.

E.5 Press Pre-Qualification

Prior to the G7 calibration run, the press and its consumables should be tested to make sure all variables are in optimum condition. IDEAlliance provides several tools to assist this pre-qualification;

- The G7 Pre Qualification Checklist - Sheetfed lists the most important press variables that should be checked before G7 calibration.
- The G7 Press Prequalification Kit contains a test form and a user's guide to help pre-qualify the press and ensure the print quality is acceptable for G7 calibration.
- The **IDEAlliance Press Operator's Guide to G7** explains the G7 process in the context of traditional press operation and process control.

WARNING: The G7 method will calibrate virtually any device NO MATTER WHAT ITS CONDITION. In some cases G7 calibration might mask "bad" printing, for example compensating for excessive dot gain (TVI) on one unit of a press with RIP curves, leaving the root problem unsolved.

E.6 Calibration Run vs. Confirmation Run Priorities

G7 calibration of an offset press requires a first **calibration run** from which correction curves are calculated and a second **confirmation run** to confirm that the new curves are working as expected. Different priorities are recommended for the calibration run than for the confirmation run.

The main priority of the calibration run is to achieve the target CIELab values for the C, M, Y, K ink solids and their M+Y, C+Y, C+M two-color overprint solids, as specified in the appropriate specification or standard to which the press is being calibrated (GRACoL, SWOP, etc.)

The confirmation run uses the **G7 Production Control** methods suggested for daily G7 production printing which make the G7 gray balance and NPDC target values a higher priority than matching the exact solid ink CIELab numbers.

E.7 Calibration Press Run

The purpose of the G7 calibration run is to learn the natural condition of the press at normal operating parameters, so that any inherent tonality or gray balance differences between that press and the standard GRACoL or SWOP reference print condition to which it is being driven can be compensated for, if necessary with CtP RIP curves generated by the FanGraph or IDEAlink Curve methods.

The main priority of the calibration run is to achieve the target CIELab values for the C, M, Y, K ink

solids and their M+Y, C+Y, C+M two-color overprint solids, as specified in the appropriate specification or standard to which the press is being calibrated (GRACoL, SWOP, etc.)

E.7.1 Ink Sequence, Drying, and Coating

Although not mandated in ISO 12647-2, the suggested ink sequence for offset printing is K – C – M – Y. This sequence has been used to create characterization data sets from SWOP, GRACoL and Fogra. Other sequences may cause a significant difference between your press results and any official characterization data set, due to different ink trapping and opacity effects. Presses using UV inks and inter-station drying may not match characterization data created on wet-trap presses.

Aqueous coating tends to minimize drying time and should be applied during the G7 calibration test run. Even if coating is only applied occasionally, calibrating and profiling with coating usually produces CtP curves that work for both coated and un-coated runs.

E.7.2 Printing to Nominal Solid Ink Values

Run the press up to the nominal solid ink CIELab or density values for the process being calibrated. Nominal ink CIELab values for commercial printing on coated paper are given in the table below, with APPROXIMATE equivalent Status T densities.

NOTE: The relationship between status T ink density and Lab values shown below may not match your device or media due to metamerism effects. When in doubt, the Lab values take priority.

	L*	a*	b*	Approximate Density (T)
C	55	-37	-50	1.40
M	48	74	-3	1.40
Y	89	-5	93	1.0
*K	16	0	0	1.7

FIGURE E.5 Colorimetric Values and Approximate Equivalent Status T densities

***NOTE:** Lower L* or higher K densities for the K ink are acceptable with proper NPDC calibration.

E.7.3 Determining Aim Densities

Practical density aim values for any press, ink, densitometer combination must be determined by first running to ideal solid ink CIELab values (measured with a spectrophotometer), then adjusting CMY solids, if necessary, to achieve the best match in the two-color overprint (RGB) patches to the target CIELab values. The CMY solid patches can then be measured with the actual densitometer that will be used in production, and the measured values can be used as production press control aim densities.

E.7.4 Checking CMYK TVI

Check individual CMYK TVI values. The CMY TVIs should be within about +/- 3% of each other, with black typically about 3 – 6% higher.

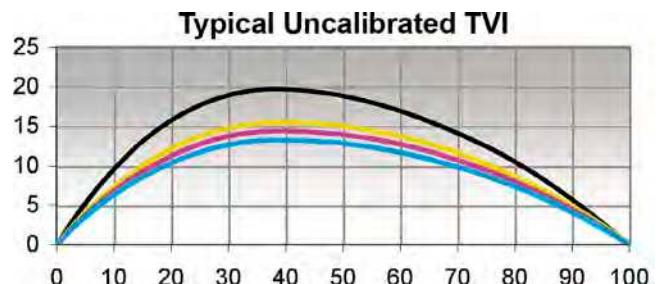


FIGURE E.6 One of many possible TVI curve sets of an un-calibrated CtP press.

Precise TVI goal values are not provided for colorimetric specifications like GRACoL and SWOP, however approximate TVI goal values can be calculated from the relative characterization data set CIEXYZ values. These TVI numbers may be slightly different from status T densitometry TVI values.

E.7.5 Calculating Wanted Gray Balance

The wanted gray balance for the HR patch is defined as the paper a^* and b^* divided by two. Wanted gray balance in any other CMY gray patch can be determined by the G7 gray balance formulae;

$$\text{Wanted } a^* = a^*_{\text{paper}} * (100 - C\%) / 100;$$

$$\text{Wanted } b^* = b^*_{\text{paper}} * (100 - C\%) / 100;$$

E.7.6 Adjusting Gray Balance and/or HR (Optional)

Note: Only perform this step if gray balance and HR density can be achieved while keeping the solid ink CIELab values within tolerance.

Measure one or more HR patches in CIELab. If the a^* and b^* values are close to wanted gray balance, try to improve gray balance by adjusting CMY solid ink densities or other variables *while staying within permitted tolerances*. At the same time, if the ND value of the HR patch is already close to the target ND value, try to improve ND with similar press adjustments.

If the 50,40,40 gray balance is significantly different from the target values, but solid ink values are correct, leave the press in its present condition and adjust gray balance later in the RIP. This is only recommended if the current gray balance condition is constant and predictable. If the press has an unusual gray balance error, and/or cannot be corrected with normal adjustments, check TVI, pressure, water and other related adjustments.

IMPORTANT REMINDER: If the press adjustments needed to achieve ideal gray balance or density on the HR patch exceed permitted solid ink tolerances, return to normal solid ink values and adjust gray balance and density later via CtP curves, using the G7 method.

E.7.7 Adjusting Cross-Sheet Evenness

NOTE: This is often the hardest part of press calibration.

Adjust the press so that solid ink densities and gray balance are as even as possible across the sheet. One way to do this is to use your spectrophotometer's 'compare' feature (if available), or manual calculations, to determine the ΔE^2 (delta E) difference on similar patches across the sheet. If you cannot reduce the ΔE variation below 2, concentrate on the ink region containing the P2P target and ignore the rest of the sheet. If the two P2P targets on the page are more than 2 ΔE different, adjust the press to get them closer to each other.

E.7.8 The Stabilizing Speed-Cycle

After achieving goal conditions, run approximately 500 - 1000 sheets at typical production speed to warm-up the press and re-check solid ink values and evenness. If solid ink values or cross-sheet evenness have drifted outside specs, adjust the press until desired tolerances are restored, then repeat the speed cycle as needed until it produces acceptably small changes from start to finish.

² Any Delta E formula can be used for this test but ΔE^*_{ab} is easiest to calculate manually.

E.7.9 Recording Wet And Dry Ink Values

Record the wet and dry Lab (and/or density) values of the solid (100%) CMYK inks. These are your target values for production work.

Remember that the ink values specified in ISO are DRY densities. If your dry ink values are significantly different (usually lower) than your wet densities, determine the appropriate allowance to wet values (e.g lower L* or higher density) so that the dried solid ink measurements are correct.

NOTE: Although ISO 12647-2 specifies solid ink values in CIELab units, many printers find it easier to control solid ink DENSITIES. This is encouraged so long as each individual printer determines their specific target densities by measuring samples of correct CIELab values printed with their own paper and inks and measured with their own specific measuring instrument(s).

E.8 Creating CtP RIP Curves

For detailed instructions refer to *G7 Calibration Using the FanGraph* or *G7 Calibration Using IDE-ALink Curve*.

Gray balance should only be corrected if the calibration run showed a clear and consistent gray balance error throughout the speed run and across the sheet.

If the average gray balance throughout the speed run and across the calibration sheet was nearly neutral, or if it is likely that the next press run it will be either neutral, or have another type of gray balance error, do not calculate gray balance correction but instead apply one common RIP curve to C, M and Y.

E.9 Confirmation Press Run

The two main purposes of the confirmation press run are to;

- Verify that the G7 calibration worked correctly.
- Practice the G7 production press control method.

A third purpose may be the creation of an (optional) custom ICC profile from the G7-calibrated press which can be used for custom proofing purposes and/or for creating custom CMYK files optimized for a specific press or custom press condition, **however note that custom ICC press profiling is not normally recommended.**

E.9.1 Making New G7-Calibrated Plates

Create new plates of the same test form using the new RIP curves and compare the plate values on the P2P target to the un-calibrated plate curve recorded in section 5. Make sure the required changes have been achieved. For example, if the 50% Curve Point had a 55% Aim Value, check that the 50% patch on the new plate is approximately 5% heavier than the un-calibrated plate.

NOTE: Due to difficulties measuring a plate's surface, exact percentages are not necessary, so long as the values are approximately correct.

The actual measured plate values DO NOT have to match the values predicted by the FanGraph or IDEALink Curve software. The G7 calibration process works independently of variations between requested and achieved plate values. So long as the plate making process is consistent and repeatable, the G7 graphing process and IDEALink Curve will work correctly on the original digital file values prior to plate exposure, not the actual measured plate values.

CAUTION: DO NOT adjust IDEALink Curve percentages to match the measured values on plate. This can actually reduce accuracy!

E.9.2 Printing the Confirmation Form

Print the same test form using the new plates or RIP curves, and the same conditions as for the calibration test run. Aim for the same wet CIELab values (or densities) recorded at the end of the calibration run. Pay particular attention to cross-sheet evenness and gray balance.

E.9.3 Characterization Run Tolerances

If the confirmation run is also a characterization run (from which an ICC profile will be made) press control tolerances should be stricter than normal production tolerances, because a characterization run must represent the nearest thing to “perfection” of which the press is capable. In many cases the required accuracy will be impossible to achieve in a single press run, but may be achievable by averaging several press runs made on different days or times.

A good general rule is that characterization tolerances should be roughly half as wide as normal production tolerances. For example, if gray balance tolerances for production work are $\pm 1.5 a^*$ and $\pm 2 b^*$, characterization tolerances should be $\pm 0.75 a^*$ and $\pm 1 b^*$.

E.9.4 Confirming NPDC Curves

During make-ready, measure the HR, SC and HC values to be sure the press is meeting the target ND values taken from the NPDC curves. If possible, quickly measure the P2P target while the press is running and either plot columns 4 and 5 manually on a fresh sheet of G7 FanGraph, or check the curve fit in IDEALink Curve software. Your graph should overlay the target graphs almost perfectly. If not, try adjusting SIDs, or run more sheets until the press warms up.

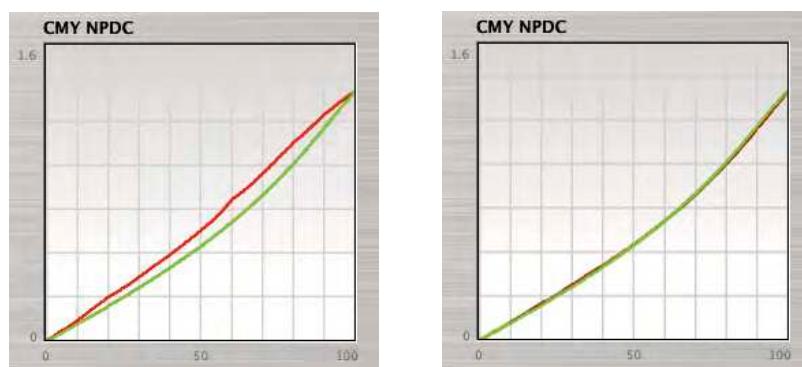


FIGURE E.7 An offset press NPDC curves before G7 calibration (left) and after (right)

E.9.5 Confirming Gray Balance on the HR_cmy Patch

Check that gray balance is correct on the HR_cmy patch. The a^* and b^* values on the HR_cmy patch should be approximately half the a^* and b^* values measured on blank white paper alongside the P2P target.

E.9.6 Confirming TVI

Check that the CMY TVI numbers are within about 3% of each other and close to the TVI numbers defined for the print specification to which the press is being calibrated, however note that TVI aim values are not as critical as the G7 ND and gray balance aims.

TVI goal values are not provided for colorimetric specifications like GRACoL and SWOP, however approximate TVI goal values can be calculated from the relative characterization data set CIEXYZ values. These TVI numbers may be slightly different from status T densitometry TVI values.

If both TVI and the G7 parameters of ND and gray balance cannot be achieved simultaneously, try adjusting press variables like ink/water balance, pressure, etc. to alter TVI without altering HR or gray balance values.

E.9.7 Confirming Cross-Sheet Evenness

Confirm that cross-sheet evenness is the same as for the calibration run.

E.9.8 Comparing to the Proof

Having achieved the closest possible match to the target G7 gray patch values, ISO ink solids, cross-sheet evenness, etc., compare the proof to the press sheet. If the proof is accurate and the stocks are the same color, the press sheet should be a good match, although it is unlikely to be perfect. If necessary make small press adjustments based on visual judgment.

E.10 Custom Press Profiling

In certain circumstances it may be desirable to create a custom ICC profile from a G7-calibrated press. The ICC profile can be used for custom proofing purposes or for creating custom CMYK files optimized for that press or printing condition.

NOTE: Custom press profiling is not recommended except in rare cases (see below). If the inks and paper are the same as those used to create the target characterization data (e.g., GRACoL or SWOP) an average press in good condition should be able to achieve a close match to that data without need for color management.

E.10.1 When an ICC Press Profile is Recommended

A custom ICC press profile is recommended when the press uses unusual inks, ink levels, screening technology or substrate which results in an appearance for which no standard characterization data or ICC profile exists.

E.10.2 When an ICC Press Profile is Not Recommended

Custom press profiling is normally discouraged due to the difficulty of obtaining truly representative sample sheets from which to measure characterization data. Most press runs differ quite strongly from the runs immediately prior to or following the test run, which means that no matter when or how carefully the press characterization run is performed, the chances of it truly representing the average performance of that press are small.

E.10.3 Profiling From Multiple Runs

If possible, make two or more separate press runs under similar conditions on different days and average the characterization data collected from the best sheets from each run.

E.10.4 Selecting Samples

Select a sampling of two or more good sheets from one or more live characterization run(s) and check them for evenness, blemishes, correct solid ink values, etc.

One of the most dangerous risks is that one or more of the target patches may have been shifted out of sync with its neighbors due to a blemish on press. This will cause a localized color error in a very narrow range of colors that may not be detected until the profile is applied to an image containing that narrow color range. The other most common danger in press profiling is that the characterization target is not printed evenly across its area in terms of solid ink coverage, TVI, gray balance or trapping.

Adding a 1/4 inch (6mm) border of CMY gray (50,40,40) around the whole target area, and another border just outside that of 50% black ink will help detect some of these problems.

E.10.5 Measuring the Characterization Data

Measure the IT8.7/4 (or equivalent) target from each of the selected sheets with an automated spectrophotometer, and save the data in CIE Lab or spectral format. (Creating a profile from spectral data offers more flexible software options.)

E.10.6 Creating the ICC profile

If more than one target was measured, try averaging several measurement sets in software like X-Rite MeasureTool or Microsoft Excel. Data that has been averaged from several sheets or several press runs printed with the same media and plate curves should produce a smoother profile with less chance of local color anomalies and which better represents the average performance of that press.

E.10.7 Creating the ICC profile

- Load the measurement data into the ICC profiling software and create an ICC profile.
- Set TAC (Total Area Coverage) to 320% or less for commercial work (GRACoL), 300% for SWOP 3, 280% or less for SWOP 5, and 260 for newsprint.
- Set the maximum Black ink value to 100% for commercial and SWOP work or 90-95 for web offset and newsprint work.
- Set GCR to maximum to maximize the available dark color gamut.
- If there is a choice, generate the largest profile possible.

E.10.8 Managing Expectations

Remember that a press characterization run is far more significant than any normal print run. The printed sheet from which the characterization data will be measured must be as 'perfect' as possible, and should match the best performance the press is capable of. Solid colors, gray balance, NPDC and trapping should all be optimum on that press run, and these characteristics should be as even as possible across the whole sheet.

Even the best press operated by the most experienced workers under ideal conditions can vary considerably from run to run, due to small changes in materials, temperature, humidity, length of run, etc. The chances of a 'perfect' press sheet from any particular offset press run are very small.

If gray balance and other tolerances cannot be controlled precisely during the characterization test, aim for the best possible result but remember that the resulting characterization data will probably NOT represent the press's average performance. For this reason it is strongly recommended to use the standardized characterization data for your printing type (e.g. GRACoL 2007 for commercial or SWOP 2007 for publication

printing) rather than creating a custom profile. If you must create a custom profile, repeat the characterization process several times over a period of days or weeks and average the results to obtain the most statistically normal data for that specific press or printing condition.

E.11 G7 Production Press Control

NOTE: This process assumes all separations, plates and proofs have been made in an ICC workflow based on standard Characterization Data and G7 calibration.

The G7 press control method is similar to traditional press control, beginning with CMYK solid-ink readings (in CIELab or equivalent densities) and followed by mid-tone readings to monitor tone shape and gray balance. The difference is that the mid tone readings are not based on traditional TVI (dot gain), but instead on density measurements of the HR, HC and SR patches.

Because offset gray balance is typically unstable, some variation from the ideal target gray balance values must be expected throughout any run. Be prepared to experiment to establish the optimum tolerances for your equipment, conditions and client-expectations.

E.11.1 Preliminary Press Adjustments

For G7 offset press control to work the press must have first been properly adjusted physically and chemically and suitable G7 curves must already have been created and tested. At least one press run should have confirmed that all the target values can be achieved simultaneously.

If you are unfamiliar with what constitutes a properly-adjusted offset press seek training from your press manufacturer or a certified G7 offset press specialist.

E.11.2 Initial Ink Levels

Run the press up to nominal CIELab levels for the CMYK solid inks and the two-color (RGB) solid ink overprints. If the nominal CIELab levels have previously been achieved and translated into correlated density values, and if the same ink, paper and measuring instrument are used, the press can be run to these correlated density values directly instead of to the standard CIELab values.

E.11.3 Checking CMY Tone Curve

Once the target solid ink values are achieved, check the CMY NPDC curve by measuring the ND values of the HR_cmy patch, the SC_cmy patch and the HC_cmy patch. If the required ND values are not within acceptable tolerances, adjust the press to correct the error(s) using small variations in ink densities, pressure, ink/water ratio, etc.

NOTE: Try to share any error evenly between HR, SC and HC patches.

E.11.4 Checking CMY Gray Balance

While checking the CMY tone curve, also check gray balance of the HR_cmy patch. The normal target values are half the a* and b* values of paper but if the nominal CIELab levels have previously been achieved and translated into correlated CMY density values, and if the same ink, paper and measuring instrument are used, correlated CMY density values can be targeted directly instead of measuring CIELab values. If gray balance is not within acceptable tolerances, adjust the press to correct the error(s) using small variations in ink densities, pressure, ink/water ratio, etc.

E.11.5 Checking K Tone Curve (NPDC)

Adjust the black solid ink density, pressure, or other press variables until the HR_k patch is as close as possible to the nominal HR_k aim density. While checking the HR_k patch also check that the SC_k patch and HC_k patches are as close as possible to their respective target ND values. Some compromise may be necessary due to normal press variations, but try and split any error evenly between the HR, HC and SC patches.

E.11.6 Nominal HR, SC and HC ND Aim Values

This chart shows ND values for HR, SC and HC with paper density *excluded* for the nominal commercial offset density range of about 1.35 (CMY) and 1.75 (K). To use this chart, add the paper ND value to each of the ND values.

Gray Patch	ND (minus paper)	
	CMY	K
25% (HC)	0.25	0.22
50% (HR)	0.54	0.50
75% (SC)	0.90	0.90

FIGURE E.8 Nominal gray patch ND aim values (minus paper) for GRACoL and SWOP

E.11.7 HR, SC and HC Aim Values for Other Density Ranges

This chart shows that the ND values of HR, SC and HC are not true constants, but vary according to density range. SC (75%) increases or decreases as a function of density range. HR (50%) is virtually a constant for density ranges greater than or equal to 1.3. HC (25%) is a constant for density ranges greater than or equal to 0.7.

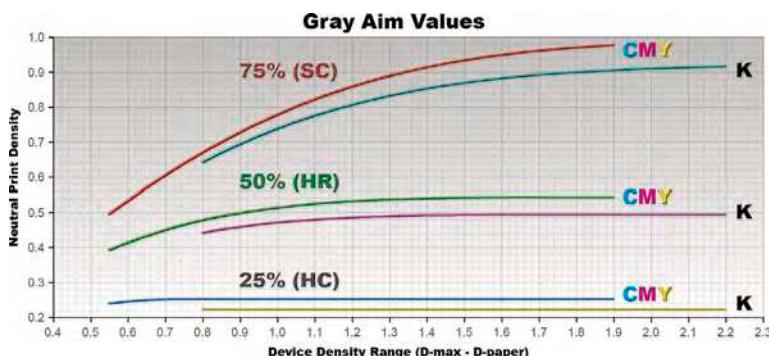


FIGURE E.9 Graph showing HR, SC, and HC aim values for devices with different dynamic ranges

This chart can be used to find precise target ND values for the HR, SC and HC control patches for a G7-calibrated system running to D-max values above or below normal. For example;

To Find HR_CMY for Non-Standard Density Range

- Subtract substrate ND from CMY = 300% ND to get CMY density range.
- Look up the CMY density range value on the horizontal (X) axis of the graph.
- Follow the density range line vertically to the green graph and note the **Neutral Print Density** value on the vertical (Y) axis of the graph.

E.11.8 Nominal HR, SC and HC CIELab Aim Values

This chart shows absolute L* values for HR, SC and HC for the nominal GRACoL density ranges of about 1.35 (CMY) and 1.75 (K) when printed on a 95 L* substrate.

Gray Patch	L* (including paper)	
	CMY	K
25% (HC)	75.7	77.7
50% (HR)	57.5	59.9
75% (SC)	39.5	39.7

FIGURE E.10 Nominal gray patch L* aim values for GRACoL paper with a 95 L* value

Note that calculating L* values for other density ranges or different substrate L* values is not trivial due to the complex non-linear relationship of L* to neutral density. In fact this the main reason NPDC, HR, SC and HC are defined in neutral density instead of L*.

E.11.9 The Role of the Proof

Having achieved the closest match to the target numbers, compare the proof to the press sheet. If the proof is accurate and the stocks are the same color, you should see a good match, although it is unlikely to be perfect. If necessary make small press adjustments based on visual judgment.

Remember, the main goal of a production G7 press run is to match an accurate G7 proof. How you achieve that match is relatively unimportant.

E.12 CIELab-Based Press Control

Controlling a press by CIELab measurement is theoretically more accurate than conventional densitometry, but also more difficult, because CIELab involves three aim values per ink (L*, a* and b*) instead of just one density number, and the relationships between ink quantity adjustments and CIELab are not intuitive.

The first challenge is determining the ideal quantity of ink that comes closest to the ideal CIELab values. The second challenge is maintaining those values on a daily basis.

E.12.1 CIELab Priorities for Each Ink

Often it is impossible to optimize all three target L*, a* and b* values because adjusting ink density to improve one value may degrade the other two.

Splitting the error equally between all three L*, a* and b* values produces the lowest Delta-E, but the lowest Delta-E may not produce the best match to the reference condition. For example, if the paper is -3.0 L* darker than normal, the yellow ink may have to be reduced so far to achieve the lowest Delta-E that b* will be reduced to unacceptably low saturation levels.

CIELab press control can be simplified by reducing the number of target L*, a*, and b* values the press operator has to focus on for each ink to just one or two, instead of three for each ink.

The following chart indicates the most important L*, a*, b* values for each ink in ***bold italics***. The other values are effectively uncontrollable at press time, apart from changing inks or paper.

Cyan	L*	a*	b*	
Magenta	L*	a*	b*	(see note)
Yellow	L*	a*	b*	(but a* is an important hue indicator)
Black	L*	a*	b*	

NOTE: If both magenta a^* and L^* cannot be optimized together, aim for the best average of both or consider changing inks. Remember a^* controls magenta saturation while L^* controls magenta lightness.

Two-color overprints are equally important but harder to control, as they are affected not only by the color of the three primaries (CMY) but also by ink tack, or trapping, ink transparency and paper absorbency. Typically the most important goal is to match the desired HUE, which means controlling the a^* and b^* ratios, as follows.

Red (M+Y)	L^*	a^*	b^*
Green (C+Y)	L^*	a^*	b^*
Blue (C+M)	L^*	a^*	b^*

Usually some compromise will have to be made between single color solids (CMY) and two-color solids (RGB).

E.12.2 Effect of Ink Density Changes on Lab Values

Most press operators are unfamiliar with the relationship between ink density changes and CIELab. The following chart shows roughly what will happen to L^* , a^* and b^* values when traditional ink density is increased or decreased.

Ink Color	More Density	Less Density	Comments
All	L^* down	L^* up	(L^* moves opposite to density)
Yellow	L^* down, b^* up	L^* up, b^* down	(b^* moves much faster than L^*)
Magenta	L^* down, a^*b^* up	L^* up, a^*b^* down	(b^* increases with excess density)
Cyan	L^* down, b^* up	L^* up, b^* down	(a^* doesn't move much)
Black	L^* down	L^* up	(a^* and b^* hardly move at all)

E.12.3 Two-color Overprints

Two-color overprints are difficult to control independently of the single ink solids, however the following hints will help preserve the vital HUE characteristic of two-color overprints.

Red	If b^* is higher than target decrease yellow or increase magenta
Green	If b^* is higher than target decrease yellow or increase cyan
Blue	If a^* is higher than target decrease magenta or increase cyan

Two color overprints can be seriously flawed when running too much water on one of the units or with a paper with poor ink or water receptivity. Another common cause for flawed two-color readings while solid CMY values are good, is printing with an incorrect ink sequence. The sequence K-C-M-Y is strongly recommended for wet-trap 4-color offset printing, but may not be optimum for other processes like offset with inter-station UV curing, gravure, flexo, etc.

E.12.4 Effects of Paper Color on Solid Ink Measurements

Printing transparent inks on non-standard paper colors may make it harder to achieve the specified solid CIELab values. For example quite small in-tolerance differences from standard paper color can have noticeable effects on the small a^* value in Yellow or the small b^* value in Magenta ink.

The effects of a non-standard paper color on solid inks can be approximately predicted by calculating separate L^* , a^* and b^* “paper errors”, as follows;

Given Standard paper CI ELab values of ...

$$PL^*_s, Pa^*_s, Pb^*_s$$

and New paper CI ELab values of ...

$$PL^*_n, Pa^*_n, Pb^*_n$$

Find paper CI ELab errors ...

$$P\Delta L^* = PL^*_n - PL^*_s;$$

$$P\Delta a^* = Pa^*_n - Pa^*_s;$$

$$P\Delta b^* = Pb^*_n - Pb^*_s;$$

A quick way of calculating approximate new target aim CIELab values for non-standard paper is to add the paper error to the standard target ink CIELab values in roughly the following proportions. Any greater precision is typically not necessary.

- Cyan – add **half** the errors
- Magenta – add **half** the errors
- Yellow – add the **whole** errors
- Black – **ignore** the errors
- Red – add **half** the errors
- Green – add **half** the errors
- Blue – add **one quarter** of the errors

E.12.5 Maintaining Gray Balance by CIELab

If the 50c, 40m, 40y gray balance patch varies from the ideal Lab values, try adjusting CMY solid ink densities (SID) within permitted tolerances to achieve the ideal CIELab gray value(s). The chart below shows how to adjust CMY ink SIDs in response to Lab error combinations. To use this chart, look for the row with the appropriate a* and b* signs, (+, -) then look in the appropriate L* column to find the suggested CMY moves, shown as up or down arrows. No arrow means no move.

a*	b*	- L*			+ L*					
-	+	▼▼	▼	▼▼▼	▼	▲	▼	▲	▲▲	▲
	+	▼▼	▼▼	▼▼▼			▼	▲▲	▲▲	▲
+	+	▼	▼▼	▼▼▼	▲	▼	▼	▲▲▲	▲	▲
+		▼	▼▼	▼▼▼	▲	▼		▲▲	▲	▲▲
		▼▼	▼▼	▼▼				▲▲	▲▲	▲▲
+	-	▼	▼▼			▼	▲	▲▲	▲	▲▲▲
	-	▼▼	▼▼	▼			▲	▲▲	▲	▲▲▲
-	-	▼▼	▼	▼	▼	▲	▲	▲	▲	▲▲
-		▼▼	▼	▼▼	▼	▲		▲	▲	▲

FIGURE E11: Chart showing how to move C, M and Y inks in response to +/- Lab errors.

E.13 Density-Based Press Control

A frequently-asked question is “what are the G7 densities?” The answer is that ink densities are no longer specified by G7, GRACoL or SWOP. Instead solid ink values are defined in CIELab units which may translate to different density values with different combinations of ink, paper and measuring equipment. For example, two magenta inks printed to the same density may produce quite different CIELab values, and conversely, two magenta inks may match the ideal CIELab target values at different densities. Further, two inks that match identically in CIELab may measure differently on different densitometers. This inconsistent relationship between CIELab and density is why neither G7, GRACoL nor SWOP publish official CMYK density values.

The good news is that densitometric press control is still quite valid (even recommended) once the optimum density values for a particular combination of ink, paper and measuring instrument have been determined. Printing to these solid values while also measuring the CMY densities of the mid-tone gray patch (HR) will produce equally good results as CIELab measurements, but is more intuitive to experienced press operators.

E.13.1 Solid Ink Densities

To determine the optimum solid ink densities for your press, first adjust the press to produce the closest match to the specified solid ink CIELab values for the two-color overprints (RGB) while keeping the CMY primaries within tolerance, then measure a sample patch with the densitometer you intend to use for production printing. Once this is done the press can be run to those solid densities so long as the inks and measuring instrument do not change. But don't forget gray balance and mid-tone density!

E.13.2 Gray Balance and Mid-Tone Density

Gray balance can be maintained on press by measuring the separate C, M, and Y densities of the HR_cmy patch. To determine the target C, M and Y densities for the HR patch, first adjust the press to produce the closest match to the wanted a^* and b^* values and the required HR neutral density (typically 0.54 plus paper density), then measure the HR patch with the densitometer you intend to use for production printing. The C, M and Y densities indicate the required balance to make that patch neutral gray, while the K channel (or Visual channel) indicates the required HR neutral density.



FIGURE E.12 Typical gray balance reading in Lab (left) and CMY density (right).

CAUTION: The readings illustrated here are for illustration only and NOT standard aim values.

Also measure the HR_k patch to find the optimum K-channel (or Visual channel) density for the black HR patch.

Running the press to match these HR-patch densities as well as the solid ink densities determined earlier will control gray balance and overall G7 curve lightness just as accurately as CIELab press control, so long as the inks and measuring instrument do not change.

E.14 Automated Press Control and G7

E.14.1 Identifying G7-Compatible Press Control Systems

If your automated press control system can maintain the gray balance and lightness of a 50c, 40m, 40y gray patch, it is technically G7-compatible. For maximum G7 compatibility it should also measure one- and two-color solids (and ideally TVI values), even though controlling each of these variables independently during a live press run may not be possible.

E.14.2 Identifying Non-G7-Compatible Press Control Systems

If your automated press control system is not capable of automated gray balance and gray lightness control, it is technically incompatible with a fully G7-based system of press control, however it may still be very useful (see *E.14.5 Using a Non-G7-Compatible Press Control System*.)

E.14.3 Calibration Run Priorities

As with manual G7 press control, the priorities of an automated press control system should be set differently for the calibration run and the confirmation run, or production work. This difference ensures that the closest possible match to the target gamut (e.g. GRACoL) is achieved at the time of calibration, and the closest match to G7 gray specifications is achieved on the confirmation or production runs, in spite of small press variations.

For the calibration run the system should be programmed to maintain the one- and two-color solid ink CIELab values within the appropriate ISO target values and tolerances. The main goals of the calibration run are accurate CIELab solids, evenness across the sheet and a fair representation of a typical press run.

E.14.4 Confirmation Run/ Production Priorities

For the confirmation run (and all production work) G7-compatible systems should be programmed to control gray balance and lightness in a 50c, 40m, 40y gray patch (HR_cmy) to match the G7 target values, with lower priority given to solid ink precision, (although solids should stay within ISO tolerances).

E.14.5 Using a Non-G7-Compatible Press Control System

On a non-G7 compatible system, use the same settings as for calibration (maintaining solids) but be prepared to make small global adjustments if necessary based on gray patch measurements with a hand-held device, and/ or subjective visual comparison with an accurate G7 proof.

E.14.6 Using the Proof

Having achieved the closest match to the target numbers, compare the proof to the press sheet. If the proof is accurate and the stocks are the same color, you should see a good match, although it is unlikely to be perfect. If necessary make small press adjustments based on visual judgment.

Remember, the main goal of a production G7 press run is to match an accurate G7 proof. How you achieve that match is relatively unimportant.

E.15 Production Plate Making Control

E.15.1 Production Plate Aim Values

Production plate process control aim values can be determined either with a G7 calibration curve applied (“curved”) or without (“uncurved”). Furthermore, “uncurved” plates may either be “linearized” or “raw.” Using “curved” aims allows every production plate to be used for process control. Using “linearized” or “raw” aims means a special “uncurved” plate must be wasted every time the plate process is tested.

To establish “curved” plate control aim points, record the actual dot values at 5% or 10% intervals on the final conformation run plates before mounting them on press.

To establish “uncurved” plate control aim points, record the actual dot values at 5% or 10% intervals on the calibration run plates before mounting them on press. If these plates were made without any pre-linearization, the aim values are “raw.” If these plates were linearized, the aim values are “linearized.”

NOTE: Even the most sophisticated plate readers may not measure the actual “printable” dot area due to differences in how the visible plate emulsion relates to the actual ink-holding dot area. This anomaly varies from plate type to plate type.

E.15.2 Production Plate Control

Production plate performance can be monitored by comparing a test plate to the production plate making aims. Errors (due to batch variations, chemistry changes, etc.) can be compensated by adjusting the RIP curves till a test plate reads the correct aim values. A small scale outside the image area is usually measured.

If using “curved” aims, any production plate can be measured to test plate making accuracy.

If using “linearized” aims, measure a special plate that has been produced with the current linearization curve, but without the G7 calibration curve applied.

If using “raw” aims, measure a special plate that has been produced with no linearization curve and no G7 calibration curve applied.

APPENDIX F: G7 FOR SOFT PROOFING

Soft proofing is the process of simulating the appearance of a CMYK proof or press sheet on a Red, Green, Blue (RGB) video display. With today's color management tools it is possible to show a very close simulation of a printed press sheet on newer display technologies, but accurate soft proofing can be difficult without proper equipment and viewing conditions.

G7 calibration cannot be applied to a soft proofing system in the normal sense (adjusting 1-dimensional tables) but any G7-based print condition can be accurately soft-proofed simply by selecting a G7-based CMYK profile as the reference condition to be simulated.

F.1 G7 Soft Proofing Requirements

The minimum requirements for good G7 soft proofing include;

- A wide-gamut, high-contrast monitor in good condition.
- A good ICC profile of the monitor.
- A good ICC profile made from the G7-calibrated device or the G7-based print specification data to be imitated, e.g. GRACoL or SWOP.
- Software capable of converting a CMYK image from the source profile (e.g. GRACoL) to the display profile in an absolute colorimetric mode.
- A controlled viewing environment which minimizes the effects of ambient lighting on the viewing experience.
- An adjacent viewing booth adjusted to the same 'color' and brightness as the video display's white point, in which a G7-calibrated press sheet or proof can be compared to the screen to confirm the soft proof is acceptable.



FIGURE F.1 Typical soft proofing setup with a dimmable viewing booth matched to display brightness

F.2 Local Soft Proofing

Local soft proofing is usually applied in Adobe Photoshop®, InDesign® or Acrobat®. When set up correctly, local soft proofing lets creative designers, photographers and retouchers work more efficiently because images that look good on screen can go straight to press without the need for a hard copy proof.

F.2.1 G7 Soft Proofing in Adobe Photoshop (CMYK Images)

- Make sure your monitor is accurately profiled using good software and measuring hardware.
- In Photoshop's Color Settings dialog, set the CMYK Working Space to a profile of the G7-calibrated working space you want to simulate, for example GRACoL or SWOP.
- Open a CMYK image in Photoshop.
- If you see a warning that the embedded profile does not match the current CMYK working space, choose Use the embedded profile (instead of the working space) to see what the person who sent the file would have seen on a similarly-calibrated display.
- To see how the image will print in your G7 CMYK working space go to Edit – Assign Profile and temporarily assign your working CMYK space to the image (if not already embedded).
- For an even more accurate soft proof of CMYK images, go to the View – Proof Setup – Custom... dialog, select the G7-based working space you wish to simulate, check Preserve CMYK Numbers and check Simulate Paper Color. This should display the actual paper color and shadow contrast more accurately.
- If you intend to use this simulation often, click Save... and give the custom proof setup a name like GRACoL_spc (for GRACoL Simulate Paper Color). This name will now appear in the View – Proof Setup menu without having to open the Custom Proof Condition dialog again.

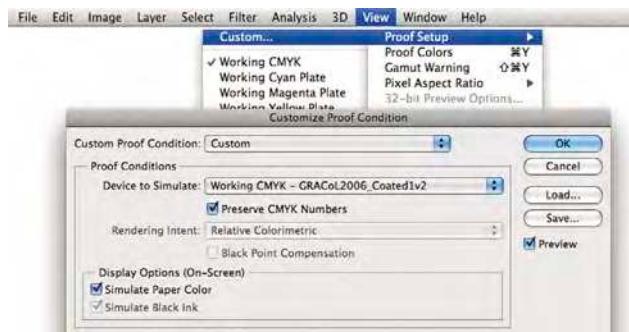


FIGURE F.2 Setting up Photoshop's CMYK soft proofing for maximum accuracy

F.2.2 G7 Soft Proofing in Adobe Photoshop (RGB Images)

- To preview an RGB image as it will appear when printed in CMYK, go to the View menu and select **Proof Colors**. This will simulate how the RGB image will look when printed in the current default CMYK space.
- For an even more accurate soft proof of RGB images, go to the **View – Proof Setup – Custom...** dialog, select the G7-based working space you wish to simulate. Select the **Rendering intent** you intend to use when converting the image, and check **Simulate Paper Color**. This should display the actual paper color and shadow contrast more accurately.

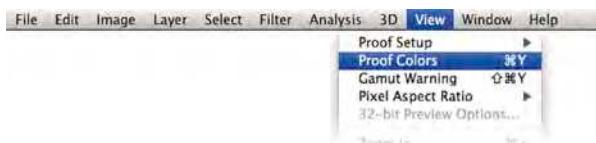


FIGURE F.3 Selecting Proof Colors from the View menu.

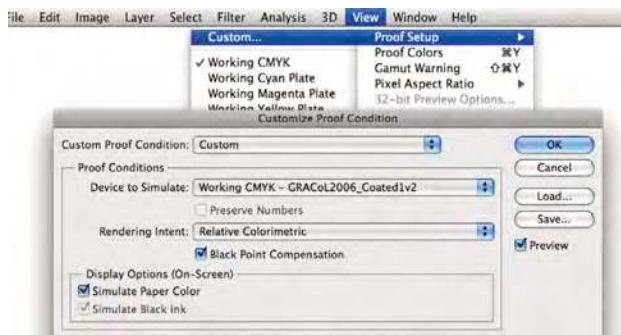


FIGURE F.4 Setting up Photoshop's RGB soft proofing for maximum accuracy

F.3 Remote Soft Proofing

Remote soft proofing allows observers in different locations to view the same file in accurate color and even communicate editorial changes without the delays and costs of shipping printed proofs. Two of the main challenges of remote soft proofing are synchronizing the color viewing experience at separate locations, and making sure each display truly matches the intended print condition. Another challenge is local ambient lighting, which can alter the appearance of one calibrated display compared to another.

IDEAlliance-certified remote soft proofing systems from various companies manage the calibration of each viewing station automatically and dictate suitable viewing conditions in the ADS (Application Data Sheet). These systems typically offer a range of viewing and collaborative tools for magnifying small details, mark-up, etc.

To use G7 in a remote soft proofing system, simply select GRACoL, SWOP or another G7-based print specification as the reference viewing condition.

Copyright and Legal Notices

This document and translations of it may be copied and furnished to others, and derivative works that comment on or otherwise explain it or assist in its implementation may be prepared, copied, published and distributed, in whole or in part, without restriction of any kind, provided that the above copyright notice and this paragraph are included on all such copies and derivative works. However, this document itself may not be modified in any way, such as by removing the copyright notice or references to IDEAlliance, except as needed for the purpose of developing IDEAlliance specifications, in which case the procedures for copyrights defined in the IDEAlliance Intellectual Property Policy document must be followed, or as required to translate it into languages other than English. The limited permissions granted above are perpetual and will not be revoked by IDEAlliance or its successors or assigns.

NO WARRANTY, EXPRESSED OR IMPLIED, IS MADE REGARDING THE ACCURACY, ADEQUACY, COMPLETENESS, LEGALITY, RELIABILITY OR USEFULNESS OF ANY INFORMATION CONTAINED IN THIS DOCUMENT OR IN ANY SPECIFICATION OR OTHER PRODUCT OR SERVICE PRODUCED OR SPONSORED BY IDEALLIANCE. THIS DOCUMENT AND THE INFORMATION CONTAINED HEREIN AND INCLUDED IN ANY SPECIFICATION OR OTHER PRODUCT OR SERVICE OF IDEALLIANCE IS PROVIDED ON AN "AS IS" BASIS. IDEALLIANCE DISCLAIMS ALL WARRANTIES OF ANY KIND, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO, ANY ACTUAL OR ASSERTED WARRANTY OF NON-INFRINGEMENT OF PROPRIETARY RIGHTS, MERCHANTABILITY, OR FITNESS FOR A PARTICULAR PURPOSE.

NEITHER IDEALLIANCE NOR ITS CONTRIBUTORS SHALL BE HELD LIABLE FOR ANY IMPROPER OR INCORRECT USE OF INFORMATION. NEITHER IDEALLIANCE NOR ITS CONTRIBUTORS ASSUME ANY RESPONSIBILITY FOR ANYONE'S USE OF INFORMATION PROVIDED BY IDEALLIANCE. IN NO EVENT SHALL IDEALLIANCE OR ITS CONTRIBUTORS BE LIABLE TO ANYONE FOR DAMAGES OF ANY KIND, INCLUDING BUT NOT LIMITED TO, COMPENSATORY DAMAGES, LOST PROFITS, LOST DATA OR ANY FORM OF SPECIAL, INCIDENTAL, INDIRECT, CONSEQUENTIAL OR PUNITIVE DAMAGES OF ANY KIND WHETHER BASED ON BREACH OF CONTRACT OR WARRANTY, TORT, PRODUCT LIABILITY OR OTHERWISE.

IDEAlliance takes no position regarding the validity or scope of any intellectual property or other rights that might be claimed to pertain to the implementation or use of the technology described in this document or the extent to which any license under such rights might or might not be available. IDEAlliance does not represent that it has made any effort to identify any such rights. Information on IDEAlliance's procedures with respect to rights in IDEAlliance specifications can be found at the IDEAlliance website. Copies of claims of rights made available for publication, assurances of licenses to be made available, or the result of an attempt made to obtain a general license or permission for the use of such proprietary rights by implementers or users of this specification, can be obtained from the President of IDEAlliance.

IDEAlliance requests interested parties to disclose any copyrights, trademarks, service marks, patents, patent applications, or other proprietary or intellectual property rights which may cover technology that may be required to implement this specification. Please address the information to the President of IDEAlliance.

G7®, GRACoL®, and SWOP® are registered trademarks of IDEAlliance. All other trademarks are as noted.