Digital Press Benchmarking

PRESENTED BY

DAVID HUNTER

ChromaChecker

Audience:

Make Up?

- Brand Companies?
- Printing Company?
- Prepress Company?
- Manufacturers?
- In Market to Purchase Digital Device?

Agenda:

Questions at any Time

- How to Quantify Customer's "Match" Expectations
- Apply to Machine Capabilities
- Customer Requirements for Print
- Actual Device Performance Compared
- Range of Color- Gamut
- Precision- consistency, repeatability, reproducibility
- Accuracy- Match to target reference
- Quality of Print- Addressability, Resolution

Terminology

Definitions for this Presentation

- Delta E (ΔE)- Metric defining color difference
  - *Higher the Number- Larger the perceived difference*
  - *One Color compared to another Color*
- *E-Factor :* CRF 95th CRF of the Delta E
  - *Version of Delta E but for comparing Images or Pages*
  - *Coined term: E-Factor (**E**xpectation and form Δ**E**)*

Terminology

Definitions for this Presentation

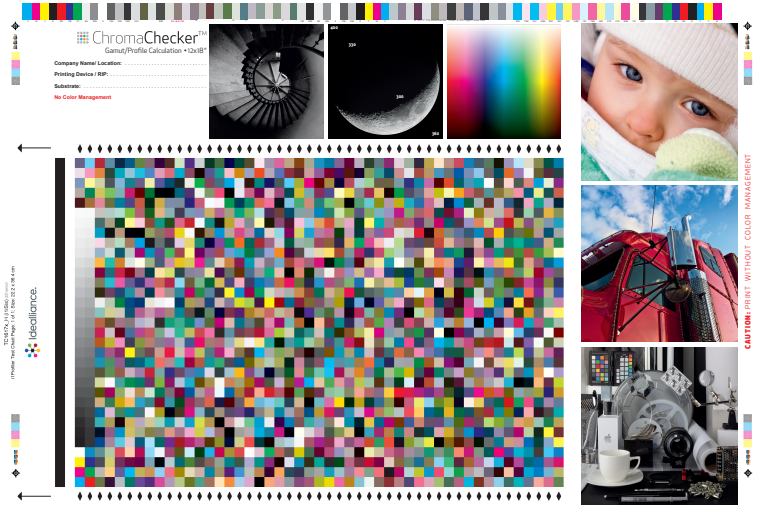
- Precision
  - *Consistency- Within Page, Within jobs, Between jobs*
  - *Quantify via E-Factor (CRF)*

- Accuracy
  - *How Close to Reference Condition*
  - *How close to GRACoL (CRF)*

Output Devices Covered:

Digital Presses and Large/Grand Format

- Similar Test forms
- Visual, and Measurement Targets
- Invited Every Major Vendor to participate
  - Vendor has choice to make data blind
- Most data came from customers



Every Day Problems

Industry Poll of Printers (1500+)

- Not Matching Color on same device between jobs
- Not Matching Spot colors “close enough”
- Not Matching Color between Devices

This Presentation Covers all of these Issues!

Old Way to Assess Printing Devices

Normal Considerations for Purchase

- Format Size
  - *How big?*
- Substrate Capabilities
  - *What can it print on*
- Budget
  - *Overall Cost, Maintenance costs*
- Does it Look OK...
  - *Visual Assessment... compared to what?*

New Way to Evaluate Printers

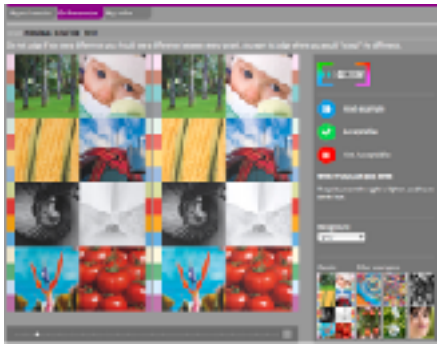
Better Purchase Considerations

- Understand the devices Range of Color (Gamut)
  - *Can it match/exceed a GRACoL Printing Aim*
  - *Can it match important Spot Colors*
- Define the Precision
  - *Within print, and between prints, between jobs*
- What is the Accuracy?
  - *Dependent on Operator/RIP performance*
- Define Machine Capabilities vs. Expectation
  - *Actual Customer Requirements*

Customer Job Requirements

Define Customer Expectations

- Quantify Expectations- Images/Spot
  - *Use E-Factor Exercise to quantify "Match" Requirements*



- Can Output Device Meet Customer Expectations
  - *Within customer's Expectations of a "Match"*
  - *If Customers Expectations is 2, Apply to Printing Device*

Customer Job Requirement

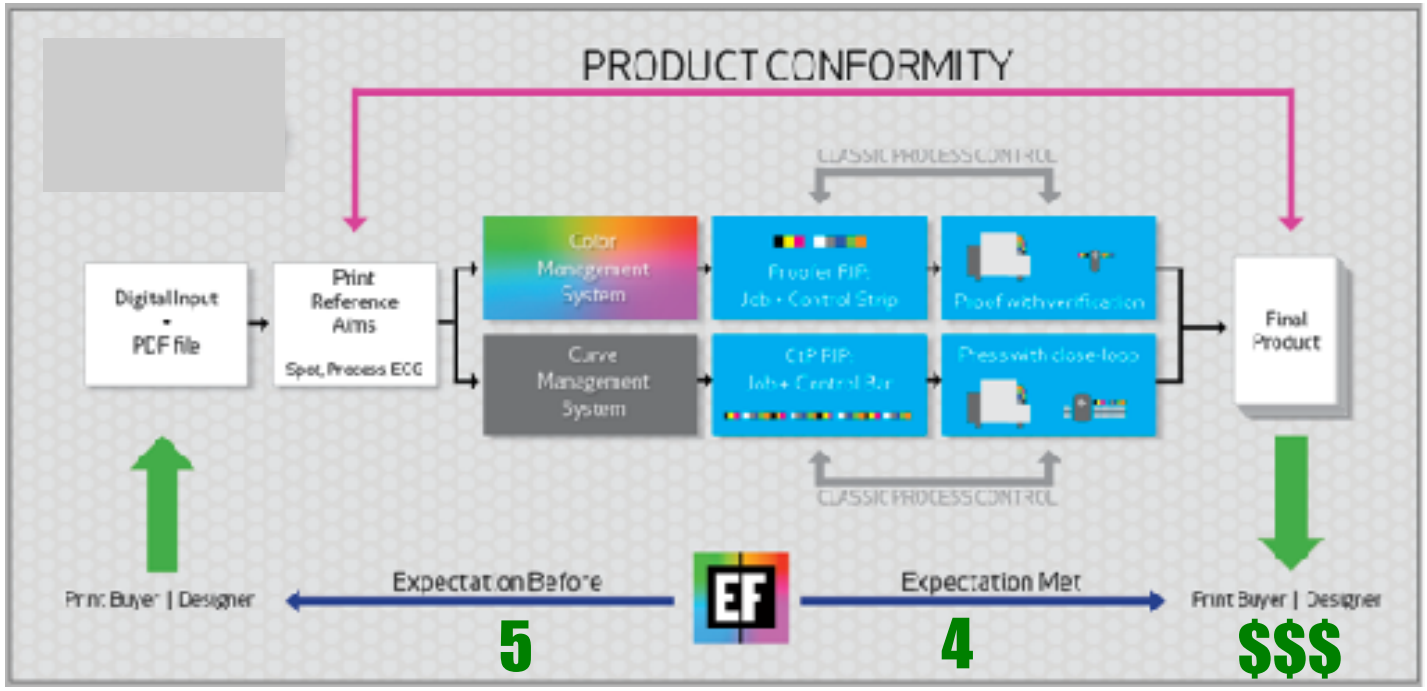
Apply Expectations to Machine Capabilities

- If Customer's Expectations for "Match" is 2
- Output devices Machine capabilities must 2 or less
  - *If Output device is equal or less than Expectations... $$$*
- Apply E-Factor to all Aspects of Output Devices
  - *Are Colors Within Gamut?*
  - *Are Colors consistent within page*
  - *Are Colors consistent throughout a multi page run*
  - *Are Colors consistent from week to week*
  - *Are Colors "matching" colors on other output devices*

CRF 95th Percentile – E-Factor

Visual Score Card= Visual Appearance

- Color Conformance- Not Process Control
- Relative Difference ***only, Doesn't tell you why***



CRF 95th Percentile – E-Factor

Visual Score Card= Visual Appearance

Psychometric Tests:
CRF 95% Stated

E-Factor: 9 or more

Unacceptable

CRF 95th Percentile – E-Factor

Visual Score Card= Visual Appearance

Psychometric Tests:
CRF 95% Stated

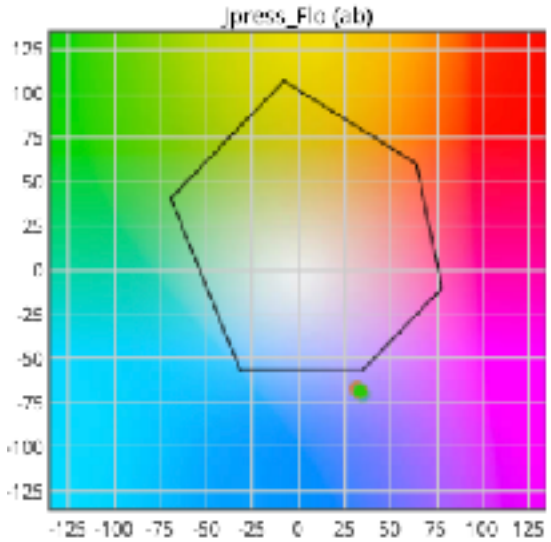
E-Factor: 2 or less

Excellent/Very Good

1. Are Colors Within Gamut?

Measure Colors- Assess Against Device

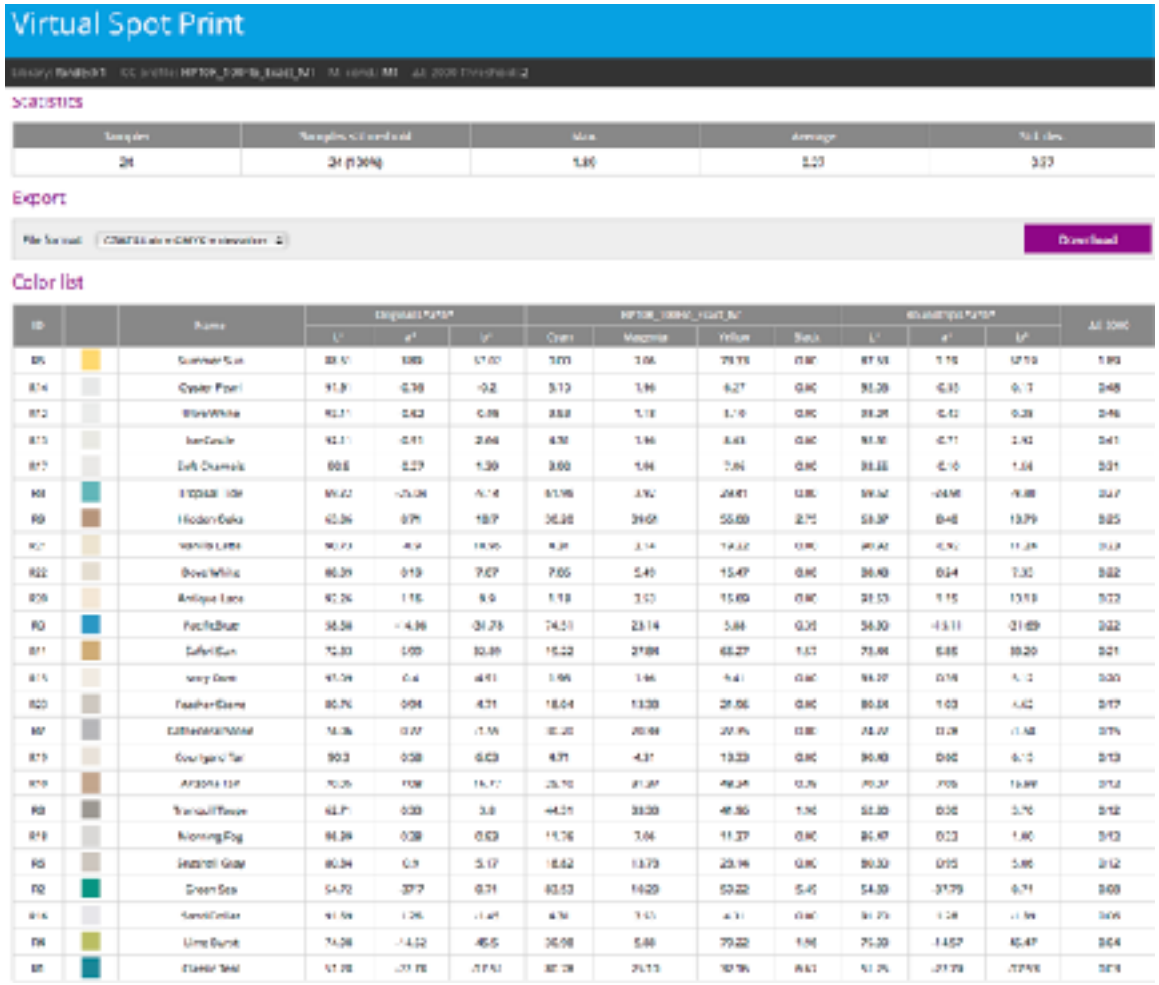
- Optimize Paper color to help your gamut
- Reflex Blue
- If Customer Expectations <5



	RGB(sRGB)								8-bit CMYK (Jpress_Flo - M0)								RAL Design
		R	G	B	hex	L*	a*	b*	ΔE_{00}	Cyan	Magenta	Yellow	Black	L*	a*	b*	ΔE_{00}	
M0		0	28	140	#00108C	18.90	38.74	-62.40	5.59	100.00	84.71	0.00	9.80	20.69	25.27	-57.45	5.39	292 21 64
M1		0	29	144	#001090	19.60	39.59	-63.72	5.69	100.00	85.10	0.00	8.24	20.76	25.64	-57.86	5.31	292 22 65
M2		0	29	137	#001089	18.73	37.05	-60.80	5.80	100.00	83.92	0.00	12.55	20.65	24.25	-56.76	5.32	291 21 62
M3		0	24	134	#001086	17.34	38.88	-61.22	6.19	100.00	83.92	0.00	16.08	20.41	23.43	-55.71	6.87	291 19 62

1. Are Colors Within Gamut?

Measure Colors- Assess within Device



2a. Are Colors Consistent within Page

Ganging jobs on Page- Consistency?

2b. Are Colors Consistent within Job?

First Page “same” as Last?

2c. Colors Consistent Week to Week

Operator to Operator, Press to Press?

Monday January 15

Friday February 19

Week to Week, Location to Location…

3. Are Colors “Matching” Target Ref.

Characterized Reference Printing Conditions

Proof

Offset Press

Digital Press 2

4. Is Resolution Sufficient

Bar Codes, Small Text- Extremely Important

Four Benchmarks Conducted

- 1. Gamut Size
  - *ISO Formula calculation, and Percent of PMS w/in 2 ΔE*
- 2. Variation (Precision) Benchmarks
  - *a. Within Page Uniformity, VI 816 Target and M-Score*
  - *b. Repeatability- 1000 page press run for digital*
  - *c. Reproducibility: Consistency over days, weeks*
- 3. Accuracy
  - *How Close Match to GRACoL and G7 Color Space*
  - *Dependent on Operator Knowledge- Caution*
- 4. Resolution (Partial)
  - *Spatial Frequency Response, Visual*

Manufacturers and Printers

Customers and Manufacturers submissions

- Domino Digital
- Fuji J-Press*
- HP Indigo Sheet*
- HP Indigo Roll*
- Kodak Nexpress*
- **Kodak Prosper**
- Konica Minolta KM 1*
- **Konica Minolta KM1**
- Xerox iGen*
- Xeikon *
- 5 Blind Submissions

Durst Rho*

Fuji Acuity

Fuji Inca*

HP Latex*

Swiss Q

EFI Vutek LX

*** Customer Submitted**

Four Benchmarks Conducted

- Dashboard to Easily Visualize Results
  - *Each Track- Different Benchmark*
- Green is Good, Red... Lower Number is Better

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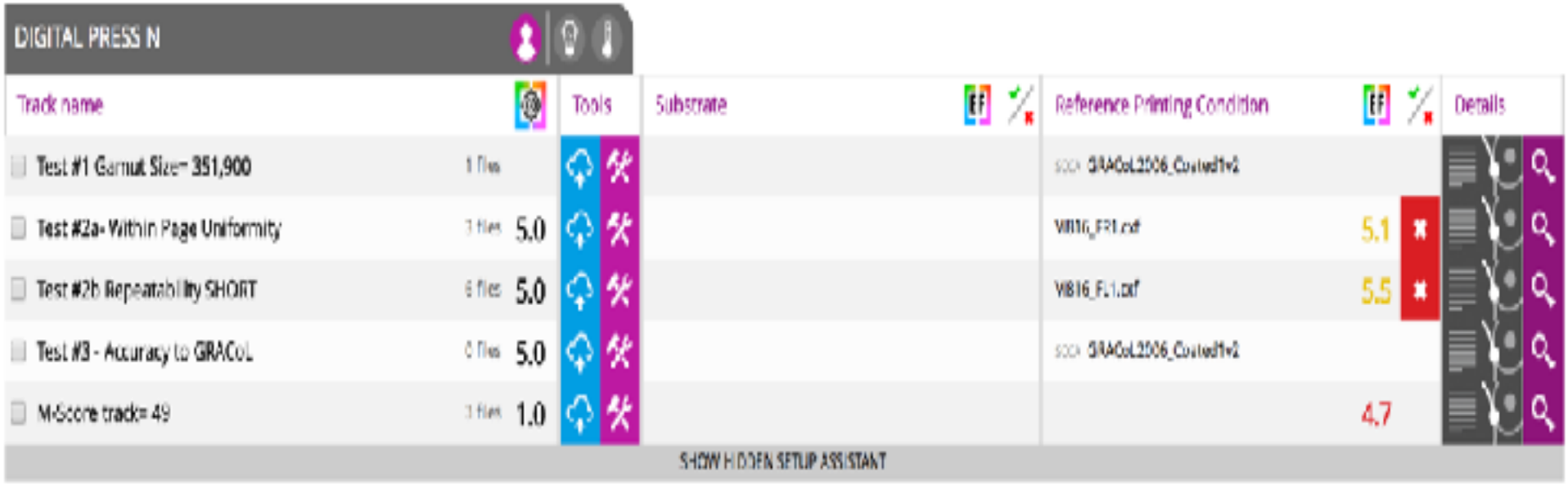

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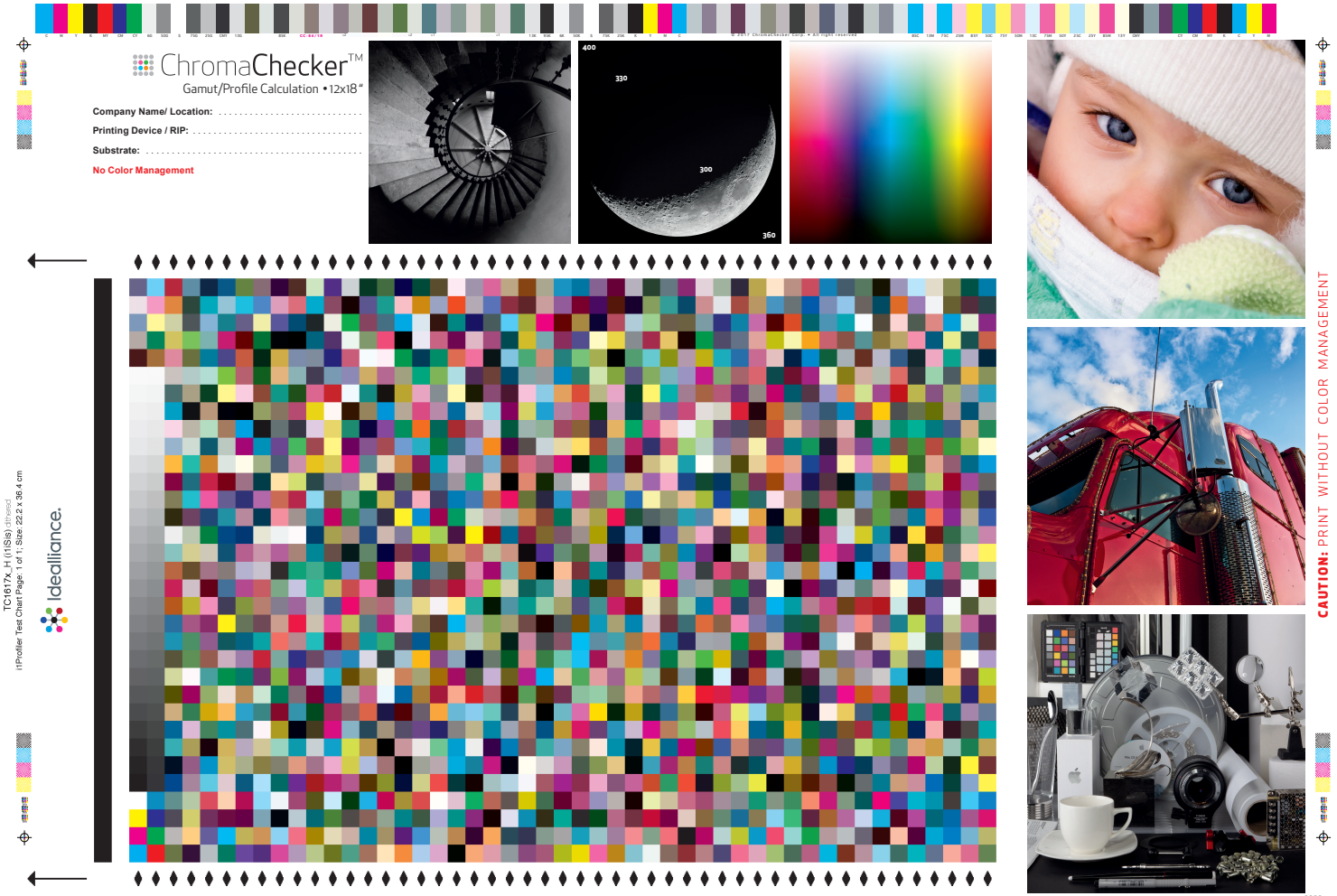
- Resolution
  - *Spatial Frequency Response, Visual*

Benchmark #1 Gamut Size

IT8 7/5 (TC1617) Target w/o CMS



Device Gamut Test #1

Gamut Size of the output device

- Larger is better- more vivid, more colors
- Calculate PMS colors accurately simulated
- Calculate if device can Simulate GRACoL
- Same Target and measurements
- Compare with Gamut Comparison Tool

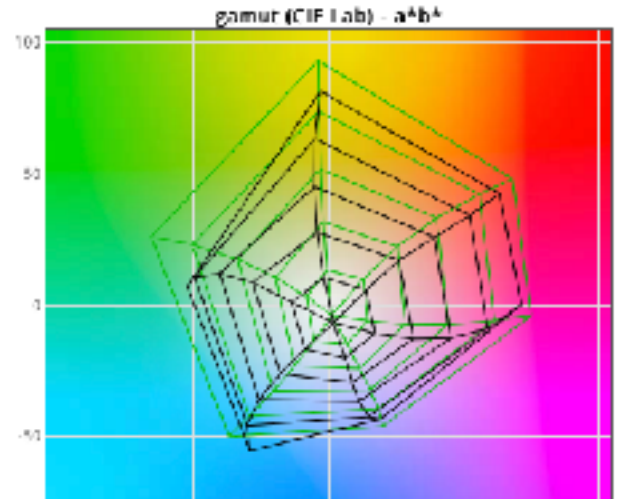
Device Gamut Test #1

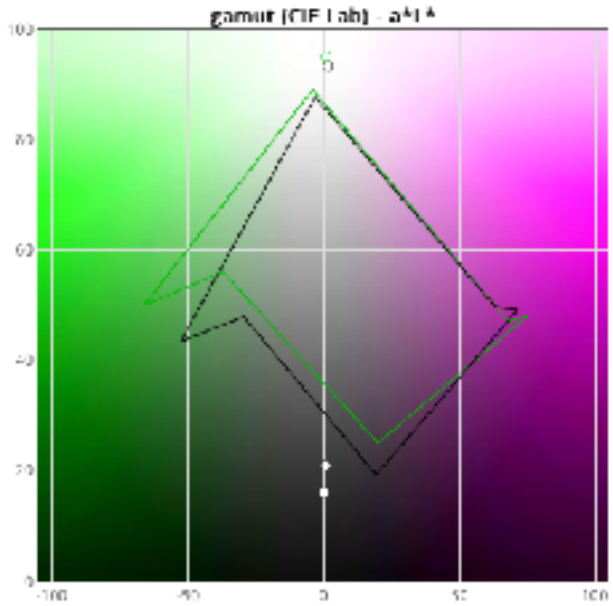
Gamut Size of the output device

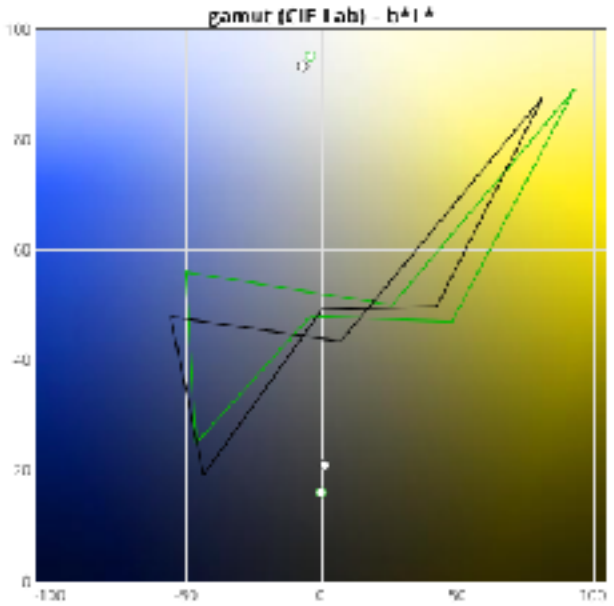
GS3250r_VIGGS3250r13oV_600x360_CMYKcm | CGATS21_CRPC6

Compare

Gamut







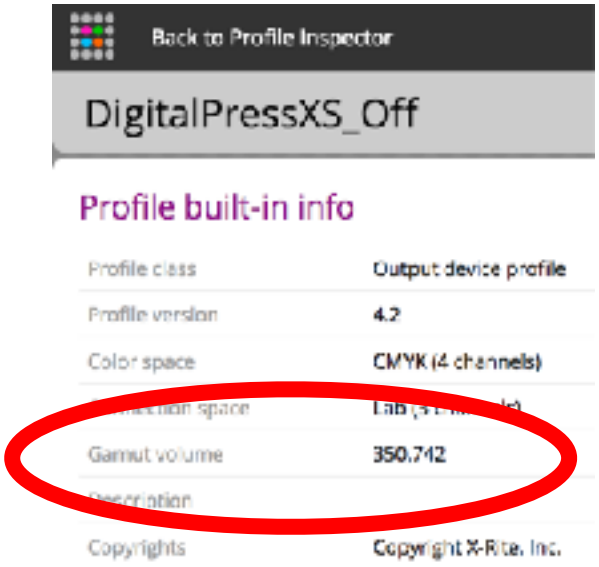
FACTOR **8.73**

Max	14.73
Average	4.35
Standard deviation	2.06

Benchmark #1 Gamut Size

IT8 7/5 (TC1617) Target w/o CMS

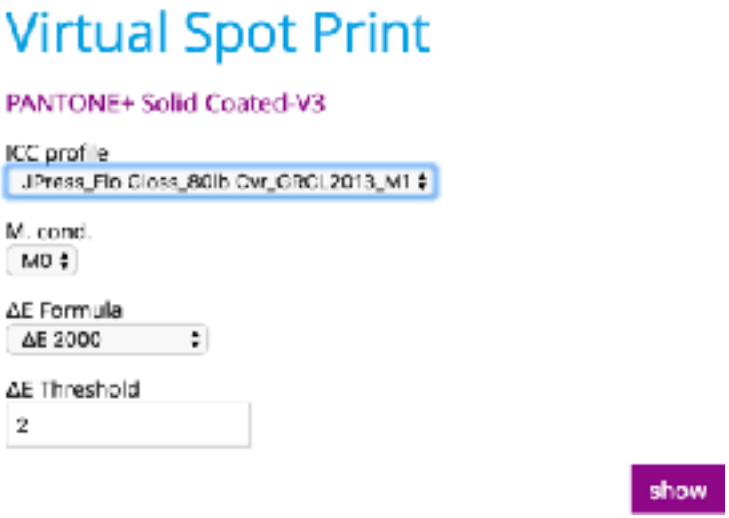
- Told vendor best substrate for color range
- ISO TS 18621-11 Metric



Benchmark #1- PMS Percentages

IT8 7/5 (TC1617) Target w/o CMS

- Told vendor best substrate for color range
- ISO TS 18621-11 Metric
- Calculate Percent of PMS Colors w/in 2ΔE



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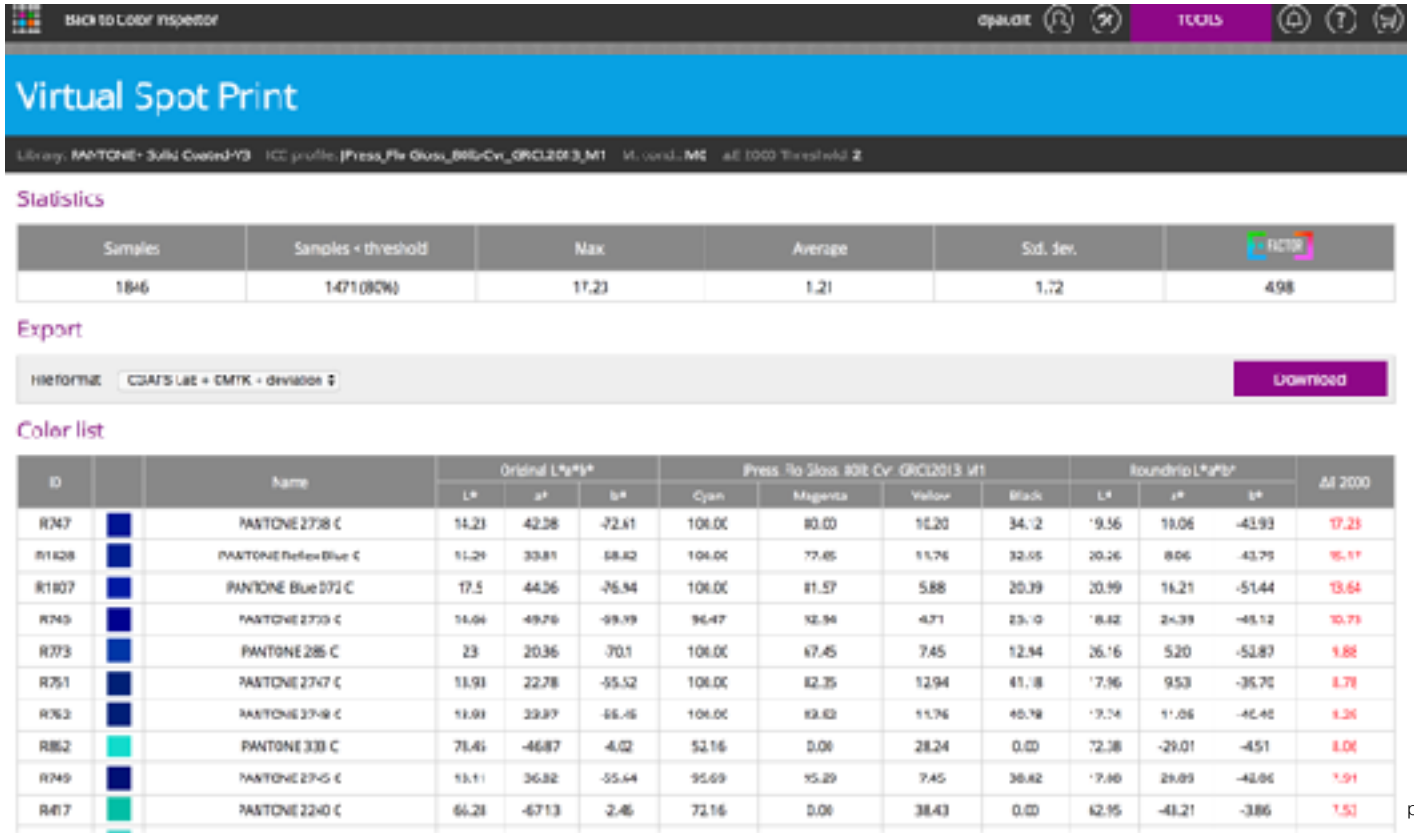

Benchmark #1 Gamut Size: Results

	ISO Gamut	% PMS within 2 ΔE
◆Fuji J-Press*	558,700	75%
◆Kodak Prosper	515,200	74%
◆Konica Minolta KM1	512,900	76%
◆Domino	504,100	71%
◆Digital Press NI	459,400	70%
◆Indigo 12000*	451,100	66%
◆Digital Press O	445,300	68%
◆Indigo WS6600*	420,900	63%
◆Igen 4 Press*	401,300	65%
◆Digital Press N	351,900	57%
◆Kodak Nexpress*	350,700	57%

Four Benchmarks Conducted

- Gamut Size
  - *ISO Formula calculation, and Percent of PMS w/in 2 ΔE*
- Variation (Precision) Benchmarks
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  - *Repeatability- 1000 page press run for digital*
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  - *Dependent on Operator Knowledge- Caution*
- Resolution
  - *Spatial Frequency Response, Visual*

Chicken Does come before Egg

Have to have **Precision** before **Accuracy**

- *Need Device consistency to know how to build ICC Profile*
- *Without consistent imaging (proper consumables and maintenance) no sense Color Managing*
- ***Assign E-Factor for Precision- Variation Allowed***
- ***Assign E-Factor for Accuracy- Deviation Allowed***
- ***Conformance requires both Precision/Accuracy***
- ***Metric "Delta E" bigger the number, bigger difference***

Device Precision- 3 Variation Tests

1st Calculate Within page variation

Variation within a Page

2nd Calculate Within Job variation

Repeatability between multiple pages in job

3rd Calculate Between Job Variation

Reproducibility: multiple jobs after calibration

Understand what Normal is, dependent on operator maintenance, and procedures

Device Variation Benchmark

Superset of P2P- Repeating Patches (7120)

- Cover Page Area- may need multiple targets

Large Format Within Page

- Size Test Form for your output media (28,610)
- 1st print- Within Page Variation

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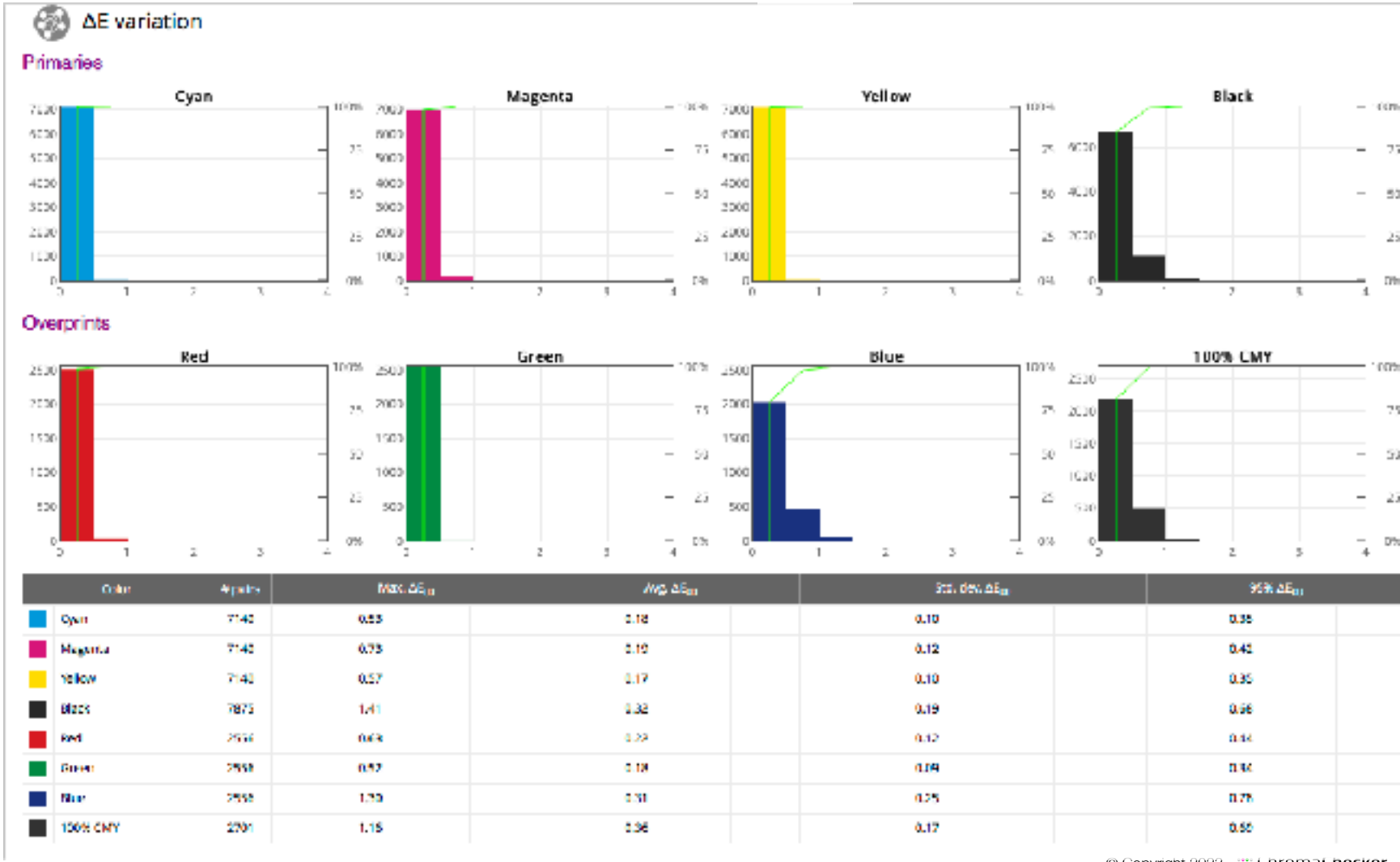
Device Variation Benchmark

Within Page, Within Job, Between Jobs

- Same Target, Multiple Calculations at same time

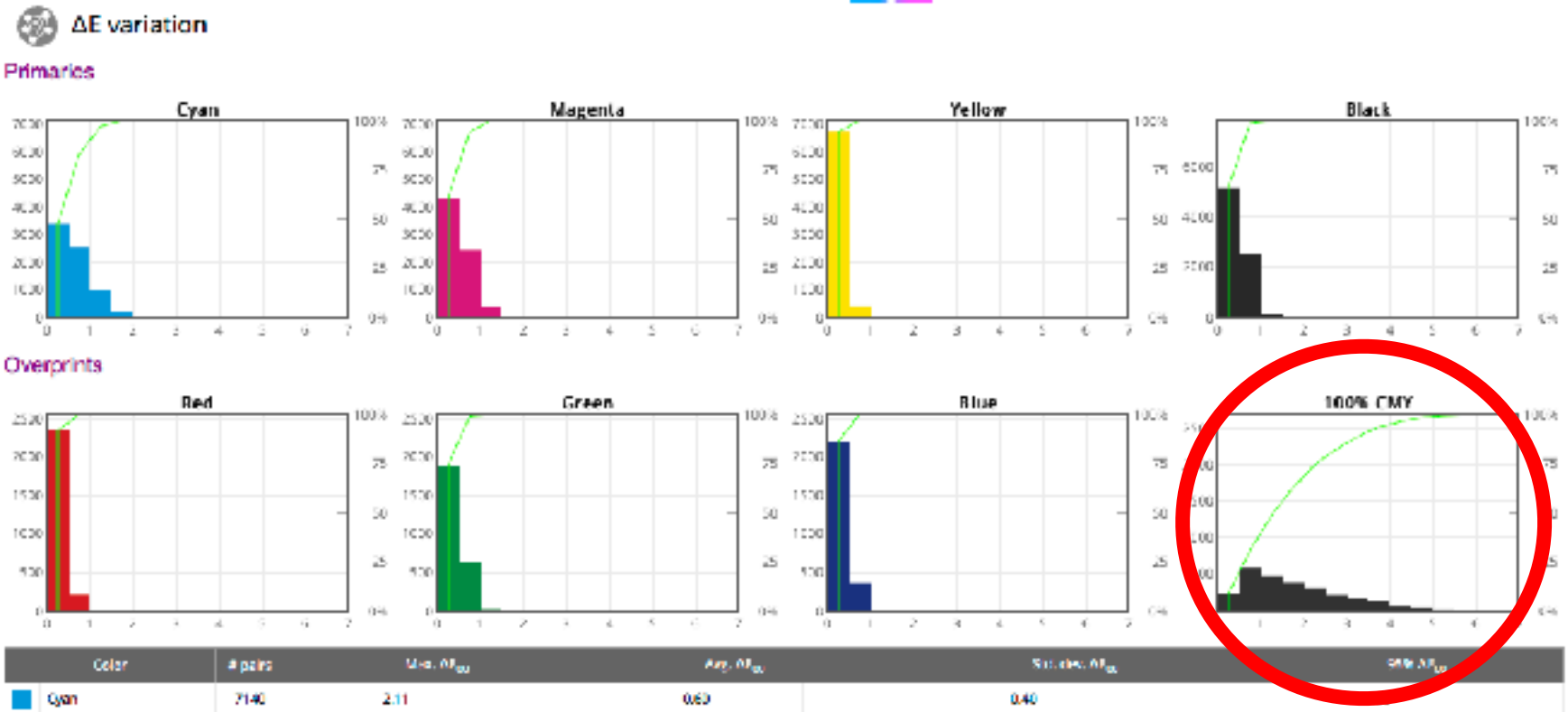
Sample Result #2a: Within Page

- Printer A: Within Page EF = 1.1



Sample Result #2a: Within Page

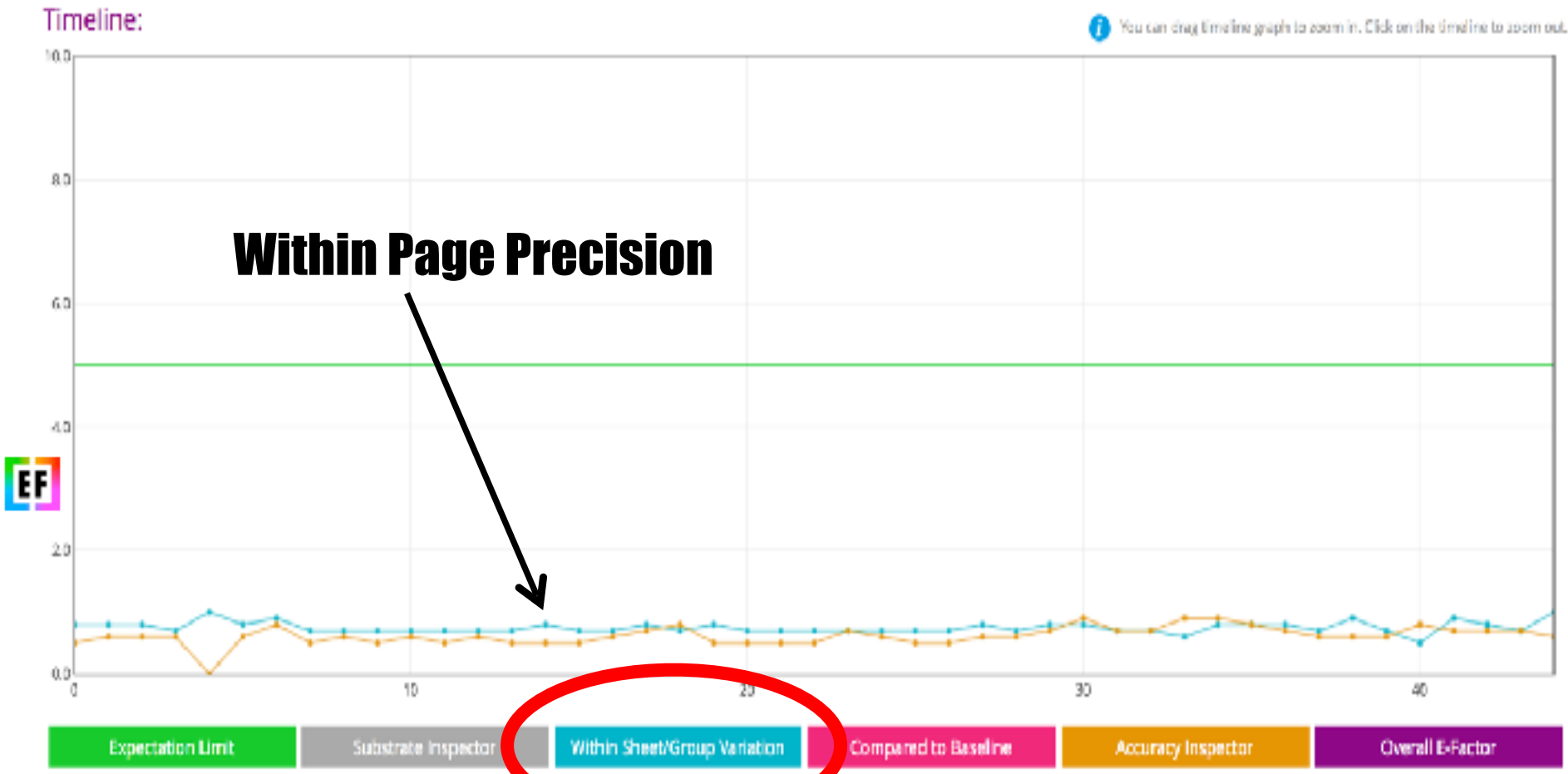
- Printer B: Within Page EF = 4.2



Color	# pairs	Max. ΔE_{00}	Avg. ΔE_{00}	Std. dev. ΔE_{00}	95th ΔE_{00}
Cyan	7140	2.11	0.69	0.40	
Magenta	7140	1.40	0.45	0.28	1.00
Yellow	7140	0.79	0.25	0.14	0.51
Black	7875	1.53	0.44	0.21	0.82
Red	2550	0.91	0.28	0.14	0.54
Green	2550	1.21	0.29	0.21	0.70
Blue	2550	0.90	0.22	0.10	0.42
100% CMY	2701	0.90	1.61	1.21	4.21

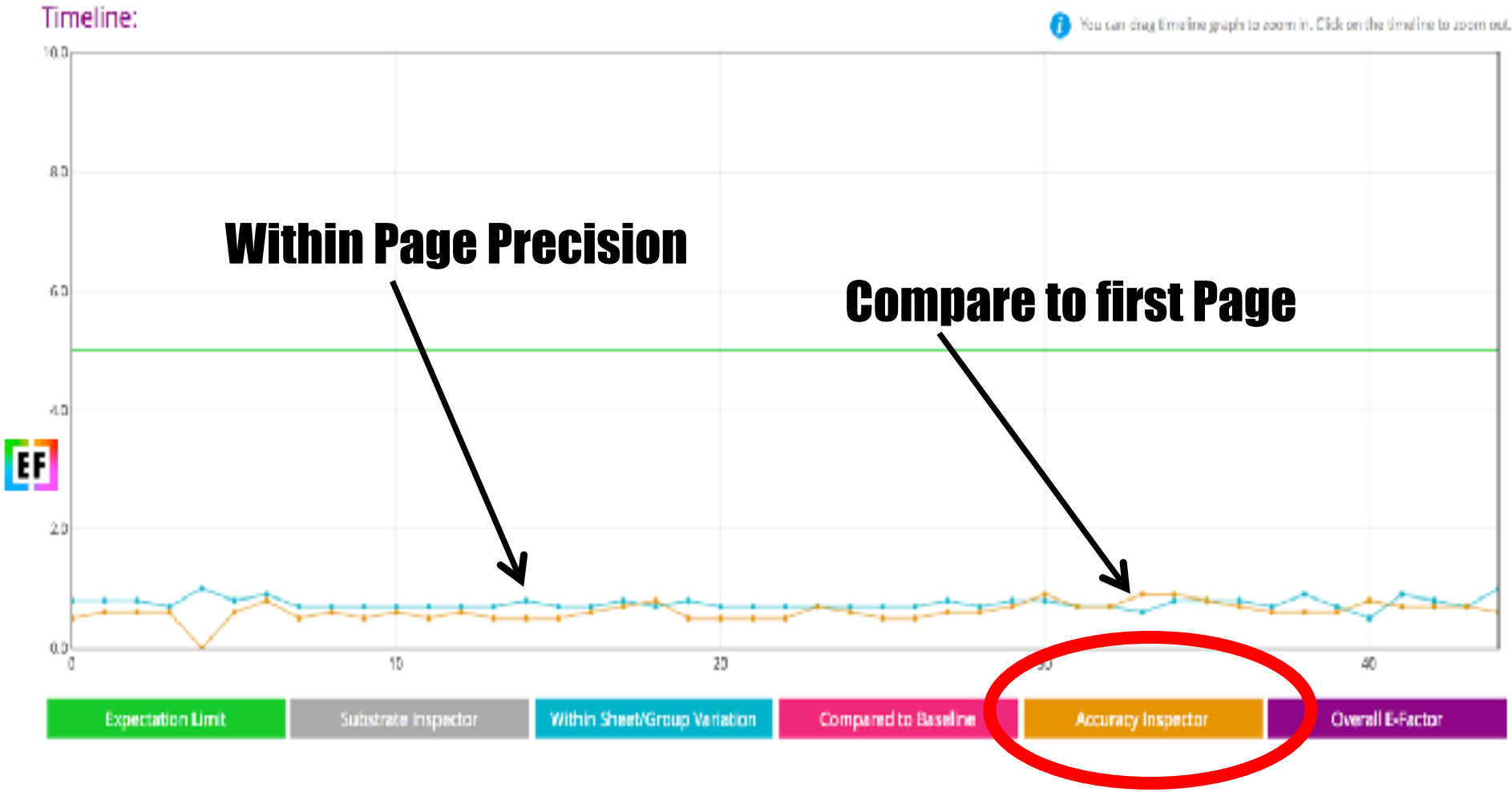
Sample Result #2b: Within Job

- Printer A: 1000 Page Run =1.0



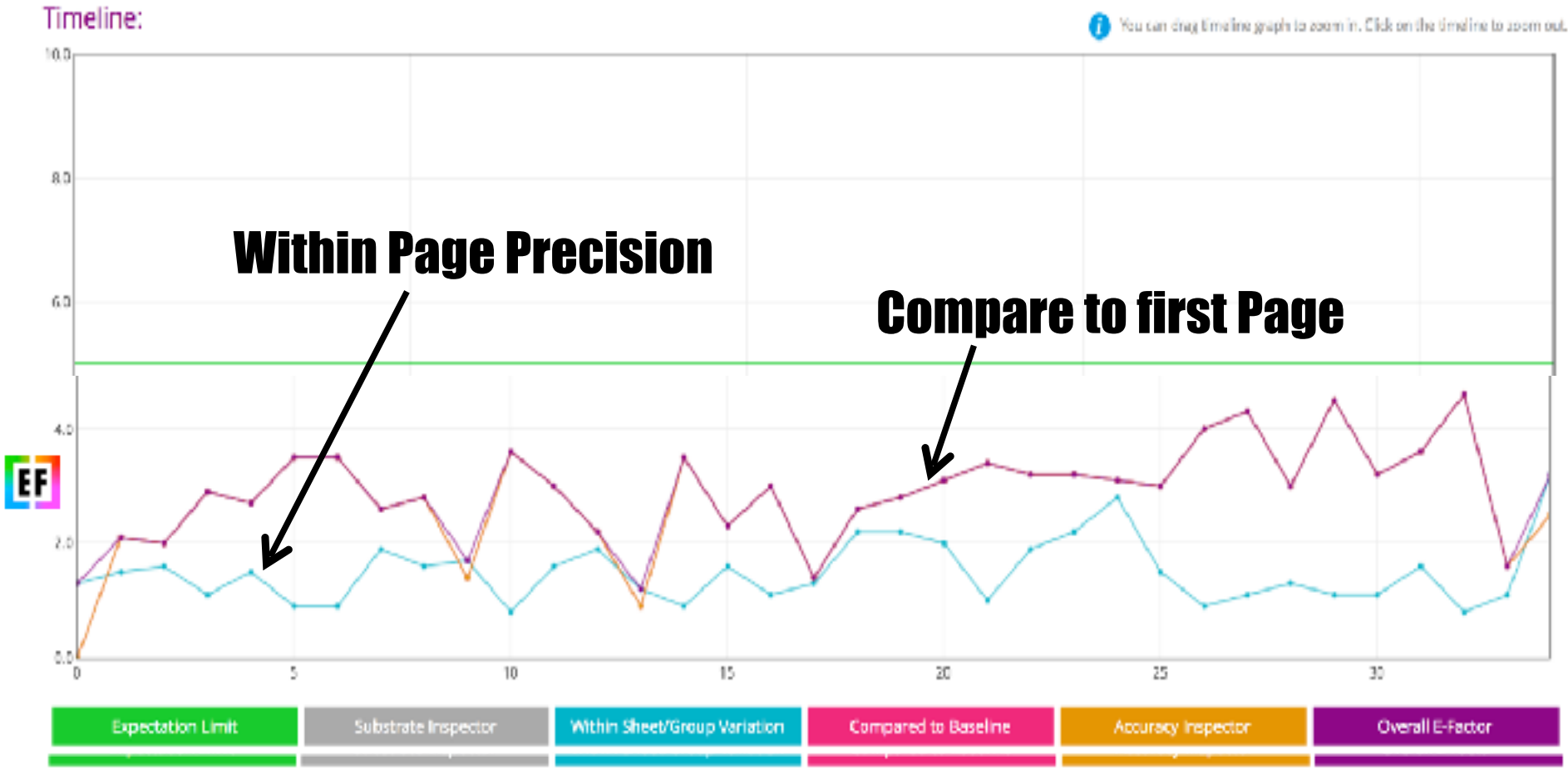
Sample Result #2b: Within Job

- Printer A: 1000 Page Run EF =1.0



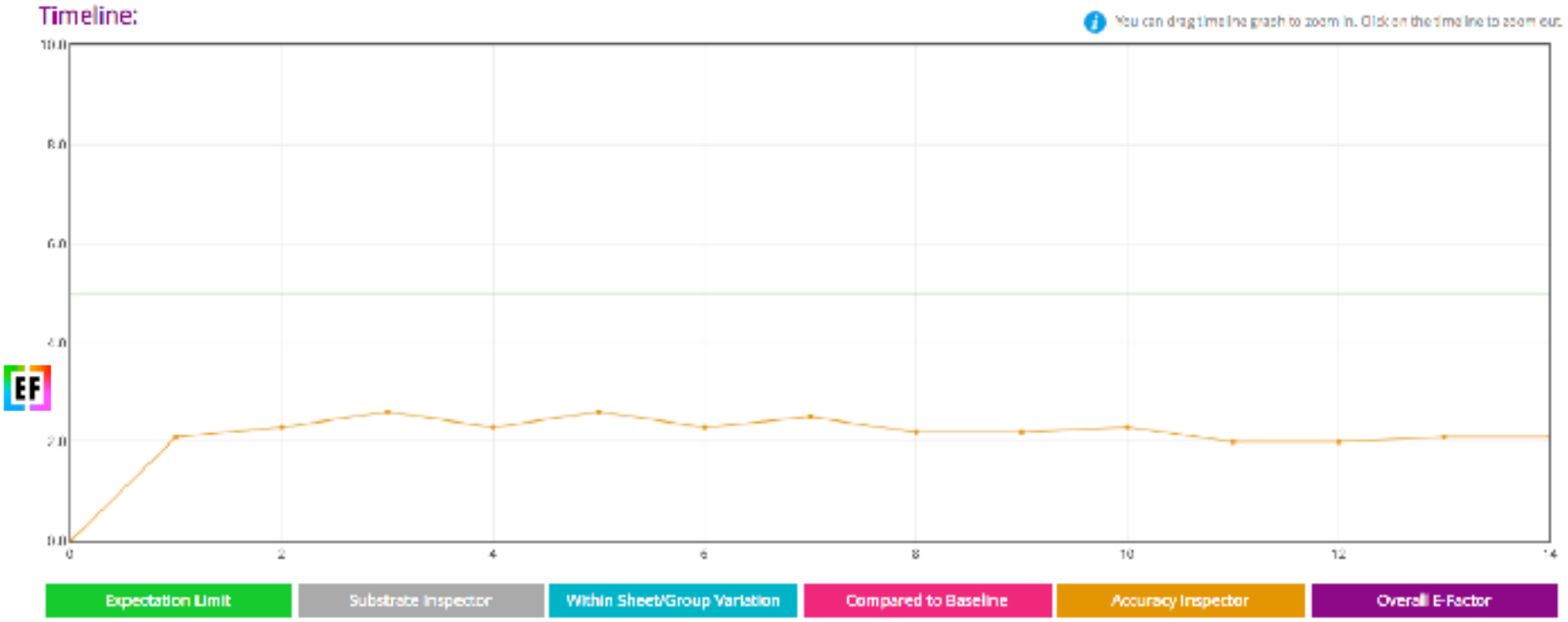
Sample Result #2b: Within Job

- Printer A: 1000 Page Run EF =3.2



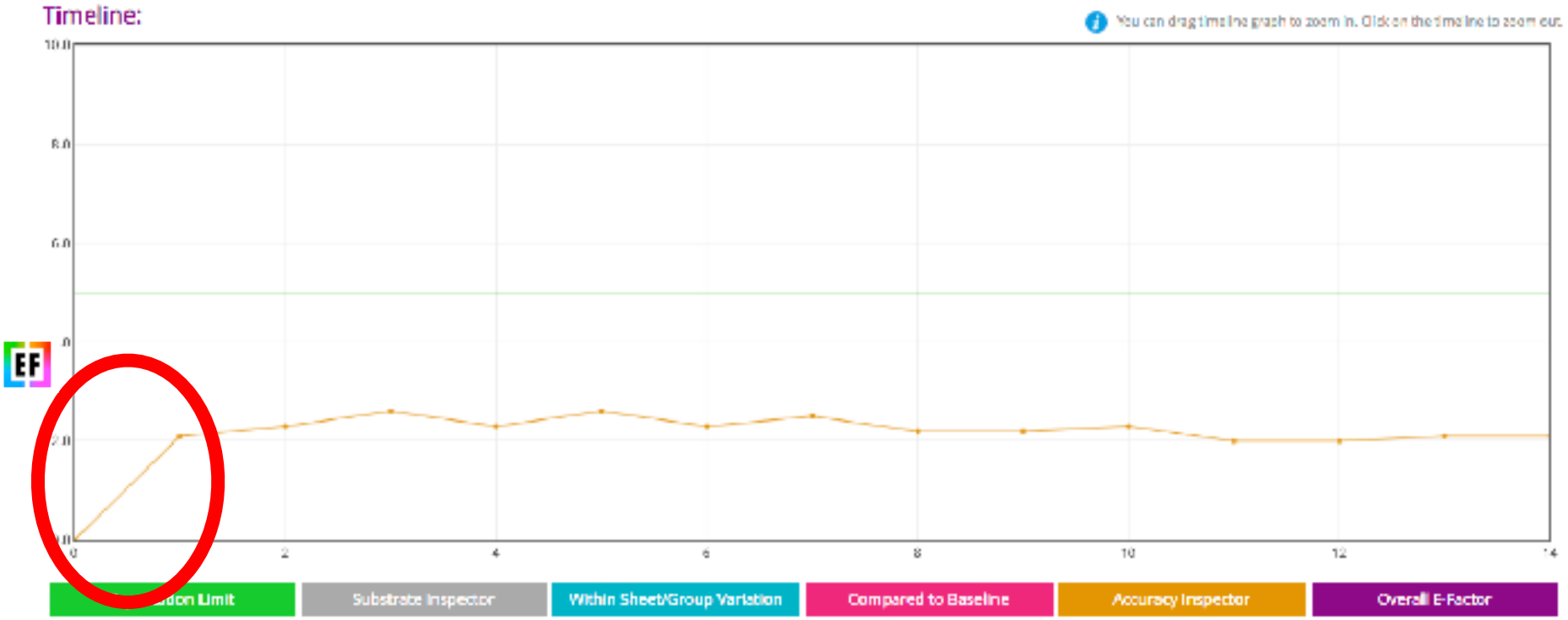
Sample Result #2b: Within Job

- Printer Anny: 1000 page run, every 50 sheets
- E-Factor (CRF 95%): Compared to first sheet



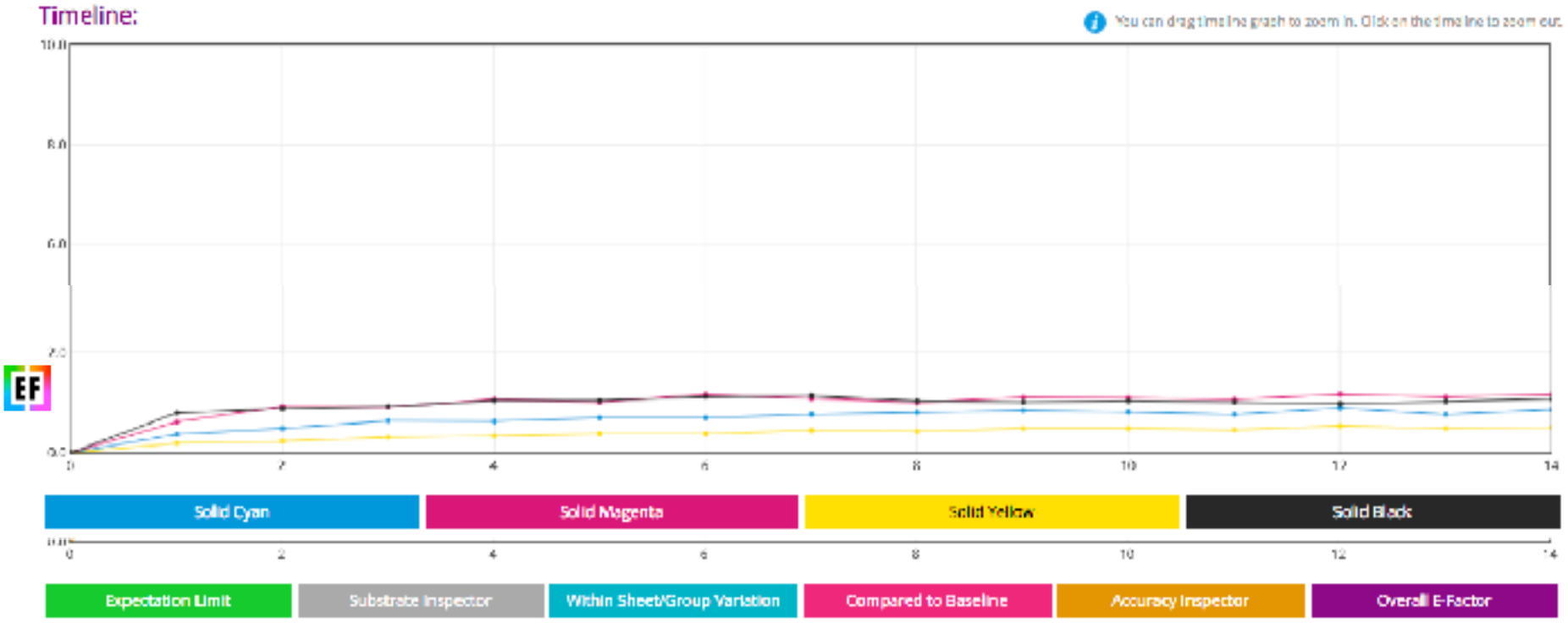
Sample Result #2b: Within Job

- Printer Anny: 1000 page run, every 50 sheets
- E-Factor (CRF 95%): Compared to first sheet?



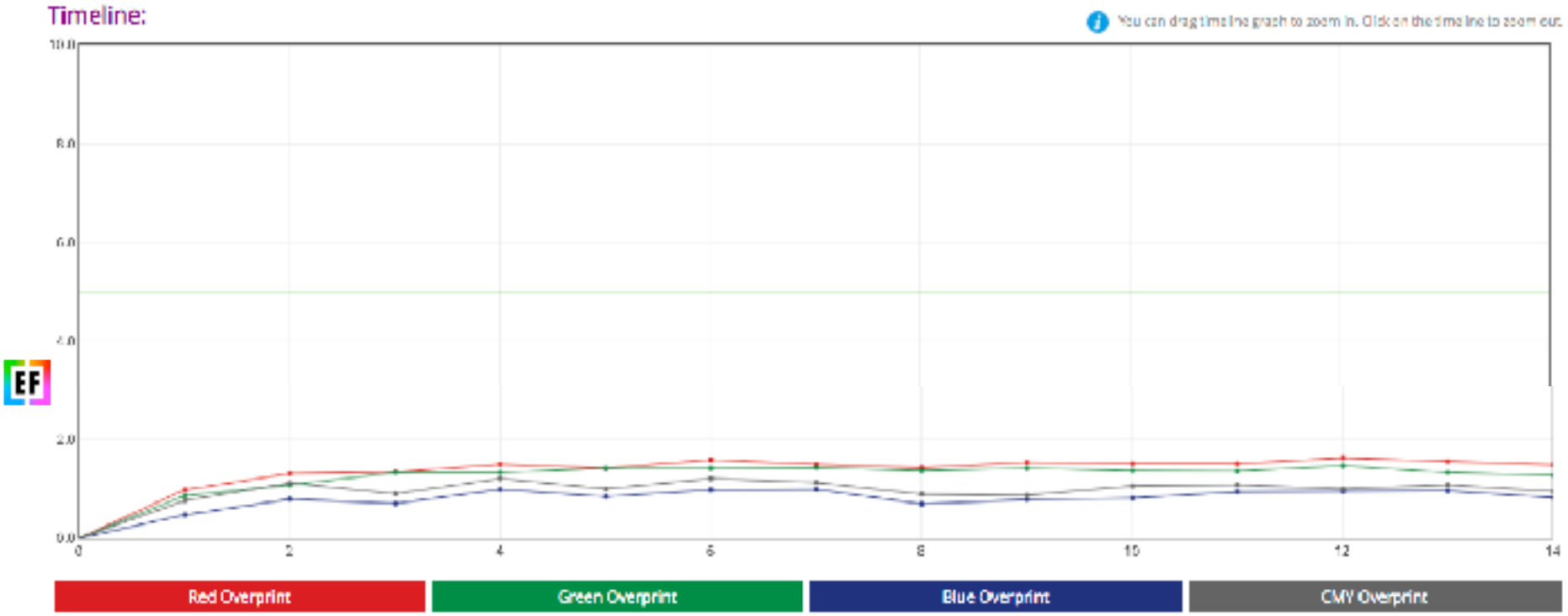
Sample Result #2b: Repeatability

- Printer Anny: 1000 page run, every 50 sheets
- CMYK Solids, Compared to first sheet



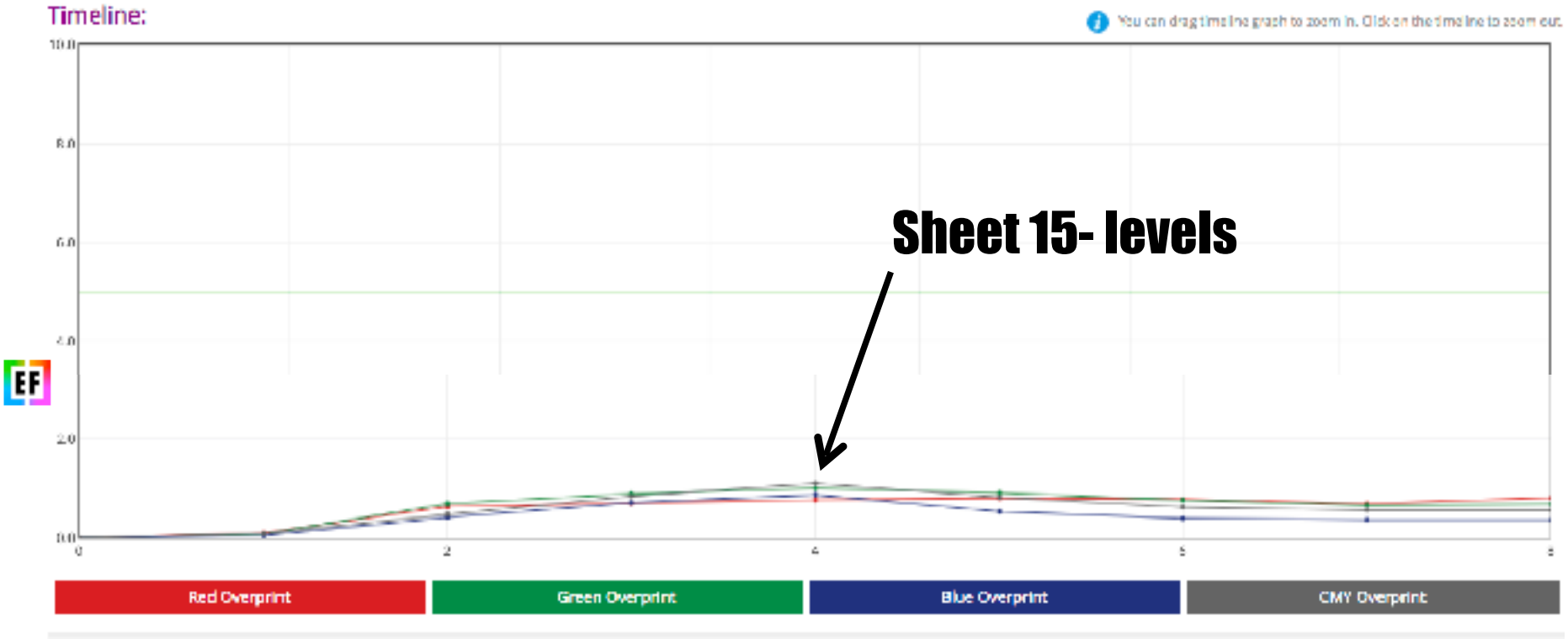
Sample Result #2b: Repeatability

- Printer Anny: 1000 page run, every 50 sheets
- RGB Overprints, Compared to first sheet



Sample Result #2b: Repeatability

- Printer Anny: First 50 sheets (every 5)
- RGB Overprints, Compared to first sheet



Sample Result #2b: Repeatability

- Printer Anny: 1000 page run, every 50 sheets
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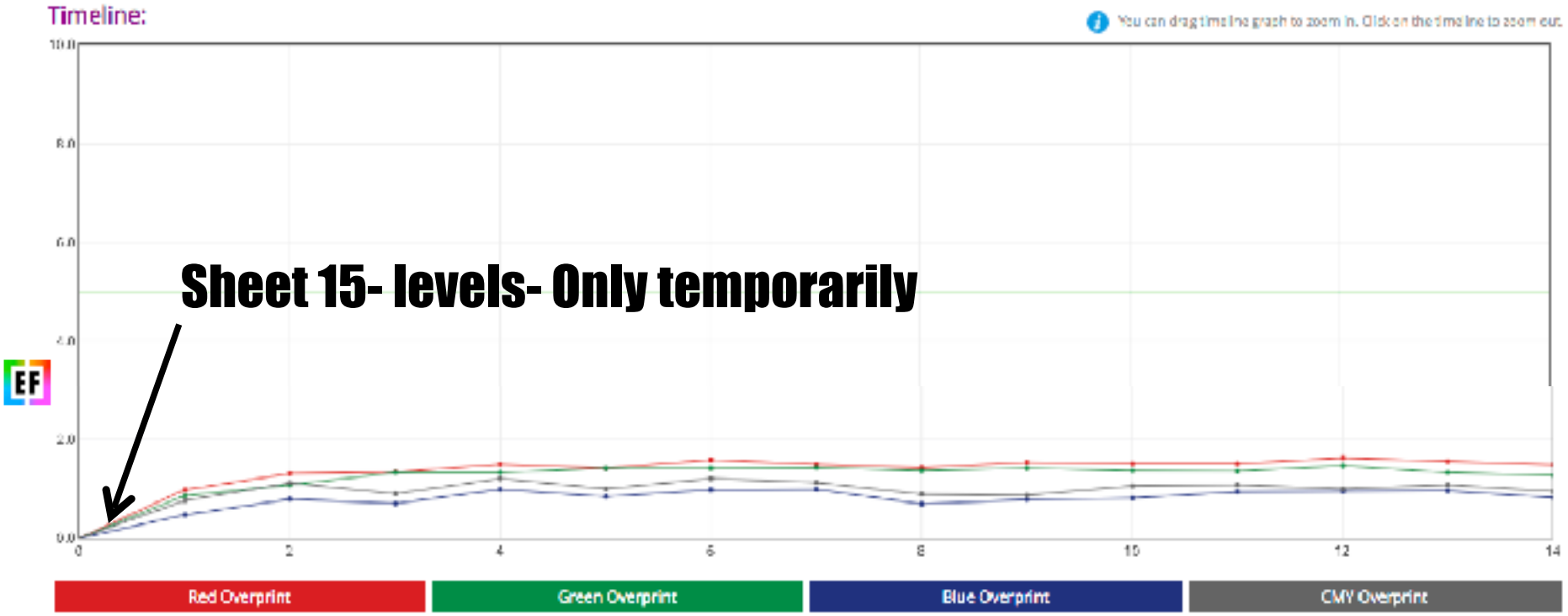

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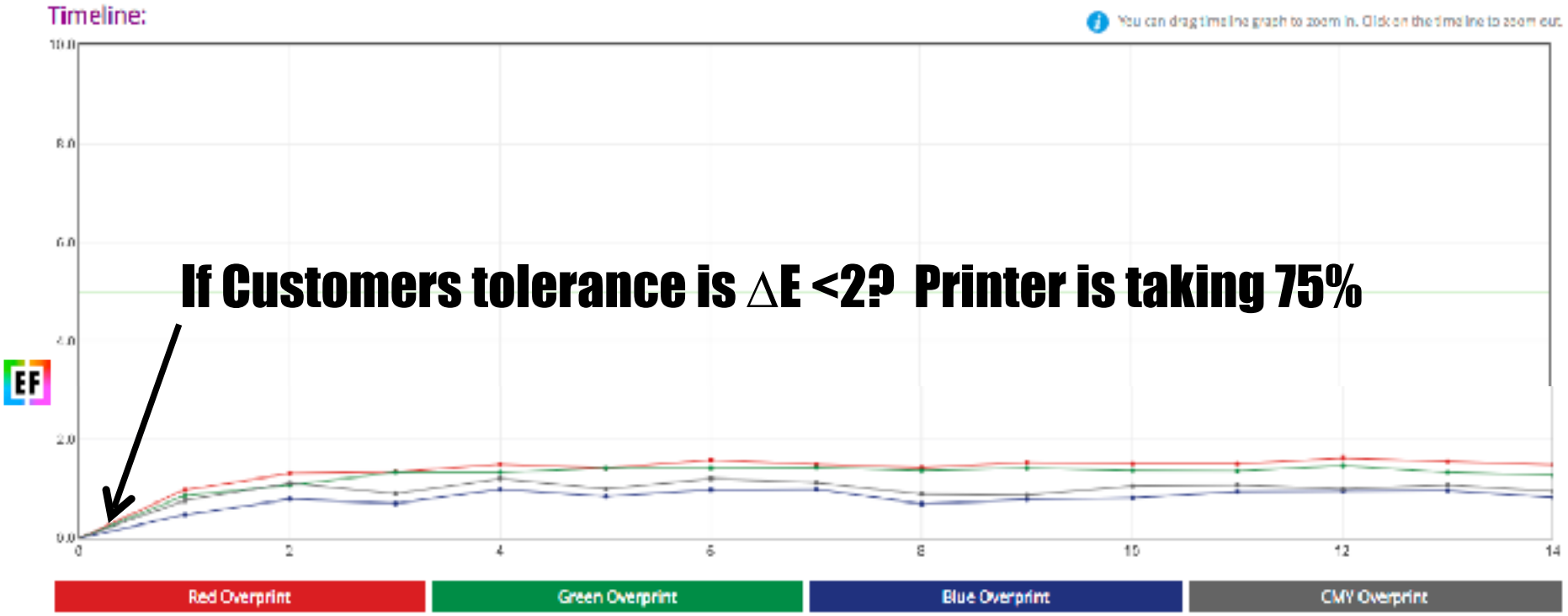


M-Score Target: Another Within Page

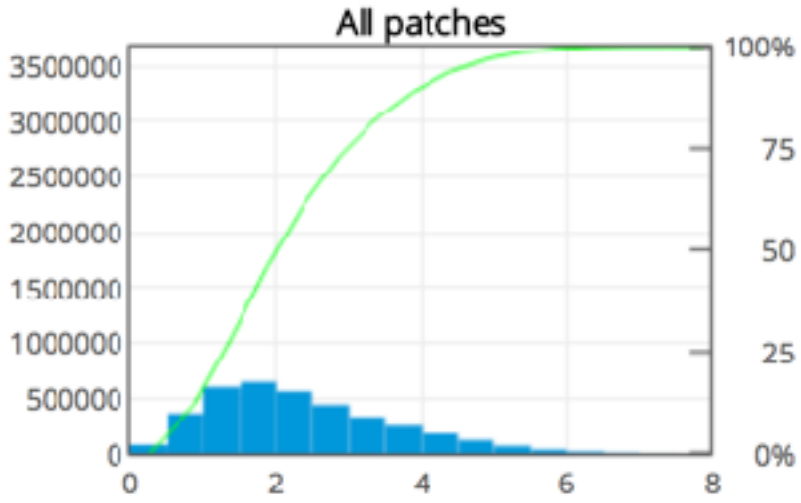
- 3 Targets: Thousand of Same Patch, 20, 40, 65
- Formula to Calculate M-Score: 49

M-Score Target: Another Within Page

- Calculate E-Factor of all patches: 4.7

ΔE variation

All patches



EF

Color	# pairs	Max. ΔE_{00}	Avg. ΔE_{00}	Std. dev. ΔE_{00}	95% ΔE_{00}
All patches	3681541	7.70	2.34	.23	4.69

Benchmark #2 Variation: Results

Printer	With/in		Between		E-Factor M
Indigo 12000*	1.0	P	1.0	P	1.1
Domino press	1.0	P	1.0	P	1.1
Fuji J-Press*	1.2	P	1.1	P	1.1
KM1 Press*	1.3	P	2.0	P	1.6
Kodak Nexpress*	1.2	P	1.8	F	2.9
Konica Minolta KM1	1.4	P	1.2	F	1.1
Digital Press O	2.3	F	3.2	F	2.2
Igen 6 Press*	2.5	P	2.2	P	2.8
Kodak Prosper	3.0	F	1.4	F	3.6
Digital Press N	5.1	F	5.5	F	4.7
Indigo 6600 *	.9	P	Incomplete		3.0
Indigo 6000 *	1.8	F			

Four Benchmarks Conducted

- Gamut Size
  - *ISO Formula calculation, and Percent of PMS w/in 2 ΔE*
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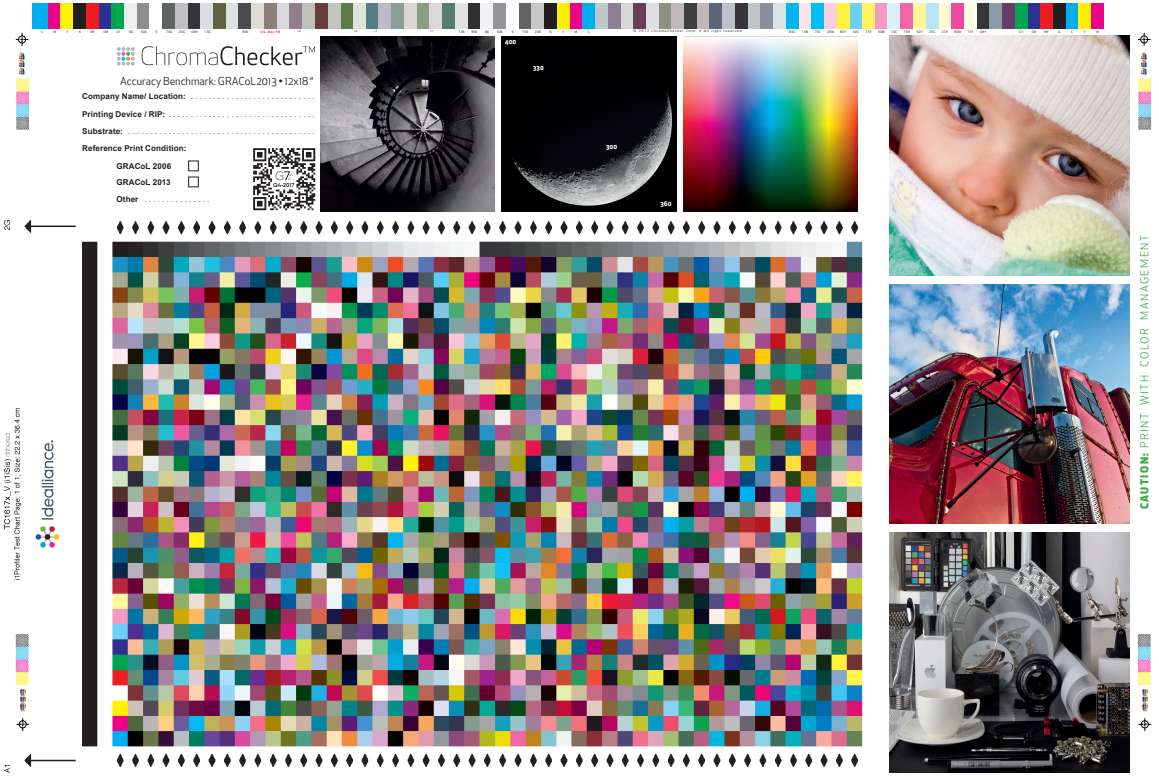
  - *How Close Match to GRACoL and G7 Color Space*
  - *Dependent on Operator Knowledge- Workflow Caution*
- Resolution
  - *Spatial Frequency Response, Visual*

Device Accuracy Benchmark #3

Two Main Calculations- Print with CMS

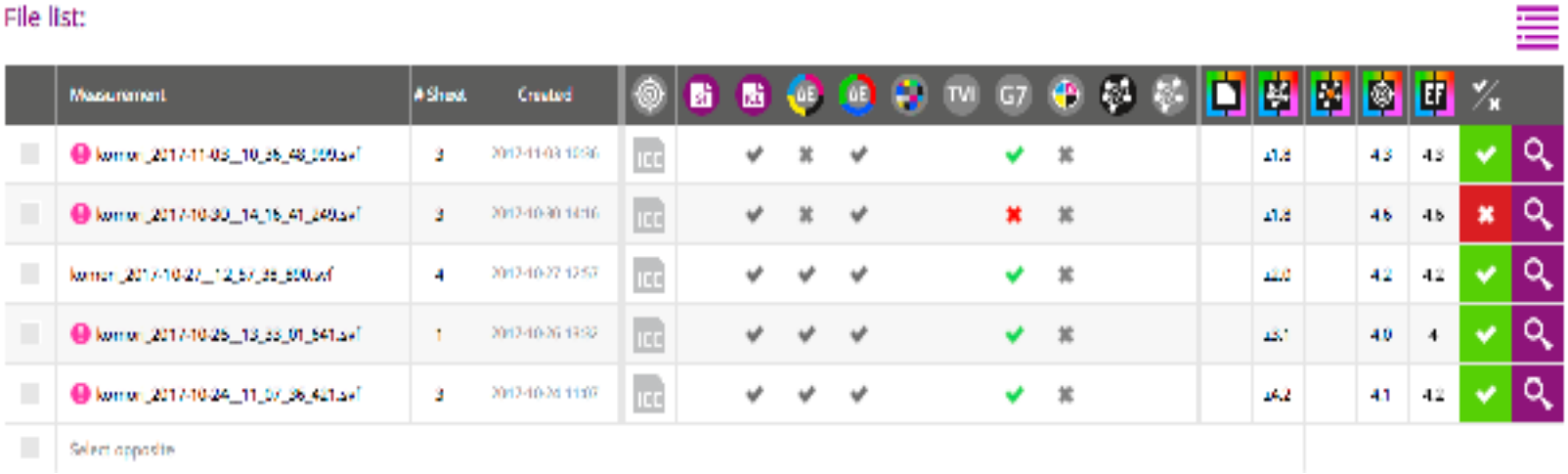
- E-Factor- How Close to GRACoL (lower better)
- Pass/Fail G7 Color Space Conformance



Why E-Factor and G7 Calculations

Just Because G7- Not necessarily Sellable

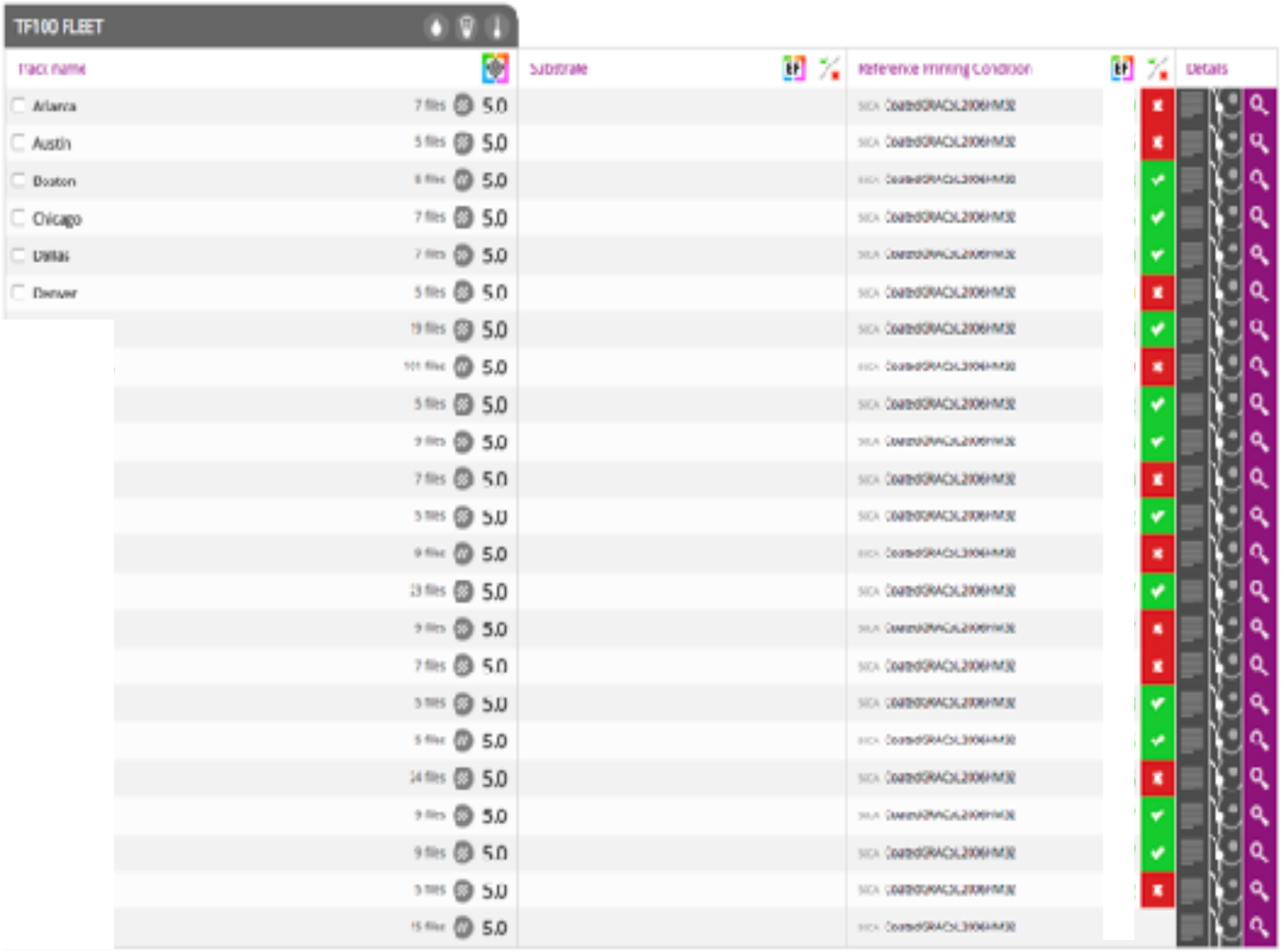
Not G7 doesn't mean not Sellable



- *Does that mean the failed one is not sellable?*
- *Visual Appearance is consistent*

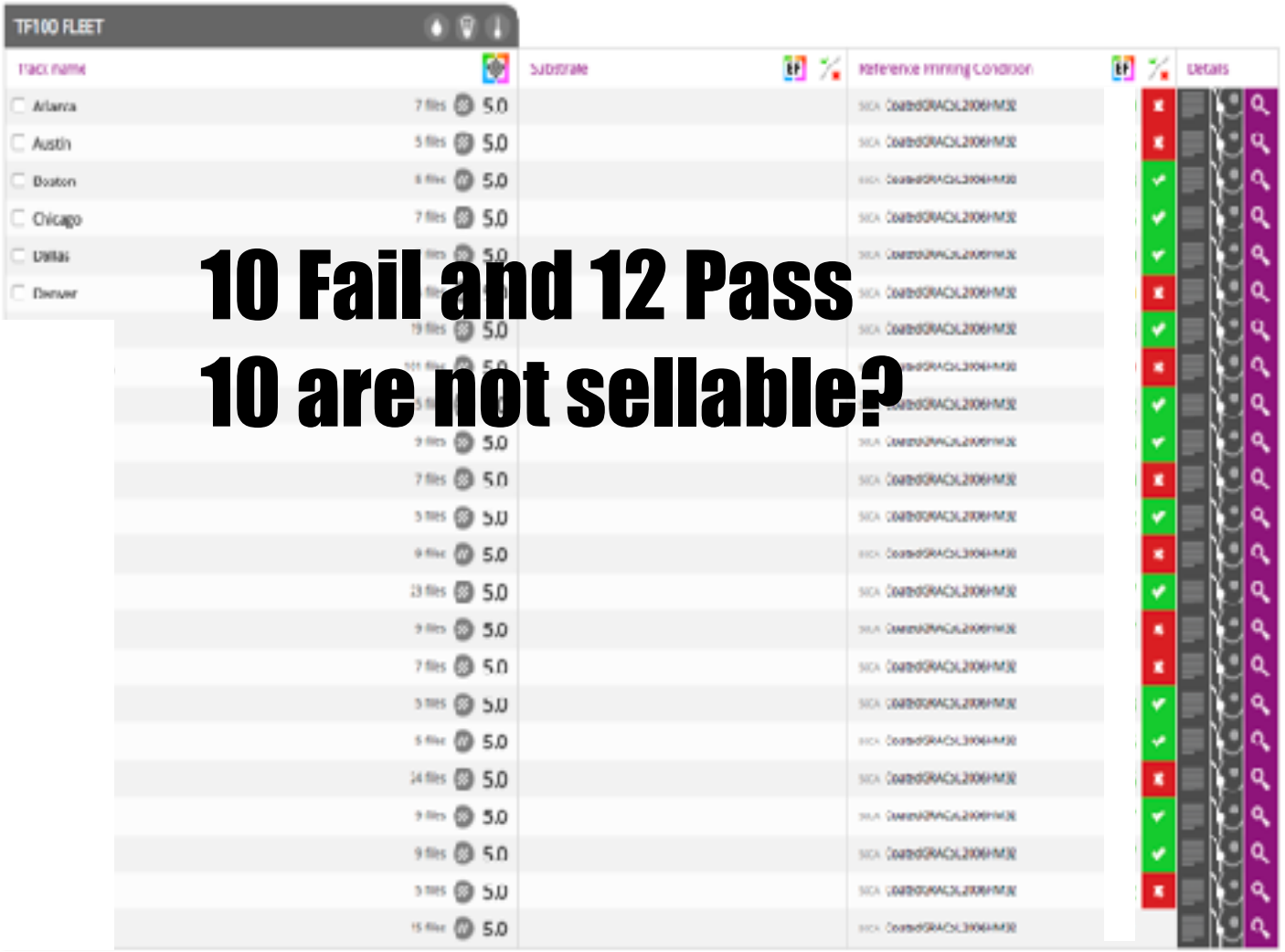
Real World Scenario #2:

Multiple devices- Multiple Cities- G7



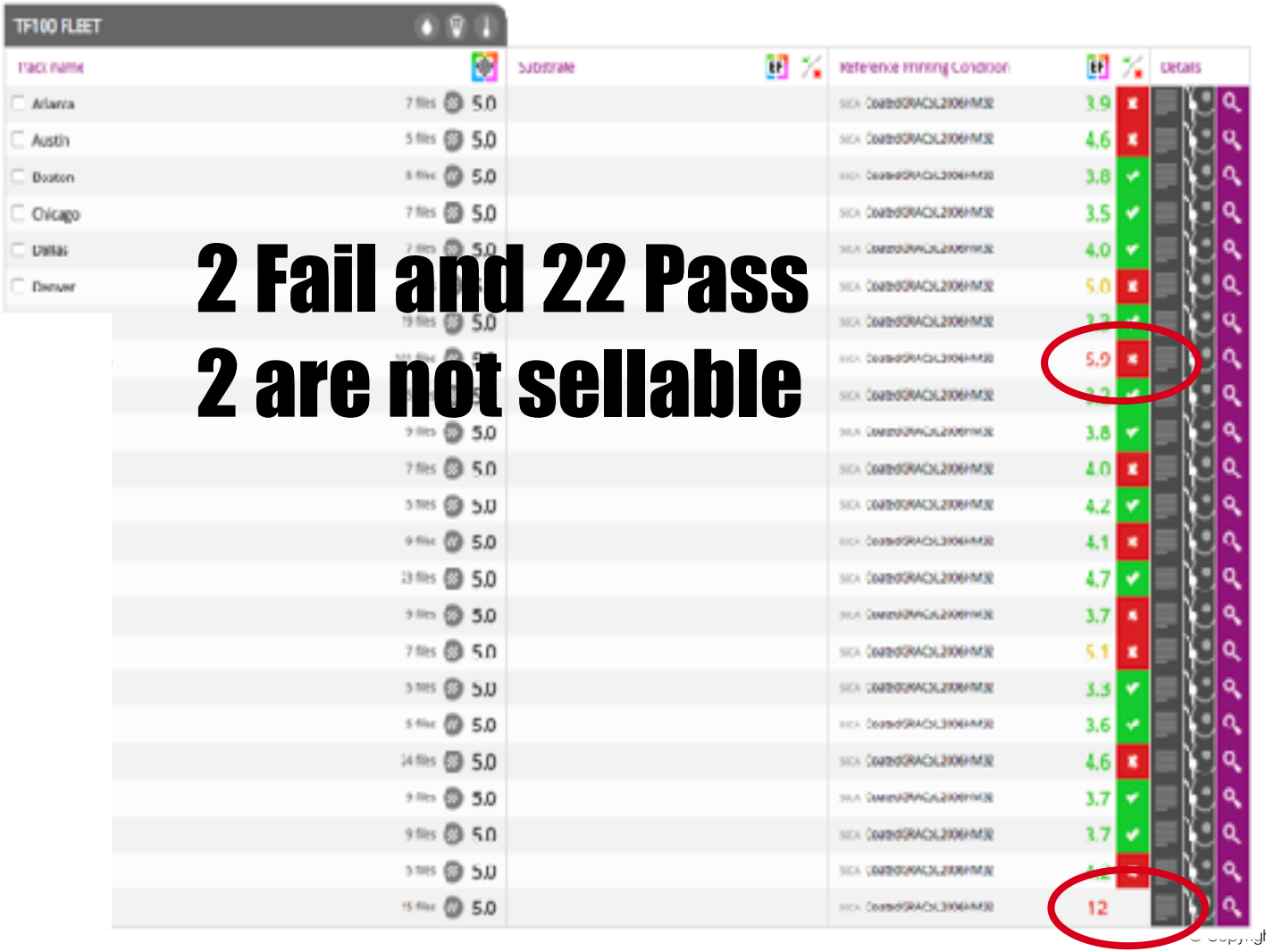
Real World Scenario #2:

Multiple devices- Multiple Cities- G7



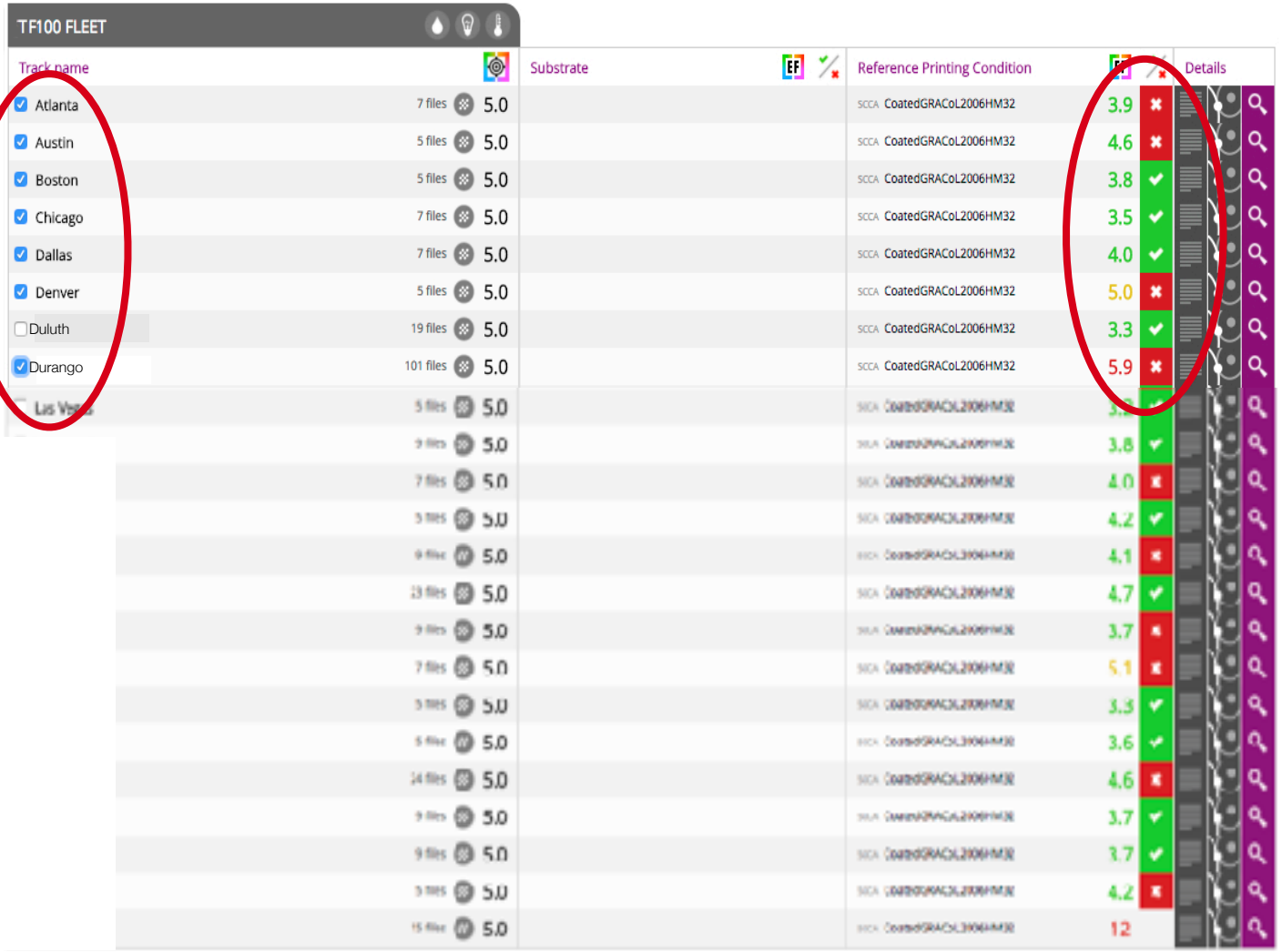
Real World Situation:

Multiple devices- Multiple Cities-

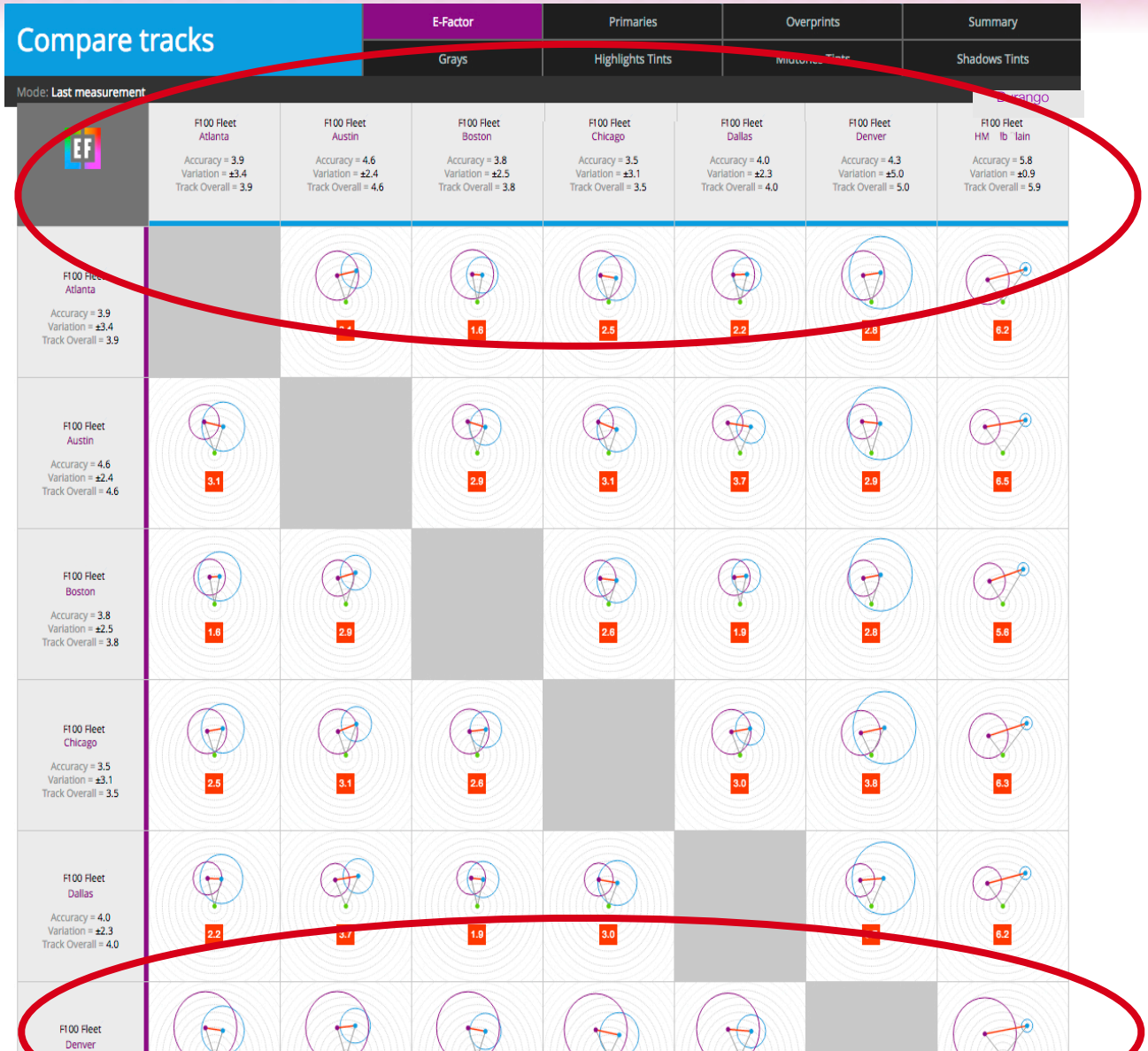


Real World Situation:

Compare Multiple devices- To

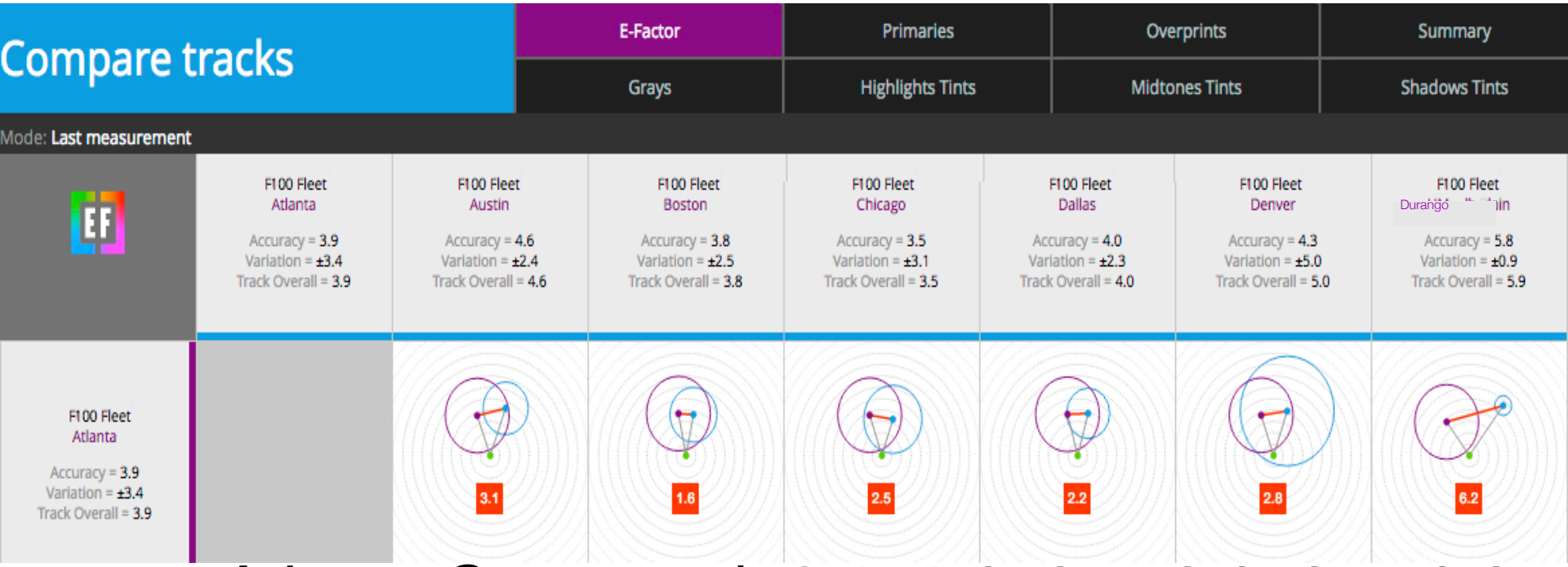


Goal: Match Color Between Plants



Compare Devices to Each Other

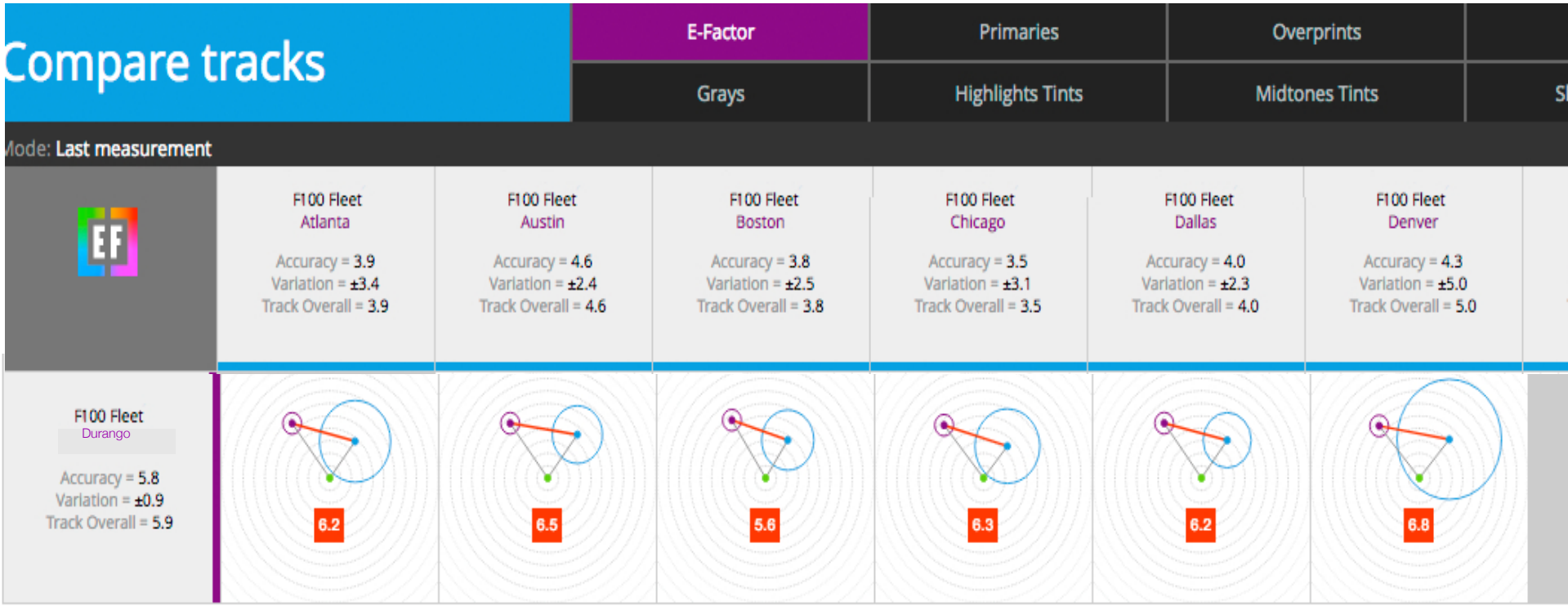
How Close Do They Match One Another



- *Atlanta Compared- 3.1, 1.6, 2.5, 2.2, 2.5, 6.2*
- *Durango: 6.2 is the problem, confirm- different*

Compare “Like” Devices Each Other

How Close Do They Match One Another



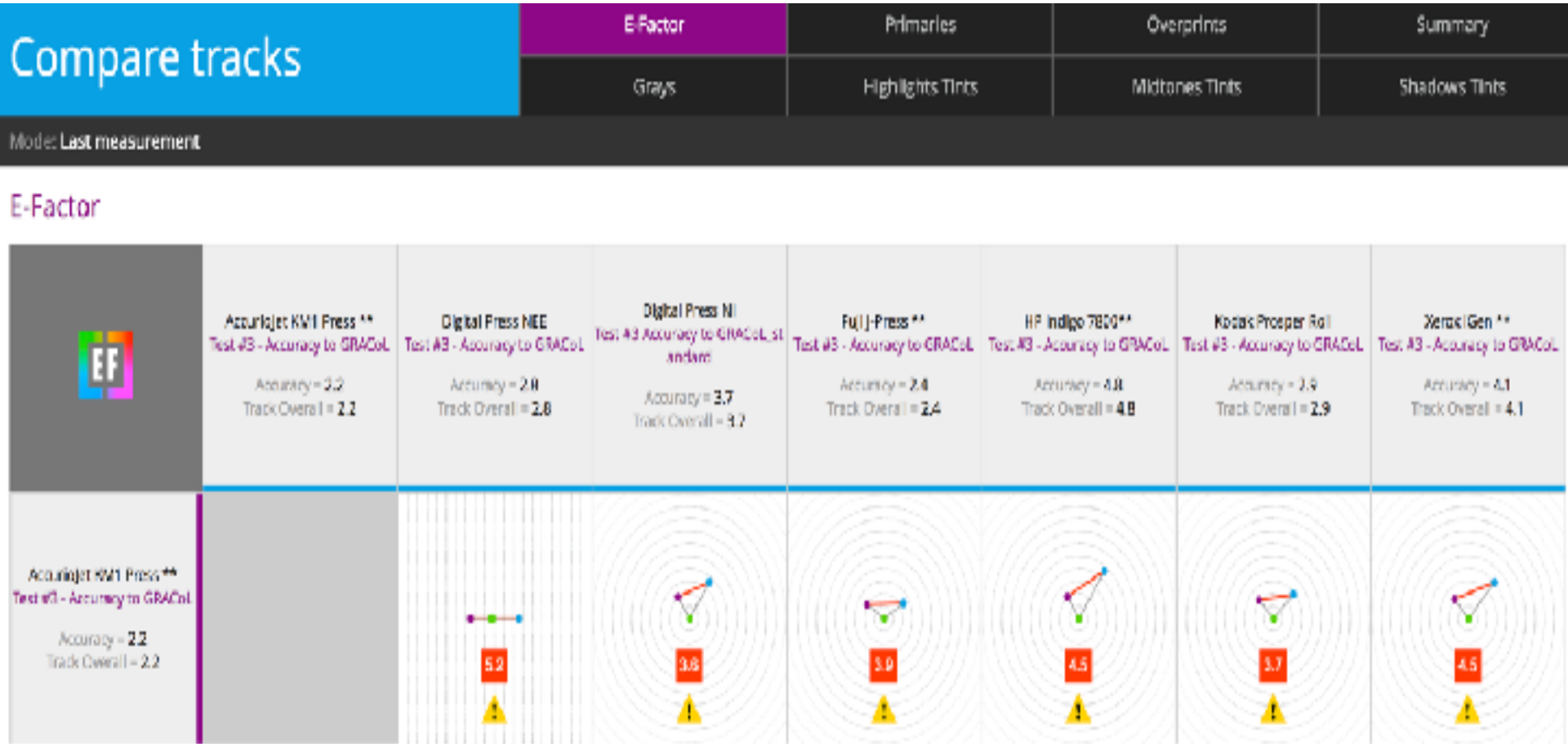
- *Durango Compared- 6.2, 6.5, 5.6, 6.3, 6.2, 6.8*

Benchmark #3 Accuracy: Results

Printer	CRF Gracol	G7 ColorSpace
Konica Minolta KM1	2.0	P
KM1 Press**	2.2	P
Fuji J-Press**	2.4	P
Indigo 12000**	2.8	P
Domino	2.8	P
Kodak Prosper	2.9	P
Digital Press NI	3.7	P
Igen 6 Press**	4.1	P
Digital Press O	4.9	F
Kodak Nexpress**	6.8	F

Device to Device Color Conformance

How close are G7 CS devices to one another?



Four Benchmarks Conducted

- Gamut Size
  - *ISO Formula calculation, and Percent of PMS w/in 2 ΔE*
- Variation (Precision) Benchmarks
  - *Within Page Uniformity, VI 816 Target and M-Score*
  - *Repeatability- 1000 page press run for digital*
  - *Reproducibility: Consistency over days, weeks*
- Accuracy
  - *How Close Match to GRACoL and G7 Color Space*
  - *Dependent on Operator Knowledge- Caution*
- Resolution
  - *Spatial Frequency Response, Visual*

Methods Judging Resolution

1. Visualize Graphics

- Judge clarity of lines, Look for over spray
- Judge clarity of text at different sizes

1. Measure Resolution

- Spatial Frequency Response- SFR
- Method to calculate resolution, Measurement device

Contrast / Resolution Target

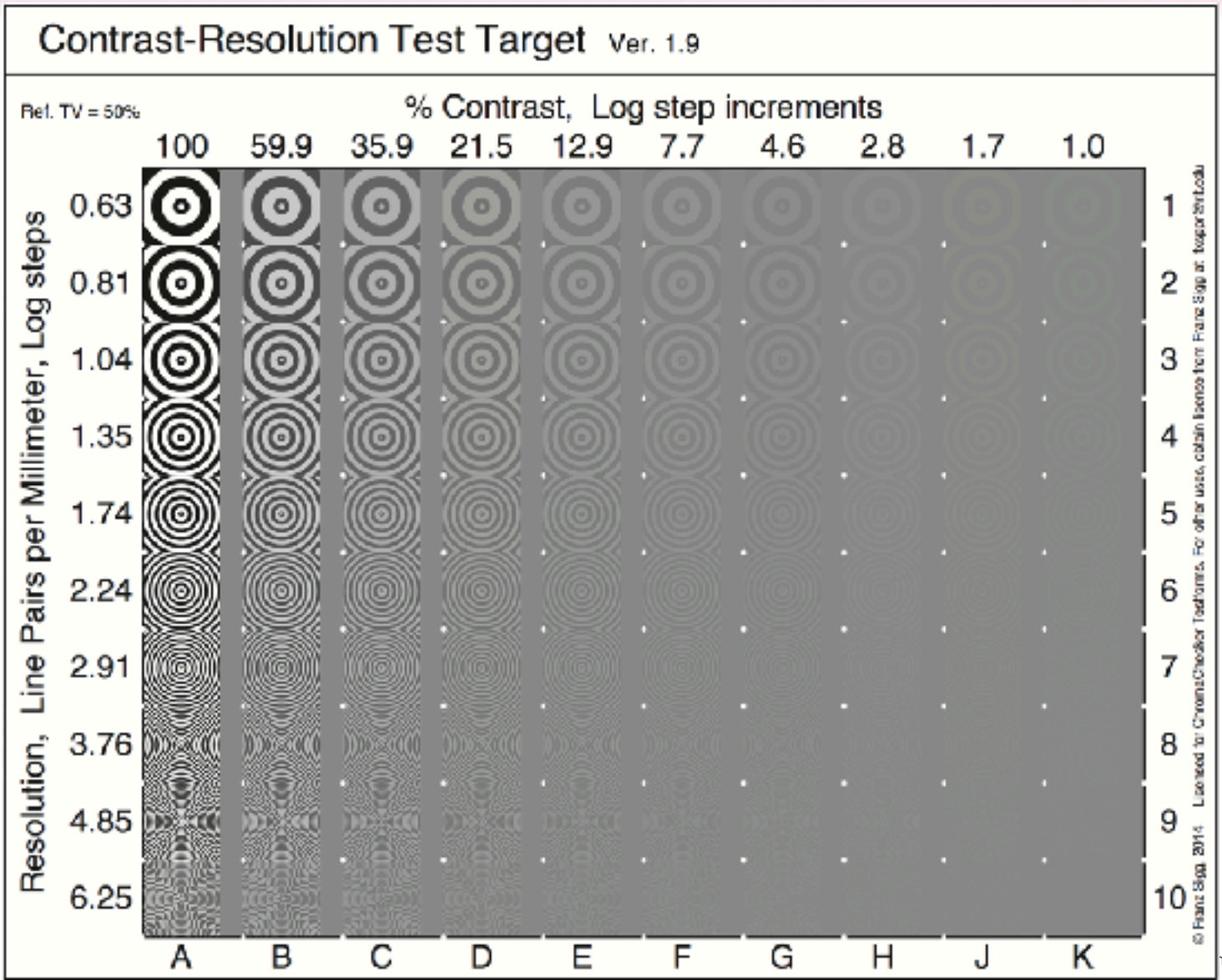


Image Target on output devices

Visualize from normal viewing distance

- Judge clarity of lines
- Look for over spray
- Judge clarity of text at different sizes
- Look where the circles blend
- Great way to compare multiple devices and see the differences
- Vendors all calculate these values differently

Image Target on output devices

These two printer advertise same resolution

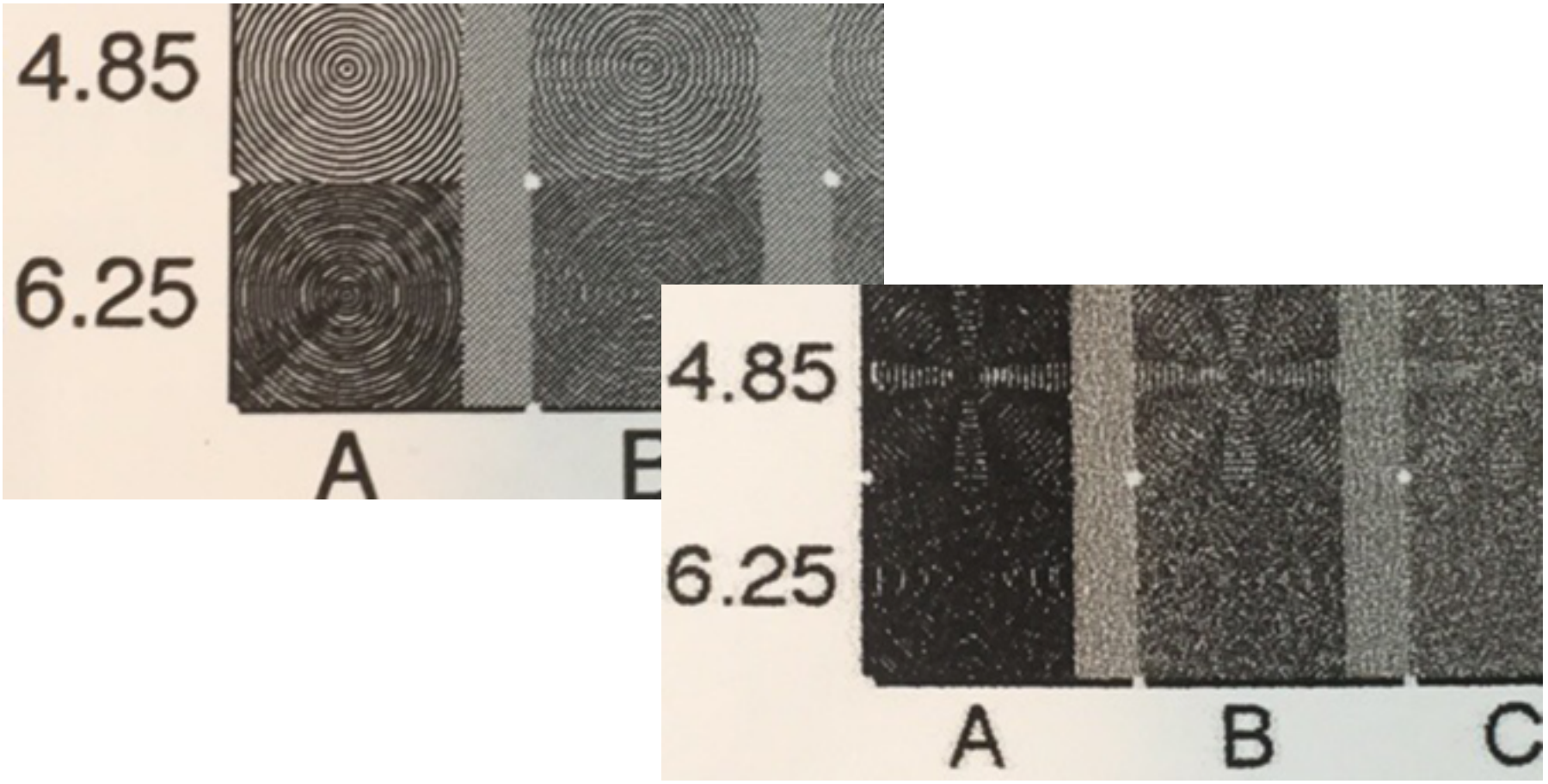
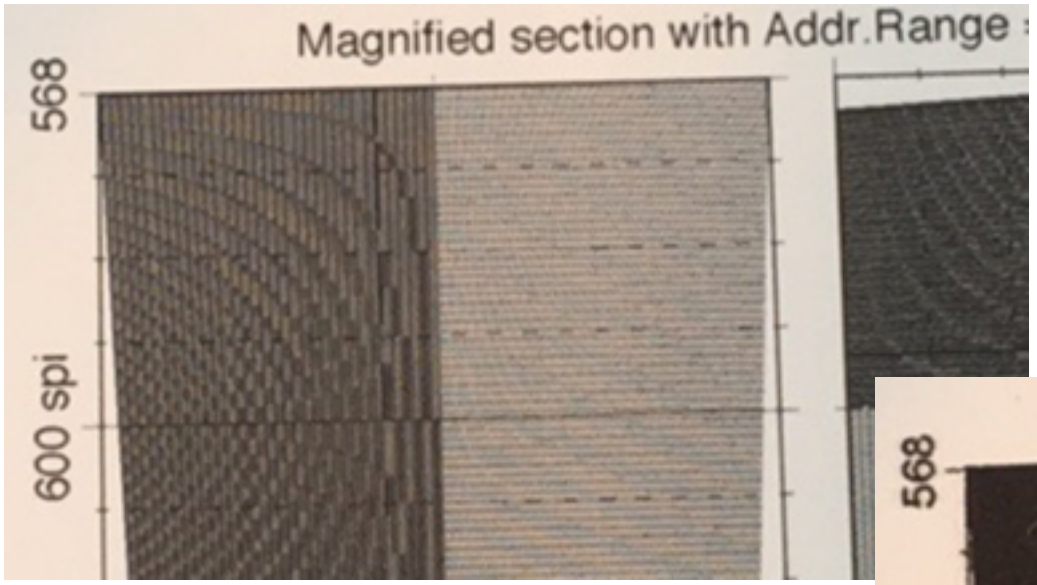
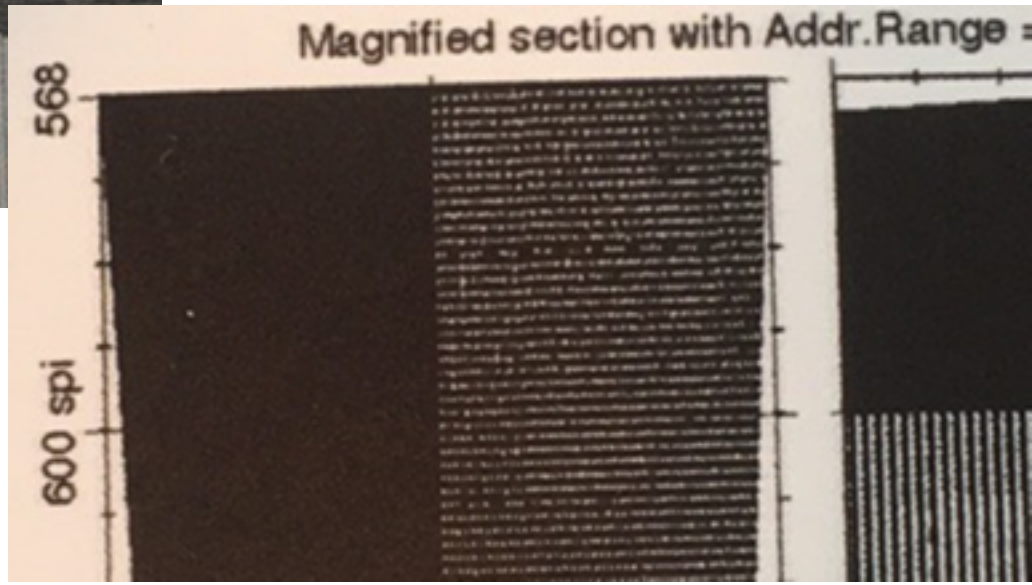


Image Target on output devices

These two printer advertise same resolution





Quantifying Resolution w/ Instrument

Many Ways to Judge Resolution/Contrast

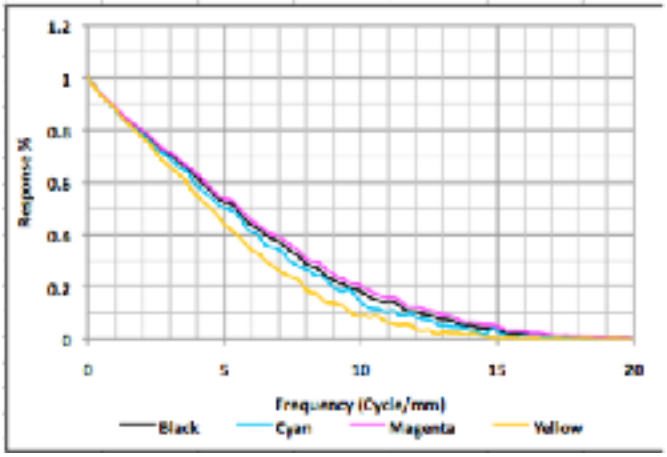
- Spatial Frequency Response
  - *Calculated Value base on Measurement Device*
- Vertical Lines/Horizontal Lines
  - *Same Size Lines*
- High Light Dots
  - *RIP Settings for Large Format devices*

Spatial Frequency Response

- Metric to attempt to define “smoothness”
- Start with devices that everyone knows:

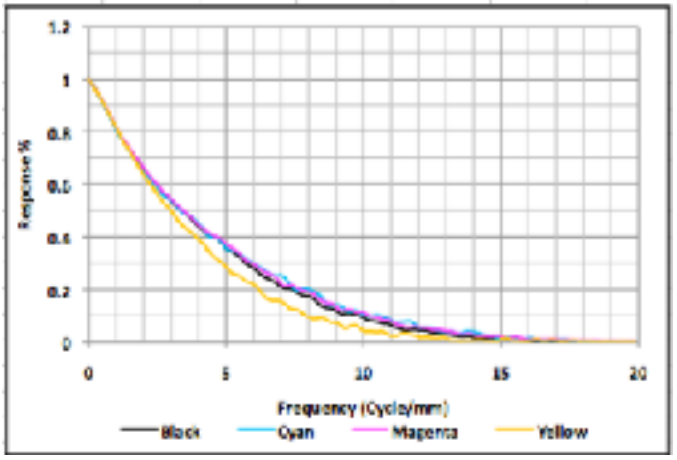
HB Offset

SFR Summ	Frequency, F [cy/pix]		Response (%)
MTF50	5.405	0.126	50
MTF30	7.903	0.184	30
MTFx	12.131	0.282	10
RNyq	43.065	1	3.691
RNyq50	21.532	0.5	0.236
Rx	1	0.023	88.759
SQF	87.975		
File			
Directory			
Color	K (Refl)		
DensStd	Status T		
Illuminant	D65		
Observer	10°		



Epson Proofer

SFR Summ	Frequency, F [cy/pix]		Response (%)
MTF50	3.358	0.079	50
MTF30	5.608	0.132	30
MTFx	9.822	0.228	10
RNyq	43.065	1	8.549
RNyq50	21.532	0.5	0.119
Rx	1	0.023	81.242
SQF	81.896		
File			
Directory			
Color	K (Refl)		
DensStd	Status T		
Illuminant	D65		
Observer	10°		

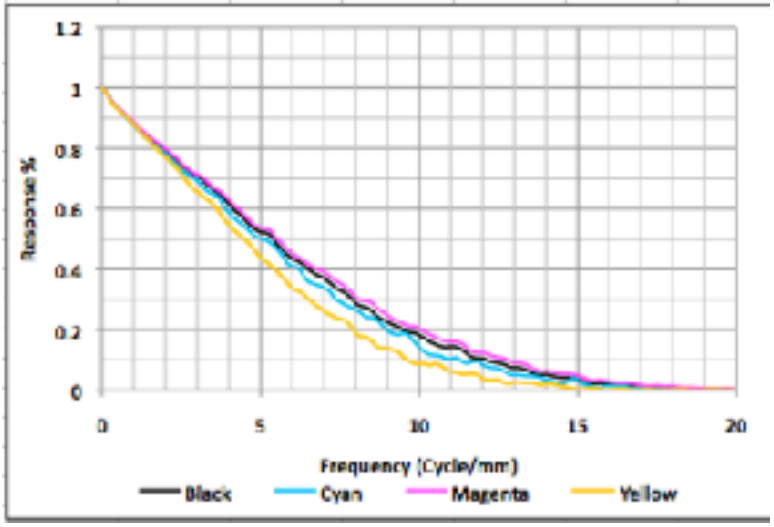


B. Spatial Frequency Response

- Heidelberg Press

HB Offset

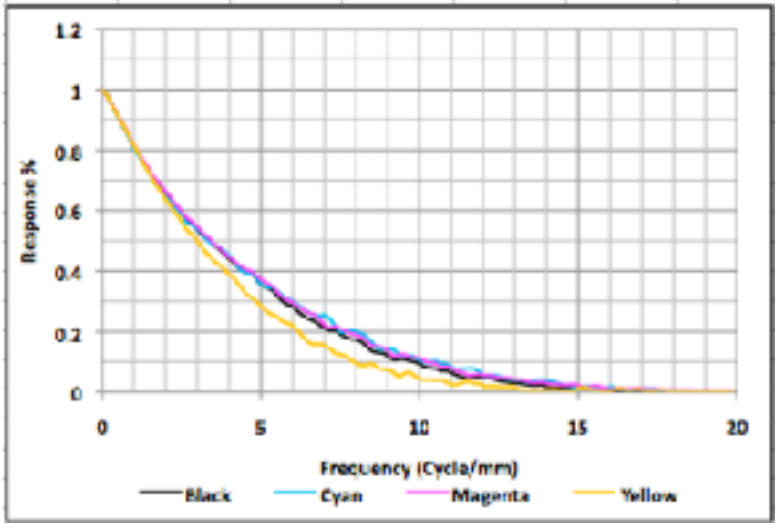
SFR Summa	Frequency	F [cy/pix]	Response (%)
MTF50	5.405	0.125	50
MTF30	7.903	0.184	30
MTFx	12.131	0.282	10
RNyq	43.065	1	5.691
RNyq50	21.532	0.5	0.236
Rx	1	0.023	88.259
SQF	87.975		
File			
Directory			
Color	K (Refl)		
DensStd	Status T		
Illuminant	D65		
Observer	10°		



- Epson Proofer

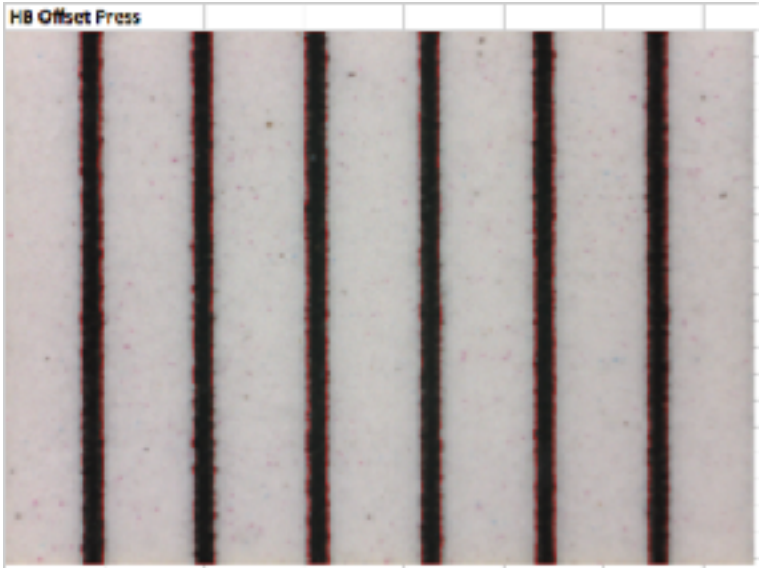
Epson Proofer

SFR Summ	Frequency	F [cy/pix]	Response (%)
MTF50	3.398	0.079	50
MTF30	5.688	0.132	30
MTFx	9.822	0.228	10
RNyq	43.065	1	8.549
RNyq50	21.532	0.5	0.119
Rx	1	0.023	81.242
SQF	81.895		
File			
Directory			
Color	K (Refl)		
DensStd	Status T		
Illuminant	D65		
Observer	10°		

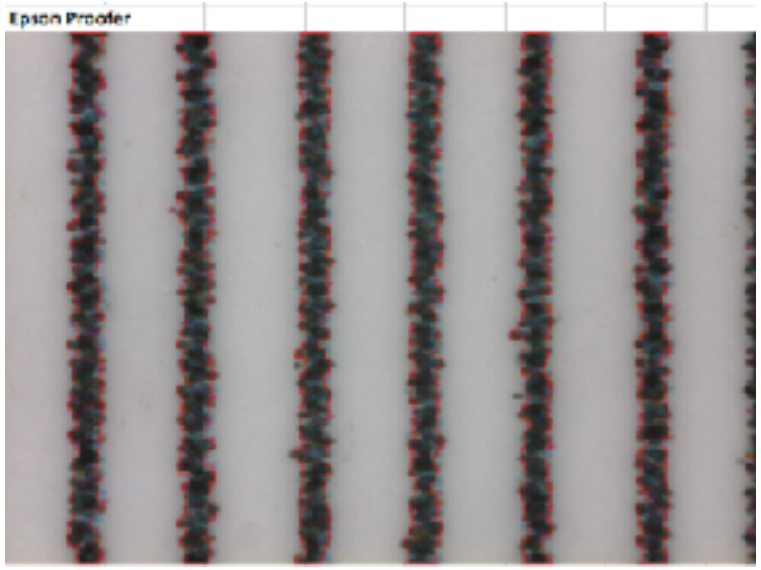


C. Vertical Lines

- Heidelberg Press



Epson Proofer

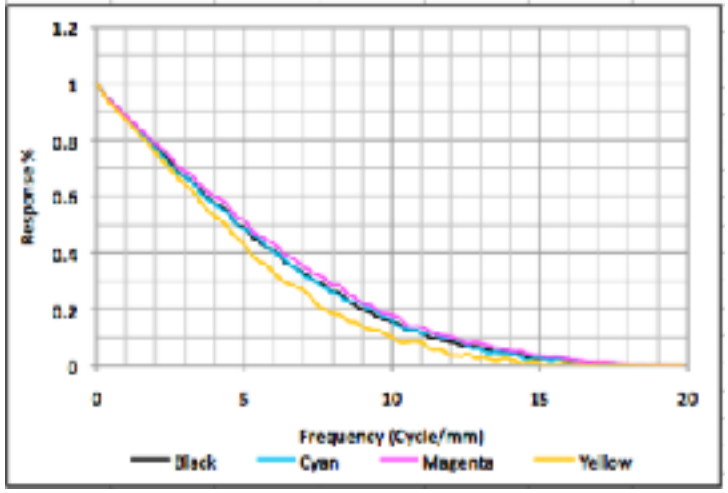


SFR Digital Presses

Comparing Devices Digital Devices

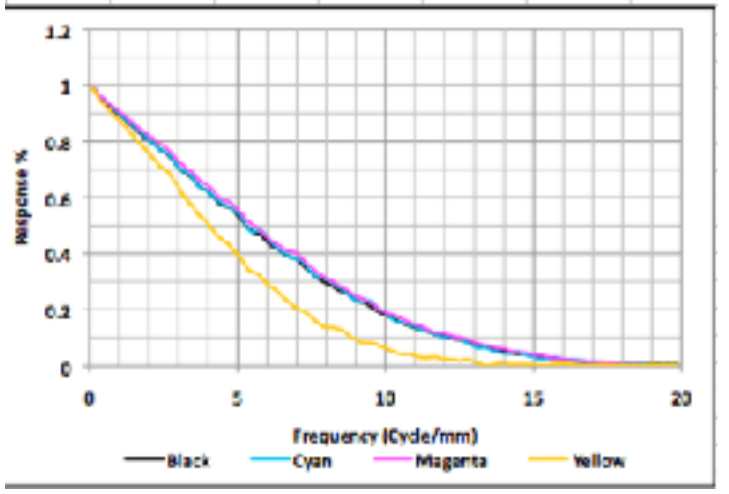
iGen

SFR Summ	Frequency	F [cy/pix]	Response (%)
MTF50	4.798	0.111	50
MTF30	7.43	0.173	30
MTFx	11.291	0.262	10
RNyq	43.065	1	4.483
RNyq50	21.532	0.5	0.236
Rx	1	0.023	87.914
SQF	87.365		
File			
Directory			
Color	K (Refl)		
DensStd	Status T		
Illuminant	D65		
Observer	10°		



KM1

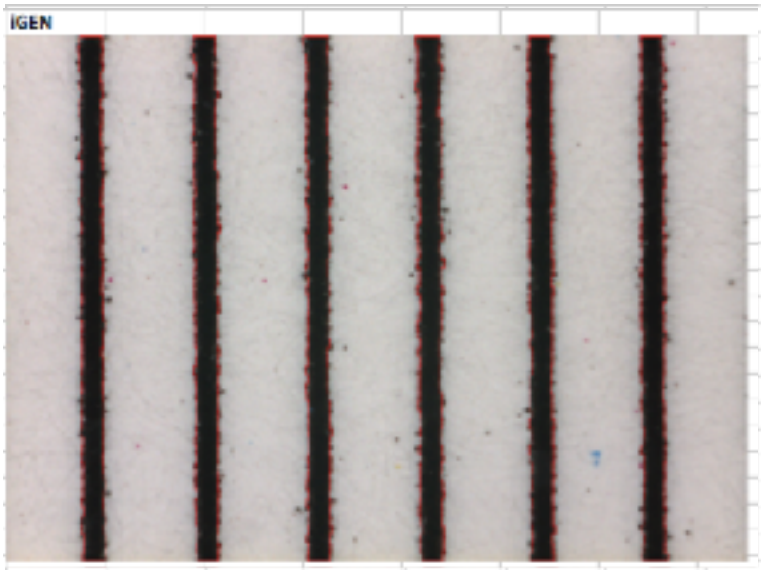
SFR Summ	Frequency	F [cy/pix]	Response (%)
MTF50	5.297	0.123	50
MTF30	7.902	0.183	30
MTFx	12.164	0.282	10
RNyq	43.065	1	8.014
RNyq50	21.532	0.5	0.251
Rx	1	0.023	88.54
SQF	88.952		
File			
Directory			
Color	K (Refl)		
DensStd	Status T		
Illuminant	D65		
Observer	10°		

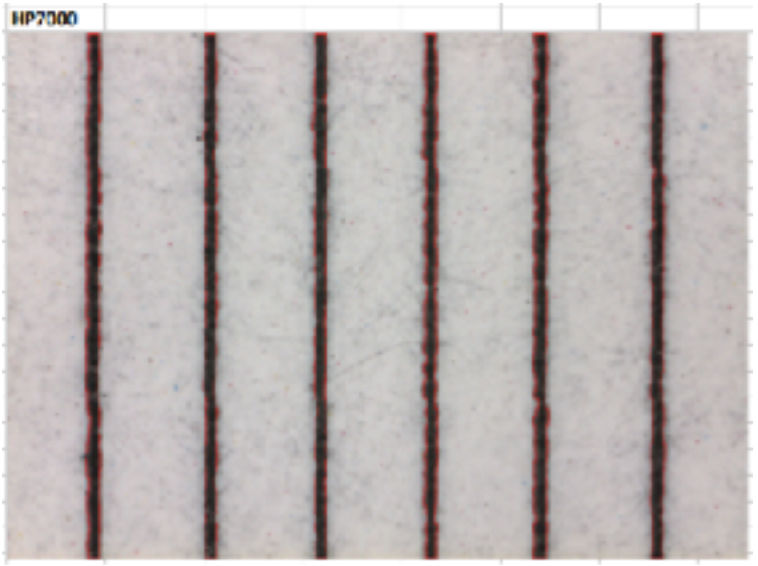


C. Vertical Lines

- iGEN

Indigo



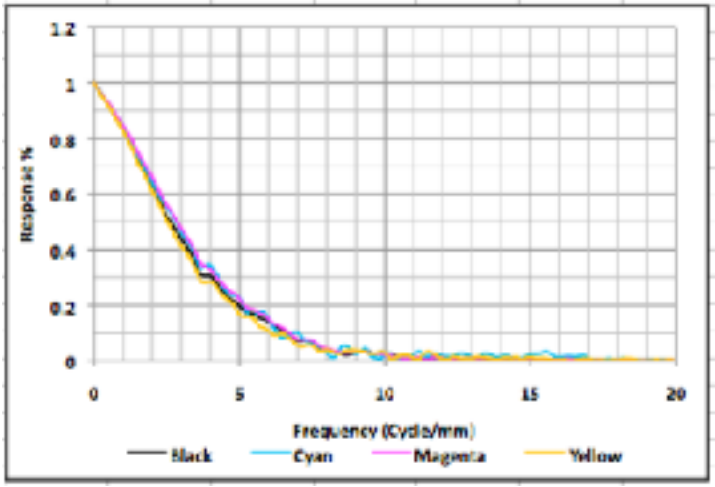


SFR Large Format Devices

Comparing Devices- Customizable Resolution

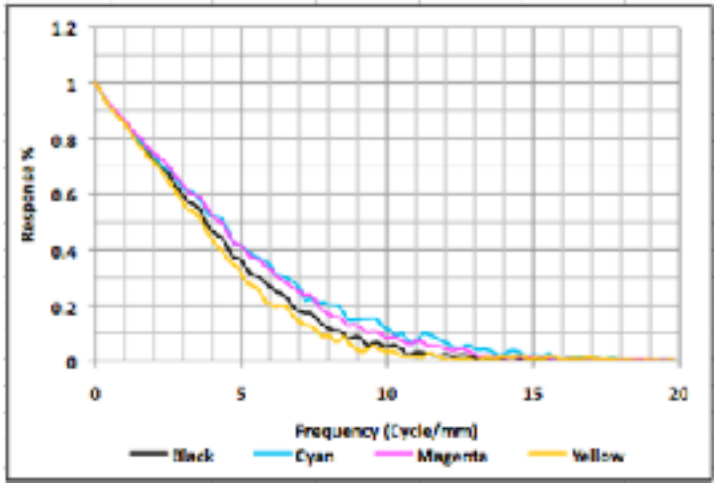
Inca Onset R40

SFR Summa	Frequency	F [cy/pix]	Response (%)
MTF50	2.631	0.061	50
MTF30	4.049	0.094	30
MTFx	6.66	0.155	10
RNyq	43.065	1	24.119
RNyq50	21.532	0.5	0.132
Rx	1	0.023	83.175
SQF	81.052		
File			
Directory			
Color	K (Refl)		
DensStd	Status T		
Illuminant	D65		
Observer	10°		



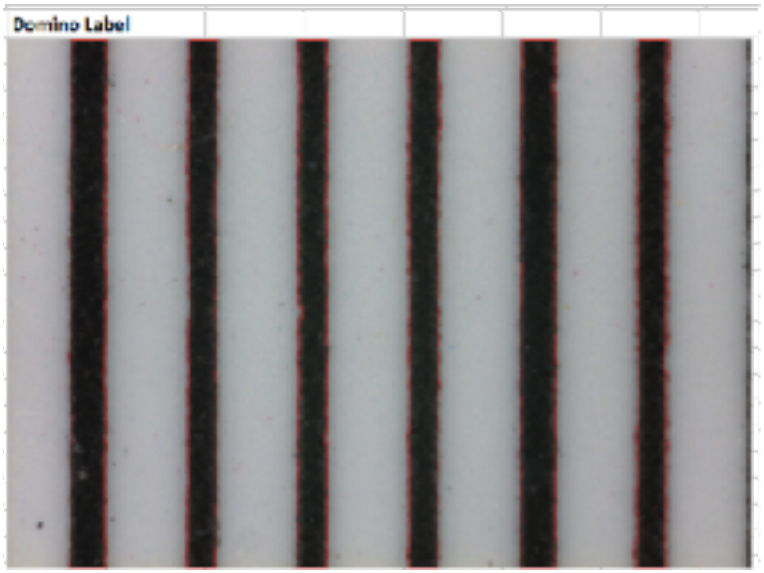
INCA Kurt

SFR Summa	Frequency	F [cy/pix]	Response (%)
MTF50	3.789	0.088	50
MTF30	5.624	0.131	30
MTFx	8.453	0.197	10
RNyq	43.065	1	5.143
RNyq50	21.532	0.5	0.118
Rx	1	0.023	85.871
SQF	84.58		
File			
Directory			
Color	K (Refl)		
DensStd	Status T		
Illuminant	D65		
Observer	10°		



C. Vertical Lines

- Domino



Inca

Critical- Machine Capabilities

Troubleshooting Requirement

- *Color Gamut: (Range of Color)*
  - Manufacturer, RIP Settings and Substrate
- *Precision: (Consistency to itself)*
  - Calibration and Maintenance (Operator)
- *Accuracy: (How Close to Target Reference, bulls eye)*
  - Prepress, Color Specialist, RIP/Workflow Implementation
- *How Close to Other Color Devices- (Proof to Press)*
  - Substrate, and more accurate, closer to one another
- *By Tracking all- Know where to look to fix problem*

Conclusion: Digital Press Benchmark

Access the Data

- *500,000 Measurements and Counting*
- *Data is to share- Share the Results*
- *Request the Targets to make your Own Benchmarks*
- *Provide Great Visual Tools – educate E-Factor*
  - *Before – After Color Management*
- *Do you want to access this information?*

Contact me, Dave Hunter

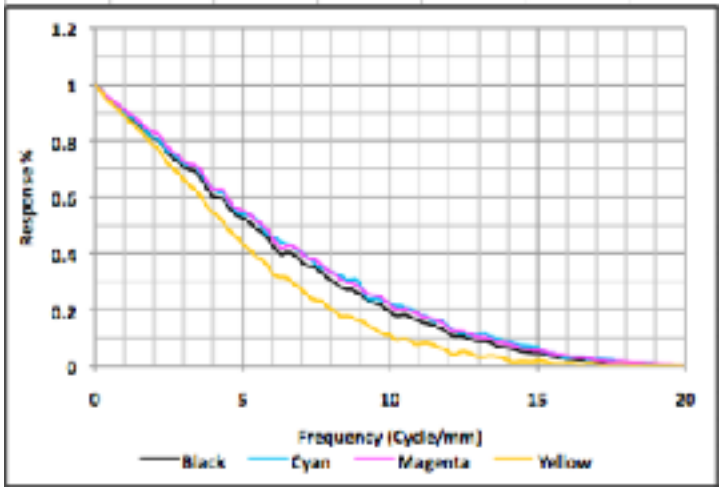
- *david@chromachecker.com*
- *651.717.0590 – Answer any questions for you...*

SFR Digital Presses

Comparing Devices Digital Devices

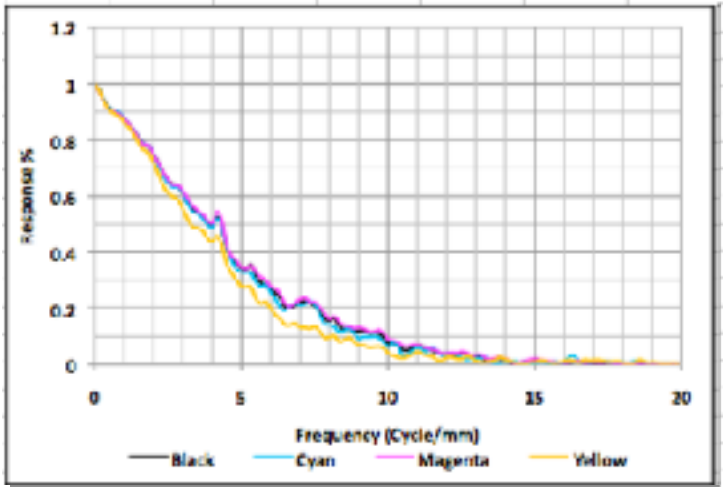
HPIndigo

SFR Summ	Frequency	F [cy/pix]	Response (%)	
MTF50	*5.348*	0.129	50	Fr
MTF30	*8.085*	0.188	30	
MTFx	*12.59*	0.292	10	
RNyq	43.065	1	8.672	
RNyq50	21.532	0.5	0.244	
Rx	1	0.023	89.832	
SQF	89.116			
File				
Directory				
Color	K (Refl)			
DensStd	Status T			
Illuminant	D65			
Observer	10°			



Screen BoC

SFR Summ	Frequency	F [cy/pix]	Response (%)
MTF50	*3.881*	0.09	50
MTF30	*5.617*	0.13	30
MTFx	9.704	0.225	10
RNyq	43.065	1	35.491
RNyq50	21.532	0.5	0.398
Rx	1	0.023	87.483
SQF	85.304		
Tile			
Directory			
Color	K (Refl)		
DensStd	Status T		
Illuminant	D65		
Observer	10°		

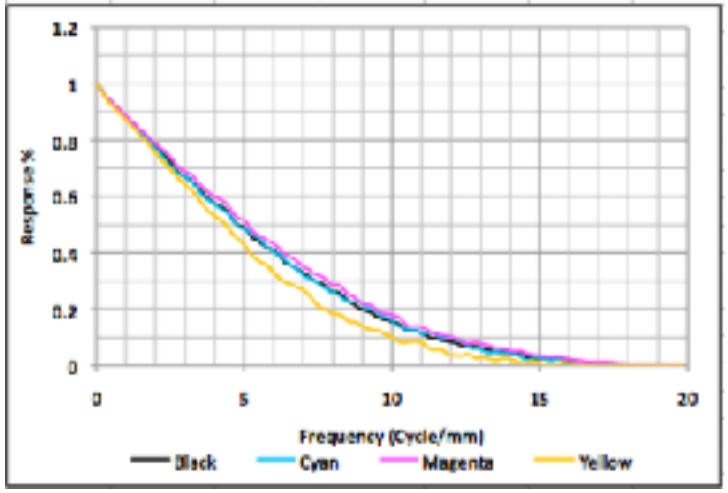


Vertical Lines Digital Presses

Comparing Devices Digital Devices

iGen

SFR Summ	Frequency	F [cy/pix]	Response (%)
MTF50	4.798	0.111	50
MTF30	7.43	0.173	30
MTFx	11.291	0.262	10
RNyq	43.065	1	4.483
RNyq50	21.532	0.5	0.236
Rx	1	0.023	87.914
SQF	87.365		
File			
Directory			
Color	K (Refl)		
DensStd	Status T		
Illuminant	D65		
Observer	10°		



KM1

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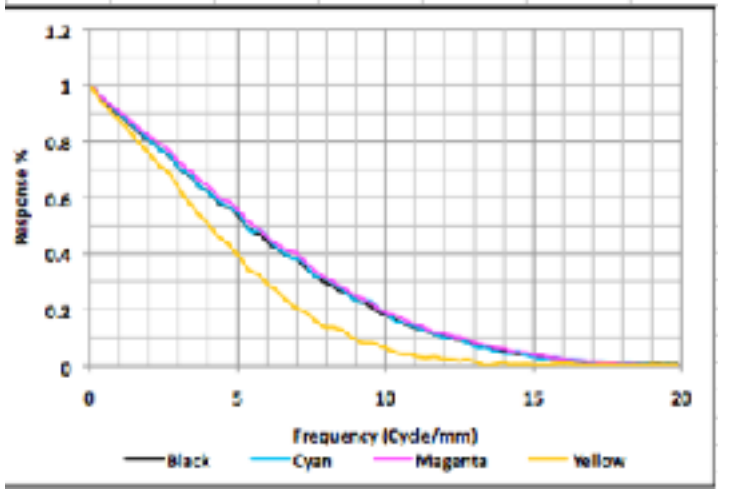
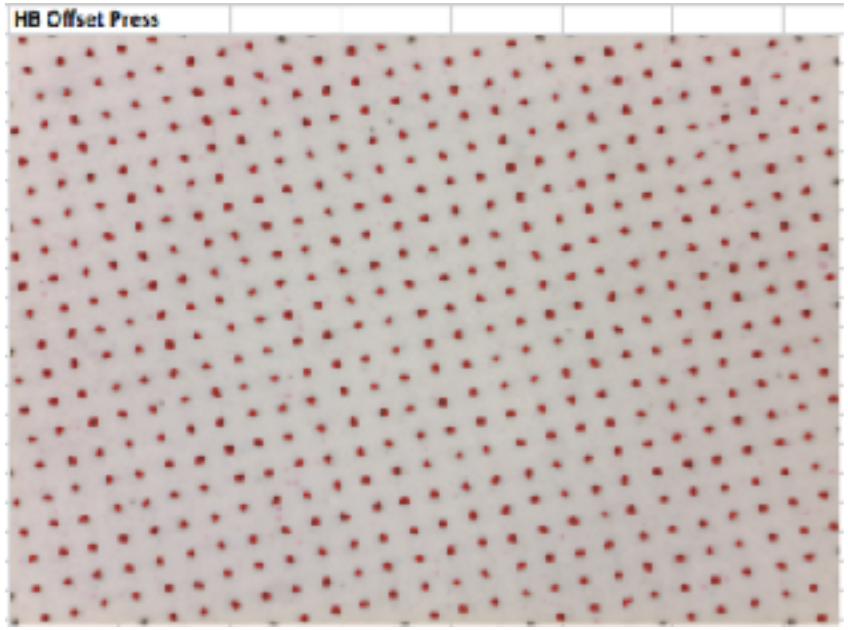
MTF30	7.902	0.183	30
MTFx	12.164	0.282	10
RNyq	43.065	1	8.014
RNyq50	21.532	0.5	0.251
Rx	1	0.023	88.54
SQF	88.952		
File			
Directory			
Color	K (Refl)		
DensStd	Status T		
Illuminant	D65		
Observer	10°		

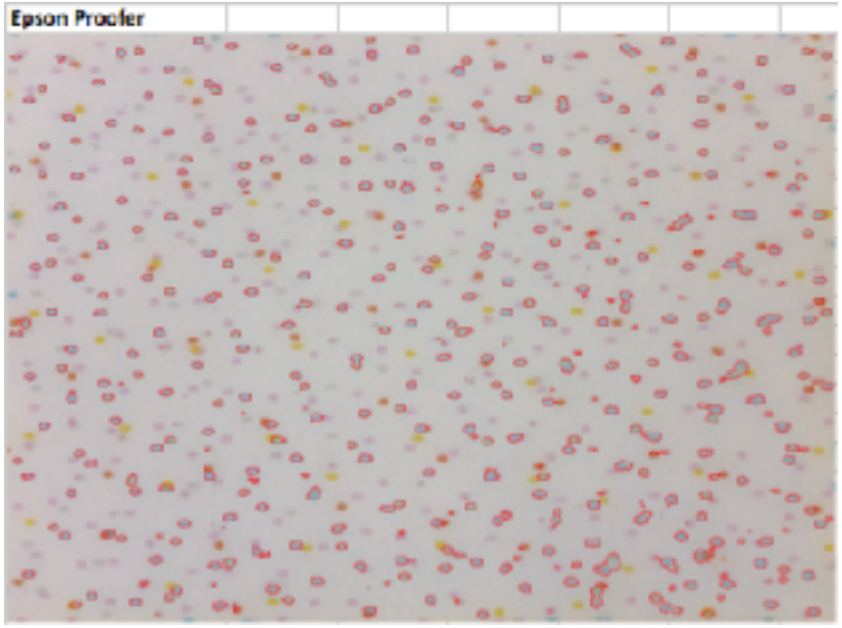


D. Highlight Dots

- Heidelberg Press



Epson Proofer



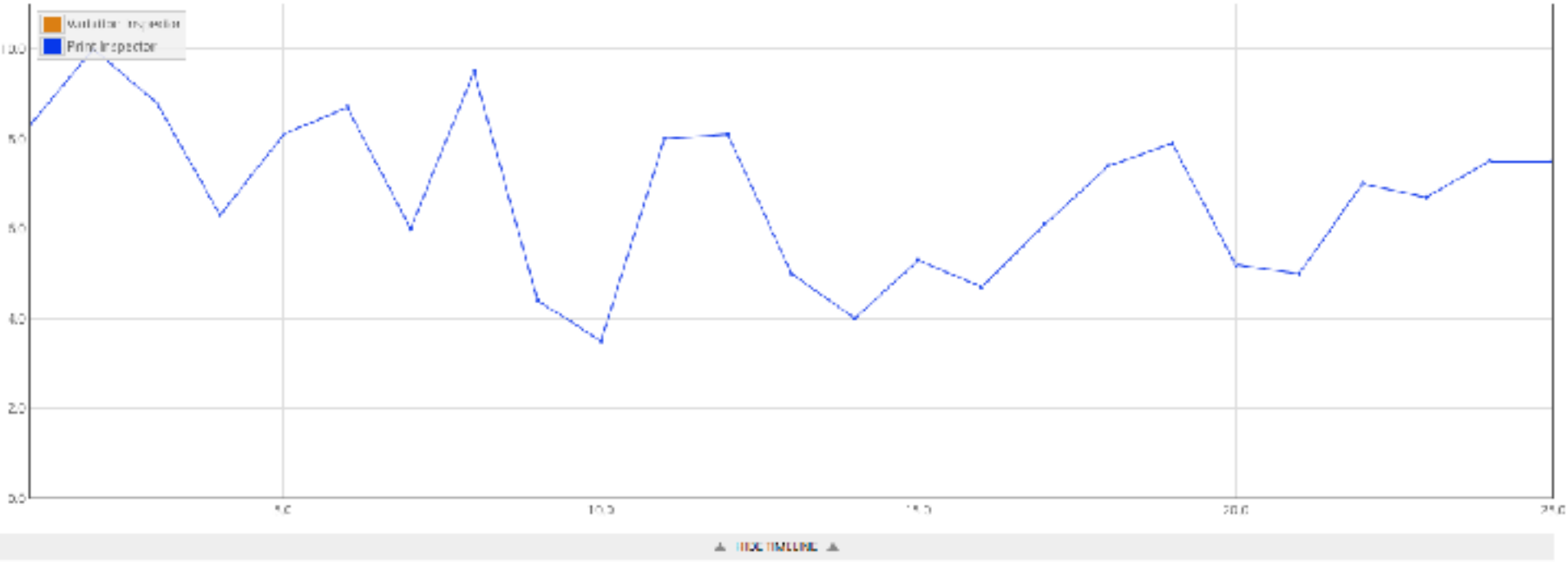
Customer Job Requirement

Product Label Multiple Colors

- Consider printing on digital device
  - *Within customer's Expectations of a "match"*
  - *If Customer's Expectations E-Factor is 2*
- Can device reproduce job customer's expectations
  - *Are Colors Within Gamut?*
  - *Are Colors consistent within page*
  - *Are Colors consistent throughout a multi page run*
  - *Are Colors consistent from week to week*
  - *Are Colors matching colors on other output devices*

Qualification Module

Assessing How Many Profiles do you need?



Do you “need” 25 profiles?

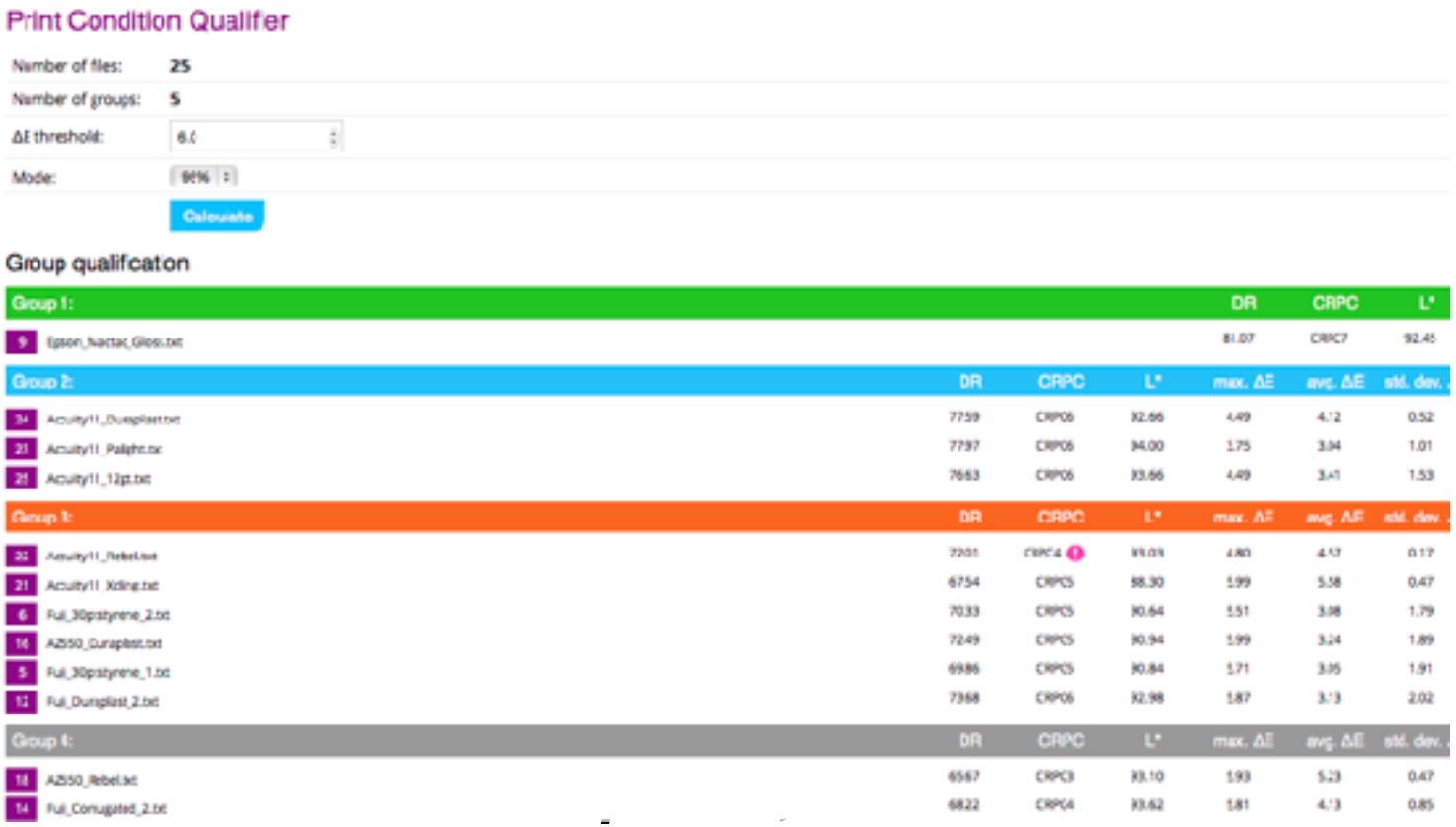
Groups Device Conditions

Based on your E-Factor; if 3 E-Factor

The... you need 13 Profiles

Groups Device Conditions

If E-Factor= 6 Only need 5 Profiles



Sho

Device Accuracy Test #5 Conclusion

Determines How many ICC Profiles Required

- Shows you which condition to profile
- Shows you the Reference Print Condition

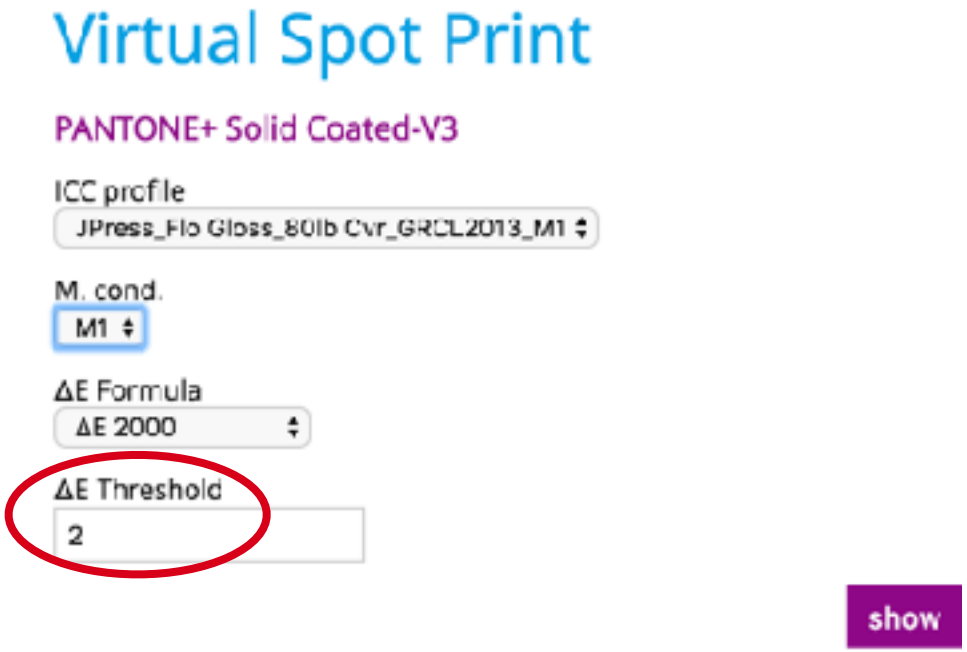
Group qualification

#	File	DR	CRPC	L*	max. ΔE	avg. ΔE	std. dev. ΔE
Group 1:		DR	CRPC	L*			
17	[illegible]_Gloss.txt	81.07	CRPC7	[illegible]			
Group 2:		DR	CRPC	L*	max. ΔE	avg. ΔE	std. dev. ΔE
2	Acuity*1_Duraplast.txt	77.55	CRPC6	92.65	4.45	4.12	0.52
5	Acuity*1_Polilight.txt	[illegible]	CRPC6	94.00	3.79	[illegible]	[illegible]
1	Acuity*1_12pt.txt	76.63	CRPC6	93.65	4.45	3.41	1.53
Group 3:		DR	CRPC	L*	max. ΔE	avg. ΔE	std. dev. ΔE
6	Acuity*1_Xcling.txt	67.54	CRPC5	88.30	4.80	4.80	0.00
4	Acuity*1_Rebel.txt	72.01	CRPC5	93.03	4.80	4.80	0.00
Group 4:		DR	CRPC	L*	max. ΔE	avg. ΔE	std. dev. ΔE
8	A2550_Rebel.txt	65.67	CRPC3	93.10	4.92	4.76	0.14
7	A2550_12pt.txt	73.71	CRPC6	93.60	4.71	3.62	0.94
25	Fuji_12pt225.txt	77	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
24	Fuji_12pt[illegible]_2.txt	71.95	CRPC5	92.52	4.92	3.14	1.73
Group 5:		DR	CRPC	L*	max. ΔE	avg. ΔE	std. dev. ΔE
9	A2550_Polilight.txt	73.63	CRPC6	94.10	4.85	3.83	0.74

Colors Within Gamut?

Considerations

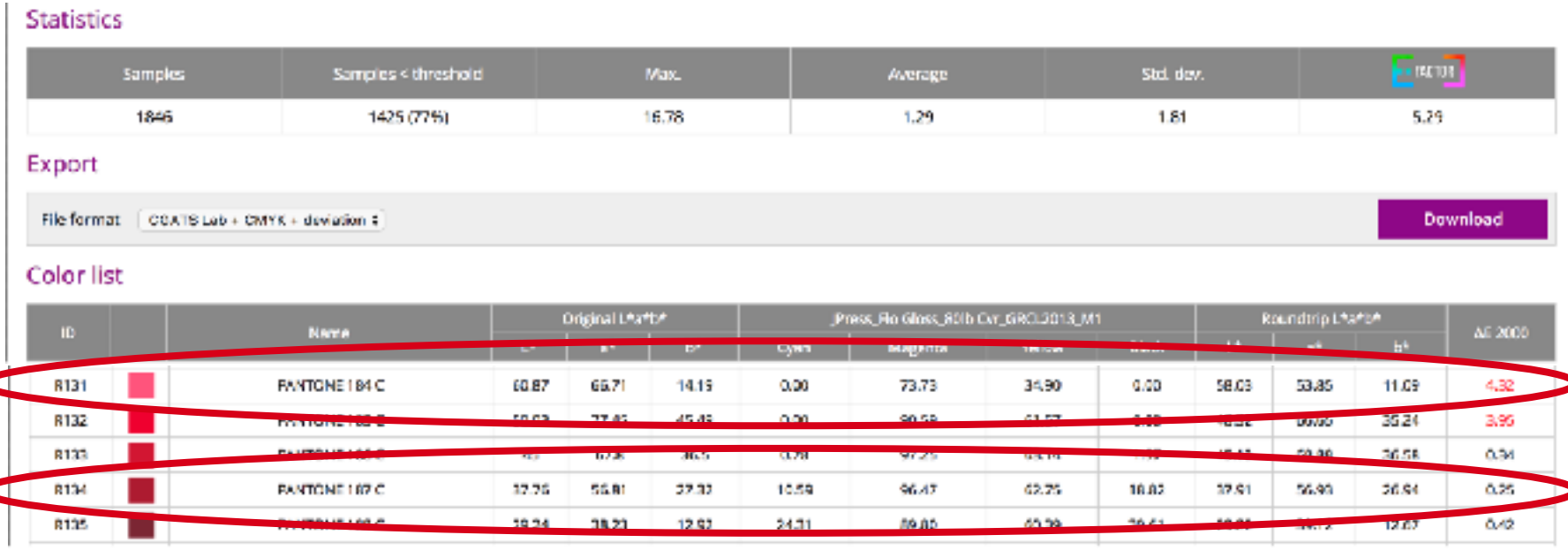
- 1) Is Color In Gamut of the device condition
  - *Within customer's Expectations of a "match"*



Customer Reproducing PMS Red

Considerations

- 1) Is Color In Gamut of the device condition
  - *Within customer's Expectations of a "match"*
  - *If Customers Expectations is 2 ΔE...*



Statistics

Samples	Samples < threshold	Max.	Average	Std. dev.	
1846	1425 (77%)	16.78	1.29	1.81	5.29

Export

File format: CGATS Lab + CMYK + deviation

Download

Color list

ID		Name	Original L*a*b*			_Press_Rio Gloss_60lb Cvr_GRO2013_M1				Roundtrip L*a*b*			ΔE 2000
						Cyan	Magenta						
R131		PANTONE 184 C	60.87	66.71	14.15	0.00	73.73	34.90	0.00	58.03	53.85	11.09	4.32
R132													3.99
R133													0.94
R134		PANTONE 187 C	32.26	55.81	27.92	10.59	96.47	62.25	18.82	37.61	56.90	26.64	0.25
R135													0.49

Customer Reproducing PMS Red

Considerations- Machine Capabilities

- 2) Can device reproduce consistently
  - *Amount of variation within page, between jobs*

Solutions for Output Improvement

- Need Cause of Problem- to provide solution
- Why:
  - *Customer File Volatility*
  - *Multiple Substrates*
  - *Temperature/ Humidity Changes*
  - *Operator not Re-linearizing*
- All Devices have variation
  - *How to control and manage*
  - *Important to understand for troubleshoot*

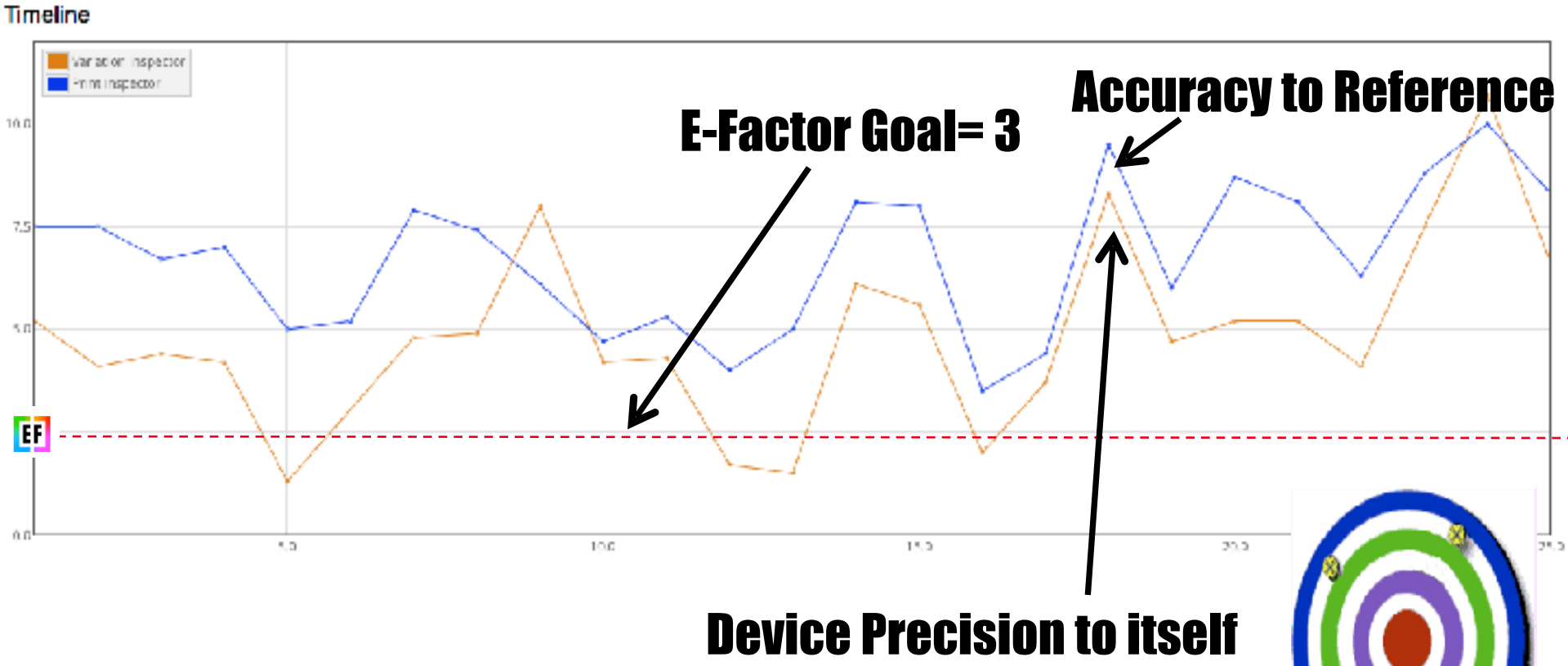
Low Accuracy

Low Precision

EF =9

Provides Operations Actionable Data

Line Graph showing any level of history



- Device ***NOT*** Consistent to itself

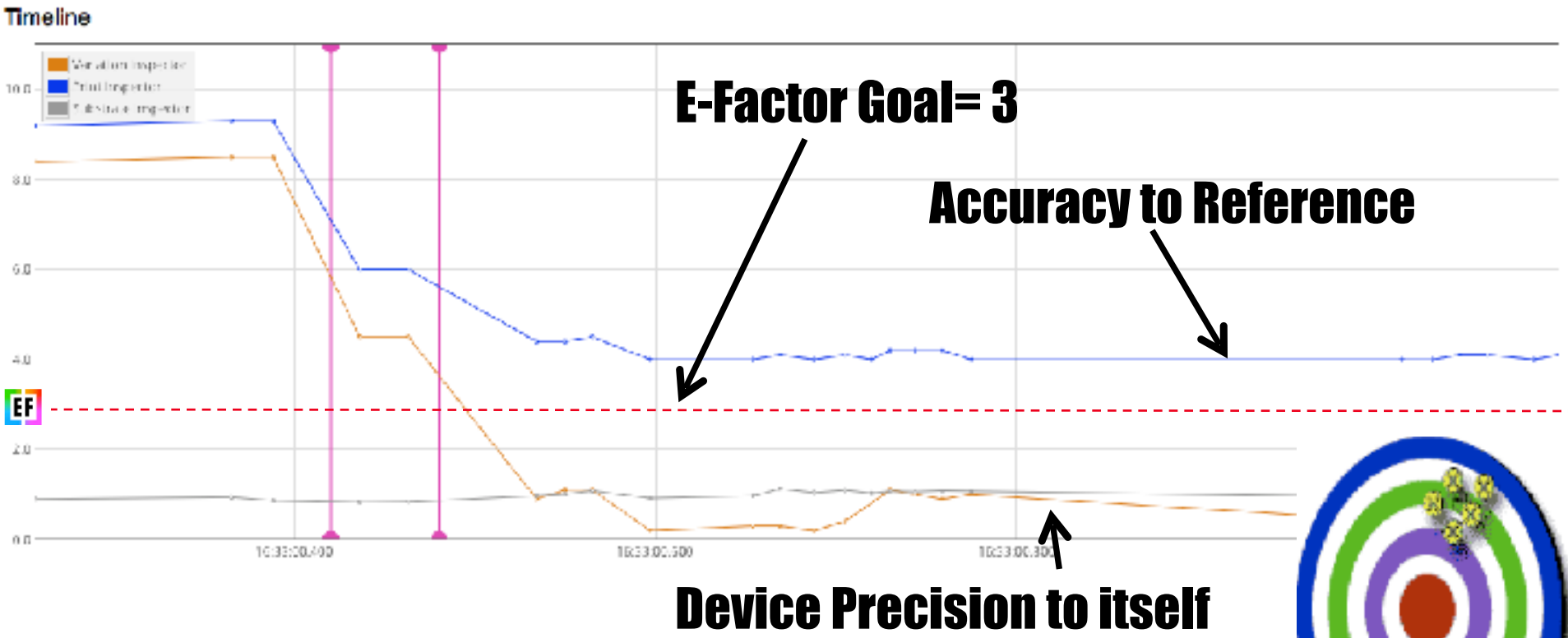
Fix Problem based on Result

Problem #1= Poor Precision

- *Symptoms:*
  - Device does not match Proof
  - Device doesn't match job run last month
  - 3rd shift does not match 1st shift
- *Solutions:*
  - Fix the Mechanics of Output Device

Provides Operations Actionable Data

Line Graph showing any level of history



EF =7

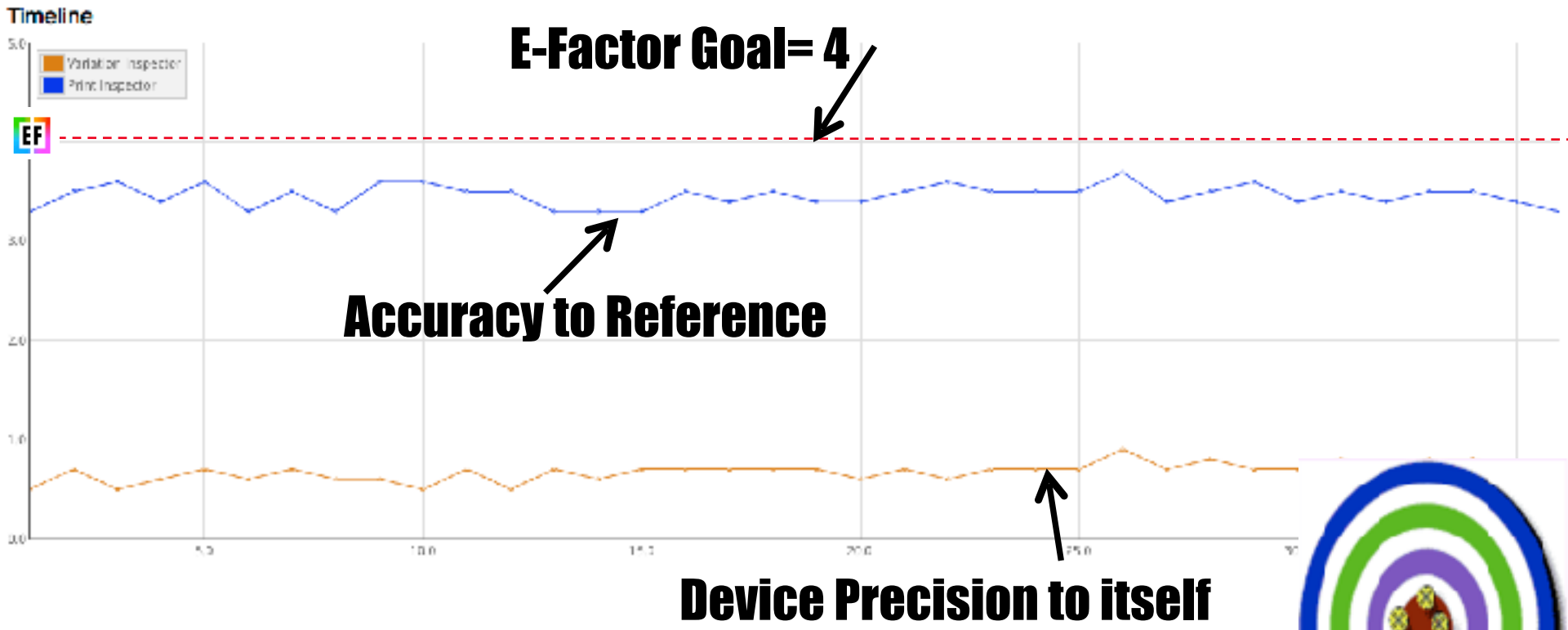
Fix Problem based on Result

Problem #2= Poor Accuracy

- *Symptoms:*
  - Output does not match Proof
  - Output doesn't match other jobs
- *Solutions:*
  - Fix the Workflow/RIP Color Conversions
  - Add G7 Curves, and or ICC Profiles

Provides Operations Actionable Data

Line Graph showing any level of history



- After Color Server and Plate Curves

EF =3.4

Summary

Specialize Helping Companies Control Color

- *Providing Resources to help customers be self sufficient*
- *ChromaChecker.com Free On-Line Tutorial for testing*
- *ChromaChecker.com Qualification, Tracking and Process*
- *Free Audit for one device, you print, we measure...*

Contact me, Dave Hunter

- *david@pilotmarketing.com*
- *651.717.0590 – Answer any questions for you...*

How Printers Reproduce Color

- Most Printers Print: ***Any Way- Any Day***
  - **Even with the same output device**

Low Accuracy

Low Precision

Not Meeting Customer Expectations

EF =9

Difference Between:

- Precision (Consistency) versus Accuracy

Low Accuracy
Low Precision

Low Accuracy
High Precision

High Accuracy
Low Precision

High Accuracy
High Precision

Five C's of Color Control

- *Color **Capture Measurement** Device*
- ***Calibration** for Output device*
- ***Characterization** for Output device*
- ***Conversion**- Convert from one color space to another*
- ***Conformance** ensures output is correct*

Difference : Precision vs. Accuracy

- *Precision (Repeatability) Depends on:*
  - Correct Color Measurement Devices
  - Proper Calibration: Devices/Instruments
- *Accuracy (Match to Condition) Depends on:*
  - Valid Characterization (ICC Profiles)
  - Proper Color Conversions (RIP)
- *Conformance Verifies Everything is Working*
  - Verifies Precision and Accuracy

Manufacturing Industry Standards

Specifications for Tolerances

- Every Industry has Tolerance Metrics
- Regular Bolt Tolerances- ASME B18.2
  - *Up to 1”= +-.02 to .03*
- Structural Bolt Tolerances- ASTM A325
  - *.3%= +-.0015*
  - *Tensile Strength: 120ksm min*
- What Manufacturing Tolerances do we use Print?
  - *Delta E for Spot*
  - *G7 Conformance for Process*

How do Printers Print Color

Industry Shows

- Most Printers print different everyday
  - Due to variation raw materials, mechanical and/or operator variation
- Some Printers print the same everyday
  - With some of their output devices
- Few Printers print an Industry Print Aim everyday
  - With some of their output devices

Determine Color Expectations!!!

Learning Experience

- Understand how close is “acceptable” to customers
- Different Customers have different levels tolerance
- Need to understand your devices capabilities
- Often choose a tolerance tighter then device limits
- Industry standard TR016 defines 4 Categories
  - *Levels 1-4 with 1 being the tightest at 2 delta E*

Performing E-Factor Exercise

On-Line Exercise- Compare one to other

- *In all the above cases, is the difference close enough or would you change the file or workflow to make closer*

Actual Print Exercise

- Do not judge where you see a difference- Judge where you ***accept*** the difference
- Ways to Think of the Differences
  - *Judge 1st sample as proof, the 2nd as print*
  - *Judge 1st as print one day, the 2nd as print another day*
  - *Judge 1st as print on one device, 2nd as another device*
  - *Judge 1st print on one substrate, 2nd as another*

How to Quantify E-Factor

- Tolerances in Delta E (00)

2 delta E

2 E-Factor

How Close is Close Enough?

- Tolerances in Delta E (00)

5 delta E

5 E-Factor

How Close is Close Enough?

- Tolerances in Delta E (00)

9 delta E

9 E-Factor

Once You have your “E-Factor”

Applies to all aspects of Color Configuration

- Determine ***Precision*** of your Device condition
  - *Is it less then your Desired tolerance? If not, need to perform maintenance on device or calibrate more often*
- Determine ***Accuracy*** of your Device condition
  - *Is it less then your Desired tolerance? If not, need to make a more accurate profile and or color conversion*
- This will ensure that your Digitally Printed pages will meet customers expectations
- Required Measurement Device to measure results
  - *Make sure Measurement device is Accurate*

In Market for new Output Device?

We can Qualify Device- Before Purchase

- Make sure device meets your needs
- Qualify your desired E-Factor
- We provide test targets for your vendors to print
- Mail targets to us, we Qualify Precision/Accuracy
- Provide you with Report, compare output devices
- Make PO with FAT- Factory Authorized Test
  - Ensures your output device performs as Demo device or $ back
  - Protection that Device will meet your expectations

ChromaChecker tracks into future

Color is Output, Not Correct

Head Scratching Moment

- *Why is it Wrong?*
- *Does not match Proof?*
- *Does not Match Previous Print?*
- *Does not match Customer's Memory?*
- *Very Subjective, Very Dangerous*
- *Try and fix through Trial and Error- Never reproducible- Chasing Tail*

Troubleshooting Procedures

One of Three Problems

1) Output Device not Printing as Expected

Cause: Mechanics or Calibration Failure

2) RIP/Workflow not configured correctly

Cause: RIP/Workflow Profile Configuration

3) File not built in actual Printing Aim Gamut

Cause: Customer built file wrong/preflight did not fix

What is the Problem?

Troubleshooting Color Issues

Checking Conformance

- Operator Level
- Very easy procedures
- Maximum two prints, understand if problem is:
  - *Mechanics of Output device*
  - *Configuration in the RIP settings*

Train Operator to Measure Color bar

Choose a Good Calibration Control Bar

- *Assess Precision and Accuracy*
- *One that allows iterating the TRC based on G7*
- *ChromaChecker PI-64, Like a mini P2P target*

Configure Software to assess >2 Condition

- *Production Condition and Baseline Condition*

Operator Measures Control Strip

Place on edge of live jobs

Use Verification Software to assess condition

Measure with i1 Device in Seconds

Instantly Receive a Pass of Fail- Make Label

Difference Between:

Precision versus Accuracy

- *Precision (Repeatability) Depends on:*
  - Proper Calibration procedures
  - Preventative Maintenance and Consumable Changes

- *Accuracy (Color Match) Dependent on:*
  - Proper Color Conversion in Workflow or DFE/RIP
  - Correct Tone Reproduction Curve control Gray Balance

Difference Between:

Precision versus Accuracy

- *Precision (Repeatability) Depends on:*
  - Proper Calibration procedures
  - Preventative Maintenance and Consumable Changes
  - **Digital Operator Responsibilities**
- *Accuracy (Color Match) Dependent on:*
  - Proper Color Conversion in Workflow or DFE
  - Correct Tone Reproduction Curve control gray balance
  - **Prepress/Prep Responsibilities**
- *Need Both parties to attain Precision and Accuracy*

Using this Procedure Troubleshooting

1) File Prep Operator; Responsible for:
   - *Files are separated in Correct Color Space*
   - *Color Conversion Policies are correct*
   - *Proofer printing color correctly*
2) Device Operator; Responsible for:
   - *That Device is Properly Calibrated for desired **Precision***
   - *Preventative Maintenance is performed and change out end of life consumables as required for **Precision** goals*

Troubleshooting Procedure

Easy, Fast Technique to Determine Problem

Maximum of Two Prints and Two Measurements

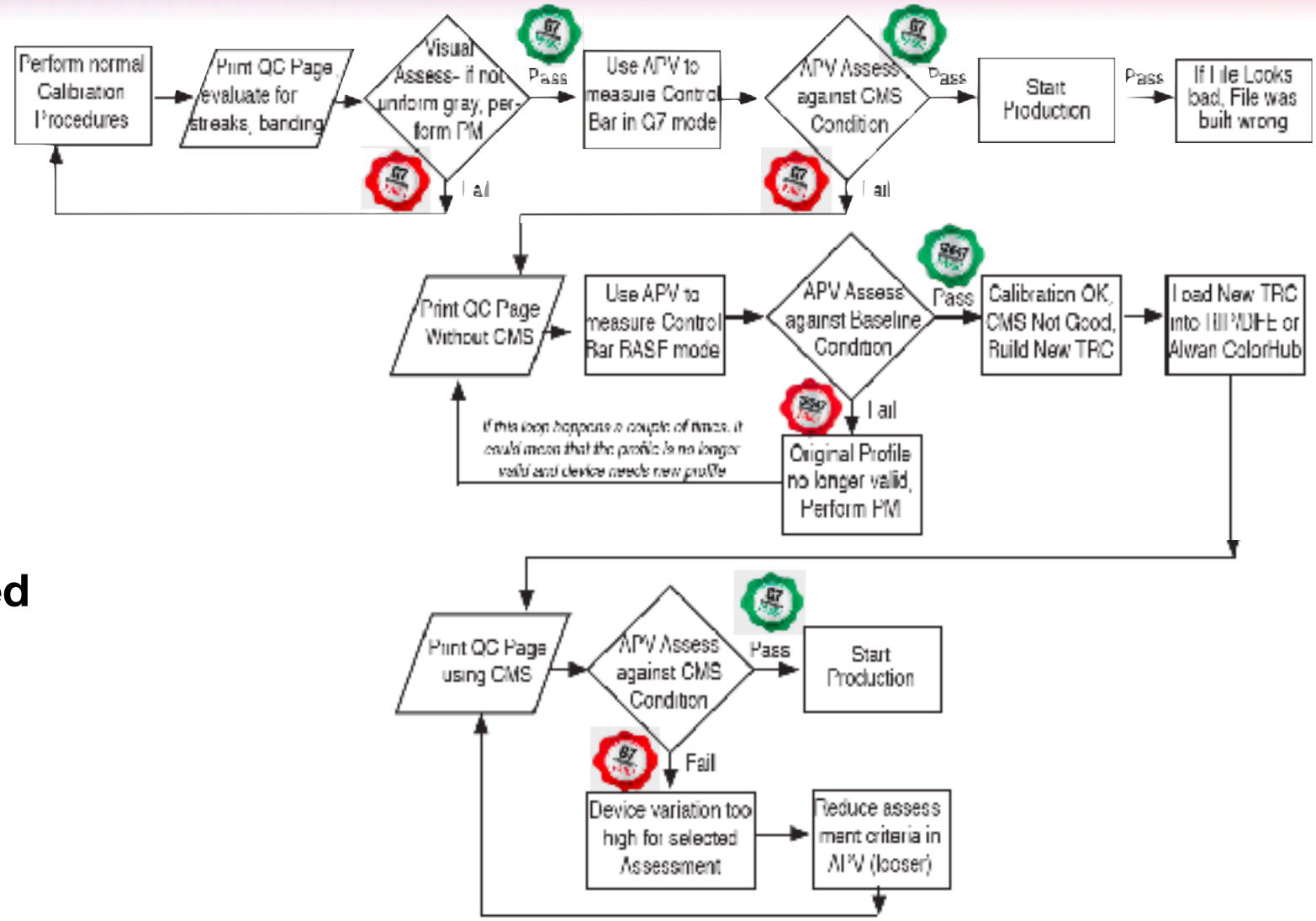
- Will Pinpoint where the problem is
  - *Device not printing correctly,*
  - *RIP is not configured/working correctly*
  - *File is not built correctly*
- Will Help Determine Problem

Troubleshooting Flow Chart

Production Verification

Baseline Verification

TRC Adjusted Verification



Define Two Device Conditions

Reference "Printing Aim" Condition (RPC)

- *Production Condition- sellable color*
- *The shop "Target" that all devices are trying to match*
- *Master "Stake in the Ground"*
- *Targeted Condition after **Color Conversion** applied*

Baseline Condition- Actual Print Condition (APC)

- *Device in a repeatable state, it's **Calibrated** State*
- *Assess the device against it's Baseline Condition*
- *Condition that the device is in "when it is profiled"*
- *Calibrated/Linearized and Ink Limited*

Conclusion: Precision

Establishing Your Precision capabilities

- Determine most important customers
- Determine most important jobs
- May strategize to only have one or two devices hold the highest precision- Costs more time and money
- Understand- Higher Precision costs more Money
- Need to learn how to charge for Increase Precision
- Reference TR016 Standard for Differentiation

ChromaChecker Color Cloud

Transition: Graphic Arts to Manufacturing

- Reports, Tracks and Notifies for any Device
  - ChromaChecker.com assesses virtually every variable in process
- Web View or iPad View of entire process
  - Provides Owner, Primary Stakeholder how manufacturing is going
- 20+ Variables required to print accurately
  - Customize time frames to check and audit equipment
  - Assign to multiple operators who will receive emails when due
  - Managerial reporting for operators that are on vacation or out

Industry Provided 7 Printing Aims

CGATs 21

- Substrate Based- NOT Print Process based
  - *Works for any Print Process!!!*
- Common References for entire supply chain
  - *Set Customers expectations for Proofing*
  - *Set Expectation for Spot Color Simulation*
  - *Standard Conditions that any Printer match*
  - *Can output any where in world and get similar*
- And Tolerances for Acceptability

Reference Print Conditions (RPC Aims)

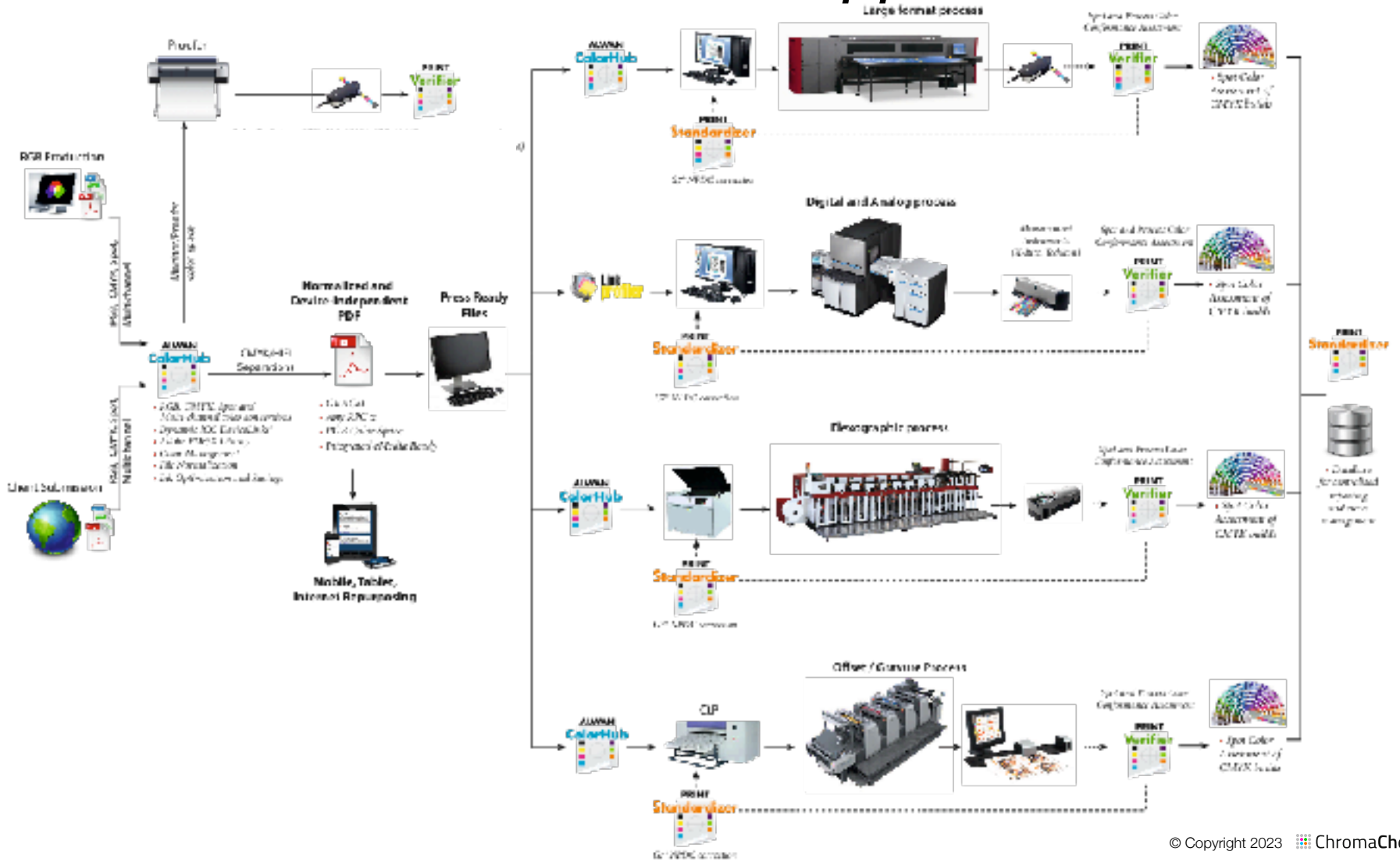
CGATs21- 7 RPCs, Small Gamut to Large

- 1) Coldset Newsprint (Gray)
- 2) Heatset Newsprint (White)
- 3) Uncoated Paper
- 4) Super Calendared
- 5) #5 Paper Coated (SWOP)
- 6) #1-2 Coated (GRACoL)
- 7) Large Gamut (Large Format, and Digital)

- Project- 8- Unreachable Gamut- Extreme Gamut

Most Printers have Multiple Devices

Provide a Shared Visual Appearance on all



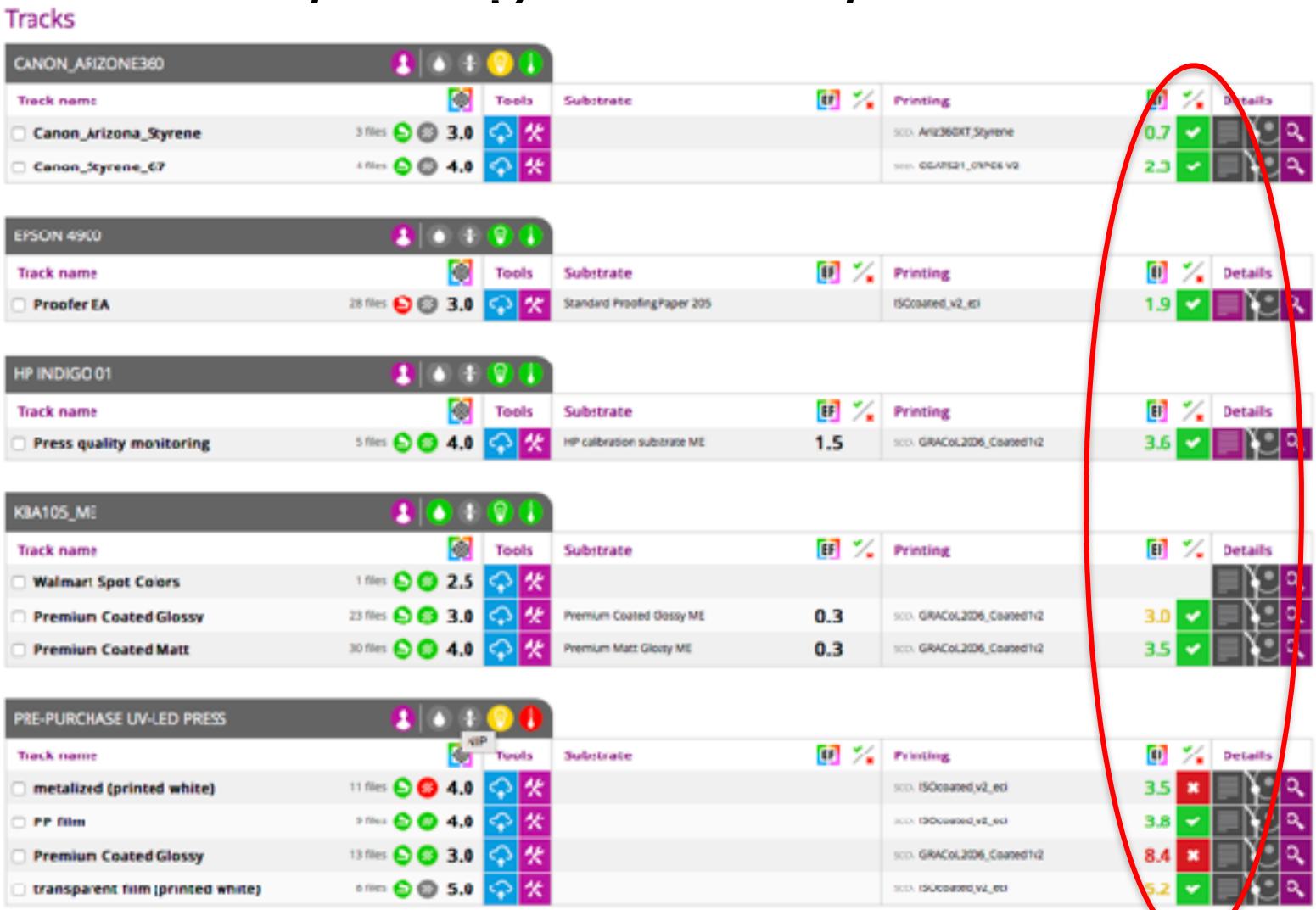
Shared Visual Appearance- G7 Process

- Printing Simulation= different paper, different gamut

- Gamut Sampler- Available on chromachecker.com

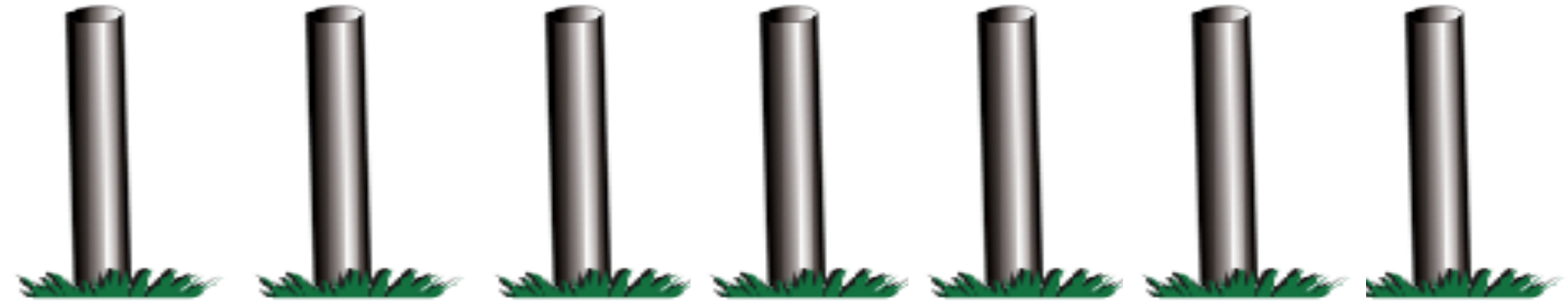
Manufacturing Dashboard

Real time reporting on all output devices!



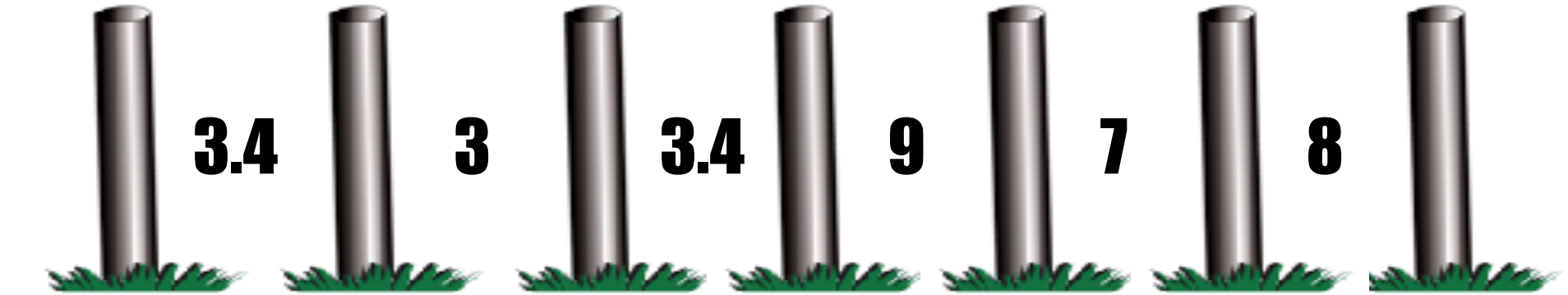
Printing Aims

- Different Target Print Conditions



Printing Aim Differences in Delta E

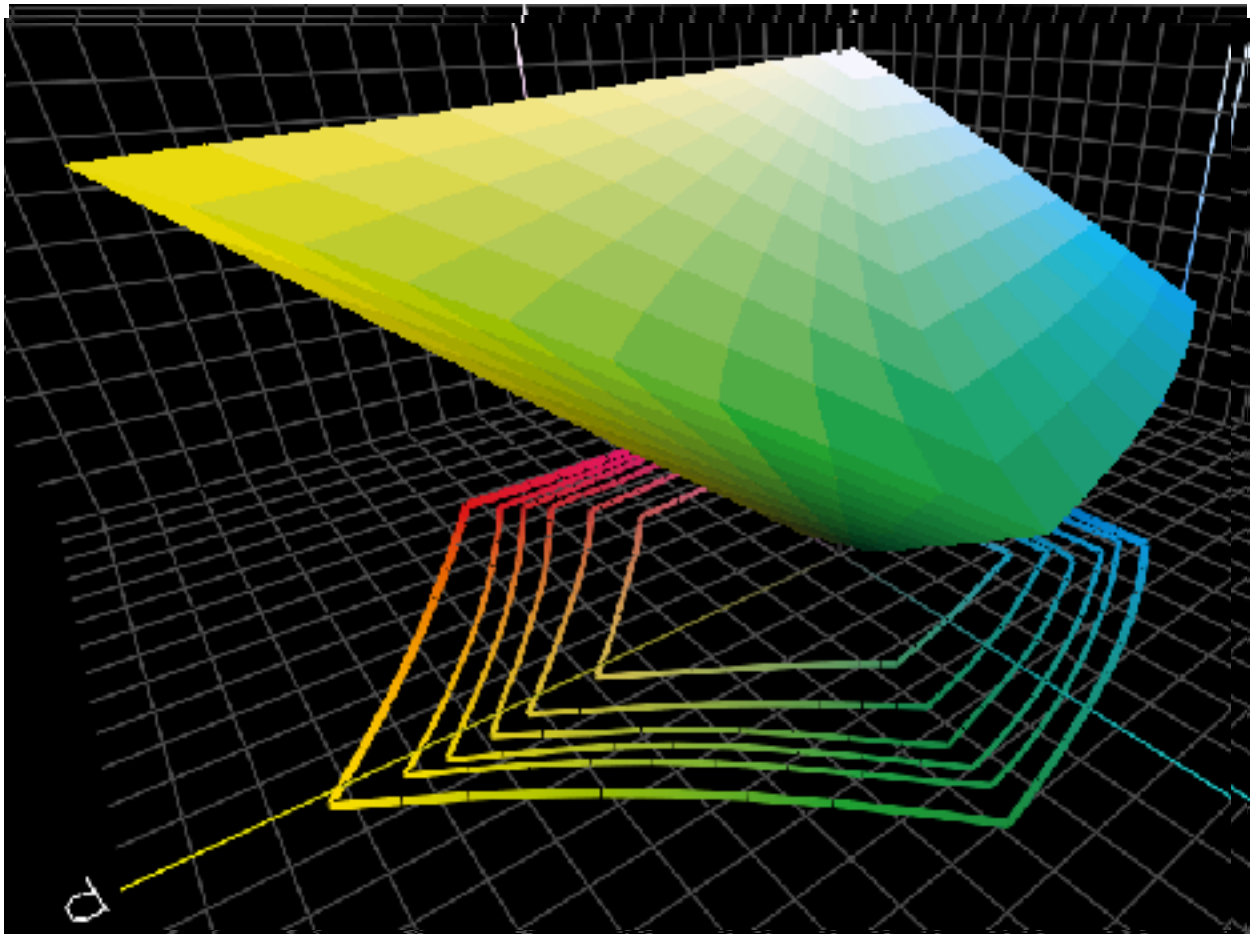
- Delta E difference between substrates



	CRPC2	CRPC3	CRPC4	CRPC5	CRPC6	CRPC7
CRPC1	8.0	9.3	12.1	14.3	15.1	17.9
CRPC2		6.9	4.6	7.1	7.7	10.3
CRPC3			9.0	11.3	11.9	14.5
CRPC4				3.4	5.8	7.6
CRPC5					3.0	4.9
CRPC6						3.4

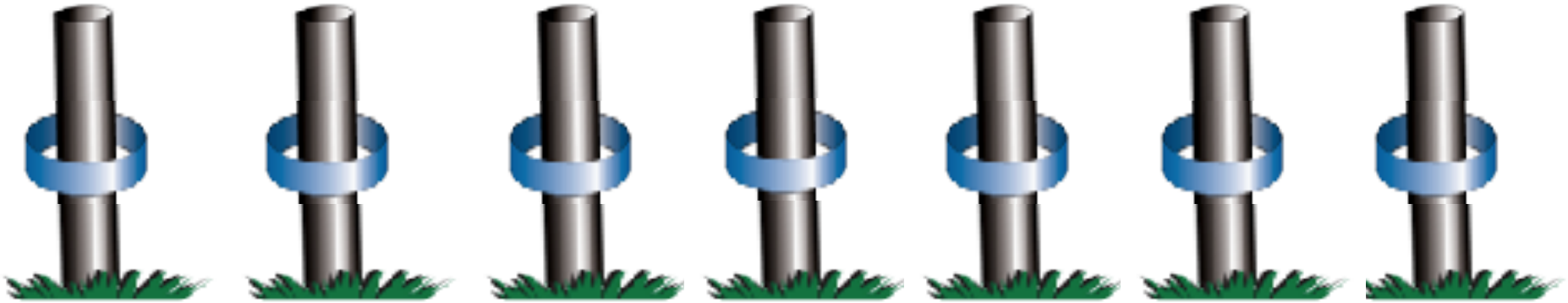
Printing Aims-Color Gamut

Map the Printing Aims to Color Space



Conformance based on CGATs 21

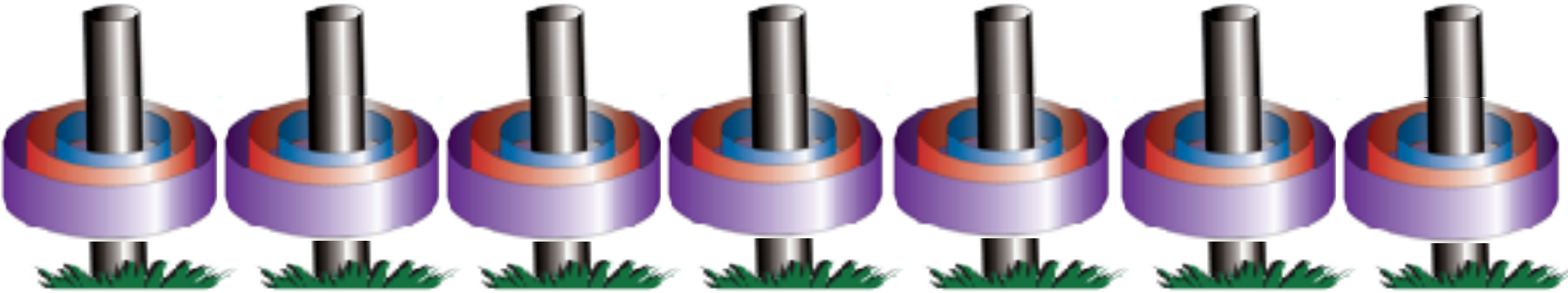
- Different Target Print Conditions



- Accuracy to Actual Print Condition- ***Conformance***

Conformance based on TR016

4 Assessments=A-Best, B-Better, C-Good, D-OK



- Accuracy to Actual Print Condition- ***Conformance***
- ***Level 1 (A)= 2 delta E (00), Level 2 (B)= 3 delta E***
- ***Level 3 (C)= 4.5 delta E; Level 4 (D)= 6 delta E***

Determine the RPC for Your work

Keep it Simple to Start

- Printing on Coated stock, choose GRACoL (RPC6)
  - *Profile is available on line- choose GRACoL2013 if using M1 measurement devices*
  - *If Paper has Optical brighteners (glows under black light) Strongly recommend using M1*
  - *If paper does not have optical brightener- you can use GRACoL2006 and an M0 device*
- Add Additional References in future if needed
  - *Uncoated is a popular condition (RPC3)*

Qualification Module

Assessing Precision for any output device

Substrate Variation (Consistency)

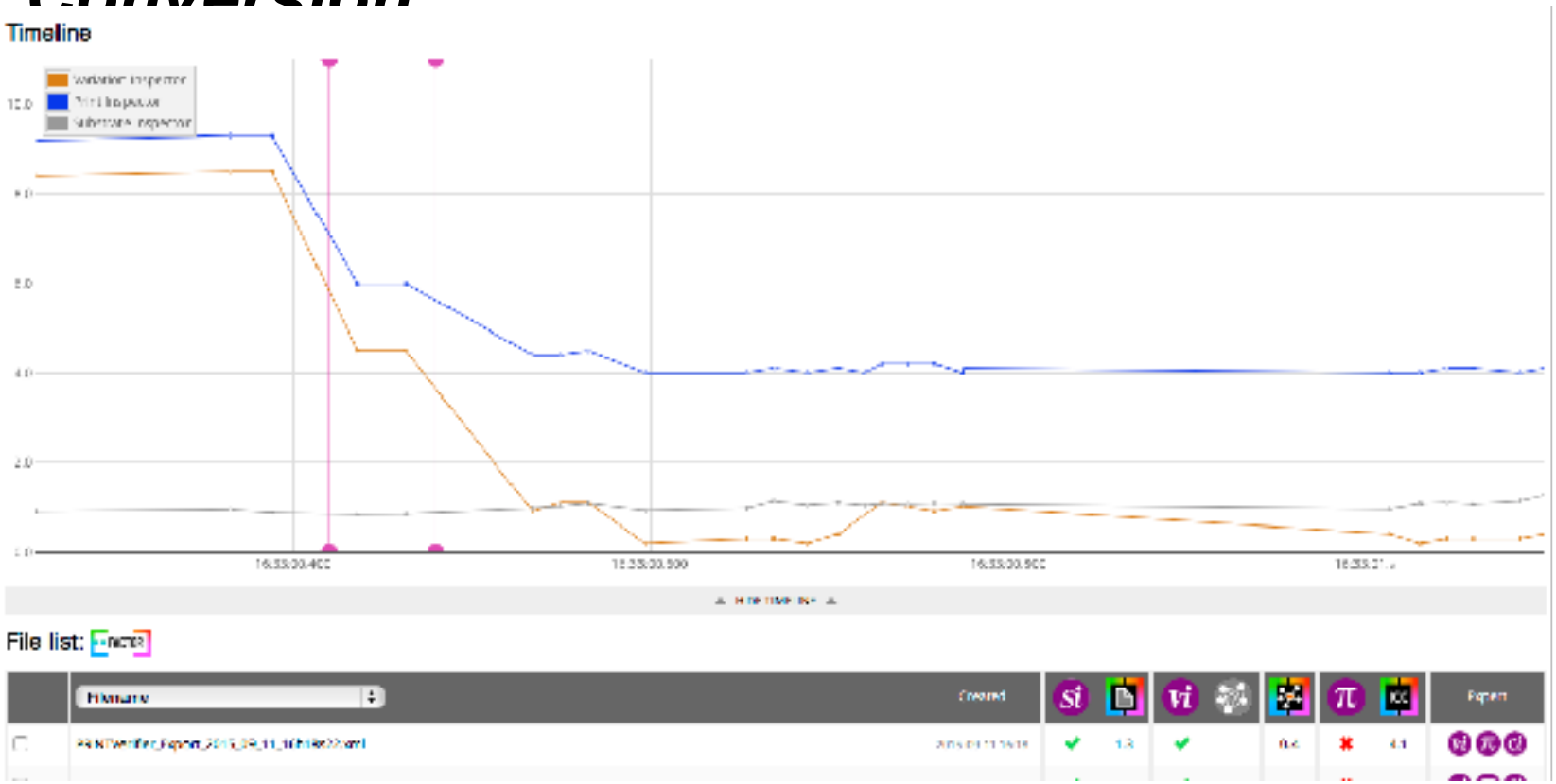
color	count	Max ΔE 2000			Avg ΔE 2000	Std. dev. ΔE 2000	95% ΔE 2000
		Result	Tolerance	Pass/Fail			
Substrate	99	0.20	2	✔	0.09	0.05	0.17

ΔE Variation (Precision)

color	count	Max ΔE 2000			Avg ΔE 2000			Std. dev. ΔE 2000			95% ΔE 2000		
		Result	Tolerance	Pass/Fail	Result	Tolerance	Pass/Fail	Result	Tolerance	Pass/Fail	Result	Tolerance	Pass/Fail
Cyan	1770	0.42	✔	4	0.11	2	✔	0.07			0.21	3	✔
Magenta	1770	0.27	✔	4	0.09	2	✔	0.05			0.18	3	✔
Yellow	1770	0.51	✔	4	0.15	2	✔	0.08			0.33	5	✔
Black	1911	1.19			0.31			0.20			0.66	5	✔
Red	590	0.44			0.14			0.08			0.29	5	✔
Green	590	0.34			0.11			0.06			0.21	5	✔
Blue	590	0.67			0.13			0.11			0.41	5	✔
10% CMY gray	703	0.80			0.28			0.13			0.51	3	✔
25% CMY gray	741	0.74			0.23			0.11			0.45	3	✔
50% CMY gray	741	1.25			0.38			0.19			0.73	3	✔
75% CMY gray	741	1.14			0.37			0.19			0.70	5	✔
100% CMY gray	566	0.90			0.31			0.15			0.59		

Tracking Module: Production View

Fail Accuracy, Pass Baseline, Color Conversion



Color Expectations- Blind Audit

Actual Print Buyer- sent to 10 Printers

- Web to Print Printers
- Assessed Precision and Accuracy
  - *Sent Same Content twice, once in "Defined" RGB*
  - *Second time four weeks later in "Defined" CMYK*
  - *Measured the results through the run (Precision)*
  - *Measured results against Print Aim (Accuracy)*
  - *Plotted the Values*
- Defining Precision and Accuracy

Actual Prints- Precision (Variation)

Same Printer over time

Actual Prints- Deviation (Accuracy)

What is "Correct" : Print Aim: GRACoL

1st Place 5 E-Factor

Target Printing Aim: "GRACoL"

10th Place 15 E-Factor

Quantify Quality Print Reproduction

E-Factor: Manufacturing Process Control

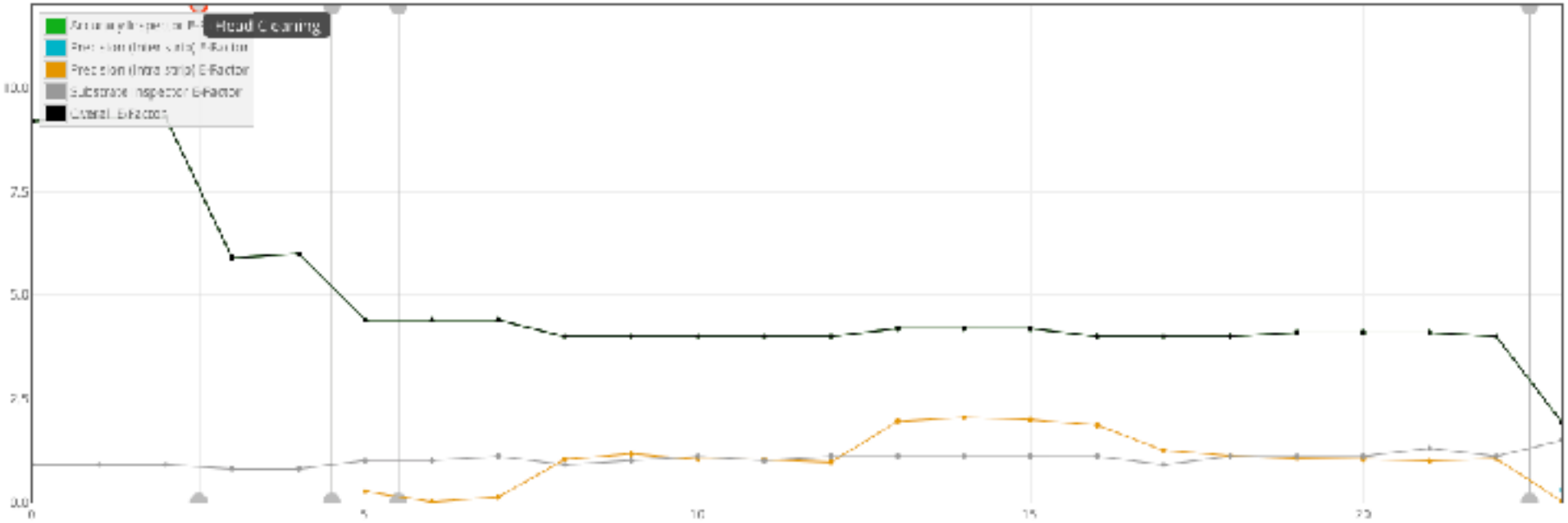
- Based on Customer's E-Factor (Expectations)
- Easy to associate all variables using one metric
- Understand immediately if device not good enough
- Differentiate your company from Competitors

ChromaChecker addresses these issues

Know effect of Maintenance on Color

Track Consumable. Maintenance vs Color

Timeline:



Vertical Gray lines show maintenance Events

Horizontal lines show Color Precision and Accuracy

Print Reproduction as Manufacturing

All Variables Influence Color Reproduction

- Output Device
  - Operator Skill
- Instrumentation
- Lighting
- Substrates
- Environment
- Plating or Imagesetting, Anilox Type

Can Compare Devices to Itself or Comparison

Summary

ChromaChecker Blueprint: Manufacturing

- Reports Color Conformity for all output devices
- Reports Precision for all supporting devices
- Works with existing Color Capture software
- Can send Alerts and Reminders when necessary
- Free Audit of existing devices, or potential new
- Guaranteed Customer Satisfaction

The way all Color will be handled within 5 yrs

Print Reproduction as Manufacturing

Need to Monitor Process Control

- Too much Time, Effort, Money to collect
- No Centralized Location to store data
- No Standard way to compare unlike data
  - Compare Instrument data vs Output data
- No Easy way to view the data
- No way to tie the information together
  - Instrument, Lighting, Substrate Variation affects Output Variation

ChromaChecker addresses these issues

ChromaChecker- Color Checker

Goals for the System

- Easy for Ownership = Understand results
- Easy for Management = make actionable results
- Provide one global location for all Process Info
- Easy to upload/enter data by operators
  - Alerts when they do not
- Open architecture- Any software, Any color bar
- Grow as you need
- Tie all Variables together to show cause/effect

ChromaChecker addresses these issues

ChromaChecker- Industry Firsts

Taking Our 30 year Industry Experience...

- Coining word "**E-Factor**," applying it to all variables
- Compare **Output** to Standard- and to other Output
- Compare **Instrument** to itself, and other Instrument
- Compare **Lighting** to itself, and other Lighting
- **Substrate** Best Match function- find Proofing stock
- **Group** Press Conditions on E-Factor
  - Minimizing the amount of Curves, or Profiles that have to be manage

Compatibility List of Software

Supports any software that exports color file

- CGATs, CXF, SVF, XML
- Supports any Color Bar or Target (P2P, IT8)

Compatibility list & Metadata

solution	APVX	APVX	APVX	i1 Profiler	i1 Profiler	PrintFIGN	IC	Patch Tool	Patch Tool	ColorPort	MeasureColor	IntelliTrax	Gateway
version	5.1.0	5.1.0	5.1.0	1.6.3	1.6.3	7	5.0	4.7.0	4.7.0	2.0.5	15	1.7	4.3
vendor	Alwan	Alwan	Alwan	X Rite	X Rite	Baiceri	Heidelberg	Babel Color	Babel Color	X Rite	MeasureColor	X Rite	Barbieri
extension	.xml	.txt	.svf	.txt	.cxf	.xml	txt	.txt	.cxf	txt	.svf	.svf	txt
format	XML	CGATS	SVF	CGATS	CXF	XML	CGATS	CGATS	CXF	CGATS	SVF	SVF	CGATS
Date of creation	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
UTC support	✔	✔	✔	✔*	✔		✔	✖	✔	✖			

Easy to Interpret Results- Dashboard

One View instantly shows Color Results

- Green is Good, Yellow is Warning, Red is Bad
- Configure for any Time Frame- Real time, Shift, etc

Master Dashboard shows status

Easy to Understand: Color

Expected Color Accuracy

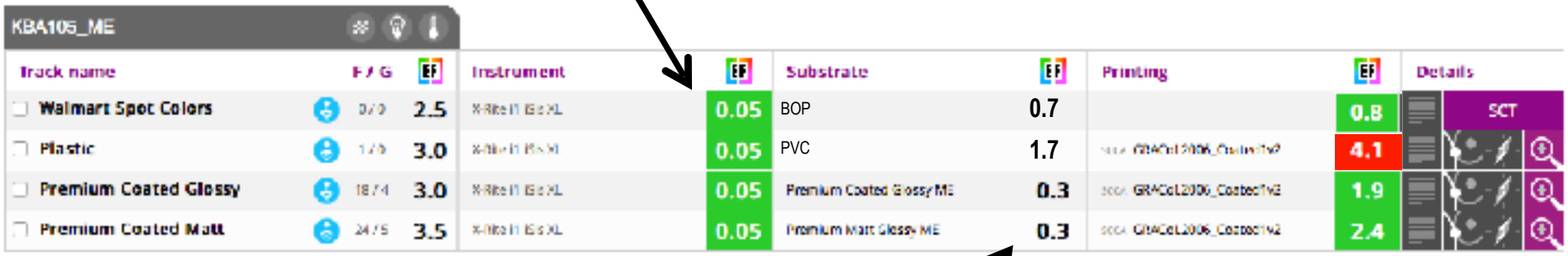
Actual Color Accuracy

- Output device E-Factor<= Customer= Expectations
- Do NOT have to understand Color to comprehend

Master Dashboard shows status

One View instantly shows All Variables

Instrument Precision

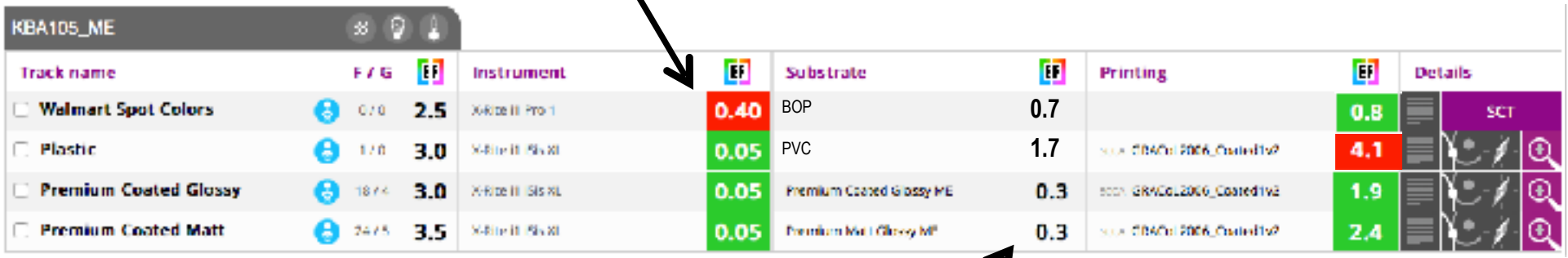


Substrate Precision

Master Dashboard shows status

If Instrument Precision is too high relevant to your Expectations, Number will show in Red

Instrument Precision



Substrate Precision

- Easily Alerts users to ***inappropriate*** tools being used to hit tight Expectations

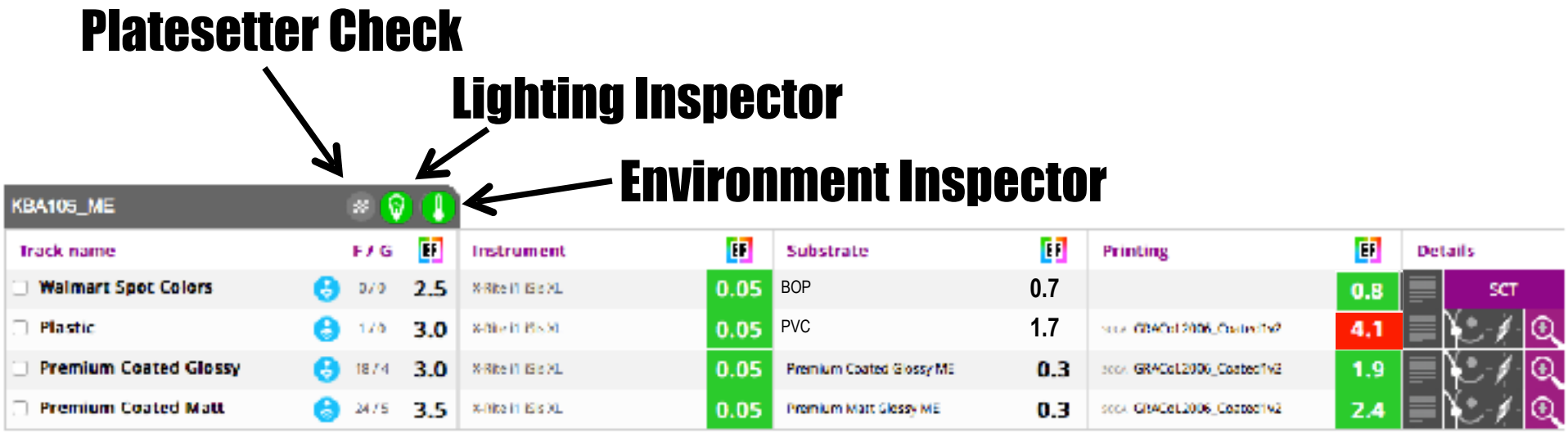
Tie All Variables Together

Provides a Complete Picture of Accountability

- When Color is wrong- one place to see what's off
- Allows for complete Accountability
- Know everyone is doing what they are supposed to
- Eliminates Finger Pointing
- Understanding the Cause and Effect of Variables

Tying All Variables to Dashboard

Green = Good; Yellow = Has not been checked;
Red = Device fails Conformance

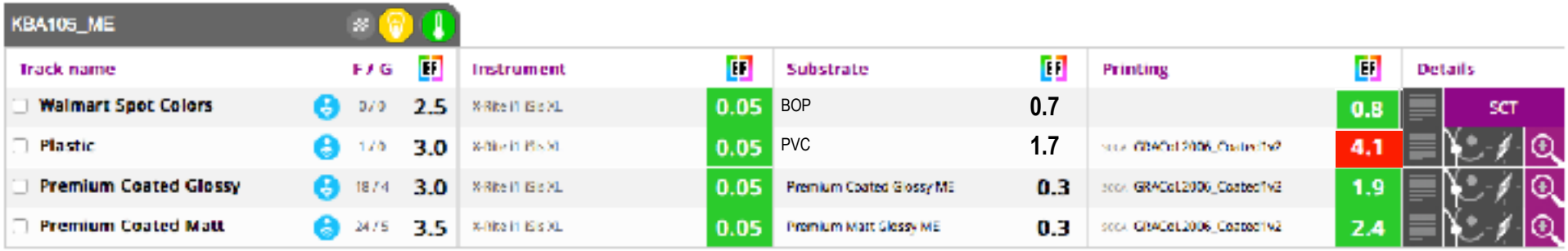


Customized timing for Analysis, once a day/week etc

Tying All Variables to Dashboard

Green = Good; Yellow = Has not been checked; Red = Device fails Conformance

Lighting Turned Yellow- Due to be Checked



Can send out alerts when devices have not been checked in the desired time frame

Dashboard- All Devices

Proofer, Large Format, Digital Press, Press

EPSON 4900

Track name	F / G	EF	Instrument	EF	Substrate	EF	Printing	EF	Details
Proofer EA	25 / 1	3.0	[illegible]	0.59	[illegible]	1.3	[illegible]	4.1	

GS-6000

Track name	F / G	EF	Instrument	EF	Substrate	EF	Printing	EF	Details
Basic Print Condition	1 / 0	6.0	[illegible]	0.11			[illegible]	5.3	

HP INDIGO D1

Track name	F / G	EF	Instrument	EF	Substrate	EF	Printing	EF	Details
Press quality monitoring	7 / 0	3.7	[illegible]	0.11	HP calibration substrate ME	1.6	[illegible]	3.7	

KBA105_ME

Track name	F / G	EF	Instrument	EF	Substrate	EF	Printing	EF	Details
Walmart Spot Colors	0 / 0	2.5	[illegible]	0.05					SCT
Premium Coated Glossy	18 / 5	3.0	[illegible]	0.05	[illegible]	0.3	[illegible]	1.9	
Premium Coated Matt	24 / 5	3.5	[illegible]	0.05	[illegible]	0.3	[illegible]	2.4	

Extensive Training on Web Site

Operator Training Courses to help educate:

- How to make devices more consistent, accurate
- Specific Courses for: Free, Self Paced, Repeat
  - *Traditional Press Operator*
  - *Large Format Operators*
  - *Digital Press Operators*
- Complete Manual with Videos on Site
  - *Covers all aspects of ChromaChecker*
  - *Covers best practice procedures for all aspects of color*

Grade Output Conformance?

Score Card of Print Attributes:

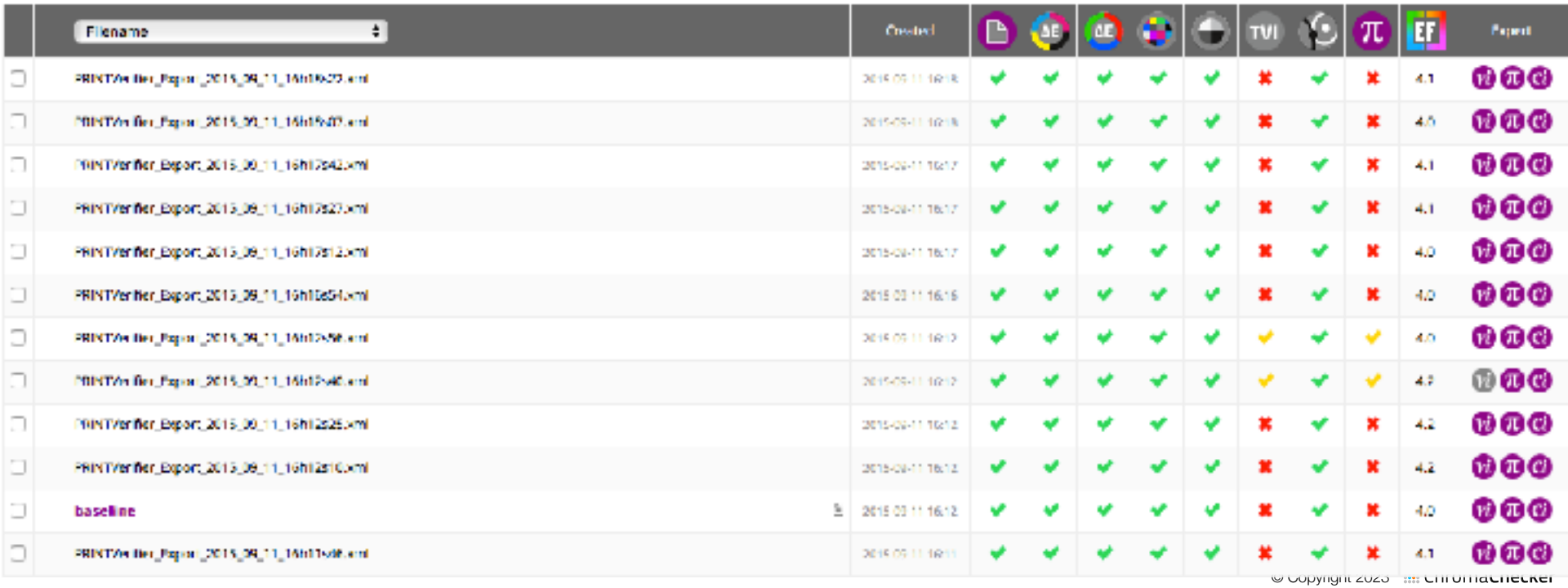
- Companies have developed their own Score cards
  - *30 Points if Solid CMYK correct, etc.*
- How well does a score represent visual match?
  - *Often- **Not Very Well**- they are attributes that customer or liason will use to get discounts on print*
- E-Factor Cuts through the ***Crap***
  - *Based on CRF for Delta E 2000: Modern metric which represents Color Difference based on Human Vision*

Score Card Output Conformance

Score Card of Print Attributes:

- Substrate, Solid Conformance, Overprints, All Colors, Gray Balance, TVI, Overall, E-Factor
- Can make any attribute normative or informative

File list



E-Factor- Expectation Factor/delta E

Scientifically Based

- Easy to Understand Name- Not Intimidating for the non Color Specialist
- Color Specialist- Means: Delta E (00) CRF
  - *Cumulative Relative Frequency, 95th Percentile of color*
- Can be applied to all variables in process
  - *Output Device Precision and Accuracy*
  - *Instrument Precision*
  - *Lighting Precision and Accuracy*
  - *Substrate Precision and Accuracy*

Master Dashboard shows status

Understand- When Color is WRONG

Expected Color Accuracy

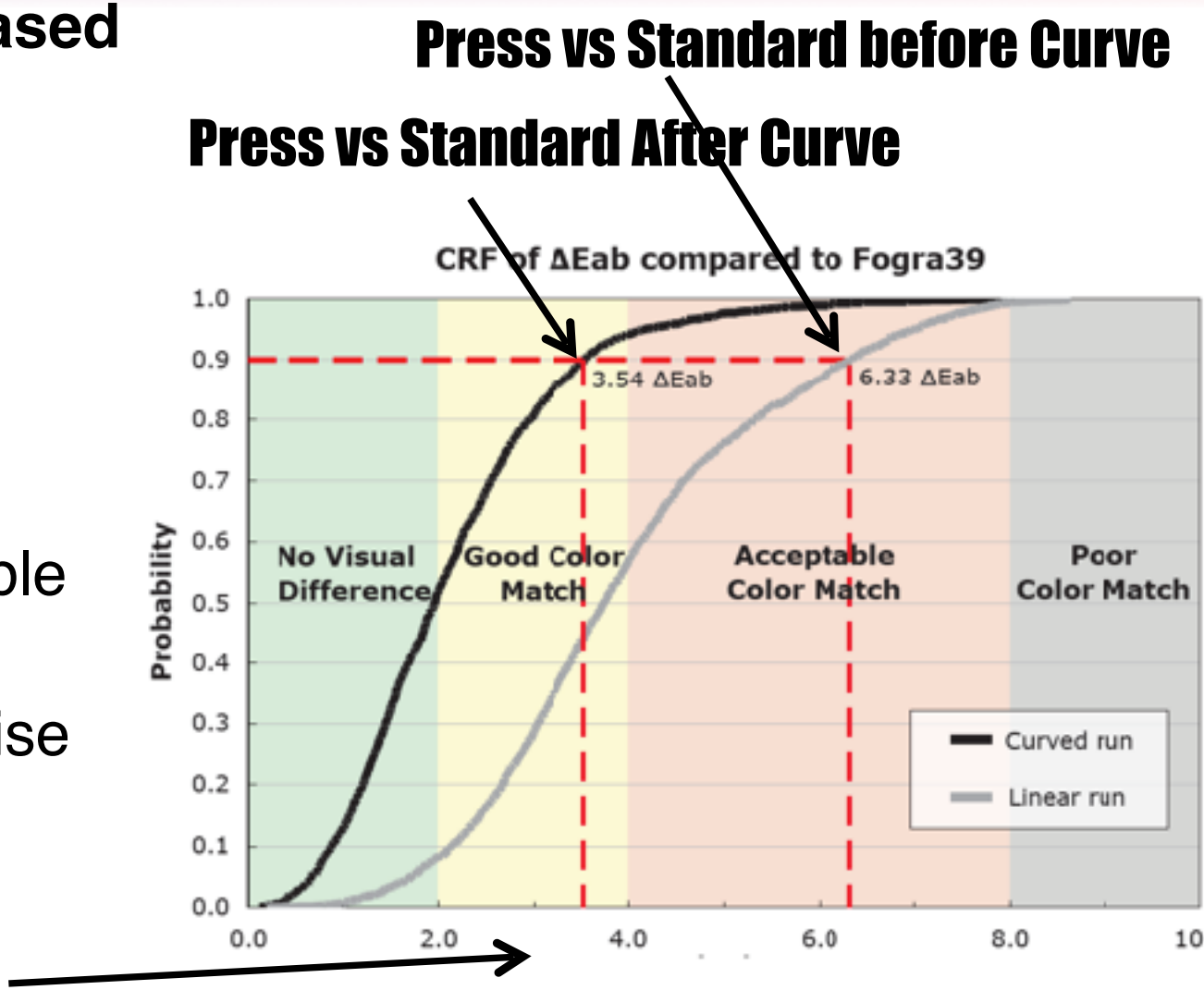
Actual Color Accuracy

- Output device E-Factor<= Customer= Expectations
- Do NOT have to understand Color to comprehend

E-Factor- Expectation Factor/delta E

Scientifically Based

- Color Plots %'s of Delta E
- 95% Predicts Probability of Match
- What is Visual, Good, Acceptable Subjective...
- E-Factor Exercise Quantifies Expectations



E-Factor Exercise defines Expectation

- Users compare colors, until Close Enough

5 delta E

E-Factor Exercise

- Hard Copy version, or Free On-Line

2 delta E

E-Factor Exercise

- Eliminates Communication Issues- sets expectations

9 delta E

Chromachecker Color E-Factor

- Scales from 1 to 9 delta E (2000)
- On Line or Hardcopy from Chromachecker.com
- Self administered
- Referenced to TR016
- Part of ISO15339
- Actual size 4x7 inches
- Apply visual assessment to actual numbers
- Quantifies Acceptable Color Match

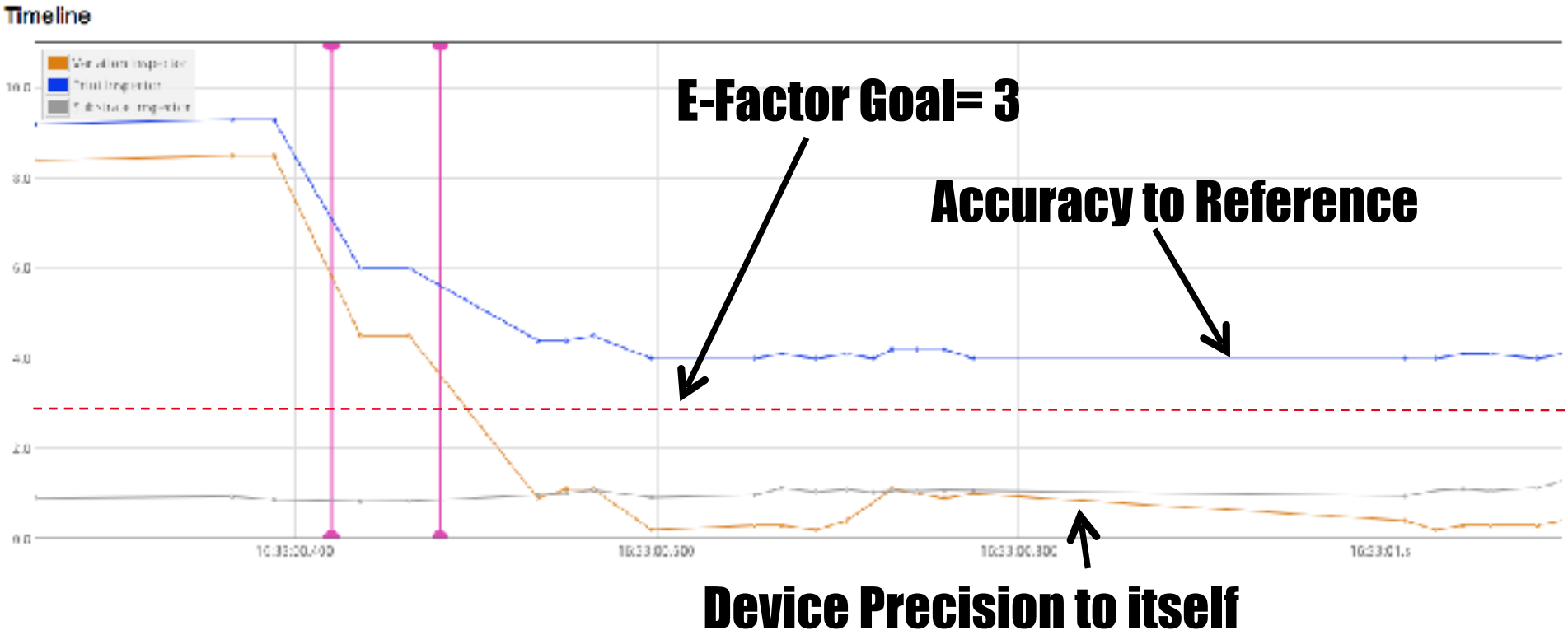
Provides Operations Actionable Data

If Device goes RED, Click Details for Track

- Three Levels of Detail to uncover cause of problem
- Viewing Top Level- Owner Level

Provides Operations Actionable Data

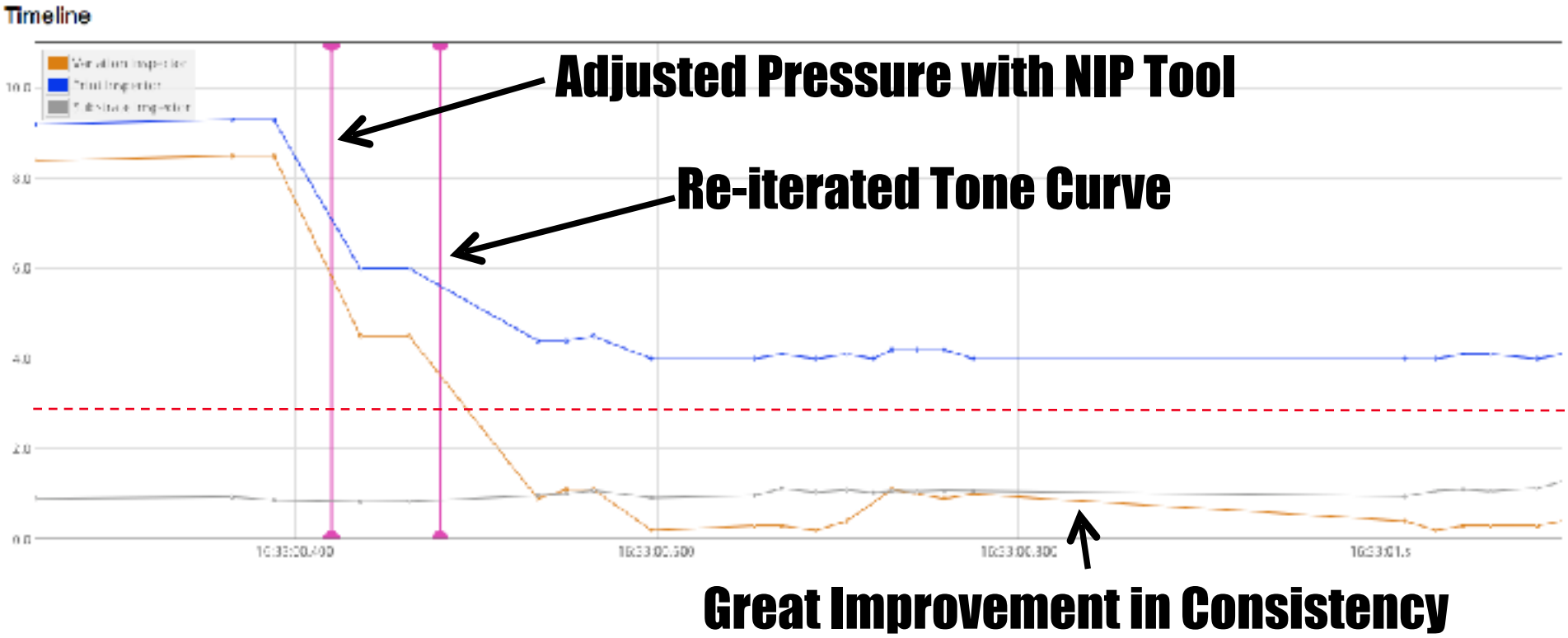
Line Graph showing any level of history



- Accuracy Relates to Color Conversion or Curves

Provides Maintenance Feedback

Any time enter: Maintenance Events



- Can tell if maintenance helped or hurt situation

Print Inspector

Can track operators effect on Print Results

- Spot or Process Conformance

Tracks affects of Substrate, Instrument

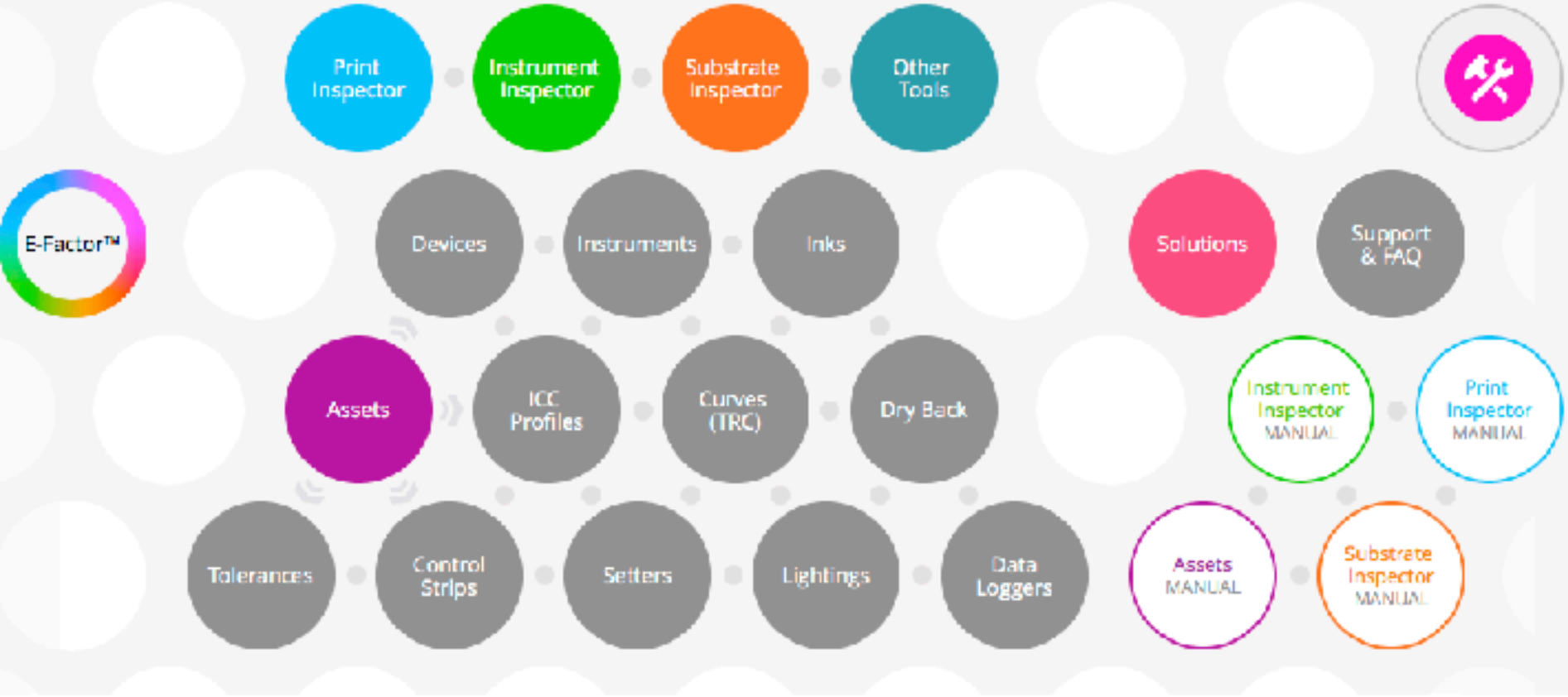
- Warns you if either substrate or instruments variation exceeds too much of total E-Factor

Assesses Consistency versus Accuracy

- Consistency- Related to device mechanics
- Accuracy- Related to Curves and or Color Mgmt

Multiple Inspectors and Tools

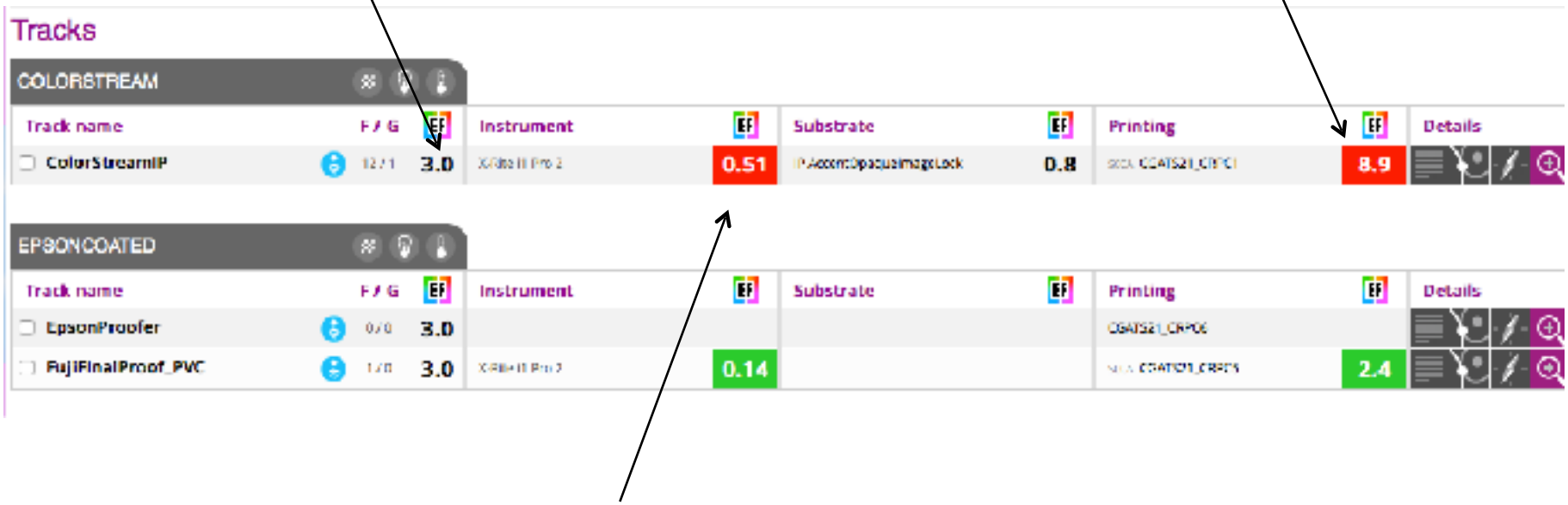
Designed to Control your Process



Desire Results vs. Actual Results

Desired E-Factor

Actual E-Factor



Instrument E-Factor- Red- too high compare to Target

Instrument Inspector

Unique Target, Printed, Represents 95% Color

- Tracks an instrument to itself

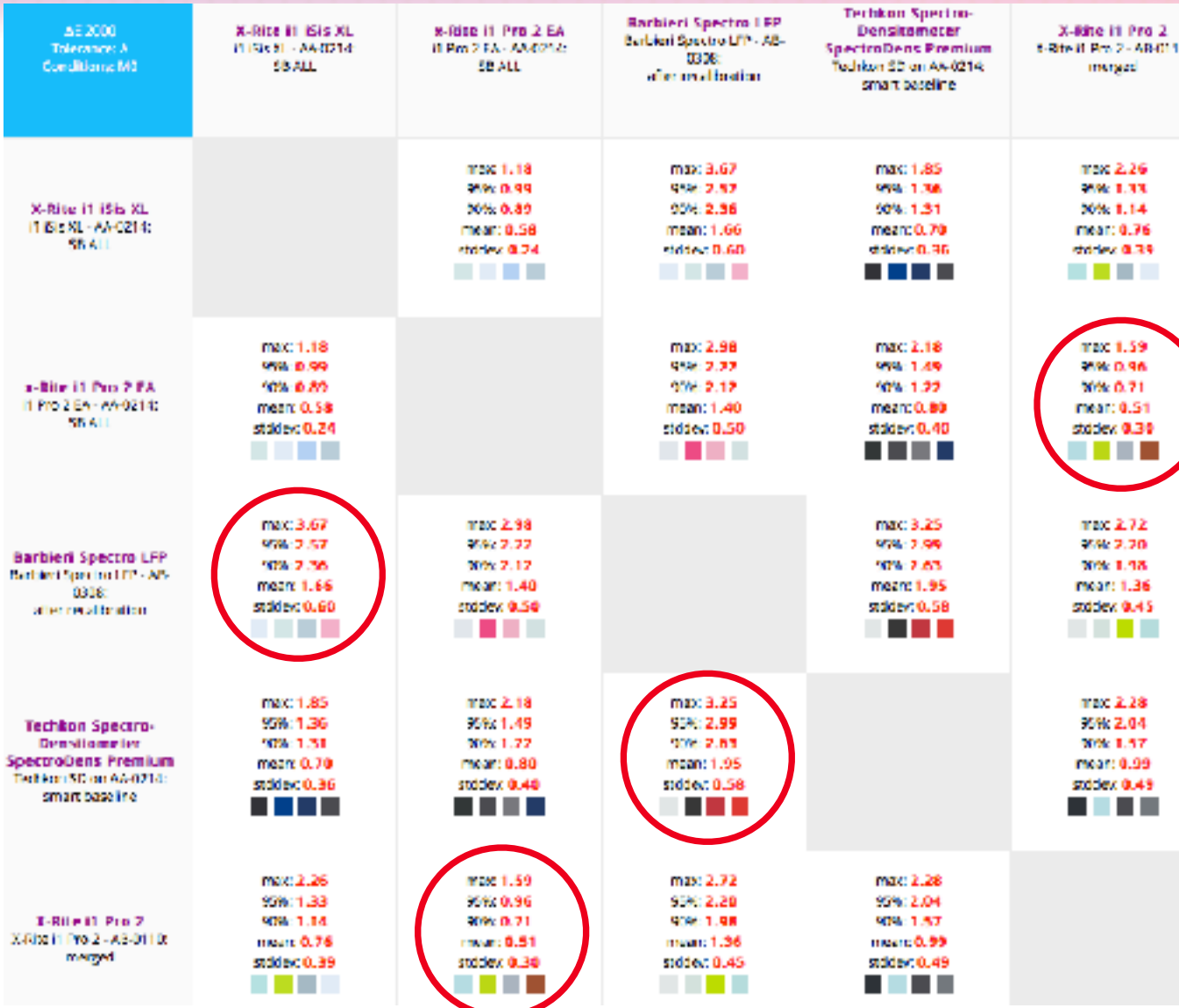
- Compare multiple instruments to one another
- Warns you when Instruments E-Factor makes up too much error compared to print process
- Ensure Instrument Consistency throughout supply chain

Instrument Inspector Comparison

Instrument Differences

Notice:

- 2 i1s
- Different Vendors



Substrate Inspector

Tracks Consistency during Production

- Instantly see results of inconsistent raw materials

Can be used to Find Best Match

- Find Proofing Stock
- Find similar production stock for different process

Lighting Inspector (Uses i1 of GL)

Assesses ISO 3664 Conformance

- Lighting Standard, both P1 and P2

Can Assess Change over time

- Know when to change bulbs

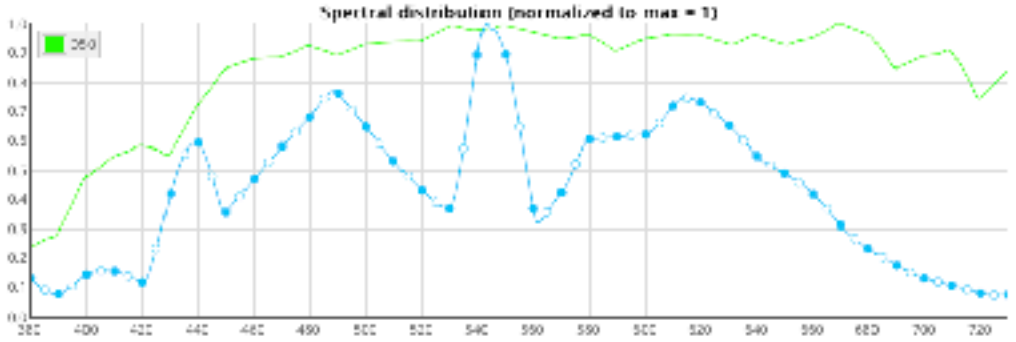
Can Compare multiple Light Booths

- See the difference in Supply Chain

Lighting Inspector (Uses i1)

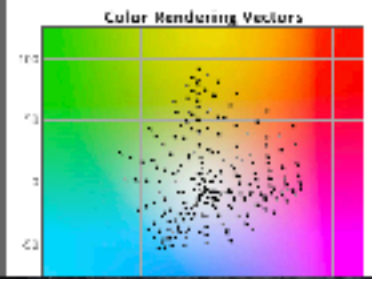
Basic information and spectral curve

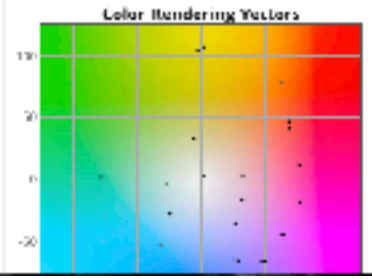
Color temperature (CCT)	4857 K
Illuminance	2159 lx
CRI (R_a, CIE 13.3)	95.3
CRI (R_a, 2012)	94.6
CQS (Q_a)	93
Metamerism Index	1.0 (C class)
ISO 3664 compliance	✔

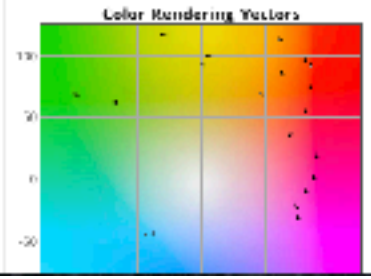


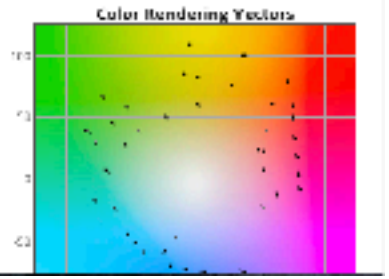
Lighting E-Factor

	DWK				Spots				Flux				Widegamut			
	AF2000	ΔE_{ab}	AC	AH	AF2000	ΔE_{ab}	AC	AH	AF2000	ΔE_{ab}	AC	AH	AF2000	ΔE_{ab}	AC	AH
E-FACTOR	1.32				2.46				2.01				1.97			
Max	1.55	1.55	2.00	2.42	2.64	2.35	2.56	3.65	2.15	2.37	4.08	3.81	2.39	2.51	4.55	3.42
95%	1.37	1.48	1.75	1.97	2.45	2.13	2.35	3.33	2.01	2.15	2.59	3.57	1.97	2.17	3.81	3.15
Mean	0.69	0.78	0.77	0.84	1.07	1.09	1.21	1.40	1.11	1.17	1.63	1.92	1.14	1.29	1.40	1.82
Std. dev.	0.32	0.34	0.34	0.51	0.65	0.55	0.65	1.14	0.48	0.52	0.86	1.14	0.54	0.54	0.91	1.02









PlateSetter – Anilox Tool

Know what values plate should be

- Track the raw/linear values (baseline)
- Track the production values
- Track consistency over time

Anilox – Associate with Print Track

- Easily enter data
- Keep track of which anilox goes with which track

Data Logger Tool

Automatically collects Temperature/ Humidity

- Track the atmospheric conditions associate with device performance
- Set high and low alarms
- Track consistency over time

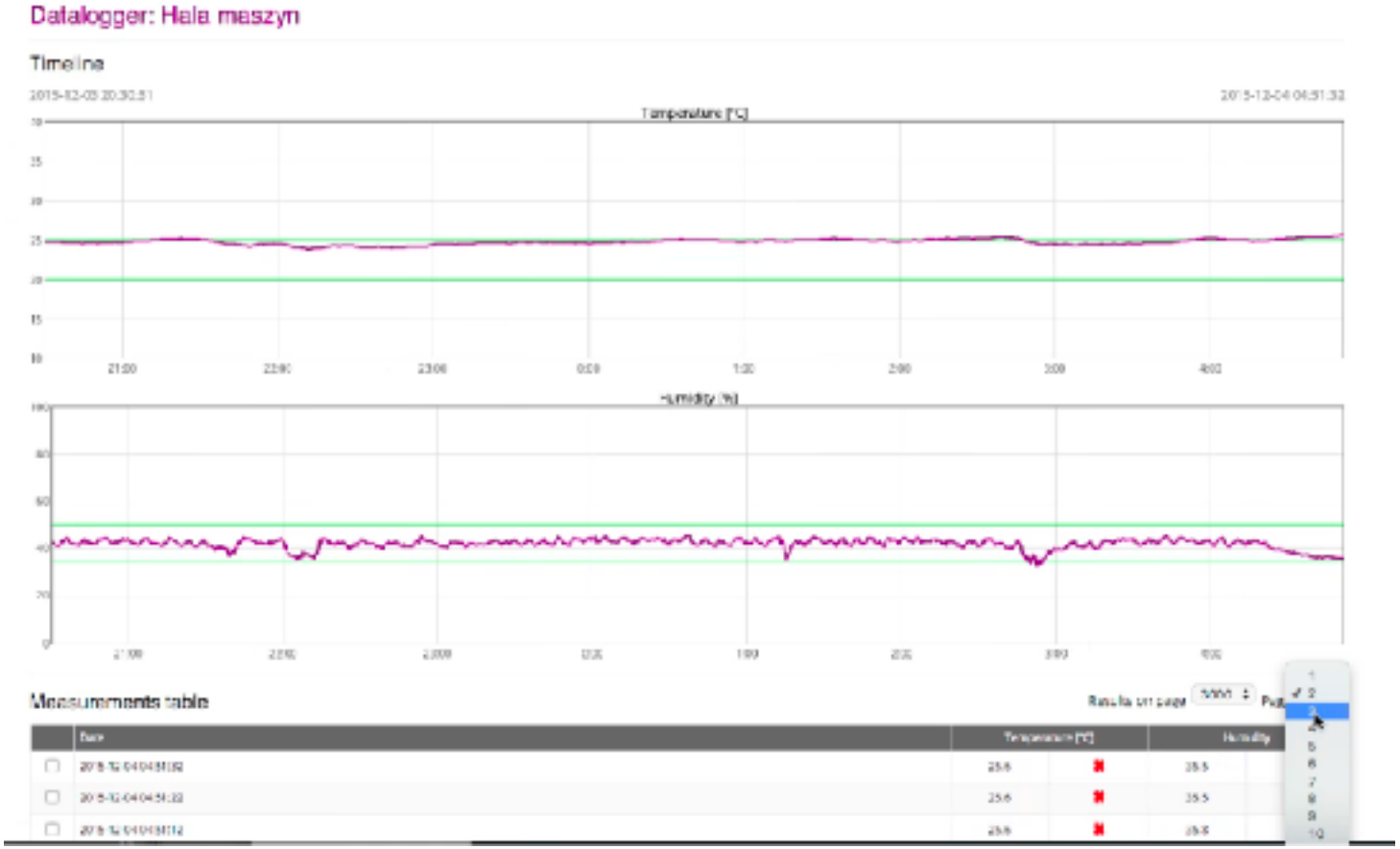
Can be used to measure water/ conductivity

- Automatically upload data

Data Logger Tool

Automatically collects Temperature/Humidity

- Automatically upload data



Start Now:

Take E-Factor Exercise- 3 Minutes

Upload your first 50 measurement- Free

- Learn What your output device “Normal” Is
- Not going to track all your variables right away
- Build your Process Control procedures one variable at a time. Grow as you Go!
  - *Start with your Output Device performance*
  - *Then Instrument, and Substrate, Lighting and Plates*
- Works with Any Target, Any Spectral Measurement
- We will help you get started...

ChromaChecker- Ease of Use

Anyone can Use ChromaChecker.com

- Three Levels of Detail for Output Devices
  - *Top Level- Owner View*
  - *Second Level – Production Manager*
  - *Third Level- Technician, Operator*
- Different Views for Different Devices
- Low Cost of use- Free to start, No Contract, Low cost per upload, only pay as you need

Track Process Control

Contact Me:

- David Hunter
- 651.717.0590
- david@chromachecker.com

Output Conformance- Track what?

Score Card of Print Attributes:

- While you are making production
- Not going to track all your variables right away
- Build your Process Control procedures one variable at a time. Grow as you Go!
  - *Start with your Output Device performance*
  - *Then Instrument, and Substrate, Lighting and Plates*

Complete Process Control Tracking

Requires a lot of work: Many Variables

- While you are making production
- Not going to track all your variables right away
- Build your Process Control procedures one variable at a time. Grow as you Go!
  - *Start with your Output Device performance*
  - *Then Instrument, and Substrate, Lighting and Plates*

Next Steps: E-Factor

Where do we go?

- Feedback for the equations
- Testing with equations
- Will hear more about Substrate Work
- Nothing Else quantifying Human Expectations
- Nothing Else quantifies:
  - *Instrumentation, Lighting, Substrates, Device Performance in Workflow*
  - *And how they interact in workflow (Weakest Link)*
- Easy to Understand for “Average User”

Difference Between:

Precision versus Accuracy

- *Precision (Repeatability/Reproducability) Depends*
  - Preventative Maintenance and Consumable Changes
  - Proper Calibration procedures

- *Accuracy (Color Match) Dependent on:*
  - Proper Color Conversion in Workflow or DFE/RIP
  - Correct Tone Reproduction Curve control Gray Balance

Difference Between:

Precision versus Accuracy

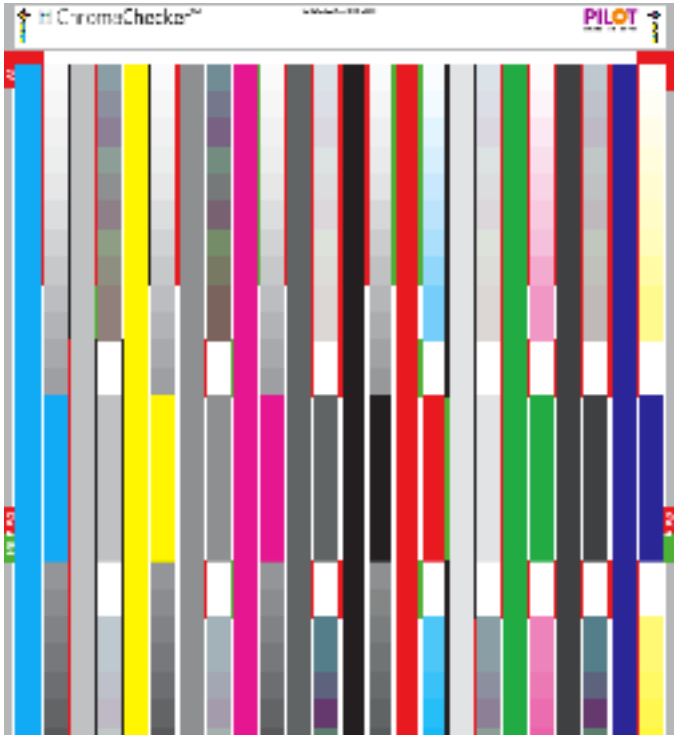
- *Precision (Repeatability/Reproducability) Depends*
  - Preventative Maintenance and Consumable Changes
  - Proper Calibration procedures
  - **Digital Operator Responsibilities**
- *Accuracy (Color Match) Dependent on:*
  - Proper Color Conversion in Workflow or DFE
  - Correct Tone Reproduction Curve control gray balance
  - **Prepress/Prep Responsibilities**
- *Need Both parties to attain Precision and Accuracy*

Assess Tone Reproduction Curve TRC

Tone Curve iteration Still FAILS

18. The Precision of the device is not tight enough for your assessment criteria

Assess Precision of your Device



Data which makes Line Graph

Consistency and Accuracy of Print Device

- Substrate, Device to Itself, Device to Reference

File list:

	Filename	Created	si		vi			π	ICC	Expert
☐	PRINTverifier_Export_2015_09_11_16h18s22.xml	2015-09-11 16:18	✔	1.3	✔		0.4	✖	4.1	
☐	PRINTverifier_Export_2015_09_11_16h18d37.xml	2015-09-11 16:18	✔	1.1	✔		0.9	✖	4.0	
☐	PRINTverifier_Export_2015_09_11_16h17s42.xml	2015-09-11 16:17	✔	1.1	✔		0.9	✖	4.1	
☐	PRINTverifier_Export_2015_09_11_16h17d27.xml	2015-09-11 16:17	✔	1.1	✔		0.3	✖	4.1	
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☐	PRINTverifier_Export_2015_09_11_16h15s54.xml	2015-09-11 16:15	✔	1.0	✔		0.4	✖	4.0	
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☐	PRINTverifier_Export_2015_09_11_16h17s00.xml	2015-09-11 16:17	✔	1.1			0.9	✔	4.0	
☐	PRINTverifier_Export_2015_09_11_16h17s24.xml	2015-09-11 16:17	✔	1.1			1.0	✖	4.0	
☐	PRINTverifier_Export_2015_09_11_16h12s10.xml	2015-09-11 16:12	✔	1.1			1.1	✖	4.2	
☐	baseline	2015-09-11 16:12	✔	1.0		±1.0	0	✖	4.0	