



The Idealliance Print Properties Committee has established a certification process for G7 Calibration Systems. The G7 System Certification Program evaluates a candidate system's ability to calibrate a printing device using only four 1-D Curves, according to the G7 formulae contained in ANSI CGATS TR015 and tolerances in this document. This Application Data Sheet (ADS) provides step-by-step instructions for evaluating the calibration accuracy of **Curve4**. For detailed instructions, see the *Curve4 User Guide*.

Manufacturer

Curve4 is a joint production of;

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and

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Certification Seal Here

Applicable Products

**Curve4 Calibrate (includes Verify module), and
Curve4 Complete (includes Calibrate and Verify modules)**

G7 System Testing Methods

Physical vs Modeling testing methods

G7 Certified Systems can be tested either by measuring physical print samples (the “Physical Method”) or by analyzing correction curves in a mathematical model of a printing system (the “Modeling Method”). Results are compared to ideal measurements determined by the G7 formulae in ANSI CGATS TR015.

A disadvantage of the Physical Method is that variations in the printing or measuring steps can reduce the reliability or accuracy of results. The Modeling Method eliminates these variations by extracting CIELAB data directly from the correction curves exported by the candidate system.

Official G7 System testing

The independent testing body (RIT) tests candidate G7 Systems by the Modeling Method, using commercially available software to convert CMYK calibration curve values to CIELAB, and a proprietary Microsoft Excel Workbook to perform the TR015 calculations.

G7 Certified System vs. G7 Master Pass/Fail tolerances

Note: G7 System Certification testing uses stricter tolerances than the G7 Master Pass/Fail document:

- 1. G7 Certified System testing does not use a weighting function, so shadow detail is tested more rigorously.*
- 2. G7 Certified System tolerances are 1.0 average and 2.0 maximum vs. 1.5 and 3.0 respectively for G7 Master Pass/Fail.*

G7 Master Pass/Fail testing in Curve4

Curve4 users can easily test G7 Master compliance with the **Verify** module and physical print samples.

Curve4 Complete users can use the **VPR** tool (a Modeling system) to eliminate the possibility of printing or measuring errors on the second print. Step-by-step instructions for both Physical and Modeling Methods are given below.

Curve4 Testing Instructions – Physical Method

Print the test target(s)

Print at least one P2P51 target on the printing system to be calibrated.

Note that to test a software's ability to calibrate accurately, the printing system must produce successive prints that are consistent print-to-print and consistent across the whole image area.

Ideally, all color management should be disabled and initial calibration curves should be "null" to produce a completely uncorrected print.

Prints should be free from blemishes, streaks or other artifacts and have had sufficient time to dry or stabilize prior to measuring. (See Curve4 User Guide for detailed target printing instructions.)

Create a new Calibration

In the **Calibration** panel, click **New** above the **Calibrations** list.

In the **Setup** panel set the **Method:** to **G7**.

In the **Based On:** list, select **Linear (none)**.

Measure the target(s)

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

Under the **Measurements** list, click the **Measure** button and follow instructions to measure the target. To average more than one target, click **Measure** again and repeat the process. (Multiple targets are automatically averaged.)

Adjust gray balance parameters

In the **Create Curves** tab, click the **Gray Balance Control** tab and set the desired **Gray correction feather-off: Start**. For maximum accuracy on a stable and repeatable printing system, set the **Start** to 98. For printing systems with unstable shadow characteristics, select a lower **Start** value, like 75 or 50.

Other controls

For system certification purposes, leave all other controls at their default settings. (For real-world production calibration, the *Curve4 User Guide* suggests when and how to adjust other controls.)

Choosing Control Points

In the **Control Points** list, select the desired curve point values. On real printing devices, fewer points are generally safer, but for maximum theoretical accuracy and/or system certification purposes, select **25-step (P2P)**.

Applying Control Point values to the printing system

If the RIP accepts digital files directly from Curve4, select the RIP name, click **Export** and import the resulting file into the RIP. (*See Curve4 User Guide for detailed instructions.*) Otherwise type the numbers in manually.

Verifying G7 Grayscale Accuracy

Print a “Verification” target

Print one or more P2P targets again on the same printing system and conditions, but through the new RIP curves.

Measure the Verification target

Create a new **Run**. The default name will be **Run 2 – Verification1**.

Click the **Measure** button and measure the new P2P target(s) as before. The data are automatically added to the **Run**.

Checking Pass/Fail status

Click the **Analyze** tab.

To test G7 Grayscale accuracy, any **Reference** can be selected, or select a G7 Grayscale reference, if available (*see Curve4 User Guide*).

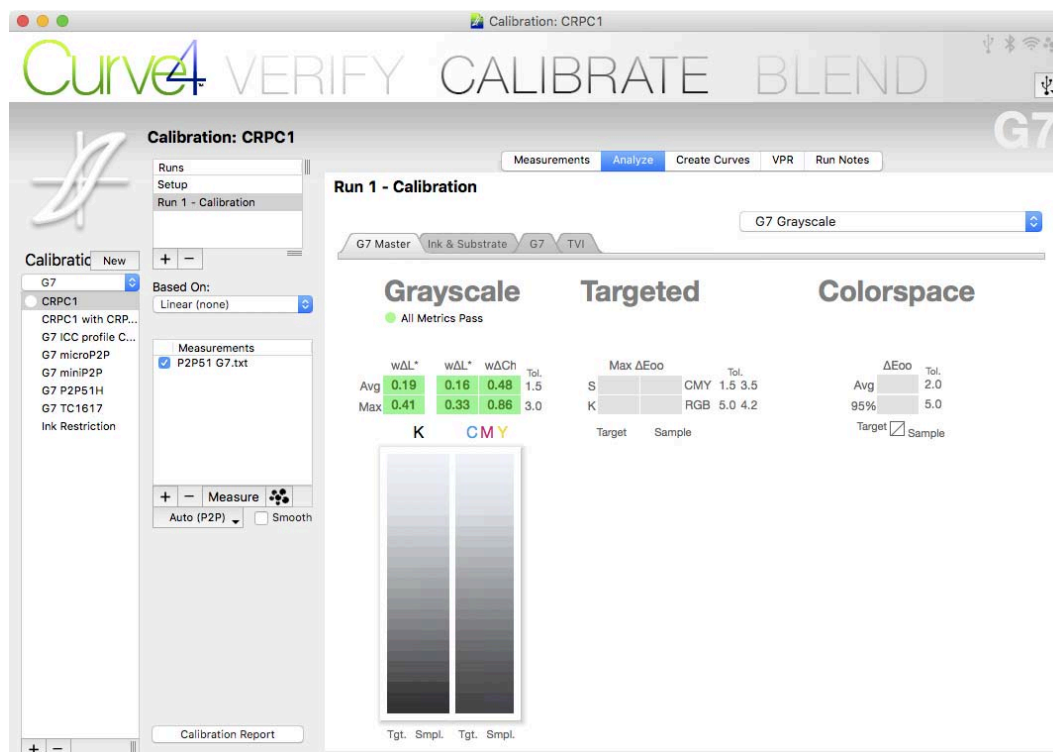


Figure 1: The Analyze G7 Master tab

If the $w\Delta L^*$ and $w\Delta Ch$ values under **G7 Grayscale** column are all green, your sample passes the current Idealliance G7 Master specifications.

Curve4 Testing Instructions – Modeling Method

NOTE: Results determined by the Modeling Method may differ slightly from results obtained by the Physical Method, due to printing and measuring variations between the first and second prints.

The **VPR** module in **Curve4 Complete** can test calculated curves without a second physical print. For the best accuracy, VPR requires a characterization target (e.g. IT8.7/4 or IT8.7/5) to be printed and measured at the same time as the P2P.

Print the test target(s)

Print at least one P2P51 target and an IT8.7/4 target, or an IT8.7/5 target.

Note that to test a software's ability to calibrate accurately, the printing system must produce successive prints that are consistent print-to-print and consistent across the whole image area.

Ideally, all color management should be disabled and initial calibration curves should be "null" to produce a completely uncorrected print.

Prints should be free from blemishes, streaks or other artifacts and have had sufficient time to dry or stabilize prior to measuring. (See Curve4 User Guide for detailed target printing instructions.)

Create a new Calibration

In the **Calibration** panel, click **New** above the **Calibrations** list.

In the **Setup** panel set the **Method:** to **G7**.

In the **Based On:** list, select **Linear (none)**.

Measure the calibration target(s)

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

Under the **Measurements** list, click the **Measure** button and follow instructions to measure the P2P or IT8.7/5 target(s). To automatically average more than one target, click **Measure** again and repeat the process.

Measure the optional characterization target(s)

If you printed a separate IT8.7/4 target, measure it into a separate **Run**.

Adjust gray balance parameters

In the **Create Curves** tab, click the **Gray Balance Control** tab and set the desired **Gray correction feather-off:** **Start**. For maximum accuracy on a stable

and repeatable printing system, set the **Start** to 98. For printing systems with unstable shadow characteristics, select a lower **Start** value, like 75 or 50.

Other controls

For system certification purposes, leave all other controls at their default settings. (For real-world production calibration, the *Curve4 User Guide* suggests when and how to adjust other controls.)

Choosing Control Points

In the **Control Points** list select the desired number and curve point values. On real printing devices, fewer points are generally safer, but for maximum theoretical accuracy and/or system certification purposes, select **25-step (P2P)**.

Export the measured data

In the **Measurements** list, highlight the P2P (or IT8.7/5) measurement.

In the **File** menu, select **Export Measurement File...** and save the measurement data with a suitable name.

If you printed a separate IT8.7/4 target, export its data from its own **Run**.

Use VPR to simulate a verification print sample

Click the **VPR** tab.

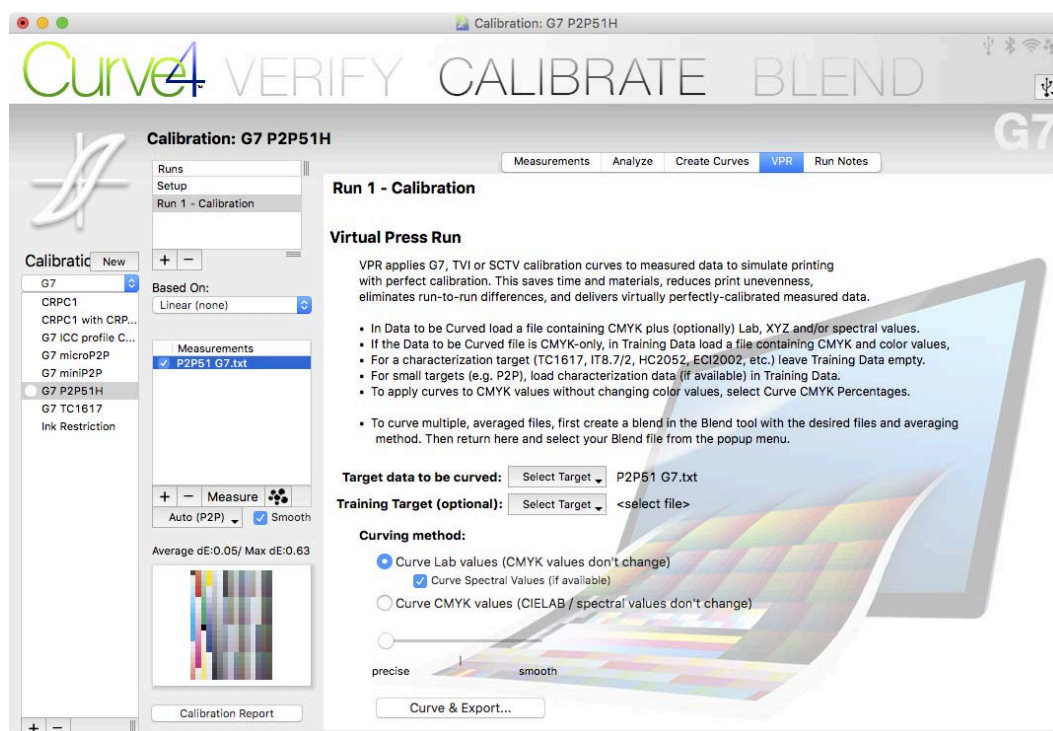


Figure 2: The VPR tab

In **Target data to be curved:**, select the same P2P or IT8.7/5 target data file used to create the curves.

In **Training Target (Optional):**, if you calibrated from a P2P, select the characterization target file (e.g. IT8.7/4) printed with the P2P target.

If you calibrated from an IT8.7/5, leave **Training Target (Optional):** empty.

Under **Curving Method:** select **Curve Lab values**.

Set the **Precise / Smooth** slider to **Precise**.

Click **Curve & Export...** and save the data with “P2P_G7” in its name.

Verifying G7 Grayscale Accuracy

Load the “Verification” data

Create a new **Run**. The default name will be **Run 2 – Verification1**.

Under the **Measurements** list, click the + button and load the P2P_G7 file.

Checking Pass/Fail status

Click the **Analyze** tab.

To test G7 Grayscale accuracy, any **Reference** can be selected, or select a G7 Grayscale reference, if available (see *Curve4 User Guide*).

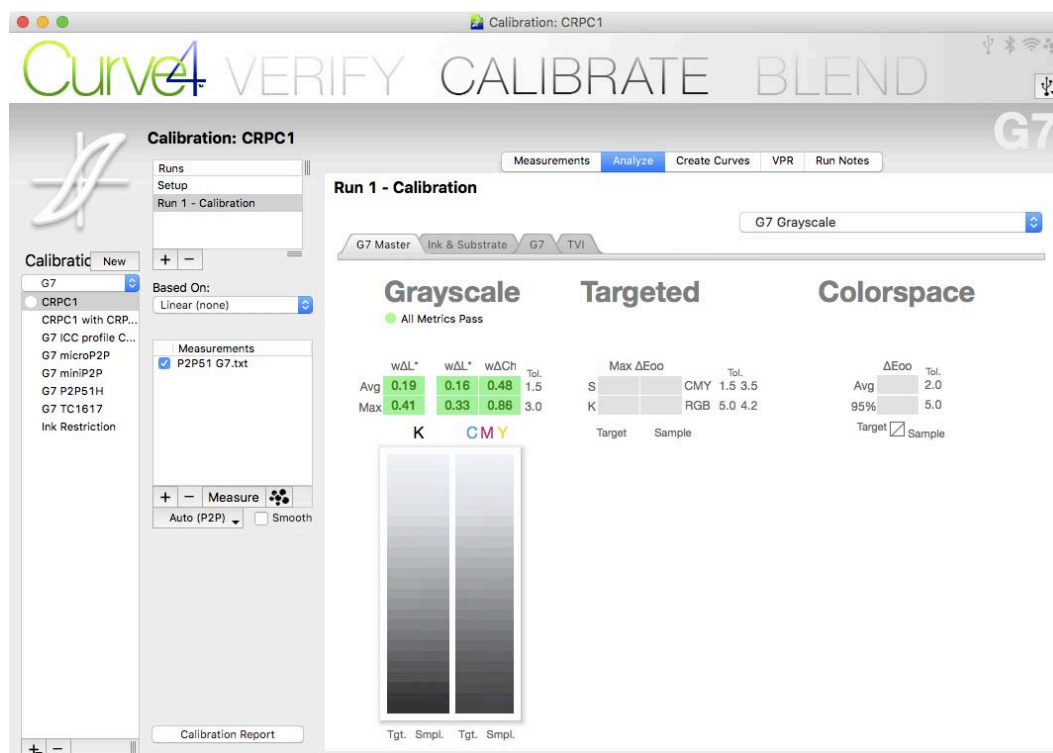


Figure 1: The Analyze G7 Master tab

If the $w\Delta L^*$ and $w\Delta Ch$ values under **G7 Grayscale** column are all green, your sample passes the current Idealliance G7 Master specifications.

Curve4 Expected Performance

Physical Method

If working from actual printed samples, **Curve4** should normally achieve accuracies substantially better than the G7 Master Pass/Fail tolerances. However note that results may occasionally be worse, or even fail G7 Grayscale compliance, if the printing system suffers from unusually severe problems such as tone reversals, unevenness or mottling across the printing area, inconsistency between first and second prints, or if complex color management or ink limiting was active when the samples were printed.

Modeling Method

If using the VPR method to avoid a second print, **Curve4 Complete** should normally achieve accuracies substantially better than the Physical Method and better than the G7 Master Pass/Fail tolerances. However note that results may occasionally be worse, or even fail G7 Grayscale compliance, if the initial print(s) suffer from tone reversals, unevenness or mottling across the printing area, or if complex color management or ink limiting was active when the samples were printed.

Official G7 System testing method

If starting with the 2010 G7 System Certification sample test files instead of actual printed samples, and if using either the official G7 System Certification Testing method or the Modeling Method, **Curve4** shall achieve tolerances much lower than the G7 System Certification tolerances shown here:

Metric	Average	Maximum
ΔCh (CMY only)	≤ 1.0	≤ 2
ΔL^* (CMY & K)	≤ 1.0	≤ 2

Table 1: Curve4 predicted tolerances for 2010 sample test files

Note: Because the current G7 System Certification method uses a simulation process that eliminates print-to-print variation, and because the sample data files provided by Idealliance for G7 System Certification are highly uniform, Curve4 can produce extremely low delta errors with those specific data files. Higher errors should be expected when calibrating live printing devices, depending on the characteristics and variability of each printing system.

Idealliance G7 Grayscale Compliance Validation

To validate G7 Grayscale compliance, a target containing two gray scales having the CMYK patch values listed in *Appendix A*: (i.e. columns 4 and 5 of the P2P51 target) must be printed and measured.

Validating NPDC compliance (CMY and K scales)

- The relative neutral density (ND) values (measured in the “K” or “Visual” channel) of each patch of both the K-only scale and CMY-only scales shall be measured and recorded.
- To obtain *relative* ND values, either the measuring device shall be zeroed on the substrate, or the white patch neutral density value shall be subtracted from itself and all other patches.
- The relative ND values shall be converted to relative L^* by the standard CIE formula in *Appendix B*: and compared to target L^* values determined by the NPDC formulae in ANSI CGATS: TR015.
- The weighted delta L^* ($w\Delta L^*$) error shall be computed for each patch by the formula in *Appendix B*:
- The average and maximum $w\Delta L^*$ must not exceed the Idealliance Tolerance values in Table 2, below, i.e. average 1.5, maximum 3.0.

Validating Gray Balance compliance (CMY scale only)

- The a^* and b^* values of each patch of the CMY-only scale shall be measured and recorded.
- The weighted delta Ch ($w\Delta Ch$) error shall be computed for each patch and compared to target values determined by the formula in *Appendix B*:
- The average and maximum $w\Delta Ch$ must not exceed the Idealliance Tolerance values in Table 2, below, i.e. average 1.5, maximum 3.0.

Idealliance G7 Grayscale Conformance Tolerances

Metric	Average	Maximum
$w\Delta Ch$ (CMY only)	≤ 1.5	≤ 3
$w\Delta L^*$ (CMY & K)	≤ 1.5	≤ 3

Table 2: Idealliance tolerances for G7 Grayscale Conformance

Appendix A:

P2P51 patch values

Column 4 (K only)

C%	M%	Y%	K%
0	0	0	0
0	0	0	2
0	0	0	4
0	0	0	6
0	0	0	8
0	0	0	10
0	0	0	15
0	0	0	20
0	0	0	25
0	0	0	30
0	0	0	35
0	0	0	40
0	0	0	45
0	0	0	50
0	0	0	55
0	0	0	60
0	0	0	65
0	0	0	70
0	0	0	75
0	0	0	80
0	0	0	85
0	0	0	90
0	0	0	95
0	0	0	98
0	0	0	100

Table 3: CMYK values in column 4 of the P2P51 target

P2P51 patch values

Column 5 (CMY only)

C%	M%	Y%	K%
0	0	0	0
2	1.49	1.49	0
4	2.98	2.98	0
6	4.47	4.47	0
8	5.97	5.97	0
10	7.46	7.46	0
15	11.21	11.21	0
20	15.01	15.01	0
25	18.88	18.88	0
30	22.84	22.84	0
35	26.9	26.9	0
40	31.11	31.11	0
45	35.46	35.46	0
50	40	40	0
55	44.74	44.74	0
60	49.69	49.69	0
65	54.9	54.9	0
70	60.37	60.37	0
75	66.12	66.12	0
80	72.19	72.19	0
85	78.59	78.59	0
90	85.34	85.34	0
95	92.47	92.47	0
98	96.94	96.94	0
100	100	100	0

Table 4: CMYK values in column 5 of the P2P51 target, rounded to 2 decimal places.

Appendix B:

Formulae

Converting ND to L*

$$Y = 1/10^{ND}$$

If: $Y > (6/29)^3$

$$L^* = 116 \times Y^{1/3} - 16$$

Else:

$$L^* = 116 \times (841/108 \times Y + 4/29) - 16$$

Calculating weighted delta L* (wΔL*)

$$\Delta L^* = (L^*_{\text{sample}} - L^*_{\text{target}})$$

$$w\Delta L^* = \Delta L^* \times (1 - \max(0, (\% - 50)/50 \times 0.75))$$

Calculating weighted delta Ch (wΔCh) (formerly wΔF*)

$$\Delta Ch = ((a^*_{\text{sample}} - a^*_{\text{target}})^2 + (b^*_{\text{sample}} - b^*_{\text{target}})^2)^{1/2}$$

$$w\Delta Ch = \Delta Ch \times (1 - \max(0, (\% - 50)/50 \times 0.75))$$