



Color Control Conversion

Presented by: David Hunter

STEPS TO DEFINING PROCESS DISCIPLINE

How to meet or exceed E-Factor?

Fourth of the 5 C's of Color Control

Capture — assess instrumentation capabilities

Calibration- make device consistent to itself & over time

Characterization — define device gamut and create profile

Conversion — map one gamut to another in the workflow

Conformance — verify new results and meet expectations

Conversion Requirements- RIP or Server

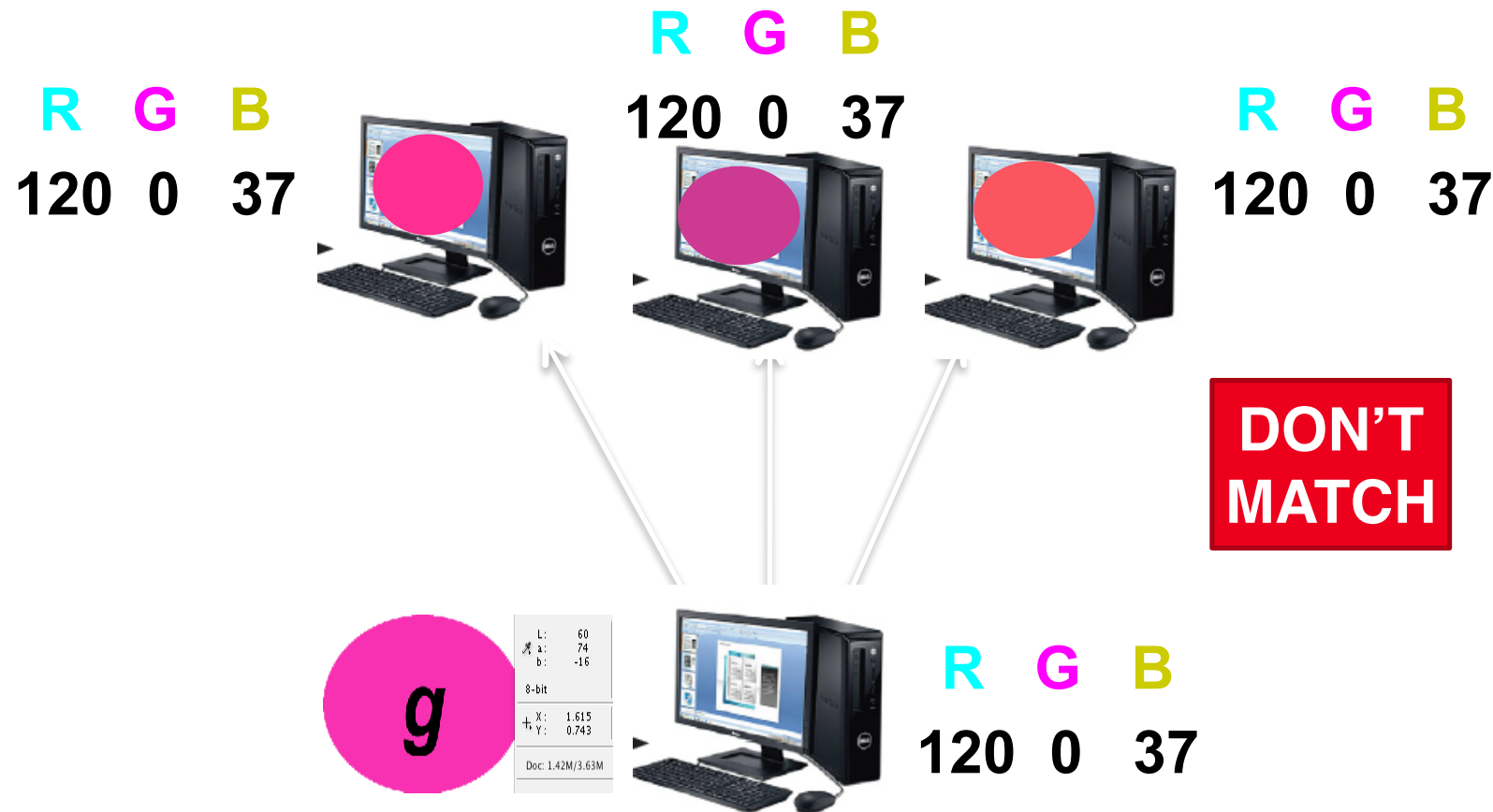
Make Conversion work... Requires Workflow software:

- Ensure Print Process is stable
- Software that performs conversion (RIP, Color Server)
 - *Choose Rendering Intent, Black Point Compensation, CMM*
- Defined Input/Source ICC Profile: RGB, CMYK, nColor
- Defined Output/Destination ICC Profile: RGB, CMYK, nColor
- Spot Color Conversion- need “Named color” LUT support
- Direction analogy, have to know where file is starting from to know how to get it (convert) to the destination

Problem- Conversion of Colors

Every Device Renders Color Differently

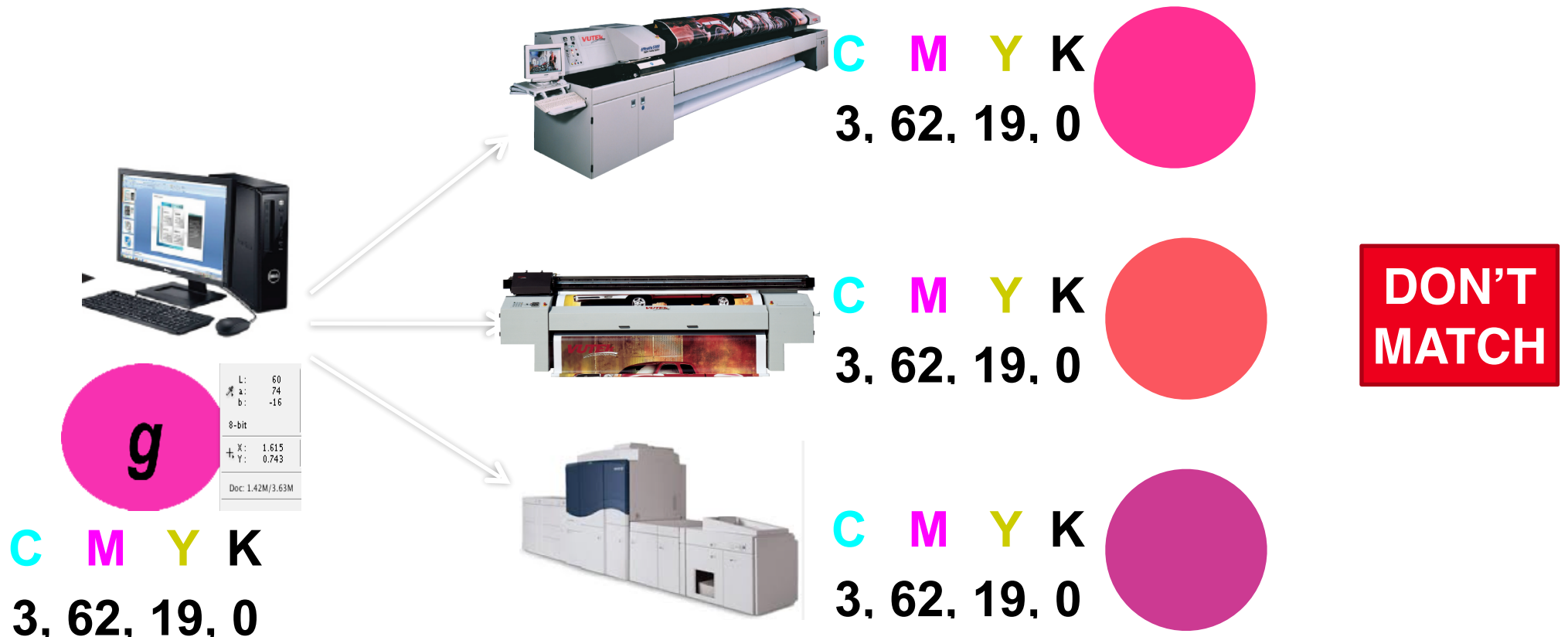
- Need to Convert to using custom ICC Profiles



Problem- Conversion of Colors

Every Device Renders Color Differently

- Need to Convert to different ICC Profiles



Problem- Conversion of Color Pages/Images

Characterization Defines Gamuts (Languages): Convert

- If No Conversion- Color is *different*, every printer *different*
- Goal- Reproduce the Original Color? or Maximize Color?



C M Y K
3, 62, 19, 0



C M Y K
3, 62, 19, 0

DON'T
MATCH



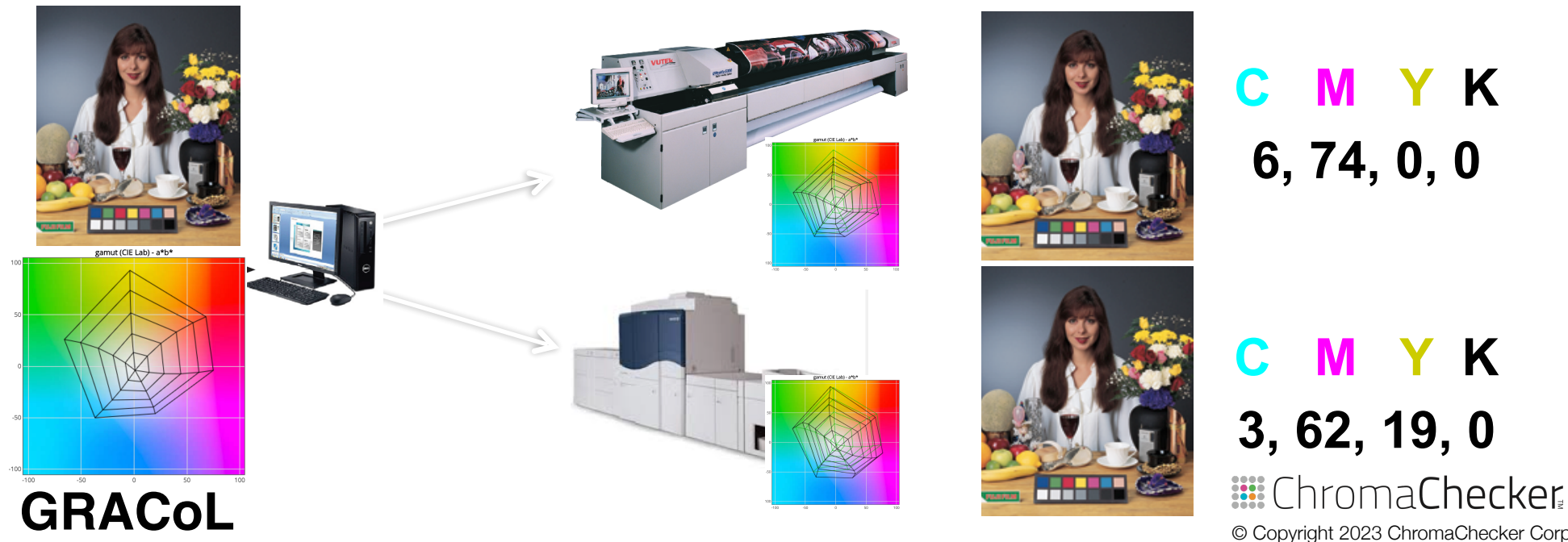
C M Y K
3, 62, 19, 0



Conversion of Pages- Strategic Issues

1. Determine Color Goals- Maximize Gamut, or Match?

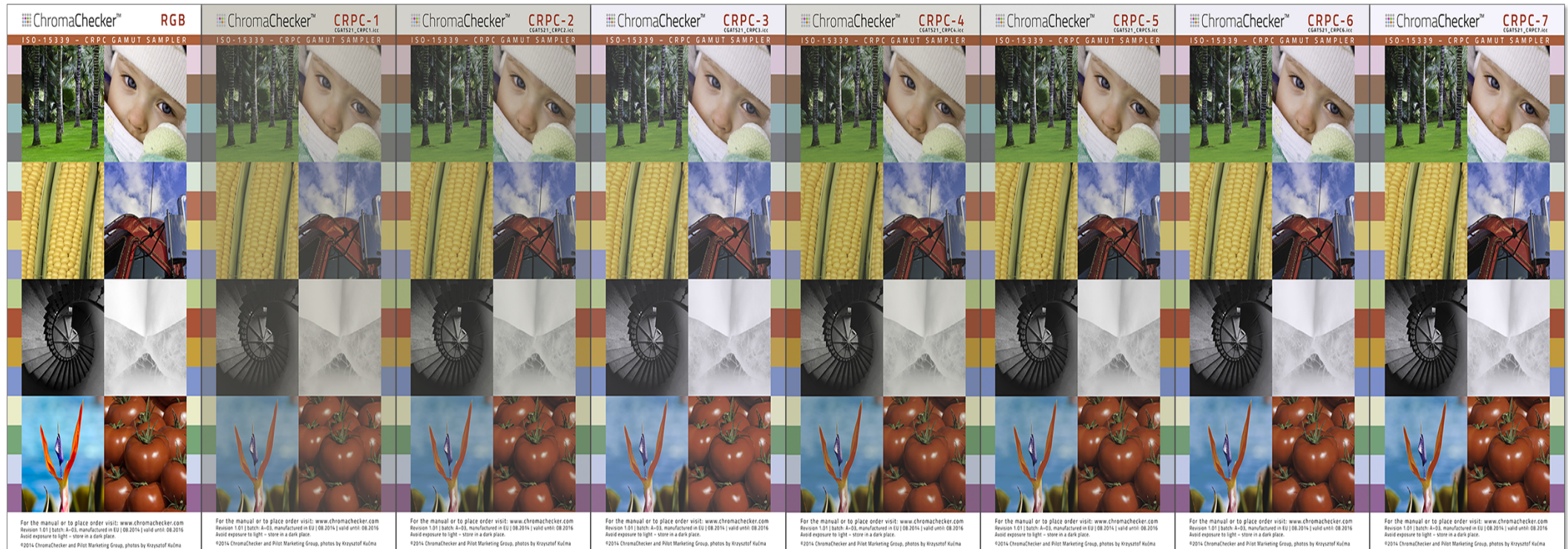
- Shared Visual Appearance (G7 Gray, Tonality)
- Color Match between printers
- Mix- Different settings to accommodate both options



Shared Visual (Common Color) Appearance

Maximize Gamut for Each Printer (Keep G7 Compliance)

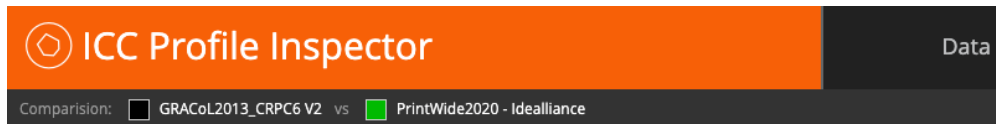
- G7 Gray, Tonality provides a common appearance
- Paper is the fifth color in four color printing



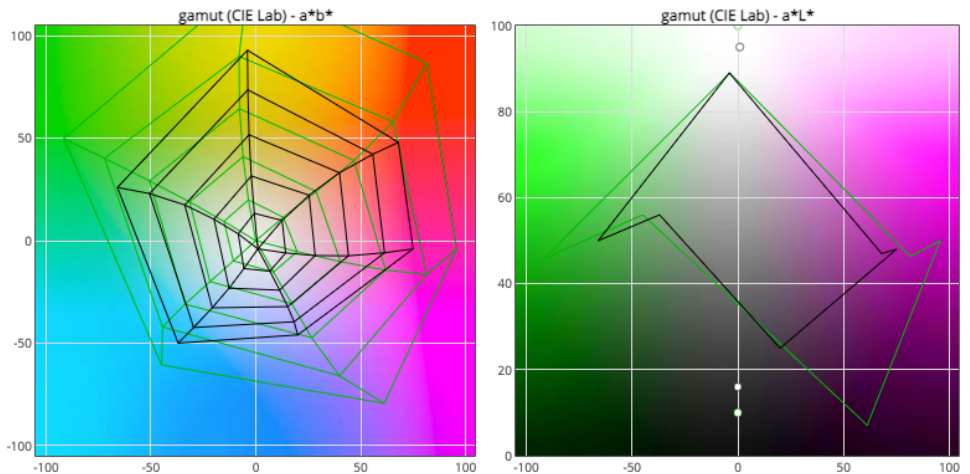
Two Popular Large Gamut CMYK Profiles

Use as INPUT Profile to Maximize Print Result

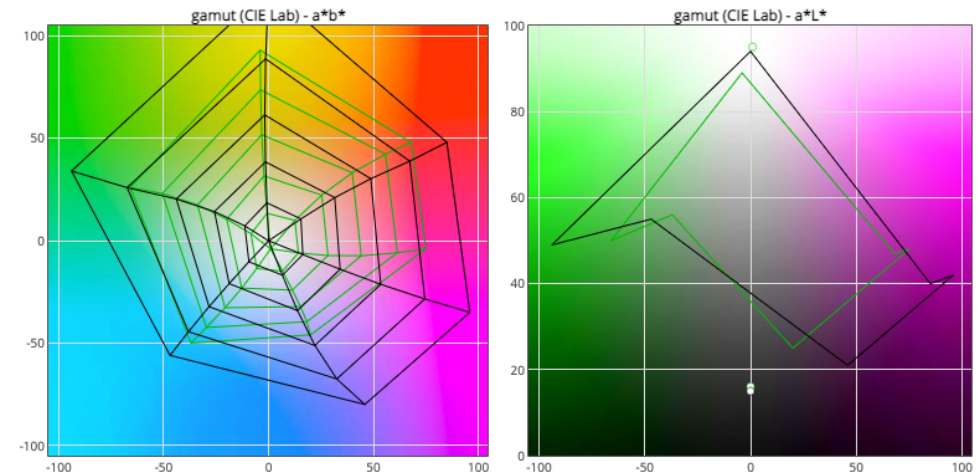
- ChromaChecker Wide Gamut (G7 Compliant)
- Idealliance PrintWide (G7 Compliant)



Gamut



Gamut



Assign Wide Gamut CMYK to Existing CMYK

Use as INPUT Profile to Maximize Print Result

- ChromaChecker Wide Gamut or PrintWide (G7 Compliant)



Two Popular Large Gamut CMYK Profiles



50%

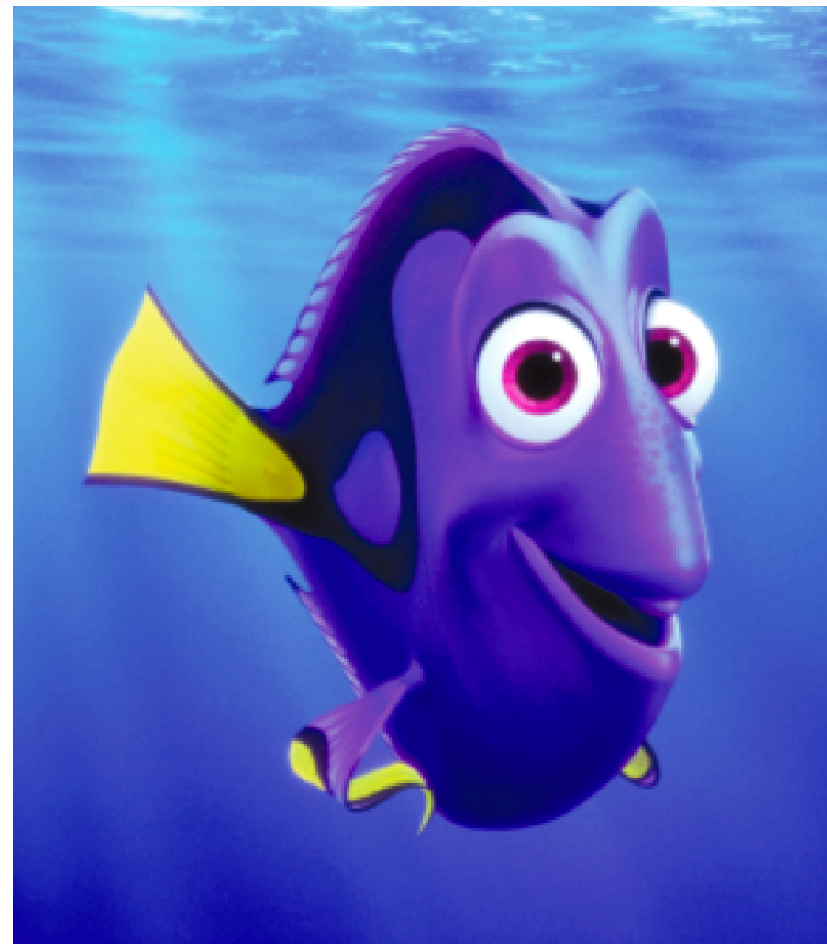


RPC8 V3 Hunter Wide Gamut (8bpc)

Two Popular Large Gamut CMYK Profiles



Original CMYK (USWebSWOP)

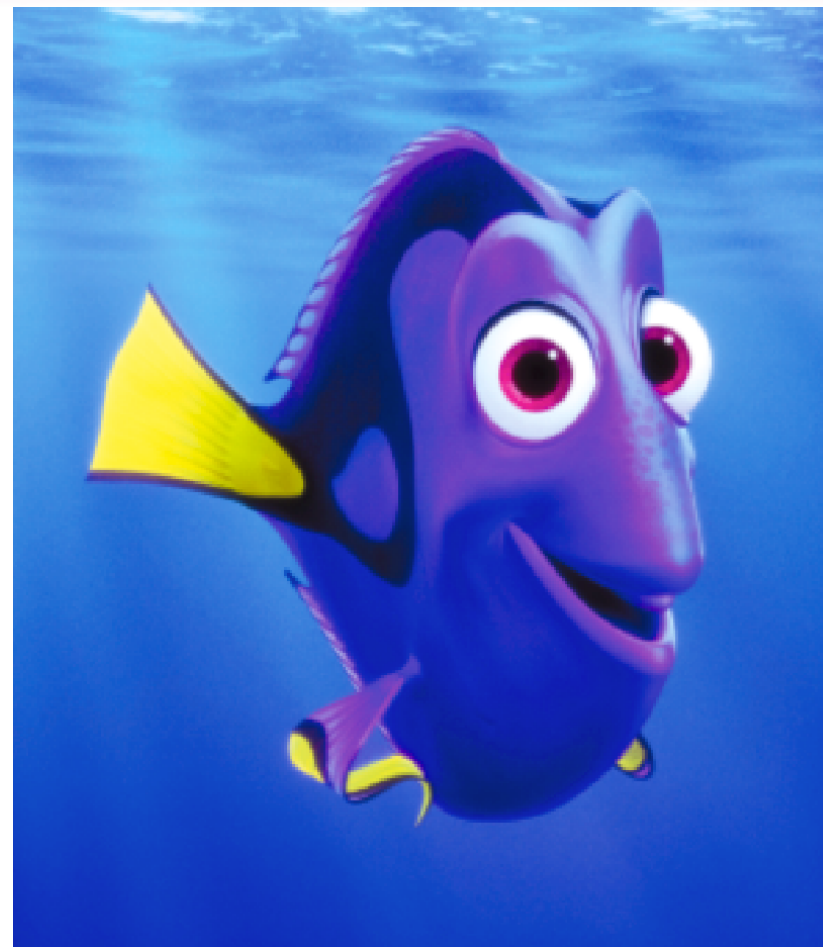


Assign PrintWide CMYK

Two Popular Large Gamut CMYK Profiles



Original CMYK (USWebSWOP)



Assign ChromaChecker Wide

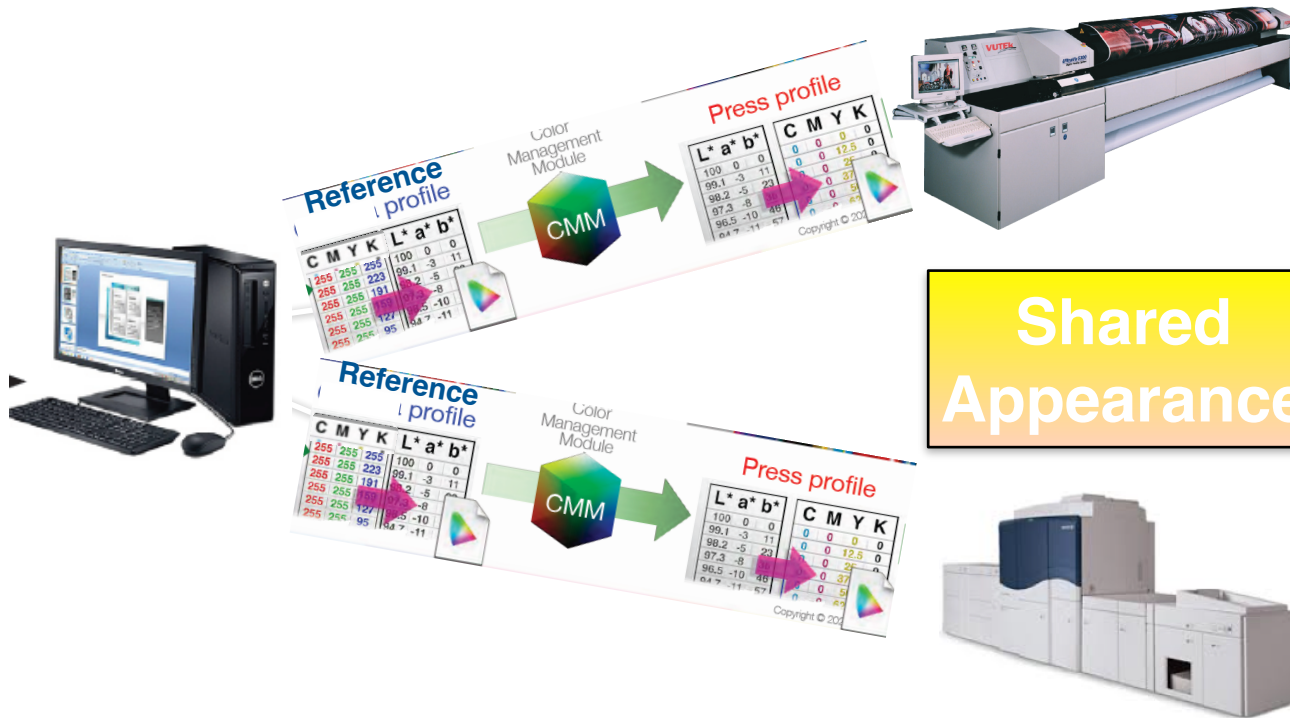
Maximize Color Conversion for Pages

Goal- Maximize Original Color

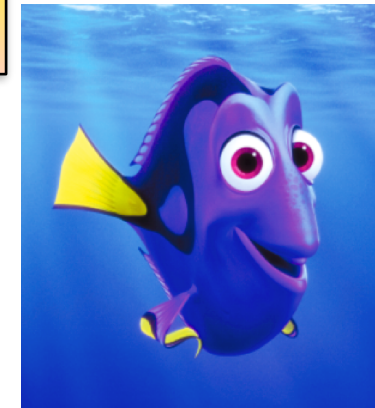
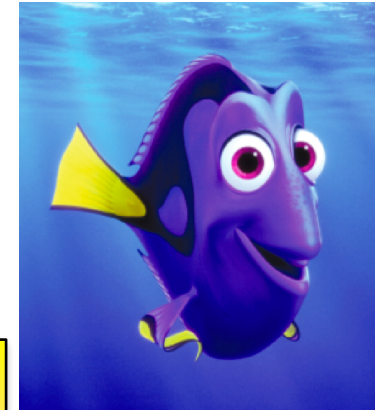
**DON'T
MATCH**



**Assign Large
Gamut Profile**



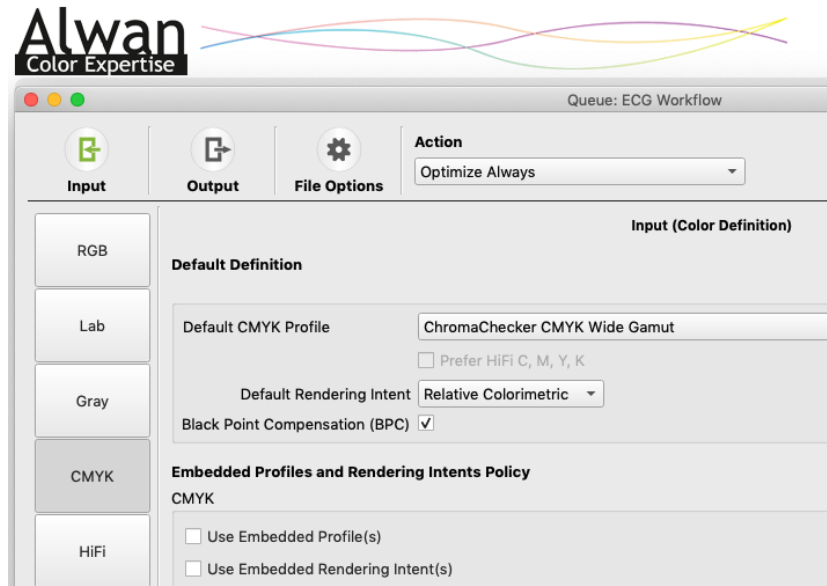
**Shared
Appearance**



Steps:

Maximize Gamut

- Need Original files in correct Large Gamut Color Space
- Assign- not Convert: into Large Gamut Color Space
 - Essentially give new definitions for CMYK values
- Easily done using Color Server



BPC- ON
Embedded- OFF

How to Maximize Printer Gamut:

When Configuring Printer to be ICC Profiled:

- Calibrate, linearize and ink limit to maximum chroma
 - Ensure Overprints do not “hook”
- Create ICC Profile for output printer

In Workflow: (RIP or Color Server)

- Set Input/Source Profile: CMYK Large Gamut
- Set Output/Destination Profile: Above printer profile
- Experiment with Rendering Intents- Relative Colorimetric to start

Result: Printer will be G7 Compliant, good hue angles

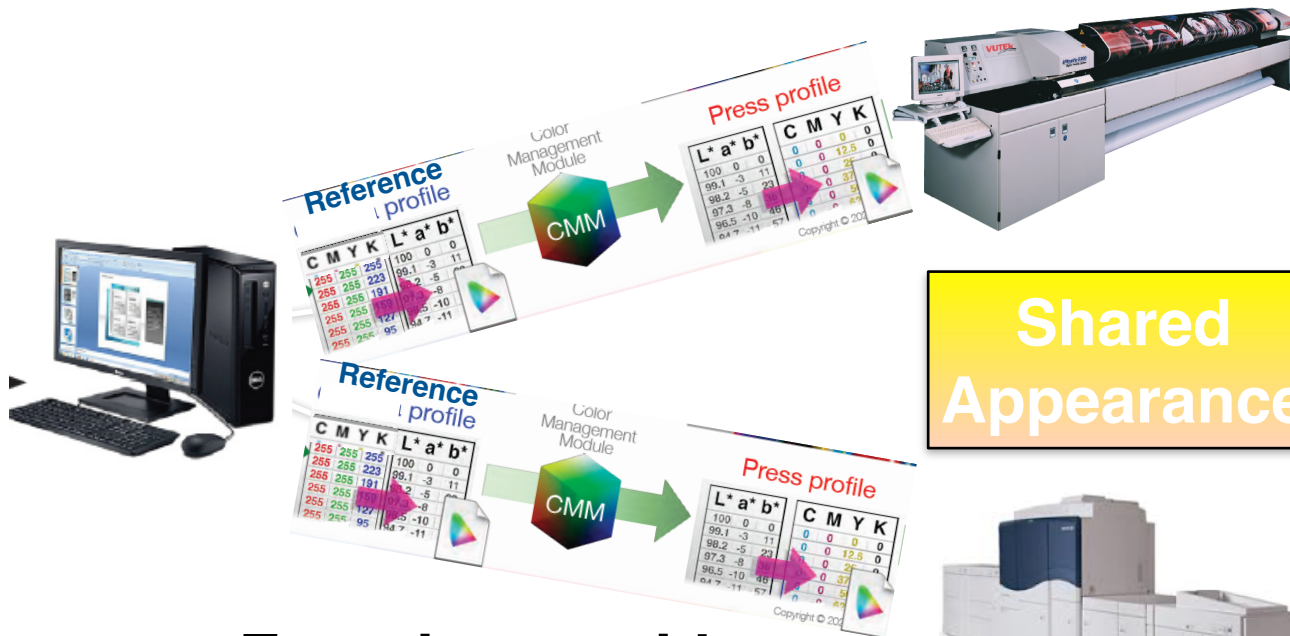
Maximize Color Conversion for Pages

Goal- Maximize Original Color

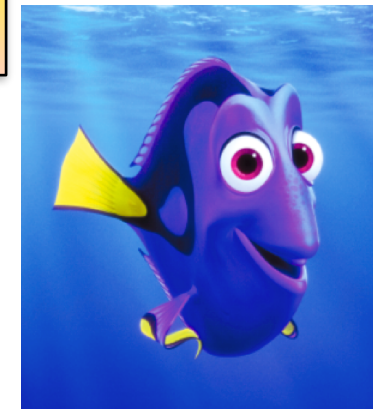
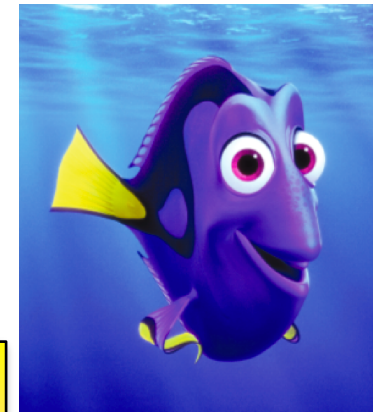
**DON'T
MATCH**



**Assign Large
Gamut Profile**



**Shared
Appearance**



**Experiment with
Rendering Intents:
Rel. Colorimetric/Perceptual**

Color Matching- Simulation Procedures

Goal Match Original Colors

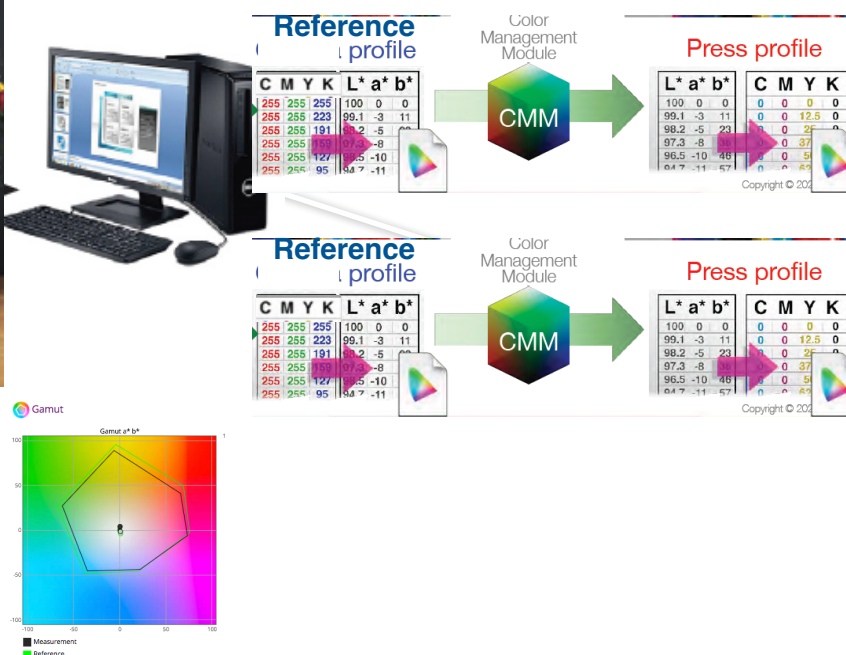
- Simulate GRACoL- Output gamut larger than GRACoL

Input/Source Profile

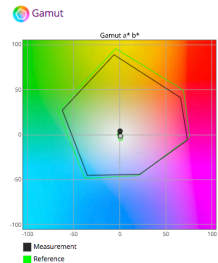
Output/Destination Profile



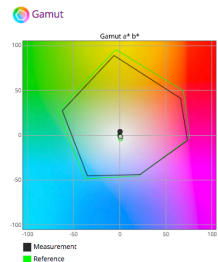
**GRACoL
Profile**



Vutek



iGen



Color Match Conversion of Pages

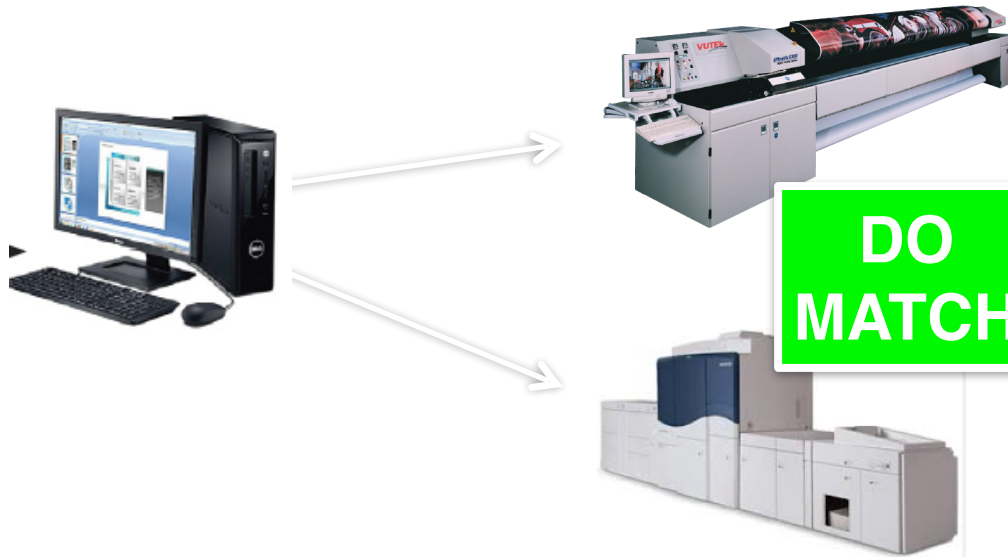
Match Color- Output Gamut larger then Reference Gamut

- Goal- Reproduce the Original Color

GRACoL



C M Y K
3, 62, 19, 0



C M Y K
10, 53, 9, 0



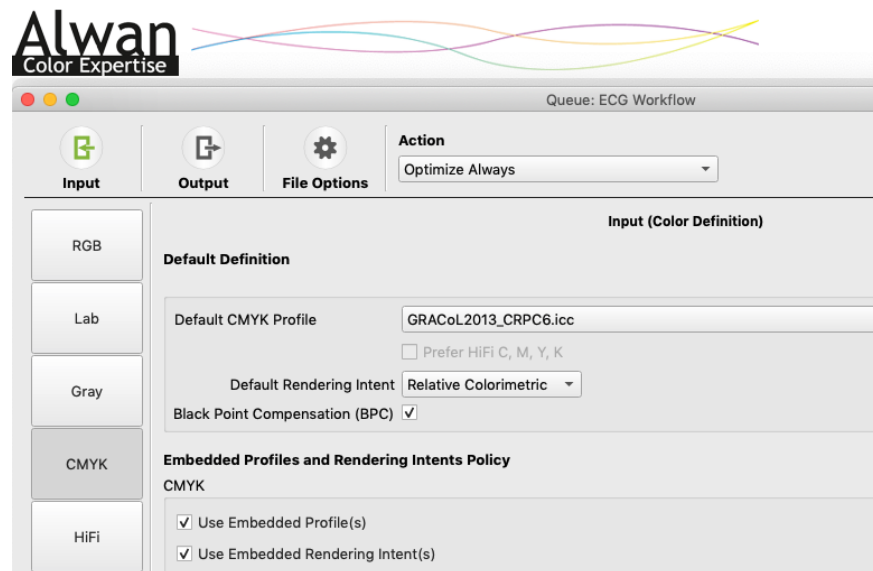
C M Y K
6, 74, 11, 0



Steps:

Match Gamut

- Need Original files in correct Reference Gamut Color Space
- Assign- not Convert: into Reference Gamut Color Space
 - Essentially give new definitions for CMYK values
- Easily done using Color Server



BPC- ON
Embedded- ON

How to Match Printer Gamut:

When Configuring Printer to be ICC Profiled:

- Calibrate, linearize & ink limit to values larger than GRACoL
- Create ICC Profile for output printer

In Workflow: (RIP or Color Server)

- Set Input/Source Profile: Reference Gamut (GRACoL)
- Set Output/Destination Profile: Above printer profile
- Experiment with Rendering Intent:
 - Relative/Absolute Colorimetric/Hybrid

Result: Printer will be G7 Compliant, good hue angles

How to Check Conformance

Different Tracks for Different Print Conditions

- Match GRACoL, Maximize Gamut, Different Paper, Post

Digital Collapse Expand Uncheck All ☐ Check All ☒

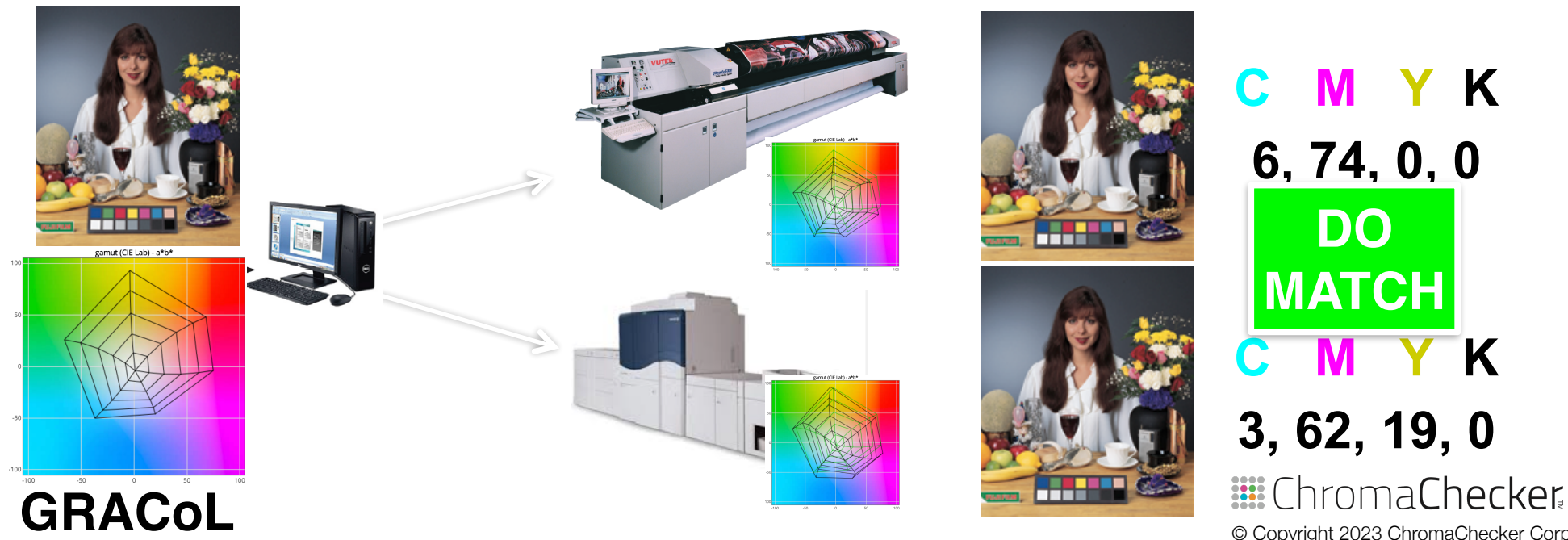
▼ ColorPress 1									
Track Name	Files				Reference Printing Conditions	Substrate		Last Meas.	
☐ Coated	485	6.0			SCCA GRACoL2013_CRPC6 V2	DW-62	1.1	2 years	4.6
☐ Uncoated	4	8.0			SCCA CRPC5_Baltoro_G7			1 year	4.7
☐ Coated_Full Gamut	3	6.0			SCCA PrintWide2020 - Idealliance	DW-62	4.1	6 years	4.1
☐ Matte Lamination	3	8.0			SCCA OK2			6 years	1.9
☐ PRE Matte Lamination	2	8.0			SCCA ok4			6 years	1.9

▼ ColorPress 2									
Track Name	Files				Reference Printing Conditions	Substrate		Last Meas.	
☐ Coated	389	6.0			SCCA GRACoL2013_CRPC6 V2	DW-62	1	2 years	5.3
☐ Coated_Full Gamut	0	6.0			SCCA PrintWide2020 - Idealliance	DW-62			

Color Conversions- Pages vs Brand Colors

Converting from current space to desired print space

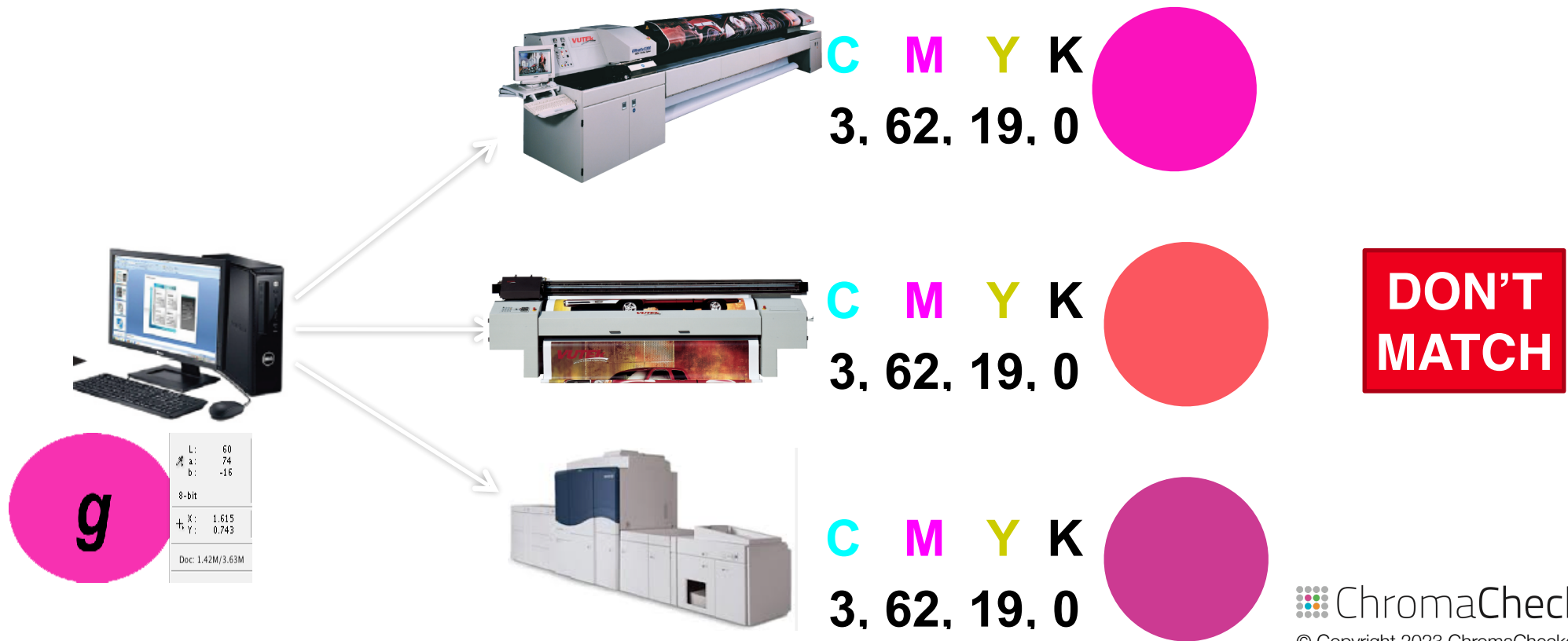
- Convert pages and images- Process conversions
- Convert brand colors- Named colors in look up table (LUT)
- Workflow/RIP function, some support, some don't



Brand Color Conversions

Do NOT manage Brand Colors as CMYK values...

- Unless you are only printing to one printer/substrate
- Colors will not match on other printers (even same model)



Brand Color Conversions

Make Brand Colors as “Named” Colors (own spot)

- Give Brand colors specific names: Coke Red
- Workflow uses Look Up Table to substitute device CMYK
- Software creates Look Up Table:

Virtual Spot Print

Tracking

LUTs

Assets

Library: BestBuy2 ICC profile: GRACoL2013_CRPC6 M. cond.: M0 ΔE 2000 Threshold: 2

Export

File format

CGATS Lab + CMYK + deviation

Save

Download

Color list

ID	Name	Original L*a*b*				Predicted Reproduction			GRACoL2013_CRPC6				ΔE 2000
		L*	a*	b*		L*	a*	b*	Cyan	Magenta	Yellow	Black	
R1	BBYHumanBlue	33.27	10.44	-56		33.05	6.15	-45.55	97.25	74.51	0.00	0.00	3.82
R9	BBY_MyBBYBlue	43.92	-21	-58		44.86	-19.24	-46.51	100.00	33.73	0.00	3.53	3.54
R0	BBYDkBlue	20.89	15.39	-42.53		23.03	16.11	-38.42	100.00	100.00	0.00	20.39	2.61
R5	BBYLtBlue	52.23	-2.62	-42.99		51.49	-3.93	-37.99	72.94	40.78	0.00	0.00	2.18
R6	BBYDkYellow	85.21	4.85	83.14		84.86	2.46	83.11	0.00	9.41	94.12	0.00	1.38
R15	BBY_PacSalesRed	50.47	65.4	52.7		49.43	63.26	49.89	0.00	91.37	100.00	0.00	1.35
R8	BBYValueRed	45.5	68.23	41.43		46.59	66.65	41.40	0.00	100.00	88.24	2.75	1.17
R2	BBYTechYellow	88.41	-4.98	97.52		88.85	-4.19	92.71	0.39	0.00	100.00	0.00	1.00
R16	BBY_GS_Orange	61.72	43.13	61.16		61.04	41.29	60.43	0.00	63.14	99.61	0.00	0.95
R3	BBYTechBlack	14.59	-1.35	-5.2		14.89	-1.65	-4.63	84.71	63.92	48.63	85.49	0.67
R13	BBY_MagnoliaRed	37.2	45.6	34.3		37.73	45.61	34.56	0.00	91.76	96.47	34.12	0.47
R7	BBYLtGray	86.4	-2.27	-10.73		86.49	-2.26	-11.28	16.47	3.92	1.18	0.00	0.38
R17	BBYDkGray	38.86	-2.07	-3.01		38.91	-2.26	-2.99	61.96	47.06	47.45	32.55	0.25
R4	BBYTechWhite	90.15	-0.29	-6.33		90.21	-0.33	-6.62	8.24	2.75	1.96	0.00	0.23
R14	BBY_PacSalesBlue	48.81	-27.89	-45.84		49.04	-28.01	-45.93	99.61	16.08	0.78	6.27	0.23
R10	BBY_GS_CoolGray3	80.5	0.33	-0.16		80.51	0.25	-0.08	18.04	13.33	17.25	0.00	0.14
R11	BBY_GS_CoolGray6	64.65	0.52	-2.3		64.77	0.49	-2.21	36.08	27.84	28.24	5.10	0.13
R12	BBY_GS_CoolGray9	46.01	-0.11	-4.06		46.00	-0.08	-4.07	54.12	43.14	40.00	22.35	0.04

Out of Gamut

Brand Color Conversions

Ensure Key Brand Colors are in Printer Gamut

- Printer can only make so many colors, substrate is key

Virtual Spot Print Tracking LUTs Assets

Library: BestBuy2 ICC profile: GRACoL2013_CRPC6 M. cond.: M0 ΔE 2000 Threshold: 2

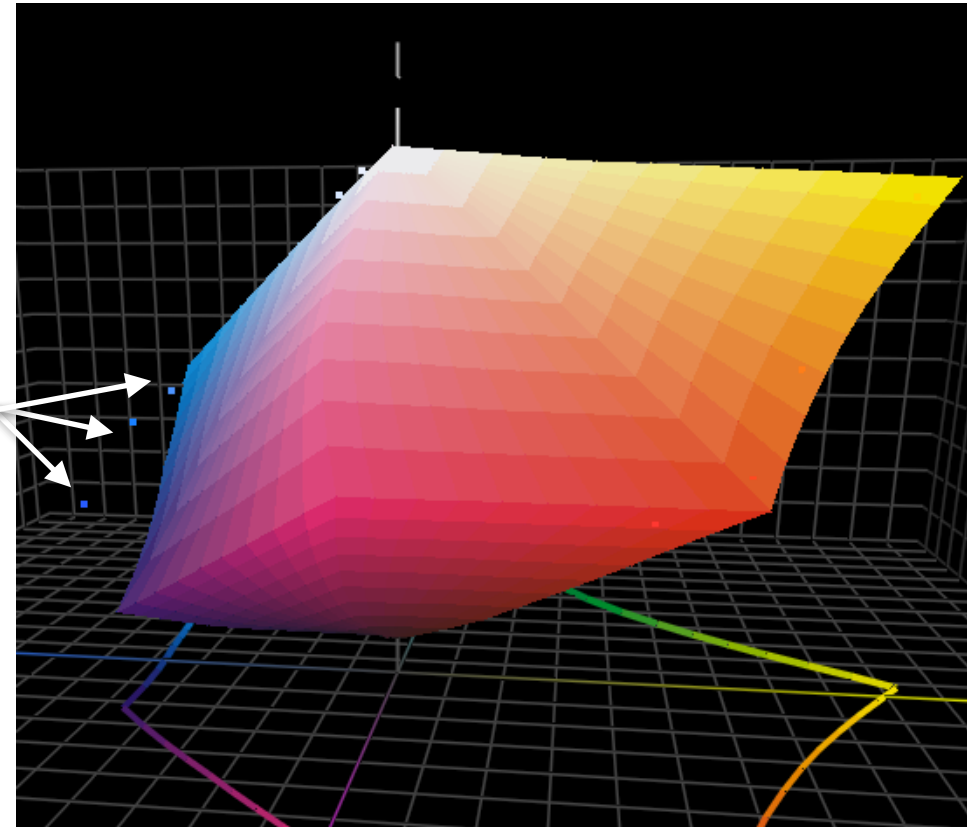
Export

File format: CGATS Lab + CMYK + deviation Save Download

Color list

ID	Name	Original L*a*b*				Predicted Reproduction			GRACoL2013_CRPC6				ΔE 2000
		L*	a*	b*		L*	a*	b*	Cyan	Magenta	Yellow	Black	
R1	BBYHumanBlue	33.27	10.44	-56		33.05	6.15	-45.55	97.25	74.51	0.00	0.00	3.82
R9	BBY_MyBBYBlue	43.92	-21	-58		44.86	-19.24	-46.51	100.00	33.73	0.00	3.53	3.54
R0	BBYDkBlue	20.89	15.39	-42.53		23.03	16.11	-38.42	100.00	100.00	0.00	20.39	2.61
R5	BBYLtBlue	52.23	-2.62	-42.99		51.49	-3.93	-37.99	72.94	40.78	0.00	0.00	2.18

Out of Gamut



Brand Color Steps

Make Brand Colors Match

- Ensure Brand Colors are set up as “Named Colors”
 - Some Color Server software can automate
- Ensure Brand Colors are in gamut of output device(s)
- Ensure Workflow can import “Named Color” List
 - Some workflows have 28 color limitation
- Export Named Color List to import into RIP/Color Server

The screenshot displays the 'Virtual Spot Print' interface. At the top, there are tabs for 'Tracking', 'LUTs', and 'Assets'. Below the tabs, a status bar shows 'Library: BestBuy2', 'ICC profile: GRACoL2013_CRPC6', 'M. cond.: M0', and 'ΔE 2000 Threshold: 2'. The 'Statistics' section shows a table with 18 samples, 14 (78%) below threshold, a maximum ΔE of 3.82, an average of 1.14, and a standard deviation of 1.17. An 'Export' dropdown menu is open, showing options like 'CGATS CMYK', 'CGATS Lab', 'CGATS Lab + CMYK', and 'CGATS Lab + CMYK + deviation'. The 'Color list' section shows a table with columns for ID, Name, Original L*a*b*, Predicted Reproduction (L*, a*, b*), and GRACoL2013_CRPC6 (Cyan, Magenta, Yellow, Black, ΔE 2000). The table lists 18 colors, with the first color (R1, BBY) having a ΔE of 3.82.

Samples		Samples < threshold	Max.	Average	Std. dev.
18		14 (78%)	3.82	1.14	1.17

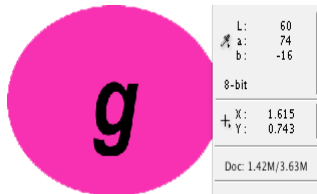
ID	Name	Original L*a*b*	Predicted Reproduction	GRACoL2013_CRPC6	ΔE 2000						
		a*	b*	L*	a*	b*	Cyan	Magenta	Yellow	Black	
R1	BBY	10.44	-56	33.05	6.15	-45.55	97.25	74.51	0.00	0.00	3.82
R9	RRY	-71	-58	44.86	-19.74	-46.51	100.00	33.73	0.00	3.53	3.54

Conversion of Brand Colors

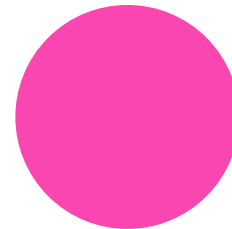
Spot Color Look Up Table (LUT)

- Renders Brand color (Lab) to device CMYK values

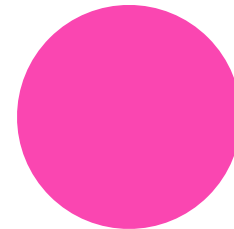
RIP or Server has
to support LUTs



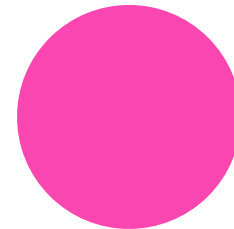
C M Y K
6, 74, 0, 0



C M Y K
3, 62, 19, 0



C M Y K
1, 75, 1, 0



Conversion Summary

Planning and Execution is Critical for Success

- Determine printers will render full gamut, vs simulation
- Ensure Customer Supplied files are in Correct Gamut
 - Wide Gamut for maximizing color
 - Reference Color for matching color
 - Named Colors for brand critical colors
- Optimize your ICC Profile Procedures
- Configure your workflows for Optimum Conversions
- Verify Results, Different Tracks for different conditions

Learn More:

Next Steps

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- Test software:
 - [Chromachecker.com/trial](https://chromachecker.com/trial)
 - ChromaChecker.com - Register
- Color Quality Conference- Jan 30, 31, 1 2024 Tampa Area
- July 11: 5th C- **Conformance**