



5th Color in 4 Color Printing Importance of Substrate

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Agenda

The Importance of Substrate

- ◆ Supply chain issues related to availability and consistency
- ◆ Affects Color reproduction due to G7 curves, and ICC profiles
- ◆ ChromaChecker 5 Step process ensuring substrates meet needs
 - ◆ Define a “production standard”
 - ◆ Benchmark substrates
 - ◆ Find “best match” alternatives
 - ◆ Track Substrate over time
 - ◆ When adding new, compare first
- ◆ Using consistent substrates is ***critical*** to matching color

Substrate Greatly Affects Printed Result

Flint Ink Sample

- ◆ Same ink, same ink film thickness, 15 substrates



Substrate Greatly Affects Printed Result

Flint Ink Sample

- ◆ Same ink, same ink film thickness, 15 substrates = 15 different colors



1. Defining Production Standard

Determine Required Process Color Expectations

- ◆ Allowable Substrate variation should be 50% of E-Factor Goal
- ◆ Set Production Standard for Substrate: alerts operator if bad
- ◆ Wrong substrate is #1 reason why prints are rejected
- ◆ Operator needs to catch before error before print



The screenshot shows the IRIDESSE software interface. At the top left, the name 'IRIDESSE' is displayed. Below it, there are icons for user, help, and notifications. The main area is a table with columns for Track name, Tools, Substrate, E-Factor (EF), Reference Printing Condition, and Details. The table contains two rows of data. The first row is for 'Coated_1' with 175 files, an E-Factor of 5.0, and a status of 3.2 with a red 'X' icon. The second row is for 'flu glass' with 10 files, an E-Factor of 4.0, and a status of 1.6 with a green checkmark icon. A 'SHOW HIDDEN SETUP ASSISTANT' button is located at the bottom of the table.

Track name	Files	Tools	Substrate	EF	Reference Printing Condition	EF	Details
<input type="checkbox"/> Coated_1	175 files	5.0	DW-62	3.2	SICA GRACoL2013_CRPC6 V2	7.1	
<input type="checkbox"/> flu glass	10 files	4.0	SAPP1 1001b	1.6	SICA HP10K_Fo_M1_Dec11	2.5	

2. Benchmark Your House Substrates

Choose Appropriate Measurement Devices

- ◆ Spectrophotometer 45/0 for flat, even substrates (M0, M1 and M2)
- ◆ ISO 13655 White/Black Backer
- ◆ Micrometer Gauge- Thickness
- ◆ Glossmeter- Gloss
- ◆ Scale- Weight
- ◆ Spherical Spectro for material that does not reflect light evenly (foil)



Adjust Substrates? Allow for Substitutions

Find Best Match Substrate (per print application)

- ◆ ΔE (00) formula doesn't work well for defining perceived difference
- ◆ 2016 TAGA Paper (Chung) on combination of metrics= differences
- ◆ Implemented in ChromaChecker **Best Match** Substrate Inspector

Substrate Inspector

Tracking

Substrate: 60# HiTech

Find the Best Match for: 60# HiTech

Match filter

Number of results: 10

Show best CIE whiteness M1 results only

Measurement and lighting conditions

M0 M1 M2

Application

Synthetic effort Gunware Digital Photo lab Other

Web offset Silk screen Large format Inkjet Select All

Flex Proofing High Speed Production Inkjet

Search Inc

Public library (selected manufacturers) Public library (unselected manufacturers) My library

Find Best Match

ChromaChecker Best Match Substrate

Find substrates support existing G7/ICC workflows

- ◆ Specific M Condition, specific print process

Baseline (60# HiTech)

Name	M1 white backing (D50/2)			CIE Whiteness	Glossiness	OBA Index	
	L*	a*	b*				
60# HiTech	96.13	1.55	-10.03	131.27	5	92	expert

Results

Name	M1 white backing(D50/2)			CIE Whiteness	Glossiness	OBA Index	EF	Ranking	
	L*	a*	b*						
HP calibration substrate M1	94.97	1.75	-8.13	121.39	59	7.4	4.1	1	expert
AurhamPlus Catin	94.69	1.81	-5.82	111.13		1.9	9.1	2	expert
Dlezer Setir	95.34	1.07	-4.56	187.38		4.5	10.3	3	expert
Cust Proof	95.34	1.01	-0.87	86.76		4.1	18.0	4	expert

- ◆ Previews predicted visual match:

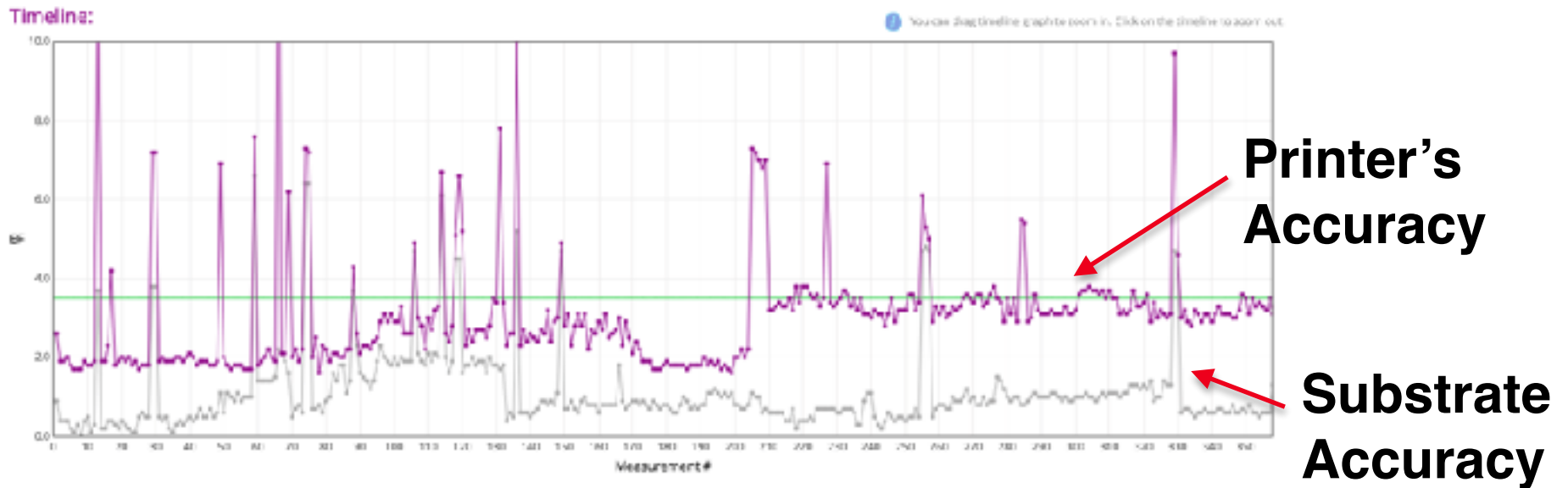
Light booth (D50, sRGB)

	M0 white	M1 white	M2 white	M0 black	M1 black	M2 black
Sub. 1						
Sub. 2						

3. Track Substrate Realtime with Printer

Every production measurement compares substrate

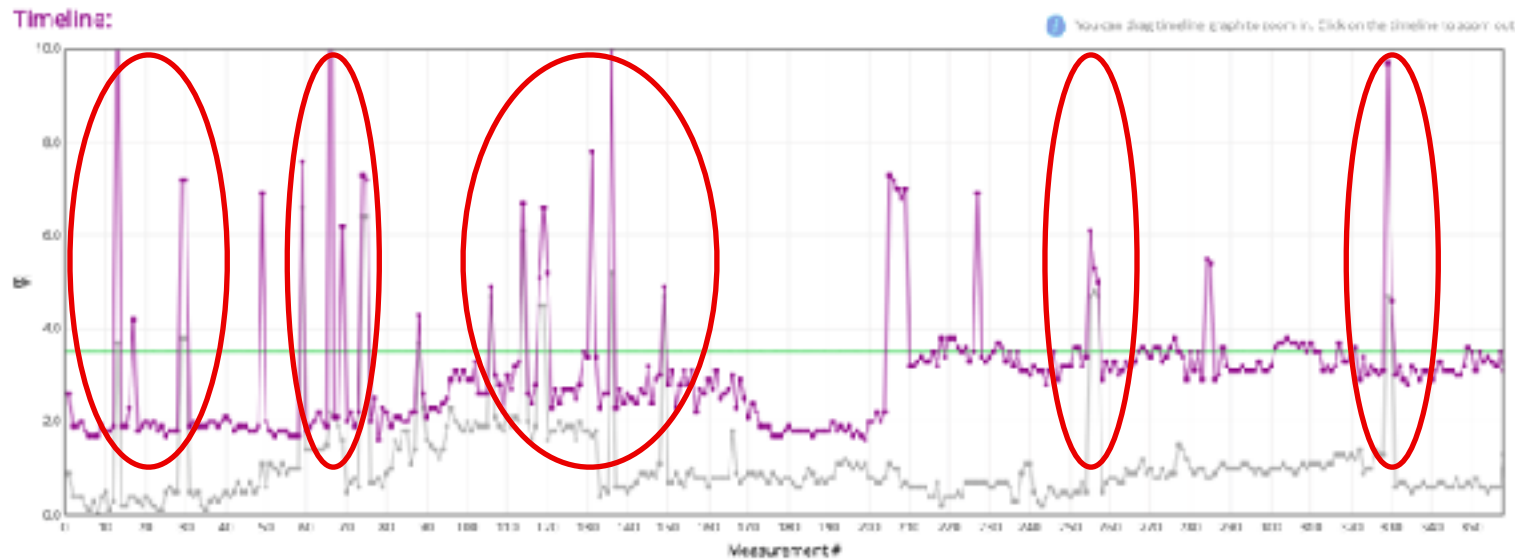
- ◆ Associate substrate benchmark with print process
- ◆ Color bar requires substrate patch



When Substrate Fails, Print Not Salable

Every production measurement compares substrate

- ◆ Associate substrate baseline with print process
- ◆ Color bar requires substrate patch



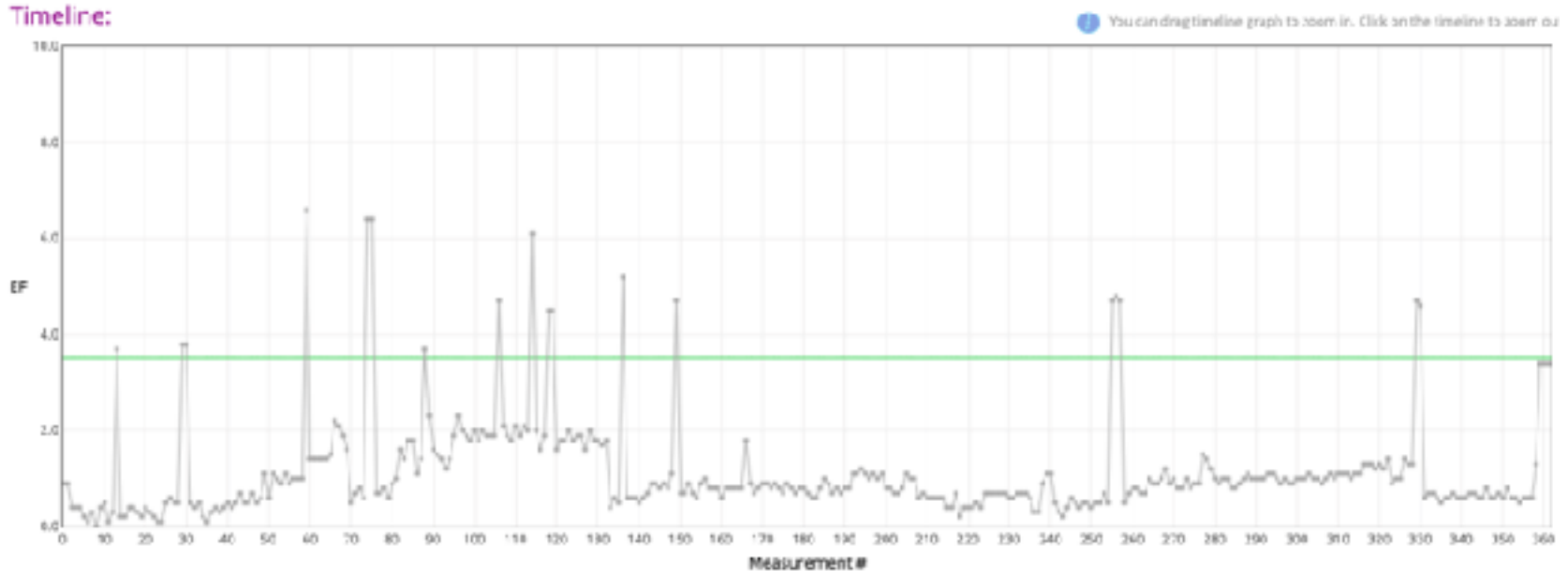
IRIDESSE		Tools		Substrate		Reference Printing Condition		Details	
<input type="checkbox"/> Coated_1	175 files 5.0			<input type="checkbox"/> DW-62	3.2			<input type="checkbox"/> GRACol2013_CRPC6 V2	7.1
<input type="checkbox"/> flu_gloss	10 files 4.0			<input type="checkbox"/> SAPPY 100lb	1.6			<input type="checkbox"/> HP10K_Flo_M1_Dec11	2.5

SHOW HIDDEN SETUP ASSISTANT

Hold Suppliers Accountable

Every production measurement compares substrate

- ◆ Track consistency of substrate over time
- ◆ 20+ customers told us this provided recourse with their suppliers
- ◆ If using G7 Curves or ICC Profiles- change in substrate ruins result



4. Adding New Substrates? Intelligently...

Baselining New- Compare with Existing substrate

- ◆ Optimize inventory, and pricing
- ◆ Build G7 Curves or ICC Profiles to work with groups of substrates

The screenshot shows the 'Substrate Inspector' software interface. The top navigation bar includes 'Substrate Inspector', 'Tracking', and 'Library'. Below the navigation bar, there are tabs for 'Manufacturers', 'Public Library', and 'Add Substrate'. The main content area displays a table of substrate data, organized into sections for different manufacturers: 'Mid States Graphics', 'Oltre', and 'Mitsubishi Imaging (MPM), Inc.'. Each section contains a table with columns for Name, Base weight (lb), Density (lb), M1 White Bedding (L, M, R), GMA Index, Application, Match, and Size. The 'Oltre' section shows a single entry for 'Oltre Mastercam 171242'. The 'Mitsubishi Imaging (MPM), Inc.' section shows a single entry for 'Serec jet 4.3 Glass 140128 Production Inkjet Paper'. At the bottom of the interface, there are buttons for 'Merge selected', 'Compare selected', 'Tools selected', and 'Delete selected'.

Name	Base weight (lb)	Density (lb)	M1 White Bedding			GMA Index	Application	Match	Size
			L	M	R				
Mid States Graphics									
Mid States Graphics Super Ultra Matte Print		98.6	98.6	98.6	98.6	11.6		match	
Oltre									
Oltre Mastercam 171242	962	978	962	962	962	7.7		match	
Mitsubishi Imaging (MPM), Inc.									
Serec jet 4.3 Glass 140128 Production Inkjet Paper	45	94.0	93.5	93.5	93.5	4.4		match	

Compare Inventory of Substrates

Baselining inventory- which can be mixed/matched

- ◆ Optimize inventory, and pricing
- ◆ Build G7 Curves or ICC Profiles to work with groups of substrates



Compare substrates

Substrate 1	Substrate 2	MI whiteness (D50/10°)	Max ΔE (00)	OBA Index (GOBA)	Glossiness	Basis weight (lbs)	Expert mode
LW-62	Domtar Lynx Opaque Ultra Uncoated Text	5.4	1.4	0.3			Details
Outre Mainsream FPK240S	Domtar Lynx Opaque Ultra Uncoated Text	-5.8	1.6	-2.9			Details
Outre Mainsream FPK240S	DW-62	-11.2	2.5	-3.2	45		Details
Outre Mainsream FPK240S	Sword Jet 4.3 Gloss SWG128	17.5	3.4	3.3	35	76	Details
Sword Jet 4.3 Gloss SWG128	Domtar Lynx Opaque Ultra Uncoated Text	-23.4	4.0	-6.2			Details
Sword Jet 4.3 Gloss SWG128	DW-62	-28.8	5.0	-6.5	10		Details

Light booth (D50, sRGB)



Printed Color on Substrate- Ultimate Test

How ink/toner interacts with substrate= Appearance

- ◆ Print small color bar (proofing wedge, CC84) on all substrates
- ◆ Use Print Condition Qualifier to determine which substrate to G7/ICC

File list:

Measurement	Sheet	Created	ICC	0E	0E	TVI	G7	EF	✂	🔍	
HP_IC1617_H_HPsemiGloss.cxf	P	2017-10-30 15:07	ICC	✓	✗	✗	✗	✗	6.7 6.7	✗	🔍
HP_IC1617_H_Poly.cxf	P	2017-10-30 14:55	ICC	✓	✗	✗	✗	✗	8.8 8.8	✗	🔍
HP_IC1617_H_HighGlossPharma.cxf	P	2017-10-30 14:34	ICC	✓	✗	✗	✓	✓	6.0 6	✓	🔍
HP_IC1617_H_Thermal.cxf	P	2017-10-30 14:21	ICC	✓	✗	✗	✗	✗	6.9 6.9	✗	🔍
HP_IC1617_H_Kimdura.cxf	P	2017-10-30 13:45	ICC	✓	✗	✗	✓	✓	4.9 4.9	✓	🔍
Select opposite											

Group / OK / Baseline Recalculate Compare G78 Curve PC qualifier Export Job Report Flag Delete

Print Condition Qualifier:

Apply Production Standard

- ◆ Smaller (3) the Production Standard, the **more** work, time, money

Print Condition Qualifier

Client:	HP Indigo Color Meet
Track:	Substrates
Number of files:	5
Number of groups:	3
ΔE threshold:	<input type="text" value="3.00"/>
Mode:	95% ▾
File header:	Filename ▾
<input type="button" value="Calculate"/>	

Group qualification

Group 1:		CRPC			
2	HP_TC1817_UPolyof				CRPC4 1
Group 2:		CRPC	max. ΔE	avg. ΔE	std. dev. ΔE
1	HP_TC1817_UHPsemiGloss.of	CRPC3	2.04	2.04	0.00
3	HP_TC1817_UHighGlossPanna.of	CRPC3	2.04	2.04	0.00
Group 3:		CRPC	max. ΔE	avg. ΔE	std. dev. ΔE
4	HP_TC1817_UThermal.of	CRPC3	2.08	2.08	0.00
5	HP_TC1817_UKinAmor.of	CRPC4	2.08	2.08	0.00

Print Condition Qualifier: Optimize Efficiency

Apply Production Standard

- ◆ Larger (5) the Production Standard, the **less** work, time, money

Print Condition Qualifier

Device:	HP Indigo Color Beat
Track:	Substrates
Number of files:	5
Number of groups:	1
ΔE threshold:	<input type="text" value="5.00"/>
Mode:	95% ▾
File header:	File name ▾
<input type="button" value="Calculate"/>	

Group qualification

Group 1:		CRPC	max. ΔE	avg. ΔE	std. dev. ΔE
2	HP_TC1617_H_foly.cxf	CRPC4 !	5.00	4.49	0.46
3	HP_TC1617_H_highGlossPharma.cxf	CRPC4	3.99	3.31	0.63
4	HP_TC1617_H_Thermal.cxf	CRPC5	4.35	3.54	0.63
1	HP_TC1617_H_1P3semiGloss.cxf	CRPC5	4.62	2.79	0.82
5	HP_TC1617_H_Gmdara.cxf	CRPC4	5.08	3.88	0.92

Substrate Summary- 5th color in 4 color

Follow ChromaChecker 5 Step Process

- ◆ Apply a Production Standard to your substrates
- ◆ Benchmarking provides ability to substitute, minimize inventory
- ◆ Best Match allows sharing G7 Curves and ICC between substrates
- ◆ Alert Operators before they print on wrong substrate
- ◆ Substrate compare allows you to add new substrates intelligently
- ◆ Print Condition Qualifier helps to minimize workflows, G7, ICC

- ◆ Provides more efficiency and productivity for manufacturing color