Curve4™

USER GUIDE

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Check for newer versions at <www.hutchcolor.com/Curve4Guide.pdf>

Contents subject to change without notice. Software UI and features may differ due to updates.
Errors? Omissions? Typos? Suggestions? - don@hutchcolor.com.

CHROMiX

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Chapter 1: Introduction

- What is Curve4
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What is Curve4?

Curve4™ is a multi-purpose graphic arts software available in three licensed levels; Curve4 Verify, Curve4 Calibrate and Curve4 Complete, plus a free Curve4 Demo version. Each level includes the functionality of the previous levels. The licensed level is shown on the splash screen with the word VERIFY, CALIBRATE, COMPLETE or DEMO.

Curve4 VERIFY

is the world's first software tool dedicated to Verifying a printed sample's compliance to the Idealliance G7 Master® program. With Curve4 Verify, print buyers, prepress users and G7 Experts can quickly ...

- Measure a test print or proof with a variety of automated spectrophotometers.
- Verify the Pass/Fail status of a sample for "G7 Grayscale", "G7 Targeted" or "G7 Colorspace" according to the Idealliance G7 Master program specifications.
- Verify Pass/Fail status of individual proofs using standard ISO 12647-7 control strips.
- Export measured data for G7 Master submission or use in other programs.
- Explore how the Calibration and Blend levels work in Demo mode.

Curve4 CALIBRATE

adds the ability to ...

- Calibrate any stable and repeatable 4-color (CMYK), 3-color (RGB or CMY)[1] or 1-color (B&W) printing system to the G7 specification.
- Calibrate by the TVI method to match ISO-standard or custom TVI curves.
- Calibrate "spot color" inks using the new ISO-standard SCTV method.
- Use smaller P2P targets for faster calibration.
- Calculate suggested ink restriction settings for ink-jet and other printing systems.
- Apply ink restriction via calibration curves by restricting maximum output values to less than 100%.
- Explore how the Blend level works in Demo mode.

Curve4 COMPLETE

enhances the efficiency and flexibility of Curve4 Calibrate with sophisticated data processing functions and a new "Blend" window that lets you ...

- Quickly re-calibrate a press or printer with a small *ΔreCal* target printed alongside a live job.
- Calibrate G7 without a P2P, for example with an IT8.7/4, TC1617, HC2052 or ECI2002 target.
- Use the VPR (Virtual Press Run) tool to eliminate the cost of a second press run.
- Post-calibrate existing characterization data for virtually-perfect G7 compliance.
- Minimize or eliminate the effects of uneven printing in a characterization data set.
- Average characterization data from multiple sample prints and mixed target types.
- Adjust the white point of characterization data by the SCCA method.
- Adjust the black point of characterization data to approximate polarized measurements.
- Generate a new target file from measurements of a another target type, for example export an IT8.7/4 data set from a TC1617 target, or a P2P51 target from an IT8.7/4.
- Apply the Blend tool functions to data extracted directly from an ICC printer profile.

[1] *3-color and 1-color G7 calibration are described in Appendixes.*

Curve4 DEMO

With **Curve4 DEMO** you can explore Curve4's Verification, Calibration and Blend functions using pre-loaded data files, but with no ability to process live user data.

Software history

Curve4™ is the fourth generation of the world's first G7 calibration software;

- 2006: IDEAlink Curve™
- 2009: Curve2™
- 2013: Curve3™
- 2016: Curve4 Verify™
- 2017: Curve4 Calibrate™, Curve4 Complete ™

The G7 specification and G7 Master program

G7 is a printer calibration specification owned by Idealliance, with formulae defined in the ANSI CGATS technical report TR015. All Curve4 G7 calculations comply precisely with TR015.[2]

The Curve4 Verify tool assigns pass/fail scores according to metrics, rules and tolerances taken from the Idealliance *G7 Master Pass/Fail* document, available at www.idealliance.org.

If either of the above documents is upgraded or changed in a way that affects G7 calculations or the G7 Master Pass Fail rules, software updates or upgrades will maintain compliance with the latest G7 specifications.

[2] *Note that two slightly different gray balance formulae are contained in Tr015. The one used by Curve4 is in the body of TR015, not in the appendix.*

How to Use this Guide

This User Guide is arranged in four main chapters, beginning with this introduction, followed by separate chapters for each of the three main tools; Verify, Calibrate and Blend. Each Tool chapter contains sub-sections for each tool, panel, pane, tab, function and workflow within that tool. Appendixes cover items like Printing, Measuring, creating custom references, formulae, etc.

All users

Should read Chapter 1 and any appendices that look interesting.

If you purchased Curve4 Verify

The chapters on the Calibrate and Blend tools are optional.

If you purchased Curve4 Calibrate

The chapter on the Blend tool is optional.

If you are already familiar with Curve3

Start with What's new in Curve4.

Terminology

Licensed Levels

The term "*Licensed Levels" refers to the three* purchasable versions of the software; Curve4 Verify, Curve4 Calibrate and Curve4 Complete. The licensed level is visible in the splash screen.

Tools

Each licensed level introduces one of three main *Tools* selected at the top of the application window. If a tool is not supported at that license level, it will only operate in Demo mode.

- Curve4 VERIFY introduces the *Verify* tool.
- Curve4 CALIBRATE adds the *Calibrate* tool.
- Curve4 COMPLETE adds the *Blend* tool.

Panels

Within each *Tool*, one or more *Panels* may be displayed, depending on selections within the tool.

Panes

Each *Panel* may use different *Panes* to display specific options or functions.

Tabs

Some *Panels* and *Panes* have *Tabs* that access additional functions or variables.

Runs

The term *Run* refers to a printing and measuring event such as a commercial "press run". In systems like ink jet and xerography, a Run may consist of a single print, but the process is still called a *Run*.

User Guide updates

New versions of the user guide can be downloaded from www.hutchcolor.com/Curve4Guide.pdf.

What's New in Curve4

Curve4 maintains the same basic functionality as Curve3, but with many new features, faster speed, enhanced accuracy and minor bug fixes. If you're already familiar with Curve3, here's a quick look at what's new in Curve4's. You'll find full details in the subsequent chapters.

Enhanced Verification features

While Curve3 Verify only reported G7 Grayscale Pass/Fail and solid ink delta E values, Curve4 Verify adds full Pass/Fail reporting for the Idealliance G7 Master program, including G7 Grayscale, G7 Targeted and G7 Colorspace, plus all "special case" annexes. Curve4 also verifies individual production proofs with the Idealliance ISO 12647-7 2009 or 2013 control strips.

Direct target measurement

All license levels of Curve4 drive a range of spectrophotometers directly, including Barbieri Spectro LFP, Konica Minolta FD9, Techkon SpectroDens, X-Rite i1Pro 1&2 (manual or i/O table) and X-Rite i1iSis 1&2. Most 3rd-party target reference files are recognized. Measured data is loaded directly into the current tool and can be exported for G7 Master submission, or use by other software.

New session management system

What used to be called "*Sessions*" in Curve3 are now called *Verifications*, *Calibrations* or *Blends*, depending on the current tool, and are automatically saved in a "Work List" to the left of the Tool. The Work List can have user-defined sub-folders and be re-sized or hidden as needed.

New Ink Restriction tool

Added primarily for ink jet users, Curve4 Calibrate can calculate suggested maximum ink levels from a P2P or a special *LimitFinder* target. The resulting *Restriction Percentages* can be applied either via the RIP's ink restriction (sometimes called "Ink Limiting") settings – if available, or by reducing the 100% value in the RIP's calibration curves to less than 100% (if supported by the RIP).

New calibration targets

Curve4 is compatible with a range of new calibration targets including the following;[3]

Compact, high-speed P2P targets

Smaller P2P targets reduce measuring time and real-estate without sacrificing accuracy.

Targets for TVI and SCTV calibration

The new SCTVi target is optimized for TVI and SCTV calibration.

Ink Restriction targets

New ink restriction targets help calculate suggested ink restriction percentages for ink jet printers.

[3] *For more details, see Appendix A: Target Printing*

Delta re-calibration (ΔreCal) targets

Recalibrate from a small ΔreCal target included in a live press run, instead of printing a whole P2P.

SCTV (Spot Color) calibration

Building on Curve3's *Special Ink* feature, Curve4 calibrates spot colors by the *SCTV* method defined in *ISO 20654:2017 - Measurement and Calculation of Spot Colour Tone Value*. SCTV applies to all ink colors and printing methods, effectively replacing TVI with a more visually-uniform formula that is recommended for all Pantone® inks and extra inks (e.g. OGV) in 7-color "expanded-gamut" printing.

Enhanced TR015 compliance

The G7 NPDC formulae used in Curve4 are virtually identical to those in Curve3, but comply more exactly with the official G7 formulae in CGATS TR015. Very small differences may be noticed in output calibration percentages or wΔCh or wΔL* scores, but printed results should look the same.

.Cxf file handling

Curve4 accepts .cxf and .mxf measurement files in the Verification, Calibration and Blend tools. The Blend Tool can also export .cxf and .mxf files that are directly compatible with software like i1Profiler.

Extract data from an ICC profile

Curve4 CALIBRATE and COMPLETE can extract characterization data from an ICC profile. Just load the profile into the Measurements list and Curve4 extracts CIELAB values for the TC1617 target[4].

Fast re-calibration (ΔreCal)

With the Complete license, Curve4 can quickly update an existing calibration using special ΔreCal targets that are small enough to include with most live jobs.

P2Pless calibration

With the Complete license, Curve4 can calculate G7 (or TVI) calibration curves from a wide variety of targets other than the P2P, such as the TC1617, IT8.7/4, HC2052, ECI2002, etc.

New Blend tool

The Curve4 Complete license includes not only the proven VPR (Virtual Press Run) technology but also a new Blend tool containing powerful tools for averaging, smoothing and adjusting characterization data. Options include editing both the white and black points of a dataset, applying G7 calibration to legacy data and regenerating new target files with patches not in the original data.

Enhanced reporting

Curve4 generates new 1-page reports for *G7 Master*, *Proof Quality* and *Calibration*.

[4] *The TC1617 is a new Idealliance target comprising the unique patch values of the standard IT8.7/4 target, minus duplicates, and columns 4 and 5 of the P2P51 target.*

System Requirements and Installation

Curve4 is a stand-alone software available for Mac OS X 10.7 or later and Windows 7 or later. Apart from cosmetic differences, Mac and Windows versions of Curve4 are functionality identical.

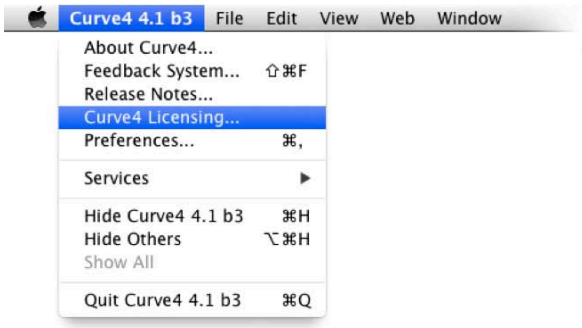
IMPORTANT: Once registered, there is a charge to change your Curve4 license to another OS.

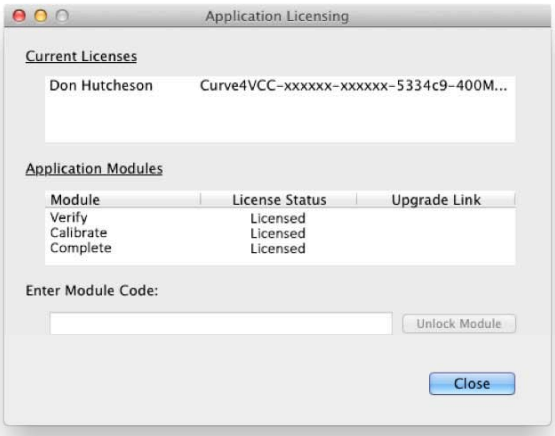
Installing and registering Curve4

After buying Curve4, an emailed authorization code must be registered to unlock your copy. Go to www.chromix.com/Curve4/register, enter your authorization code, username, etc., then download Curve4 at http://www.chromix.com/Curve4, launch the software and enter username and serial #.

Installing license upgrades

When upgrading to a higher licensed level, the new license code is entered in the Application Licensing window accessed from the Curve4 menu.





Different license codes activate each module

Upgrading from Curve3

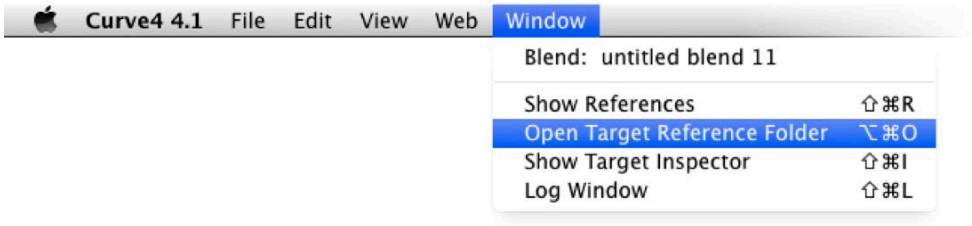
Curve3 used a "Color Standards" folder inside the Curve3 startup folder to hold custom CGATS reference files for use by the Curve3 Verify function. The need for this folder is eliminated in Curve4 by the ability to save custom CRPCs, (described in *Appendix C: Custom References*).

If you had a folder in your Curve3 startup folder called "Control Point Files", copy its contents into the folder within Curve4's application support location called "Custom Control Points". This folder is created after you run Curve4 for the first time and create a Calibration *Run*.

Target Reference Files folder

Curve4 comes pre-loaded with some basic target definitions that show up in the *Target* list in the *Measure* window. You can make new target types visible in the *Target* list by adding their definition files to the *Target Reference Files* folder, accessed from the Window menu item.

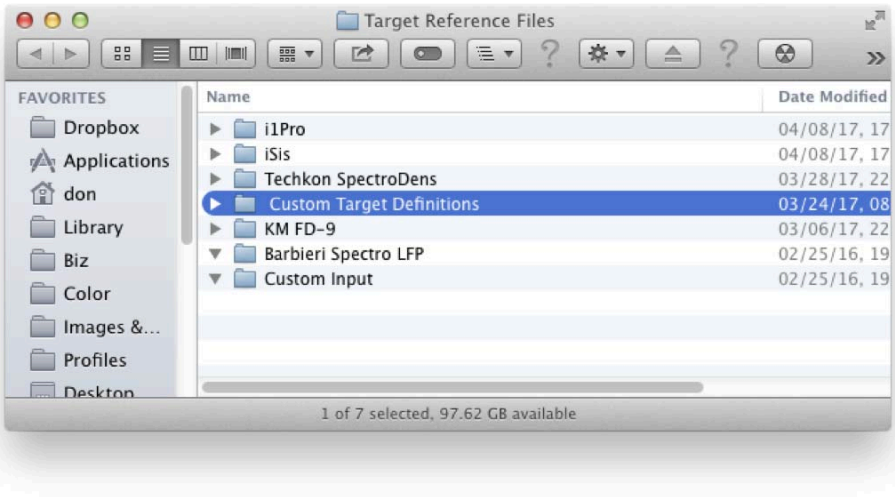
The *Target Reference Files* folder has sub-folders for each measuring device. Be sure to put your files in the correct device folder or they wont appear when that device is selected in the *Measure* window.



Accessing the Target References Folder

Custom Target Definitions folder

With the Curve4 Complete license, the Blend Tool lets you *Regenerate* custom targets of your own choosing or design from data. If you plan on regenerating a particular target often you can save its CGATS definition file in the Custom Target Definitions folder inside the *Target Reference Files* folder.



The Target Reference Files folder with the Custom Target Definitions folder highlighted

Software updates

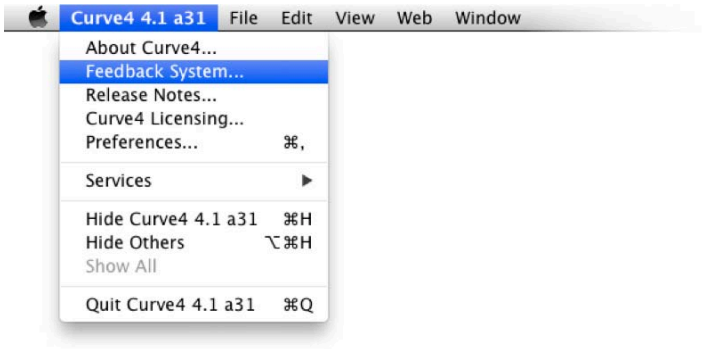
Select *Check for new versions daily* in *Preferences* to be notified when updates are available.

The Updates pane

Feedback / Suggestions / Support

You can report problems or suggestions for new features using the Curve4 feedback system, accessed in Windows through the *Window* menu and in Mac OS through the *Curve4* menu.

The Feedback system logs everything into a formal development / resolution system that offers the best chance of seeing your comments properly managed and scheduled. Please don't email or call us as post-it notes tend to get lost.



Accessing the Feedback System (Mac)

Maxwell users

If you have a Maxwell account (free at www.chromix.com) and you use the same email address associated with your Maxwell account when submitting Curve4 feedback, all your feedback items will be linked to your account and you can log into Maxwell to check their status.

If an action has been made by us to acknowledge, fix or add the feedback item, these notes will be available to you in Maxwell.

RIP compatibility information

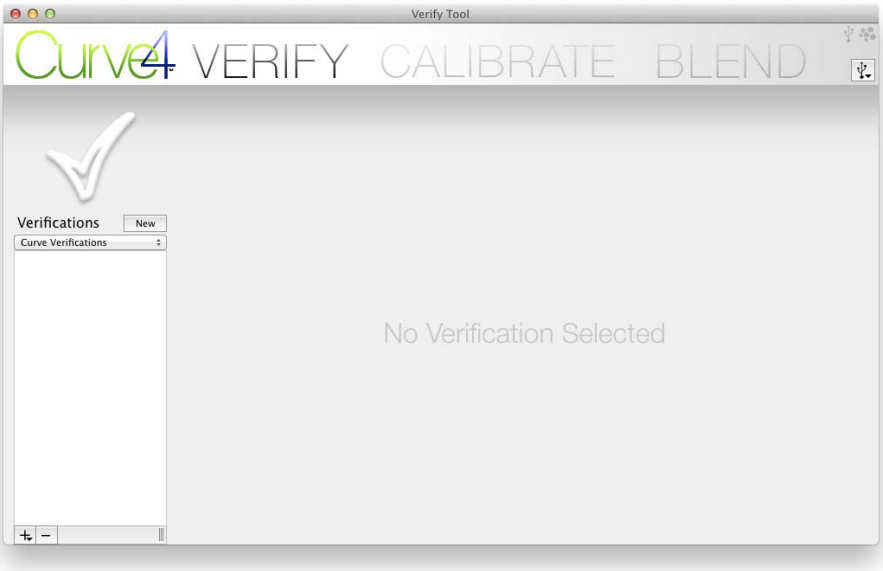
Keeping up with new RIP versions is a constant battle and we realize some of the information in that part of the User Guide may be out of date.

If you find an error in *Appendix D: RIP-Specific Notes*, or have information on how to import Curve4 calibration data into a RIP not yet covered in the appendix, please send your information via the Feedback system, along with screenshots, step-by-step workflow instructions or whatever you have.

Software Principles

First launch

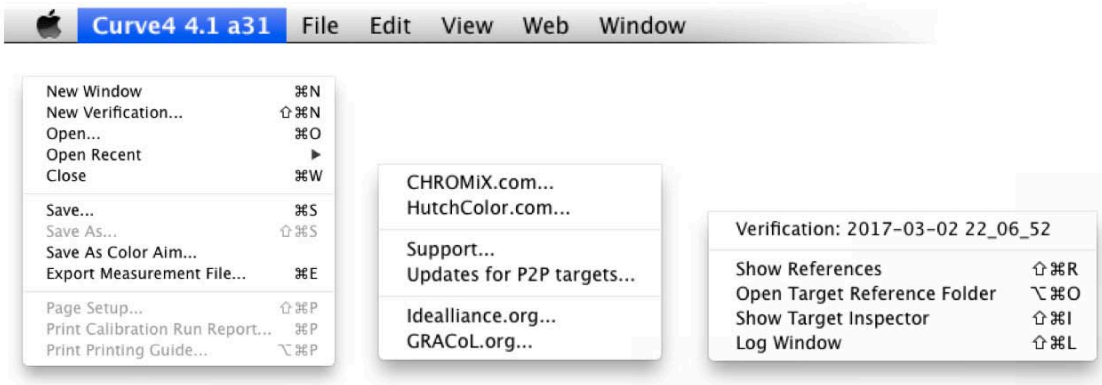
The first launch of Curve4 shows the message *No Verification Selected* and an empty *Verifications* "Work List". Subsequent launches open in the last Tool used (Verify, Calibrate or Blend) with previous Verifications, Calibrations or Blends shown in the Work List.



First launch appearance

The main menu bar

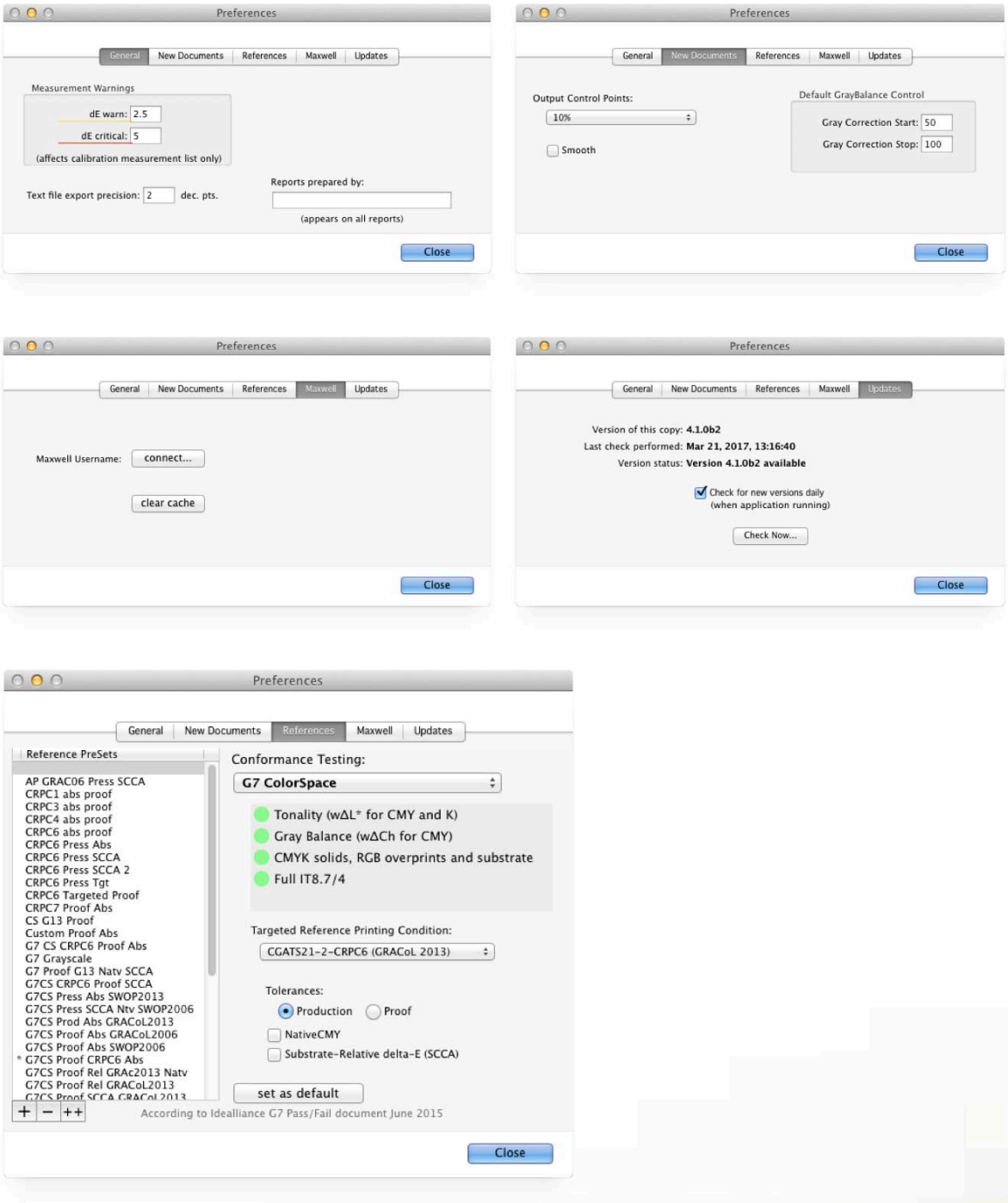
Numerous Curve4 functions are accessed from the menu bar at the top of the desktop (Mac) or the Curve4 window (Windows).



The Curve4 Menu bar in Mac OS X (top) with File, Web and Window menus shown.

Preferences

The Preferences pane is accessed by clicking *Curve4* in the menu bar (Mac) or *Edit* in the application bar (Windows). Five tabs labeled *General*, *New Document*, *References*, *Maxwell* and *Updates* control basic software parameters. Each tab is described where appropriate within this User Guide



The five Preferences-panes (Mac).

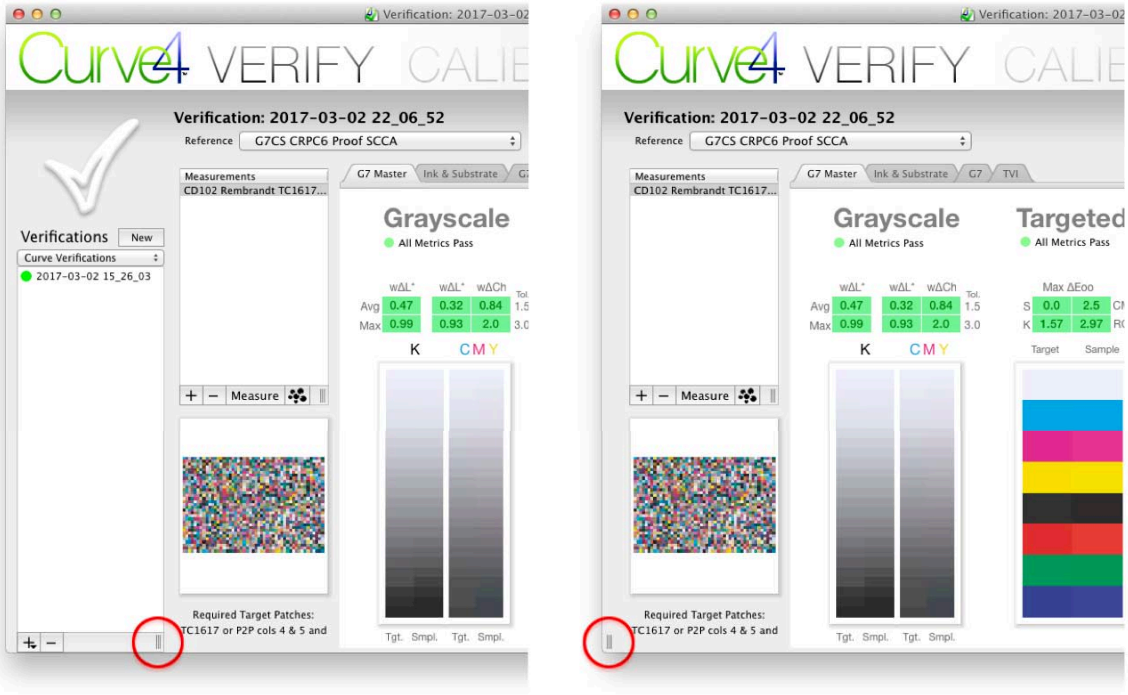
The main Tool bar

A Curve4 *Tool* (Verify, Calibrate or Blend) is selected by clicking its name in the bar at the top of the application window. If that tool is not licensed, it will only run in Demo mode.

The main Tool Icons with Verify currently selected

The Work List

With Curve4 you can perform three basic types of work; Verify, Calibrate or Blend. Each tool shows previously-saved *Verifications*, *Calibrations* or *Blends in* a "Work List" to the left of the tool. The Work List can be re-sized by dragging the handle bottom right of the list, or hidden and revealed by double-clicking the handle.



The Work List can be revealed or hidden by double-clicking the handle circled in red. Drag the handle to re-size the list.

Deleting items from the Work List

To delete a Verification, Calibration or Blend, select its name in the Work List and click the minus (–) button below the list. An alert window will ask you if you really want to delete the item.

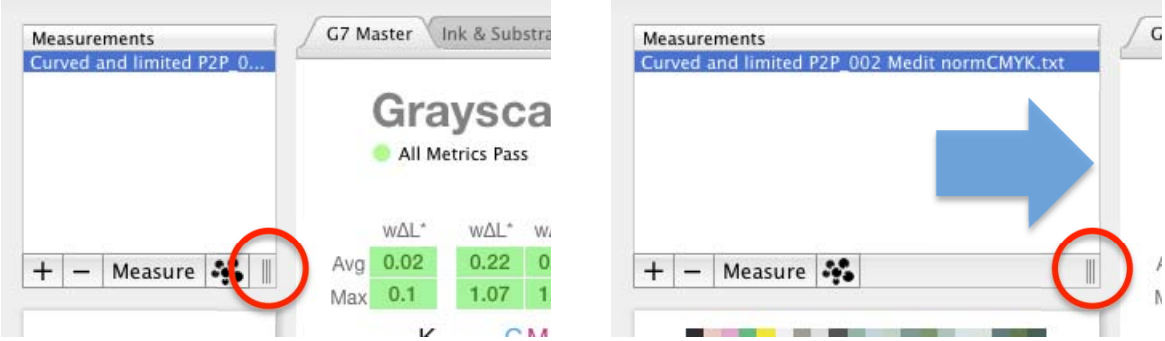
For quicker deletions you can by-pass the alert window by holding the Option key while clicking the minus (–) button.

The Measurements list

In all three Tools, a Measurements list shows measurement files loaded or measured directly into that Verification, Calibration or Blend. Measurement files are accepted in these formats;

- CGATS
- .cxf
- .mxf
- CMYK ICC profile (requires CALIBRATE or COMPLETE license)

The width of the Measurements list can be re-sized by dragging the handle bottom right of the list. Items above and below it are re-sized at the same time.



The width of the Measurements list can be changed by dragging the handle circled in red.

Accepted color types and priority

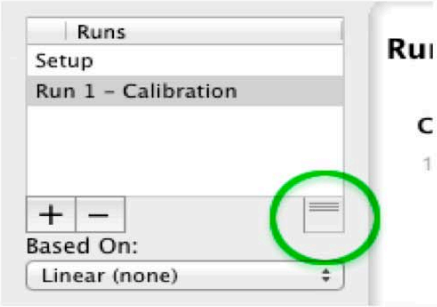
Curve4 measures and accepts color data in CIELAB, CIEXYZ and/or spectral units. When multiple data types are included in one file, Curve4 uses only one type in the following order;

1st: Spectral
2nd: XYZ
3rd: LAB

Lower-priority data in the same file are ignored.

The Runs list

In the Calibrate tool, a *Runs* list is created for each Calibration. A *Run* is a unique target printing and measuring event, for example an offset press run, or a few pages printed on an ink jet printer.



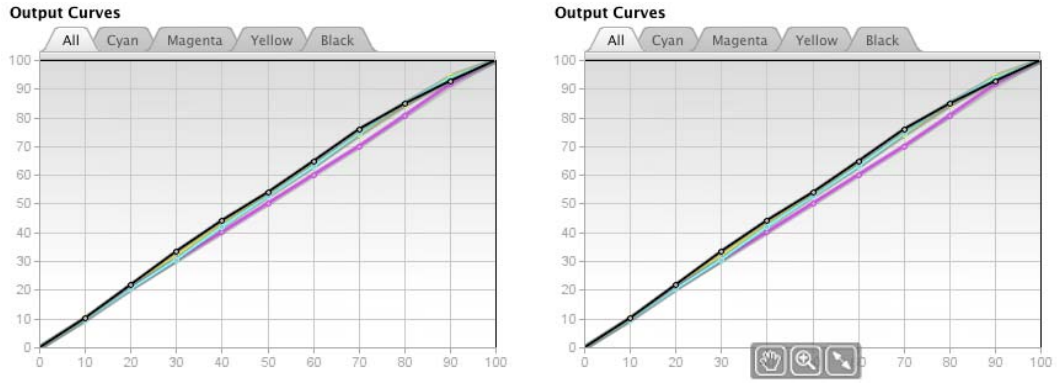
The height of the Runs list can be changed with the handle circled in green.

Each calibration typically contains at least two *Runs*, a *Calibration Run* and a *Verification Run*.

When re-calibrating a printer that has been previously calibrated by Curve3 or Curve4, a new *Run* containing the new target (e.g. a ΔreCal target) is linked to the original *Run* by selecting the old *Run* in the *Based On:* list, then the new *Run* appears indented below it. For convenience, the original *Run* can be referred to as the *"Basis Run"*.

Manipulating graphs

Most of the graphs in Curve4 can be enlarged, magnified and scrolled. Move the mouse over the lower part of a graph to reveal the graph's *Scroll, Magnify* and *Expand / Contract* controls.



Output Curves graph with zoom controls hidden (left) and visible (right)

Expanding and contracting a graph

To expand a graph, move the mouse over the lower part of the graph to make the tools visible, then click the *Expand / Contract* tool. The graph will become larger. To restore it to normal size, click *Expand / Contract* again.

Magnifying a graph

To zoom in on a graph, click the *Magnify* tool then click on the to graph zoom in. Keep clicking to increase the zoom factor. To zoom out, hold the *Option* key (Mac) or *Alt* key (Windows) while clicking. The *Magnify* tool works in normal and expanded graphs.

Scrolling a graph

If a graph has been zoomed, part of it will be hidden. To reveal hidden areas, click and hold the *Scroll* tool (hand symbol) on part of the graph and drag in the required direction.

Shortcut keys

Left / Right arrows

In the Calibrate *panel*, use the *Left / Right Arrow* keys to move between the pane buttons.

The left/ right Arrow reminder prompt

Shift + Left / Right arrows

In a panel or pane with tabs, such as *Analyze* or *Create Curves*, use the *Shift-left Arrow* and *Shift-right Arrow* keys to move between tabs.

The shift-left/ right Arrow reminder prompt

Up / Down arrows

If there is more than one *Run* in a Calibration, you can quickly switch between *Run*s by clicking once in an empty part of the list, then using the *Up / Down Arrow* keys to view each *Run* in the same pane.

If there is more than one file in the *Measurements* list, you can quickly switch between files by clicking once in a spare area of the list, then using the *Up / Down Arrow* keys.

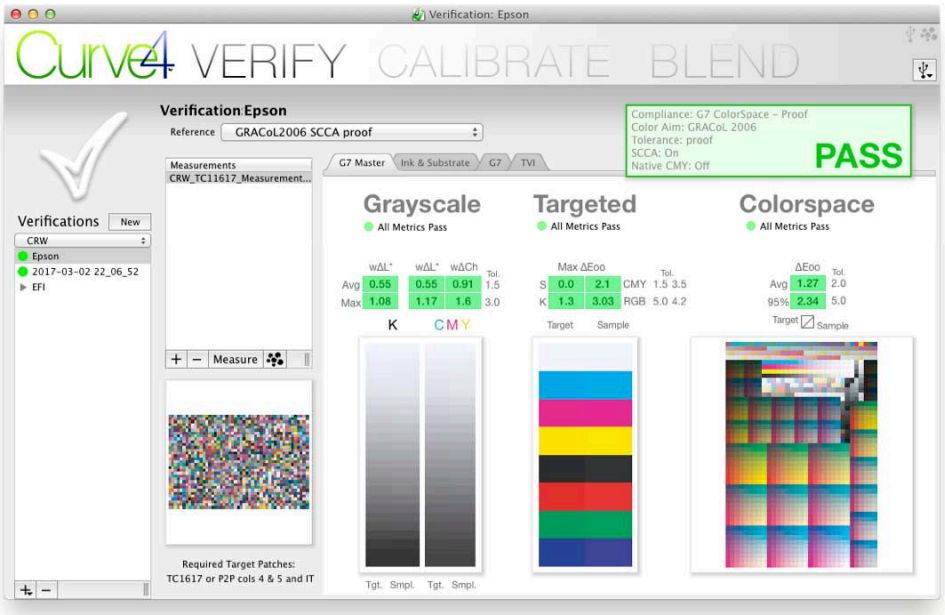
If you are not in either the *Run*s or *Measurements* list, the *Up / Down Arrow* keys will move between the main Tool panels, similar to clicking the Tool icons.

2

Chapter 2: The Verify Tool

What is Curve4 Verify?

Curve4 Verify is the world's first software tool for Verifying the compliance of a printing system or proof to the *Idealliance G7 Master* program. Whether your aim is *G7 Grayscale*, *Targeted*, or *ColorSpace*, Curve4 Verify measures your target directly and shows an instant PASS / FAIL badge. Individual tonality, gray balance, solid ink and color space scores add detail, while simulated target images show graphically how close your sample is to the intended appearance.



Curve4 Verify with Pass badge and side-by-side visual comparisons

With Curve4 Verify you can...

- Measure targets directly using a variety of current spectrophotometers.
- Load sample data files measured by external software.
- Verify that a printed sample is in compliance with the G7 Master program.
- Verify the quality of an individual proof.

- Create and save custom pre-set References.
- Create simple, easy to understand, one-page Verification reports.

Curve4 Verify vs. Curve3 Verify

Curve3 Verify reported the Pass/Fail status of G7 Grayscale compliance and showed individual delta E values for inks and solids compared to a selected reference color space. Curve3 did not report Pass/Fail status for G7 Targeted or G7 Colorspace compliance, nor did it drive measuring devices - measurements had to be imported from 3rd-party software like X-Rite i1Profiler, MeasureTool, etc.

Curve4 Verify goes far beyond Curve3's capabilities, with Pass/Fail reporting for the complete range of Idealliance G7 Master conditions. It can also test the quality of individual proofs using the Idealliance ISO 12647-7 target (2009 or 2013).

Curve4's biggest productivity improvement is its ability to directly measure targets with a variety of automated spectrophotometers.

Available tests

	Curve4	*Curve3*
Solid ink (absolute)	Y	Y
Solid ink (relative)	Y	N
G7 Grayscale	Y	Y
G7 Grayscale - Native CMY	Y	Y
G7 Grayscale - Screen	Y	N
G7 Targeted (absolute)	Y	N
G7 Targeted (relative)	Y	N
G7 Colorspace (absolute)	Y	N
G7 Colorspace (relative)	Y	N
Standard proof tolerances	Y	N
Standard print tolerances	Y	N
Custom reference print conditions	Y	Y
Custom Pass/Fail tolerances	N	Y

Available tests in Curve4 vs Curve3. Note that "absolute" means values are compared in absolute mode. "Relative" means they are compared using the SCCA (Substrate-Corrected Colorimetric Aims) method.

Verifications

Each job in Curve4 Verify is called a *Verification*. Each time you create a new Verification it is saved in a list that you can revisit as often as you like in future.

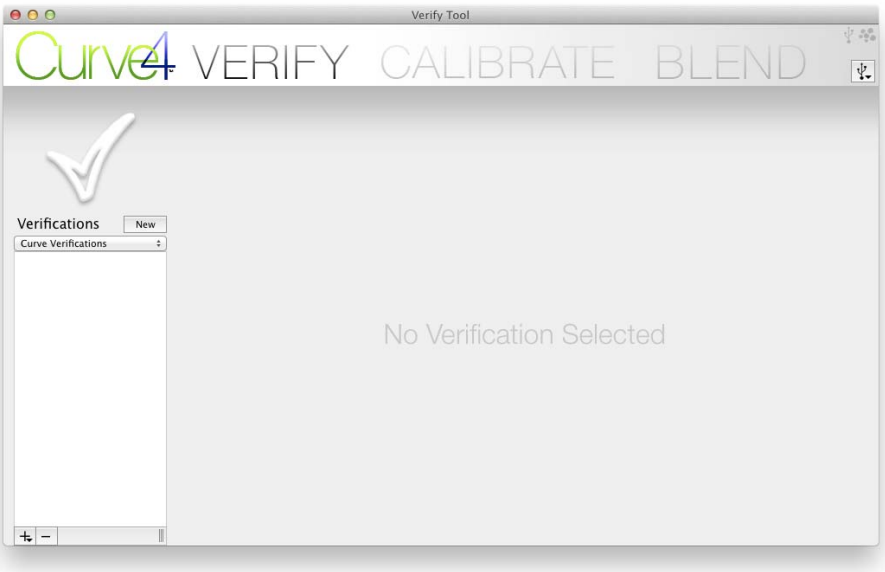
References

Each Verification compares your sample to a pre-set *Reference*, which defines a set of target values and tolerances based on *G7 Master* variables, including target color space (CRPC), absolute or relative white point (SCCA), proof vs. print tolerances, etc.

Some basic References are supplied with the software, or you can create and save your own custom References.

Verification Workflow

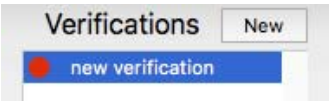
When you first launch Curve4 Verify, a blank panel appears saying *No Verification Selected* with an empty Verifications list. On subsequent launches, the list shows previously-saved Verifications.



First launch screen

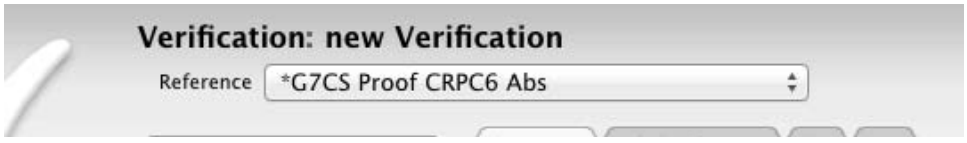
Create a new Verification

To create a new Verification, click the *New* button, or the (+) button below the Verifications list. This adds a new verification to the list.



The default Reference

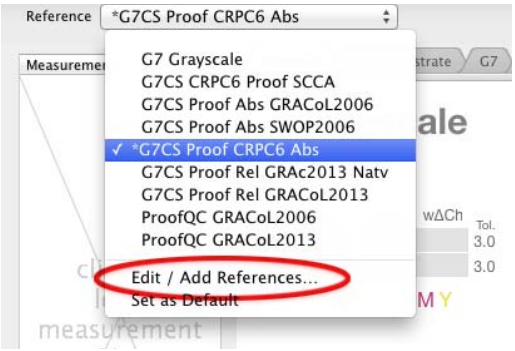
A default Reference (marked with an asterisk (*) is automatically selected in a new Verification. A Reference is a set of target values and tolerances to which a sample will be compared



The References list

Change the Reference

To change the reference, select a new one in the Reference list. If you don't see an appropriate *one*, click *Edit / Add References...* and either create a new Reference, or duplicate and edit an old one.



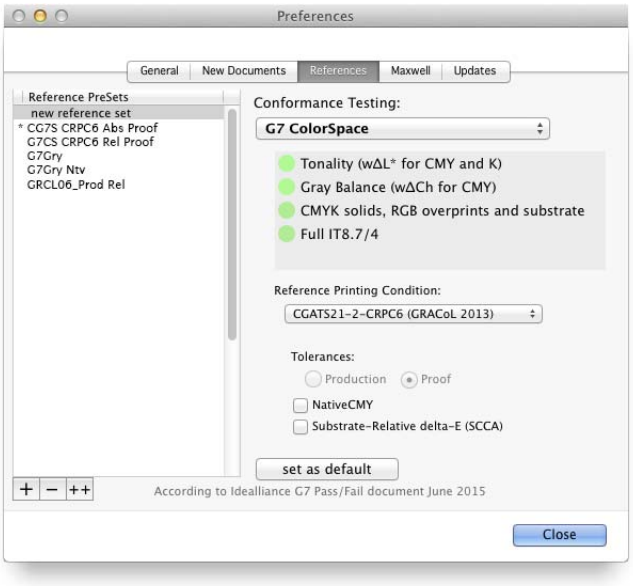
The References list showing the Edit / Add References... option.

Reference parameters

A reference contains parameters for;

- Compliance Test
  - G7Grayscale
  - G7 Targeted
  - G7 Colorspace
  - Proof Pass / Fail
  - G7 Grayscale - Screen
- Target color space (CRPC)
- Tolerances (Production / Proof)
- SCCA (on/off)
- Native CMY (on/off)

For explanations and instructions for creating or editing a Reference, see *Appendix C*: *Custom References*.



Right: The Edit / Add References window

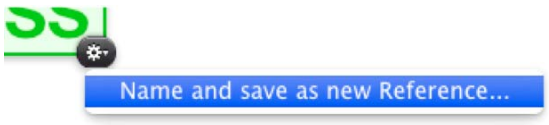
Modifying a Reference in the Pass/Fail badge

Moving the mouse over the PASS / FAIL badge reveals a plus (+) button, which lets you temporarily modify the Reference from within the Pass Fail badge.

Click the + button to alter reference parameters within the Pass Fail badge.

After clicking the + button it turns into an x. To cancel the modifications, click the x.

To save the modifications as a new *Reference*, click the *Save* button (bottom right) which takes you to the References window with the edited Reference temporarily named *Custom*. Double-click the name *Custom* and give the new Reference a unique name.

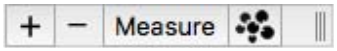


Click the bottom right button to save modifications made in the PASS / FAIL badge.

Add measurements

Direct measuring

To measure a target, connect your device, click the *Measure* button and follow the instructions (see *Appendix B: Measuring*).



Click and load

Click where it says *click to load measurement files*[5] in the Measurements list and select a measurement file. To add more files, click the (+) button below the list.

Drag-and-drop

Drag and drop one or more measurement files into the list.

Maxwell

Click the Maxwell icon to download measurements from your Maxwell account. Click the icon again to download more measurements.

ICC profiles *(with CALIBRATE or COMPLETE license)*

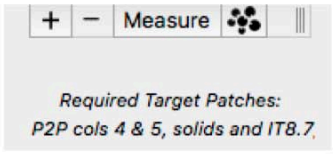
Load an ICC profile into the Measurements list to extract CIELAB values for the TC1617 target.

Deleting measurements

Measurements can be deleted from the list by clicking the (-) button.

Required test patches

The target patches required by the selected Reference are listed under the *Measurements* list. These patches can be supplied in a single target, or a combination of several targets.

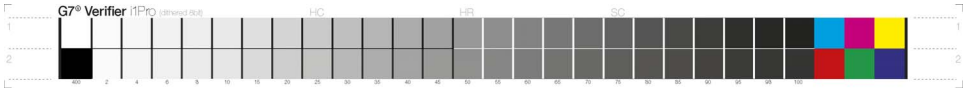


The message below the Measurements list shows the required patches for the selected Reference type

G7 Grayscale or G7 Targeted test targets

The smallest target for testing *G7 Grayscale* or *G7 Targeted* compliance is the *G7 Verifier*. Other usable targets include the P2P51 or P2P25 or TC1617.

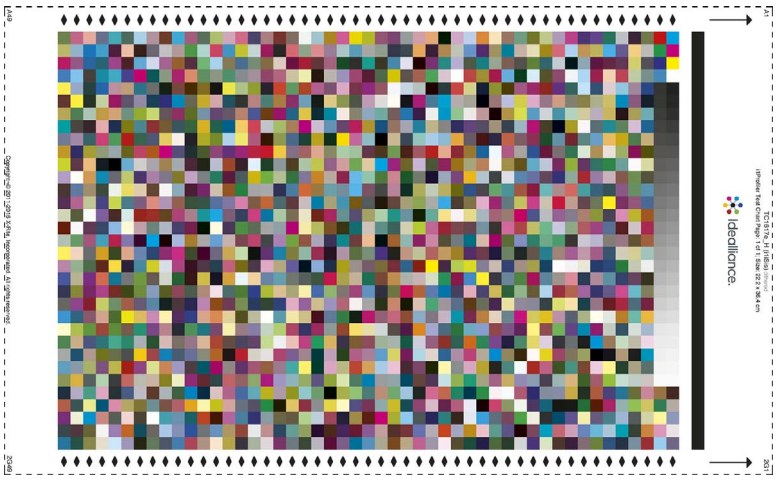
[5] *You can change the message in Preferences – New Documents.*



The G7 Verifier target

G7 Colorspace test targets

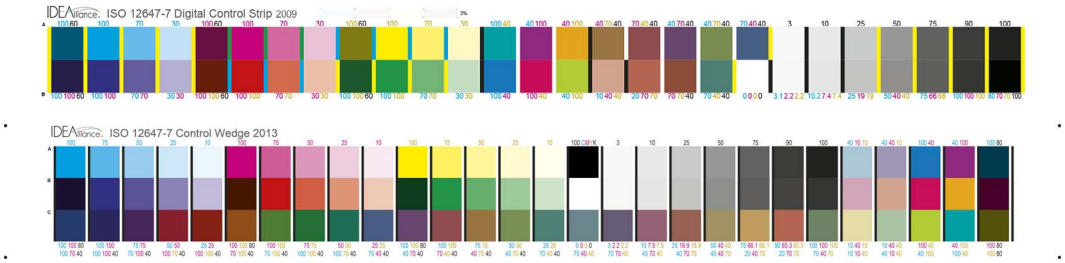
The most efficient target for testing G7 Colorspace compliance is the TC1617. Other usable targets include a combination of the P2P51, P2P25 or G7 Verifier plus an IT8.7/4 target



The TC1617h target

Individual proof test targets

Recommended target: Idealliance ISO 12647-7 Control Wedge 2013. Other options include the Idealliance ISO 12647-7 Digital Control Strip 2009, or the TC1617 (a bit impractical for single proofs).



The Idealliance ISO 12647-7 Digital Control Strip 2009 and Idealliance ISO 12647-7 Control Wedge 2013.

How multiple targets are handled

If you load more patches than needed into the *Measurements* list, Curve4 Verify automatically finds the required patches and ignores unwanted patches.

If you load duplicate targets, or targets with duplicate patches (identical CMYK percentage values), Curve4 automatically averages their measurement values.

If you load data from different devices or printing conditions, you may get unexpected or failing results.

CAUTION: When loading multiple targets, make sure they come from the same device and print run.

Interpreting Results

The PASS / FAIL badge

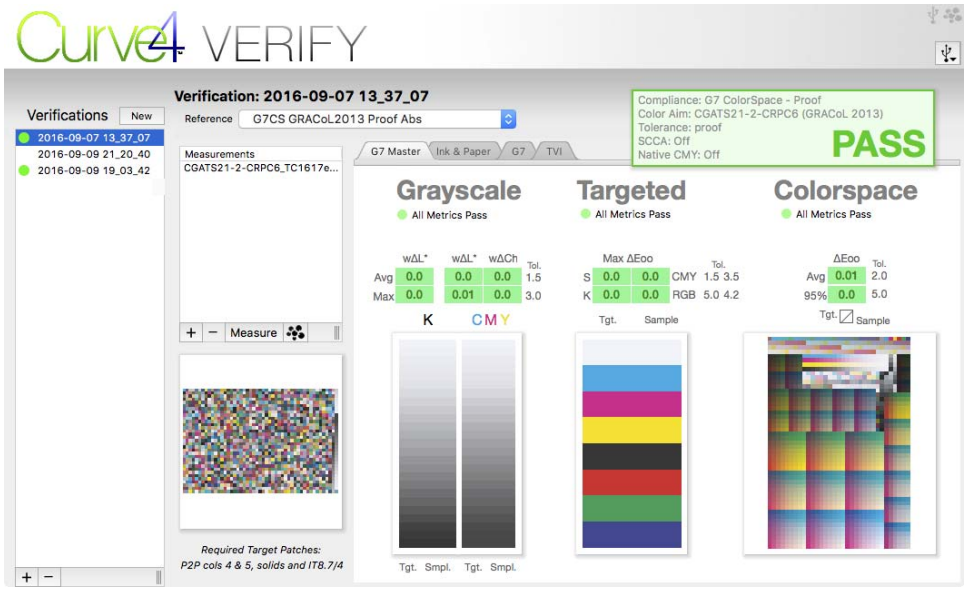
Verify displays a green PASS or red FAIL badge at the top right to show the status of your sample. The badge also shows the parameters of the selected *Reference*, including Compliance type, Color Aim, Tolerance level, SCCA on/off and Native CMY on/off.

The green PASS and red FAIL badges

Depending on the *Reference* selected, the main panel will display the *G7 Master* or *Proof* tab, with additional tabs available for *Ink & Paper*, *G7* and *TVI*.

The G7 Master tab

When *Compliance Test* is set to anything but *Proof Pass / Fail*, the *G7 Master* tab appears, summarizing the current sample's quality according to the Idealliance *G7 Master Pass/Fail* document.



The G7 Master tab

Separate Pass / Fail results are shown for *Grayscale, Targeted* and *Colorspace*. Red or green dots, colored metric boxes and messages explain the reason for a failure. The tolerance (Tol.) values shown alongside each metric are defined by the Idealliance G7 Master program and explained in the *G7 Master Pass/Fail* document available from www.idealliance.org.

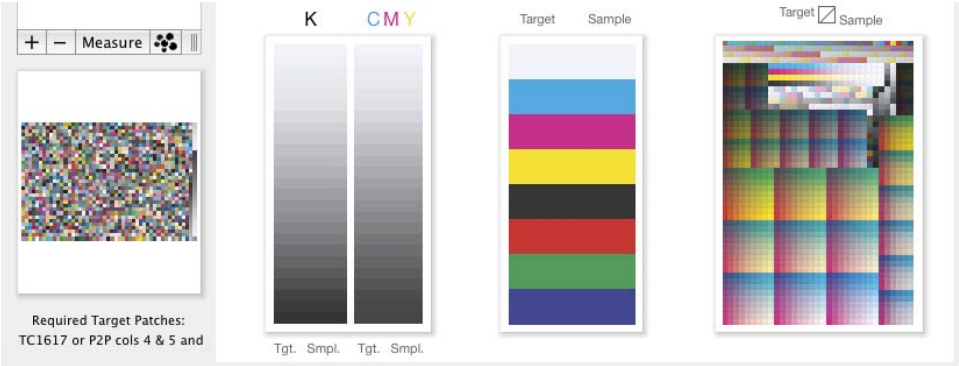
Pass/Fail hierarchy

Note that a sample may pass the individual tests of one G7 condition, e.g. G7 Colorspace, but fail those of another, e.g. G7 Grayscale. For example in the illustration below, the sample has passed the IT8.7/4 metrics (right) but fails G7 Colorspace because G7 Targeted failes.

Individual metric values are shown for G7 Grayscale, G7 Targeted and G7 Colorspace

Simulated target images

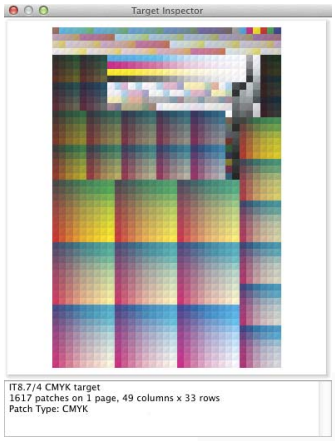
The G7 Master tab displays side-by-side images of the G7 gray scales, Ink solids and IT8 target. Split patches in each image show desired color (left) and measured color (right). In a “perfect” print, the left and right side of each patch would be identical, but in practice, some difference is inevitable, even in the highest-quality printing and proofing.



Simulated target patches display your sample’s color (left) next to the target color (right). Note that even the best proofing and printing will typically show some difference between sample and reference.

The target Inspector Window

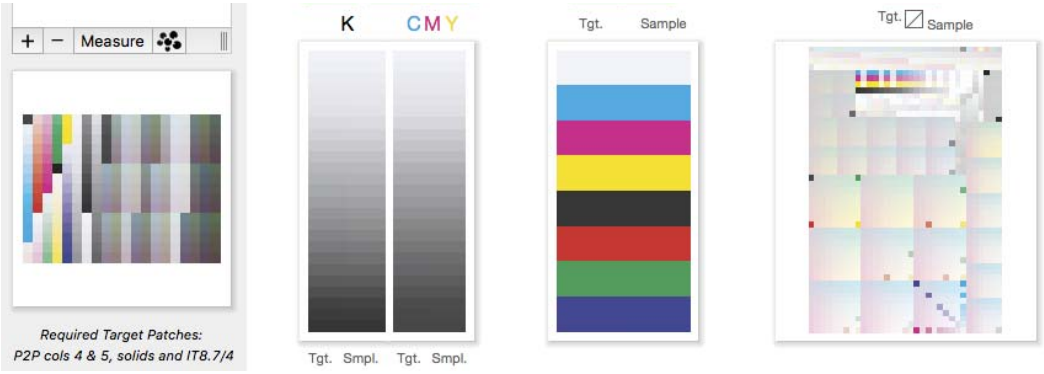
Click any of the target images to enlarge it into the *Target Inspector* window.



The Target Inspector window can be enlarged and stretched. Click the red dot to close it.

Missing (ghosted) patches

Ghosted (light density) patches in the target images represent measurements that are missing in the sample files. In the example below, only a P2P51 target was loaded for a *G7 Colorspace* Verification. Adding an IT8.7/4 (as requested below the list) will fill in the ghosted patches.

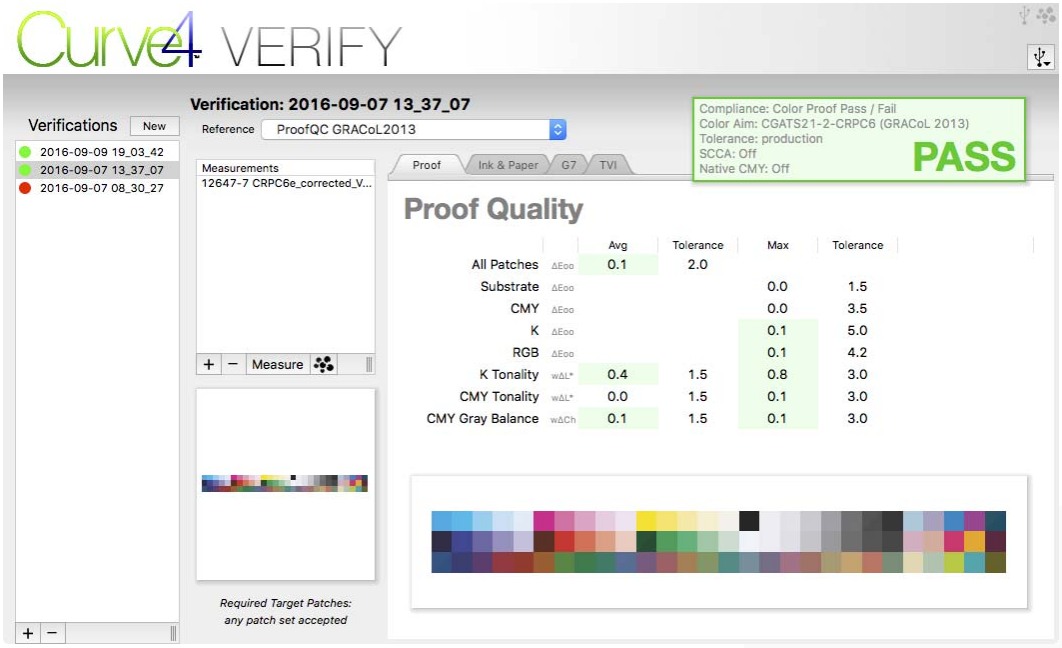


Missing patches are shown as "ghosted" versions of their desired color

The Proof tab

If the *Compliance Test* is *Proof Pass / Fail*, the *G7 Master* pane changes to the *Proof* pane. This pane verifies individual proofs according to the Idealliance *G7 Master Pass/Fail* document, in which you can find explanations for the numbers shown in the *Proof* pane.

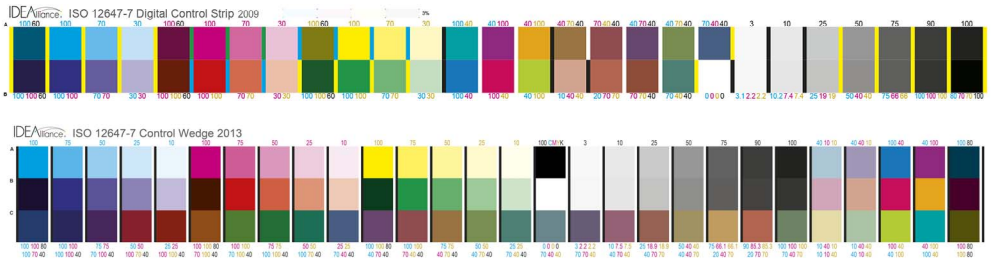
If a number seems to be missing from the chart, it is not part of the G7 Master Pass/Fail protocol.



The Proof tab

Proof QA targets

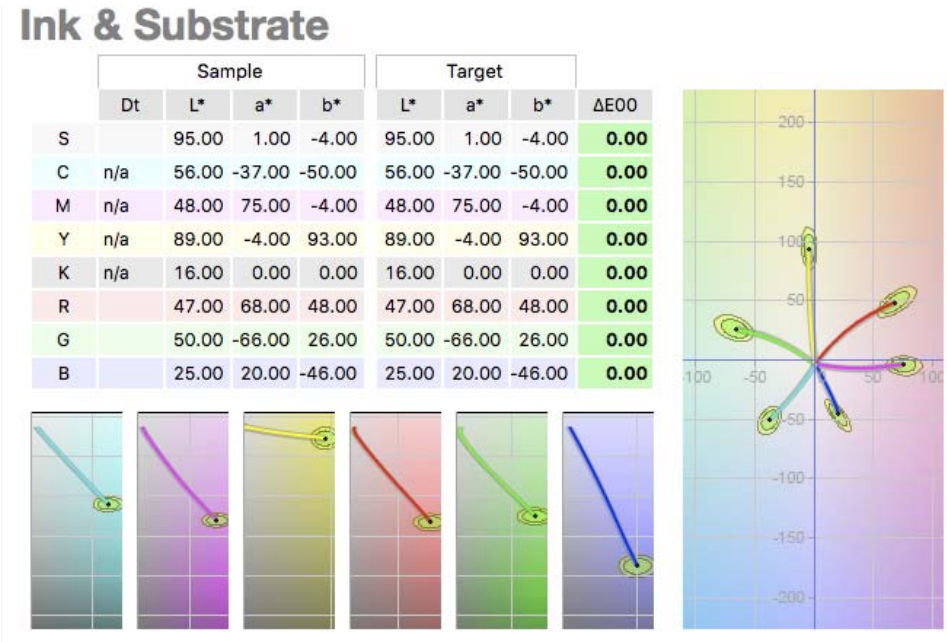
Measurements can be taken from the two-row Idealliance ISO 12647-7 Digital Control Strip 2009 or the three-row Idealliance ISO 12647-7 Control Wedge 2013.



The Idealliance ISO 12647-7 Digital Control Strip 2009 (top) and the Idealliance ISO 12647-7 Control Wedge 2013 (bottom).

The Ink & Substrate tab

The *Ink & Substrate* tab lists sample vs. measured CIELAB and delta E_{00} values for substrate and primary (CMYK) and secondary (RGB) solids. Density (status T) values are displayed if the measured data are spectral, otherwise the density fields contain "n/a".



Ink & Substrate

		Sample			Target			
	Dt	L*	a*	b*	L*	a*	b*	ΔE00
S		95.00	1.00	-4.00	95.00	1.00	-4.00	**0.00**
C	n/a	56.00	-37.00	-50.00	56.00	-37.00	-50.00	**0.00**
M	n/a	48.00	75.00	-4.00	48.00	75.00	-4.00	**0.00**
Y	n/a	89.00	-4.00	93.00	89.00	-4.00	93.00	**0.00**
K	n/a	16.00	0.00	0.00	16.00	0.00	0.00	**0.00**
R		47.00	68.00	48.00	47.00	68.00	48.00	**0.00**
G		50.00	-66.00	26.00	50.00	-66.00	26.00	**0.00**
B		25.00	20.00	-46.00	25.00	20.00	-46.00	**0.00**

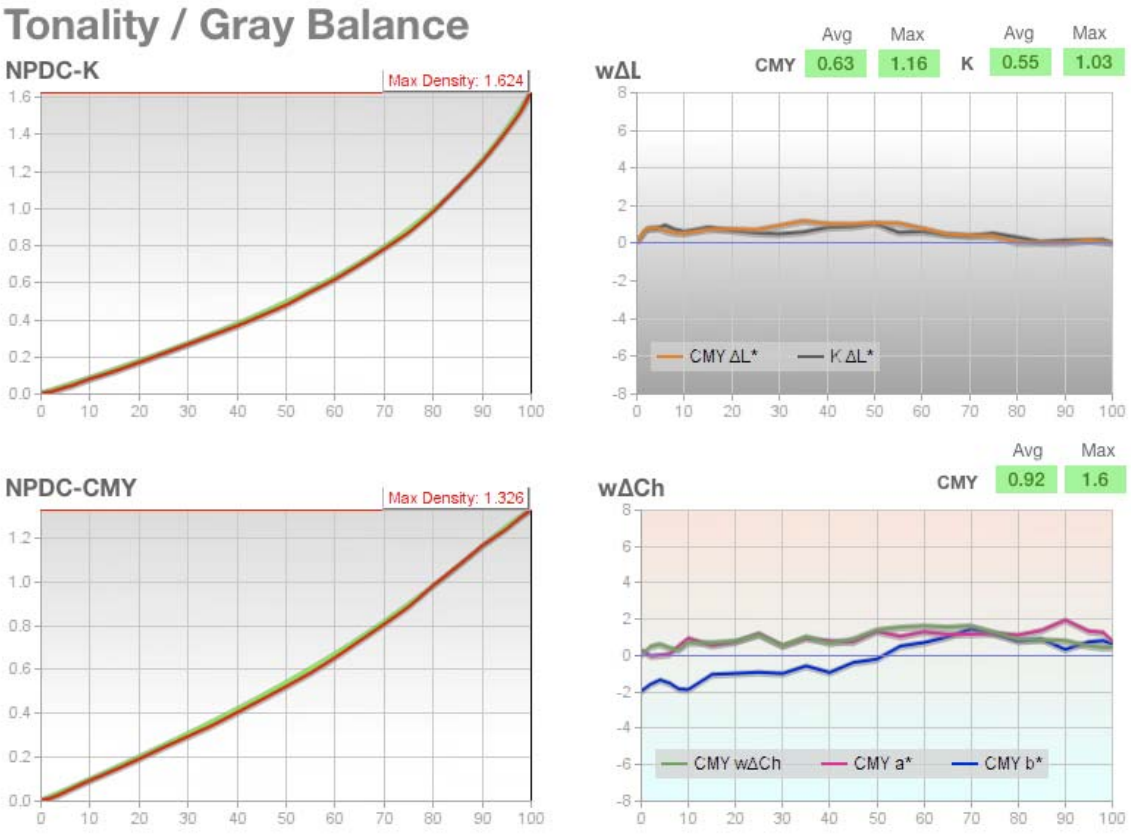
The Ink & Substrate tab. (Loading the reference CRPC as the sample results in zero deltaE values.).

The Hue/Chroma graph (right) shows the pure primary and secondary ink scales in an LAB plan view. The six smaller graphs (below) show Lightness (vertical) vs. Chroma (horizontal) of the same six ink scales. The ellipses show the allowed tolerances for each target color. The closer the end point of a graph is to the center of the ellipse, the lower is the delta-E error.

Note: Curve4 Verify *tolerances are fixed by the type of Reference selected and are NOT affected by the Measurement Warnings numbers in the Preferences dialog.*

The G7 tab

On the left of the *G7* tab, graphs for *NPDC-K* and *NPDC-CMY* are shown with their respective maximum densities. On the right are graphs for *Tonality* and *Gray Balance* with individual scores for average and maximum wΔL* and wΔCh in green for **PASS** or red for **FAIL**.



The G7 tab

Tonality (wΔL*) graph

The lines on the *wΔL** graph represent the *weighted delta L** of CMY (orange) and black (gray). The horizontal "zero" line represents the ideal G7 NPDC condition.

Gray Balance graph

On the *wΔCh* graph, the pink (a*) and blue (b*) lines show the color of the CMY scale, while the green (wΔCh) line shows the gray balance error in *weighted delta Ch*. Note that if the Reference is set to *Native CMY*, the wΔCh error may be reduced near the right side of the graph.

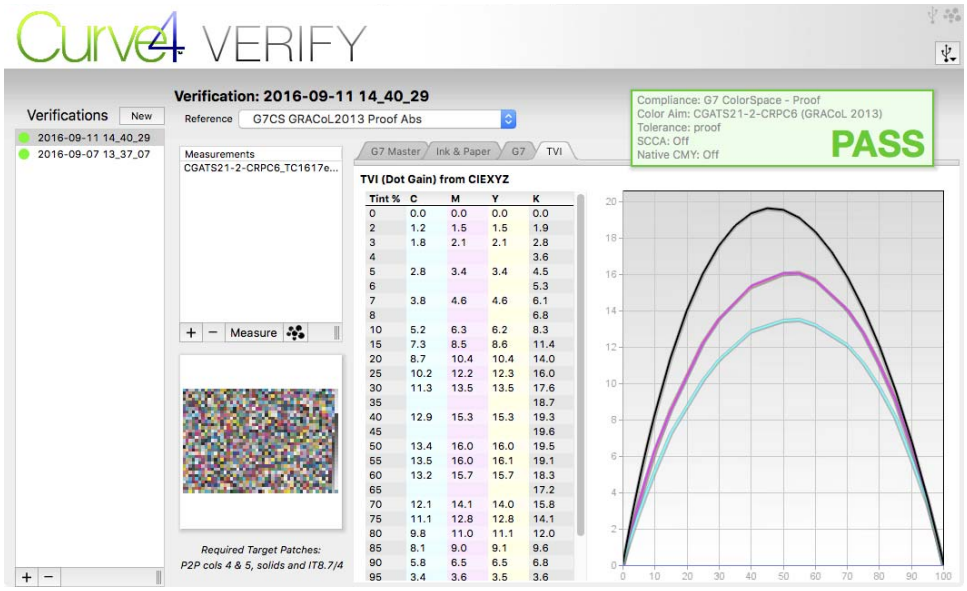
Weighting function

The weighting function for wΔL* and wΔCh is defined in the G7 specification (TR015) and described in *Appendix H: Formulae and Data Formats*.

The TVI tab

The *TVI* tab shows TVI percentage values and graphs for informational purposes only (G7 does not specify TVI values). Note that Curve4 calculates TVI from CIEXYZ values, not from traditional density values, so these graphs and numbers may differ slightly from true density-based TVI calculations.

Note that the PASS / FAIL badge is based on G7 metrics only and does not refer to TVI performance.



The TVI tab

Renaming a verification

To change the name of a Verification, double-click it and start typing.

3

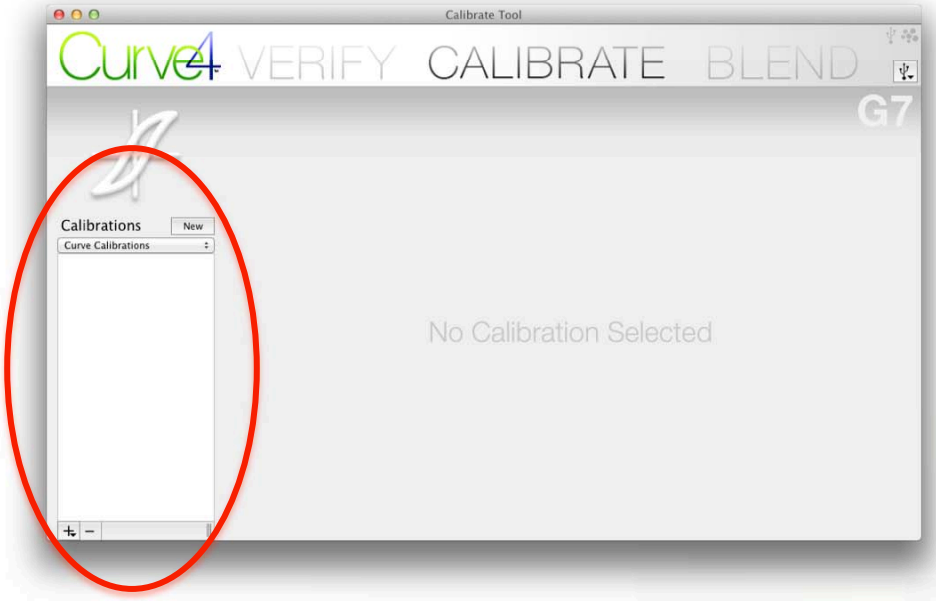
Chapter 3: The Calibrate Tool

What is Curve4 Calibrate?

Curve4 Calibrate is a printer calibration tool that fully supports the Idealliance G7 specification, as well as legacy TVI calibration and the new ISO-standard SCTV (Spot Color) method. Curve4 Calibrate also supports several new, smaller P2P targets for faster operation.

First launch

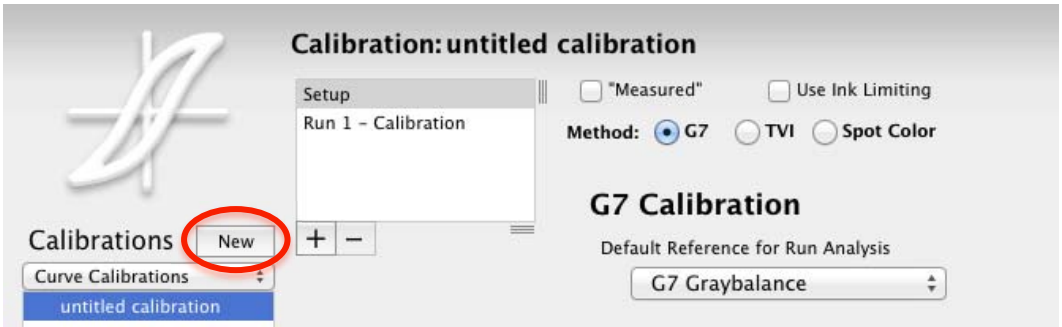
When you first launch the Calibrate tool it is blank, with the message *No Calibration Selected* and an empty Calibrations list to the left. Note that where Curve3 saved "Sessions", Curve4 saves a "Calibration" each time you exit the Calibrate tool. On subsequent launches, the list shows previously-saved Calibrations.



The Calibrate tool on first launch, with an empty Calibrations Work List on the left

Selecting and creating Calibrations

If you have previously-saved Calibrations, you can select one in the Work List. To create a new *Calibration*, click the *New* button or the (+) button below the list. This adds an *untitled calibration* to the list and reveals the *Runs* list with *Setup* selected. (The *Setup* panel is described in the next section.)

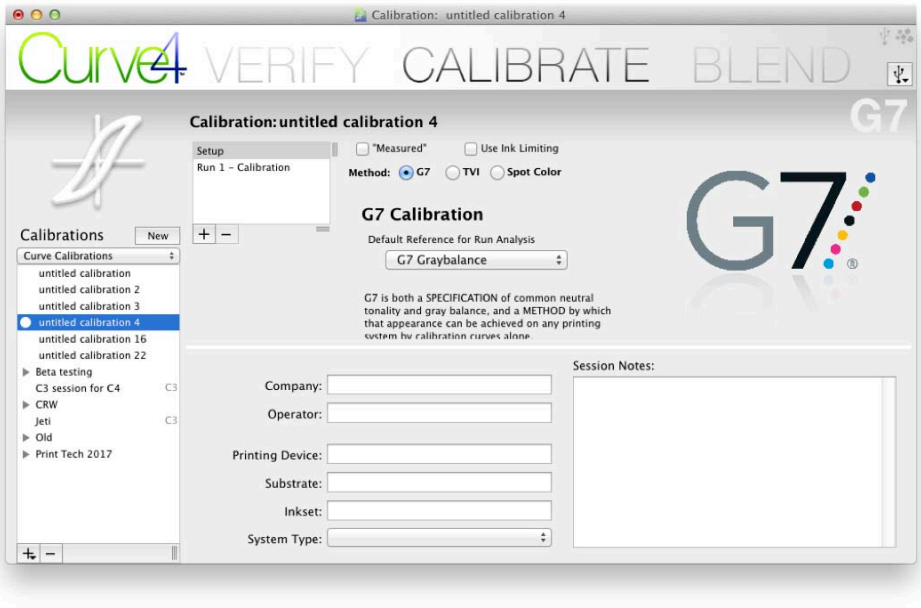


Clicking the New button opens the Setup panel and puts an untitled calibration in the Runs list.

Note that the current *Calibration* name always appears near the top of the *Run* panel, regardless of which mode it is in.

The Setup Panel

The Setup panel is opened by default when you create a new Calibration. To exit the *Setup* panel, click any *Run* in the *Runs* list. To return to the *Setup* panel, click *Setup*.



A new Calibration Setup panel. Note the selected Calibration name above the Runs list.

The *Setup* panel sets the parameters for the *Calibration*, including the calibration *Method*, the *Default Reference* (used in the *Measurements - Analyze* tab), the choice of *Measured* instead of *Wanted* output values (if required by your RIP) and the option to begin with an *Ink Restriction* test.

Calibration Method

The *Method:* buttons selects the type of calibration; *G7*, *TVI* or *Spot Color (SCTV)*.

G7 Calibration

G7 calibration is the default standard for all US printing, and is widely used in other countries. G7 works with all printing technologies, inks or substrates, produces “shared neutral appearance” without additional color management, and has many other advantages over legacy TVI calibration.

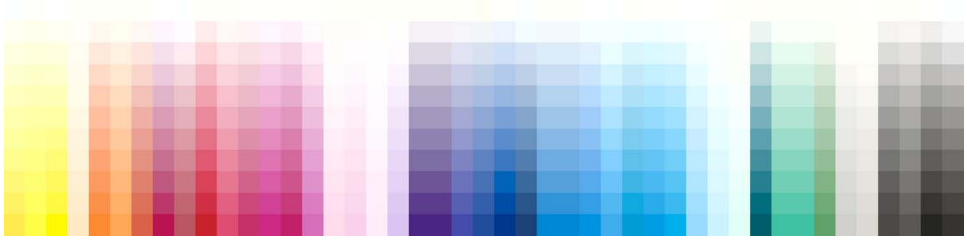
TVI Calibration

TVI calibration is included for users who have not yet switched to G7. Curve4 will calibrate to ISO 12647-2:1994 (or 2013) TVI curves or your own custom TVI curves *(see Appendix I: Custom TVI Curves).*

Spot Color (SCTV) Calibration

SCTV calibration is defined in *ISO 20654:2017 - Measurement and Calculation of Spot Colour Tone Value* and replaces the traditional practice of assigning the black or cyan plate curve to a spot color. SCTV is recomended for all custom inks in offset, flexo, gravure and screen printing, and mandatory for calibrating OGV (Orange, Green, Violet) plates in 7-color expanded-gamut printing.

The illustration below shows that, unlike traditional spot color plate curves, SCTV produces visually-uniform steps with all ink colors. It also closely-matches the blends displayed in Adobe® software.



SCTV-calibrated tone scales for a selection of inks, showing uniform tone steps from highlight to shadow.

Measured

If your RIP only accepts 'Measured' values (there is no place to enter Wanted values), click the *Measured* box in the Setup panel. Otherwise leave it set to *Wanted*.

The 'Measured' option

Ink Restriction

When Ink Restriction is enabled in the Setup panel, an *Ink Restriction Run* appears first in the *Runs* panel. Using Ink Restrictions is explained later in a separate section.

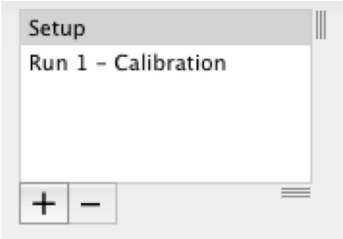
An Ink Restriction Run appears first in the Runs list (left) when Ink Restriction is selected in Setup (right)

Information and Notes

The lower half of the *Setup* panel has data entry fields for information about the device, media, etc. which will be included on the *Calibration Report*. The *Notes* box can be used to record unusual conditions, reasons for the exercise, test results, or what you had for lunch.

The Run Panel

Each *Calibration* has its own *Runs* list. When you start a new *Calibration*, an empty *Run 1 – Calibration* appears in the *Runs* list. Double-click to re-name it.



A *Run* refers to a single press run or test print. Additional *Run*s (such as Calibration and Verification) can be added by clicking the plus (+) button. To delete a ***Run***, select it and click the minus (-) button.

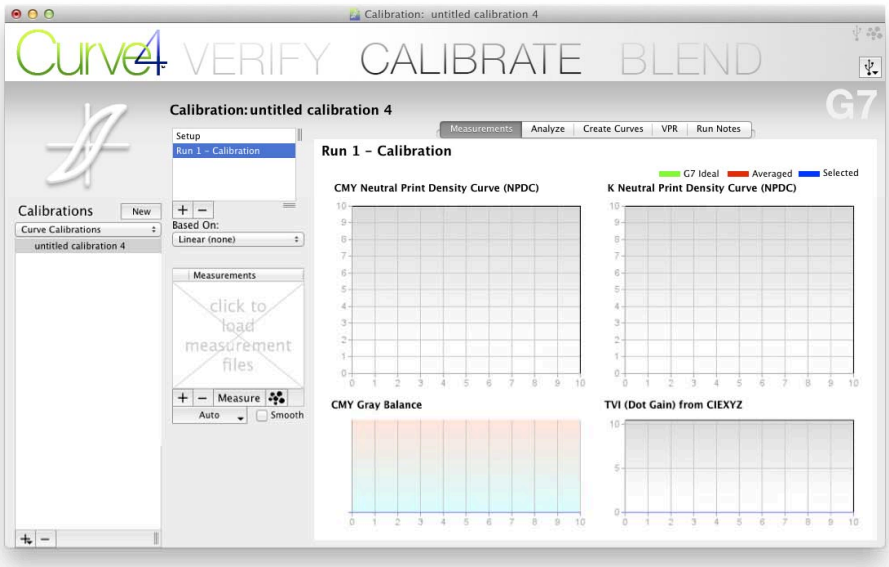
Run Panes

Buttons in the *Run* panel toggle between *Measurements*, *Analyze*, *Create Curves*, *VPR* and *Run Notes* panes. (The VPR pane is only functional with the Curve4 Complete license.)

Pane buttons in the Run panel

By default, the *Run* panel opens in the *Measurements* pane.

The Measurements pane

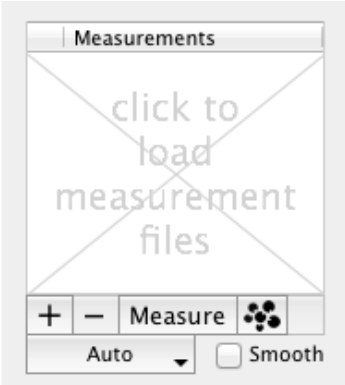


The Measurements pane

The *Measurements* pane lets you import target measurements and evaluate their tonality, gray balance and TVI.

The Measurements list

The *Measurements* list holds all the measurements for a *Run*. Multiple measurements can be loaded in one *Run*, either by measuring directly with an attached spectrophotometer, or by loading data files from another software, or Maxwell.

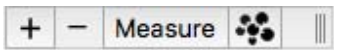


The Measurements list remains visible regardless of which Run Pane is open

Measuring and importing data

Direct measuring

To measure a target click the *Measure* button (see *Appendix B: Measuring*). To measure another, click the *Measure* button again.



Click and load

If the *Measurements* list is empty, you can click on the message “click to load measurement data” and select a measurement file. To add more files, click the (+) button below the *Measurements* list

Drag-and-drop

To quickly load multiple files into a Run, open their folder in a System window, highlight one or more files and drag them into the list.

Maxwell

To download measurements from your Maxwell account click the Maxwell icon. Click the icon again to download more measurements.

ICC profiles

If you load or drag a CMYK ICC profile into the measurements list, Curve4 automatically extracts TC1617 data and calculates the necessary G7 calibration curves.

Deleting measurements

Measurements can be deleted by clicking the (-) button below the list.

Multiple targets

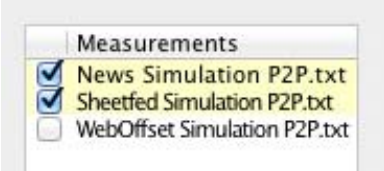
Curve4 Calibrate automatically averages measurements from multiple P2P targets, even if they are different types of P2P, e.g. a P2P25 and P2P51.

With the Curve4 Complete license, Curve4 automatically extracts and averages appropriate information from different target types, for example a P2P51 and an IT8.7/4 or TC1617.

Curve4 Calibate can mix different P2P types (left). Curve4 Complete can mix any target types (right).

Disabling and Enabling Measurement Files

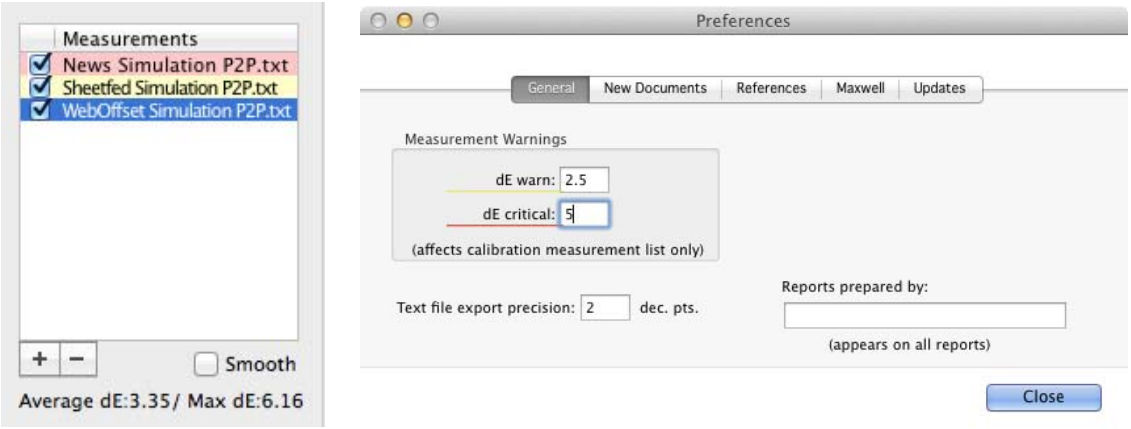
To disable a measurement file (remove it from the average) clear the checkbox alongside it. To re-enable it make the check mark appear again. Only measurement files with a check mark are used to display graphs or calculate calibration curves.



De-selected files (un-checked) are omitted from the average.

Measurement File Warning Colors

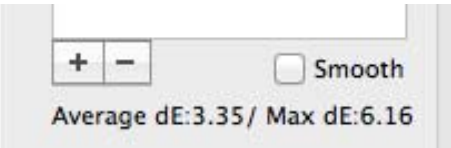
Yellow or pink warns you when a file differs significantly from the average of all checked files. Tolerances for to each color code can be set in *Preferences... Measurement Warnings*.



Colored files (left) differ from the group average by tolerances set in Preferences (right)

- The *dE warn* value sets the delta-E level above which a file turns yellow
- The *dE critical* value sets the delta-E level above which a file turns pink.

Highlighting a single measurement file shows its Average and Max delta-E below the list. Average delta-E is calculated by first calculating the delta-E of each patch in the highlighted file compared to the list average of each patch, then averaging the resulting delta-E values. Max delta-E represents the greatest difference between any patch and its list average.

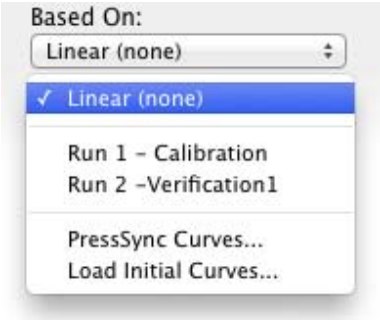


Average and maximum delta-E of a highlighted file (blue) appears below the list

The Based On: list

The *Based On:* list tells Curve4 what curves were active when the current Run's samples were printed.

IMPORTANT: For Curve4 Calibrate *to work correctly, EITHER the calibration target must be printed with no curves in the tables or LUTs where* Curve4*'s calibration values will be applied, OR the curves that were active when the target was printed must be selected in the Based On: list.*



The Based On: list tells Curve4 what curves were active when the current Run's samples were printed.

The *Based On:* selection will not change anything in the Measurements or Analyze panes. It only affects the curves and *Control Point* percentages in the *Create Curves* pane.

When to use the Based On: list

The *Based On:* list should normally be left at *Linear (none)*, except when...

- Refining a G7 calibration to improve accuracy.
- Up-dating the calibration of a printer that has drifted over time.
- Using a ΔreCal target (requires a Curve4 Complete license).
- The calibration target was printed with non-linear curves in the tables or LUTs where Curve4's calibration will be applied.

For new calibrations

Select *Linear (none)*.

For re-calibrations (P2P or ΔreCal targets)

Select the *Run* that produced the calibration curves through which the new target was printed.

To allow for existing RIP curves

If the target was printed through calibration curves not generated by Curve4, you can load a text file of those curves by clicking *Load Initial Curves...* in the *Based On:* list. This can be enormously valuable if, for example, after an expensive offset or gravure press run, you discover the plates or cylinders were accidentally made with active curves.

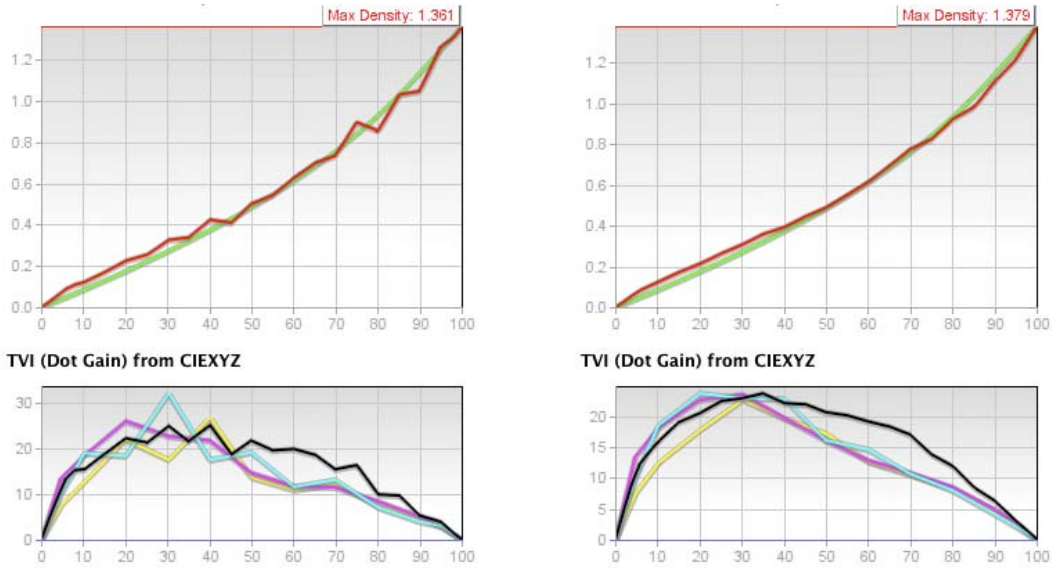
For detailed information about the Based On: list and re-calibrating, see Re-calibration (Iteration).

The Smooth button

The *Smooth* button below the *Measurements* list can be switched on and off from any of the *Run* panel's active panes (*Measurements*, *Analyze*, *VPR* or *Create Curves*).

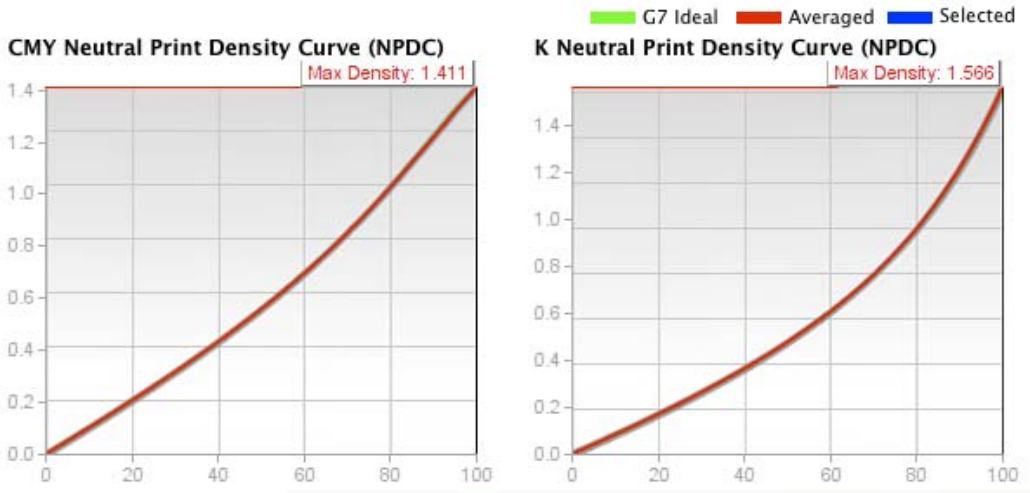
Smoothing reduces the effects of uneven or inconsistent printing or measuring by effectively "re-printing" the target through a model of the printing device. Accuracy depends on the number and quality of measurement files. All the active (checked) files in the *Measurements* list are combined to create the model. As you add more files, the smoothing function becomes more effective.

CAUTION: smoothing only affects Curve4*; it does not eliminate printing or measuring errors. If you smooth the calibration Run, also smooth the confirmation Run. If smoothing makes a major difference in the graphs, try to solve the root cause of the problem in the printing or measuring process.*



Results of uneven printing or measuring: Raw (left), Smoothed (right)

The NPDC graphs

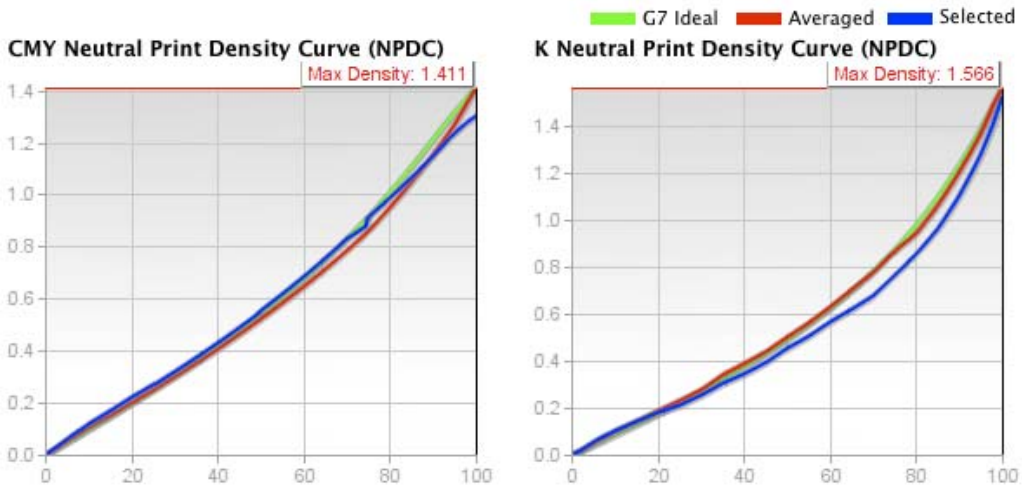


Ideal NPDC graphs (from CRPC6-GRACoL 2013 data)

In the *Measurements* pane, two NPDC graphs display the measured neutral density values from columns 4 and 5 of the P2P in red, with the ideal G7 curve in green. If two or more measurement files are in the list, the red graphs show the average of all active (checked) files.

In a perfect G7 sample, the red line would completely hide the green.

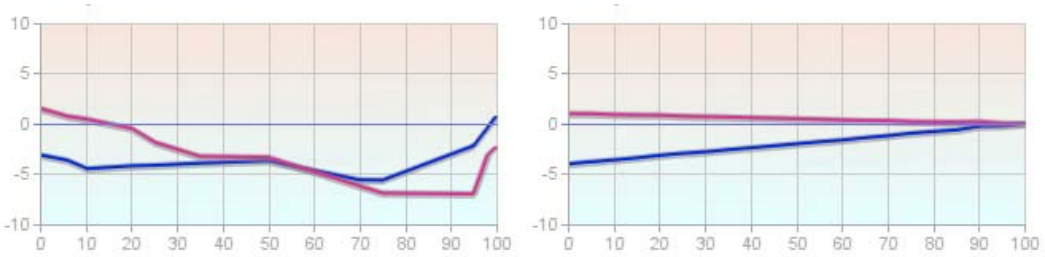
To compare one measurement file's NPDC to the average of all active files, click on the file in the Measurements list. The selected file appears as a blue line on the graph. The closer the blue line is to the red line, the better that file fits the average.



Typical NPDC graphs of an un-calibrated press. The blue line shows the file selected in the list.

The CMY Gray Balance graph

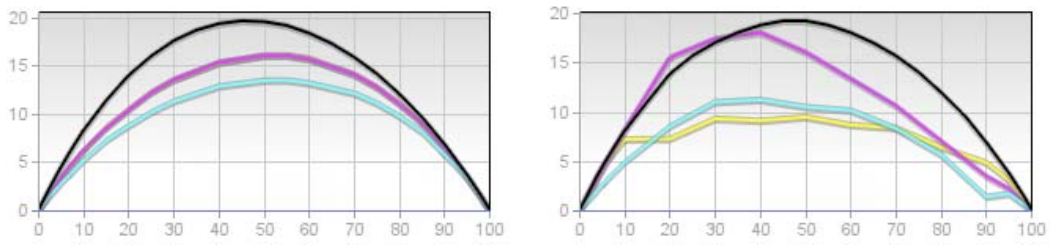
The pink line in the CMY Gray Balance graph shows the a* value of the CMY gray scale. The blue line shows the b* value. In a perfectly calibrated sample, the magenta and blue lines would be perfectly straight, as shown below, but this is extremely rare, even in very good devices.



Bad gray balance (left) vs. perfectgray balance (right).

The TVI graph

In TVI calibration the TVI graph helps determine calibration accuracy. But when calibrating by the G7 method, these graphs are for informational purposes only, as G7 does not specify any rules for TVI. Having said that, the TVI curves of a well-adjusted offset press should appear approximately "normal" (e.g. below left), but other printing methods like Ink Jet may display quite strange TVI graphs (e.g. below right), yet still perform normally.

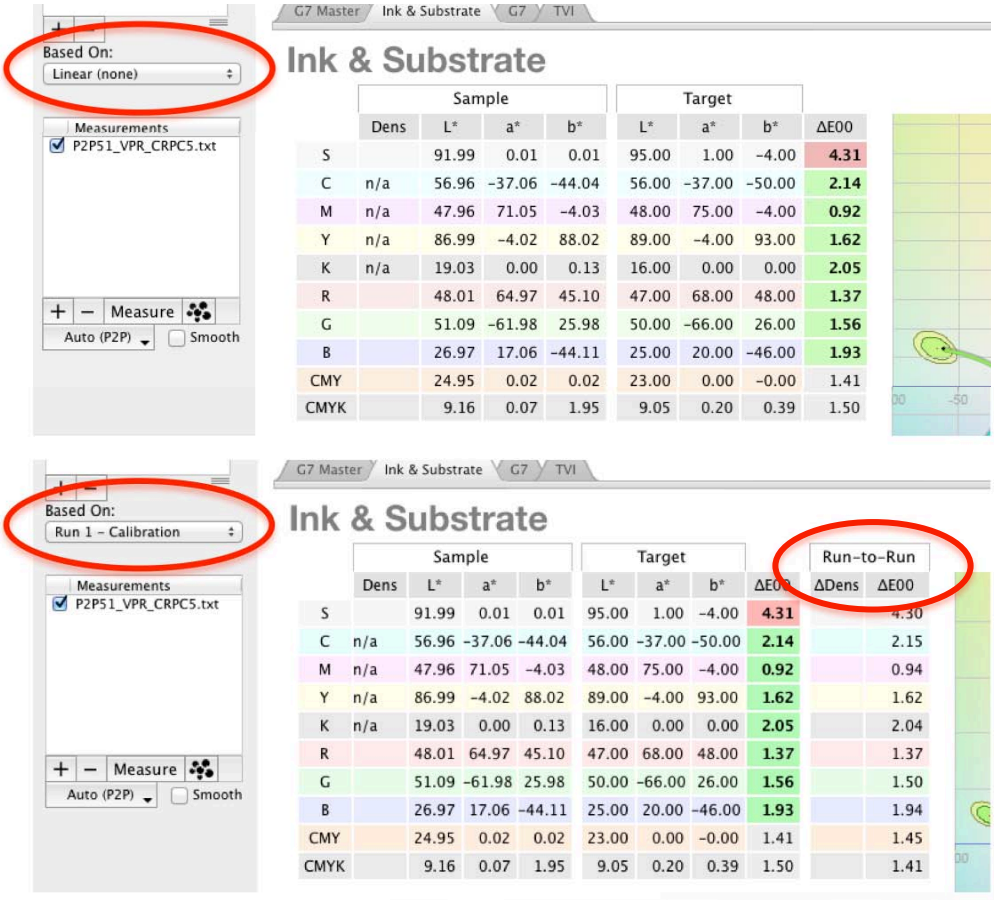


Typical TVI graohs for CRPC6 (left) and high-density Ink Jet (right) after G7 calibration.

Note that traditional density-based TVI cannot values be calculated correctly from Lab or XYZ data, so Curve4 calculates "colorimetric TVI" values instead, substituting CIEXYZ for the traditional RGB reflectance values. The resulting curves may therefore be different than traditional density-based TVI curves, especially with non-typical ink colors. For more information about XYZ-based TVI, see *Appendix I: Custom TVI Curves*.

The Analyze pane

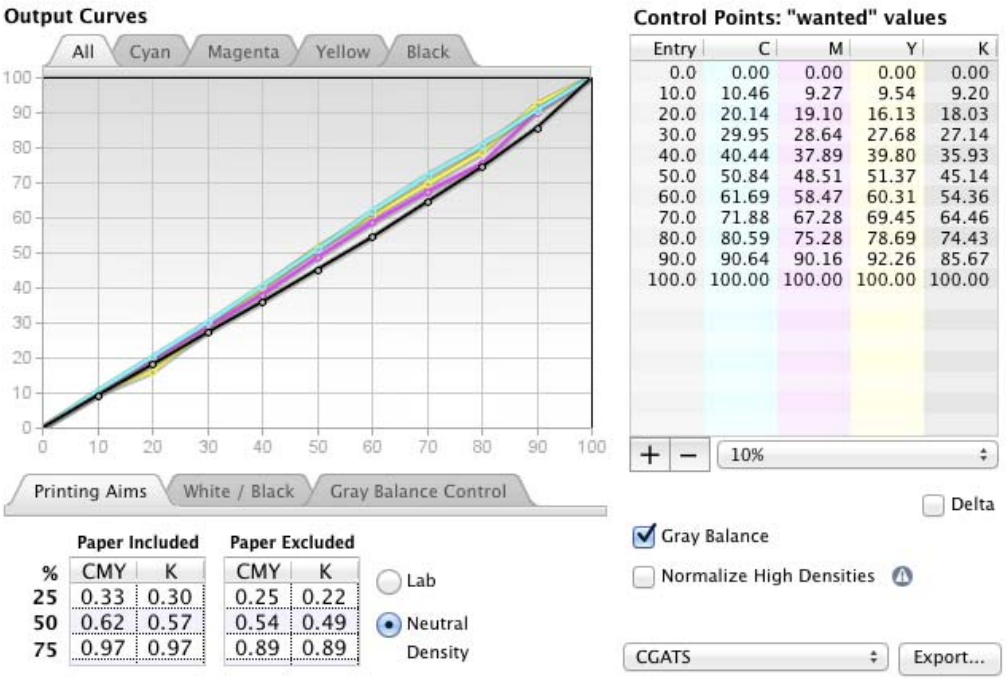
The Analyze pane is similar to the Verify Tool, except if a Run is based on a previous Run, when the Ink & Substrate tab lists the ΔE_{00} (and ΔDensity if both runs use spectral data) between runs.



The Ink & Substrate tab for a Run based on Linear (above) an earlier Run (below)

For full details on how to use the *Analyze* pane, see *Chapter 2: The Verify Tool*.

The Create Curves Pane



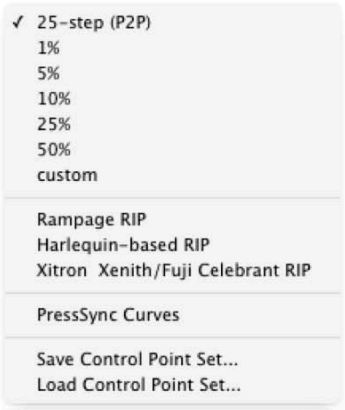
The Create Curves pane

The Create Curves pane displays a graph of the curves necessary to calibrate the printing system, a list of *Control Point* percentages, a list of *Printing Aims*, some buttons or tabs that modify the way the curves are calculated, and options for exporting the control point values.

Choosing Control Point Values

A menu below the *Control Points* list offers pre-set lists in intervals of 1%, 5%, 10%, 25% or 50%, plus some RIP-specific presets and "25-step (P2P)", which has points for every gray scale patch in the P2P target. You can also save and load custom Control Point sets.

Note: If your RIP requires a fixed set of Control Points not on the list, send a feedback item with the RIP model and the required control points for possible inclusion in a future Curve4 *release.*



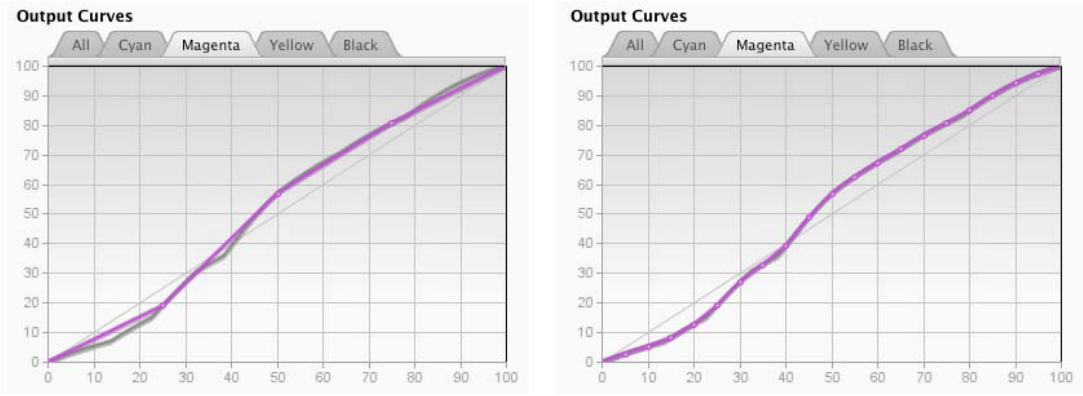
Choosing pre-set Control Points

Adding/Subtracting Control Points

To add a Control Point click on the Plus (+) button below the Control Point Set list. To delete a Point, highlight it, then click the Minus "–" button. You can add as many points as you like to make the curve shape as smooth as possible, but fewer Points are generally better unless the printer is extremely stable and repeatable or you have averaged many P2P samples from one or more Calibration *Run*s.

Which Control Points?

To help decide the optimum number of control points, use the color tabs above the graph to see the ideal curve in gray and the current control points in color. Add extra points until the colored line is as close as possible to the gray line.



Calibration graph showing ideal line (gray) and the current Control Points line (pink)

In the example above the left hand image shows the poor fit of the magenta curve with control points at 25%, 50% and 75%. Increasing the number of control points greatly improves the fit.

Delta Values vs Absolute values

By default Curve4 calculates absolute TV (Tone Value) percentages for every Control Point. If your RIP requires delta TVI (Tone Value Increase) percentages instead, click the *Delta* checkbox.

Control Points: "wanted" values

Entry	C	M	Y	K
0.0	0.00	0.00	0.00	0.00
10.0	-2.60	-4.70	-2.05	-3.91
20.0	-5.44	-7.26	-5.49	-4.56
30.0	-4.77	-2.93	-0.44	-4.08
40.0	-3.83	-0.87	3.09	-2.70
50.0	1.90	6.88	6.76	-0.39
60.0	3.00	7.41	8.77	-0.21
70.0	3.57	6.61	8.76	-0.97
80.0	3.66	4.96	7.16	1.12
90.0	3.12	4.20	5.05	1.73
100.0	0.00	0.00	0.00	0.00

+ − 10%

Control Points: "wanted" values

Entry	C	M	Y	K
0.0	0.00	0.00	0.00	0.00
10.0	7.40	5.30	7.95	6.09
20.0	14.56	12.74	14.51	15.44
30.0	25.23	27.07	29.56	25.92
40.0	36.17	39.13	43.09	37.30
50.0	51.90	56.88	56.76	49.61
60.0	63.00	67.41	68.77	59.79
70.0	73.57	76.61	78.76	69.03
80.0	83.66	84.96	87.16	81.12
90.0	93.12	94.20	95.05	91.73
100.0	100.00	100.00	100.00	100.00

+ − 10%

Delta Values (left) vs. absolute values (right)

The Delta display is also useful when comparing the calibrated device to the Ideal NPDC curves. Delta values less than 1% typically indicate a good calibration.

Saving a Custom Control Point Set

You can save custom control point sets with the *Save Control Point Set...* and *Load Control Point Set...* menu items. To have your custom sets appear in the menu, save them in the Custom Control Points folder (see *Chapter 1. Ugrading from Curve3*).

Wanted vs. Measured values

By default, Control Point values in the *Create Curves* panel are 'Wanted' percentages, for example, if 50% has a control point value of 55%, it should be darkened by 5%. If your RIPs requires 'Measured' values instead of Wanted values, click *Measured* in the *Setup* panel and the values in the *Control Points list* will change so that, when entered into the RIP, the correct calibration curves are produced

Control Points: "wanted" values

Entry	C	M	Y	K
0.0	0.00	0.00	0.00	0.00
10.0	10.20	8.65	9.31	9.20
20.0	20.05	18.21	20.05	18.21
30.0	30.98	28.95	31.93	27.07
40.0	41.79	38.73	42.81	35.92
50.0	52.00	48.01	53.24	45.35
60.0	61.78	58.46	63.37	54.98
70.0	71.83	68.77	72.92	65.18
80.0	79.90	77.62	82.35	75.42
90.0	88.66	87.44	92.44	85.79
100.0	100.00	100.00	100.00	100.00

+ − 10%

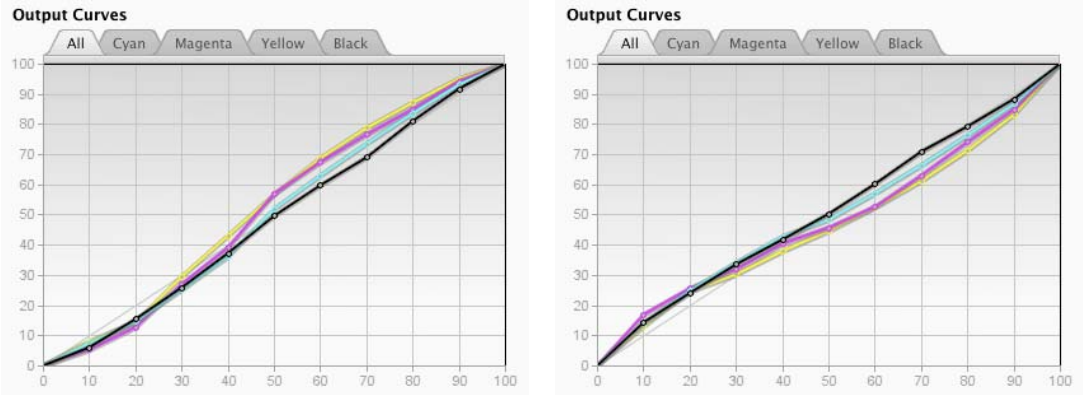
Control Points: "measured" values

Entry	C	M	Y	K
0.0	0.00	0.00	0.00	0.00
10.0	9.78	11.46	10.68	10.77
20.0	19.96	21.90	19.95	21.91
30.0	29.18	30.92	28.33	33.19
40.0	38.27	41.57	37.60	44.39
50.0	47.99	52.05	46.71	55.05
60.0	58.29	61.34	56.80	65.66
70.0	68.37	71.40	66.51	74.09
80.0	80.11	82.21	77.63	84.88
90.0	91.74	92.87	87.53	93.74
100.0	100.00	100.00	100.00	100.00

+ − 10%

Effect of 'Measured' setting on the Control Points in the Create Curves panel. Note the red warning above the list showing these are not the normal Wanted values

Clicking *Measured* changes the *Control Point* percentage values and curve graphs in the *Create Curves* panel as shown in the lists below, produced by the same Calibration.

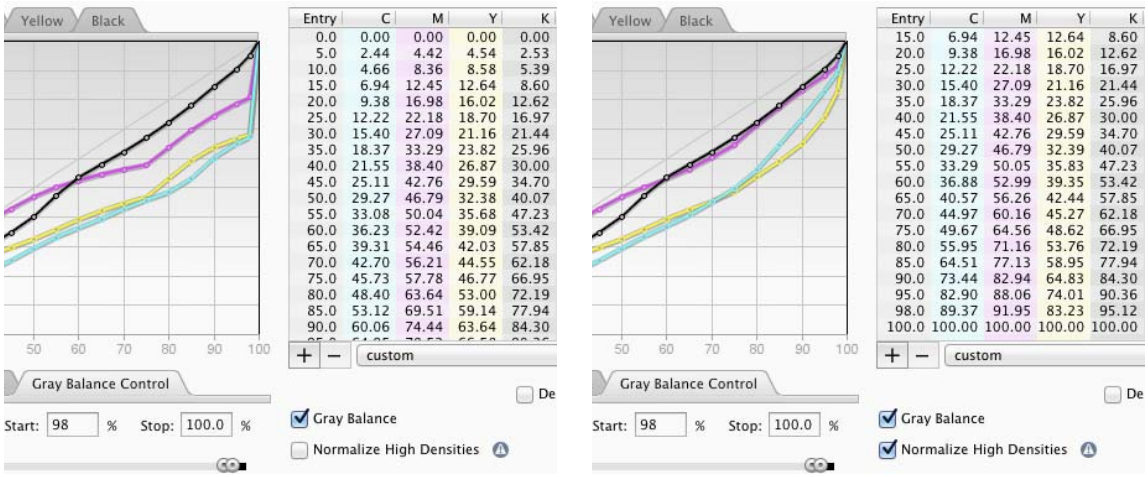


Output Curves graph in Wanted mode (left) and Measured mode (right)

Normalize High Densities

For perfect G7 calibration, some printing systems need extreme calibration curves at high CMY densities. Although the resulting calibration may pass G7, the result may be undesirable visually or for ICC profiling. The *Normalize High Densities* button solves this by smoothing the dark end of the CMY

curves, however note that although the result should pass G7 in lighter grays, high-density grays may fail.



Conventional G7 calibration curves (left) vs. curves with Normalize High Densities ON (right)

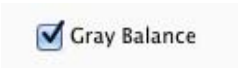
CAUTION: Normalize High Densities may cause the system to fail G7 compliance and should only be used when the CMY curves show extreme curve changes in shadows.

(Left): A high-density ink jet with conventional G7 calibration. (Right): The same printer calibrated with Normalize High Densities. Notice the smoother tonality in high-saturation areas (apple, garments, etc.) in the right-hand sample.

The Gray Balance switch

By default, Curve4 tries to correct gray balance errors, but gray balance correction may be less effective on devices whose gray balance is inconsistent due to process instability, uneven inking, etc.

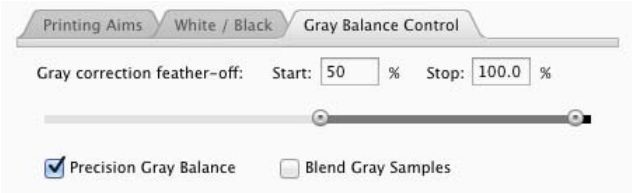
Gray balance can be switched ON and OFF by with the *Gray Balance* button. When *Gray Balance* is on, separate Control Point values are given for C, M and Y. When Gray Balance is off (un-checked), the CMY values are equal and will achieve NPDC calibration, but not gray balance.



Caution: Only switch Gray balance off if the press already produces neutral gray balance naturally.

The Gray Balance Control tab

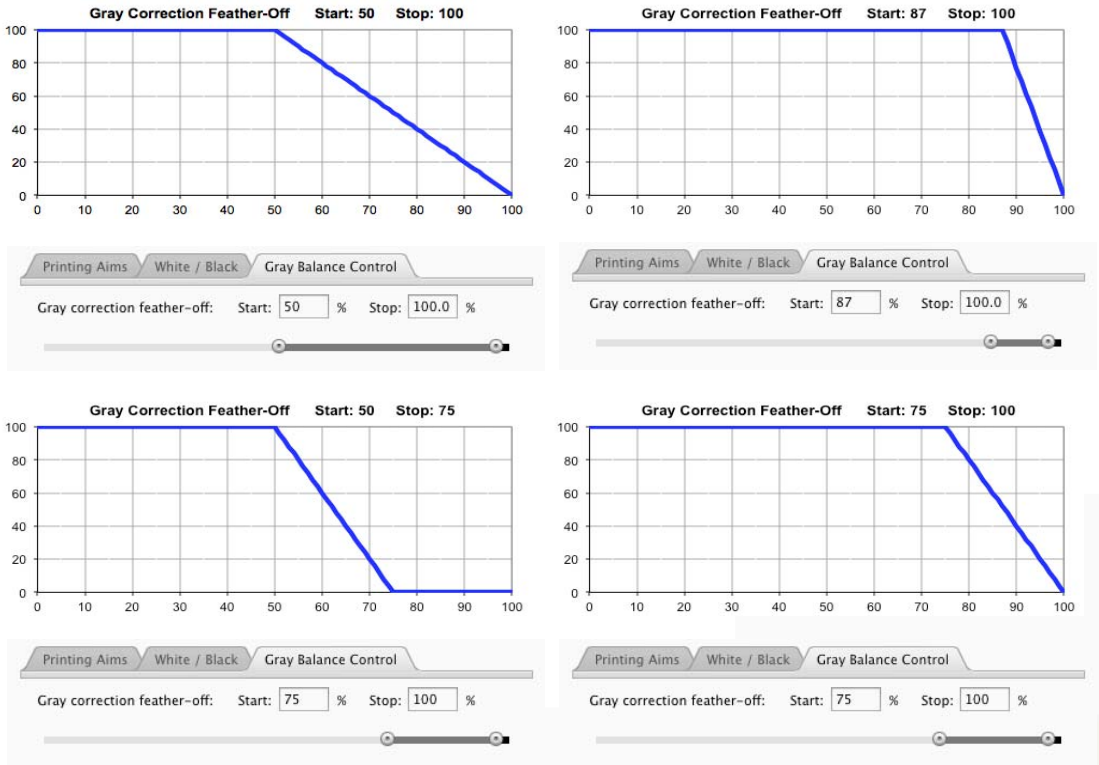
You can affect how G7 gray is calculated in the *Gray Balance Control* tab.



The Gray Balance Tab

Gray correction feather-off:

The *Gray correction feather-off:* slider sets the range in which gray balance correction reduces from full to none. Grays with cyan values lower than *Start:* receive full correction. Values higher than *Stop:* receive none. Raising the *Start:* value extends correction further into shadows.



Effect of various Gray correction feather-off: Start: and Stop: percentages

The default *Start:* (50%) and *Stop:* (100%) values fully correct grays from 0% to 50%, with progressively less correction from 50 to 100%, e.g. half at 75% and no gray correction at 100%. The default settings are recommended when gray balance may vary in darker tones from run to run, e.g. most printing systems.

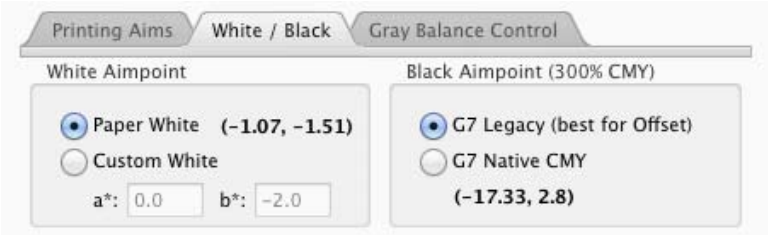
Precision Gray Balance and Blend Gray Samples

Curve4 calculates the most precise gray balance possible from a P2P target, but if the measured data are noisy or uneven, too much precision can cause spikes or erratic Output Curves. If you think the Output Curves should be smoother, try turning *Precision Gray Balance* OFF and/or turn *Blend Gray Samples* ON.

The White / Black tab

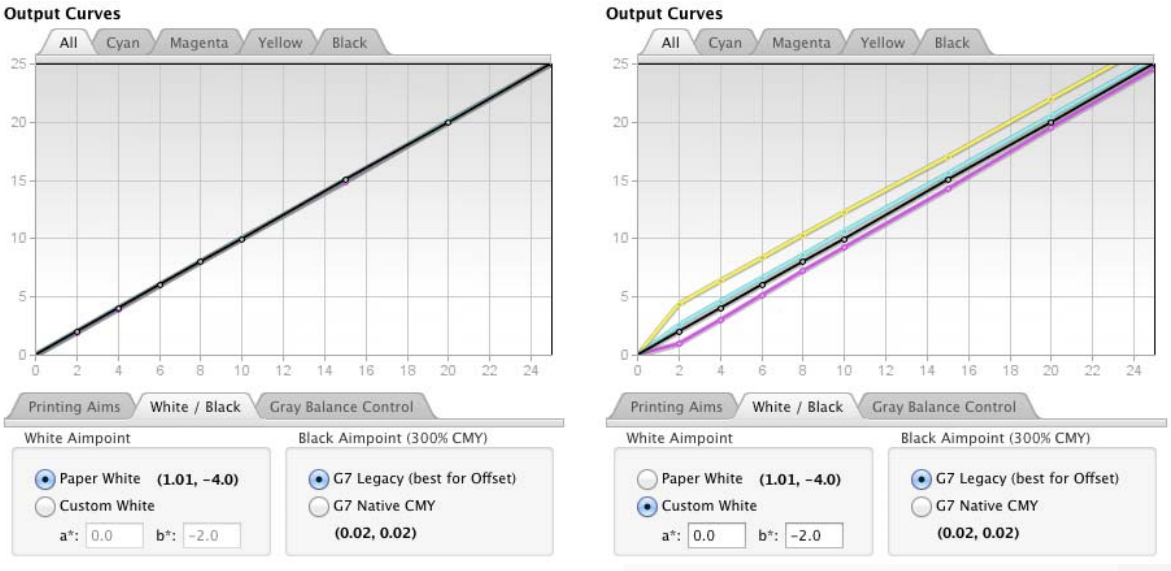
The *White / Black* controls modify how Curve4 calculates gray balance compared to standard G7.

White Aimpoint



The White / Black tab

With *White Aimpoint* is set to *Paper White*, gray balance is based on the color of the substrate (standard for G7). To force printed grays to mimic another substrate color, click *Custom White* and enter the a* / b* of the substrate you want to simulate. The resulting calibration curves will adjust CMY gray balance to match the desired substrate, *except in very light tones*.



The effect of different White Aimpoint settings

CAUTION: Custom white may cause undesirable color shifts or fail G7 Grayscale compliance.

Using White Aimpoint when creating an ICC Profile

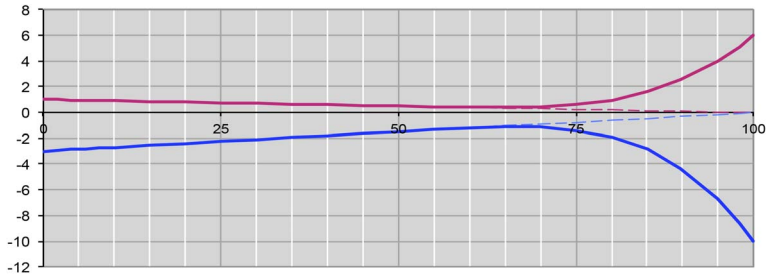
Converting to an ICC profile made from characterization data printed with *Custom White* settings will cancel the Custom White effect, except when using the *Absolute Colorimetric* intent.

To take advantage of the Custom White effect, print the characterization target through RIP curves made with the default *Paper White*, then replace the RIP curves with the *Custom White* curves for production printing.

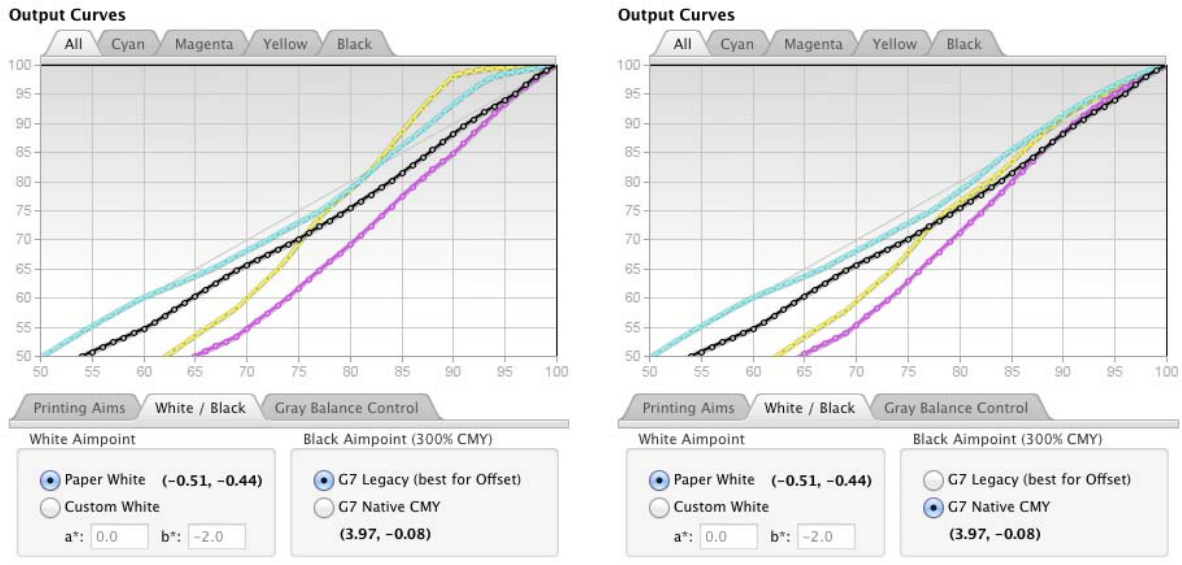
Black Aimpoint (300% CMY)

When *Black Aimpoint (300% CMY)* is set to *G7 Legacy*, Curve4 tries to neutralize the scale to reach 0.0 a* / b* at 300% CMY. If the 300% point is very non-neutral, the resulting calibration curves may cause "plugging" or banding in dark neutrals or saturated colors.

The *G7 Native CMY* button bends the gray balance aim curves in very dark tones to aim for the "native" 300% CMY a* b*, instead of 0.0 a* / b*. With a strongly colored 300% CMY, *G7 Native CMY* yields smoother calibration curves and ICC profiles, while keeping neutral gray balance in lighter tones.



Legacy G7 target gray balance (dotted) vs Native CMY targets (bold) when 300% CMY = 6 a, -10 b**

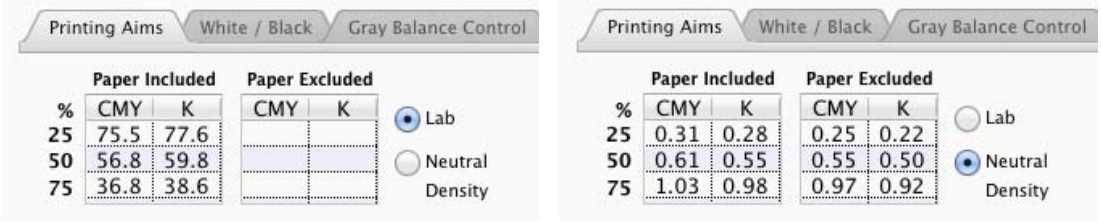


Typical effect of Black Aimpoint G7 Legacy (left) and Native CMY (Right)

CAUTION: The G7 Native CMY option is only meant for use when 300% CMY balance cannot be adjusted on press. Do NOT use G7 Native CMY with an offset press! Instead make 300% CMY as neutral as possible by press adjustments, prior to calibrating.

The Printing Aims tab

The *Printing Aims* tab shows the HC (25%), HR (50%) and SC (75%) aim values for the calibrated device in either ND or L*. The *Printing Aims* are process control aim values that allow you to test your device's NPDC performance during production.



Printing Aims in Lab (left) and ND (right)

With the ND button active the *Printing Aims* values are neutral density (ND) values. If you prefer to monitor gray aims in L*, click the *Lab* button. (L* aims are only given with paper included.)

Note: Before using these values for process control, check that on-press measuring device measures the same as the device that read the P2P.

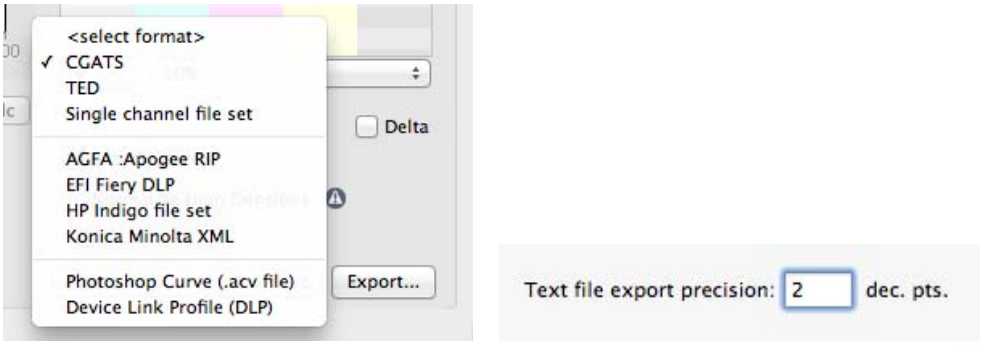
Output product

The product of a Calibration *Run* is a list of CMYK *Curve Point* values or *Calibration Curves* that, when entered into the printer or RIP, should result in a properly calibrated print. These values or curves can be installed in the RIP by manual typing or by importing a RIP-compatible file exported from Curve4.

Export...

If your RIP can accept externally-generated calibration curves, click *Export...* to export the Control Points in the appropriate file format. If your RIP is not in the list, encourage the manufacturer to contact HutchColor or CHROMiX so their file format can be added in a future version of Curve4.

The decimal precision of exported text files can be adjusted with the *Text file export precision:* preference in the *Preferences* window.



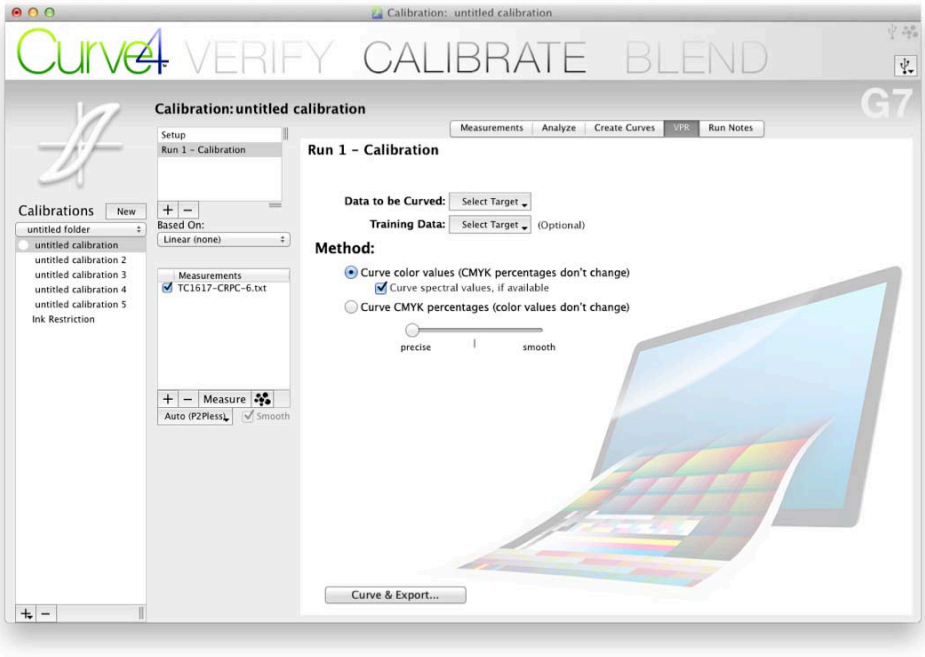
The Export... format selection list and the text precision preference

The VPR (Virtual Press Run) Pane

Note: VPR is activated by the Complete license and is also used in the Blend tool (see Chapter 4).

What is VPR?

Virtual Press Run (VPR) applies G7 (or TVI or SCTV) calibration curves to data printed at the same time as the target from which the curves were made. The result is a new data set equivalent to what would be measured from a target printed through the same curves.

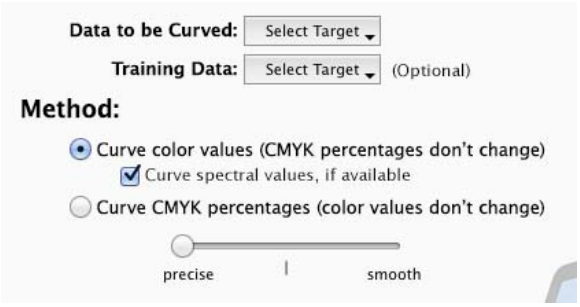


The VPR pane.

VPR eliminates the time and cost of a second press run, eliminates differences between the calibration and characterization runs, and reduces the effect of printing variations across the target area. An ICC profile made from VPR data represents a virtually perfectly-calibrated press.

Data to be Curved:

The VPR tab in the Calibrate tool applies the calibration curves of the current run to any data selected with the *Data to be Curved:* button.



The VPR controls.

The *Data to be curved:* file defines the type of target and number of patches that will be output. It can consist of CMYK percentages only, or may also contain colorimetric or spectral data. If the *Data to be curved:* file is a characterization data set containing both CMYK percentages and colorimetric or spectral values, for example measurements from an IT8.7/4, no *Training Target* is needed.

Training Data: (Optional)

If the *Data to be curved:* file contains no color data (only CMYK percentages) a *Training Target* must be selected, otherwise the exported file will contain only CMYK percentages.

If both the *Data to be curved:* and the *Training Target* contain color data, only the color values in the Training Target are used, with color values in the *Data to be curved:* being ignored.

CAUTION: For VPR to work correctly, the color data in the Training Target or the Data to be curved: must be printed in exactly the same way as the target(s) that created the calibration curves.

Method:

Curve Lab values

When *Curve Lab values* is selected, the CMYK values in the Target data file remain unchanged but the measured Lab values are altered to what would have been produced if a second press run had been printed through the Output Curves. *Curve Lab values* results in a modified characterization data file in the standard CGATS format that should be accepted by all profiling software.

Curve Spectral values

Curve Spectral Values does the same as Curve Lab values, but if the data file contains spectral data, modified spectral values are exported.

Curve CMYK values

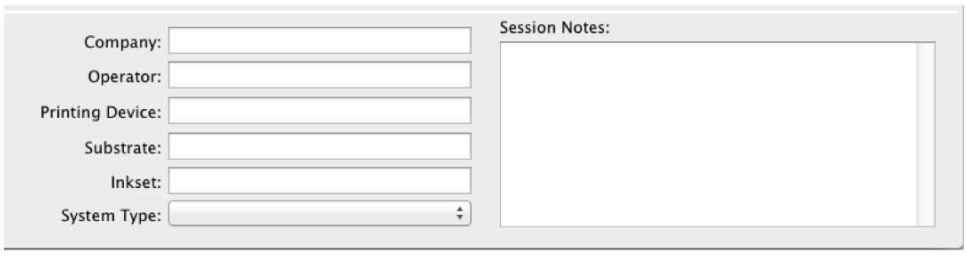
When *Curve CMYK values* is selected, the Lab or spectral values remain unchanged but the CMYK values are altered by the calibration curves. *Curve CMYK values* is less useful and results in non-standard CMYK values which may not work in some profiling software

Quality slider

For most work, leave the quality slider at “precise”. “Smooth” may help with uneven data but is not recommended for high quality work.

The Run Notes Pane

The *Run Notes* pane lets you record information specific to an actual *Run* that may not belong in the more general *Notes* box in the *Setup* panel.



The setup panel saves information about the calibration that is used on the Calibration report

G7 Calibration

Workflow summary

- Select a calibration or create a new one
- Determine ink restrictions (if desired)
- Print one or more P2P targets
- Load measurement data
- Set Based On: status
- Adjust gray balance and other parameters
- Select required Control Points
- Apply Control Points values to the RIP
- Print a new P2P target through new curves
- Verify G7 calibration accuracy

Create or select a Calibration

- To create a new Calibration click *New* above the Calibration Work List or click the Plus button (+) below the list. If you are continuing work on an existing Calibration, select it from the list.

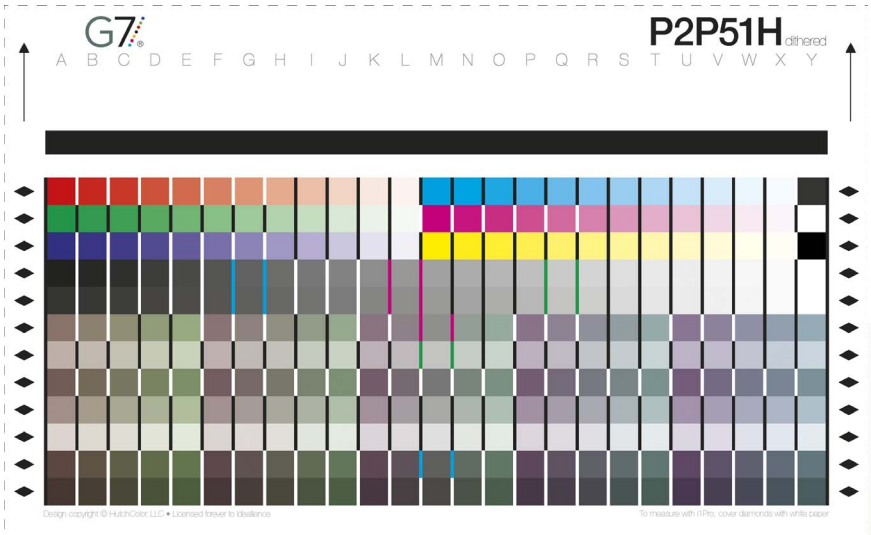
Ink restriction

Because ink restriction is normally only performed in rare cases, such as setting up an ink jet printer for the first time, it is covered later in a separate section titled *Ink Restriction*.

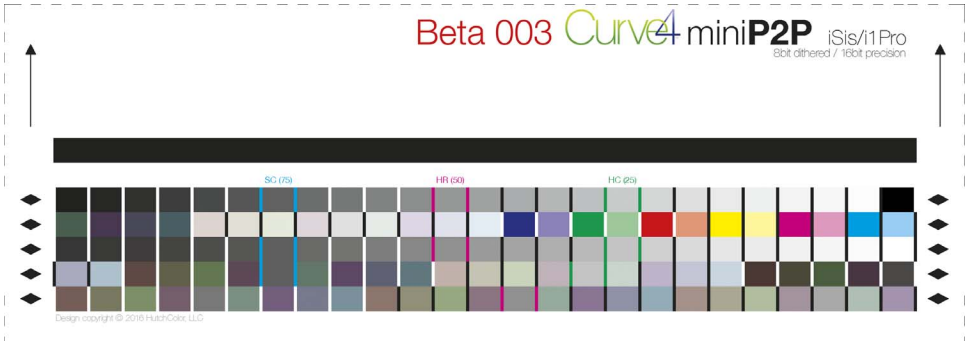
Print the target(s)

(See *Appendix A: Target Printing*.)

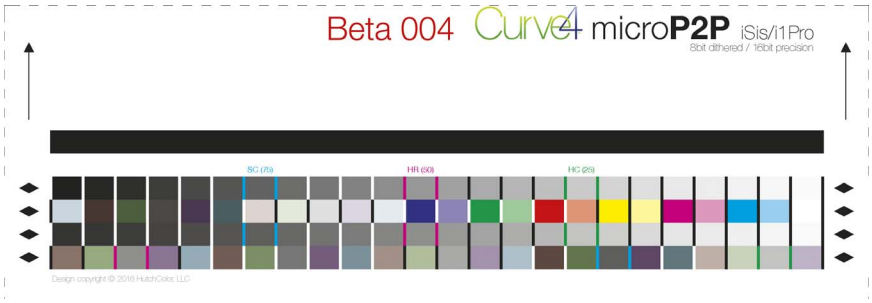
Curve4 can calibrate G7 with the standard *P2P51* target and two new smaller targets, the *miniP2P* (125 patches) and *microP2P* (93 patches).



The P2P51H (horizontal)



Curve4 miniP2P (beta iSis version)



Curve4 microP2P (beta iSis version)

In general, the more patches in a target, the better will be the result, but smaller P2P targets can save time and real estate and have shown excellent performance on well-behaved printing systems.

To see if you can safely use the smaller targets, print the P2P51 and the smaller target and compare their curves in Create Curves. If they look virtually the same, you can safely use the smaller target.

Note that with the Complete license, Curve4 can also calibrate with a variety of other targets using the "*P2Pless*" method, and perform re-calibrations with extremely small "ΔreCal" targets.

Start a new Calibration

- In the *Calibration* panel, click ***New*** above the *Calibrations* list to create a new Calibration.

Set Calibration Method to G7

- In the ***Setup*** panel change the ***Method:*** to ***G7***.

Select the Based On: status

- If the targets were printed without RIP curves, select *Linear (none)* in the *Based On:* list.
- If the targets were printed through a non-linear RIP curve – e.g. a previous *Run*, select that *Run* in the *Based On:* list.
- If you are using *Ink Restriction*, select *Ink Restriction* in the *Based On:* list.

Load calibration data

- In the *Runs* list. click on *Run 1 - Calibration*.

- In the *Measurements* list, either click the *Measure* button to read a target directly, or drag and drop measurement file(s) into the list, or click *Maxwell* icon to load data from your Maxwell account.
- To add more files, click *Measure* again or the Plus (+) button.

Adjust gray balance parameters

- Click on the *Create Curves* tab.
- Open the *Gray Balance Control* tab and set the desired threshold, etc.

Choose Control Points

- In the ***Control Points*** list select the required number and values of curve points. Start with a pre-set list and add points as necessary using the Plus (+) button below the list.

Apply Control Point values to the RIP

- To type the Control Point correction values into your RIP you can either read them directly from the *Create Curves* pane, or print the list of curve points in a *Calibration Run Report*.
- If your RIP accepts digital files directly from Curve4, select the RIP name in the *Export...* list, then click *Export...* and import the resulting file into your RIP.

Print a new P2P target through new curves

- Print one or more new P2P targets through the new RIP curves. Be sure to use identical ink, substrate and conditions (except for the new RIP curves) as when you printed the first P2P target.

Verify G7 calibration accuracy

G7 accuracy can be verified by creating a new (Verification) *Run*.

- Create a new *Run* in the *Runs* list. The default name will be *Run 2 – Verification*.
- Measure one or more P2P targets printed through the RIP curves.
- Click the *Analyze* tab.
- If the wΔL* and wΔCh values under G7 Grayscale are all green your sample passes.
- For more detailed analysis, click on the *G7* tab.

P2Pless calibration

With the Complete license, Curve4 can calibrate with targets not originally designed for printer calibration, for example an IT8.7/4 or TC1617, instead of a P2P51.

An obvious benefit is that if you intend to create a custom profile, you don't have to print a separate P2P target, so less space is required on the printed sample. But a more important advantage is that the calibration curves come from exactly the same location as the characterization data, which yields optimum results when post-calibrating a dataset with VPR to make a G7-optimized ICC profile.

P2Pless calibration can also apply G7 to legacy characterization data such as TR001 (on which the Adobe *US Web Coated (SWOP)* profile was based), or foreign data from organizations such as Fogra.

Accepted targets

P2Pless calibration works from an unlimited variety of CMYK target types, including all standard characterization targets such as IT8.7/3, IT8.7/4, ECI2002, HC2052, TC1617 etc., as well as custom user-generated targets. Simply measure or load data from the desired target; Curve4 automatically extracts the needed data and does the rest.

With the Complete license you can even calibrate from an existing ICC profile.

Optimum targets

For optimum P2Pless calibration, use a target with as many gray patches as possible, for example the HC2052 or TC1617. These targets also produce better ICC profiles and are strongly recommended as permanent replacements for earlier targets like the IT8.7/3, IT8.7/4 or ECI2002.

Switching P2Pless on and off

Curve4 automatically detects when Measurement data can be used for P2Pless calibration, but you can over-ride the auto selection via the Pop-Up menu below the Measurements list. For example, a target that can be used for P2Pless calibration may perform better if used as a ΔreCal target (see *Delta re-calibration (ΔreCal)* below).

When the pop-up below the Measurements list is set to Auto, P2Pless data are automatically recognized

Working with multiple targets

If multiple targets from the same press run are added to the Measurements list, the P2Pless function automatically extracts and averages the best patches for that calibration.

Calibrating from an existing ICC profile

If you load an existing ICC CMYK profile into the measurements list, Curve4 (with Complete license) extracts the characterization data and produces calibration curves. These can then be applied to the RIP as normal, or to the profile data via the VPR tab.

Note that the original profile itself is not corrected. To obtain a new “post-calibrated profile”, create a new profile form the modified characterization data exported from VPR.

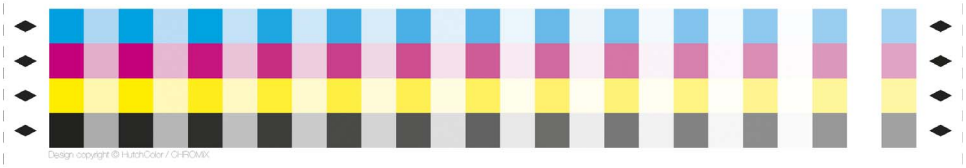
TVI Calibration

Workflow summary

- Print one or more SCTVi or P2P targets
- Change the calibration mode to TVI in the Setup panel
- Select the desired TVI target curves for each ink
- Load measurement data
- Select required Control Points
- Apply Control Points values to the RIP
- Print a new Target through new curves
- Verify TVI calibration accuracy

Print the target(s)

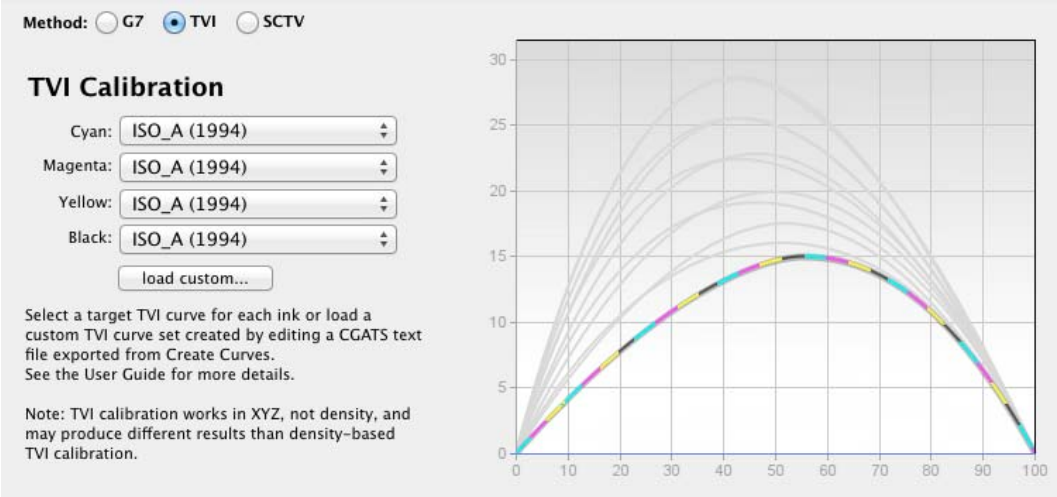
(See *Appendix A: Target Printing*.) Curve4 TVI calibration can use a regular P2P but better results will be had with the Curve4 *SCTVi* target.



Curve4 SCTVi target (beta version)

Start a new Calibration

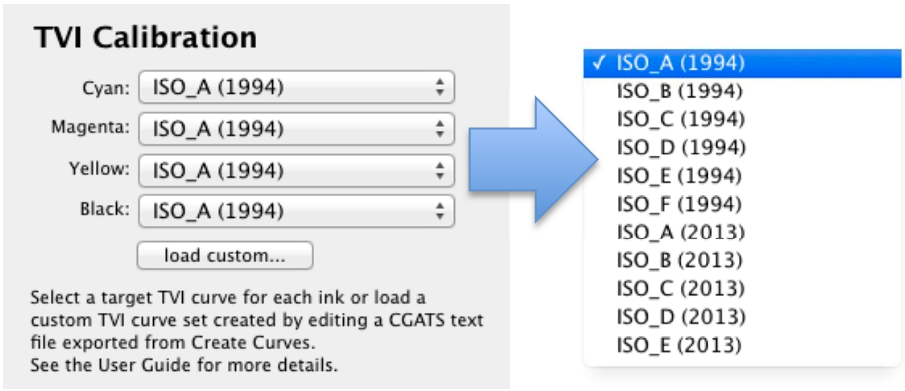
- Click *New* above the *Calibrations* list to create a new Calibration.
- In the *Setup* panel change the *Method:* to *TVI.*



The TVI Setup panel

Select the Target TVI Curves

- Select the desired TVI target curves for each channel from the six 1994 ISO 12647-2 curves, or the five 2013 curves, or your own custom TVI curves.



TVI curve selector and standard ISO 12647-2 TVI curves

Loading custom TVI target curves

The *Load custom...* button lets you load a custom set of target TVI curves, for example from a previous press run or a non-standard press condition. To create a custom TVI reference curve set, see *Appendix I: Custom TVI Curves*

- Select the custom TVI target curve in the *Load custom...* list.
- To use a combination of custom and standard ISO curves, first load the Custom target curve set, (which sets all four inks to the custom curves) then select the desired ISO curve(s) for any ink that you want to match a standard TVI curve.

Select the Based On: status

- If the targets were printed without RIP curves, select *Linear (none)* in the *Based On:* list.
- If the targets were printed through a non-linear RIP curve – e.g. a previous *Run*, select that *Run* in the *Based On:* list.

Load calibration data

- In the *Runs* list. click on *Run 1 - Calibration*.
- In the *Measurements* list, either click the *Measure* button to read a target directly, or drag and drop measurement file(s) into the list, or click *Maxwell* icon to load data from your Maxwell account.
- To add more files, click *Measure* again or the Plus (+) button.

Note: Depending on the target used for TVI calibration, the NPDC and Gray Balance graphs in the Measurements panel may be blank.

Choose Control Points

- In the *Control Points* list select the required number and values of curve points.

Apply Control Point values to the RIP

- If your RIP accepts digital files directly from Curve4, select the RIP name in the *Export...* list, then click *Export...*and import the resulting file into your RIP.
- To type the Control Point correction values into your RIP you can either read them directly from the *Create Curves* screen, or print the list of curve points in a *Calibration Run Report*.

For more information see *Section 11: Applying Control Point Values.*

Print a new target through new curves

Print one or more new targets through the new RIP curves. Be sure to use identical ink, substrate and conditions (except for the new RIP curves) as when you printed the first target.

Verify TVI calibration accuracy

TVI accuracy can be verified by creating a new Verification *Run* in the *Calibrate* panel.

- Under the *Runs* list click the Plus (+) symbol to create a new Calibration *Run*. The default name will be *Run (#) – Verification(#)* but you can change the name by clicking on it
- Measure or load one or more calibrated targets into the Measurements list
- Click on the *Analyze* tab
- Click the *TVI* tab
- Check that the CMYK TVI curves match the target TVI curves

Note that all graphs and results displayed in the new Verification *Run* are based on an average of all selected (checked) samples in the list.

SCTV (Spot Color) Calibration

Workflow summary

- Print one or more SCTVi or P2P targets using any desired ink colors in place of the normal Cyan, Magenta, Yellow or Black inks.
- In the Setup panel change the calibration mode to *SCTV.*
- Measure the target(s) directly into Curve4, or load 4-channel CGATS file(s) measured off line.
- Select the required Control Points.
- Apply Control Points values to the RIP.
- Print a new target Target through new curves.
- Verify calibration accuracy.

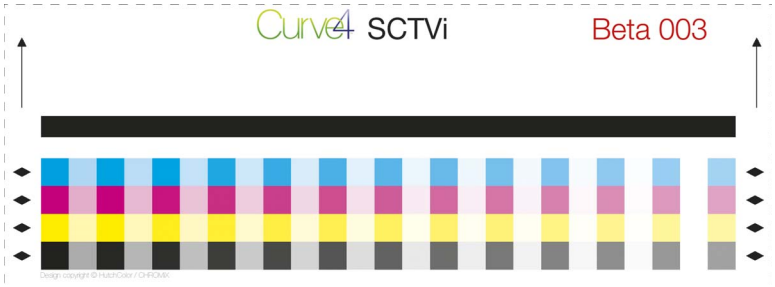
Print the calibration target(s)

(See *Appendix A: Target Printing*.) SCTV calibration can use a P2P but better results will be had with the Curve4 *SCTVi* target.

Assigning inks to the CMYK channels

Curve4 doesn't need to know what inks you print in each channel of the target. You can assign inks of any color to the CMYK target channels, but try to assign the darkest ink to the Black channel so the target markers (e.g. diamonds) are readable by the measuring device.

If calibrating less than four inks, assign the empty target channels to one of the inks in use so each patch of the target is printed.



Curve4 SCTVi target (beta version)

Start a new Calibration

- Make sure Curve4 is in *Calibration* mode, then click *New* above the *Calibrations* list to create a new Calibration.

Set Calibration Method to SCTV

- In the *Setup* panel change the *Method:* to *SCTV*.

Load calibration data

- In the *Runs* list. click on *Run 1 - Calibration*.

- In the *Measurements* list, click the *Measure* button to read a target directly, or drag and drop measurement file(s) into the list, or click *Maxwell* icon to load data from your Maxwell account.
- To add more files, click *Measure* again or the Plus (+) button.

Note: Measurement data must be in a 4-channel CGATS format. If you load a file with more than four channels, Curve4 will only use the first four channels of data.

Select the Based On: status

- If the targets were printed without RIP curves, select *Linear (none)* in the *Based On:* list.
- If the targets were printed through a non-linear RIP curve – e.g. a previous *Run*, select that *Run* in the *Based On:* list.
- If you are using *Ink Restriction*, select *Ink Restriction* in the *Based On:* list.

Choose Control Points

- In the *Control Points* list select the required number and values of curve points.

Note: Depending on the target used for SCTV calibration, the NPDC and Gray Balance graphs in the Measurements panel may be blank.

Apply Control Point values to the RIP

- If your RIP accepts digital files directly from Curve4, select the RIP name in the *Export...* list, then click *Export...* and import the resulting file into your RIP.
- If not, manually type the Control Point correction values into your RIP.

Verify SCTV calibration accuracy

Print one or more new targets through the new RIP curves with identical ink, substrate and printing conditions (except RIP curves) as the first target.

- Create a new *Run* and load one or more targets into the Measurements list.
- Click on the *Create Curves* tab and *Deltas*.
- Perfect SCTV calibration should produce Curve Point values no greater than about +/- 1.0%.

Ink Restriction

Curve4*'s Ink Restriction* function helps you determine maximum CMYK percentages for printing systems whose native ink levels must be restricted manually, such as ink-jet. The suggested *Restriction Percentage (RP)* for each CMYK channel is normally typed into the RIP which then reduces all CMYK percentages by a constant factor equal to RP/100. If the RIP doesn't accept Restriction percentages, Curve4 can export curves with Restrictions "baked in", i.e. pre-multiplied by RP/100 that achieve the same effect when loaded in the RIP.

The ink restriction tool can also help *guide* the adjustment of an offset press to achieve neutrality at 300% CMY, but note that *offset calibration curves should never have maximum values less than 100%*.

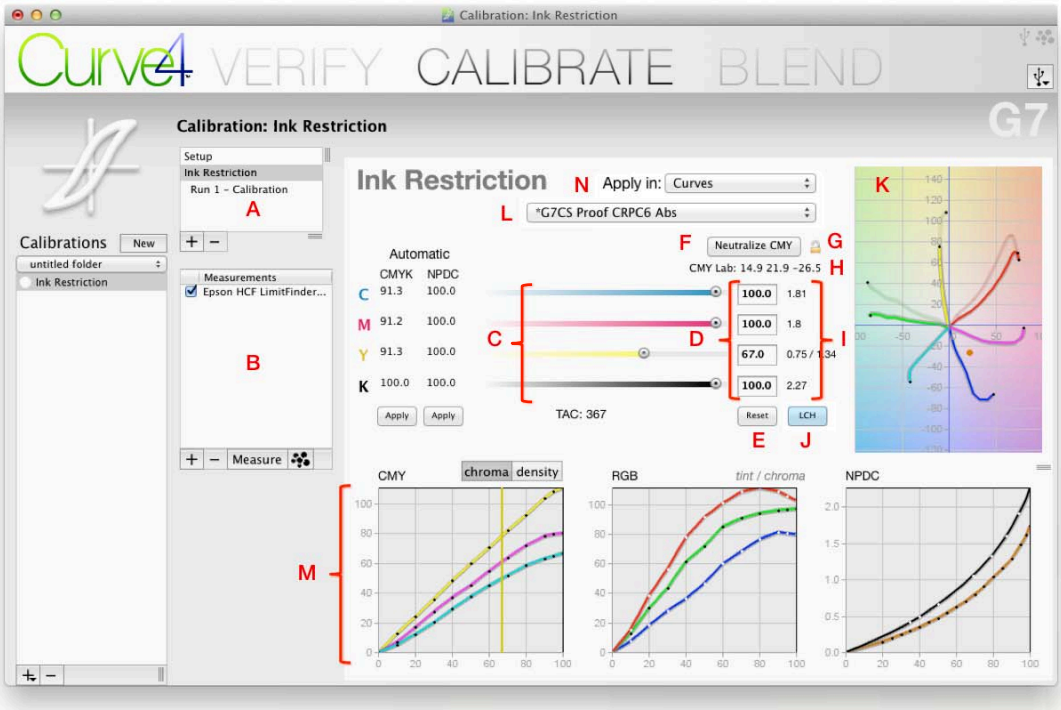
Ink Restriction logic

Curve4 estimates suggested *Restriction Percentages* based on three main conditions;

- Where CMYK inks start to stop gaining density or chroma.
- Where the CMY NPDC flattens (no density gain) or "reverses" (density is lost) with increasing ink.
- Where CMY percentages produce the darkest possible "neutral" gray.

It is hard to estimate Ink restriction values from measurements alone. If you don't agree with the suggested *Restriction Percentages* you can alter or ignore them, but the *Ink Restriction* tool remains valuable for estimating Restriction Percentages, because it displays graphically and numerically the neutrality and density resulting from your manual Restriction Percentages.

The Ink Restriction panel



The Ink Restriction panel. See next page for letter-coded explanations

A - Runs List

Selecting *Ink Restriction* in the *Setup* panel creates a new *Run* called *Ink Restriction*, with a second called *Run 1 – Calibration* that is automatically based on the *Ink Restriction Run*.

B - Measurements List

Measuring or directly loading target data into the *Measurements* list automatically calculates two sets of suggested *Restriction Percentages* based on CMYK and NPDC. Multiple targets are averaged.

C - CMYK sliders

Restriction Percentages can be changed by dragging the CMYK slider handles.

D - Restriction percentages

The four *Restriction percentage* boxes show the net result of all other controls. Double-click and type in any box to change a *Restriction percentage*.

E - Reset button

The *Reset* button restores all sliders and *Restriction Percentage* values back to 100%.

F - Neutralize CMY

The *Neutralize CMY* button sets the CMY percentages to the darkest possible "neutral" CMY gray, (close to zero a* and b*). *Neutralize CMY* will not increase, any existing *Restriction percentage*.

G - Padlock icon

The padlock synchronizes the three CMY sliders to keep maximum CMY neutral when any CMY slider is moved - useful if you want to lighten or darken the maximum CMY point while keeping it neutral.

H - Darkest CMY Lab values

Lab values of the darkest neutral CMY patch with the current *Restriction Percentages*.

I - Darkest density / LCH

The darkest CMYK densities or LCH values are shown to the right of the *Restriction percentage*s.

J - LCH / Dens switch

Toggles between darkest LCH and darkest Density. Without spectral data, dens displays "n/a".

K - Hue / Chroma graph

The "spider graph" shows the hue and chroma of the six primary colors. Bold lines show the effect of the *Restriction Percentages*, lighter lines show the original. A brown dot shows the 300% CMY patch.

L - Verification Reference

The Reference pop-up defines the target ellipses on the Hue / Saturation graph.

M - 2-D CMY, RGB and NPDC graphs

CMY graphs show Chroma or density (with spectral data). NPDC brown = CMY, black = K.

N - Apply in:

Apply in: chooses to apply Restrictions in the RIP or in Control Points of the Create Curves pane.

Ink Restriction Workflow

Summary

- Determine CMYK Restriction Percentages (RPs).
- Apply RP values to the RIP or as pre-scaled calibration curves.
- Print the ink-restricted P2P or other calibration target.
- Apply calibration curves to the RIP.

Note that in a normal ink jet RIP, the RP factors work independently of calibration curves.

Optimize printer settings

- First determine the optimum combination of resolution, speed and other settings that yields a wide color gamut with printed samples dry enough to handle and measure.
- These tests should be done with no color management active.
- Record the optimum settings.

Print the test target

- Print one or more ink restriction targets in the optimized printer state determined above.

Note that Curve4 can calculate Ink Restriction Percentages from a variety of targets, including the Curve4 LimitFinder (shown here), P2P51, TC1617, etc.

Speed, effectiveness and precision of the Ink restriction function may vary according to the target type and the printing condition.

How many patches?

With printing systems whose high-density regions behave smoothly, the effectiveness and accuracy of Curve4's Ink Restriction function can be improved by adding more patches to the measurements list, for example adding a P2P51 and/or a TC1617 to a LimitFinder target.

With printing systems whose high-density characteristics contain "folds" or "reversals" in CIELAB space, more useful ink restriction data is sometimes obtained from fewer patches, i.e. targets whose patches have wider-spaced percentages.

Beta LimitFinder14 target.

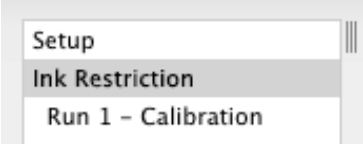
Select Ink restriction

To use the *Ink Restriction feature;*

Selecting Ink Restriction in the Setup panel

- Create a new Calibration Run.
- In the *Runs* list click *Setup* and check the *Ink Restriction* box.

An *Ink Restriction Run* appears first in the *Runs* panel, followed by *Run 1 – Calibration*.



- Click on the *Ink Restriction Run* to open the *Ink Restriction* pane.

Automatic ink Restriction calculation

- Measure or load target data into the *Measurements* list. This starts an automatic background calculation that may take a while. Be patient.
- Once calculation is finished, two sets of suggested *Restriction Percentages* based on CMYK and NPDC data appear to the left. If Curve4 sees no need for ink restriction, all values will be 100%.
- If you agree with the automatic numbers, click *Apply* to move a column's percentages into the *Restriction percentage* boxes to the right of the sliders.

Neutralize CMY

- For the darkest possible neutral CMY patch, (zero a* and b*) click *Neutralize CMY*.
- If there were numbers in the boxes before you clicked *Neutralize CMY* and you think the new *Restriction Percentages* are too low, click *Reset* (sets all values to 100) then click *Neutralize CMY* again to find the darkest neutral CMY density.

Manual adjustment

- You can change the *Restriction Percentages* manually by dragging the CMYK sliders or by typing in the boxes. If you don't like where things are going, click *Reset* to put all values back at 100%.

Padlock icon

- If you want to lighten or darken the maximum CMY point while maintaining neutrality, click the padlock icon to the right of the *Neutralize CMY* button. This will synchronize the three CMY sliders and keep the maximum CMY point neutral when any CMY slider is moved.

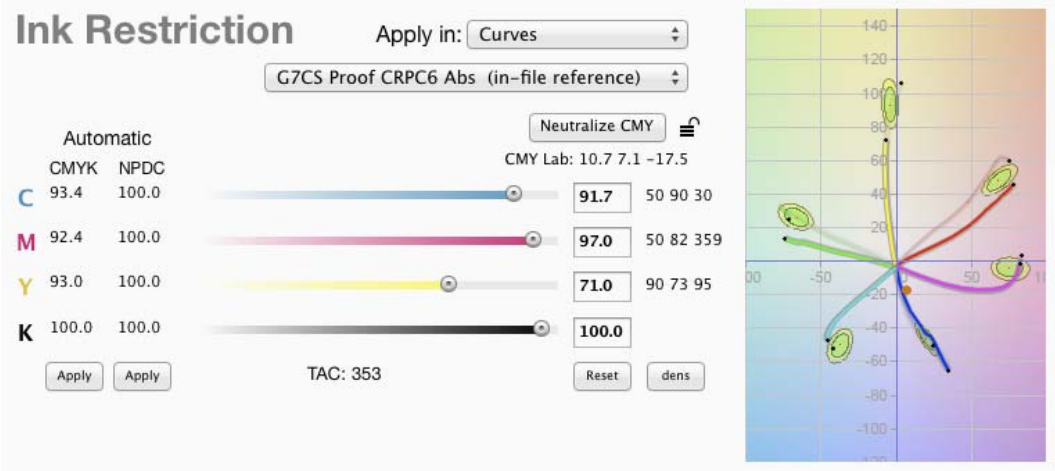
Monitoring darkest Lab and density values

The Lab values of the darkest neutral CMY patch are shown below the *Neutralize CMY* button. These values change dynamically to show the effect of the Restriction Percentages.

With spectral data, maximum CMYK densities are shown to the right of the *Restriction percentage* boxes. Densities change dynamically as *Restriction Percentages* change. When a percentage is less than 100, the maximum density at 100% and the new restricted density are shown side by side. With non-spectral data, the density fields say “n/a”.

Effect on hue and chroma

As you change the *Restriction Percentages*, the hue/chroma lines in the “spider graph” change to show the effect of the reduced ink levels. The original hue/chroma lines remain faintly visible.

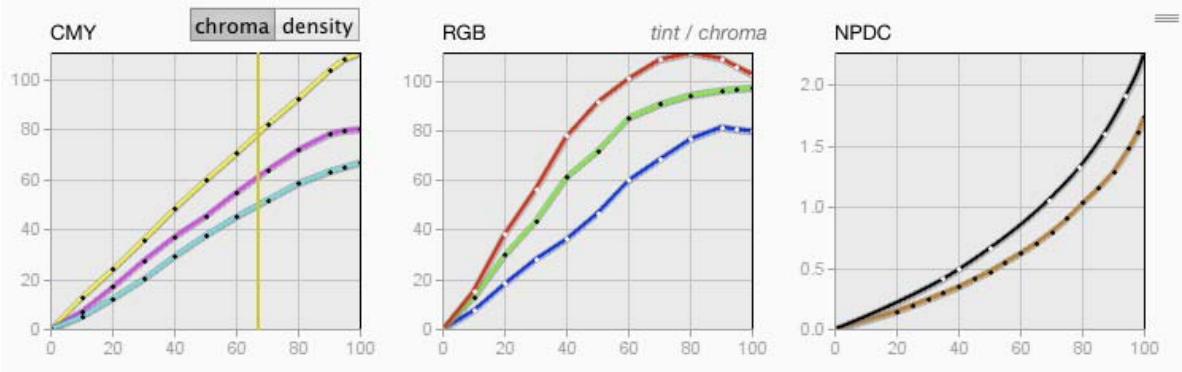


The Hue/Chroma graph showing changes due to manually-reduced Yellow.

A brown dot shows the hue and chroma of the current CMY Restrictions.

2-D graphs

The two graphs at the bottom left of the panel show CMY and RGB scales in either density or chroma vs. percentage. (Density graphs are only available with spectral measured data.) Vertical lines on the CMY graph shows the current Restrictions. The bottom right graph shows the two NPDC graphs for CMY (brown) and K (black).



Left: CMYK density or Chroma graphs. Middle: RGB chroma graphs. Right: NPDC graphs for CMY and black.

Note: The accuracy and resolution of all graphs in the Ink Restriction panel depend on the target(s) used and the condition of the printing system.

Apply Restriction Percentages in a RIP

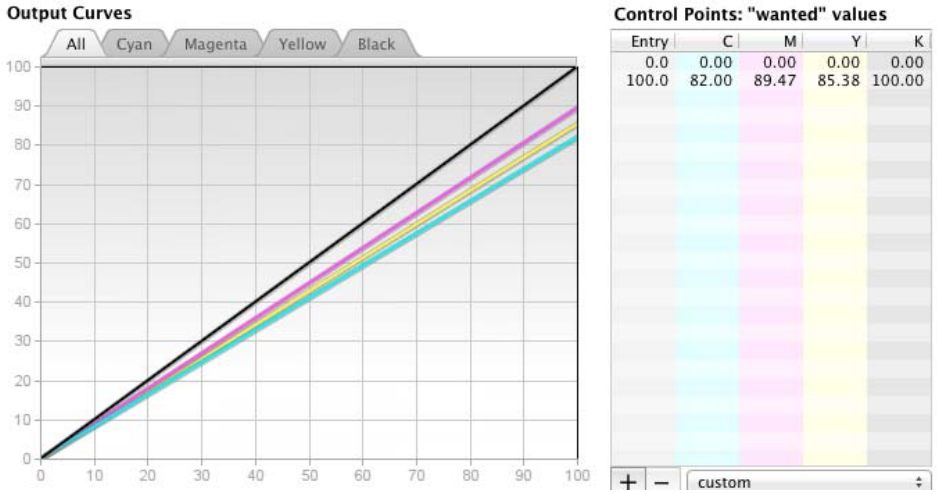
If the RIP accepts independent CMYK restriction percentages;

- Select *Apply in: RIP* and enter the CMYK restriction percentages in the RIP.
- Print the first calibration target (e.g. P2P) through the Ink-restricted RIP.
- Measure the resulting P2P and calibrate as normal.
- Apply the calibration curves to the RIP per the manufacturer's instructions.

Apply Restriction Percentages via Curves

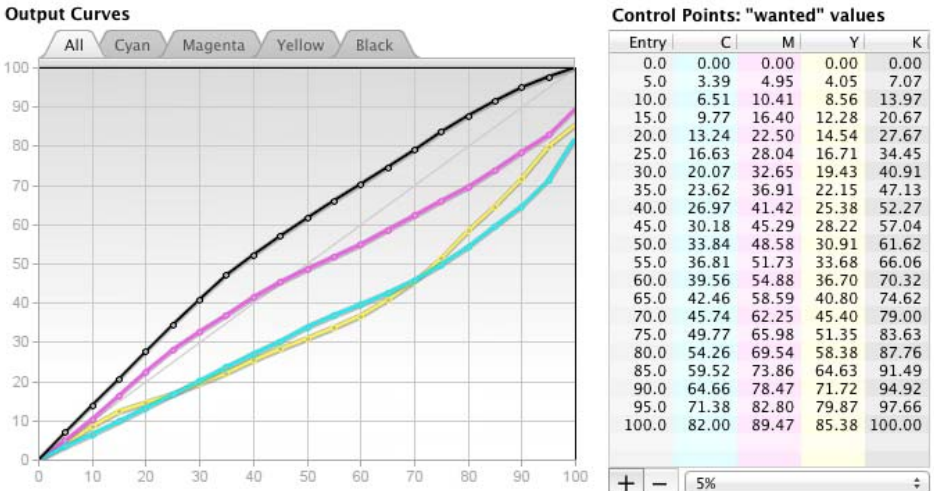
If you are not using a RIP (e.g. printing from Photoshop) or if the RIP does not accept Restriction Percentages, you can apply Ink Restriction via calibration curves exported from Curve4, as follows:

- Print and measure the ink Restriction target and select *Apply in: Curves*.
- In Create Curves, choose 0 and 100% control points to make linear restriction curves.



Setting restricted output curves to 0 and 100% to create a set of linear restriction curves.

- Load the linear curves in the RIP and print a P2P51 target *through the linear curves*.
- Measure the resulting P2P into *Run 1 - Calibrate*.
- In Create Curves, select as many control points as you like, as shown below.



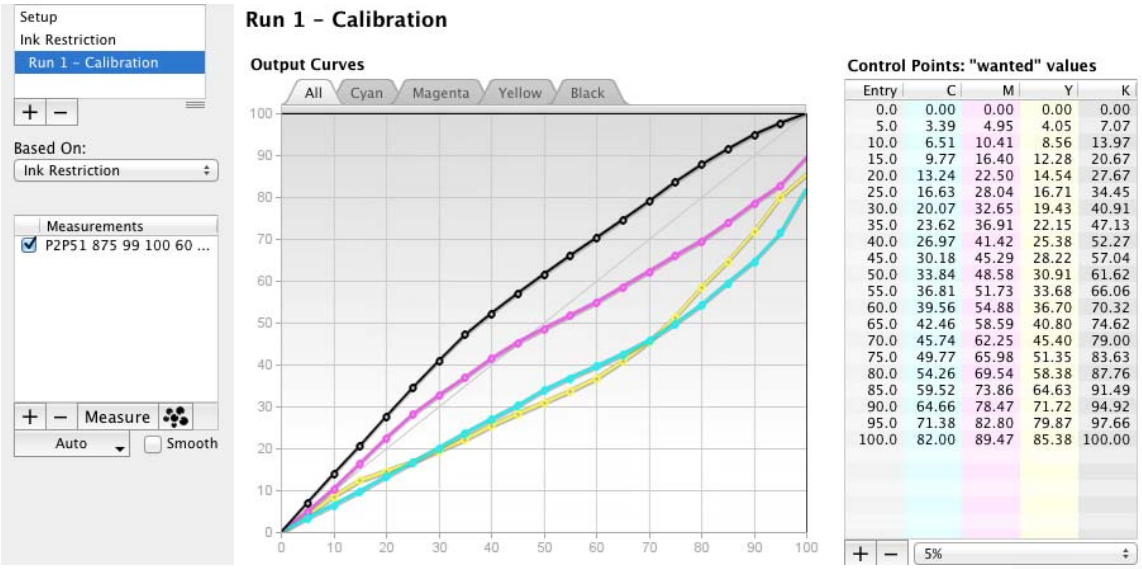
Ink-restricted curves from the P2P target printed through the linear curves.

- Export the new curves and replace the *linear curves* in the RIP.

If the Ink Restriction target contains P2P values

If the ink restriction target contains P2P data, you may be able to export restriction curves that also achieve G7 calibration in one pass (without printing a P2P target through linear restriction curves), but the resulting calibration may not be as accurate as the two-step process outlined above.

Experiment to see what system works best for your printer and RIP.



Ink Restrictions applied in Output Curves. Note that some maximum output values are less than 100%.

Re-Calibration (Iteration)

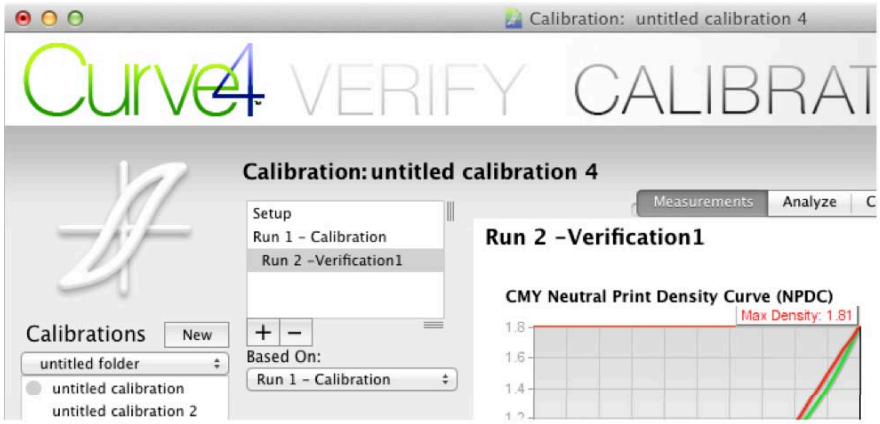
This section describes how to re-calibrate from a print based on previous calibration curves. Re-calibration is also known as “iteration”.

When to re-calibrate

- The printing system has changed since you last calibrated but you want to avoid a special calibration run with linear curves.
- The first print was made (accidentally or deliberately) with non-linear calibration curves.
- You want to ‘tweak’ a previous calibration to increase accuracy.
- The raw printing condition is so far out of balance that two rounds of G7 calibration (i.e. iteration) is necessary.

The Basis Run

In the *Based On:* list, select the Calibration *Run* that produced the curves used to print the new target. The original Calibration (known as the “*Basis Run*”) can be from Curve4 or imported from Curve3.



The Based On: list

When a new *Run* is based on a previous *Run*, it becomes indented in the *Runs* list under its basis *Run*.

Caution: The Basis Run MUST be the Run used to create the calibrate curves through which the new target was printed, otherwise recalibration will not work correctly

How re-calibration works

When a verification *Run* is based on a previous calibration *Run*, Curve4 calculates the calibration curves with allowance for the curves in use when the new target was printed. The calibration curves calculated by the new *Run* REPLACE the previous RIP curves, and in most cases will be very similar.

Re-calibration targets

Curve4 Calibrate can recalibrate with any P2P target. The recalibration target does not have to be the same as used for the original *Basis Run*. For example, the basis *Run* could have used a P2P25 and the recalibration *Run* can use a P2P51.

With the Curve4 Complete license you can recalibrate in *P2Pless* mode with a characterization target like the IT8.7/4 or TC1617, or with a tiny ΔreCal target that can be included with most live jobs.

The ΔreCal function is described in the next section.

If you don't have a saved Calibration

Iteration only works if the Basis *Run* is recorded accurately – which is why you should save every Calibration when prompted. If you don't have a saved calibration, Curve4 lets you import RIP curves as a text file as shown below.

Creating and importing an Initial Curves file

The *Initial Curves File* format required by Curve4 is similar to a CGATS text file exported from *Create Curves*. If you know the RIP curve values you can create an *Initial Curves File* as follows:

- At the RIP terminal, record the actual curves applied to the *Run* involved

NOTE: Record the "Wanted", not "Measured" values, even if the RIP only accepts Measured values. In other words, record the new plate values that should result after calibration.

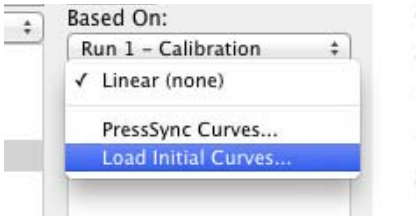
- In any Curve4 Calibration with any measurement data, go to *Create Curves* and make a list of nominal Curve Point values identical to the "File values" or "Initial Values" in the RIP curves.
- Export a CGATS text file.
- Open the CGATS file in Microsoft Excel or an equivalent text editor.
- Replace the CMYK output values in the CGATS file with the output values from the RIP.
- Save the edited file in the *Tab Delimited Text (.txt)* format.

	A	B	C	D	E	F	G
1	NUMBER_OF_FIELDS	6					
2	BEGIN_DATA_FORMAT						
3	SampleID	SAMPLE_	CMYK_C	CMYK_M	CMYK_Y	CMYK_K	
4	END_DATA_FORMAT						
5	NUMBER_OF_SETS 11						
6	BEGIN_DATA						
7	A0	0	0	0	0	0	
8	A1	10	10.38	10.02	11.98	10.05	
9	A2	20	19.93	20.61	21.02	20.64	
10	A3	30	30.72	30.53	30.29	30.5	
11	A4	40	40.04	39.97	41.22	40.03	
12	A5	50	49.38	49.72	49.95	50.3	
13	A6	60	59.5	60.56	59.8	60.53	
14	A7	70	69.93	70.05	69.79	70.17	
15	A8	80	79.81	80.4	80.33	79.85	
16	A9	90	90.12	90.57	90.57	89.87	
17	A10	100	100	100	100	100	
18	END_DATA						
19							

A CGATS text file exported from Curve4. Values red numbers are the RIP curve values

Working with an Initial Curves file

In the *Based ON:* list, select the Initial Curves file created as described above. This will not change anything in the Measurements or Analysis tabs, but it will change the curves and Control Point values shown in the Create Curves tab.



*The **Load Initial Curves ...** option in the Based On: list*

Precision limits

If you are using re-calibration to improve an imperfect G7 calibration, typically one to two rounds of iteration will improve results if the device is very stable. But continuing to iterate beyond one or two rounds can actually reduce calibration accuracy due to run-to-run variations in the printing. Even a small change in solid ink densities, dot gain or gray balance between runs can cause the corrections calculated for one run to be incorrect for a later run.

One way to verify how much change has happened between runs is to check the Run to Run data under the Analyze Pane. See *Chapter 3: The Analyze Pane*.

Applying re-calibration curves

The new Control Point values are *NOT* added to the initial RIP curves as delta values. Instead they *REPLACE* the old curve values. If you add them as delta values the calibration will fail.

If the device has not changed much between the first and second *Run*s, the new curves will often be very similar to the old curves. However if the initial curves were not calculated by Curve4 (or Curve3) and did not match G7, the new curves may be quite different.

Avoiding errors

Basing a Calibration *Run* on a Basis *Run* can easily go wrong if you are not careful. You must be absolutely sure which Basis *Run* was used to calibrate prior to the current *Run*, and the settings in that Basis *Run* must not have changed, especially the following:

- Measurement files active or disabled in the *Measurements* list
- Number and values of the *Control Points*
- *White / Black* tab settings
- Gray balance On/Off
- Gray Balance Control tab settings
- Normalize High Densities status
- The Basis *Run* selected in the *Based On:* list (if any)

Note: A Calibration Run may be based on a Basis Run which was itself based on an earlier Basis Run, which in turn may be based on an even earlier Basis Run, and so on. For Iteration to work correctly it is important that all Basis Runs leading up to the current Run are included in the session, and all Curve4 *settings active when each Basis Run was applied have not been altered.*

Delta Re-Calibration (ΔreCal)

The Curve4 Complete license activates the *ΔreCal* function in the Calibrate tool. *ΔreCal* is a variation of normal recalibration (described earlier) that doesn't require a full P2P target. Instead a small *ΔreCal* target printed on a live job is measured and used to update an existing set of calibration curves.

The *ΔreCal* function can restore a printer to optimum G7 compliance without the time and cost of a new G7 calibration press run, and without requiring a large P2P target.

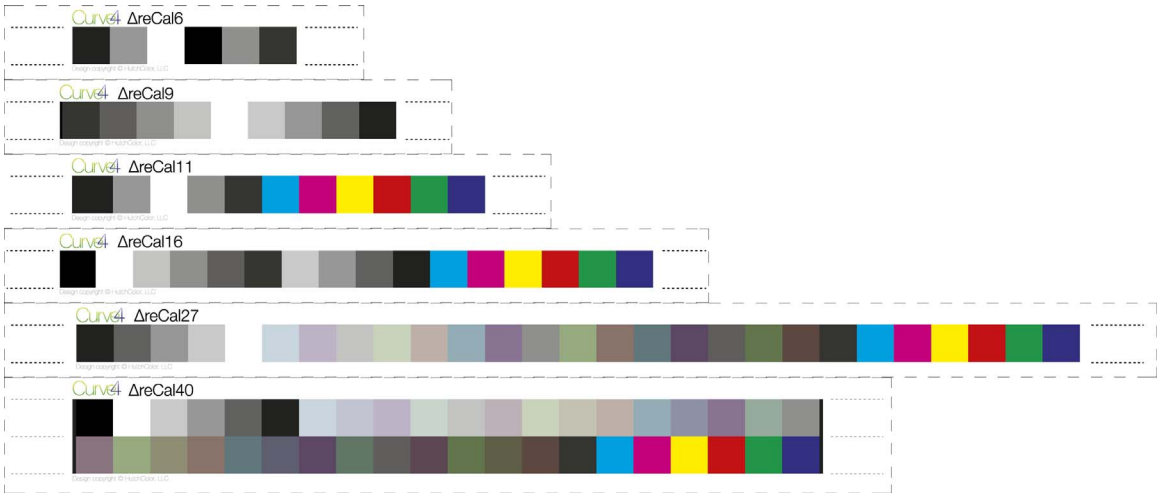
This section assumes you have already read the section on Re-calibration (Iteration).

ΔreCal requirements

- The printing system being re-calibrated must have had at least one initial calibration, and the *Basis Run* from that initial calibration must be available in your software.
- The *ΔreCal* target must have been printed through the RIP curves created from that *Basis Run.*
- For best results, the printing system should be using the same media, inks, ink quantities, device settings and other variables as the initial calibration.
- In the *ΔreCal Run*, you MUST select the correct *Basis Run* in the *Based On:* list.

ΔreCal targets

Curve4 ΔreCal targets ranging from 6 patches up to 40 are provided. More patches theoretically offer more accurate recalibration but even the smallest target seems to work well in certain situations.



Curve4 ΔreCal targets

ΔreCal workflow

- Create calibration curves with a normal P2P51 (or an IT8.7/4 or TC1617 in *P2Pless* mode).
- In live production, include one or more ΔreCal targets alongside the work.
- If the press drifts, create a new *Run* with the ΔreCal target(s).
- In the *Based On:* list, select the original *Run* that made the current RIP curves
- Replace the current RIP curves with the new curves generated by the ΔreCal Run.

ΔreCal target placement

If the printing process varies across the print area, the location of the ΔreCal target can impact accuracy. Try to place the ΔreCal target as close to live work as possible and in line with any ink starvation effects. Keep all targets as far as possible from the edge of an offset sheet.

The easiest placement for a ΔreCal target on an offset press is near the control bar, but this is only appropriate with even ink distribution around the cylinder. Make sure the target doesn't lie in a region of ink starvation, for example directly in line with a heavy take-off area.

ΔreCal frequency

While it seems tempting to re-calibrate after every press run, it is usually wiser to average the ΔreCal targets from several runs, for example over a whole week or month. Re-calibrating too often, for example after every press run, can actually make the process less stable if the measured ΔreCal target does not represent the average status of the press.

Whenever possible, it is better to find the source of variation and solve it in the printing process.

Applying Calibration Curves

The ultimate product of Curve4 is a set of CMYK Control Point values (a.k.a. “calibration curves” or “linearization curves”) that can be applied in several ways:

- In the calibration or linearization section of a CtP (Computer-to-Plate) RIP.
- In the calibration or linearization section of a film-setter RIP.
- In the calibration or linearization section of a proofing RIP.
- In the calibration or linearization section of a digital press controller or RIP.
- In the calibration or linearization section of an inkjet print controller or RIP.
- In Adobe Photoshop CS4 (or later) Via DLPs (Device-Link-Profiles).
- In Photoshop 6 (or later) via Photoshop Curves.

Transferring curve values to a RIP

Most RIPs and printer drivers provide some form of user-accessible calibration or linearization, but how the calibration works and what type of information it will accept can vary widely. This section offers general advice on applying Curve4 Control Point values to the RIP. No single set of instructions can apply to all systems and some experimentation may be necessary.

Notes for some RIPs are offered in *Appendix D: RIP-Specific Notes*. If your RIP is not mentioned or you feel the notes are incorrect, please send comments (with screen images if possible) via the feedback system or directly to don@hutchcolor.com for future versions of the Curve4 *User Guide*.

If you are not sure how to apply Control Point values to your RIP, see the manufacturer’s instruction manual or contact your supplier.

Manual entry

To type the Control Point values produced by Curve4 into your RIP you can either read them directly from the *Create Curves* screen, or print the list of curve points in a *Calibration Report* from the *File* menu or the *Calibration Run Report* button.

Digital transfer

If your RIP accepts digital calibration data from Curve4, select the appropriate file type in the list, click *Export...*. save the data then import it into the RIP.

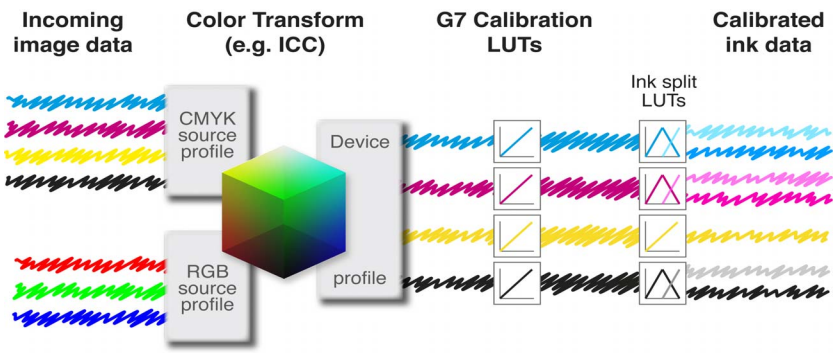
Basic Calibration principles

Curve4 assumes that the calibration or linearization system controls the behavior of three or four individual CMYK (or CMY) colorants (inks) via separate 1-dimensional curves or LUTs (look-up tables) for each ink. If your printer does not use 1-D calibration curves, or requires more than four calibration curves, it may or may not be directly compatible with Curve4.

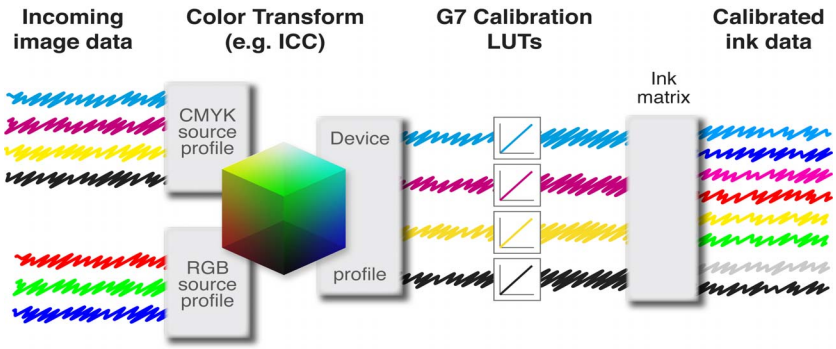
CMYK+ Calibration

If your printing system uses more than four inks (e.g. CMYK inks plus light cyan, light Magenta, light black, red, green or blue) *and* requires separate calibration curves for each ink, the four calibration curves calculated by Curve4 will not work correctly.

If your printing system applies calibration curves to CMYK data after initial color management but before any ink-splitting functions, as shown in the diagrams below, the four calibration curves calculated by Curve4 should work correctly.



Ideal G7 calibration curve location with light and dark inks



Ideal G7 calibration curve location with CMYK plus RGB inks

Calibration naming conventions

Different manufacturers use different names for the data columns or values their calibration software accepts. The following diagrams illustrate some of the common naming conventions. Typically there are three columns representing the initial file value, the actual value measured on the plate, and the value you want the dot to become after calibration.

Index Value	Actual Value	Desired Value
0	0	0
5.00	5.00	5.00
10.00	10.00	10.00
15.00	15.00	15.00
20.00	20.00	20.00

Typical RIP naming.

Control points (a.k.a. file values or initial values)

The user interface of a typical RIP calibration or plate linearization system usually begins with a series of control points which may be called 'file values', 'index values', 'initial values', etc. Each control point is named for the image value or halftone dot percentage it controls. In Curve4 these are the *Control Points* listed in the *Create Curves* pane.

Some rips require a fixed set number of control points. Others let you enter your own choice of points. Curve4 has some pre-set Control Point sets and lets you add or subtract Control Points.

Measured values

In the second column, most plate linearization systems ask you to enter the halftone percentage dot sizes measured on the plate. For Curve4 to work properly, the Measured column values must be the same as the Control Point or File values. If the RIP does not let you enter Wanted values, Curve4 can calculate Measured values instead (see *Measured vs. Wanted Values*).

Wanted values

In the third column, most plate linearization systems let you enter the 'Wanted' percentage values, which may also be called 'Desired', 'Intended' or 'Aim' percentages, etc. By default Curve4 shows Wanted percentages in the *Control Points* list. Usually the wanted percentages will be slightly different for each ink, but on rare occasions, for example if you switch off gray balance, or if the device had no gray balance error, all three CMY Wanted values for any Control Point may be the same.

Measured vs. Wanted values

Normally the Control Point values shown in the *Create Curves* pane are the percentage values that each Control Point wants to change to calibration. For example, if the 50% Control Point has a Control Point value of 55%, the device wants to output a 55% value for a Control Point, or incoming file value, of 50%. In other words, 50% tones are darkened by 5%. However a few RIPs demand 'Measured' values instead of Wanted values.

If the RIP does not accept Wanted values

If your RIP only accepts Measured values (there is no place to enter Wanted values), click the *Measured* button in the *Setup* panel. The Control Point output values will now be calculated as if they were measured directly from single-color scales on the P2P calibration target, and the RIP should determine the correct Wanted values internally.

Note: The Measured values calculated by Curve4 *simulate integrated halftone percentage readings from individual ink scales, but will usually not match percentages measured from the CMY scales of a P2P target, because they include gray balance and NPDC corrections.*

G7 Calibration vs. plate linearization

If your RIP offers two sets of curves for the separate functions of 'Linearization' and 'Tonal editing', G7 calibration can be performed independently of device linearization by loading the Curve4 calibration values in the Tonal editing curves. However if the RIP has only one set of curves for linearization, with no separate editorial tone correction curves, G7 calibration must use the linearization curves, which normally makes separate plate linearization impractical.

In many cases G7 calibration eliminates the need for separate plate linearization, but you still need a way to control plate consistency in production, independent of G7 calibration, otherwise a whole new G7 press run would be needed every time the plate system changes.

The following section outlines two methods of controlling plate values independently of G7 calibration, on a RIP that has just one set of curves. Both methods work, but one method may be more suitable depending on your specific RIP and workflow needs.

Caution: Small differences in measuring geometry, plate processing, plate emulsion color, etc. can produce different plate dot measurements that may not reflect changes in printed dot size. Re-linearization based on plate measurements can sometimes reduce printing consistency.

Pre-linearized method

In this method, plates are linearized before G7 calibration and subsequent plate changes are corrected by adding delta values to the G7 Wanted values, without needing a new G7 press test.

Initial Linearization

- Prior to G7 calibration, linearize the plates as normal. This will normally produce different Measured values than Control Point values in the RIP.
- Enter the measured values in the linearization section of the RIP, leaving Wanted values the same as the Control Point values.

Caution: Avoid linearizing in finer steps than 10%. Smaller steps may introduce errors caused by the measuring instrument or plate artifacts.

- Expose a new plate and check that linearization worked correctly. If it did, the measured plate values should be close to the Control Point values, or File values.

G7 Calibration

- Perform a G7 calibration press run through the Initial Linearization curves created above, and measure the P2P target on one or more good printed sheets.
- In the *Create curves* pane check the *Delta* box.
- Add the delta values shown to the Wanted values in the RIP.
- Expose a new plate and check that the delta values have been achieved on plate, for example if Curve4 asked for a delta of +3% at 50%, where the plate previously measured 50% it should now measure about 53%.

Re-Linearization

Re-linearization should not normally be needed unless there has been a significant change in the plate process, for example a new batch of plates or a change in chemistry or laser power.

- To check linearization, temporarily restore the RIP to a linear state, but don't lose the current Wanted values.
- Expose a new linear plate and measure it.
- If the new Measured values are different from the old Measured values (recorded during the Initial Linearization), enter the new Measured values in the RIP.

Note: If the plate system has not changed, the Measured values should be within +/- 1% of what they were originally.

- Restore the current Wanted values to restore G7 calibration.

Post-linearized method

In this method the G7 calibration plates are made through a 'Linear' or 'Null' LUT, but the actual plate values are recorded as 'Reference Plate Percentages'. Future plate deviations are corrected by editing the G7 Wanted values until a measured plate matches the original Reference Plate Percentages.

Initial Plate Setup

- Prior to the G7 calibration run, set the RIP curves so that Control Point, Measured and Wanted values are identical. This should be the same as loading a 'Null' or 'Linear' LUT, but see some important cautions later under *Specific RIP Notes.*
- Produce a set of plates for the G7 calibration run and measure the plates at 5% or 10% steps.

Note: The actual Measured values do NOT have to be the same as the file values. For example it is not a problem if the 50% dot measures 45%, 53% or similar.

- Record these measured values as Reference Plate Percentages.

G7 Calibration

- Perform a G7 calibration press run through the same Null curves established in Initial Plate Setup, and measure the P2P target on one or more good printed sheets.
- In the *Create curves* pane make sure the *Delta* box is NOT checked.
- Enter the Control Point values shown in Curve4 as Wanted values in the RIP.
- Make a new plate and check that the wanted changes have been made. For example, if Curve4 asked for a 50% dot to reduce to 47%, on the plate the 50% patch should measure about 3% less than it measured without the curves, but it does not have to measure exactly 47%.

Note: Values measured on plate don't have to be exactly the same as Wanted values in Curve4. They only need to be RELATIVELY correct, compared to the original un-linearized plates.

- If the G7-calibrated plates are correct, measure one or more plates at 10% intervals and record these values as '*Reference Calibrated Percentages*' for future use when post-linearizing.

Post-Linearization on Top of G7 Calibration

This method allows you to make small plate linearization changes due to plate batch differences, and is ideal when only one or two curves are used in the RIP. When many curves are affected simultaneously by a basic optical, chemical or mechanical change in the plate system, Post-Linearization Without G7 Calibration (next item) may be more efficient.

- After any change in the plate process, for example a new batch of plates or change in exposure or processing, measure a plate made through the active G7 calibration LUTs at 10% intervals.
- Compare the measured percentages with the *Reference Calibrated Percentages* recorded in G7 Calibration (above).
- If the measured percentages are different from the *Reference Calibrated Percentages*, add the DIFFERENCE to the G7 Wanted percentages in the RIP. For example if the 50% file value measured 47% in the Reference Calibrated Percentages, but now reads 45%, add 2% to the current Wanted value at 50%.
- Produce a new plate and check it matches the Reference Calibrated Percentages.

Post-Linearization Without G7 Calibration

This method is convenient when many G7 curves are affected equally by a basic plate hardware or chemical change that affects all plate workflows. It is also the recommended way to handle plate quality control in general.

- To check the raw plate process, make a new plate through a Linear or Null LUT.
- Compare the Measured percentages with the Reference Plate Percentages recorded in Initial Plate Setup (above).
- If the Measured percentages are different from the Reference Plate Percentages, adjust exposure or other variables until the measured values match the Reference Plate Percentages.
- Once the plate matches the Reference Plate Percentages, any pre-existing G7 curves should continue to work properly.

Calibrating via a DLP

One way of exporting Curve4's Control Points is inside a DLP (Device-Link-Profile). DLPs exported by Curve4 contain precise 1-D CMYK calibration curves, but none of the normal 4-D transformations of a typical DLP. A Curve4 DLP acts like a very precise RIP calibration table which can be used in a RIP or

Photoshop. Photoshop can be used either as a low-productivity calibration workflow (if no other RIP solution is available), or to provide a quick calibration test prior to installing curves in a RIP.

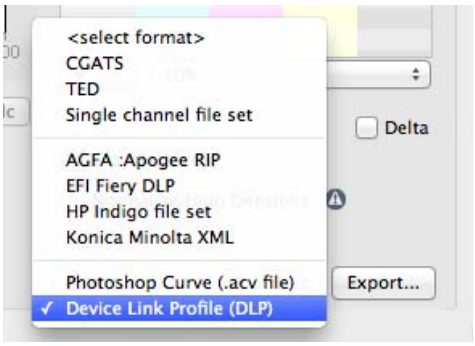
Note that DLPs exported by Curve4 may not work in all RIPs. Test before using them in production.

Saving a DLP from Curve4

- In Setup make sure *Wanted* is checked (not *Measured*)

Caution: DLPs created in Measured mode will NOT produce the desired result.

- In the Create Curves pane, select ***Device Link Profile*** in the *Export...* list



Exporting a Device Link Profile

- Click *Export...* and save the DLP in your computer's ICC profiles folder.

Choosing Measured vs Wanted with DLPs

Even if the RIP you plan on using the DLP in normally requires Measured values, always build the DLP with the Wanted option selected in Curve4's *Setup* panel. This is because a DLP acts separately from the normal RIP calibration curves.

Using a DLP in a Photoshop workflow

Photoshop CS4 and later can apply a Curve4 DLP. Photoshop CS3 and earlier cannot.

A Curve4 DLP applied in Photoshop provides a low-productivity but highly accurate calibration option when no other solution is available. It is not a very efficient way to apply calibration curves, but it can be useful for converting individual images or for demonstrating G7.

Caution: For safety, keep a copy of the original image as this process will change pixel values.

- Open a CMYK file to which you want to apply the DLP.
- In the *Edit* menu select *Convert to Profile…*
- Click the *Advanced* button (if visible).
- Under *Destination Space* click *Device Link.*
- Select the DLP from the *Profile:* list and click *OK.*

Note: This immediately applies the calibration curves to your image, which may now look incorrect if the assigned CMYK profile does not allow for the intended correction.

- Save the file under a new name to avoid over-writing the original
- Send the converted file to the device whose calibration curves made the DLP

Testing RIP accuracy in Photoshop

The result of applying a Curve4 DLP in Photoshop should be virtually identical to applying the same control point values in a production printing system or RIP. However in some cases a RIP may produce

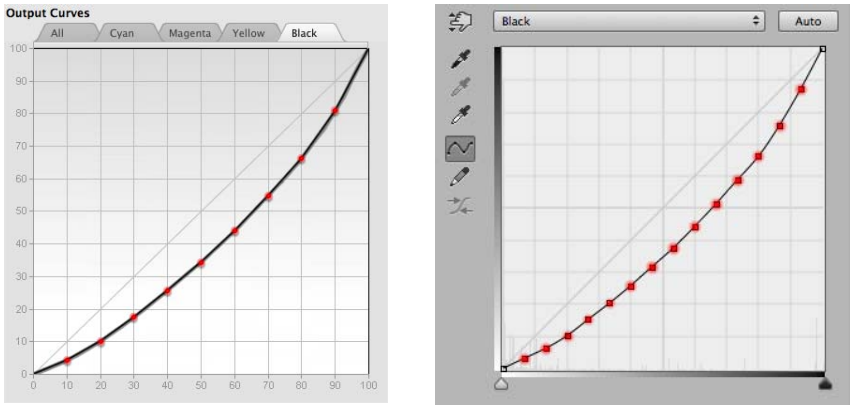
unexpected results from Curve4 calibration data. This is usually revealed as a *Fail* in the *Calibrate – Analyze – G7* pane (if using the G7 method) or incorrect curves in the *Calibrate – Analyze – TVI* pane.

You can see if the RIP applies the curves correctly as follows:

- Print an original[6] P2P target with no color management or calibration curves.
- Perform a G7 calibration and enter Curve4 calibration values in the RIP.
- Also export a DLP with exactly the same Curve4 settings.
- Print the same P2P target through the RIP with calibration curves but no color management.
- Measure the printed target into a new Curve4 *Run.*
- Name the *Run* "RIP method".
- Open a CMYK image of the same original P2P target in Photoshop CS4 or later.
- In the *Edit* menu select *Convert to Profile…*
- Under Destination Space click the *Device Link* button.
- Select the DLP from the *Profile:* list and click *OK.*
- Save the file under a new name to avoid over-writing the original.
- Print the converted file with the same settings used to print the original P2P.
- Measure the printed target into a new Curve4 *Run.*
- Name the *Run* "Photoshop method".
- In the *Calibrate* pane, compare the two *Run*s in the *Analyze – G7*pane.
- If the Photoshop method is successful but the RIP method is not, check how you entered the data into the RIP and if necessary, call your RIP provider for help.

Calibrating via Photoshop curves

Curve4 calibration can be applied via a Photoshop *Curves Pre-set* (.acv) file.



User Control Points in Curve4 (left) are translated into 14 equally-spaced points in Photoshop (right).

Results should be similar to calibrating with a RIP, but note that the Photoshop Curve will always contain the maximum number of points allowed by Photoshop (14) spaced at 7% intervals, regardless of the Control Point values and spacing you selected in Curve4. If this is not precise enough, use a DLP instead.

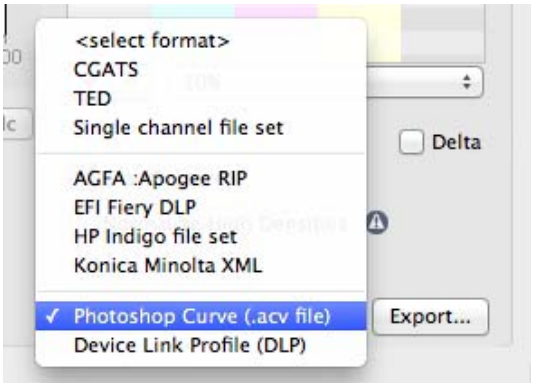
Saving a Photoshop curve from Curve4

- In *Setup* make sure *Wanted* is checked (not *Measured*)

Caution: Photoshop Curves created in Measured mode will NOT produce the desired result.

[6] *Be sure the P2P target image is unprocessed and contains the original CMYK percentages*

- In the *Create Curves* pane select *Photoshop Curve (.acv file)* in the *Export...* list



Exporting a Photoshop Curve

- Click *Export…*
- Save the .acv file where you can easily find it in Photoshop

Using a Curve4-generated Photoshop curve

Applying a Photoshop curve is not very efficient, but can be useful for occasional work where no RIP is available, or for converting individual images.

Caution: For safety, keep a copy of the original image as this process will change pixel values.

- Open a CMYK file to which you want to apply the calibration
- Open the *Curves* dialog either from the *Image – Adjustments…* menu or as an Adjustment Layer in the *Layers* menu
- At the top right of the Curve dialog, click the small icon which reveals more options and select *Load curves Preset…*
- Select the Curves Preset you saved from Curve4.

Note: This immediately applies the calibration curves to your image, which may now look incorrect if the assigned CMYK profile does not allow for the intended correction.

- Apply the curves either by flattening the image (be sure you have a copy) and saving it, or by exporting it as a new file without layers
- Send the curved file to the device whose calibration curves made the .acv file

Unit values and precision

Because an 8-bit pixel has 256 possible tone values, a good calibration system should accept fractional percentage values, as produced by Curve4. If your system only accepts integer percentages (whole numbers like 1%, 2%, 50%) accuracy may be compromised.

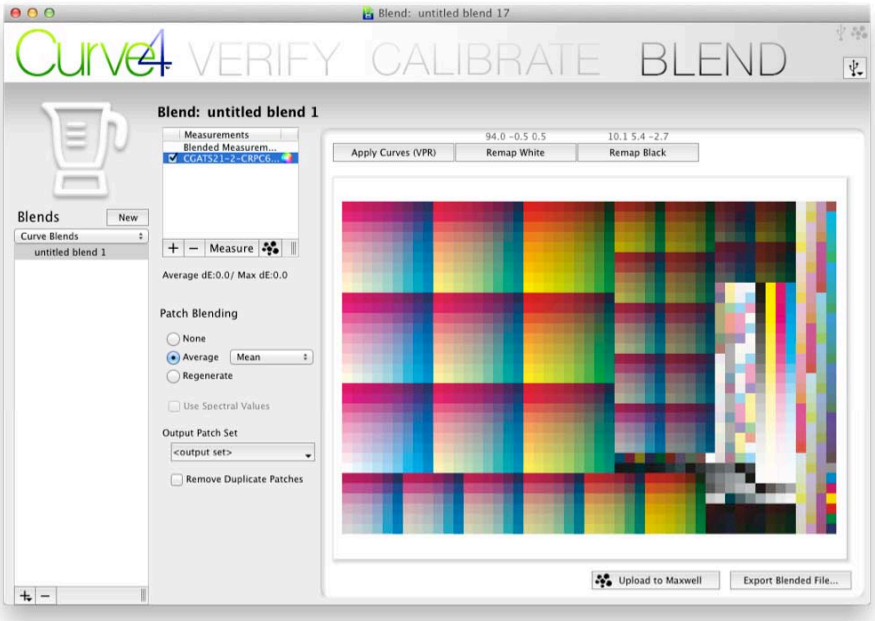
Some systems work in 8-bit digital units ranging from 0 to 255 where 255 = white and 0 = black. Curve4 percentages can be converted to 8-bit values using the formula:

$$8bit\ value\ =\ (100 - output\ \%)\ x\ 2.55;$$

A few RIPs accept calibration values in density units, usually with two decimal places. At the present time density values are not provided by Curve4.

Chapter 4: The Blend Tool

What is the Blend Tool?



The Blend tool with an IT8.7/4 target loaded.

The Blend tool (only available with the Complete license) offers a number of powerful utilities for modifying and improving characterization data, from which you can make better or more valuable ICC profiles. For example you can...

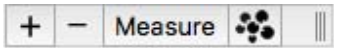
- Average multiple characterization datasets
- Smooth individual or multiple datasets
- Re-map the white point of a dataset by an enhanced SCCA method
- Re-map the black point of a dataset to approximate polarized measurements
- Post-calibrate a dataset with G7 or TVI curves
- Regenerate new target files with patches not in the original data.

Measuring and importing data

As with the Verify and Calibrate tools, data can be loaded into the measurements list in multiple ways;

Direct measuring

To measure a target click the *Measure* button (see *Appendix B: Measuring*). To measure another, click the *Measure* button again.



Click and load

If the *Measurements* list is empty, you can click on the message "click to load measurement data" and select a measurement file. To add more files, click the (+) button below the *Measurements* list

Drag-and-drop

To quickly load multiple files into a Run, open their enclosing folder in an Operating System window then select one or more files and drag them into the list.

Maxwell

To download measurements from your Maxwell account click the Maxwell icon. Click the icon again to download more measurements.

Working from ICC profiles

If you load an ICC profile into the measurements list, Curve4 extracts TC1617 CIELAB data from the profile's "Forward" (A2B) tag. The extracted data is used like any other measurement file.

Deleting measurements

Measurements can be deleted by clicking the (-) button below the list.

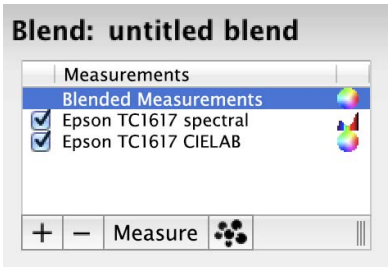
Accepted data types

Blend can work with colorimetric (e.g. CIELAB or CIEXYZ) or spectral color data.

Icons alongside each file identify whether the data in that file are colorimetric or spectral, asshown here;

Colorimetric: 

Spectral: 



Patch Blending (Averaging)

The Patch Blending selection controls how the data in the *Measurements* list are treated when more than one file and/or duplicate patches are present.

None

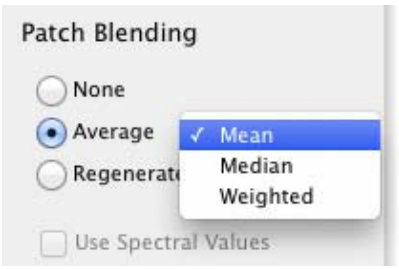
When the *None* button is selected, all patches in the measurements list are left untouched with no averaging applied.

Average

When the *Average* button is selected, any duplicated patches with identical CMYK values are output individually (if required by the selected output target) but with a common color value determined by the averaging mode, as follows;

Mean

.. the simple average of all patches with the same CMYK values.



Median

.. the median average of all patches with the same CMYK values.

Weighted

.. the weighted average of all patches with the same CMYK values.

Note that when *Patch Blending* is set to *Average*, the *Output Patch Set* list shows only targets containing real patches found in the measured data.

Regenerate

When the *Regenerate* button is selected, a completely new target defined by the *Output Patch Set* (see below) is created from the measurement data, including patches that may not exist in the measured data. Missing patches are created by an interpolation process similar to applying an ICC profile to a CMYK image. The interpolation process is so accurate that when *Regenerate* is selected, all patches (not just the missing ones) are regenerated by the same process.

The new target defined by the *Output Patch Set* can be either a pre-defined target like the TC1617 or IT8.7/4, or a custom target defined by a CGATS file type.

For more information see *Output Patch Set,* below.

Output Patch Set

The Output Patch Set determines what type of file is output by the Blend Tool.

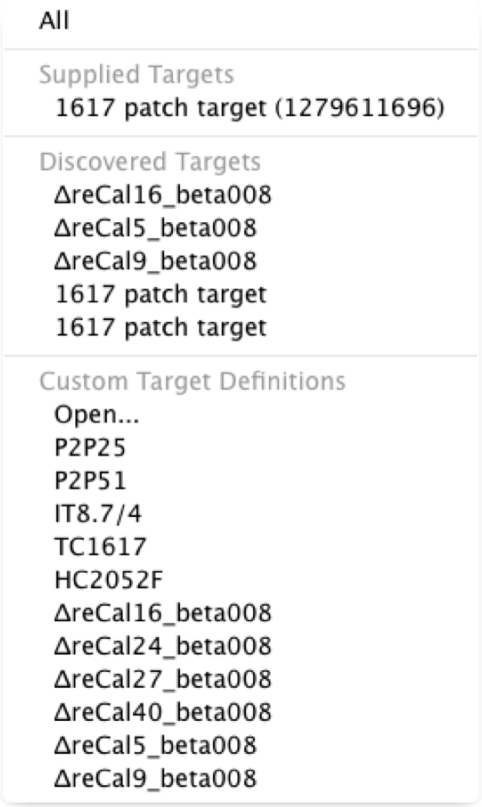
All

All patches are concatenated (strung together) and output as one large file with all patch color values exactly as they were input.

For example if the Measurements list contains two 1617-patch IT8.7/4 files and a 300-patch P2P51, the total output file will contain 3,534 patches.

Remove Duplicate Patches

If *Remove Duplicate Patches* is checked, patches with identical CMYK values are output as a single patch, whose color value is the simple average of all similar patches.



Supplied Targets

Shows all the target types in the list. If multiple targets or duplicate patches are present they are averaged according to the *Average* setting.

Discovered Targets

Shows all the targets that can be assembled from real patches in the Measurements list. If multiple targets or duplicate patches are present they are averaged according to the *Average* setting.

Custom Target Definitions

Shows all Supplied and Discovered targets, plus the option to *Open...* a custom target with CMYK values not in the Measurements list, or select from custom target definitions you have added to the *Custom Target Definitions* folder (see *Chapter 1: Software Principles*).

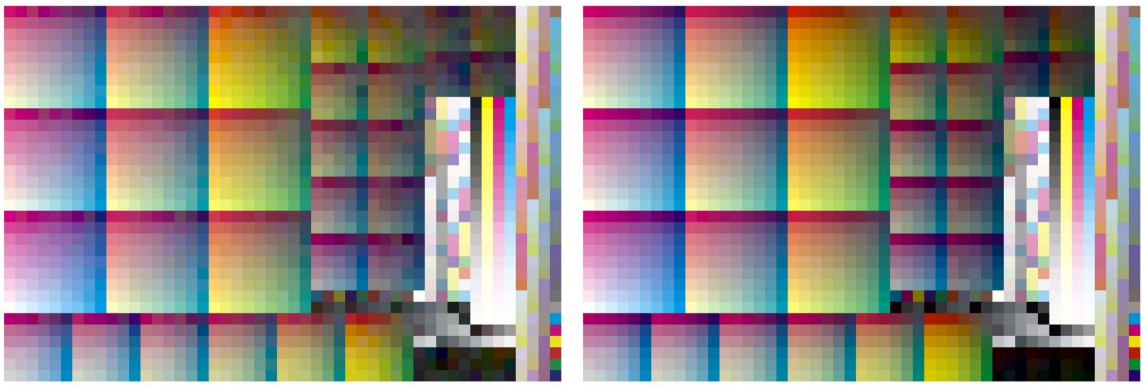
Note that custom targets can only be created if their patch values exist in the Measurements list, unless *Regenerate* is selected, in which case any taregt can be created even if its patch values are missing from the measurement files.

Data Smoothing

The ***Average*** button acts as a data smoothing function that minimizes the effect of press variation across the printed target area. Smooth data is essential when creating ICC profiles, otherwise the profile can introduce banding or mottling in live images, as shown below.

Banding from a profile made from noisy data (left) and after smoothing (right)

Uneven data is often revealed when a randomized IT8.7/4 target is rearranged and displayed in its visual layout, as shown below. Notice the mottled appearance of adjacent patches in the left target, and the smoother appearance of the same patches in the right target, after Averaging in Curve4.



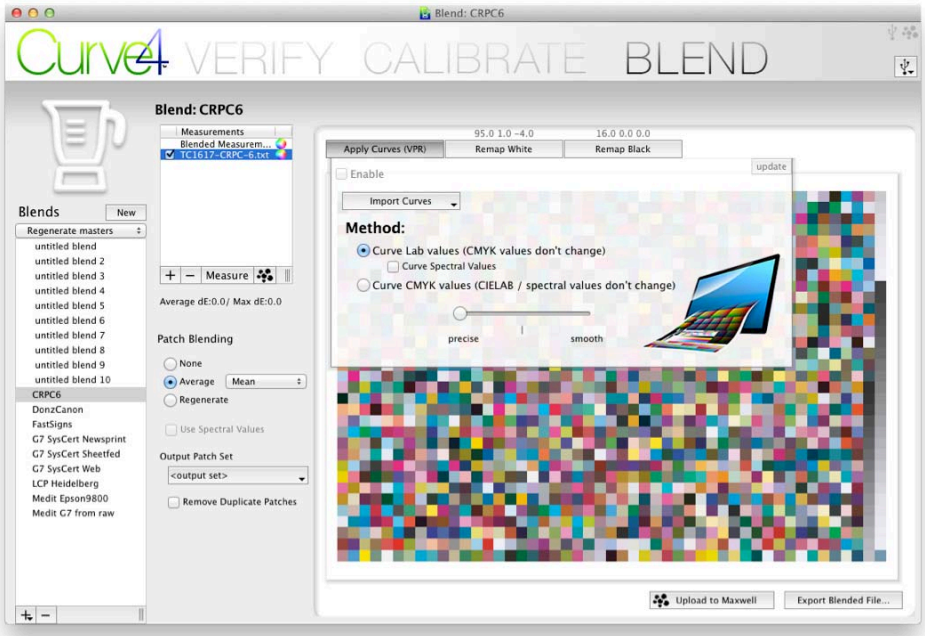
The IT8.7/4 target with noisy data file (left) and the same data after smoothing (right)

Smoothing single vs. multiple targets

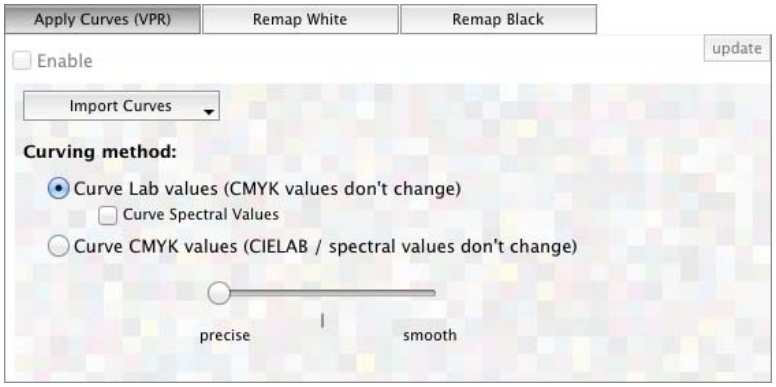
The Averaging function in the Blend tool can improve a single data file somewhat, but a better approach is always to measure and average multiple targets from print samples.

Apply Curves (VPR)

The *Blend VPR* pane applies calibration curves to measurements in the current Blend.



The Blend Apply Curves (VPR) pane.



The Apply Curves (VPR) pane.

Import Curves

The Import Curves button opens a list of available calibration curves including all Runs in the current Calibrations folder. It also lets you open curves saved in a text file.

CAUTION: For VPR to work correctly, the color data in the current Blend must be printed in exactly the same way as the target(s) that created the calibration curves being applied.

Method

Curve Lab values

When *Curve Lab values* is selected, the CMYK values in the Target data file remain unchanged but the measured Lab values are altered to what would have been produced if a second press run had been printed through the Output Curves. *Curve Lab values* results in a modified characterization data file in the standard CGATS format that should be accepted by all profiling software.

Curve Spectral values

Curve Spectral Values does the same as Curve Lab values, but if the data file contains spectral data, modified spectral values are exported.

Curve CMYK values

When *Curve CMYK values* is selected, the Lab or spectral values remain unchanged but the CMYK values are altered by the calibration curves. Note that *Curve CMYK values* performs a different, less useful function and results in non-standard CMYK values which may not work in some profiling software.

The Quality slider

For most work, leave the quality slider at “precise”. “Smooth” may help with uneven data but is not recommended for high quality work.

Applying the curves

To VPR data measured from a characterization target such as the IT8.7/4 or HC2052, or any custom characterization target saved in the CGATS file format;

- *Import* the curves you want to apply.
- Select the *Method* (normally Curve Lab values).
- Set the Quality slider (“*precise*” is normally best).
- Click *Enable.*
- Click *Export Blended File* and save the new characterization data file in a suitable location.

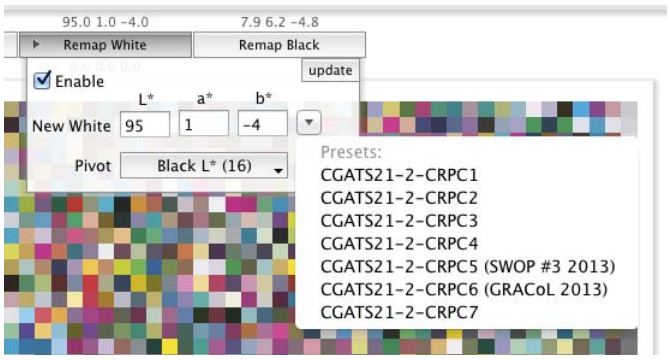
Note: When you click Export Blended File, all functions in the Blend Tool pane are applied at once, including Patch Blending, Curves, Remap White and Remap Black. If you only want to apply curves to the data, be sure all other functions are off .

Remap White (SCCA)

The *Remap White* pane lets you change the white point of the output data to simulate the effect of printing the same inks on a different colored substrate using the SCCA (Substrate Corrected Colorimetric Aims) method. *Remap White* affects not only the white point (substrate color) but all color values in the data.

Entering new white point LAB values

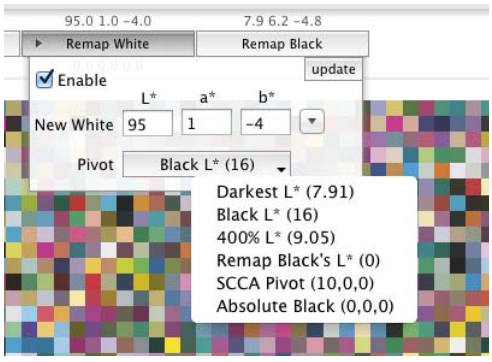
Either type in new L*, a* b* values or select a new white point from the presets list accessed by the down arrow next to the LAB values.



The Remap White pane with the Presets list.

Pivot

The *Pivot* number is the darkest L* value at which the Remap White point function hinges, or pivots. To understand this requires an understanding of how the SCCA function works;



The Remap White pane with the Pivot options list.

For every patch in the dataset, the SCCA algorithm subtracts a constant offset from X, Y and Z, multiples the remaining X, Y and Z values by constant gain factors determined by the new white point, then adds back the XYZ offset. The XYZ offset values are derived from the Pivot L* value, as follows;

Darkest L*

- SCCA pivots on the darkest L* found in the data set, which may not be a neutral patch.

Black L*

- SCCA pivots on the L* of 100% black ink, which is usually not be the darkest L* in the dataset.

400% L*

- SCCA pivots on the L* of 400% patch (100% or all four inks), which may not be the darkest L* in the dataset.

Remap Black's L*

- SCCA pivots on the L* value determined by the Remap Black pane.

SCCA Pivot (suggested default)

- SCCA pivots on the default 10 L* value specified in the SCCA formula.

Absolute Black

- SCCA pivots on 0 L*.

With small white point changes, all the above options are virtually indistinguishable. They are provided mostly for experimental color scientists. The recommended default is *SCCA Pivot* except when using the *Remap Black* tool, when you must select *Remap Black's L*.*

Applying Remap White

- Enter the desired new Lab values.
- Click *Enable.*
- Click *Export Blended File* and save the new characterization data file in a suitable location.

Note: When you click Export Blended File, all functions in the Blend Tool pane are applied at once, including Patch Blending, Curves, Remap White and Remap Black. If you only want to remap the white point of the data, be sure all other functions are off.

Remap White cautions

Although the SCCA function used by Remap White is an ISO standard and has been shown to work well in laboratory environments, its accuracy cannot be guaranteed in all cases. For example, SCCA assumes the substrate (e.g. paper) is a perfect reflector (which is never true) and ignores ink variables like absorbency, opacity, trapping and fluorescence.

SCCA is good for simulating small white point changes on similar stock types, but is less accurate with different paper or substrate types, for example simulating how a coated data set would look on uncoated paper. Remember Remap White (SCCA) is a shortcut to real printer characterization.

Remap Black

Remap Black changes the black point of a data set to increase or decrease apparent ink density, saturation and contrast. Like Remap White, Remap Black alters XYZ values in a linear function, but pivots on the white point instead of black to affect shadows more than highlights.

Why do we need to Remap Black?

Remap Black helps solve a common problem whereby a proof that is meant to simulate a matte material like newsprint or uncoated stock has too little contrast compared to the original print. The simplest explanation for this is that most spectrophotometers generate more optical flare on matte surfaces than the eye sees in a viewing booth, which causes darker areas to measure lighter than they appear. For a more detailed explanation, see *Appendix K: The 0-45 Problem.*

Appearance of an actual newsprint sample in a viewing booth (right) and its typical washed-out proof (left).

One solution would be to measure matte materials with a polarized spectrophotometer, but polarizing is a rare option in automated spectrophotometers, and M1 measurements are not possible with a polarizing filter.

Another solution is to modify the measured data with the Remap Black tool, which approximates the effect of polarized spectrophotometry without the cost of a polarized spectrophotometer, and without sacrificing M1 capability.

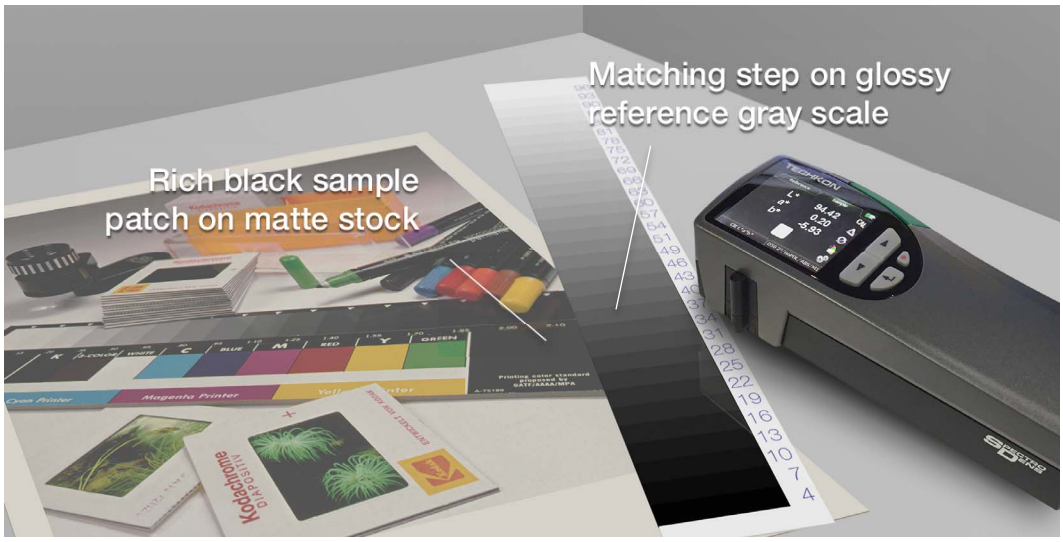
Determining black L* correction values

To determine the black L* correction values you will need;

- A “reference gray scale” printed on glossy material
- A dark neutral “sample patch” printed on the matte material from which the characterization data was measured.

Note that the sample patch can be any dark black area in an actual image, or a deliberately printed swatch, for example e.g. 400% rich black. The CMYK percentage values in the sample patch are unimportant.

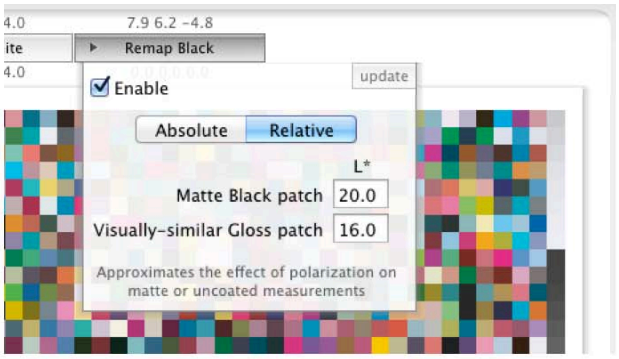
- In a viewing booth, slide the reference gray scale over the sample patch until you find the step on the gray scale that *visually matches* the *neutral density* of the sample patch. Tilt the matte sample to get the maximum visual contrast, as you might tilt it during normal viewing.
- With a spectrophotometer, measure the L* value of the matte sample patch.
- Measure the L* value of the matching step on the glossy reference gray scale.



Finding matching neutral densities by eye in a viewing booth.

Entering values – Relative method

To solve the problem of washed-out proofs discussed on the previous page, set up the Remap Black control by the *Relative* method. To find the L* values for *Matte Black patch* and *Visually-similar Gloss patch*, see *Determining black L* correction values*.)



Remap Black pane in Realative mode.

- In the *Remap Black* pane, click *Relative*.
- Enter the L* value of the sample patch in the *Matte Black patch* box.
- Enter the L* value of the matching patch on the reference gray scale in the *Visually-similar Gloss patch* box.

Entering values – Absolute method

If you just want to make give the data a specific black L* value, use the *Absolute* method.

- In the *Remap Black* pane, click *Absolute*.

- Enter the L* value of the desired maximum black value.

Applying Remap Black

- Enter *Absolute* or *Relative* L* values as shown above.
- Click *Enable.*
- Click *Export Blended File* and save the new characterization data file in a suitable location.

Note: When you click Export Blended File, all functions in the Blend Tool pane are applied at once, including Patch Blending, Curves, Remap White and Remap Black. If you only want to remap the black point of the data, be sure all other functions are off.

Remap Black cautions

Remap Black approximates the major benefit of polarized (or spherical) spectrophotometry, i.e. restoring the lost contrast often experienced with 0-45 geometry optics, but your remapped data will not be exactly the same as measurements made with an actual polarized or spherical instrument.

Although Remap Black has produced major improvements in a number of real-world tests, it is not a recognized standard, has not been tested independently, and comes with no guarantee of effectiveness. We encourage you to test Remap Black and share your experiences with us via the feedback tool.

Exporting Blended Data

When you have enabled all the controls you want to apply to the data in the Measurements list, click *Export Blended File...* or *Upload to Maxwell*...

The Export and Upload buttons

The content of the Exported file is defined by the *Output Patch Set* selection.

Output File Format

The Blend Tool outputs processed data either in CGATS, .cxf or .mxf file formats.

CGATS text files contain some basic header information but may not match the original file you started with. If the output file must have the same header as the original file;

- Open both files in Microsoft Excel or an equivalent software
- Copy the rows between BEGIN_DATA and END_DATA in the modified file
- Paste these rows over the same locations in a COPY of the original file
- Save the modified file as a ".txt" file.

Note: The changes made by Blend will not be reflected in the header data. For important work you should make a note of the changes in the header for future reference.

A

Appendix A: Target Printing

Basic rule: Calibration targets should be printed exactly the same as normal work.

Stabilizing the System

Before attempting to calibrate or profile a printing system it should be in a stable and repeatable “base-line” condition that can be defined and restored through a combination of media, ink mechanical, physical, chemical and/or software specifications. All variables and process settings must be recorded carefully for later reference.

The ideal base-line setup depends on the printing technology, substrate, colorant selection and many other variables that are too numerous to cover in detail here. For the purposes of this document we assume you already know how to operate your printing system and simply offer a few basic guiding principles.

RIP curves

When performing a brand new calibration, make sure there are no calibration curves present in the RIP or driver. If you are re-calibrating, make sure you know the curve values in use and can select them in the *Based On:* list, either from a previous Calibration, or as a text file.

Ink levels and ink-restriction

In offset, gravure, flexo and screen printing, the quantity of ink offered to the printing surface is largely controlled by mechanical means at the time of printing. Naturally it is important that the ink quantity delivered during calibration is the same as during subsequent profiling or production printing.

With ink-jet and xerographic printers, ink quantity is controlled by resolution or media settings that cannot normally be adjusted during production. While this tends to help consistency, it requires some initial testing to establish the correct settings. Most ink-jet printers can deliver more ink than needed, and some form of ink-restriction or ink limiting is needed to prevent wasting excess ink and avoid problems with drying, swelling, cracking, etc. Curve4’s Ink Restriction feature can helps determine optimum Ink Restriction Percentages.

Note: Ink restriction is one of the most powerful tools for matching two or more printers of the same model to each other, assuming all use the same ink and media.

Color Management (Off!)

Targets for calibration or for ICC profiling should be printed without any color management, GCR or “ink saving” applied. Once the system is calibrated and characterized, GCR and/or custom ink-saving features can be added via the profile, in the RIP, or with custom ink saving software in the workflow.

If color management cannot be disabled, conventional G7 cannot be applied, but if the RIP offers editorial tone curves, G7 can be applied on top of color management. Just print the calibration target through the color management setup then enter Curve4’s correction values via editorial curves.

Size changes (don’t)

If the target will be measured on an X-Rite DTP70 or a X-Rite iSis, be sure to print the target at exactly the same size as the file. If the target will be measured with an X-Rite i1iO or a hand-held device in spot mode, you can re-size or stretch the target size to fit the measuring area.

Back-side printing

Ideally, nothing should be printed on the reverse side of any calibration (or characterization) target. If back-printing is unavoidable, for example in web printing, either measure with black backing or make sure the reverse image is a flat tint of uniform color and density across the whole target area.

Drying time

Most printing systems require some kind of drying or curing period before color and density are stabilized. Measuring a target before the drying time is complete may result in incorrect calibration curves. The same rule applies when measuring characterization data for Curve4’s VPR function.

Before calibrating or profiling a printing system, find the correct drying time by measuring a P2P target immediately after it is printed, and then again after about 10 minutes, 30 minutes, and if necessary up to 24 hours. Look for changes in the gray balance and NPDC curves in the Measurements pane. When measuring the same target multiple times, be careful not to scratch the surface or damage the target.

The minimum drying time after which no change was observed indicates the required drying time for all targets before measuring them.

Coating and finishing

If you normally apply coating or finish process, for example aqueous varnish or a laminate, be sure to apply the same finish to the calibration targets, and to the characterization targets if making profiles. If you only apply the finish sometimes, test to see if curves calculated with the finish applied are good enough for non-finished work. If not, you will need two sets of curves for finished and unfinished prints.

To determine if you need separate calibration curves for coated and un-coated printing, print a target (or series of targets) with and without coating, but with everything else the same, then compare the NPDC graphs and gray balance corrections suggested by Curve4. If they are nearly the same, use one common set of curves for both conditions.

Averaging multiple targets

On devices with uneven ink coverage or other irregularities across the printing surface, at least two P2P targets should be printed in the same page. On an offset or digital press, print as many targets as are practical and average them in Curve4.

The *Smooth* button can improve calibration, even when multiple targets have been measured.

On any device, the best calibration curves are made by performing several G7 Calibration press runs over several days or weeks, and averaging the results.

Averaging multiple press runs

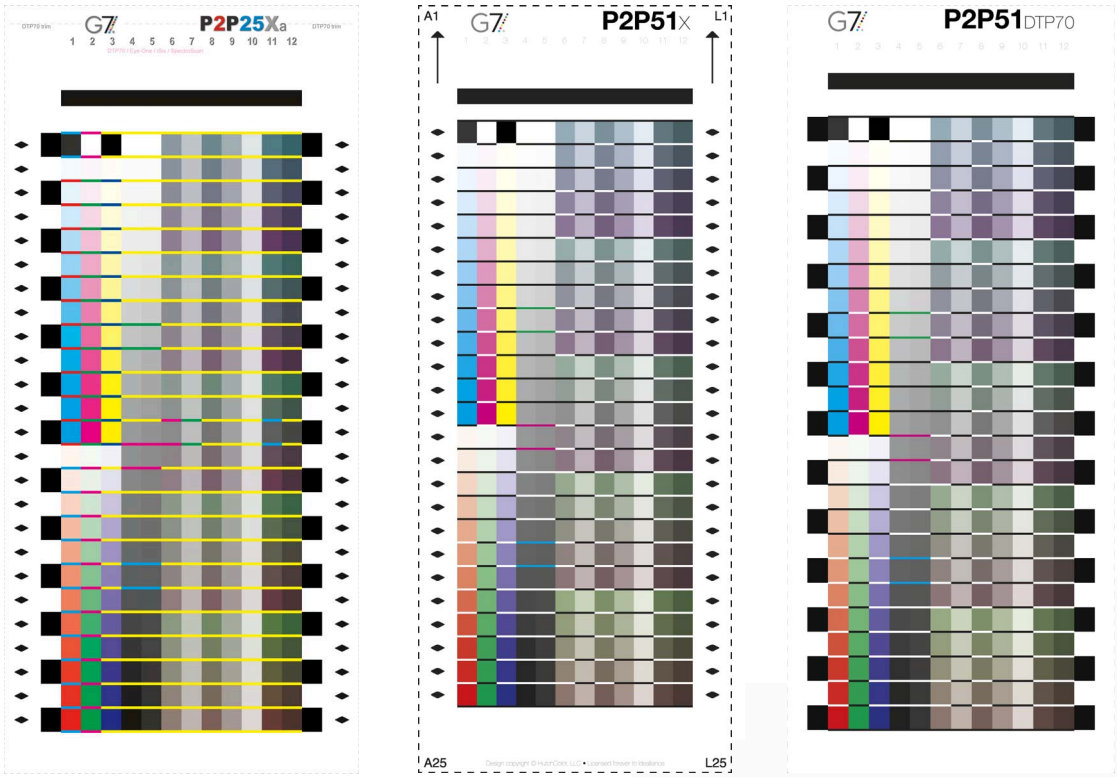
On printing systems whose performance varies significantly from press run to press run, such as offset lithography, screen printing, flexography and electro-photography (dry or wet toner), one press run is not enough to determine the average performance of that system over time.

On any device the best calibration curves are made by performing several calibration press runs over several days or weeks, loading as many samples as you can from each press run, then de-selecting any that don't fit the average of the group.

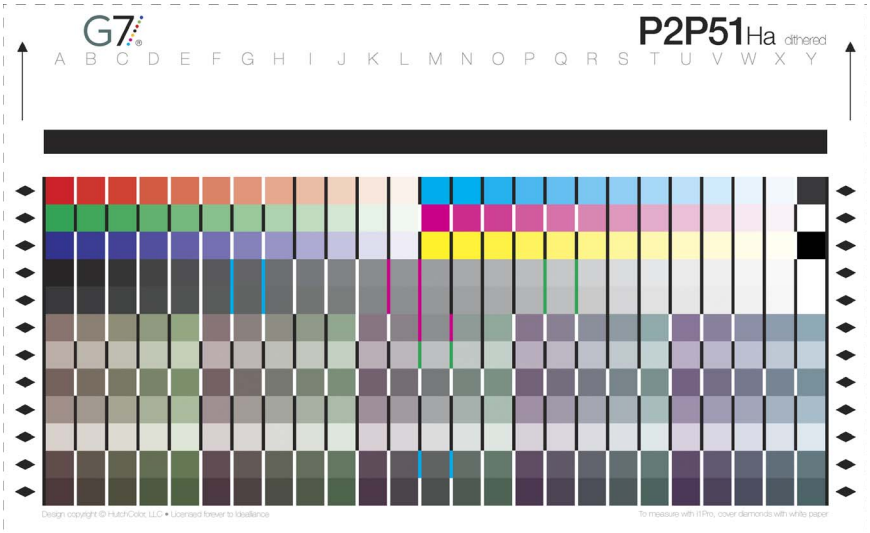
Compatible targets

The P2P51

The P2P51 replaces the old P2P25 as the recommended default G7 target in Curve4. Available in three versions; P2P51x (vertical), DTP51Ha (faster measuring on i1iSis) and P2P51_DTP70 (for DTP70 users), these targets can be downloaded free from www.Idealliance.org or www.hutchcolor.com and from within Curve4 in the *Web* menu under *Updates for P2P targets…*



The old P2P25 target (left), the new P2P51x target (center) and the P2P51_DTP70 (right).



The new P2P51Ha target reduces measuring time by about 50% on the X-Rite i1 iSis.

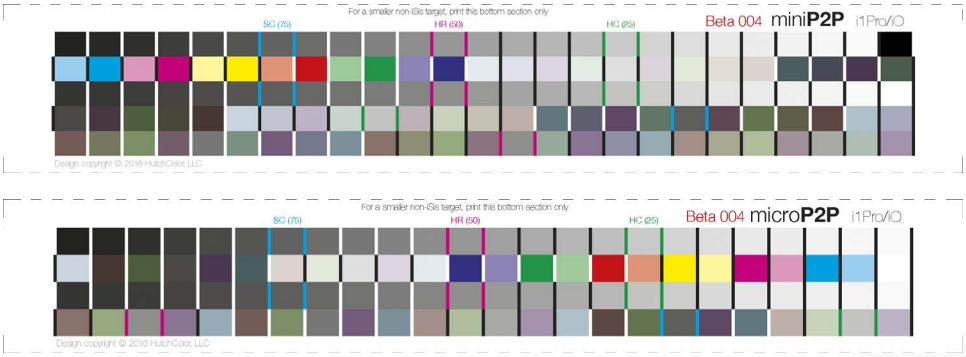
Compatibility with older P2P targets

Curve4 calibrates with the P2P51, P2P25 and certain custom P2P targets like the P2P26 (optimized for HP Indigo) and P2P27 (fore-runner of the P2P51).

With the Complete license, Curve4 will also work with earlier P2P targets including P2P12, P2P14, P2P19, P2P21 and P2P23, but these are not recommended.

MiniP2P and microP2P

Curve4 introduces two new smaller P2P targets, the *miniP2P* (125 patches) and the *microP2P* (96 patches), which take up less room and are much faster to measure than the P2P51. Tests show they can produce similar quality to the P2P51 on most printing systems, but in some cases the P2P51 may be more accurate, especially in dark shadow areas.



The miniP2P (top) and microP2P (bottom).

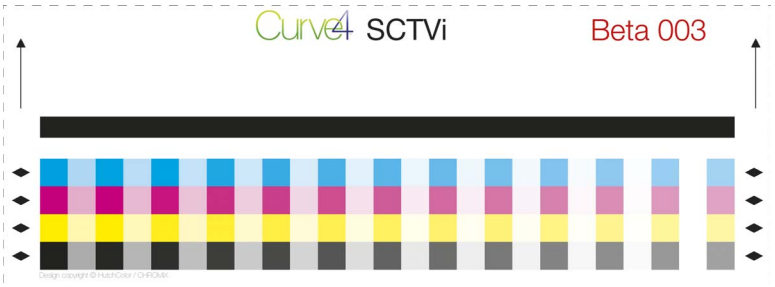
Custom-generated and odd-size targets

If your device or software needs a custom target, you may be able to create one in your own software from a P2P definition file, but be aware of the following:

- Custom-generated P2P targets MUST contain fractional percentage values, especially in light patches below 10%. Rounding fractional percentages to integers will cause calibration errors.
- 8-bit P2P targets supplied by HutchColor employ LSB (least significant bit) dithering to deliver 16-bit performance. This extra precision is normally unavailable in user-generated targets.

TVI / SCTV calibration targets

The new *Curve4 SCTVi* target is designed for both TVI and SCTV calibration. Curve4 can also calibrate TVI and SCTV with a P2P target with slightly less precision.

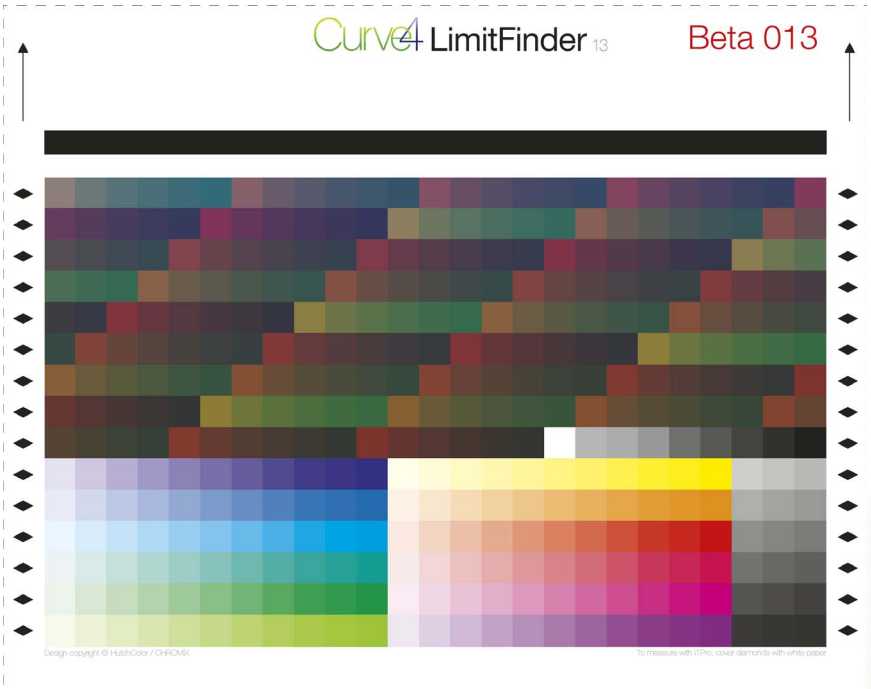


Curve4 SCTVi target (beta version)

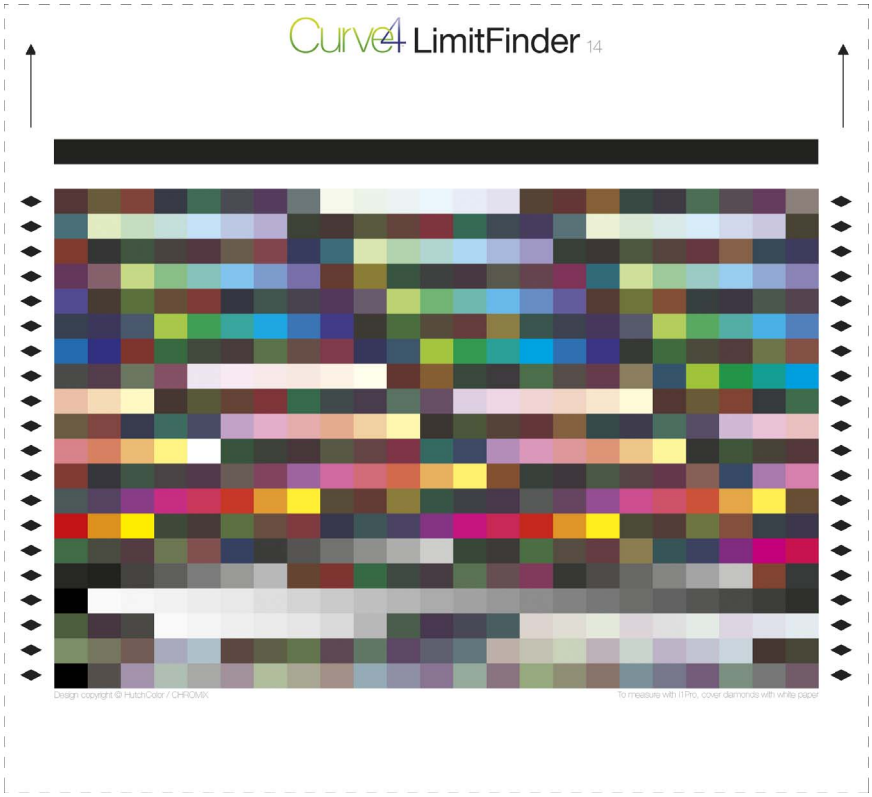
Note that when used for SCTV calibration, the SCTVi target channel names “CMYK” are place-holders only. In fact you can assign any ink you like to each channel and Curve4 will still work correctly.

Ink restriction targets

The Curve4 ink restriction function will work with many different kinds of target including the P2P51, TC1617 and a variety of custom Ink Restriction targets such as the *LimitFinder 13* or *LimitFinder 14*.



LimitFinder 13 (375 patches)



LimitFinder 14 (460 patches)

For information in how to use each of these targets, see their respective User Guide chapters.

B

Appendix B: Measuring

The most requested feature in Curve3 – built-in measuring – is provided in all Curve4 license levels.

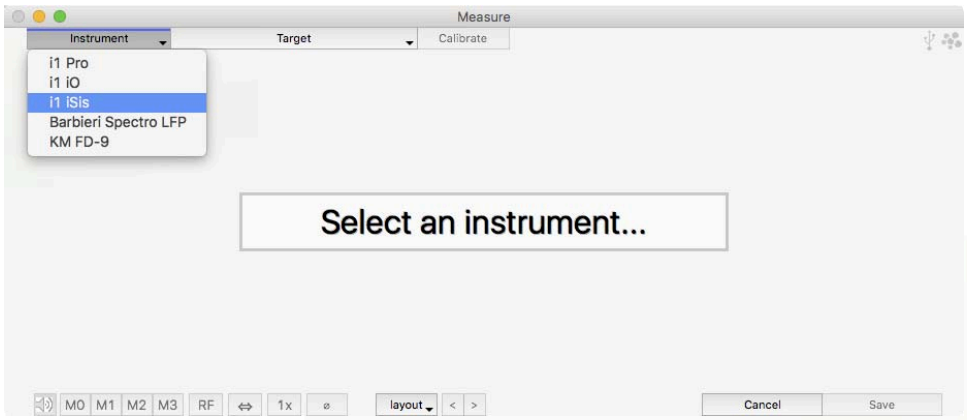
Supported Devices

Curve4 can measure with the following instruments;

- Barbieri Spectro LFP
- Konica Minolta FD-9
- Techkon SpectroDrive
- Techkon SpectroDens
- X-Rite i1 Pro versions 1 & 2
- X-Rite i1/iO versions 1 & 2
- X-Rite i1iSis versions 1 & 2

Depending on the instrument, Curve4 enables M0, M1, M2 and M3 illuminant options, Reflective / Transmissive mode, aperture size and single or multiple measurements per patch.

Connecting

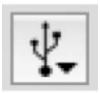


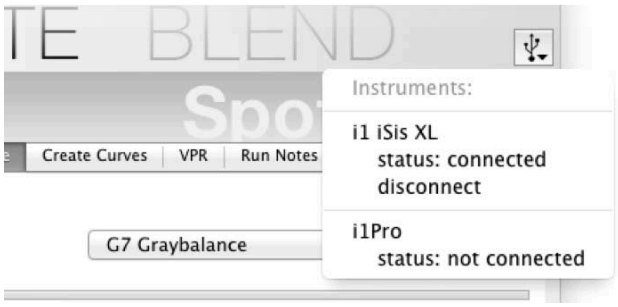
Device selection

- Connect the device to a USB port.
- To begin measuring, click the *Measure* button below the *Measurements* list.

Connection status / disconnect

Click the small USB icon (top right of the main Curve4 window) to see what measuring instruments are currently connected.



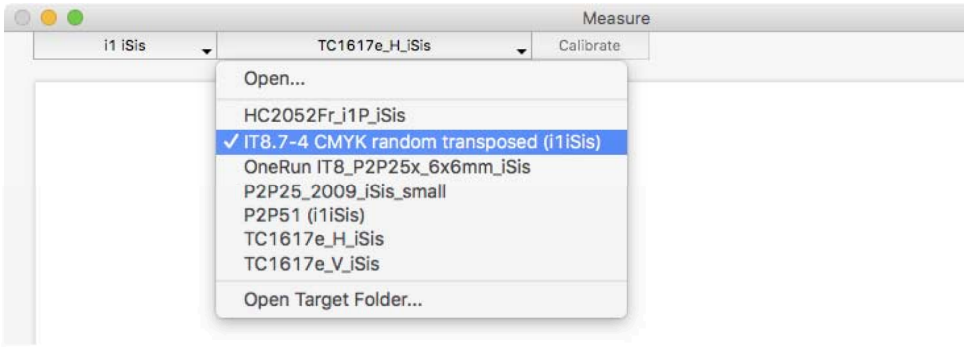


The Instruments: USB connection list.

To release an instrument so another software (e.g. i1Profiler) can use it, without quitting Curve4, click that instrument's *disconnect* button.

Selecting a target

Click on the *Target* list and select the target you want to measure.



The target selection list.

Target Definitions

Curve4 recognizes target definition files created by ...

- Barbieri Chart Generator
- X-Rite ColorPort
- X-Rite i1Profiler
- X-Rite MeasureTool

... as well as standard CGATS text target definition files (for some instruments).

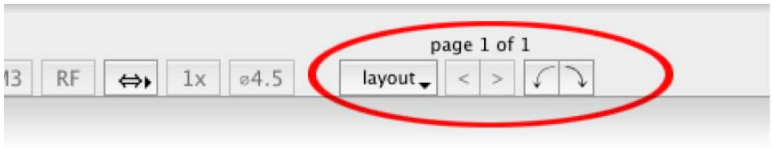
Adding targets to the list

If the target you want to measure is not in the *Targets* list, either click *Open...* and load the target reference file directly, or click *Open Target Folder...*[7] and copy the target reference into the folder for your device. The new target will appear immediately in the list.

Accessing the Target References Folder from the Window menu.

Target orientation

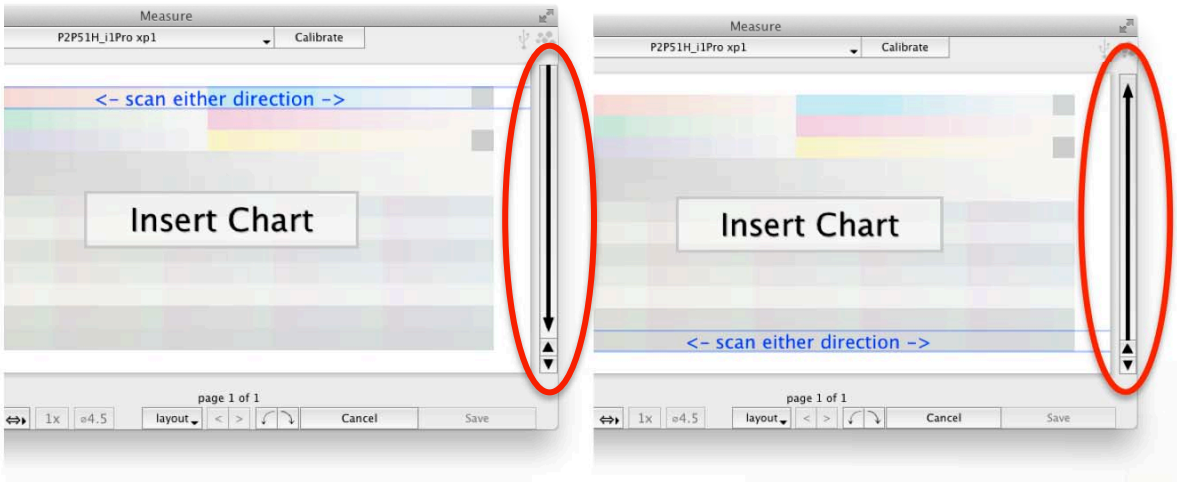
If the image in the *Measure* window is rotated or flipped compared to the printed target, click the rotate arrows until it matches.



Target rotate buttons

Measuring direction

When measuring with the i1Pro, you can change the order in which rows are measured by clicking the long arrow to the right of the measure window so it faces the opposite direction.



Altering measuring direction for i1Pro

To re-measure a specific row, click the small arrows.

[7] *Note: the Target Reference Folder can also be accessed from the Window menu.*

Measure

Follow the instructions to measure the target. Note that there is no need to save anything – the data is loaded automatically into the *Measurements* list.

Exporting Measured Data

To export measurements taken by Curve4;

- Select the file in the Measurements list
- In the main menu, click File – Export Measurement File...
- Navigate to a suitable location and click Save

C

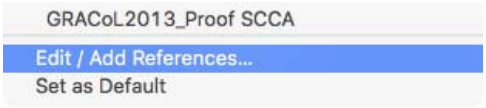
Appendix C: Custom References

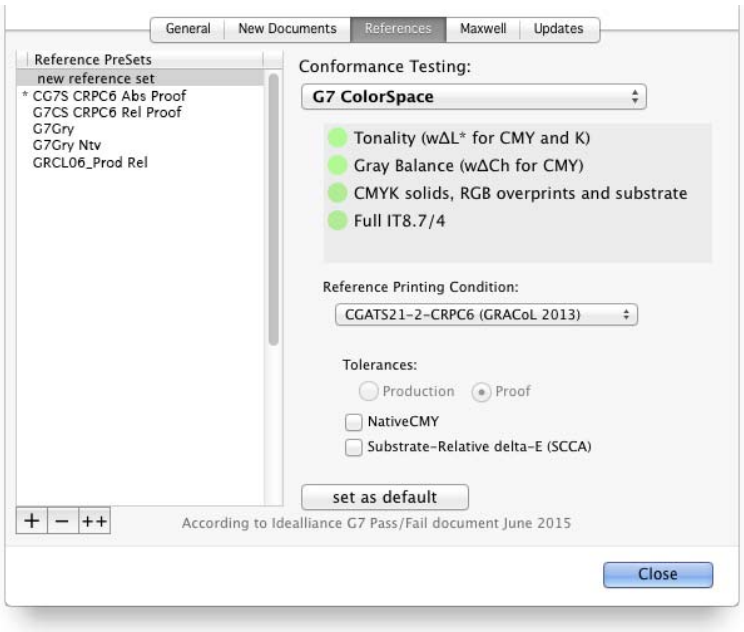
A *Reference* is a set of metrics and tolerances used by a *Verification*. Variables are taken from the Idealliance G7 Master Pass/Fail document and include G7 compliance type (Grayscale, Targeted, Colorspace), target color space (CRPC), production or proof tolerances, SCCA and Native CMY.

Adding a New Reference

To create a new Reference;

- Click the *Reference* pop-up and click *Edit / Add References*... to open *References setup*.





The Reference setup window. Your default reference is marked with an asterisk (*).

- Click the (+) button.

- Give the Reference a name that replaces the temporary *"new reference set"* name (see *Reference Naming Conventions*).
- Set the desired parameters.
- If you want to make this the default reference, click *set as default.*
- Close the window.

Note: The new reference is not automatically applied. You must choose it after closing the window.

Deleting a Reference

- Select the *Reference* you want to delete and click the minus (-) button.
- To avoid the warning message, hold down *Option* while clicking the (-) button.

Duplicating an existing Reference

- Select the *Reference* you want to duplicate and click the (++) button.
- Give the Reference a name.
- Set the desired parameters.
- Close the window.

Editing a Reference in the Pass/Fail badge

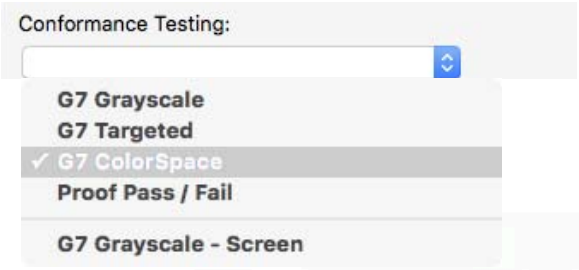
Moving the mouse over the PASS / FAIL badge reveals a + button, which lets you temporarily modify the Reference from within the Pass Fail badge.

Click the + sign to alter reference parameters within the Pass Fail badge.

To make the modifications permanent, click the *Save* button (bottom right). This takes you to the References window with the edited reference temporarily named *Custom*. Double-click the name *Custom* and give the new Reference a unique name.

The Compliance Test: list

Each Verification preset supports one of five items in the *Compliance Test:* list, *G7 Grayscale*, *G7 Targeted*, *G7 Colorspace*, *G7 Grayscale / Screen* and *Proof Pass / Fail*.



The Compliance Test: list determines what type of test the reference will perform

G7 Grayscale

Select *G7 Grayscale* to test the basic G7 definition of tonality (NPDC) and gray balance, for example if your printed sample does not use standard colorants or match a standard color space.

G7 Targeted

Select *G7 Targeted* if the sample meets not only G7 Grayscale compliance but also has primary and secondary solid ink colors that match the CIELAB ink values in the selected CRPC within Idealliance G7 Master tolerances.

Note: G7 Targeted compliance can be absolute or relative to the substrate (see SCCA below).

G7 Colorspace

Select *G7 Colorspace* if the sample meets not only G7 Targeted compliance but also its IT8.7/4 measurements match the selected CRPC within Idealliance G7 Master tolerances.

Note: G7 Colorspace compliance can be absolute or relative to the substrate (see SCCA below).

G7 Proof Pass / Fail

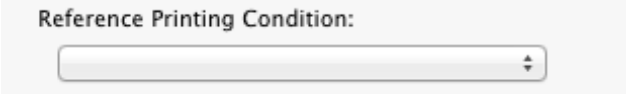
Select *G7 Proof Pass / Fail* to Verify individual proofs with an Idealliance ISO 12647-7 target.

G7 Grayscale – Screen

Select *G7 Grayscale – Screen* to evaluate a screen-printed sample. This sets wider tolerances (defined in the *G7 Master Pass Fail* document) to allow for the unusual challenges of screen printing.

The CRPC: list

If the Verification type is *G7 Targeted*, *G7 Colorspace* or *Proof Pass/Fail*, select the CRPC (Characterized Reference Printing Condition) that the print or proof is aiming for from the *CRPC:* list.

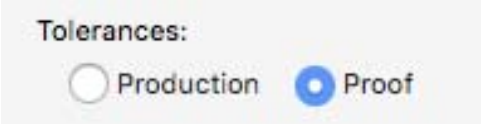


The CRPC: list selects the CRPC for G7 Targeted, G7 Colorspace or Proof Pass/Fail.

If *Compliance Test:* is set to *G7 Grayscale* or *G7 Grayscale – Screen*, *CRPC* is ignored.

Tolerances

The Idealliance G7 master specification defines more stringent Pass / Fail tolerances for proofing than for production printing. The tolerances used by a Verification preset are selected by the *Production / Proof* radio buttons.



G7 Master compliance has tighter tolereances for proofing than production printing.

To create a Reference for a production printing system, e.g. an offset press, click *Production*.

To create a Reference for proofing system, click *Proof*.

Note: G7 Proof Pass / Fail references cannot be set to Production tolerances.

Native CMY

The G7 Master Pass / Fail specification makes a special exception for printing systems that cannot achieve neutrality in the 300% CMY patch. This exception, known as “Native CMY”, adjusts the gray balance target values in very dark tones (above about 75%) to aim for the native a*, b* value of the device’s 300% patch, rather than the traditional 0.0 a* and 0.0 b* specified by G7.

If your printing device cannot be adjusted by physical means (such as adjusting ink densities) to achieve a near-neutral CIELAB value in the 300% CMY patch, select *Native CMY*.

Note that Native CMY is only intended for printing systems that cannot be made neutral at the 300% CMY point by physical adjustments on press, for example xerography.

CAUTION: Native CMY is not intended for high quality offset printing. If you have to use the Native CMY option to pass an offset press, it will be unlikely to visually match one of the standard CRPCs.

SCCA

The G7 Master Pass / Fail specification makes a special exception for print samples that, for whatever reason, cannot be made on a substrate of the same brightness or color as the Reference CRPC. This exception is known as “SCCA”, which stands for Substrate-Corrected Colorimetric Aims.

Check the SCCA box if the measured sample’s substrate color or brightness are significantly different from the Reference CRPC. Note that this is only necessary when *Compliance Test:* is set to *G7 Targeted*, *G7 Colorspace* or *G7 Proof Pass / Fail*.

SCCA modifies the sample’s CIELAB values by linear XYZ scaling (similar to the Relative Colorimetric rendering intent), to simulate how the colorants would have looked if printed on a substrate of the correct color and brightness. This closely approximates what a human observer sees when two prints on different-colored substrates are viewed INDIVIDUALLY (i.e. not alongside each other). Differences that might be unacceptable when viewed side-by-side are typically impossible to detect when viewed apart, which is how most real-world printing is viewed – i.e. without a reference proof.

SCCA is based on a characteristic of human vision known as “chromatic adaptation” which automatically (and sub-consciously) adjusts the visual system’s red, green and blue sensitivity, much like a digital camera’s automatic white point adjustment. Within a few seconds, the brightest “white” in a scene appears neutral and other colors are adjusted by the same amount.

Editing a Reference

CAUTION: Editing a Reference will change the way other Verifications based on that Reference display the Reference name (see In-file References.

- Select the *Reference* you want to edit.
- Change the desired parameters.

NOTE: If the name contains hints or abbreviations indicating the Reference's settings, be sure to change the Reference name to indicate the changed settings.

- Close the window.

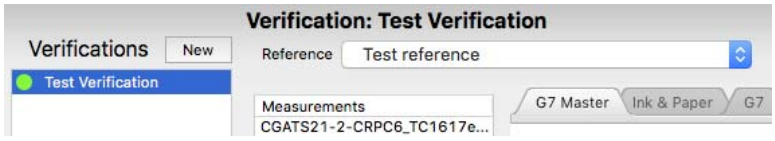
NOTE: It is usually wiser to create a new reference than edit an old one.

How Curve4 protects existing Verifications

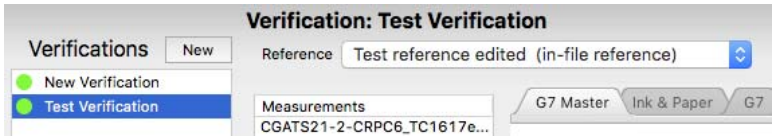
Curve4 prevents Reference edits invalidating earlier Verifications with the following rules:

- When you edit a Reference, only the currently-open Verification is affected.
- To protect a Verification, at the time it is created Curve4 embeds the Reference settings permanently inside it. If you change the reference in the list, it will not affect old verifications.
- When you open an old Verification that uses the edited Reference, the Reference name will be appended with the words ***(in-file reference)*** and the original settings will be unchanged.

In-file References



Original Reference name



Reference name when the old Verification is re-opened after the Reference was edited in a New Verification

REMEMBER: Changes to a Reference DO NOT AFFECT PREVIOUS VERIFICATIONS. if you re-name or edit a Reference, previous Verifications will display the OLD NAME plus "(in-file reference)" .

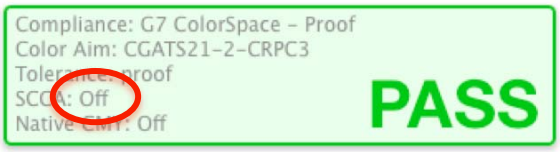
Reference naming

For clarity, try naming a Reference with abbreviations of its settings, such as those suggested below.

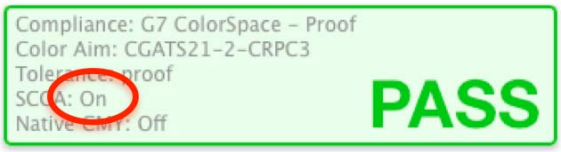
G7 Grayscale	G7GRY
G7 Targeted	G7TGT
G7 Colorspace	G7CS
Proof Pass (/ Fail)	PrfQC
G7 Grayscale Screen	G7Scrn
Production / Proof	Prod / (Proof)
Native CMY ON / OFF	Ntv / ___ (nothing)

SCCA on	**Rel** (for relative matching) or **SCCA**
SCCA off	**Abs** (for absolute matching) or ___ (nothing)
CGATS-CRPC1 ... CRPC 7	**CRPC1 ...CRPC7, etc.)**
GRACoL 2006	**GRCL06**
SWOP #3 2006	**SWP306**
SWOP #5 2006	**SWP506**
XCMYK 2017	**XCMYK17**

For example, a Reference for G7 Colorspace proofs that match CRPC6 (GRACoL2013) with SCCA off would be named *G7CS CRPC6 Proof* while a Reference for checking individual GRACoL2013 proofs with SCCA on would be named *Abs PrfQC CRPC6 Rel*;



Pass badge for a SCCA Off (Absolute).



Pass badge for SCCA On (Relative).

Saving a Custom Color Aim (CRPC)

If you wish to build a reference based on a custom printing condition not in the list of standard CRPCs, you can create a custom Color Aim from measurement data of a TC1617 target.

To save a custom CRPC

- Open the Verify tool.
- Create a new Verification.
- Select any Colorspace Reference (the CRPC and other settings don't matter).
- In the *Measurements* list, load a TC1617 data file that passes G7 Grayscale compliance.
- Select the TC1617 file in the *Measurements* list and select *File – Save As Color Aim*.
- Give the CRPC a suitable name.
- In the References list select *Edit / Add References...*
- Create a new *Reference* and select your custom CRPC from the *CRPC:* list

Optimizing a custom CRPC

Before saving a Custom CRPC, we strongly recommend you process the data so that its G7 Grayscale performance is virtually perfect, as follows;

- Load the candidate TC1617 data in a new Calibration Run.
- In Create Curves, select *25-step (P2P)*.
- In the Gray Balance Control tab slide the *Start* handle to 98%.
- Click the *VPR* button and load your candidate data in *Data to be Curved:*.
- Leave *Training Target (optional):* empty.
- Click *Curve & Export...*

D

Appendix D: RIP-Specific Notes

CAUTION: Due to the continual improvement of third-party software, these instructions may no longer be accurate. Please check with your RIP manufacturer for the latest information.

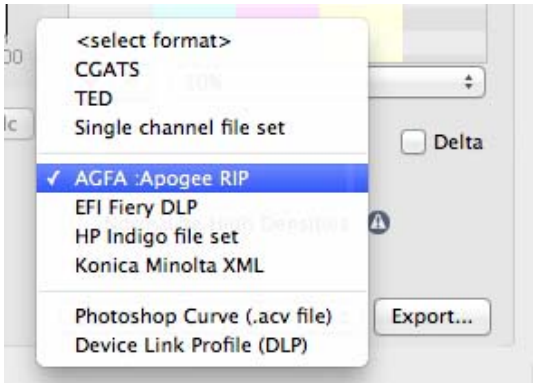
Not all of these notes have been confirmed or endorsed by the respective manufacturers. They are provided as a convenience here with no guarantee of accuracy. If you find an error or have information on how to import Curve4 calibration data into a RIP not in this appendix, please send your information via the Feedback system, along with screenshots, step-by-step workflow instructions etc.

Export File Type list

RIPs that accept files exported from Curve4 are listed in the *Export...* list in *Create Curves*. Some RIPs use generic file types like *CGATS*, *TED* or *Single channel file set*. Other RIPs require custom formats that may be added in future versions of Curve4 as specifications become available.

Agfa :Apogee

- In Create Curves – Export... select AGFA :Apogee RIP
- Click *Export...* and save the file with a suitable name (e.g. (name of printer, date).
- In *:Apogee* select the saved .xml file exported by Curve4



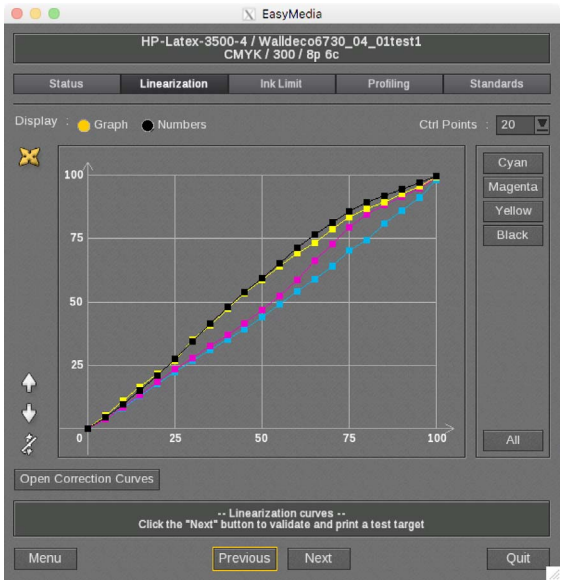
*The **Export...** file format list with Agfa :Apogee selected*

Note: More complete instructions will be available in a future User Guide. Meanwhile, for detailed instructions please see your Agfa service supplier.

Caldera

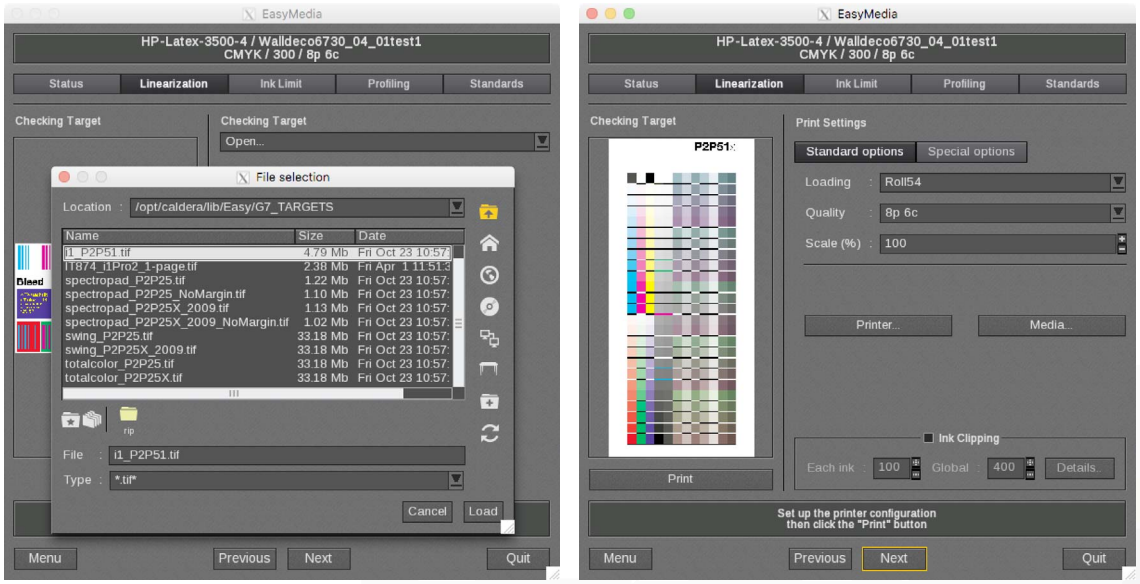
You can use Caldera's built-in G7 tool or import G7 curves from Curve4. These notes apply if using Curve4.

- In *Caldera EasyMedia*, print and read the caldera linearization chart and perform ink restriction (if desired) – this creates a TEMPORARY linearization that will be replaced by G7 curves



Initial Caldera linearization curves – compare these with the final G7 curves in Figure 12.4

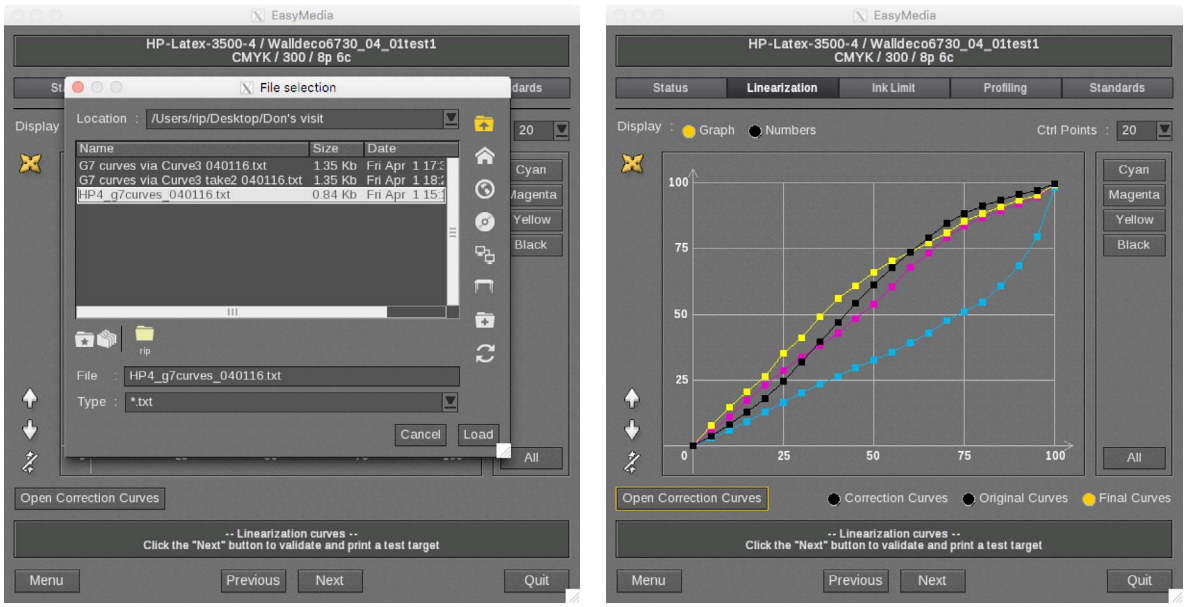
- The next screen asks Do you want to test your settings? click Yes – Next
- From the drop-down menu select *Open* and load a P2P51 target



Selecting the P2P51 target ans setting print parameters

Note: For speed, move the P2P51 into the appropriate directory, e.g. /opt/caldera/lib/Easy/G7_Targets

- Click **Print** – this prints the target through the temporary linearization
- Measure the P2P target and import the data into a new Curve4 *Run*
- In *Create Curves*, select the calibration parameters, including possibly *Normalize High Densities* and/or the *Native CMY* option
- Export the correction curves as CGATS. (Values must be Wanted and NOT DELTAS!)
- In *EasyMedia* click the Previous button until you arrive back at the linearization graphs
- Click *Open Correction Curves* and import the CGATS file exported from Curve 3



Caldera's import list (left) and final G7 correction curves (right)

- When you see the option to display *Correction Curves, Original Curves* or *Final Curves*, click *Final Curves* then *Next* to create the final linearization
- Where the next window asks "Do you want to test your settings?" click "Yes, I want to print a testing target now"
- From the drop-down menu, select *Open* and load a P2P51 target
- Click *Print* – this prints the target through the final linearization
- Measure the P2P target and import the data into a new Curve4 *Run*
- Click *Verify* and confirm accurate G7 calibration

If the results pass G7

- If the results are good, click *Next* and proceed with the Caldera profiling steps, etc.

CAUTION: Applying additional ink restriction after G7 calibration may reduce G7 accuracy

If the results fail G7

- Check that you followed the calibration workflow *exactly* as described above
- Confirm printer stability by printing a P2P target several times and comparing measurements
- Check ink levels. G7 failure is often related to excessive inking or inadequate ink drying
- If none of the above solve the problem, try the steps in *G7 Iteration* (below)

G7 Iteration

- If the first test fails G7, or you want to improve the results, go to the *Create Curves* pane in Curve4 and select the *Run* that created the curves in the *Based On:* pop-up list

- Now the calibration curves should be similar to the previous curves but slightly different
- Export the curves as a new CGATS file and import them into EasyMedia via the *Open Correction Curves* window
- Print a new P2P and Verify the new G7 curves by the same procedure as above

NOTE: Iteration should only be needed in rare cases, and usually indicates either an unstable printing system, bad initial measurements or a printer with excessive ink levels.

Attempting to iterate more than once is not recommended.

CREO Prinergy (Harmony curves)

When printing the first P2P target, using the pre-set *** NONE *** setting in both Current or Target should produce an un-calibrated plate. However on rare occasions *** NONE *** has been seen to trigger hidden calibration values which are not retained when *** NONE *** is replaced by a user-constructed curve, which then causes the G7 process to fail. Symptoms of this failure include unexpected dot values on plate and/or incorrect gray balance or NPDC curves after G7 calibration.

If in doubt, print the first P2P target using your own 'Custom Linear' calibration curve constructed from Current and Wanted curves, as follows:

Constructing a Custom Linear *Current* curve in Harmony

- Click File – New Curve – Current …
- In *Current Curve Properties* make sure Curve Set is '*CMYK Curves'*
- Enter the other required property values
- Click *File – Save Curve As …* with a suitable name, e.g. 'Custom Linear Current'

Constructing a Custom Linear *Target* curve in Harmony

- Click File – New Curve – Target …
- In *Target Curve Properties* make sure Curve Set is '*CMYK Curves'*
- Enter the other required property values
- Click *File – Save Curve As …* with a suitable name, e.g. 'Custom Linear Target'

Constructing a Custom Linear *Calibration* curve in Harmony

- Click *File – New Curve – Calibration …*

Exporting G7 Curves for Harmony

- In *Create Curves*, select *Single channel file set* and click *Export*
- Save the resulting folder with a suitable name, where it can be accessed from within Harmony

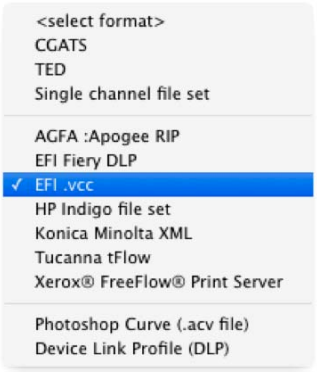
Loading G7 Curves into Harmony

- In the *Harmony Target Curve window*, select the Black channel
- Click *Edit – Import Curve Profile...* and load the black curve from the *Single channel file set* folder
- Repeat for the Cyan, Magenta and Yellow curves
- Save the Harmony Target curve and proceed as normal

EFI

Fiery XF (ink jet)

- In Fiery XF, make a base linearization (.EPL) and load this onto the media tab of the output device.
- Print a P2P51 with color management off.
- Use Curve4 to measure the P2P51 and create G7 correction curves.
- Save the curves in the EFI .vcc format - this is an XF “Visual Correction Curve (VCC).



Selecting Fiery .vcc output

- Load the VCC file on the EPL media tab, then print the P2P51 again and verify G7 Grayscale compliance in Curve4 Verify.
- If necessary iterate till optimum G7 Graysale compliance is achieved.
- Once G7 verification is satisfactory, make an XF media output profile from the XF Color tools.

EFI (DLP method)

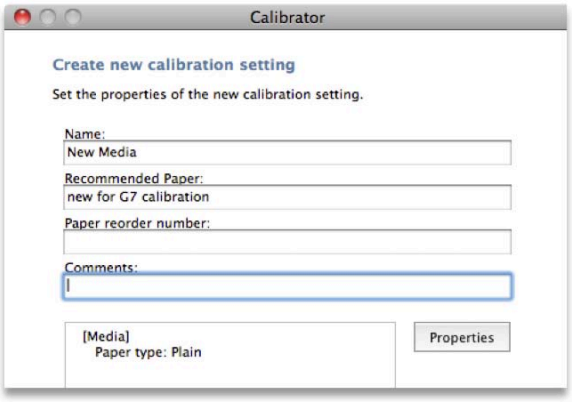
EFI Fiery controllers can accept calibration curves exported from Curve4 as device link profiles (DLPs) using two approaches - “Unmanaged” and “Managed”. In the Unmanaged approach, G7 curves are applied without any other color management, typically resulting in a “G7 Grayscale” compliance. Unmanaged G7 calibration can also be used as a basis for custom ICC profiles, which can then be combined with the G7 correction curves into a fully color-managed DLP within the Fiery controller.

The following instructions give an overview of the process. For full details, please consult your Fiery manual or EFI service provider.

G7 Curve only (G7 unmanaged):

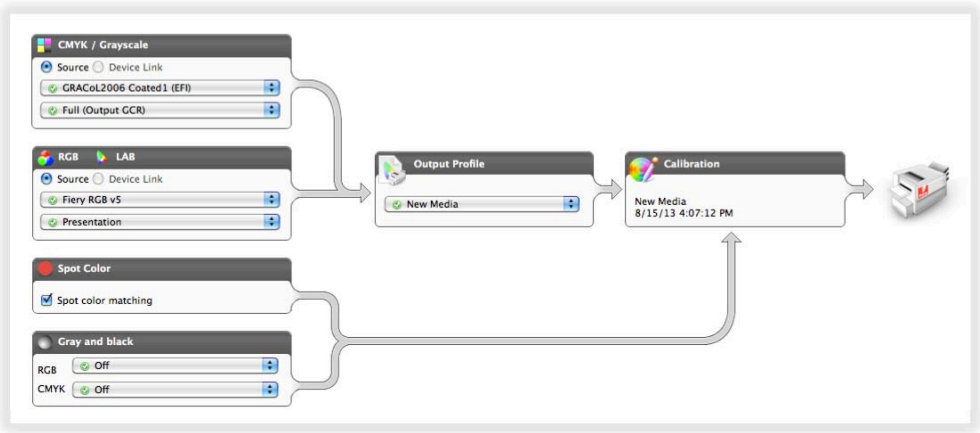
This method allows a user to print though the G7 curves alone in an “unmanaged” workflow, resulting in a “G7 Grayscale” or “G7 Extreme” compliance level.

- Warm up the engine and run *Fiery Calibration* for your chosen media (calibration settings)
- If no appropriate calibration settings exists for your media / print properties, create a new calibration settings set using *Manage Calibration Settings : Create New…*
- Click the Properties button to select and save your Calibration Print Properties (“Settings”), follow all the steps for creating a new Set



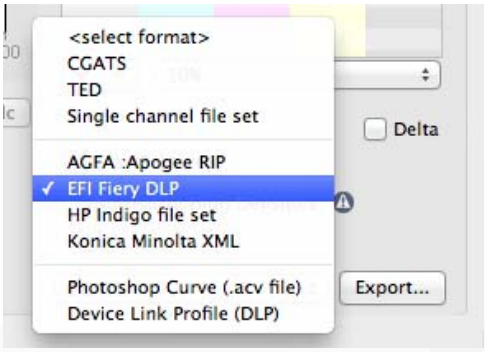
Creating New Calibration Settings Set

- In Color Setup uncheck Use media defined profiles if available
- Device Center: Color Setup: Color Management: Expert Settings…: Output
- Set Default output profile to your new calibration settings profile
- Be sure to click Apply in the Color Management Pane



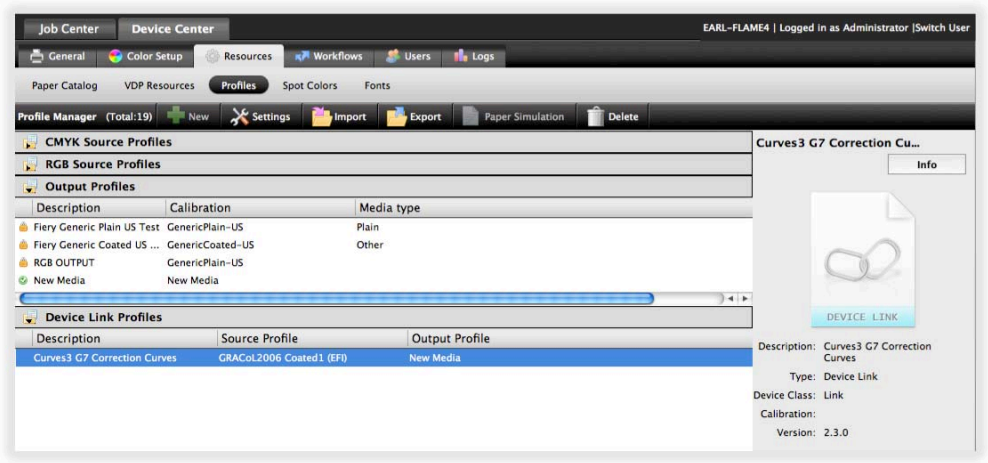
Setting New Calibration as Default

- Print the P2P51 target Bypass Conversion
- Print Properties: Color: Expert Settings…: Color Input: CMYK / Grayscale: Bypass Conversion
- Print 5 or more copies. If the print area exhibits streaking, ghost images, mottle or unevenness, print more copies and (if possible) rotate half the copies by 180°.
- Measure the P2P51 target(s) and average them in Curve4.
- Generate G7 correction curves - high resolution curves are recommended, e.g. 25-step (P2P)
- Export as a EFI Fiery DLP



Exporting an EFI Fiery DLP

- Upload the G7 curves DLP to the Fiery (Device Center: Resources: Profiles: Import)
- Associate to a Source profile, and the calibrated Output profile the P2P51 target was printed with



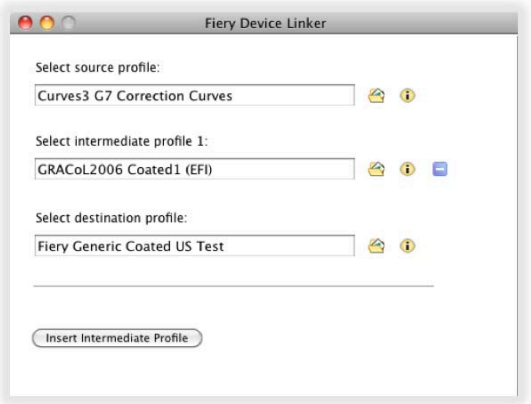
Setting DLP Associations

When printing through the associated Source and Output profile, the G7 curve DLP will be used in place of Source and Output profile. The association of the calibrated Output profile is important to get the correct Fiery calibration applied.

G7 simulated:

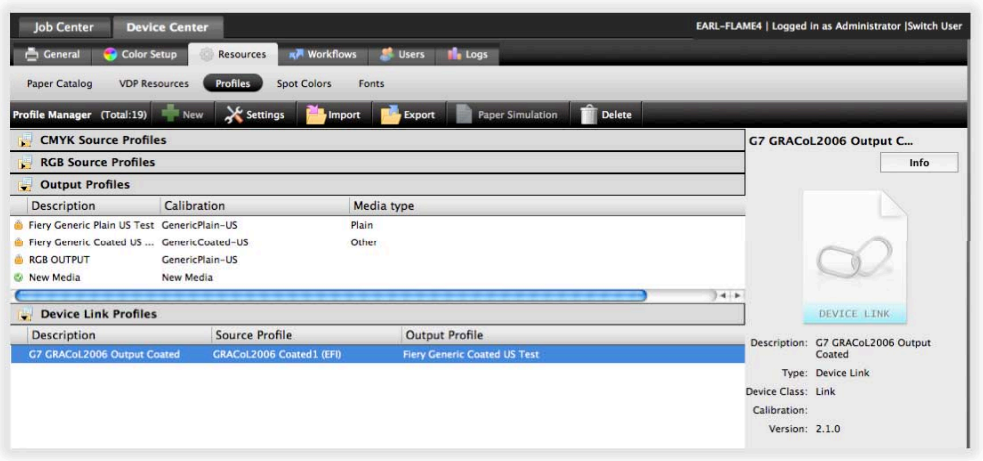
This method creates a G7 curve for GRACoL CMYK Source and an existing Output profile on the server. The user may use a factory default profile, or a custom created media profile. This is a CMYK simulated / ICC color-managed workflow. However, the G7 correction curve state is not profiled (less accurate).

- Warm up the engine, and run Fiery Calibration for your chosen media (calibration settings)
- In Color Setup, set your Output profile as default
- Device Center : Color Setup : Color Management : Expert Settings… : Output : Use media defined profiles if available : Off (unchecked)
- Set “Default output profile” to your calibrated settings profile
- Be sure to click Apply in the Color Management Pane
- Print the P2P51 target GRACoL Coated
- Print Properties : Color : Expert Settings… : Color Input : CMYK / Grayscale : “GRACoL2006 Coated1 (EFI)”
- Print 5 or more copies. If the print area exhibits streaking, ghost images, mottle or unevenness, print more copies and (if possible) rotate half the copies by 180°.
- Measure the P2P51 target. If the print area exhibits streaking, ghost images, mottle or unevenness, measure 5 or 6 separate targets and average them in Curve4.
- Generate G7 correction curves
- Load one or more P2P measurement files in a new Run
- For smoother results, click the Smooth button
- Make sure the Delta option is NOT checked
- Export as EFI Fiery DLP
- Create “*G7 curves – GRACoL – Output*” Device Link Profile with Fiery Device Linker 4.5
- Select “Create a custom device link”
- Select source profile = your newly created G7 Curves DLP
- Insert intermediate profile = GRACoL2006 Coatred1 (EFI)
- Select output profile = your calibrated Output profile



Creating G7 Curve – GRACoL – Output DLP

- Rendering Intent
  - If printed P2P51 with Paper Simulation = On, select Absolute Colorimetric
  - If printed P2P51 with Paper Simulation = Off, select *Relative Colorimetric*
  - Preserve gray should be unchecked
- Upload "G7 curves – GRACoL – Output" DLP to the Fiery
- Device Center : Resources : Profiles : Import
- Associate to GRACoL2006 Coated1 (EFI) profile, and the calibrated Output profile the P2P51 target was printed with



Setting DLP Association

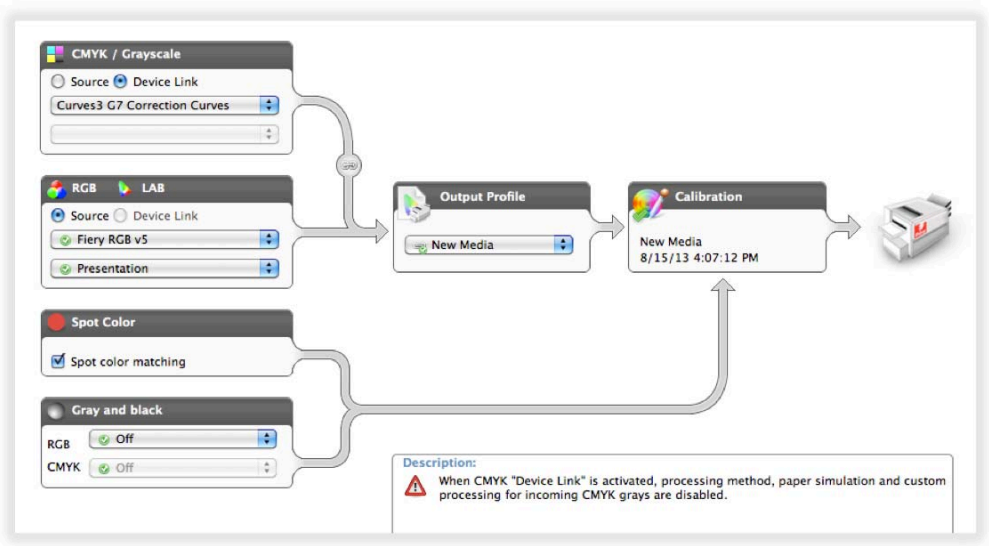
When printing through the associated GRACoL Source and Output profile, the "*G7 curves – GRACoL – Output*" DLP will be used in place of Source and Output profile. The association of the calibrated Output profile is important to get the correct Fiery calibration. This workflow will yield CMYK GRACoL simulated output with the G7 correction curves applied.

Output profile created with G7 Curve (G7 simulated):

This method uses the first procedure to create a G7 DLP for the native (unmanaged) printer, then by printing the CPS profiling patches through the G7 curves, a G7 calibrated output profile is produced. Finally, a source profile, the new output profile, and the G7 curves DLP are combined to create a

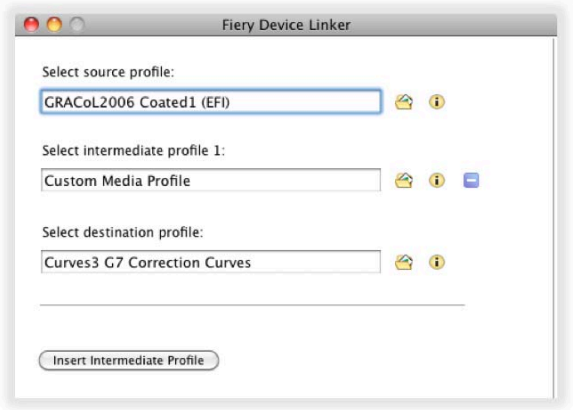
complete G7 / color managed DLP. This procedure is the most faithful to the G7 methodology, but requires the most steps.

- Follow the steps for the *G7 Curve only (G7 unmanaged)* procedure to produce a G7 curves DLP, and install on the Fiery with source and output associations
- From Fiery Printer Profiler 4.5, Print the characterization target through the G7 correction DLP
- Select Fiery server, Instrument, Patch Layout, as normal
- From the Print Properties Dialog, select the G7 correction DLP-associated profiles
  - Color : Expert Settings… : Color Input : CMYK / Grayscale : Source : *Associated Source*
  - Color : Expert Settings… : Output : Default output profile : *Associated Output*
  - Color : Expert Settings… : Color Input : CMYK / Grayscale : Device Link : check



Setting Profiling Print Settings, Selecting G7 Correction DLP

- Print, measure, and process, the patches as normal
- Save the resulting profile locally
- Create "*Source – Output – G7*" *curve* Device Link Profile with Fiery Device Linker 4.5
- Select "Create a custom device link"
- Source profile = your desired Source profile
- Intermediate profile = your newly created Output profile
- Output profile = the G7 correction curve DLP
- Rendering Intent
  - Select *Absolute Colorimetric*, for Paper Simulation = On like workflow
  - Select *Relative Colorimetric*, for Paper Simulation = Off like workflow
  - Preserve gray should be unchecked



Creating Source – Custom Output – G7 Curve DLP

- Upload "*Source – Output – G7*" curve DLP to the Fiery
- Device Center : Resources : Profiles : Import
- Associate to source profile, and an output profile with the same calibration set used to print the profiling patches.
- When printing through the associated Source and Output profile, the "*Source – Custom Output – G7 Curve*" DLP will be used in place of Source and Output profile. The association of the calibrated Output profile used to print the P2P51 and CPS Profiling Patches is important to get the correct Fiery calibration. This workflow will yield CMYK simulated output that is both G7 calibrated and CPS profiled.

ErgoSoft

The following information, supplied by ErgoSoft, is believed to be accurate at the time of writing. For changes or additional support, please contact your Ergosoft service provider.

Items needed

- *ErgoSoft RIP*, Release 14.1.2.5090 (or higher).

Process description

- In the ErgoSoft RIP create a new *Print Environment*.
- Perform the standard linearization and set target densities (ink restrictions) as desired.
- Print a P2P target and measure it in Curve4.

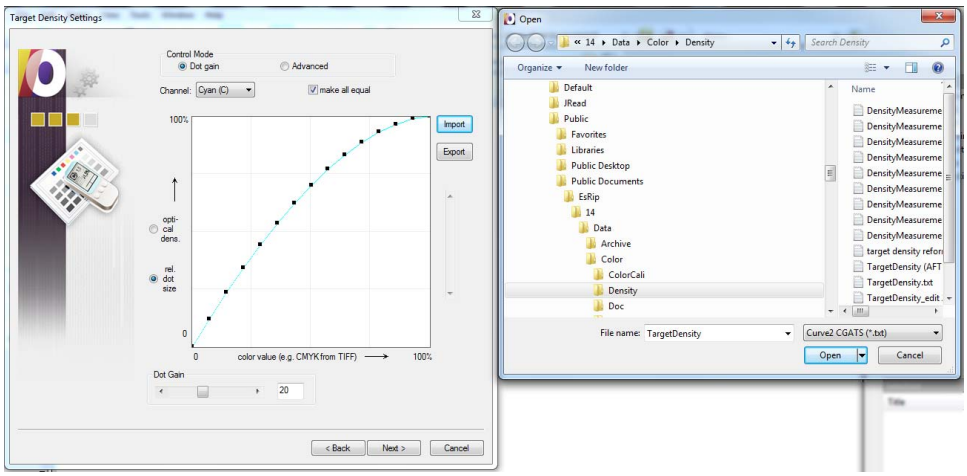
Create calibration curves in Curve4

- In Curve4 load the CGATS file exported from ErgoSoft in a new *Run.*
- In the Control Points list in Curve4's Create Curves window select 5% or Highlight/Shadow Weighted.
- Export the calibration as a CGATS text file.

Import the calibration into ErgoSoft

Here you import the calibration curves exported from Curve4 as a *target response* in the ErgoSoft RIP's linearization process.

- Open the linearization session created earlier and proceed to the *Target Density Settings.*
- Click the *Import* button, select *Curve2 CGATS* format and import the Curve4 CGATS file.



Importing Curve4 calibration curves

The print Environment now contains the correction curves and is ready to be used.

Validation

Before running live work, confirm that the correction curves are working correctly, as follows:

- Create another ColorQPC Measure Session.
- Unlock create new settings then import the P2P_2009.txt file as *Device Colors from File.*
- Print and measure the ColorQPC chart and export the CGATS measurement data.

- In Curve4 load the CGATS measurement data file in a new *Run.*
- Check the G7 Pass / Fail status in the *Analyze – G7* tab.

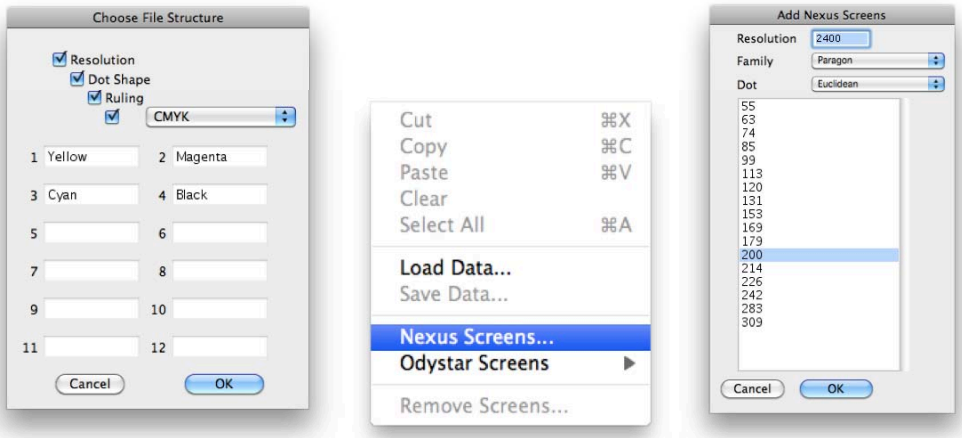
If the validation is *not successful* you may export the new curves from Curve4 and import those as new *Target Density Settings* by repeating the steps in *Import the Calibration into ErgoSoft* (above). Remember, this is possible because your ErgoSoft RIP's linearization process is iterative.

ESKO

Nexus / Symphony

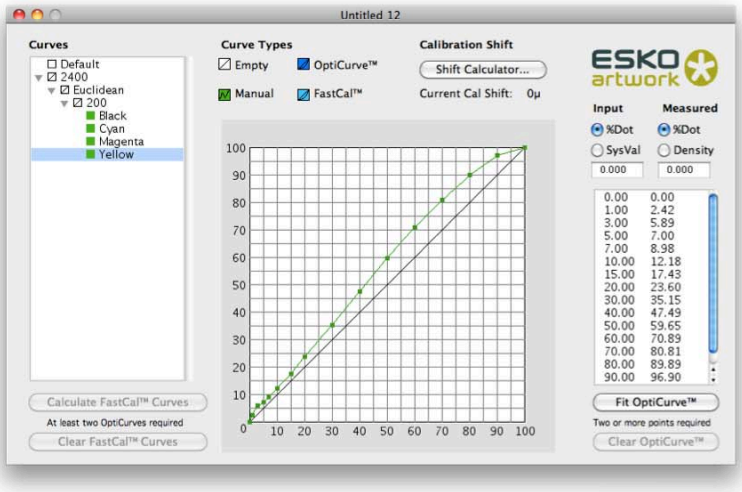
ESKO's Nexus is calibrated using Symphony Calibrator and Control Point data direct from Curve4:

- In Create Curves – Export select Single channel file set
- Click *Export...* and save. This produces a folder containing four simple text files
- In *Symphony* create a *New* calibration (CMYK)
- In the *Edit* menu select a screen ruling under *Nexus Screens...*



Setting up Nexus screens

- Expand the *Curves* list until you see the individual CMYK checkboxes



Entering calibration values in NEXUS

- Select each color checkbox in turn and in the *Edit* menu select *Load Data...* to import the individual text files exported from Curve4

- In the *File* menu save the calibration in the Nexus *Calibration_File* folder
- In Nexus load the Symphony curve

ESKO IntelliCurve

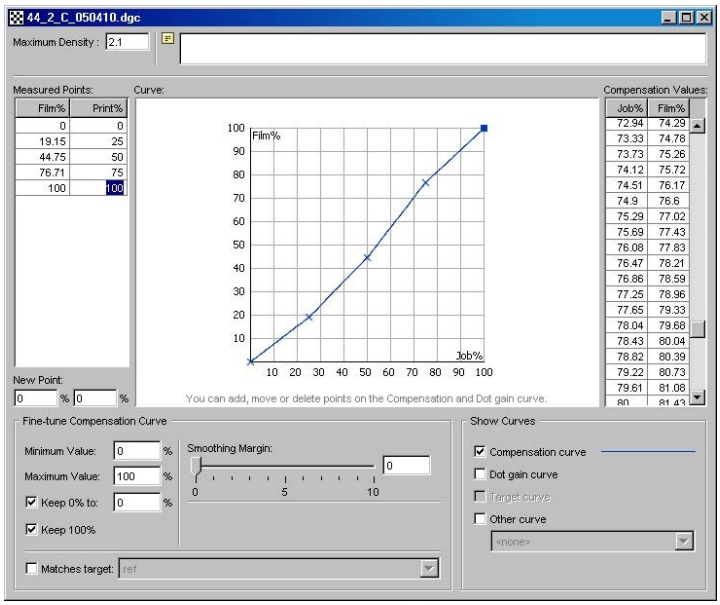


Figure 12.18 The older ESKO IntelliCurve interface

Note that in IntelliCurve, “Measured” points are really “Wanted” when producing a Compensation curve. For maximum adherence to Curve4 values move the *smoothing* slider to zero.

HP Indigo

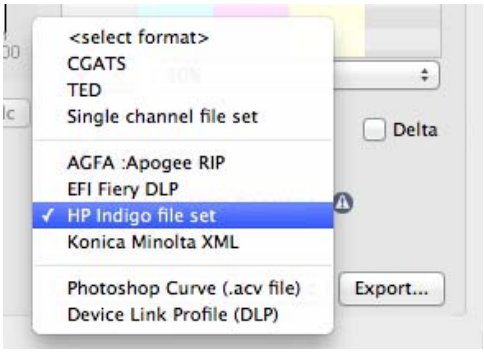
Curve4 version 3.0.1 and later can export curves directly in the HP Indigo RIP format. For detailed instructions on how to install the curves on an Indigo RIP, please see the latest HP instructions.

Print the P2P target

Perform a normal HP color calibration, then print the P2P51 (or P2P26 for slightly better gray balance).

Export HP Indigo File set

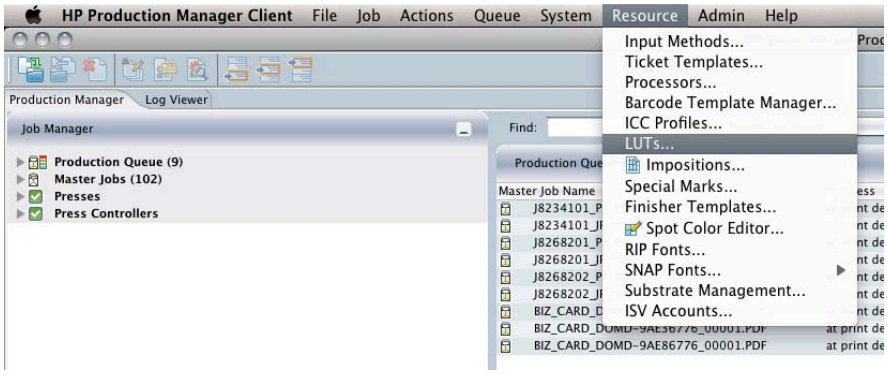
In Curve4, export the desired calibration as an HP Indigo File Set.



Selecting HP Indigo from the Export list

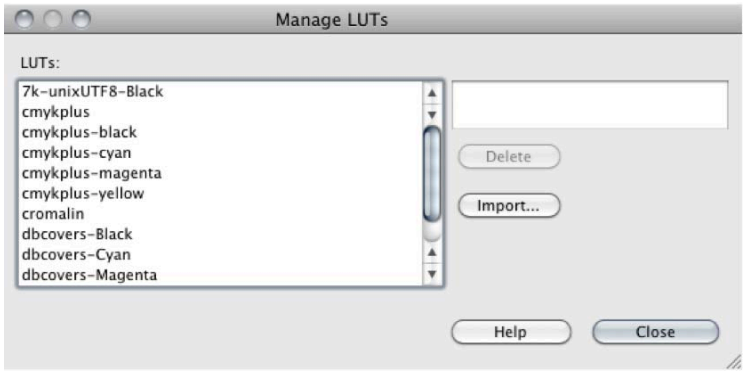
Import LUTs into HP Production Manager

In HP Production manager, choose *Import* and select the *LUTs...* option.



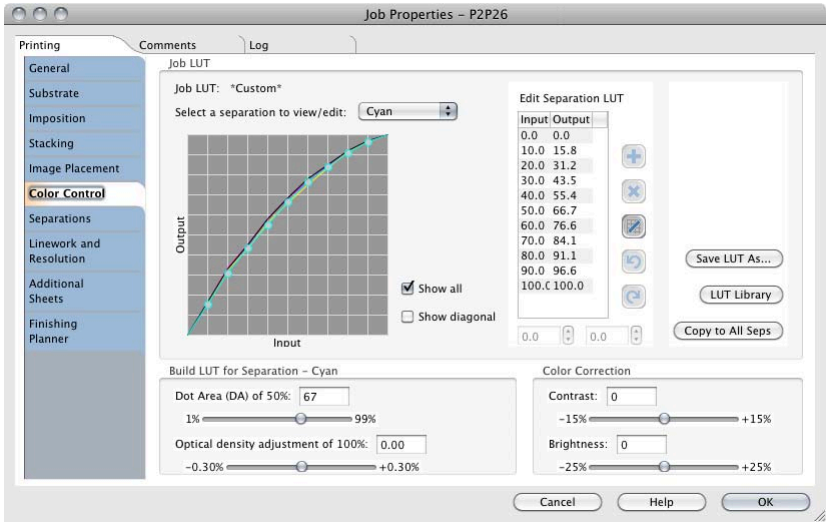
The Resource – LUTs option in HP Production Manager

Choose *Import* and select the LUTs to be imported.



Seleting the desired LUTs Color Control

In *Job Properties* select *Color Control* > *LUT Library* and select your LUTs.



LUTs selected via the LUT Library button

Kodak ColorFlow

ColorFlow 8.0.2 has introduced a G7 button, which theoretically eliminates the need for third party G7 calibration software. However the need to import curves generated in Curve3 and Curve4 remains important.

At present, the only known way to do this is via the legacy Harmony application, if available.

More detailed information will be provided in a future User Guide version. Meanwhile, if you need to import curves from Curve4 into Kodak ColorFlow, please contact Kodak or your Kodak service provider directly.

Konica Minolta IC601

- In Create Curves – Export select *Konica Minolta*
- Click *Export...* and save the file with a suitable name (e.g. (name of printer, date).
- In the Konica Minolta IC601 *Color Centro* application open the *Tone Curve Adjustment* tool, select *Load Tone Curve* and load the .xml file exported by Curve4.

ONYX

These notes were co-developed with ONYX and apply to ONYX® ProductionHouse™, ONYX PosterShop® and ONYX RIPCenter™, Version X10.1 or later, using Curve2, Curve4 or later versions.[8]

Overview

In ONYX Media Manager, CMYK ink restriction and light/dark ink splitting are performed, then a P2P target is printed and its measured data are exported to Curve4. Calibration curves fron Curve4 are exported back to Media Manager, where (optional) ink restrictions are applied and a characterization target is printed through the G7 curves. The resulting ICC profile is automatically married with the G7 curves in the final the Media Profile. *(Note that this workflow may differ depending on how many inks are used and whether the printer is controlled by ONYX in halftone or contone mode.)*

Note: ONYX G7 Calibration works in both Halftone and Contone modes. In contone mode, ink restrictions are controlled by the printer and may lead to over-inking.

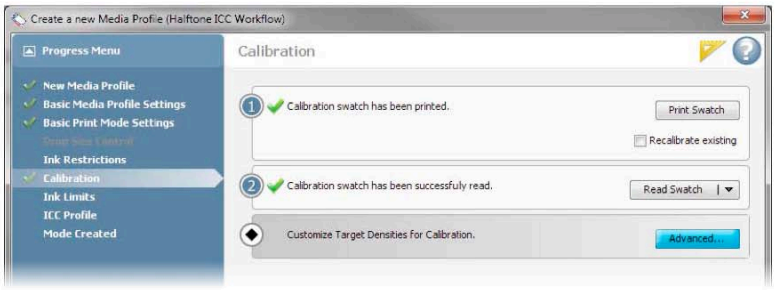
Upgrading to the P2P51 target

For best results, the P2P51 target should be used for all ONYX G7 calibrations, not the legacy P2P25.

- Download the P2P51 target (free at <www.hutchcolor.com/Images_and_targets.html>)
- Inside the master P2P51 download package is a folder called “ONYX old vs new P2P”. Inside this are two sub-folders: “P2P25” and “P2P51”, each containing a file with the same name (“Curve2MMPatches.txt”) but different values. Be careful not to lose track of which file you are installing.
- To install the new P2P51, simply drag the contents of the P2P51 folder into the ONYX\Common folder on your ONYX server and overwrite the original Curve2MMPatches.txt file.
- To revert to the legacy P2P25, simply drag the contents of the P2P25 folder into the ONYX\Common folder and overwrite the existing Curve2MMPatches.txt file.
- Newer versions of ONYX may already use the P2P51. If in doubt, overwrite the old file anyway.

Creating a G7 Media Model

- In *Onyx Media Manager*, create a new (or edit an existing) media model. (Remember, a media models exists inside a media group.)
- Print and measure the ink restriction swatch.

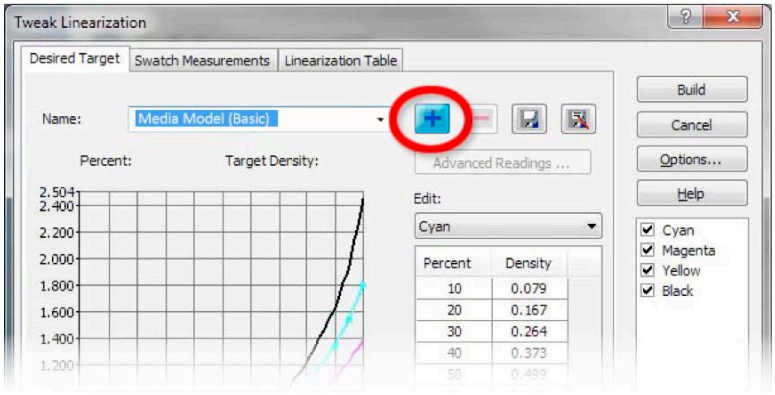


The advanced button in Onyx Media Manager

- The automatic restrictions are usually a good starting point, but can be adjusted manually, for example to produce a more neutral 300% patch.

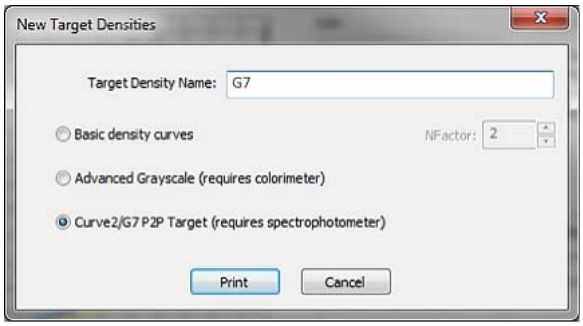
[8] *Note that wherever the Onyx interface refers to Curve2, Curve4 may be used instead.*

- Print and measure the calibration swatch, then click the Advanced… button to open the *Tweak Linearization* window
- In the *Tweak Linearization* click the blue plus (+) button to start G7 calibration



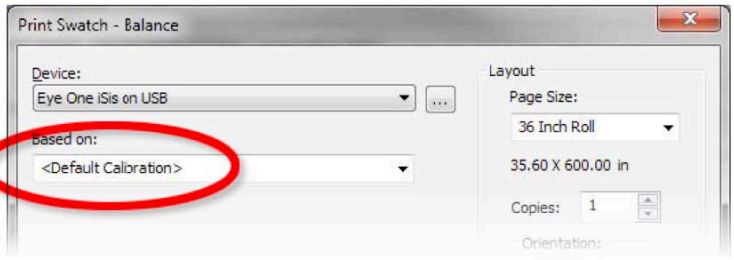
The blue plus button initiates the G7 calibration process

- In the *New Target Densities* window enter a name like “G7” or similar
- Select Curve2/G7 P2P Target



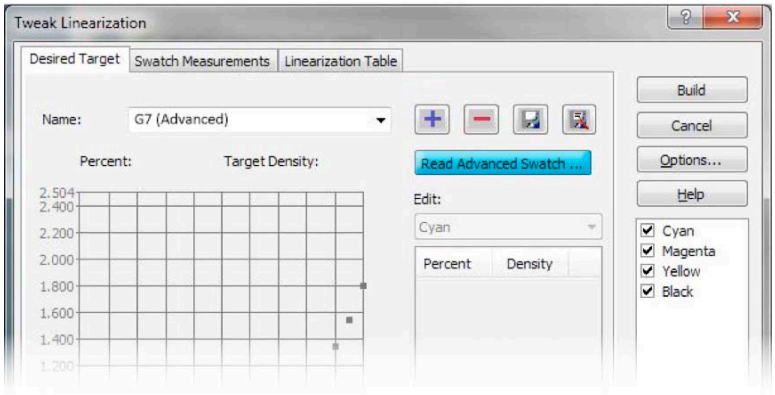
Selecting the Curve2/G7 P2P Target definition

- Click Print to open the *Print Swatch – Balance* window



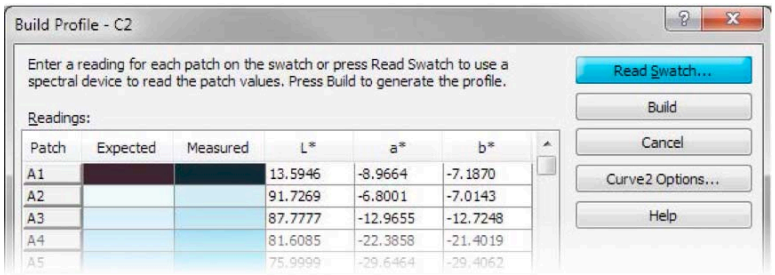
Select Based on: Default Calibration

- Select the desired measuring device
- In the *Based on:* list select *<Default Calibration>*
- Click *Print* again
- Once the target is printed, in the *Tweak Linearization* window, click *Read Advanced Swatch…* to measure the P2P target



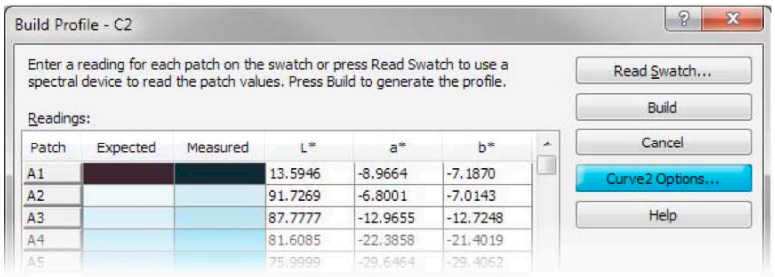
Selecting the Curve2/G7 P2P Target definition

- In the *Build Profile* screen click Read Swatch...



The Read Swatch button

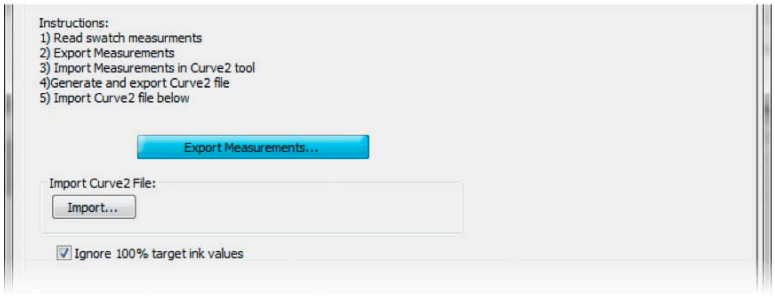
- Once measurement is finished, click *Curve2 Options…*



The Curve2 Options... button

IMPORTANT: Do NOT CLICK BUILD yet!

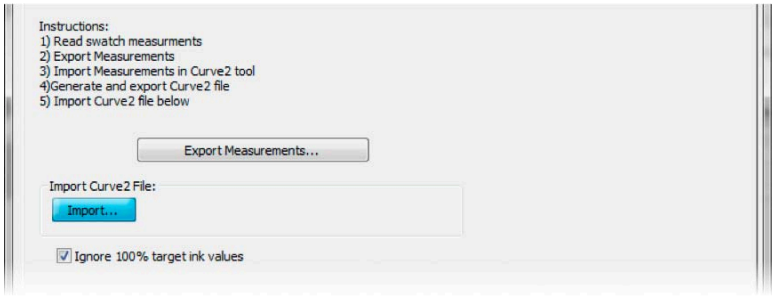
- In *Build Options* click *Export Measurements* and save the P2P measured data file



Exporting P2P measurements

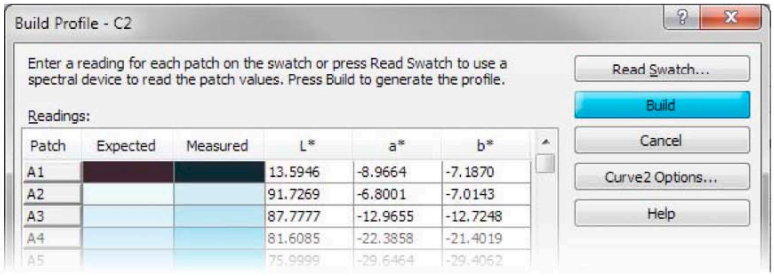
IMPORTANT: Leave the Build Options window open while you use Curve4

- In Curve4 load the P2P text measurement file into a new *Run*
- In *Create Curves* select the desired parameters then *Export* a CGATS calibration file
- In the *Build Options* window click Import… and select the CGATS.txt file



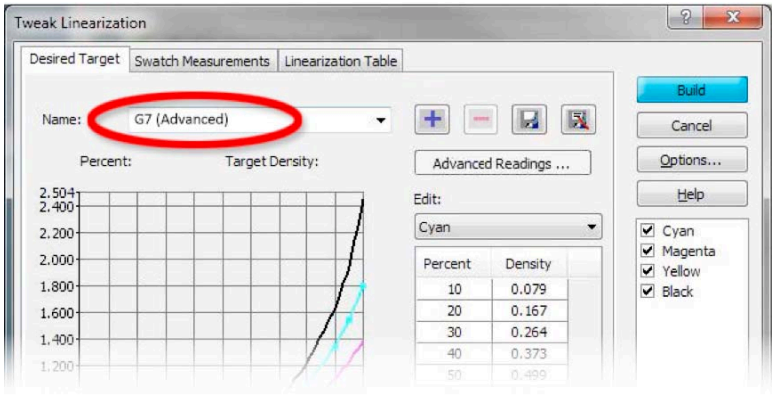
Importing G7 calibration curves from Curve4

- Check Ignore 100% Target Densities then click OK
- In the *Build Profile* window, click *Build*



*The **Build** button in the Build Profile window*

- The *Tweak Linearization* curves should now *approximately* match those in Curve4



Completing the process

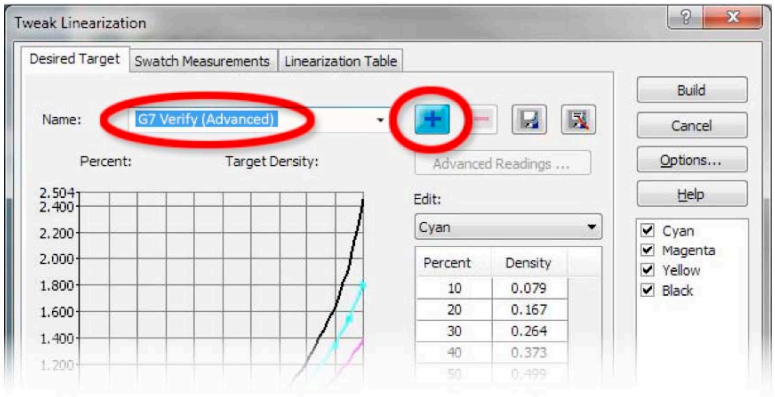
- The linearization name should be as you named, e.g. <G7 (Advanced)>
- Click *Build* again to finish the G7 calibration process

IMPORTANT: ***You must click Build twice****, once in Build Profile and again in Tweak Linearization*

Verifying the G7 Media Model

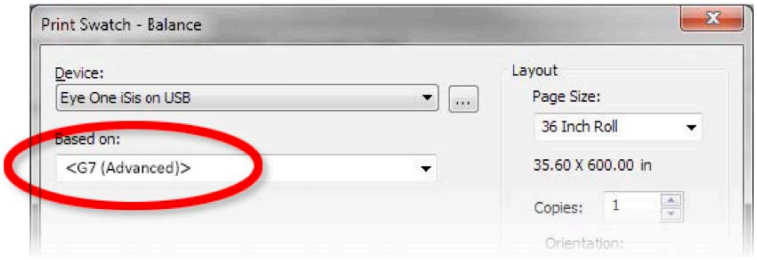
To Verify G7 calibration accuracy, create a new *temporary* media model and print the P2P target again.

- In the *Media Manager Calibration* window, click Advanced
- In the *Tweak Linearization* window, name the new media model <G7 Verify> or similar
- Click the blue plus (+) button



Creating the temporary G7 Verify Media Model

- In the *New Target Densities* window, select Curve2/G7 P2P Target and click Print
- In the *Print Swatch – Balance* window set *Based on:* to the G7 calibration you want to test, e.g. <G7 (Advanced)> (*not* Default Calibration)



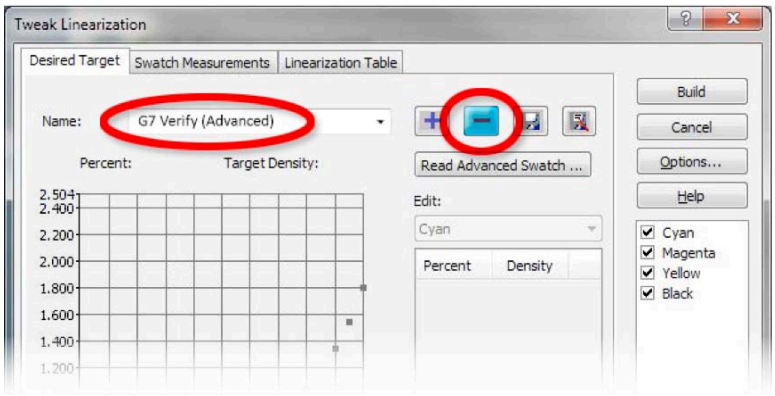
Printing the verification P2P target (step two)

IMPORTANT: The Based on: list must show your G7 calibration name, not "Default Calibration"

- Click *Print*, then in the *Build Profile* window, click Read Swatch to measure the P2P
- Click *Curve2 Options…* and Export the .txt file
- Load the P2P data in a new Curve4 *Run* and go to the *Analyze – G7* pane

If the results pass

- Select the temporary media model and delete it by clicking the red minus button
- Proceed to Ink Restrictions



Deleting the temporary media model after verification

If the results fail

- Check that you followed the calibration workflow *exactly* as described, paying particular attention to the notes and warnings in red (at several critical moments the wrong action can invalidate the process)
- Confirm the printer is stable and repeatable by printing and measuring a P2P target several times in succession
- If neither if the above tests solves the problem, your printer may be incapable of good G7 calibration in one iteration, in which case try the steps outlined in ***G7 Iteration*** (below)

G7 Iteration

- If the first G7 test fails, or if you want to try and improve the G7 results, go to the *Create Curves* pane in Curve4 and select the previous *Run* in the Based On: pop-up list
- The suggested calibration curves should be similar to the previous curves but slightly different
- Export the curves and import them via the *Build Options* window
- In the *Build Profile* window, click Build, then in the *Tweak Linearization* window click Build again to update the G7 calibration

- Verify the new G7 curves by the same procedure as above

Ink Restrictions

- After confirming a good G7 calibration, set *Ink Restrictions* (if desired)
- Be sure to click *Build* again after setting Ink Restrictions
- After adjusting ink restrictions, print a P2P target as a live job, but with all ICC profiles off, then measure the P2P and check that it still passes G7 specifications in a new Curve4 *Run*.

NOTE: Extreme ink restriction settings may alter the effectiveness of the G7 calibration.

- Proceed to Create the ICC Profile

Create the ICC Profile

- Continue the workflow by printing a characterization target through the G7 calibration curves
- Click *Build* again after creating the profile to complete the Media Profile

NOTE: In the final Media Profile, the ICC profile will always be used in combination with the G7 calibration upon which it was built.

Re-Calibration

If the printer drifts due to changes in hardware or consumables, the old G7 media model can be edited, as follows:

- For safety reasons, make a copy of the old media profile.
- In Media Manager, select *Edit Existing Profile* and the media profile copy you want to edit
- Print and measure a new calibration strip using the existing Ink Restriction settings.
- Click *Advanced* and print the P2P target
- Measure the target and create new G7 curves in Curve4
- Import the new G7 curves into Media Manager, over-writing the old ones
- Unless the ink hues or maximum densities have changed, you should be able to continue using the old ICC profile. In fact, this is the main advantage of G7 re-calibration.

Wasatch SoftRIP

These notes are believed to be valid at the time of writing but may not apply in all cases. For up to date information or technical support, contact your Wasatch reseller or Wasatch directly

Items needed

- Wasatch SoftRIP version 7.3 or higher.
- Special License Codes to enable to CGATS Import. Examples of these codes are shown below.

  CGATSIMPORT-XXXX-XXXX-XXXX
  CGATSIMPORTNOWARN-XXXX-XXXX-XXXX

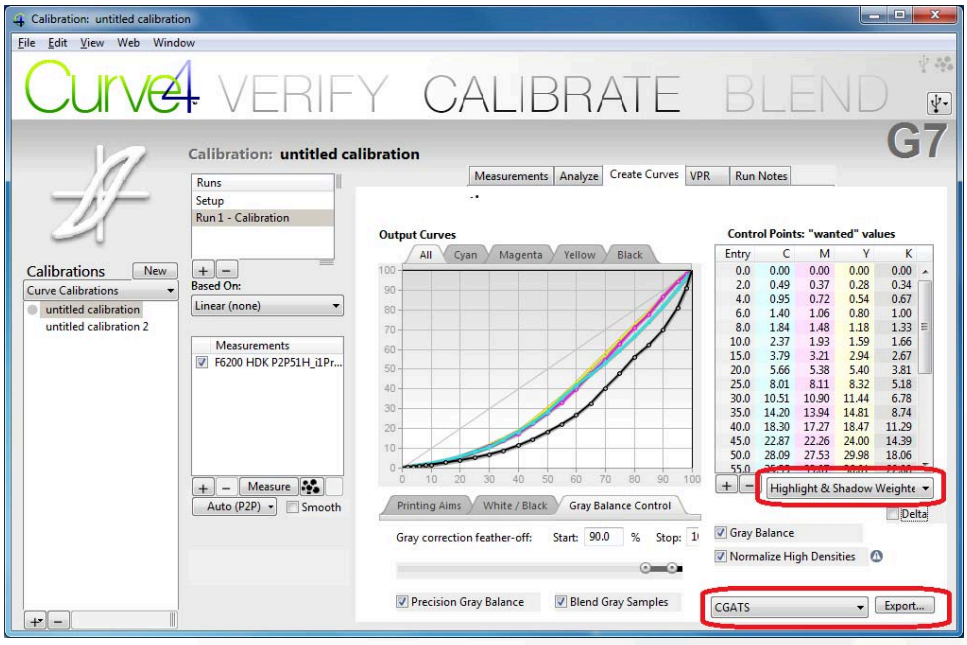
Note that the Imaging Configurations created using this approach cannot be shared with other workstations or locations that do not have these CGATS dongle codes activated.

Process description

- In the Wasatch SoftRIP, create a new Imaging Configuration.
- Select the desired Print Mode (Resolution), Media Mode (Fabric or Rigid), Dot Type (Variable or Fixed) Weaving Mode (number of passes) and Print Direction (UniD or BiD).
- Define your Ink Restrictions per Channel and Total Ink Limit, then save the Imaging Configuration. *(The Total Ink Limit can be edited later in the calibration process if needed.)*
- Print the P2P51 Target using the newly created and saved Imaging Configuration.
- In Curve4, create a new Calibration and measure the P2P51 Target.
- In Create Curves, select 25-step (P2P).
- Adjust the settings for White / Black and Gray Balance Control as needed.

NOTE: Some experimentation may be needed depending upon the colorant and substrate. Settings used for one print condition may not be suitable for other print conditions

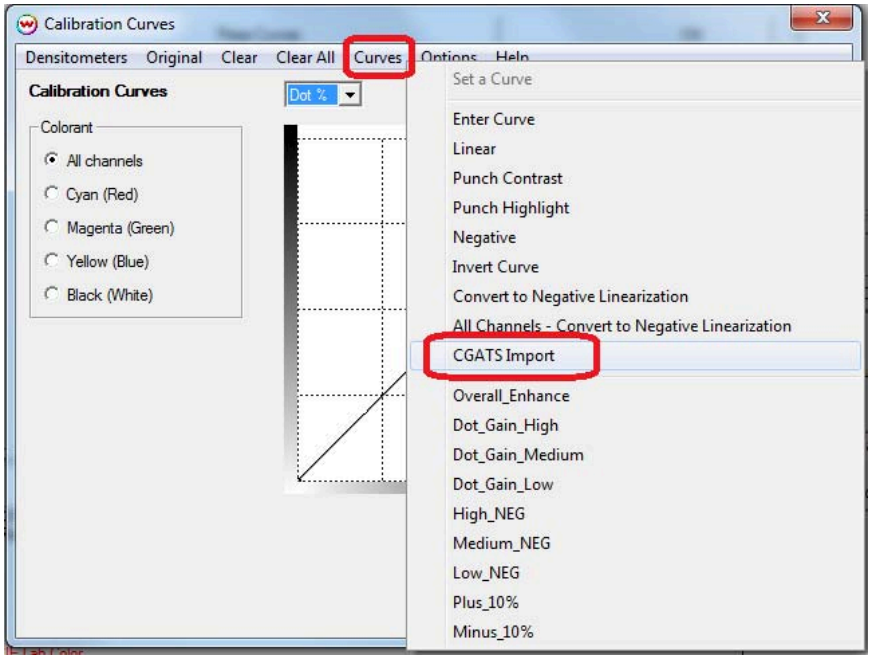
- Select *CGATS* as the file format and *Export* as shown below.



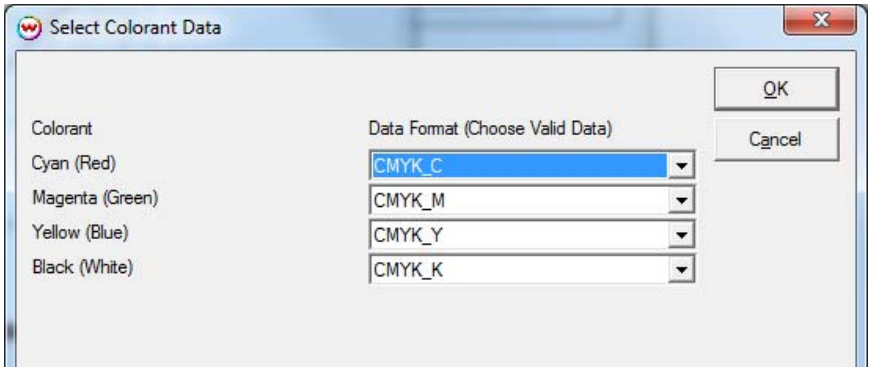
Exporting curves

Select the *Imaging Configuration* in Wasatch and open the *Color Transforms – Calibration – Calibration Curves.*

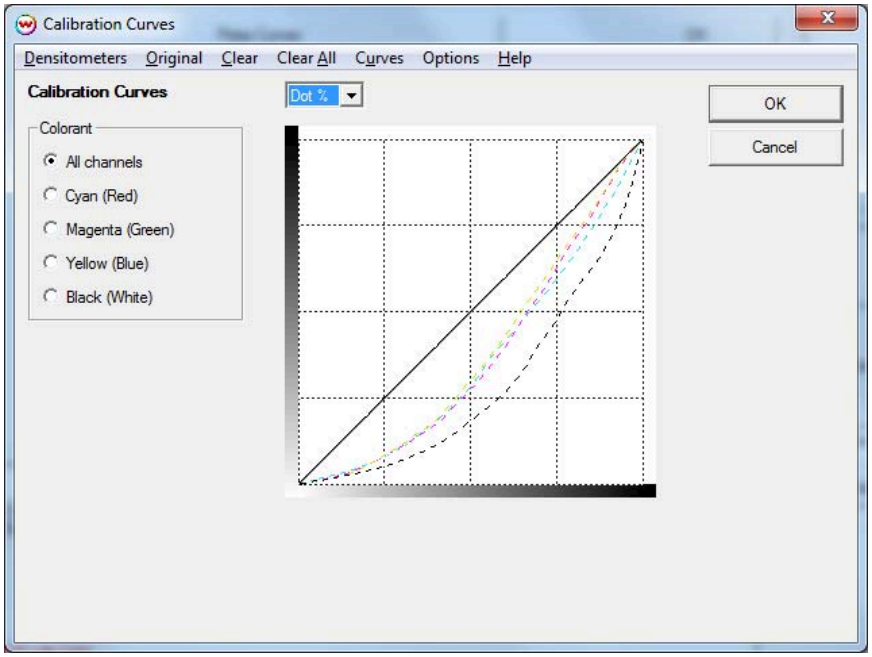
- From the Curves Pulldown menu, select the *CGATS Import* as shown below.



- Access the location where the CGATS file was saved from Curve 4 and select the file.
- The following informational dialog will be displayed, ensuring that the measurements will be applied into the proper channels.



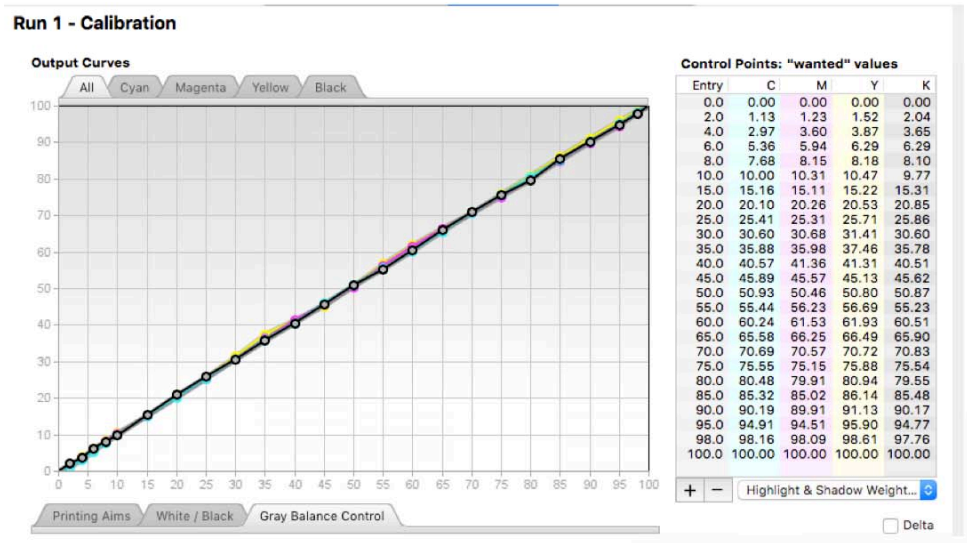
- OK this dialog and the Curves will be displayed in the Calibration Curves dialog of Wasatch.



- Click OK to accept and close all open dialogs. When prompted, save the Imaging Configuration using a descriptive name.

Verification or Iteration

- Print the P2P25 Target again using this Imaging Configuration.
- Measure the P2P25 Target and save the measurements as described earlier.
- Import the desired measurement file (M0, M1, or M2) into the Curve 4 Measurements and Create Curve, selecting Highlight and Shadow Weighted (P2P). The resulting Curve should be a straight line, with slight, if any variation as shown below.



- If there is a difference of more than 2 percent in any of the colors, re-measure the first set of patches and verify the results. If the difference remains, create a *Verification Run* and merge the two sets of measurements.

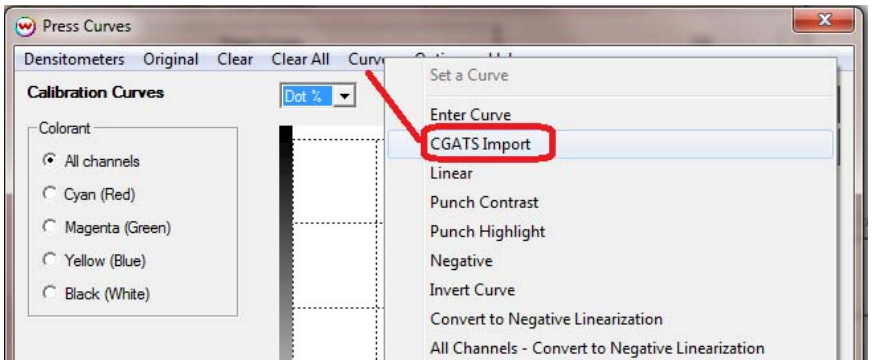
- Create your ICC Output Profile. Verify that the settings used during the creation of the profile we followed, and install it into the Wasatch Imaging Configuration.

Aligning multiple printers using the same Ink Restrictions, Ink Limit and ICC Profile

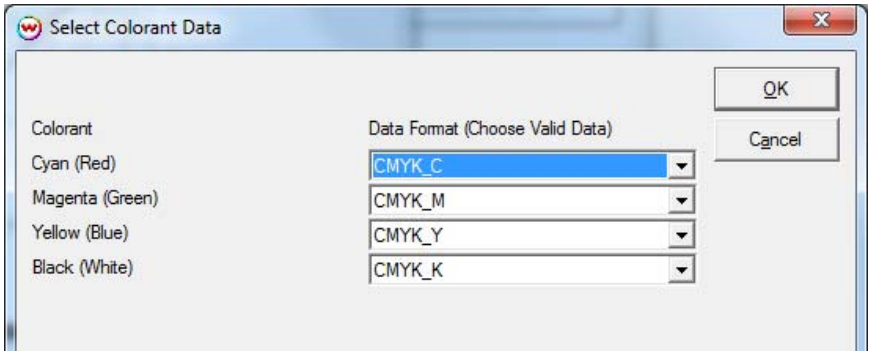
- Once the Master Color Configuration has been set up and saved, this can be moved to another printer (*assuming that workstation has the CGATS Codes*).
- Copy the Master Imaging Configuration to the second workstation and access the Color Transforms dialog. Disable, then Enable the Use Embedded ICC Profile dialog at the top left of the dialog. The Wasatch RIP will know that a change has been made to the Imaging Configuration and will require a Save or Cancel to close. Save using a new descriptive name.
- Access the Color Transforms dialog again and disable the ICC Output Profile.
- Save again appending the name *ICC Off* to the end of the existing name.

NOTE: THIS IMAGING CONFIGURATION WILL ONLY BE USED ONCE (to print the P2P51 target with Color Management disabled), then it will be discarded.

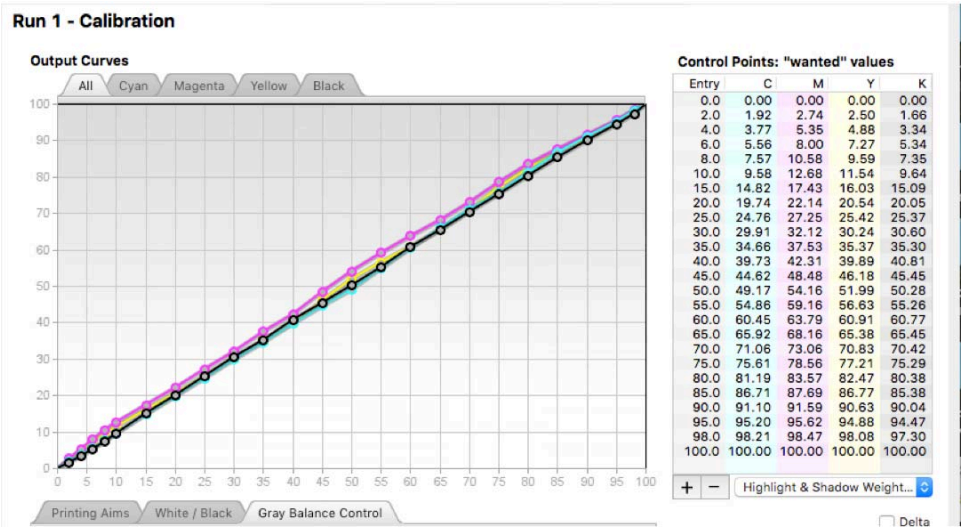
- Print the P2P25 Target using the ICC Off Imaging Configuration.
- Measure the P2P25 Target and save the measurements as described earlier.
- Import the desired measurement file (M0, M1, or M2) into the Curve 4 Measurements and Create Curve, selecting Highlight and Shadow Weighted (P2P).
- Select CGATS as the file format and Export.
- Define a proper naming convention and save the CGATS file noting that this is a Recalibration for another printer.
- Select the original *Imaging Configuration* in Wasatch for the second printer. This is the Imaging Configuration that contains the Ink Restrictions, Calibration created from the first printer, Ink Limit and ICC Profile.
- Open the *Color Transforms – Calibration – Press Curves* as shown below.



- From the CGATS Import Open dialog, select the CGATS file for the recalibration of the other printer.
- As before, the dialog displaying the channels will be displayed.



- The *PressCurve* be loaded into the dialog as shown below



- Click *OK* to accept and close all open dialogs. When prompted, save the Imaging Configuration using a descriptive name.

Re Calibrating printers using the CGATS Import

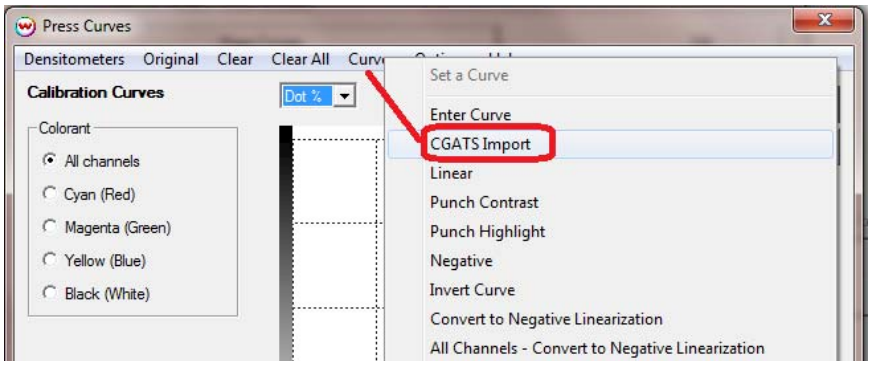
To re-calibrate the printer using the CGATS Import functionality:

- Disable the ICC Output Profile and save the Imaging Configuration appending the name **ICC Off** to then end of the Configuration name
- Print the P2P51 Target, measure and Save
- Create a new Calibration in Curve4 and Import the measurements
- If the resulting Calibration Curves are a straight line, there is no need to re-calibrate
- If the resulting curve shows any variation from a straight line, a new Press Curve CGATS file will need to be created.
- Open the ICC Off Imaging Configuration in the Wasatch RIP
- If there is a Press Curve in place within the Configuration, remove it. If there is not a Press Curve in place, you can use the Calibration Curve that was just printed and measured and Import it into the Imaging Configuration that was used to create the ICC Off Imaging Configuration

NOTE: The ICC Off Imaging Configuration is only used once

- If a Press Curve was in place, reprint the P2P25 Target, measure and Save
- Create a new Calibration in Curve 4 and Import the measurements
- Select CGATS as the file format and Export

- Define a proper naming convention and save the CGATS file noting that this is a Re-calibration for a specific printer
- Select the original *Imaging Configuration* in Wasatch for the printer you are re-calibrating. This is the Imaging Configuration that contains the Ink Restrictions, Calibration created from the first printer, Ink Limit and ICC Profile. Open the *Color Transforms – Calibration – Press Curves* as shown below.



- After Importing the CGATS file, click OK to close all open dialogs and save using a descriptive naming convention.

Working with Incompatible RIPs

If no simple method exists to import Curve4 calibration curves into your RIP, you should still be able to achieve G7 compliance through a color-managed workflow that simulates a G7-based CRPC.

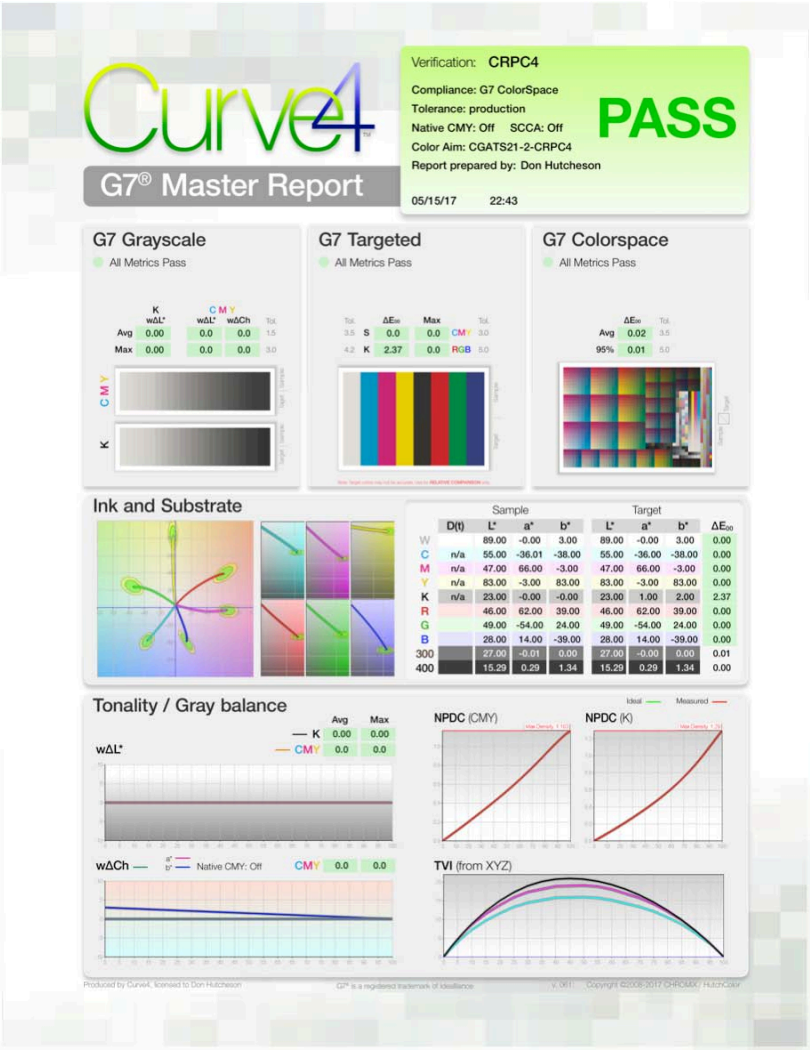
Print a P2P target through the RIP's color management and use Curve4 to Verify its accuracy.

We recommend asking your RIP manufacturer when they intend to provide G7 compatibility, either with on-board calibration tools of by accepting RIP curves from external software like Curve4.

Appendix E: G7 Master Report

The *G7 Master Report* provides a record of a G7 Master Verification.

All items in the report are explained in *Chapter 2: The Verify Tool.*

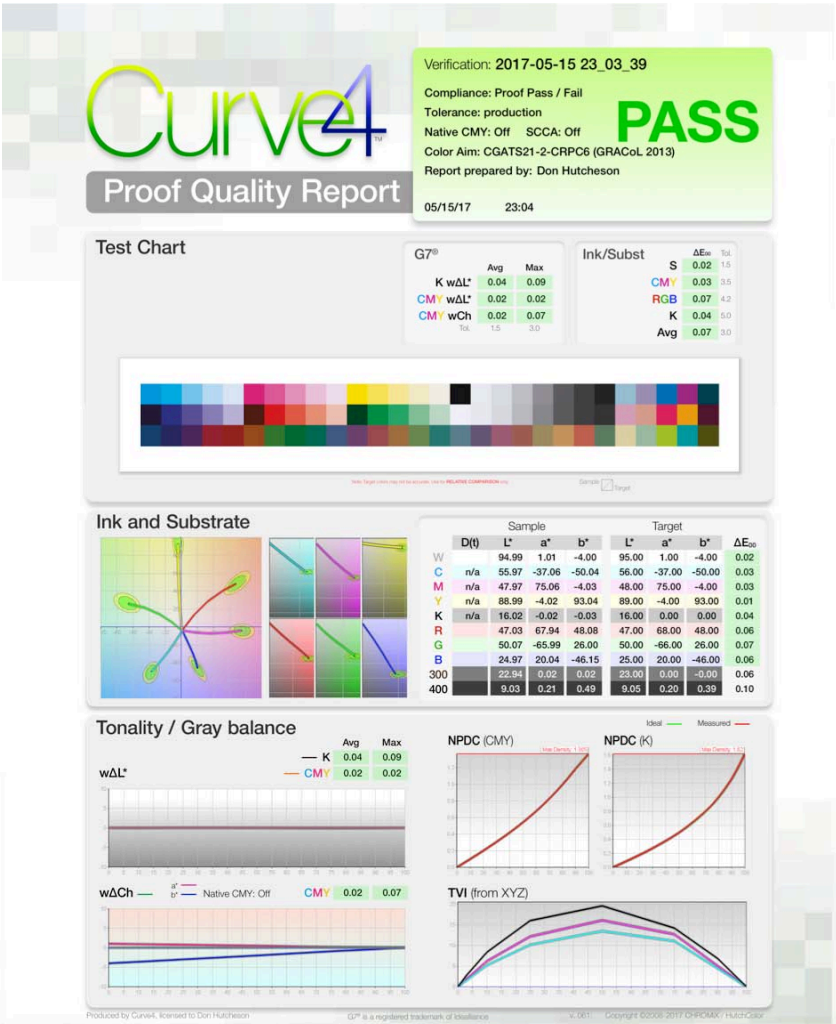


The G7 Master Report

Appendix F: Proof Quality Report

The *Proof Quality Report* provides a record of an individual Proof Verification.

All items in the report are explained in *Chapter 2: The Verify Tool*.

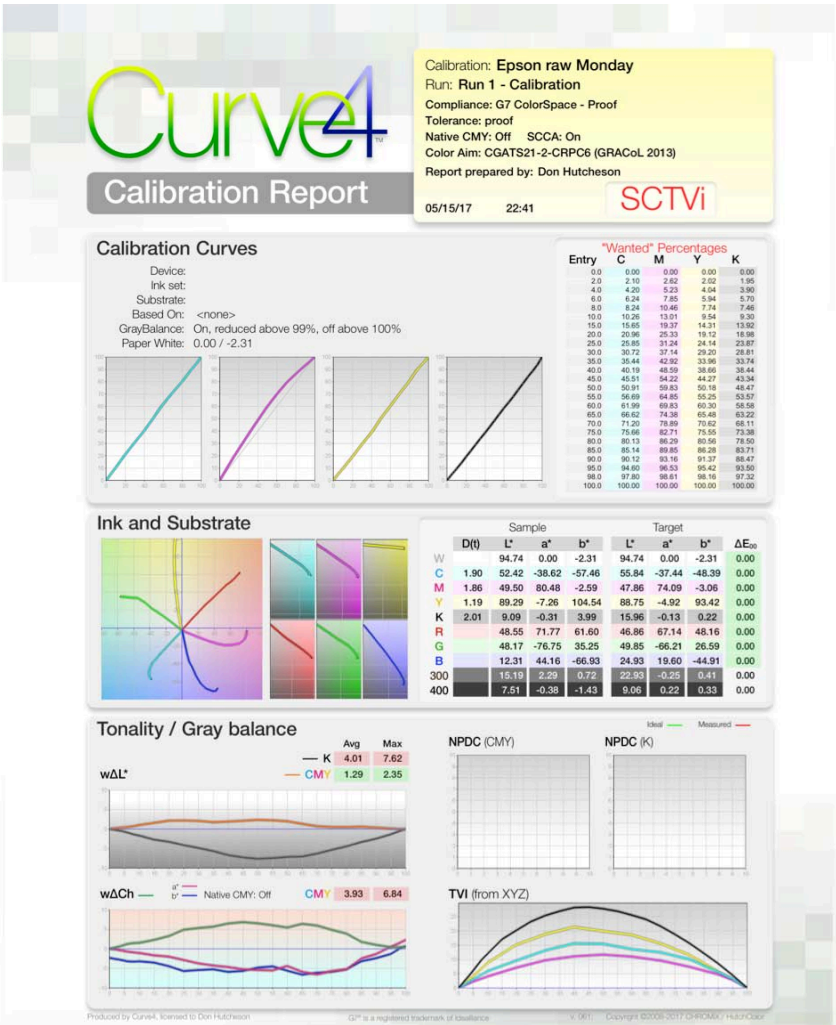


The Proof Quality Report

Appendix G: Calibration Report

The *Calibration Report* provides a record of a Calibration, and a convenient way of transporting curve point values manually into a RIP.

All items in the report are explained in *Chapter 3. The Calibrate Tool*.



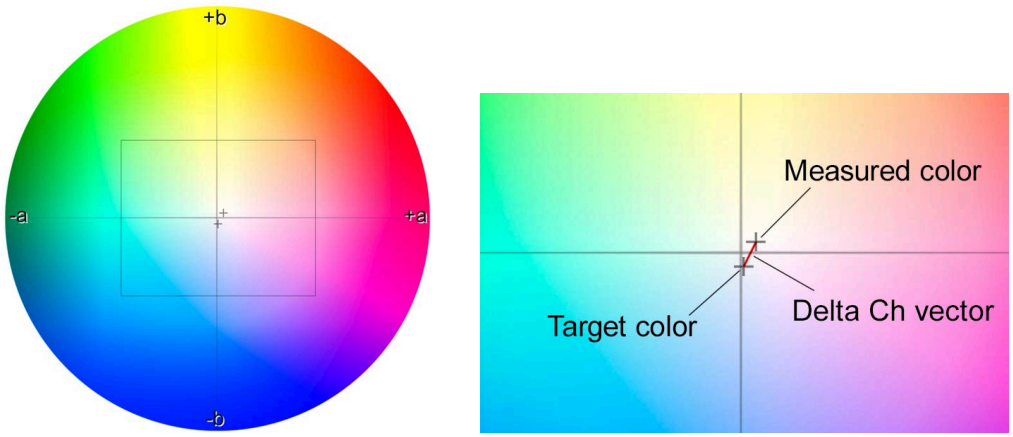
The Calibration Report

Appendix H: Formulae & Formats

Delta-Ch

Delta-Ch (ΔCh) is the difference in color between two measured samples, ignoring any difference in lightness. This makes *ΔCh* the perfect metric for expressing errors in gray balance, because the smaller the ΔCh number, the less unwanted color is present in the sample.

Graphically, *ΔCh* is the shortest line, or vector, between two points on the a*/b* graph, as shown below.



On a CIE a/b* diagram ΔCh is a straight vector between two samples (enlarged at right)*

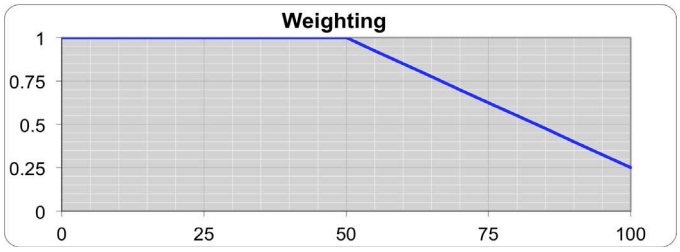
Mathematically, *ΔCh* is an absolute (always positive) expression of the combined delta a* and delta b* values, where:

$$\Delta Ch = \sqrt{\Delta a^2 + \Delta b^2}$$

Weighted delta Ch (wΔCh)

Weighted delta-Ch (wΔCh) is the delta Ch value after it is passed through a weighting curve that reduces the significance of Ch errors in darker regions. The weighting function is defined in the G7 specification (TR015) and the G7 Master Pass/Fail document as follows;

$$w\Delta Ch = \Delta Ch\ x\ (1 - max(0, (\% - 50)/50\ x\ 0.75))$$



The official G7 weighting function for wΔCh

Delta-L*

Delta-L (ΔL*)* is the difference in lightness between two measured samples, ignoring any difference in color. This makes *ΔL** the perfect metric for measuring Tonality (NPDC) errors in G7.

Mathematically, *ΔL** is the result of subtracting the measured sample's L* value from the target L*, as follows:

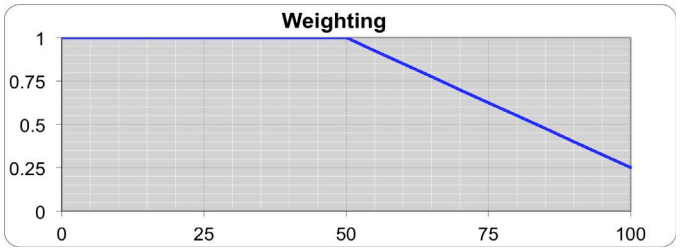
$$\Delta L^* = L_T - L_S$$

Where L_T is the target *L** and L_S is the sample *L**.

Weighted delta L* (wΔL*)

Weighted delta-L (wΔL*)* is the delta L* value after it is passed through a weighting curve that reduces the significance of L* errors in darker regions. The weighting function is identical to that for *wΔCh*, as follows;

$$w\Delta L^* = \Delta L^*\ x\ (1 - max(0, (\% - 50)/50\ x\ 0.75))$$



*The official G7 weighting function for wΔL**

Native CMY

The Native CMY formula used in Curve4 complies with the Idealliance G7 Master specification, from which the following explanation is quoted by permission;

"G7 Native CMY" is similar to G7 Grayscale, except that the target a* and b* values for CMY gray levels darker than 50% cyan are gradually adjusted along a trajectory that ends at the native a* and b* values of that device's 300% CMY level.

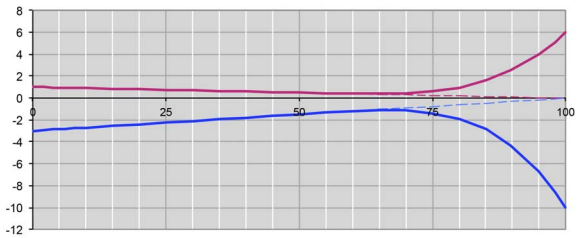
Target a*, b* algorithm:

Given: a^*_{-s} , b^*_{-s} (s = substrate) and a^*_{-300} , b^*_{-300};

For Index percentage values 0 to 100;

$$a^*_{-tgt} = a^*_{-s}\ x\ (1 - {}^{C}/_{100}) + a^*_{-300}\ x\ if(C < 50, 0, ((C-50)/50)^4)$$
$$b^*_{-tgt} = b^*_{-s}\ x\ (1 - {}^{C}/_{100}) + b^*_{-300}\ x\ if(C < 50, 0, ((C-50)/50)^4)$$

The graph below shows the "target" a* (red) and b* (blue) when CMY 300% is 6 a*, -10 b*.



G7 Native CMY gray balance for 300% CMY = 6.0 a, -10 b**

G7 Native CMY maintains G7's original neutrality up to about 75%. Native CMY only deviates from legacy G7 gray balance in areas normally covered by high amounts of black ink.

IMPORTANT: Printing systems that can achieve neutral 300% CMY by mechanical adjustment (e.g. offset) should NOT use Native CMY if the goal is G7 Targeted or G7 Colorspace.

Color data types

Data measurement files may contain CIELAB, CIEXYZ and/or spectral data. When multiple data types are included in the same file, Curve4 uses them in the following order:

Priority 1: Spectral
Priority 2: XYZ
Priority 3: LAB

File formats

CGATS text

Curve4 reads and writes most CGATS-standard files saved out of software from Barbieri, basICColor, Konica-Minolta, X-Rite, and others.

Decimal separator

- Correct: period (.)
- Incorrect: comma (,)

Spectral data range

- Correct: 0-1.0
- Incorrect: 0 – 100

XYZ data range

- Correct: 0-1.0
- Incorrect: 0 – 100

.cxf

The Verify, Calibrate and Blend tools also accept .cxf and .mxf measurement files and the Blend Tool saves .cxf and .mxf files.

Other formats

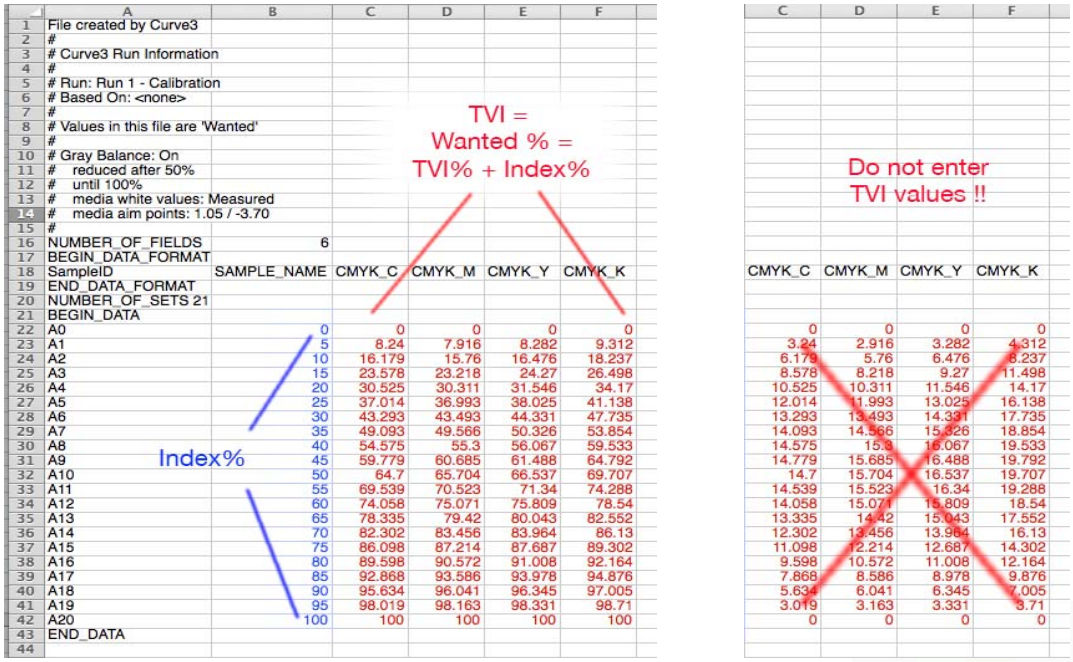
Other file types are also accepted, for example the Logo file format exported from X-Rite MeasureTool™ and files exported from CHROMiX ColorThink™.

Custom text files exported from an application like Microsoft Excel® will be accepted so long as each patch row contains both the device values (CMYK) and measured color values in a separate row.

Appendix I: Custom TVI Curves

Creating a custom TVI target curve

- In Microsoft Excel open a CGATS file exported from Curve4 in *Create Curves.*
- Edit the file so it contains the desired number of index percentages (typically in 5% or 10% steps) and the wanted output percentages (not TVI) alongside each index for CMYK.



	A	B	C	D	E	F
1	File created by Curve3					
2	#					
3	# Curve3 Run Information					
4	#					
5	# Run: Run 1 - Calibration					
6	# Based On: <none>					
7	#					
8	# Values in this file are 'Wanted'					
9	#					
10	# Gray Balance: On					
11	# reduced after 50%					
12	# until 100%					
13	# media white values: Measured					
14	# media aim points: 1.05 / -3.70					
15	#					
16	NUMBER_OF_FIELDS	6				
17	BEGIN_DATA_FORMAT					
18	SampleID	SAMPLE_NAME	CMYK_C	CMYK_M	CMYK_Y	CMYK_K
19	END_DATA_FORMAT					
20	NUMBER_OF_SETS 21					
21	BEGIN_DATA					
22	A0	0	0	0	0	0
23	A1	5	8.24	7.916	8.282	9.312
24	A2	10	16.179	15.76	16.476	18.237
25	A3	15	23.578	23.218	24.27	26.498
26	A4	20	30.525	30.311	31.546	34.17
27	A5	25	37.014	36.993	38.025	41.138
28	A6	30	43.293	43.493	44.331	47.735
29	A7	35	49.093	49.566	50.326	53.854
30	A8	40	54.575	55.3	56.067	59.533
31	A9	45	59.779	60.685	61.488	64.792
32	A10	50	64.7	65.704	66.537	69.707
33	A11	55	69.539	70.523	71.34	74.288
34	A12	60	74.058	75.071	75.809	78.54
35	A13	65	78.335	79.42	80.043	82.552
36	A14	70	82.302	83.456	83.964	86.13
37	A15	75	86.098	87.214	87.687	89.302
38	A16	80	89.598	90.572	91.008	92.164
39	A17	85	92.868	93.586	93.978	94.876
40	A18	90	95.634	96.041	96.345	97.005
41	A19	95	98.019	98.163	98.331	98.71
42	A20	100	100	100	100	100
43	END_DATA					
44						

	C	D	E	F
	CMYK_C	CMYK_M	CMYK_Y	CMYK_K
	0	0	0	0
	3.24	2.916	3.282	4.312
	6.179	5.76	6.476	8.237
	8.578	8.218	9.27	11.498
	10.525	10.311	11.546	14.17
	12.014	11.993	13.025	16.138
	13.293	13.493	14.331	17.735
	14.093	14.566	15.326	18.854
	14.575	15.3	16.067	19.533
	14.779	15.685	16.488	19.792
	14.7	15.704	16.537	19.707
	14.539	15.523	16.34	19.288
	14.058	15.071	15.809	18.54
	13.335	14.42	15.043	17.552
	12.302	13.456	13.964	16.13
	11.098	12.214	12.687	14.302
	9.598	10.572	11.008	12.164
	7.868	8.586	8.978	9.876
	5.634	6.041	6.345	7.005
	3.019	3.163	3.331	3.71
	0	0	0	0

A CGATS file exported from Curve4, showing the Index and TV (Tone Value, not TVI) percentages for a custom TVI target curve set

- Give the text file a suitable name like “GRACoL TVI” and save it somewhere convenient.

IMPORTANT: The percentages in red are TV (Tone Value), not TVI (Tone Value Increase)

	A	B	C	D	E	F
1	NUMBER_OF_FIELDS	6				
2	BEGIN_DATA_FORMAT					
3	SampleID	SAMPLE_NAME	CMYK_C	CMYK_M	CMYK_Y	CMYK_K
4	END_DATA_FORMAT					
5	NUMBER_OF_SETS 21					
6	BEGIN_DATA					
7	A0	0	0	0	0	0
8	A1	5	8.24	7.916	8.282	9.312
9	A2	10	16.179	15.76	16.476	18.237
10	A3	15	23.578	23.218	24.27	26.498
11	A4	20	30.525	30.311	31.546	34.17
12	A5	25	37.014	36.993	38.025	41.138
13	A6	30	43.293	43.493	44.331	47.735
14	A7	35	49.093	49.566	50.326	53.854
15	A8	40	54.575	55.3	56.067	59.533
16	A9	45	59.779	60.685	61.488	64.792
17	A10	50	64.7	65.704	66.537	69.707
18	A11	55	69.539	70.523	71.34	74.288
19	A12	60	74.058	75.071	75.809	78.54
20	A13	65	78.335	79.42	80.043	82.552
21	A14	70	82.302	83.456	83.964	86.13
22	A15	75	86.098	87.214	87.687	89.302
23	A16	80	89.598	90.572	91.008	92.164
24	A17	85	92.868	93.586	93.978	94.876
25	A18	90	95.634	96.041	96.345	97.005
26	A19	95	98.019	98.163	98.331	98.71
27	A20	100	100	100	100	100
28	END_DATA					
29						

*Any rows above the **NUMBER_OF_FIELDS** row can be deleted, if desired, from the file*

TVI calculations

Curve4's TVI curves are calculated from tristimulus data (CIEXYZ) instead of the density values used in traditional TVI calculations.

The black TVI value should be exactly the same as Status T or Status E density-based TVI but Cyan, Magenta and Yellow TVI values may differ from traditional TVI, depending on ink colors.

XYZ-based TVI target values

The formula used by Curve4 to calculate TVI from CIEXYX values is as follows;

Required

Paper XYZ values (Xp, Yp, Zp).

Solid ink XYZ values for cyan (XSc), magenta (YSm), yellow (ZSy) and black (YSk).

XYZ values for the for various tint percentages (T) of each ink, e.g. XTc, YTm, ZTy, YTk.

For each tint percentage (T)

$$Cyan\_TVI = (Xp - XTc) / (Xp - XSc)\ x\ 100;$$
$$Magenta\_TVI = (Yp - YTm) / (Yp - YSm)\ x\ 100;$$
$$Yellow\_TVI = (Zp - ZTy) / (Zp - ZSy)\ x\ 100;$$
$$Black\_TVI = (Yp - YTk) / (Yp - YSk)\ x\ 100;$$

Therefore...

$$Cyan\_TV = Cyan\_TVI + T;$$
$$Magenta\_TV = Magenta\_TVI + T;$$
$$Yellow\_TV = Yellow\_TVI + T;$$
$$Black\_TV = Black\_TVI + T;$$

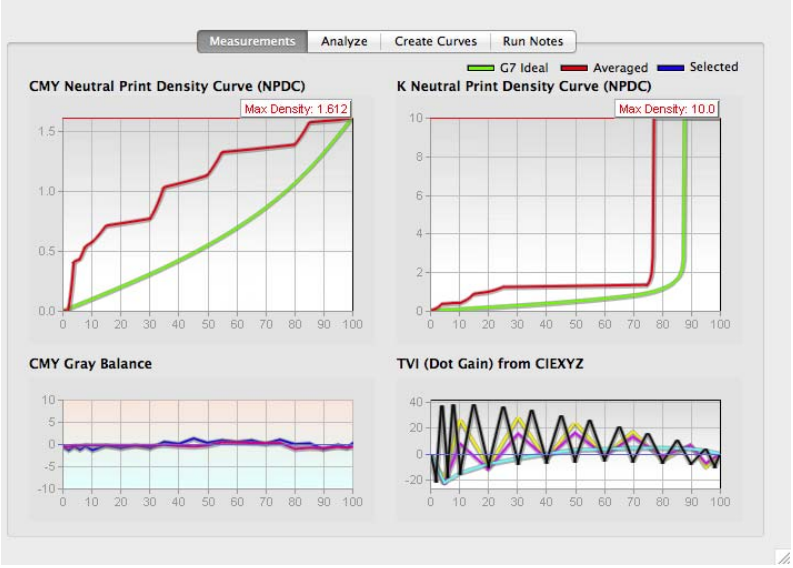
J

Appendix J: Trouble-Shooting

This section includes a few cool tips and tricks, and some of the unexpected results that can occur in Curve4 due to printing or measuring problems. In some cases the problem can addressed with Curve4's controls but in others you may have to re-measure or re-print the data.

Incorrect i1iO alignment

If the X-Rite i1iO is incorrectly aligned (wrong corner points entered), the measured data will not align correctly with the percent values in the reference file. This will usually show up immediately as a strange curves in the Measurements pane similar to these...



Result of incorrect i1iO alignment

Corrective action

The only solution to this problem is to re-measure the target using proper i1iO alignment.

Uneven printing

If the P2P target is printed unevenly due to mottling, streaking or uneven ink coverage, the NPDC graphs and calibration curves may exhibit reversals or spikes, as shown below.

Corrective action

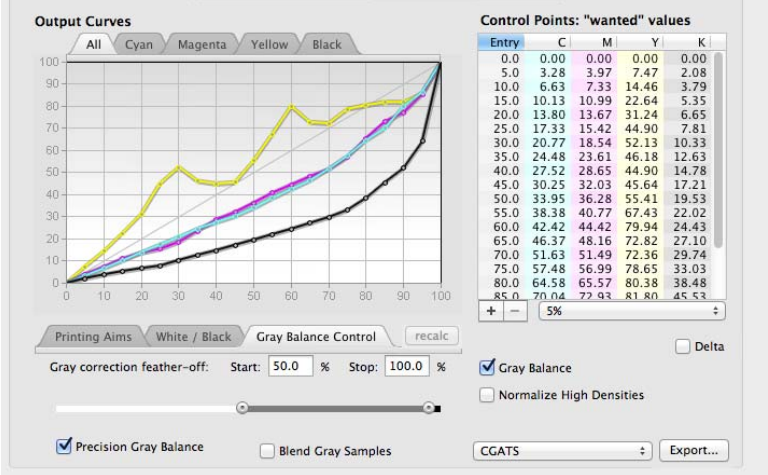
The ideal solution is to solve the problem at the printing device and re-print the P2P target. If that is not be possible, try the following actions, but remember the resulting calibration may not seem to be very effective if the printing issues persist.

- Measure multiple targets (as many as possible) and let Curve4 average them
- Click the *Smooth* button
- Select *Blend Gray Samples* in Create Curves
- Click *Normalize High Densities* (but be aware the result may fail G7)

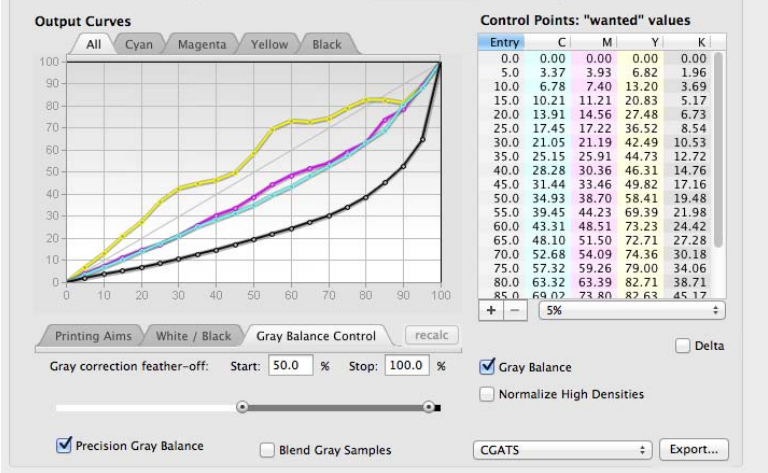
TIP: Often a combination of the above actions will give the best results, for example measure multiple targets and use Smooth and Blend Gray Samples.

Oscillations in the NPDC graphs caused by an unevenly printed P2P target

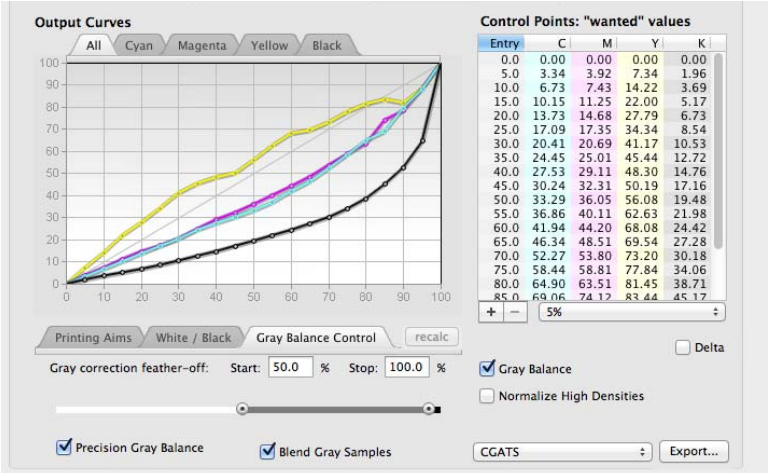
*NPDC oscillations reduced by the **Smooth** button*



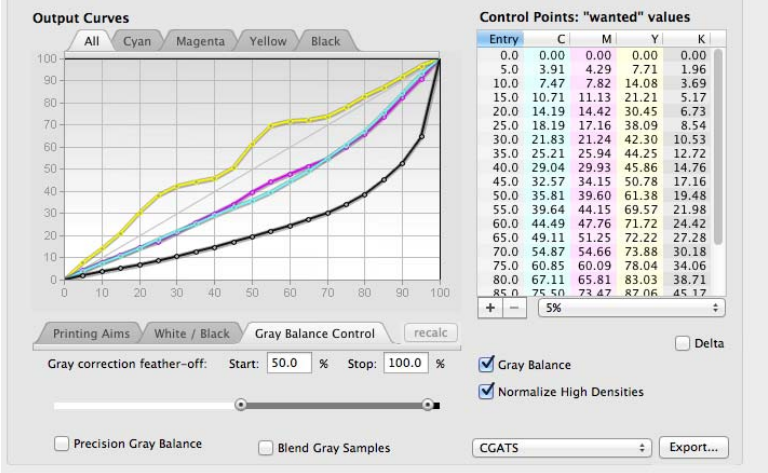
Reversals in the calibration graphs caused by an unevenly printed P2P target



Calibration reversals reduced by the Smooth button



Further improvements using Blend Gray Samples

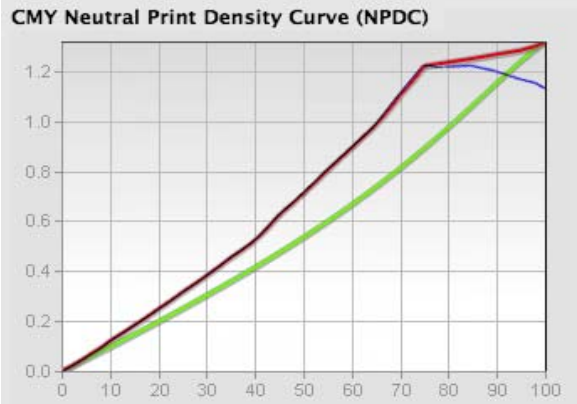


Shadow reversals eliminated by ***Normalize High Densities***

Density Reversals

An increase in dot percentage in either of the two P2P gray scales should normally produce an increase in ND (neutral density), but sometimes the ND values start to decrease at very high percentages due to a reduction in gloss, ink bronzing, ink-restriction functions, etc.

Curve4 cannot calculate G7 NPDC curves correctly from reversing data, so it adds a small artificial ND increase to every step higher than the one at which reversal first occurred. Typically the calibration will pass G7 even though small errors remain in the darkest part of the resulting NPDC, but in extreme cases the resulting prints may show excessive shadow contrast or tone jumps in high-density areas.



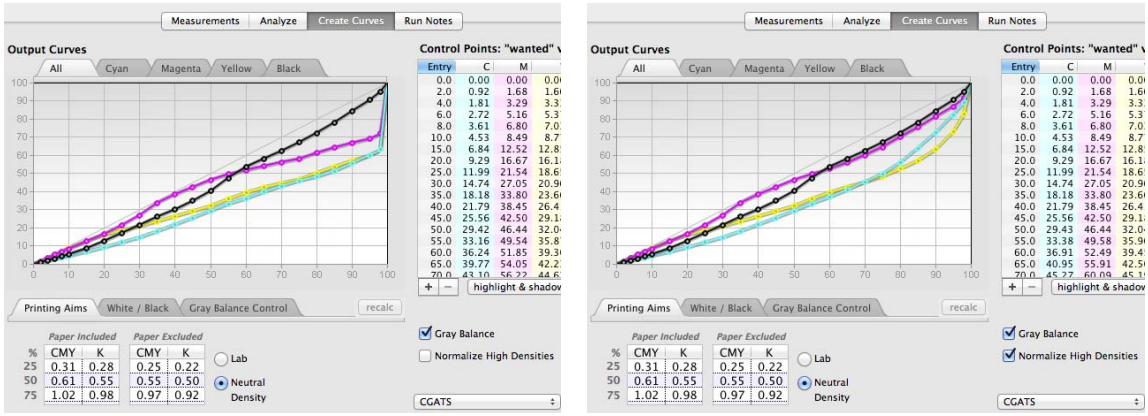
Density reversal in original NPDC data (blue) and modified by Curve4 (red)

Corrective action

Try eliminating the cause of reversal in the printing process by reducing ink, improving ink trapping or eliminating the RIP function that caused the problem. If the resulting prints still have too much shadow contrast or sudden tone changes in saturated colors, see the next section, *Calibrating Extremely High Densities.*

Calibrating Extremely High Densities

Calibrating a high-density ink-jet printer for *G7 Extreme* compliance can result in excessive contrast in saturated color areas, as indicated in the last few steps of the *Output Curves* (left-hand diagram, below). This is one of the rare instances where traditional G7 calibration may not be the best option, either visually or as a basis for subsequent ICC profiling.

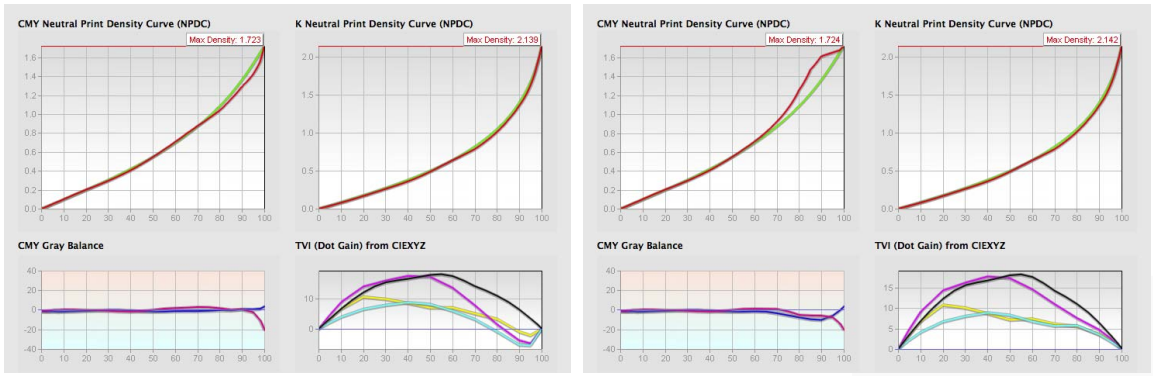


Calibration curves likely to produce extreme contrast in the calibrated print (left) and softened with the ***Normalize High Densities*** *option*

Corrective action

To get a more useful calibration that still retains the main benefits of G7, click *Normalize High Densities.* This replaces the conventional NPDC curves at higher densities with smoother curves that result in more acceptable shadow contrast. Just be aware that the resulting calibration may no longer pass official G7 tolerances (see *Caution* below).

CAUTION: The Normalize High Densities option may cause the device to fail G7. A Pass can usually be achieved by creating an ICC profile through the Normalized calibration and converting a P2P from a G7-based profile, such as GRACoL2006_Coated1v2.



Legacy calibration (left) compared to Normalize High Densities calibration (right). Although the CMY NPDC curves are too heavy in the right graph, the TVI curves show that the individual ink colors are actually smoother and result in a better ICC profile.

K

Appendix K: The 0-45 Problem

ICC-based digital proofing is capable of an extremely close match between proof and print when the prints from both systems have a smooth or glossy surface. However the same is not always true when the printed sample the proof is trying to match has a matte surface, such as uncoated paper or newsprint. In these cases the proof often appears lighter or “washed out” next to the original print when compared in a standard D50 viewing booth.

The problem (explained in detail below) seems to be that most spectrophotometers “see” matte-surfaced materials differently from the human eye. Until equipment and standards can be up-dated to solve the problem at its root, the Remap Black function in Curve4’s Blend tool lets you modify your measured data to effectively cancel, or at least reduce, the problem, and produce proofs that match the original print more closely.

Why matte measurements seem too light

Reflective spectrophotometry works by illuminating a sample with a controlled light source and measuring the color of the light reflected up into the optics. Ideally, all the “incident light” coming from the source should penetrate the ink film, scatter off the substrate (e.g. paper), pass upward through the ink again and be collected by the analysis optics. In practice, some of the incident light is reflected directly from the top surface of the sample, without any color information. This reflected white light is known as “specular reflection”.

Optical flare

On a glossy or smooth stock such as proofing paper, most of the specular reflections bounce safely away at 45 degrees, without entering the analysis optics. But on matte or uncoated stock, the surface is far from mirror-like, consisting instead of tiny crystals or fibers, so the specular reflections scatter in all directions, some traveling directly up into the analysis optics. The result is a small amount of unwanted “optical flare” which lightens the measurement value, leading to an apparent loss of density or saturation. When a profile is made from these measurements, any good proofing system will faithfully reproduce what appears to be a washed-out proof with lower than expected ink densities, less saturation and a loss of image contrast.

0-45 optical geometry

The ISO-standard “0-45” optical geometry employed in most spectrophotometers focuses one or more beams of light onto the sample area at an angle of 45 degrees, while the analysis lens looks

straight down at 90 degrees to the surface. In some devices the arrangement is reversed. The term “0-45” refers to the illuminant beam’s 45 degree angle to the optical axis.

Although 0-45 geometry is an industry standard, it doesn't mimic the way humans view prints and proofs in a retail store or a D50 viewing booth, for two reasons:

First, unlike a 0-45 spectrophotometer, the incident light in a viewing booth comes from more angles than just 45°, which reduces the relative percentage of unwanted specular reflections arriving at the eye. The result is less flare and higher apparent contrast than a 0-45 spectrophotometer measures.

Second, if our viewing position or the placement of the samples causes too much flare, we only have to tilt the print slightly to improve its contrast. It's a subconscious reaction that changes with subject, environment and viewing position, but which is hard to automate in a cost-effective instrument.

The net result is that when viewing a matte or uncoated print in a D50 light booth or typical real-world environment, we don't see the same amount of flare as a densitometer does, so the matte sample has more contrast and color than a proof that attempts to simulate it. This didn’t matter in the days before ICC proofing, but thanks to the accuracy expected of ICC proofing, it’s now a serious problem.

Related pressroom problems

A related problem is that most pressroom measuring instruments (hand-held or closed-loop) use the same 0-45 geometry and report much lower relative densities on uncoated stock than the eye perceives. This makes it harder to control color accurately on press because large visual differences are expressed as smaller measured differences.

Press systems that allow the use of polarization can give more realistic densities, but break with published standards, yielding Lab or density values that don’t necessarily match non-polarized aim values.

Short term solutions

There are three possible short-term solutions to the 0-45 problem;

1. Polarization

Polarized measuring devices reduce the effect of specular reflections, but automated polarizing spectrophotometers are not widely used in the USA and are generally expensive.

- At the time of writing the Barbieri LFP is the only integrated x-y scanning spectrophotometer with built-in switchable polarizing.
- Another option is the ColorScout™ table (www.colorpartner.de) which can be adapted to a variety of hand-held polarizing spectrophotometers such as the Techkon SpectroDens.
- The discontinued X-Rite SpectroScan had a polarizing option but is no longer available.

2. Spherical illumination

Spherical measuring devices reduce the effect of specular reflections by illuminating the sample in manner similar to real-world viewing, i.e. with light coming from multiple angles.

At the time of writing, no integrated automated spherical spectrophotometers are available, but the ColorScout™ table can be adapted to several hand-held spherical spectrophotometers from KonicaMinolta, X-Rite and others.

3. Modify the measured data with Curve4

Curve4's Remap Black utility (in the Blend tool with the Complete license) approximates the effect of polarizing or spherical illumination by increasing the contrast of measured data.

The resulting data is not exactly the same as polarized or spherical data, but should be a good enough approximation to solve most of the problem.

Users wishing to obtain more realistic proofs of uncoated or matte materials are encouraged to try the Remap Black utility.

Long term solution

The long term solution requires attention by standards groups, manufacturers and educators to;

- Acknowledge the problem exists.
- Research causes and possible solutions.
- Manufacture hardware or software changes.
- Publish new CRPCs to replace or augment those affected by the problem.
- Modify measuring standards and/or recommended best practices.
- Educate the industry.

(We recommend you don't hold your breath.)