



# Achieving Accurate and Consistent Color in Digital Print Production

## A Guide to the Barbieri DOC Process Control Solution

### Introduction

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This paper is intended for professionals in the digital printing industry who require a cost effective solution to achieve accurate and consistent color in wide and large format, flatbed and industrial printing. We explain process control in digital printing and address the current shortcomings with a guide to the *Barbieri DOC Process Control Solution*, proving accurate and consistent color is achievable and cost effective. This guide serves to assist you in determining your best color management option.

### What is Process Control in Digital Printing?

Process control in digital printing is a series of actions which ensure output meets expectation by managing variables which can impact production. The main objective is to **ensure accurate and consistent color reproduction** by creating a tailored a solution for each printer and media combination.

The FOGRA Process Standard Digital<sup>2</sup> (PSD) is an evolving set of guidelines used to evaluate color in digital print production. Its three objectives are:

1. Output process control to achieve repeatable results.
2. Evaluating color fidelity using a media relative method.
3. PDF/-X compliant workflows.

#### THE DIGITAL PRINT INDUSTRY

is forecast to grow by 225 percent over the next decade<sup>1</sup>. Evolving technologies and applications will further add to the demands on the digital printing professional.

Even with readily available innovations, the shortcomings of current practice in process control include tedious manual labor, inaccurate guesswork and wastage due to unseen changes to printing conditions. Using technology such as the Barbieri DOC Process Control Solution—which incorporates leading edge methods for process control, ensures accurate and consistent results for optimal performance and saving costs.

<sup>1</sup> *The Future of Digital Printing to 2024*,  
Smithers Pira

<sup>2</sup> FOGRA Process Standard Digital

## Challenges In Digital Printing

Digital printing professionals must ensure colors are accurately reproduced. As technologies evolve and demands change, digital print volumes are increasing and extending into textile, ceramic, glass, laminate and automotive applications among others. Printers will increasingly need to cater to a range of different media, evolving imaging technologies and inks.

Without a cost effective process control, businesses can be impacted by:

- Production downtime.
- Wasted ink and media.
- Shipping, application and removal costs.
- Damaged client relations and reputation.
- Lost revenue and missed opportunities through lack of competitiveness.

On a day to day basis, changes to printer conditions can go undetected, occurring if there is any change to temperature and humidity, media and ink.

## Standard Printing Workflow

The workflow for printer configuration (*fig. 1*) involves selecting a printer configuration and material combination. Calibration and profiling is then performed. The verification process then analyzes if printing conditions have changed. Measurements are then made on a control strip, generating a quality report and enabling evaluation over time and in multiple locations.

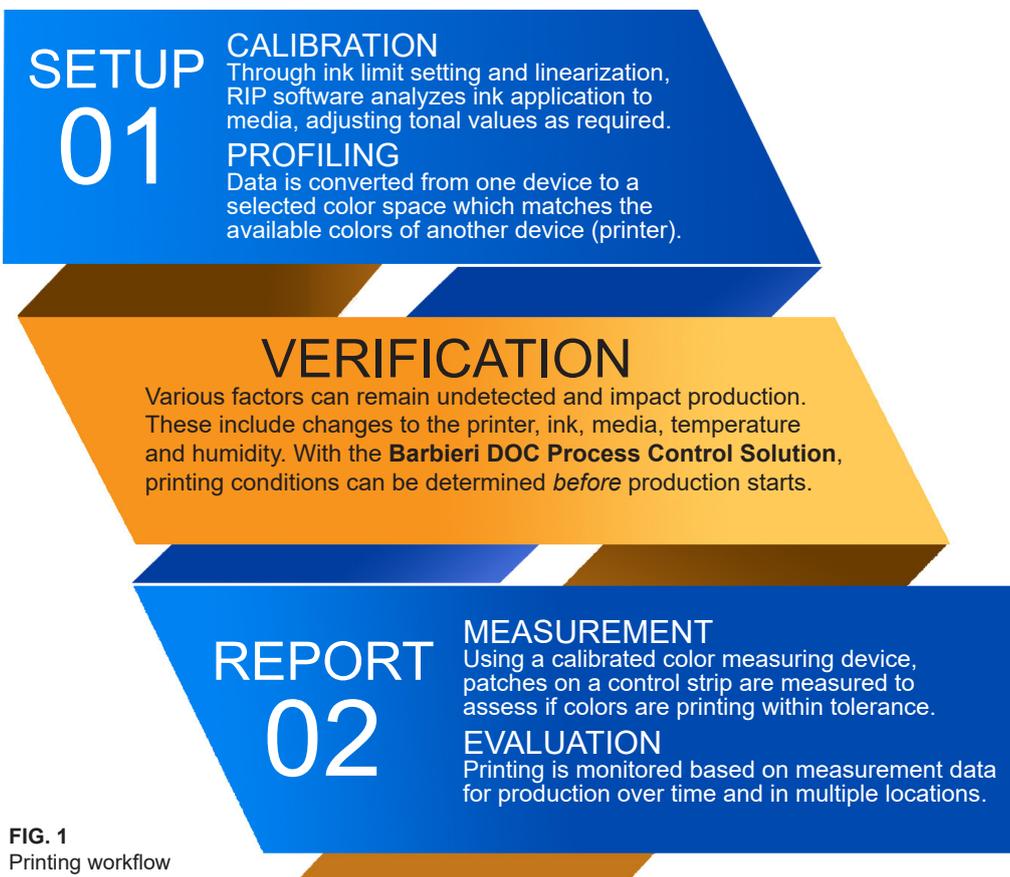
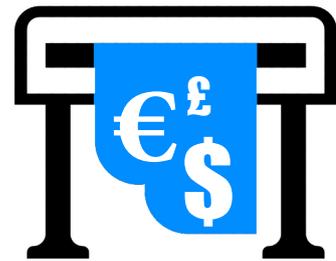


FIG. 1  
Printing workflow

IS YOUR PROCESS CONTROL  
SAVING YOU MONEY?



Wide format printers have the capability to print close to 900 square metres per hour and on expensive substrates of up to 5 metres in width.

Production downtime and wasted resources can be avoided. Investing in the best available color measurement technology to improve process control boosts production *and* your bottom line.

# What are the Benefits of Process Control in Digital Printing?

Improving process control has a range of benefits in digital print production.

- Assesses print conditions daily, *before* production starts.
- Eliminates the need to cut large format media (using a portable device).
- Processes measurements on the spot (using a portable device).
- Enables production to be monitored over time and in multiple locations.
- Uses a benchmark, or initial *reference file*, to determine printing conditions.

## Barbieri DOC Process Control Solution

The Barbieri DOC Process Control Solution provides an instant pass/fail report, analyzing if printing conditions have changed before production starts, saving time, ink and media. It addresses the shortcomings of current practice in process control.

The Barbieri DOC Process Control Solution is achieved in three steps:

### 1. Setup: Create and Save a Reference File

Setup is only performed once for every printer/media combination and completed in minutes. After calibration and profiling, a control strip is printed on the selected media. This control strip is measured using a device with Barbieri DOC<sup>3</sup>. A reference file is automatically created and saved as a preset based on the selected printer/media combination. Alternately, an external 'absolute' reference such as FOGRA or IDEAlliance can be used.

### 2. Daily Check: Print and Measure Control Strip

This check is performed daily, before production starts. It is based on the saved DOC reference file created during setup. A control strip is printed on the media. In the device's DOC option, the saved job with the reference file for the printer/media combination is selected. The control strip is measured within minutes for an instant pass/fail result.

- Daily checks are made at the printer and on media when using portable device.
- Use free Barbieri control strip, IDEAlliance, UGRA/FOGRA or custom wedges.

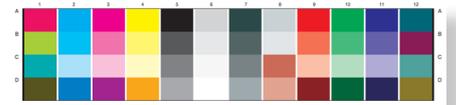
### 3. Report: Instant Pass or Fail Results

Results are instantly displayed as pass or fail on the device screen (when using the SpectroPad) and also saved as a PDF. The generated report shows the printer/media combination, reference used, tolerance sets and values.

This data can be transferred via wifi or USB to monitor printer performance and quality control.

#### 1. SETUP

Print and measure a control strip. This printer/media combination is auto saved as a reference file.



#### 2. DAILY CHECK

Select the saved reference and measure the control strip.



#### 3. REPORT

Results shown on device or PDF.

**DOC Report**

Measurement: Canon/W400\_C6029C-p20150300032611  
Printer: Canon/W400  
Media: C6029C  
Date/Time: 2015-03-03 09:25  
Meas. Cond./Backing: M1/White Backing  
Measurement device: SpectroPad ver:6.10 SN:A000000  
Gateway Version: 4.3.44  
Reference: Canon/W400\_C6029C-p201411308533800.pdf.ref  
Evaluation: Media Absolute  
Tolerance Set: T2\_medium.uni  
Color Difference Formula: Delta E 2000  
Control Strip: Barbieri DOC Control Strip CMK v1\_1a

**DOC Results**

Average: Maximum:  
Total: 1.52 ΔE<sub>00</sub> (< 3.50 ΔE<sub>00</sub>) ✓ Total: 2.79 ΔE<sub>00</sub> (< 7.50 ΔE<sub>00</sub>) ✓ Media: 1.69 ΔE<sub>00</sub> (< 3.50 ΔE<sub>00</sub>) ✓  
Grayscale: 2.07 ΔE<sub>00</sub> (< 3.50 ΔE<sub>00</sub>) ✓ PrimSec: 1.78 ΔE<sub>00</sub> (< 5.50 ΔE<sub>00</sub>) ✓

Color	Ref L	Ref a	Ref b	L	a	b	ΔE <sub>00</sub>	Color	Ref L	Ref a	Ref b	L	a	b	ΔE <sub>00</sub>
D51	48.24	18.11	3.78	47.88	18.08	3.88	1.42	100	37.02	22.17	16.86	48.82	21.68	18.82	0.92
A2	65.95	34.01	-0.14	65.40	32.52	-0.79	0.82	100	65.68	-0.98	22.91	65.12	-0.97	22.22	0.75
B3	49.78	16.38	-10.39	47.98	16.12	-11.28	1.78	100	62.78	17.81	-10.22	62.21	18.88	-14.19	1.68
M4	57.68	-0.01	16.41	58.98	-0.28	16.08	1.99	100	58.90	-0.41	16.98	59.18	-1.12	1.95	1.02
M5	24.01	-0.21	-4.43	23.83	-2.11	-6.72	1.42	100	55.60	-1.28	-0.98	54.18	0.13	-17.68	2.38

3 The Barbieri SpectroPad (portable), Spectro LFP and Swing include DOC functionality option.

## The Reference File and Reference Printing Conditions

A basic requirement for color measurement is a **reference file**. This reference file uses the defined printer/media combination to match measurements made on a control strip. **Reference printing conditions** use a characterization data set to match CMYK data to the printed output. This characterization data set is based on the required measurement mode (eg. M0, M1 or M2) and measuring conditions such as illumination (eg. D50), media backing and observation angle (eg. 2°).

## About the Control Strip

Barbieri DOC operates with an industry compliant, proprietary control strip. It also supports the FOGRA wedge, IDEAlliance and custom strips. The control strip is a set of patches which meet ISO requirements<sup>4</sup>. The ISO standard recommends a 48 patch minimum, including solid process primary and secondary colors, their mid and shadow tones and grays.

## Barbieri Control Strip Patches and DOC Measurements

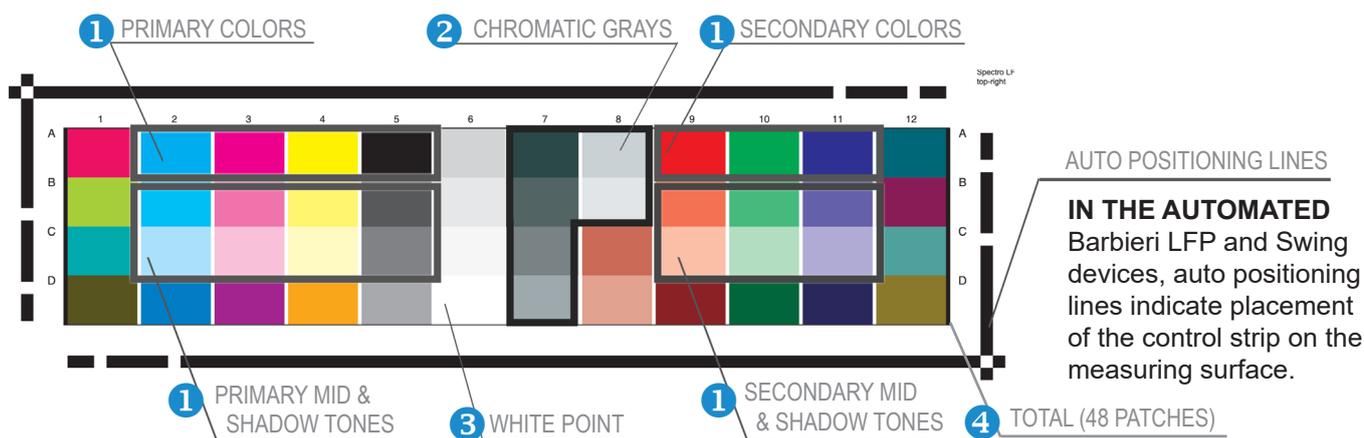


FIG. 2 Barbieri CMYK Control Strip

Tolerances are given in Delta E values based on these control strip patches:

- 1 The maximum tolerance values for primary and secondary colors measure patches A2, A3, A4, A5, A7, A8, A9, A10, A11, B2, B3, B4, B5, B9, B10, B11, C2, C3, C4, C5, C9, C10 and C11.
- 2 Average grayscale measures B7, C5, C6, C7, D5 and D7.
- 3 The media is measured on an unprinted “white point” in patch D6. This action verifies the substrate is within tolerance of the media defined in the reference file.
- 4 The total average and total maximum tolerance measures all patches.

<sup>4</sup> Refer to Section 5.1, ISO 12647-7.

# Guide to the Barbieri DOC Report

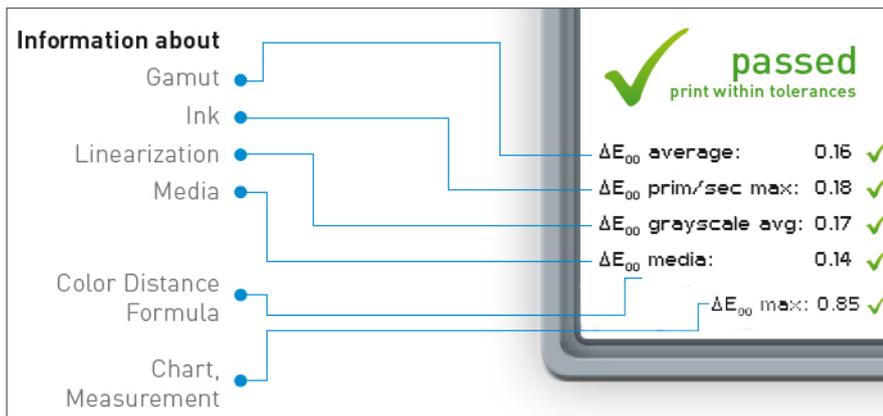
The Barbieri DOC report is generated using evaluation software to calculate Delta E ( $\Delta E$ ) values. These pass/fail results are calculated using tolerance sets which assess the control strip colors and media, giving a result based on an *acceptable amount of difference* to the reference file.

Different applications, such as high quality prints and textiles, have different tolerances. A tolerance set will depend on customer expectations and the possibilities of the printer/media combination. Barbieri recommend three tolerance sets, shown in *Table 1*. Custom sets can also be used to suit the purpose of the media and printer capability.

<b>Barbieri Tolerance Sets</b>	T1	T2	T3
Color Distance Formula $\Delta E_{00}$	Narrow	Medium	Wide
Average Total	<2.50	<3.50	<4.50
Maximum Total	<6.50	<7.50	<8.50
Primary/Secondary	<4.50	<5.50	<6.50
Grayscale	< 2.50	<3.50	<4.50
Media	< 2.50	<3.50	<4.50

**Table 1** Tolerance sets used to determine pass/fail for DOC Process Control Solution

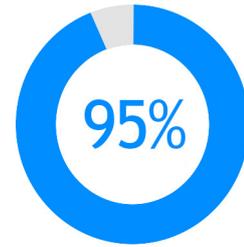
## Data Values in a Barbieri DOC Report



**FIG. 3** Data displayed on a Barbieri SpectroPad using the DOC Process Control Solution

- $\Delta E_{00}$  CIE DE 2000 COLOR DISTANCE FORMULA is the most recent calculation and recommended metric.
- INK measures solid primary and secondary process colors. PRIMARY refers to Cyan, Magenta and Yellow (CMY) channels. SECONDARY refers to Red, Green and Blue (RGB); i.e. CMY combined.
- GAMUT refers to the match between the device and printed color space.
- LINEARIZATION is a vital calibration procedure to determine if adjustments are needed for how ink is applied to media.
- GRAYSCALE is a mixture of CMY amounts which incrementally achieve ink distribution linear in appearance.
- MEDIA measures a blank patch within the control strip to verify the substrate remains unchanged in relation to the reference file.

USING ONLY MAXIMUM OR 95% QUANTILE VALUES



Using only maximum values includes outliers, which can impact the interpretation of results.

A more robust representation of results can be obtained by using the quantile (eg. at 95%), as any outliers are dismissed.

The **Barbieri DOC Process Control Solution** has the capability to calculate maximum *and* quantile values.

**MEDIA ABSOLUTE (side-by-side)**  
vs  
**MEDIA or SUBSTRATE RELATIVE\***



**ABSOLUTE (side-by-side) EVALUATION** refers to matching color based on a reference characterization data set printed on the same media or substrate specified.

**MEDIA or SUBSTRATE RELATIVE EVALUATION** is individual image appraisal of color appearance used if white points differ due to two different substrates.

\* *Media relative*, the term used by **FOGRA**, is an increasingly favored method for evaluation. **IDEAlliance** refer to this evaluation method as *substrate relative*.

The **Barbieri DOC Process Control Solution** has the capability to measure media relative *and* absolute.

## Conclusion

Digital wide and large format, flatbed and industrial printing professionals require a **cost effective process control solution** to achieve accurate and consistent color. This is especially important given the current and forecast growth of the digital printing industry.

As innovations and production techniques evolve, the guidelines for process control for digital printing also evolve. Outdated practices and limited technologies impact production and revenue by causing printer downtime and wastage. Unseen factors unnecessarily impact production.

The Barbieri DOC Process Control Solution is cost effective and easy to use. It offers flexibility with media types and evaluation methods, customization and instant results. It was devised to address the shortcomings of current practice in process control based on client experience, innovations from international industry bodies and internal research and development.

A process control solution which is cost effective and delivers optimal production *is* possible with the Barbieri DOC Process Control Solution.

## Barbieri DOC Process Control

- ✓ Industry compliant and versatile– use proprietary or preferred control strip.
- ✓ Determine on the spot if colors are printing accurately (*when using portable device*).
- ✓ Monitor printer performance over time and production in multiple locations.
- ✓ Avoid wasted resources from changes to ink, media, temperature, humidity and after printer maintenance.
- ✓ Generate an instant PDF report, transfer via USB, wifi or view results on device.
- ✓ Easy to use for results within minutes.



**✓DOC** Available with these Barbieri spectrophotometers



SpectroPad



Spectro LFP qb



Spectro LFP



Spectro Swing

## About Barbieri

**Barbieri** is an internationally operating manufacturer and supplier of intelligent color measurement systems which ensure the highest image quality for professional digital printing. The international Barbieri technical laboratory continuously discovers new features, characteristics and applications to improve products and assist clients for improved performance.

**Barbieri is the color measurement market leader for wide and large format, flatbed and industrial printing.**

## How can you achieve accurate and consistent color reproduction with your process control?

Upgrade a Barbieri device with the Barbieri DOC Process Control Solution or select DOC as a feature with any new Barbieri SpectroPad, Spectro LFP or Spectro Swing.

This white paper was written by Tanja Polegubic during an internship with Barbieri Electronic as a research component to the *Master in Color Design & Technology (1° edition)* from the Politecnico di Milano, Italy.