THE PRINTER'S GUIDE TO G7 IMPLEMENTATION

FULLY REVISED AND EXPANDED GUIDE

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About This Guide

Techkon instruments have always supported G7® with features that make it easy to use. G7® has been a key part of the standardization of printing around the world, helping companies to become more efficient and make better use of their manufacturing process. In the second 2018 revision of this guide, Techkon would like to present you with background information about G7®, as well as technical details on calibration. In the end, there is a section about how to use the Techkon SpectroDens, and it's G7® feature set.

Basic information about G7®

What is G7®?

G7® has had a revolutionary impact on how printing is done in North America, as well as other regions. The term is used every day in the world of print to refer to an expected print condition. Many print buyers and designers use G7® as a catch phrase for CMYK printing across many different print technologies.
Don Hutcheson invented G7® out of a need for a simple and effective way to calibrate CMYK devices. He noticed that photographers had used gray scales for image calibration for more than 100 years. Don used this as a basis and created methods and aim points for G7® that we use today when performing a calibration, or assessing a print. Unlike other print specifications which rely primarily on dot gain, G7® is a colorimetric specification that has been mathematically formalized in CGATS TR015.
G7® has precise definitions with several key elements:

- G7® is a specification for gray scale appearance and applicable to any CMYK printing process
- G7® defines two elements, tonality and gray balance
- Tonality represents the weight of the CMY and K curves and is referred to in G7® as Neutral Print Density. Tonality in G7® can be defined by density or LAB values.
- Gray balance represents how gray should appear to the human eye. In G7®, itis defined in terms of CIELAB a* and b* values.
- In addition to being a specification, G7® also is a calibration method that can be used to calibrate any CMYK device.

Common Visual Appearance

One of the most valuable things about G7® is its applicability to any CMYK printing system. When used across multiple systems, each can produce a result visually similar to the others, even if they are completely different print processes. This is often referred to as common visual appearance. For example, a plastic bag produced using G7®, and a folding carton produced using G7® will have similar tonality and gray balance. This means a brand or print buyer can have one proof and have similar results across many printing methods and locations. It is the common G7® tonality and gray balance that achieves this. This common visual appearance was very difficult to achieve prior to G7® and required many different proofs and sets of color corrections. Traditional print calibration methods have relied on TVI (tonal value increase) curves and do not work across multiple print processes. While the common visual appearance resulting from G7® is not perfect and cannot control all variables in color reproduction, the results are surprisingly good.

G7® and Paper

G7® is substrate relative. This means the color of the G7® gray adapts to the color of the substrate. For example, on a blue paper, the gray will have a bluer target value or aim than it would on a yellow or neutral paper. This is so grays will look natural or “relative” to the substrate. A normal gray on a blue paper would look too yellow, and a normal gray on a yellow paper would look too blue. There are no fixed values for the gray balance targets in G7® and, since it adapts to the substrate, the gray always looks natural. (One of the really handy features of the TECHKON SpectroDens is that it dynamically calculates and advises on these gray balance targets based on the color of the paper).

Key Metrics for G7®

For G7® we have important metrics that we must pay attention to. First, G7® is based on color, not dot gain or density. We determine the correct color based on LAB measurements. So when we are working within G7® we need to have a good understanding of how to measure and evaluate LAB measurements.
The two main things we will be measuring with G7® will be:

- Gray balance, which is expressed as LAB values. (Gray balance is evaluated with a metric called weighted **Δ**Ch.)
- Neutral print density (NPDC), which is commonly expressed as density, but can also be expressed as LAB values. (NPDC is evaluated with a metric called **Δ**L.)

The ‘weighted’ term refers to reducing the significance of errors in darker areas which do not have the same visual impact as errors in the highlight areas.

There are three sets of patches that are used for G7® control and evaluation:

- HC – The Highlight Contrast patch is made of C25, M19, Y 19
- HR – The Highlight Range patch is made of C50, M40, Y40 and is the most commonly used G7® patch for evaluation and process control.
- SC – The Shadow Control patch is made of C75, M66, Y66

G7® Compliance Levels

There are 4 different levels of G7® Compliance that can be achieved. Which level depends on the type of printing you are doing and the precision needed.

The three levels are:

- G7® Gray
- G7® Targeted
- G7® Colorspace

G7® Gray is when G7® gray balance and tonality are achieved. For devices that cannot match the gamut of reference color space, G7® gray will provide basic common visual appearance. Examples of this may be a wide format printer or silk screen press that cannot achieve the gamut of GRACoL or SWOP.
G7® Targeted is when you achieve G7® Gray, and also match reference print condition C, M, and Y solids within 3.5 **Δ**00, the K solids within 5.0 **Δ**00 and overprints within 4.2 **Δ**00. An example of this would be matching GRACoL on a sheetfed-offset press.

G7® Colorspace is when you achieve G7® Gray, G7® Targeted, and a specific delta E average across the entire colorspace, as well as achieving a specific **ΔE** at the 95th percentile. Some offset presses can match this, but a more typical example would be an inkjet proofer.

All of the compliance levels above are recognized as compliance levels within the G7® Master program. More detailed information on these levels can be found in the IDEAlliance G7® Master Pass/Fail document, available at http://www.idealiance.org.

What about Targeting a G7® Colorspace like GRACoL

Many people confuse G7® and GRACoL and may use G7® and GRACoL interchangeably. GRACoL and G7® are related, but they are not the same thing.

- G7® is a specification describing gray balance and tonality, as well as a calibration method.
- GRACoL is a reference print condition for sheetfed offset printing based on using G7® as a calibration method. (GRACoL stands for General Requirements and Conditions for Offset Lithography. GRACoL is maintained by an IDEAlliance subcommittee.)

So to get GRACoL, we use G7® as a calibration method on a sheetfed offset press. GRACoL meets all the conditions of G7® because it is a calibration and print condition based on a G7® calibration. SWOP is similar and is a print condition for web offset printing based on G7® calibration.

Both GRACoL and SWOP are what is referred to as Reference Print Conditions. Print buyers and designers use these reference print conditions even when they don't know exactly what press or printing machine they are going to print on. There are additional reference print conditions based on G7® in CGATS 21 and ISO 15339. These are well-defined color spaces that, in addition to meeting G7® specifications, have complete characterization data sets including specification of reference paper color.

To target a G7® colorspace like GRACoL or SWOP we pay close attention to the color of solids and overprints, as well as gray balance and tonality. Additional details on how to do this appear later in this document in the calibration session.

Table showing G7® Colorspaces and M Condition

Colorspace	**Print method**	**Measurement method**
GRACoL 2006	Sheetfed offset printing	M0
SWOP 3 2006	Web offset printing, 3 grade paper	M0
SWOP 5 2006	Web offset printing, 5 grade paper	M0
CGATS 21-2_CRPC1/ISO PAS 15339	Coldset news offset printing	M1
CGATS 21-2_CRPC2/ ISO PAS 15339	Heatset news offset printing	M1
GRACoL2013UNC_CRPC3/ ISO PAS 15339	Uncoated sheetfed offset printing	M1
CGATS 21-2_CRPC4/ ISO PAS 15339	Super calendered	M1
SWOP2013C3_CRPC5/ ISO PAS 15339	Updated SWOP 2013 on grad 3 sheet	M1
GRACoL2013_CRPC6/ ISO PAS 15339	Updated GRACoL 2013 on grad 1&2 sheets	M1
CGATS 21-2_CRPC7 ISO PAS 15339	Expanded coated wide gamut printing	M1
XCMYK 2017	Expanded Gamut	M1

How is G7® connected to ISO and other print standards

ISO 12647 is a print standard used by printers around the world. If you work with major brands or people buying print internationally you will notice that they often refer to this standard. When Don Hutcheson implemented G7® in 2005, he was the GRACoL chairman. The project at that time was to develop a new version of GRACoL, which was to include a calibration method. G7® was intended to be in harmony with ISO 12647, and the G7® NPDC curves were averaged from multiple press tests using ISO standard paper and ink. If you compare GRACoL 2006 with other ISO 12647 implementations (such as FOGRA 39) you will notice that the two reference print conditions are nearly identical. (They are so close that most people cannot tell the difference.)

In 2012 ANSI CGATS TR015 was published as a formalization of the G7® neutral print density and gray balance methodologies. There are also additional print standards, developed in 2013, named CGATS 21 and ISO PAS 15339. These contain a collection of TR015-based reference print conditions that range from newsprint to premium coated. Updated versions of GRACoL and SWOP are based on reference characterizations contained in CGATS 21 and ISO 15339. The ISO 12647-2 standard was updated in 2013 as well. GRACoL 2013 is based on these changes.



Comparison of GRACoL 2006 (left) and GRACoL 2013 (right). The differences are based on a slightly bluer paper color.

G7® is how we calibrate to the print standards from CGATS 21 and ISO 15339.

- G7® is a valid method for calibrating to IS0 12647-2:2004, and ISO 12647-2:2013
- CGATS TR015 is a standard that formalized the G7® method
- All of the datasets in CGATS 21 and ISO PAS 15339 are based on G7®

How to perform a G7® Calibration

There are several different ways to achieve G7® on a printing machine.

- On a machine such as an offset press or flexo press that uses look-up tables (LUT) or curves, we use the traditional G7® calibration method to perform this calibration.
- On a machine such as a proofer or digital press, we use ICC profiles to perform this calibration. Even though digital presses can easily achieve G7® using ICC profiles, in many cases, it is advisable to have a look up table (LUT) based G7® calibration in addition to the ICC profile. That is because performing curve based G7® is much faster than creating ICC profiles. The quick and easy curve based G7® linearization can be a great print condition upon which to build your ICC profiles. (Much faster to recalibrate to than the slow method of rebuilding ICC profiles).

In this section, we will go through how to perform a G7® calibration on a sheetfed offset press.

Picking a Reference Print Condition

Before we begin to calibrate, we need to pick our target reference print condition. That is because the color of the inks, the paper, and other materials are dependent on this print condition. For example, GRACoL and SWOP contain LAB definitions of solids, overprints, and paper.

- If we do not care about matching a reference print condition and only want to achieve G7® then we do not need to worry about what ink and paper we have. In some cases if we know we have an ink or paper that cannot match an existing reference print condition we may just choose only to match G7®. This calibration would be to the G7® Gray compliance level and means we would only be achieving G7® gray balance and tonality.
- If we need to calibrate to a reference print condition such as GRACoL, this will guide us in knowing what ink and paper to use. By calibrating to a reference print condition such as GRACoL, we should able to create a good proof to press match between the GRACoL proof and the press sheet. This compliance level is usually G7® Targeted, which means we will be achieving gray balance, tonality, ink solids and ink overprints. For this guide we will be targeting GRACoL 2006.

Requirements

In order to perform the calibration there are prerequisites that we need to have on hand:

- Measurement device for pressroom. The measurement device must be capable of measuring LAB color, and density
- Measurement device for plates.
- ISO compliant inks. The inks must be able to achieve the ISO ink solids and overprints specified in ISO 12647-2.
- G7® curve creation software. Though you can do G7® with no software using the fan graph method, it is much more efficient when using software. For the purposes of this exercise, we are going to use Curve 4

software from Chromix. Curve 4 is inexpensive and easy to use. There are also a number of other software programs that have been certified by IDEAlliance as being capable of accurate creating the G7® curves.

- Paper that is compliant with the reference print condition you are trying to match.

A Few Notes on Paper

The choice of paper is one of the most important choices you can make. If you are calibrating to GRACoL 2006 (and unless you are performing an M1 calibration such as GRACoL 2013) then make sure to avoid papers with excessive optical brighteners. The closer the paper color is to the target reference print condition, the closer your proof to press match will be. Even if you typically use brighter papers for this calibration pick the closest match the reference print condition, and then at the end of the calibration you can tail in your normal production stock and make sure the proof to press match is acceptable. Optical brighteners have a negative effect on the validity of traditional M0 measurements, and thus affect the calibration.

Machine preparation

A press calibration is a moment in time. Ideally, we would do many press runs and average these to create our calibration. Few facilities have the time and resources to do multiple runs, so we need to make sure that our press calibration run is the best we can do. The entire calibration is based on the mechanical condition of the press, as well as the consumables we have. We need to make sure the press is in good mechanical condition.
To do this, make sure any major repairs or changes to the units are done before the calibration. Doing these types of changes after the calibration will often invalidate the calibration. Rollers should be striped, pressures adjusted, water checked. Blankets should be replaced a day or so prior to the calibration, and packing checked. Everything on the press needs to be checked and set to standard print conditions.

Documenting your Print Conditions

Because this press run is a moment in time, it is very important to document the print conditions. A document that can be downloaded http://www.freeprocesscontrol.com/press.pdf can provide you with a worksheet to record these print conditions. This includes inks, blanket type and packing info, conductivity, roller stripes, pressure, and other information. This information is very important, because if the calibration drifts this information will help determine what has changed. Without being able to return to the referenced machine calibration state, we will be unable to tell what has changed.

Preparation of the Press Form

The press form can be downloaded from www.idealliance.org, or you can make your own form. The forms at www.idealliance.org provide good guidelines for placement of elements. Most important is that there should be at least 2 P2P51 targets on the form. You will notice that these are located on left and right, and top and bottom of the sheet. The form should be imaged as a linear plate. Before running, we want to measure the plate with a plate reader and make sure we have a linear plate. Acceptable tolerances for a linear plate are generally +/- 2%. If for some reason you do not have linear plate or choose to run with a non-linear plate make sure to record the values on the

plate so that you can return the plate to this condition should your platesetter drift. (Over linearization can cause printing issues). Keep in mind different line screens and screening types will require different curves.

1st Calibration Run

The first calibration run has several objectives:

- Ink targeting. In this first calibration run, we want to make sure that we can adjust ink solids to the right color for solids and overprints
- Provide linear sheet for measurement and creation of initial curves
- We will start up and have the press operator run the press up to normal densities. (At this point lower densities are better than higher as it is easier for the press operator to add ink rather than to remove and take ink off.)
- Once the press operator is running pay close attention to the following:
- Registration. The press operator needs to achieve the best registration they can achieve. While no press is perfect, and paper has a great deal to do with this, registration can have a great impact on gray balance.
- Evenness. Make sure the press sheet is even. If the press does not have a scanner and you are reading with a handheld, you can focus on the P2P targets. Even color is important and uneven inking can invalidate the calibration.
- Charge. Measure vertically up and down the sheet and have the operator adjust the charge if it is not even. In normal production, operators cannot measure charge, but the typical G7® test form contains bars that let you check and measure charge, which is important for a valid calibration.
- Once we know we are printing correctly, we can begin to adjust for ink targeting. In G7® we do not have static target density numbers. We create the numbers for that press and ink combination by using LAB measurement.

To do this we make sure we have the target values for our reference print condition on hand. Below are the target values for GRACoL 2006 and 2013. (Values for other G7® based datasets are available in CGATS 21 or ISO 15339.)

GRACoL	Paper			C 3.5 Δ00			M 3.5 Δ00			Y 3.5 Δ00			K 5 Δ00		
	L*	a*	b*	L*	a*	b*	L*	a*	b*	L*	a*	b*	L*	a*	b*
2006	95	0	-2	55	-37	-50	48	74	-3	89	-5	93	15	0	0
2013	95	1	-4	56	-37	-50	48	75	-4	89	-4	93	16	0	0

GRACoL	Red 4.2 Δ00			Green 4.2 Δ00			Blue 4.2 Δ00		
	L	a*	b*	L*	a*	b*	L*	a*	b*
2006	47	68	48	50	-68	25	24	17	-46

2013	47	68	48	50	-66	26	25	20	-46

GRACoL 2006 and 2013 Colorimetric Values (**changes in red**)

We read each ink solid and compare it to the desired solid, and then adjust. For example, if yellow should be L*89 a*-5 b*93, but the measurement is L*90 a*-4 b*89 you need to increase yellow density. Doing this requires a basic understanding of LAB. The goal here is to achieve the lowest delta E on press when compared to the reference print condition. For GRACoL 2006 the required Δ00 is 3.5 or less for C, M, Y solids, Δ00 5 or less for K, and Δ00 4.2 or less for overprints. Ink targeting requires increasing or lowering density until we achieve the lowest possible delta E. Most *current* measurement devices have the ability to provide you with the Δ00 calculation and LAB numbers.

Note that according to the G7 Master Pass/Fail Guide the target aims can be absolute or relative. Absolute means the aims are the exact values of the original dataset. Relative uses something called substrate correction (SCCA) and allows adjustment of the aims for the solids and the overprints based on the paper color. This can be particularly helpful when printing on substrates that vary from the target substrate. For example, when printing on a bright blue paper and aiming at GRACoL 2006 it may be impossible to achieve the target aims without using substrate correction. This is because paper is an important part of the reference print condition. When the substrate has deviated too far from the target aim, then you no longer can achieve the absolute colorimetric aim. Idealliance allows substrate correction for G7 Master submissions.(The Techkon SpectroDens can provide you with the both absolute and substrate relative Δ00 E and LAB numbers, as well as a density recommendation and prediction of the lowest delta E, making ink targeting very easy to do.)

Once we have achieved the lowest possible ΔE here, we then want to target the overprints. Overprints are perhaps more important than the solids. Keep in mind that few people are buying printing made up of solid Cyan or Magenta. Poor Δ00 on the overprints can indicate a problematic proof to press match. In the same manner as above, we need to adjust the overprints to have the lowest delta E possible. For example, if my CM overprint reads L*24 a*17 b*-20 but should be L*24 a*17 b*-26, then I would need to increase Cyan. You may require slight adjustments to the solid densities to achieve the best overprints. If so make sure they stay below the Δ00 limit for the reference print condition.

Keep in mind the color of the paper has a great effect on your ability to achieve these solids and overprints. A paper that is too blue will make some of these difficult to achieve, as will a paper that is too yellow.

Once you have the solids and overprints dialed in you are going to read the solids and these will become the target densities your operator will use. Have the press operator level the sheet and keep an eye out for registration, doubling, and print defects. Once the sheet is even, have the operator run a long set. Being stingy on paper doesn't help here, and running too few sheets will not represent the actual print condition. If you normally coat, then have the coater on with the most common coating. One benefit of the coating is that it fixes the sheets and simulates dry-back.

Once you have a level sheet, take at least 3 sheets for measurement. Look closely before leaving the press as bad sheets are often the culprits in failed press calibrations.

Measurement and Curve creation

The next step is to measure the sheets. Ideally, the sheets would have set over time to account for dryback, but in many plants they do not have the luxury of waiting overnight before continuing the calibration. Part of the reason we drive the ΔE of the solids and overprints as low as possible is to make sure they will be valid after dryback. (If you do notice a large color change after dryback you will need to wait for dryback before continuing with the calibration.) The sheets should be measured using the same M condition measurement parameters as the reference print condition. For GRACoL 2006 this is M0, D50, 2 degrees and white backing. For GRACoL 2013 or any of the CGATS 21 G7-based print conditions this is M1, D50, 2 degrees, and white backing. Changing the measurement parameters has a big effect on the measurements, so make sure your settings match. This can be done using a measurement application provided by the instrument manufacturer, or in Curve 4 can be done directly within the application.

We are going to measure 3 press sheets, with 2 targets on each sheet. Name the measurements noting sheet number and position so you can make correlations if there are issues with the targets.
Before measuring we must determine whether to measure into Curve 4 directly, or to measure using a different program, and to import the measurements. Measurement into Curve 4 is simple and easy, but it does not support all instruments. It is often desirable to have the individual measurements available for further analysis in other programs, and for review in the future. Make sure you name and save the measurements in a folder (If measuring directly within Curve 4, note you can also export the measurements from Curve 4 for use in other applications.)

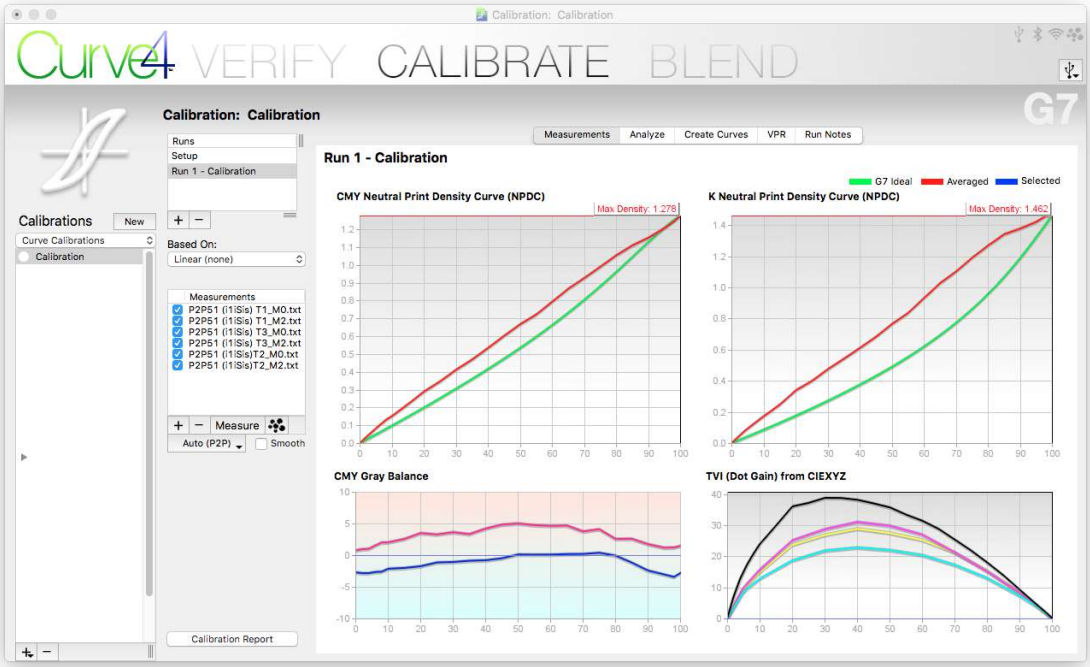
Once measured, we launch the software for making curves. In Curve 4 this involves launching the software and importing the measurements.

To start a new session, we are going to select the + button in the lower right and select ‘new calibration.' Next select Window>Show References from the Curve 4 menus. In this screen, you will select the dataset you are printing to, and make sure the substrate relative option is enabled if you are printing a paper that has a significantly different white point than your characterization dataset aims.

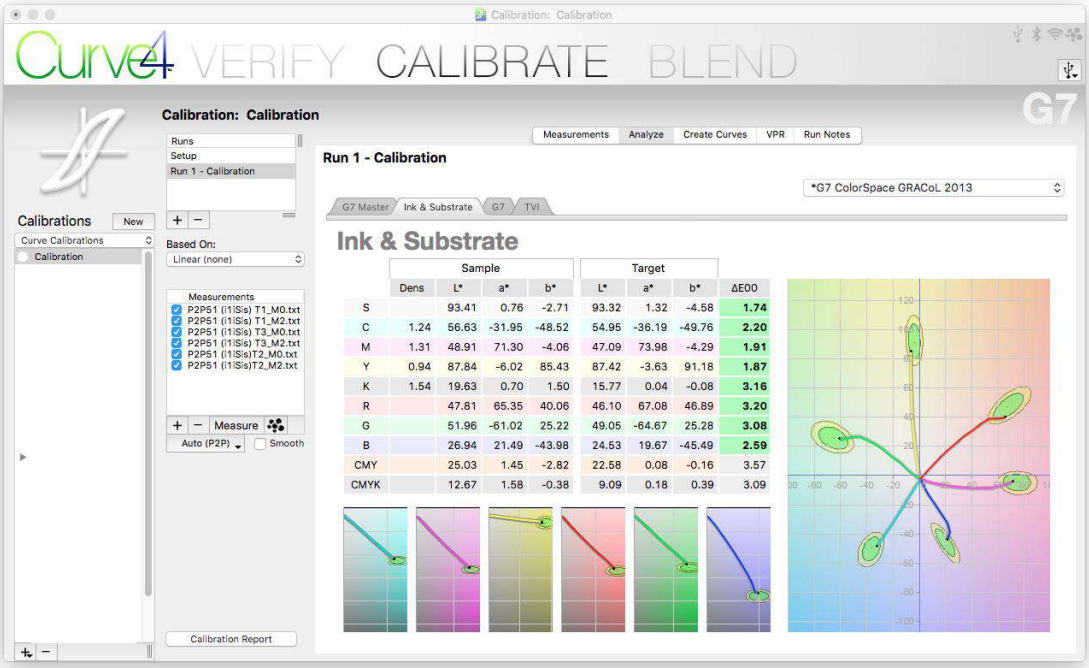
Once the measurements are imported, The Curve software will automatically calculate the NPDC aims, as well as gray balance aims, and will show these on the main screen. This first glance gives you an idea of how close you are on this first run. Click on each of the measurements one by one, and look for any measurements that have a high ΔE compared to the other measurements. (In Curve 4 this shows in the lower right corner below the measurements). If you see that any of your measurements have a high ΔE compared to the others uncheck that measurement so it is not included in the calculations. (The bad measurement could be due to a misread, bad patch, etc. Bad measurements are an important thing to watch for as they can invalidate the calibration.) Next, go to the Analyze tab and select the ink and paper tab. Make sure the characterization data set on the upper right is the same one you are targeting. Look at the deltas for each of the solid inks. These measurements should be similar to what you measured on press with the handheld SpectroDensitometer. The tab to the right of ink and paper is G7®. Select this tab, and this will show you how close we are to G7® compliance. This screen shows ΔL (tonality) and ΔCh (gray balance).

Unless these screens show green for the average and max, we will need another press run to achieve our calibration. Note that it is normal for the first run to 'fail'. The goal of this first run was to make sure we have ink solids and overprints tuned to the lowest possible delta.

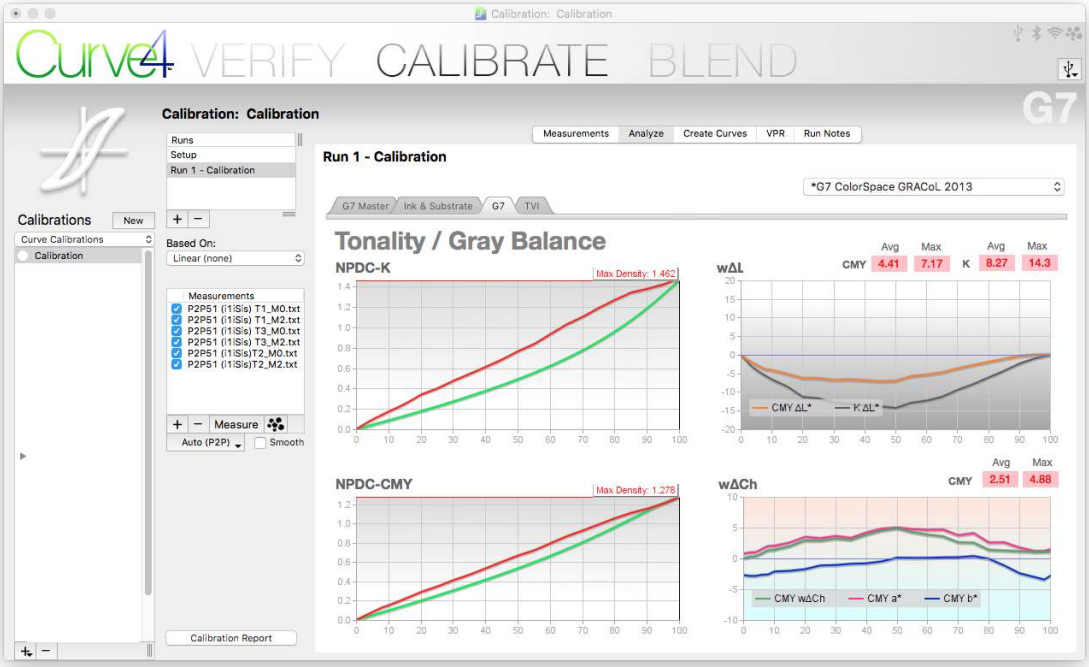
Next we click on the Create Curves tab. This tab shows us the required curves to achieve G7®. Depending on the RIP you may be able to save out the curve to a file and import it directly into the RIP. (If your rip is not listed, you can always hand enter the values into the RIP.) Once we have made these changes we output the corrected plates and go back on press. Before going back to press, it is important to read the plates and make sure the requested changes have been made.



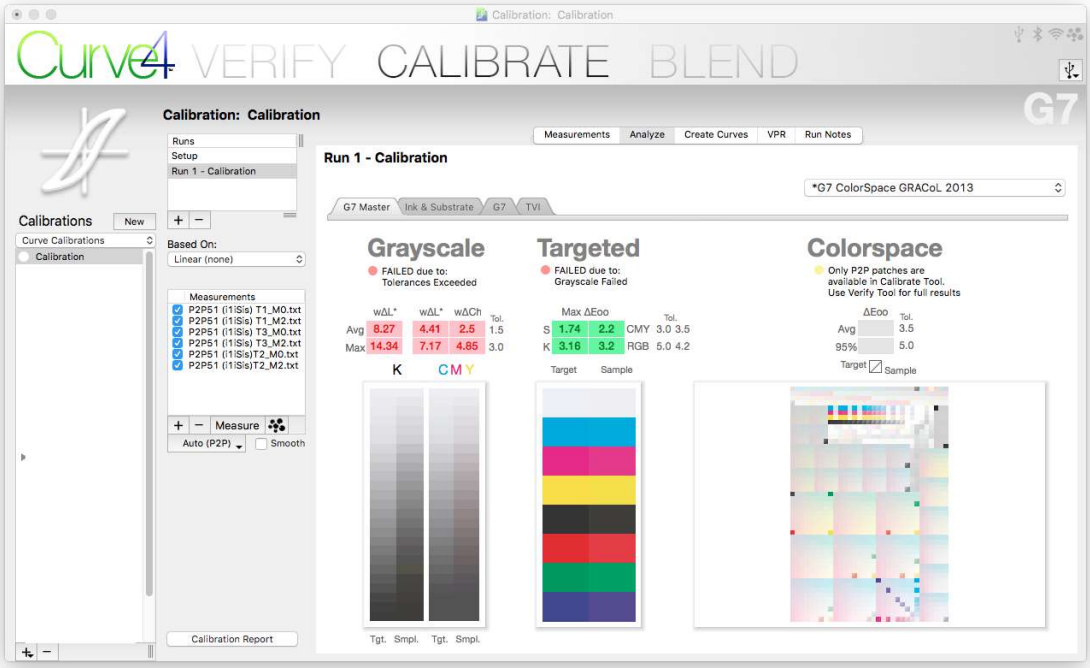
- First Run: Green line is desired NPDC, Red line is actual press result. These sheets are too heavy. Gray balance in bottom left of window shows sheets are too red.



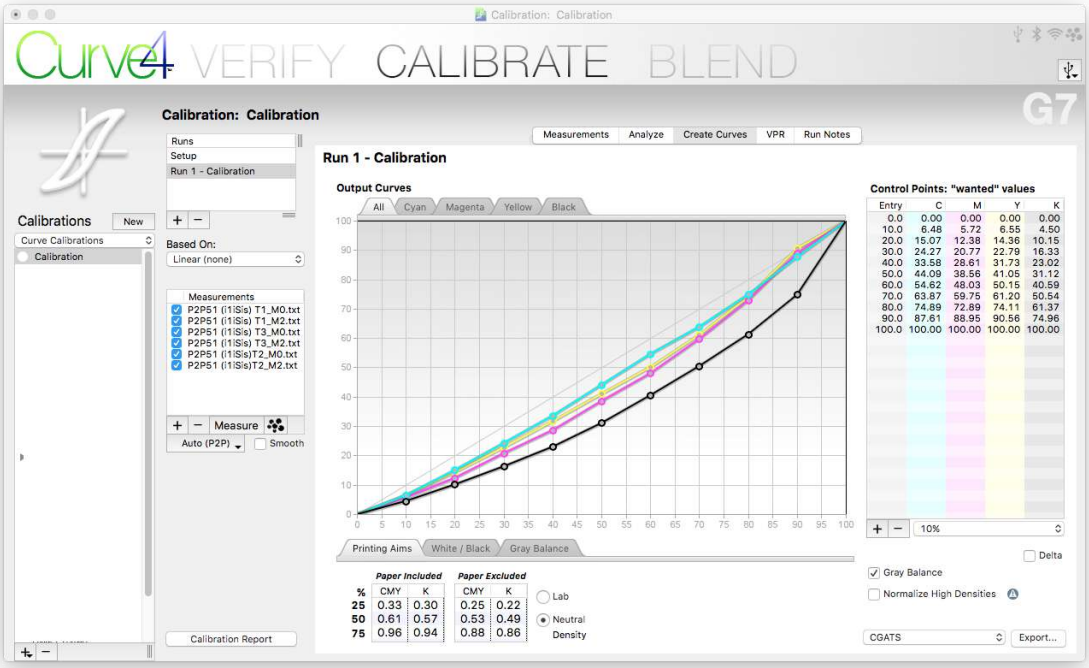
· Ink and Paper: Check to make sure delta E of ink and paper correlate to what you were reading on press.



· G7®: The above screen shows a failure to meet ΔL and ΔCh requirements. This is not unusual on the first run.



· Curve 4 also has a new feature that shows results as compared to G7 compliance levels. This is an easy way to see how a G7 Master submission would be judged.



· Create Curves: The screen above shows the curve values to be entered into the RIP for G7® Creation.

2nd Calibration Run

When we go back on press, we are going to run back up to the same exact densities. Once the sheet is even, we will check ink solids and overprints to make sure they still meet the requirements of our reference print condition. If the sheet is level, registered, and the printed sheet has no defects we can begin to evaluate gray balance. For this, we are going to do a quick check of the HR patch. We could also check for the NPDC now, or wait until we measure into Curve 4 to check the NPDC. In this case, we will wait until we are back in the Curve 4 software.

Remember that gray balance definition of G7® is based on the color of the paper. This means the target aim for this patch changes dynamically with the color of the paper.
(The Techkon SpectroDens can dynamically make this calculation for you, or you can easily perform this calculation in your head.)

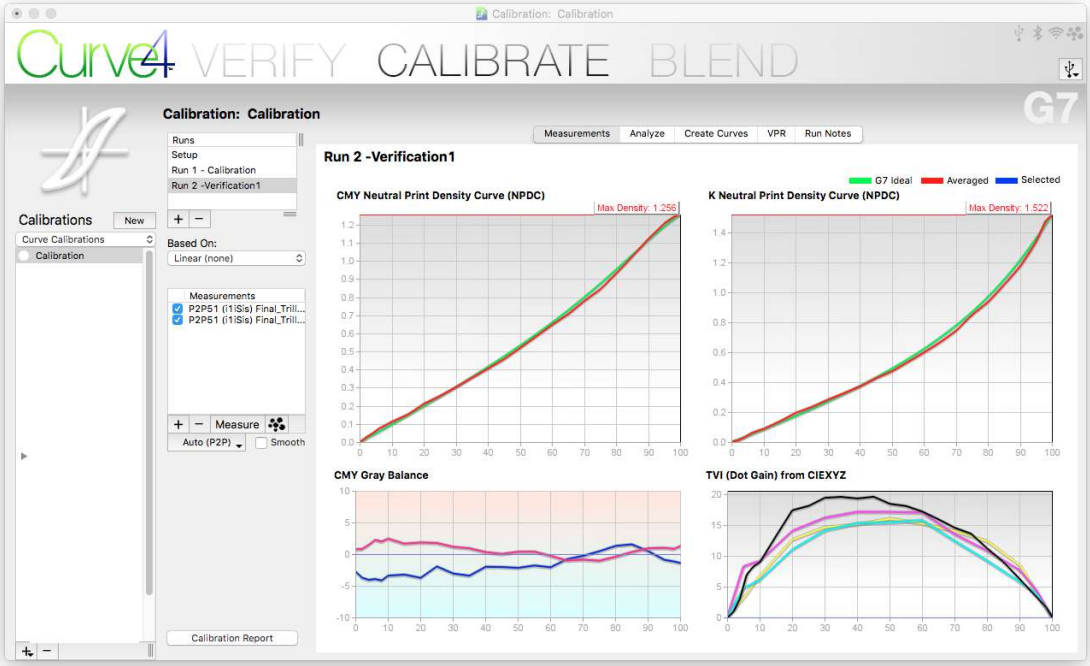
The gray balance aim we will be using will be based on the a* and b* values from the color of the paper.
The official equation as published in the IDEAlliance G7® How To Guide is for calculating the a* and b* aim of the 50% HR patch is
$1 - {}^{50}/_{100} =$ **0.50**
So if our paper has the following a* and b* value:
a* 1 b* -4
Then the target a* and b* value for our gray balance on the HR patch would be.
a* 0.5 b* -2
The HR patch is the easiest to calculate as it involves just cutting the a and b* values in half.*

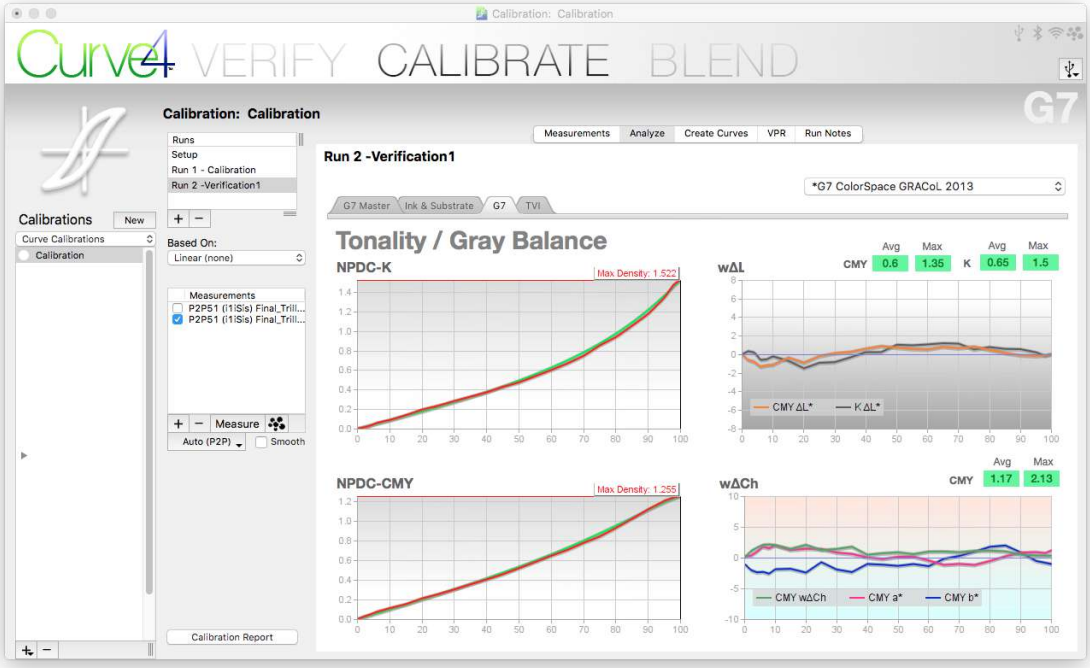
- We are going to read the HR patch and see if it is close to the gray balance target. If it is right on, then we will pull 3 sheets and measure them.
- If it is still a little off – say it is a* 1 b* -1 then we will make a small density adjustment to move it slightly closer. If you can make a slight density adjustment of a few points and bring the gray balance closer without moving the solids and overprints out of tolerance, this will give us the gray balance we need and we can measure the sheet.
- If we cannot achieve the adjustment with a slight move, then we are going to have to pull off the sheets and make another curve adjustment by measuring these sheets and using Curve 4 to iterate our current plate curve.

Evaluating Your Results

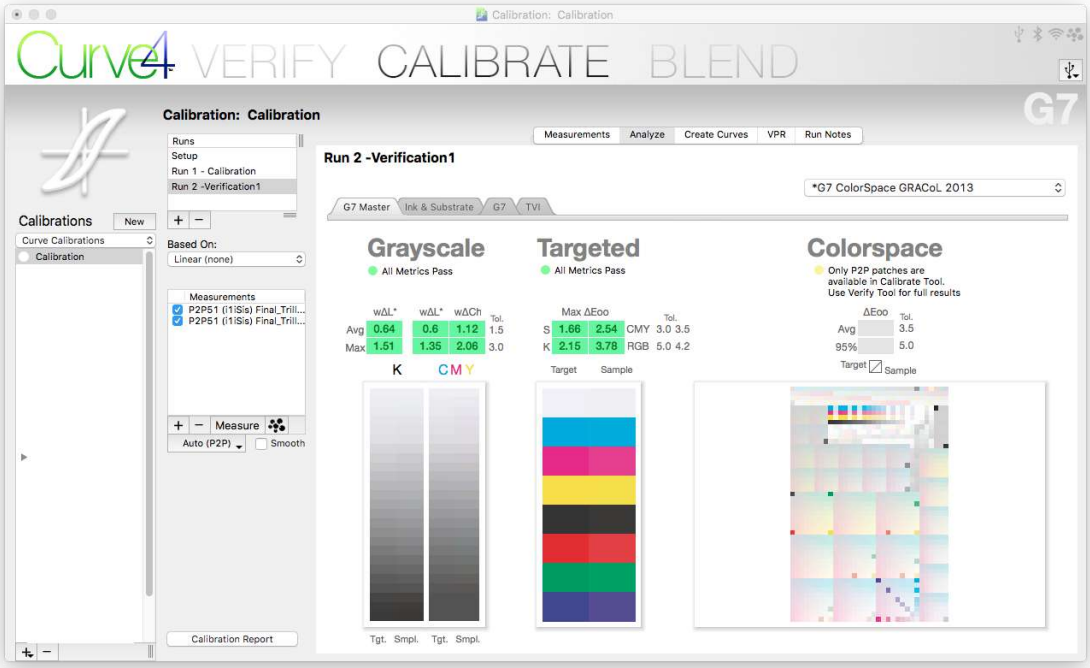
Once we have measured the sheets, we will import the measurements back into Curve 4. On the first screen we should see a much closer match between the target NPDC curves and our printed result. Next, we will check the Analyze tab and select Summary to make sure we have achieved the desired tolerance level. This summary screen is new to Curve 4 and is matched to the G7 Master Pass/Fail requirements. Finally, we will click on the G7® tab. Here we can see that both our NPDC and gray balance are within tolerance. (If not, we must regenerate correction curves and go back on press.) At this point we have achieved our G7® calibration.

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In the two images above, notice the NPDC graphs are now close to the target NPDC Curve, and gray balance in the bottom right of the screen is close to the target aim.



Curve 4 features a G7 Master report that shows compliance to G7 Master levels. In this screen, you can see our measurements have passed the G7 Targeted compliance level.

With everything passing it is now time to look at the proof.

Proof to Press Match

There are several important things to keep in mind when evaluating the proof:

- You must have up to date bulbs and proper lighting for a proof to press match to be valid. In some cases when matching 2006 datasets with new lighting, you may choose to place a UV filter between the lights and the viewing area. In either case, without correct viewing conditions, a proof to press match will not be valid.
- You must have a verified and valid proof. The proof must be to the target print condition, for example, GRACoL. The proof must be verified by reading an IDEAlliance G7®/ISO control strip with a UV included instrument.
- Expectations for proof to press match should be no greater than 85%-90%. That is to say that not everything on the sheet will match. The proof is a simulation and if 90% of the objects match, that is about as good as it will get.
- If you are calibrating on a paper containing high amounts of optical brighteners, you may experience a color matching issue between the proof and press sheet. This can be minimized by using proof and press substrates with similar amounts of optical brighteners in them. Optical brighteners, when combined with lighting, can lead to visual mismatches.

Normally in this process, the proof to press match is acceptable. If not it often is lighting or paper. In some cases, you may choose to make a slight adjustment to the press curves to improve the proof to press match. If you make this slight adjustment remeasure the sheet after the edit to make sure the sheet is still G7® compliant.

Recording print metrics

Once you have a final G7® press sheet, place several sheets in the drawer for reference and record the print metrics. These measurements will be used for troubleshooting in the future if there is a problem with proof to press match. Here are the metrics we want to record using the press operators instrument: (Keep in mind we already have an additional set of metrics recorded in the Curve 4 software)

- LAB values for solids
  - Used to tell if ink is the correct color, has changed, or has become contaminated
- LAB values for overprints
  - Used to tell if overprints have changed, chemistry issues, ink issues
- LAB values for HR, HC, SC
  - Used to check gray balance
- CMY density for HR
  - Used as an easy way for press operators to check gray balance during production.
- Density for solids
  - Used for press control
- Dot gain for all colors, 25%, 50%, 75%
  - Used to tell if there is an issue with a specific unit on press

Checking production

During production, operators should be periodically checking gray balance.
Gray balance can be checked via LAB targets, or by using CMY density all. If using CMY density all, it should be compared to the calibration CMY density all values. Adjusting the press values to the calibration values should improve the match.

Once we have recorded the above metrics, we can use these in live production. If a press operator is having trouble matching a validated proof the press operator can check the following metrics:

1. Confirm they are at the target density
2. Confirm there are not any unit issues such as blanket, rollers, etc. by checking dot gain per unit and comparing to calibration data.
3. Check gray balance. Gray balance can be checked via LAB targets, or by using CMY density all.
4. Check LAB color of solids to make sure ink has not changed or contaminated.
5. Check LAB color of the overprints to make sure there is not an ink or chemistry issue
6. Check LAB color to make sure the color of the substrate is in tolerance.

Normally reading the above metrics will quickly tell what has changed on a press sheet, and provide information for press troubleshooting and correction.

Using Your Techkon SpectroDens with G7®



The Techkon SpectroDens has many features specifically designed for G7®. Many of these such as the GrayGuide feature, which dynamically calculates G7® aims based on paper color, cannot be found in other instruments on the market. When performing a G7® calibration, checking production, or performing quality control measurements there are a number of features that are useful.

GrayGuide Feature – Guidance for Checking and Adjusting Solids, Overprints and Gray Balance

One of the first steps in a typical G7® calibration involves targeting the ink to the LAB values of the reference print condition. G7® datasets such as GRACoL are based on ISO 12647 aims. When reading a solid Gray Guide provides a quick and powerful way to evaluate and correct ink issues.



GrayGuide above, showing the user the ΔE, as well as corrective action to improve the ΔE further.

When you read a solid the screen will present you with a ΔE, showing how close you are to the target value. The screen also gives you a recommendation on how to improve the ΔE, telling you whether to move the density of the ink up or down, and predicting how low the ΔE can go. This feature is very handy because with one click you get all the information you need to move the ink as close to your reference value as possible. When selecting an overprint the SpectroDens gives you the Δ00 but does not give you the predictive information on how to improve the Δ00. It does give you the LAB values.



GrayGuide above, shows ΔE, as well as reference and measured LAB values for the CM overprint. Using the LAB values you can make adjustments to improve the delta E.

The GrayGuide G7® feature is one of the best features in the SpectroDens. First, go to the GrayGuide setup screen and scroll to the bottom. Here you can select the reference print condition. (For GRACoL this is GRACoL c1 white). Auto set a/b. This should be set to .5 for a and b. (This is performing the gray balance aim calculation according to G7®/CGATS TR015) . There is also a feature called SCCA, which performs relative substrate correction, according to CGATS 21/ISO 15339. Substrate correction adjusts the aim points for the reference print condition based on the paper color. If you are trying to match GRACoL 2006 you should leave this off, but if trying to get the best proof to press match based on the color of your paper you may want to consider leaving this on.
The GrayGuide performs a number of features. Most valuable is that in this one mode and on one screen you can see all the G7® values, along with traditional values such as density.



Above: Selecting reference print condition in GrayGuide Setup. The SpectroDens contains all published G7 print conditions including XCMYK.

NPDC Functions:

- When selecting an NPDC patch such as the HR patch the SpectroDens tells you how close you are to the target NPDC, and give you corrective information. By following the guide on how to increase or decrease density you can improve your match to the NPDC target.
- Check of Solids using Density and Overprints, using ΔE.

- When measuring a solid patch the SpectroDens will auto detect the patch and will present you with the density and ΔE of the patch. If you read an overprint the SpectroDens will present you with the ΔE as well as the measured LAB values.

Check of Gray balance

One of the best features of the SpectroDens is the check of gray balance. By selecting the CMY HR patch, the SpectroDens will give you the A/B values, as well as the NPDC information. In addition to giving you this information it also gives you suggested correction information. For the NPDC this information is telling you whether you need to add or remove density to hit the correct NPDC. For gray balance, the screen tells you how much C, M, and Y density to add or subtract in order to meet the gray balance target.

The GrayGuide can check using dynamic G7 values, or check against a predefined reference print condition such as GRACoL. This dynamic G7 method has you measure the paper, and 100% CMY and K patches. In this mode the Spectrodens will calculate dynamic gray balance based on paper color and printing method. The NPDC curves are calculated based on your print condition as defined in CGATS TR15, the document defining G7. The image below shows G7 being calculated using the dynamic method.



This 'reference' G7 method compares against a defined reference print condition such as GRACoL. This method does not calculate the NPDC curve but uses the L values of the reference print condition. The image below shows the 'reference' G7 result in GrayGuide.



The GrayGuide also contains the ability scan a small control strip and quickly see a pass/fail result, and a number of important print attributes at one time.
The supported control strips are:

- Techkon GrayGuide v2
- SpotOn! Verify v2
- Bodoni CMYK 4CX
- PrintSpec



To perform this scan you place the SpectroDens on the first patch and then hold the measure button and quickly move the SpectroDens across the bar. Tolerances can be set in the GrayGuide settings.



The GrayGuide comes preset with G7 Master Pass/Fail preferences. These can be set to your own custom tolerances if needed.

Scan Media Wedge

The scan media wedge mode allows you to read the IDEAlliance ISO 12647-7 Control Strip. You can either manually move the device, selecting each patch or set it up to auto scan. This can be helpful for verifying proofs, as well as other printed materials. The SpectroDens will read and then present you with a summary of the wedge print condition. The SpectroConnect software allows you to analyze the data in more detail, as well as to print a report.



OBA Index

The SpectroDens has a feature that can help you determine the amount of OBA contained in a substrate. The OBA Index will give perform a calculation that takes both an M1 and M2 measurement, and gives an Index number based on the difference between the two values. The value ranges from 0 (representing low OBA) to 15 (representing high OBA levels).



Scan Control Strip

The SpectroDens version 4 has a new feature that allows measurement of full-width press sheets.





How I Use It All

1. On the initial press run I use the GrayGuide check feature to help tune the inks, and overprints. I read C, M, Y, and K solids in several spots across the sheet and then have the operator adjust accordingly based on the SpectroDens recommendations. Once the ink solids are within the Δ00 tolerance I then measure the overprints, and adjust until these are within the tolerance of the reference print condition.
2. On the confirmation G7® run, or during live production I use the SpectroDens in the following manner:

a. Read density and confirm that the inks are all at the proper densities, and the solids and overprints are all within the reference print condition ΔE.
b. Read the gray patch and confirm that the NPDC and gray balance are correct. If gray balance is not correct I use the recommendations from the SpectroDens to correct gray balance
c. Read the K NPDC and make any adjustments based on the SpectroDens recommendations.

Learning More

You can learn more about G7® at the following sites:
https://techkonusa.com/
The Techkon site has articles, whitepapers, downloadable forms, and webinars about G7®.
http://www.freeprocesscontrol.com
The freeprocesscontrol site has additional articles and information about G7®.
http://www.idealliance.org
The IDEAlliance web site has information about G7®.
http://www.gracol.org
The GRACoL page on the IDEAlliance web site has the most current updated information about GRACoL and G7®, as well as information on IDEAlliance activities.

What about G7® and Digital Print?

While this document is mostly about G7® and offset lithography, G7 is also used for other print methods such as digital, flexo, and gravure print. For digital print G7 provides a valuable set of aims that work across many substrates and print technology. From electrophotography to wide format printing G7 can be found, both an aim and a calibration method.
Using G7® as an aim is simple, and can be done by choosing a complete G7 based print condition, or simply using G7 graybalance as an aim. XCMYK has been a popular G7 print condition for devices that have a larger gamut than GRACoL or other G7 print conditions.

Many digital printers use G7 as a calibration method. The RIP typically uses G7 curves to quickly linearize the device back to a gray balanced condition. ICC profiles are also used, and sit atop the G7® linearization. By quickly performing a G7® relinearization the ICC profiles can be maintained. This G7® relinearization takes a fraction of time of creating profiles, and one G7 linearization can often be used as a base for profiling for multiple paper types.

Measurement Parameters and M Condition

For most of the standard G7 datasets the measurement parameters are based on ISO 12647-2 and will always be as follows:

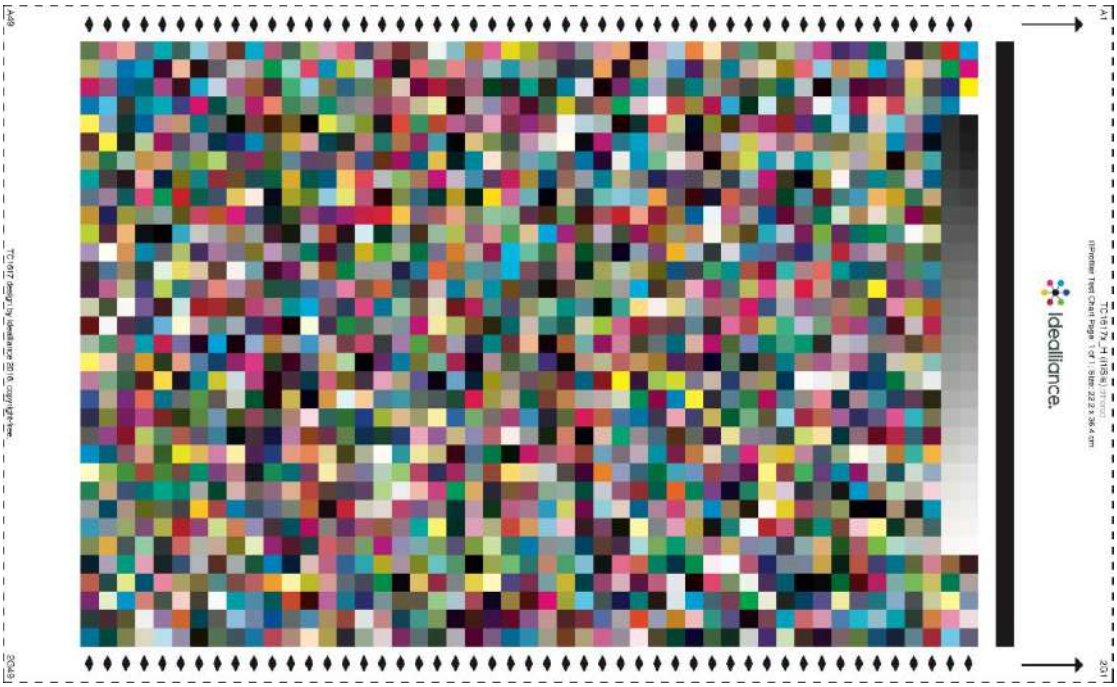
- Illuminant: D50
- Angle: 2 degrees
- Delta **Δ**00

The M condition, however, may change depending on the reference print condition you are targeting. The correct M condition to use is the one specified in the reference print condition. The M condition refers to a specific light source and can be one of the following:

- M0: No specific UV energy. This is the default lighting condition used by GRACoL 2006. At the time of ISO 12647-2:2006 and GRACoL 2006 instrument lighting did not have a defined specification for UV energy. Devices normally emitted little UV energy, though they could emit some as the amount was not defined.
- M1: Specified UV energy. This setting has a specific amount of UV energy included in it. M1 is helpful for use with substrates that contain optical brighteners. ISO 12647:2013 and GRACoL 2013 are using brighter substrates and are both specified as using M1.
- M2: UV Filter. M2 is a light source that is UV filtered. M2 is not used by any G7 reference print conditions.
- M3: Polarized. M3 is a light source that is Polarized. Few automated measuring devices support polarization, and M3 is not used by and G7 reference print conditions.

Idealliance TC1617

In addition to the P2P51 other charts can be used to calculate gray balance as well as assess compliance to G7 Targeted and Colorspace. One of these is the Idealliance TC1617. The TC1617 is based on the layout and format the of the IT8 chart. The IT8 is widely used for print standardization and contains 1617 patches. One problem of the IT8, when used for G7, is that it does not contain the gray patches that correspond to G7 and are required for calibration as well as compliance assessment. The IT8 contained a number of redundant patches which were used for consistency checking. The TC1617 is the same size and format as the IT8, but the redundant patches have been removed and replaced with the missing gray patches. These patches give the TC1617 all the same patches as the IT8 as well as the full K and grayscale from 0 to 100%. The target can be used for G7 calibration, as well as G7 assessment, and because of the full gray scale provides improved data for ICC profiling.



About Ron Ellis

Ron Ellis is a consultant specializing in brand quality, color management, automation and workflow integration. Chair of the GRACoL Committee, and an Idealliance G7 Expert, G7 Process Control Expert, G7 Expert Trainer, Ron is one of trainers used by Idealliance to train and certify G7 Expert consultants. He has performed hundreds of G7 training and calibrations and has conducted training and consulting for a wide range of customers in Europe, Asia, and North America, Well versed in ISO standards, he is certified as a PSA consultant as well as an FTA Flexo Level 2 Implementation Specialist, and was the primary developer of IDEAlliance's G7 Process Control program. Ron specializes in creating and implementing working spaces for brands and agencies that allow them to work more efficiently with vendors, saving both time and money. He can be reached at ron@ronellis.us.

Ron Ellis Consulting – Selected Customer List

Pantone	RR Donnelly
Gannett/US Today	Random House
TracyLocke	Americraft
Hill Holiday	Toth
Arnold Worldwide	Garnett Hill
Clarks Footwear	Company C
Tom's of Maine	Daymon Worldwide
Sony	Xrite
WB Mason	EFI

Edison Litho	Presstek
Prestone	Strategic Content Imaging
Publisher's Clearninghouse	GATF
Acme Printing	DraftFCB
Brand Image	DS Graphics
Potpourri	Basic Resources
PetEdge	WE Andrews
Potpourri Group	CGS
Quad	Kirkwood Printing
Packaging Graphics	Jay Packaging
Century Box	Journal Register
Graphic Packaging International	Spire
Rhorer Corporation	Hub Folding Box
Boutwell Owens	Fedex Office
Hewlitt- Packard	Canon
Konica	Lint Chocolate
Yankee Candle	Modpac
Lego	Cross Pen
Arkay Packaging	TJX Companies
Autajon Packaging	Curtis Packaging
Packaging Graphics	Techkon
Flagship Press	JS McCarthy
Hansol Paper	Hub Folding Box
Idealliance	Kirkwood Printing
Universal/Wilde	Wild Apple Graphics
Gelato Group	Embassy Graphics
Moo.com	Canon