



# Expanded Gamut Shoot-Out: Real Systems, Real Results

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Advisors

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COLOR20

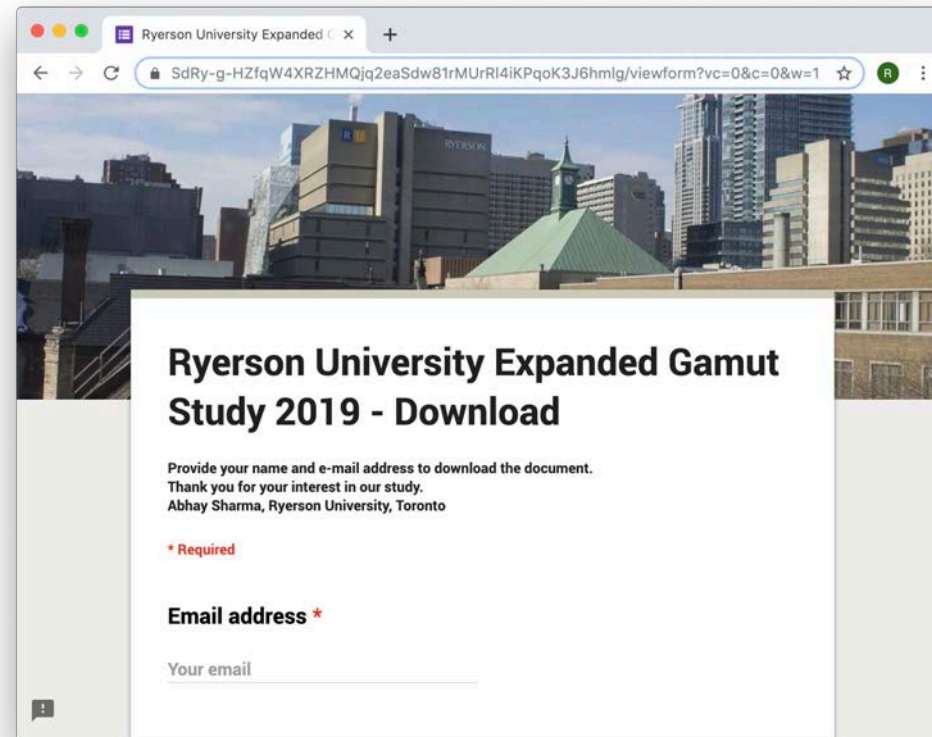
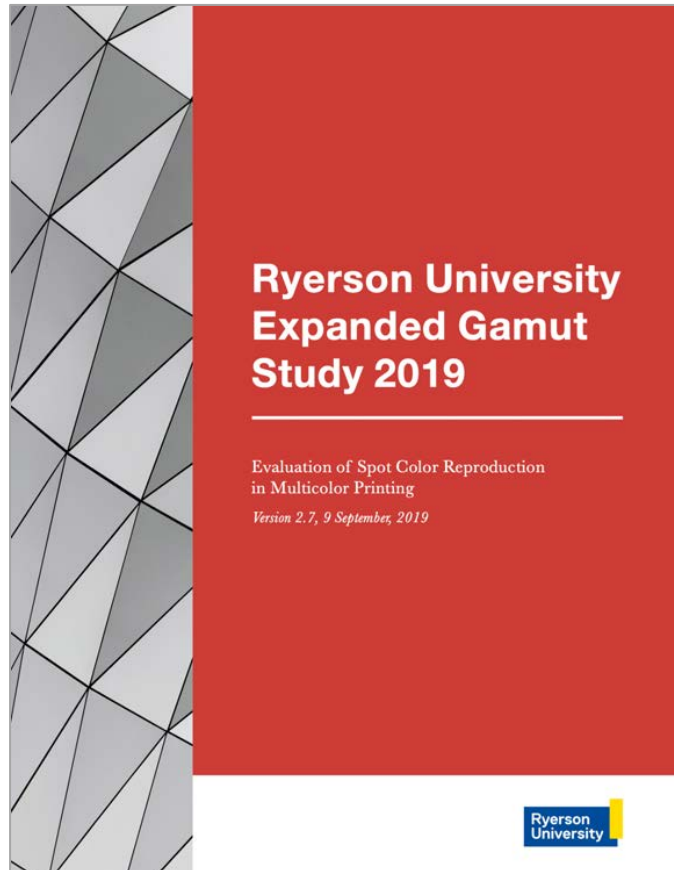
get the answers here

The logo for Ryerson University, featuring the text 'Ryerson University' in white, sans-serif font on a blue rectangular background with a yellow vertical bar to the right.

Ryerson  
University

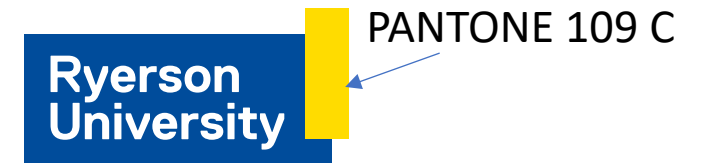
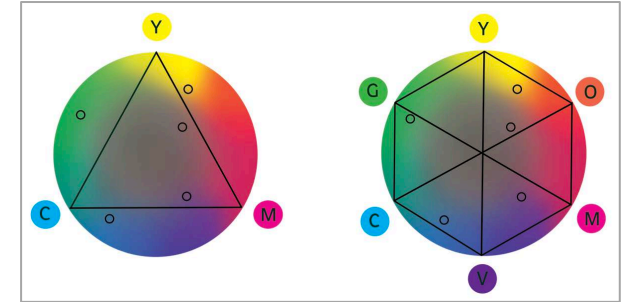
# Comprehensive Report – 450+ downloads

[tinyurl.com/ExpandedGamut](https://tinyurl.com/ExpandedGamut)



# Agenda – Expanded Gamut

- Why do we need Expanded Gamut?
- What is Expanded Gamut? (CMYK-OGV)
- Use cases – Spot Colors vs Images
- Printing Spot Colors with Kodak Spotless (KSS)
- **Increased Accuracy**
- **Using only 3 inks**
- **Print all spot colors, without spot color inks**
- How do I implement EG?
- Issues with Adobe and Pantone
- Flexo testing in 2020



# Vendors and Participants

## Software Solutions

1. Alwan – Toolbox, ColorHub
2. CGS ORIS – X GAMUT
3. ColorLogic – ColorAnt, CoPrA, ZePrA
4. GMG Color – OpenColor, ColorServer
5. Heidelberg – Prinect ColorToolbox
6. Kodak – Kodak Spotless Software, Prinergy

## PDF Editor

- Hybrid Software - PACKZ (pronounced “packs”)

## RIP/DFE

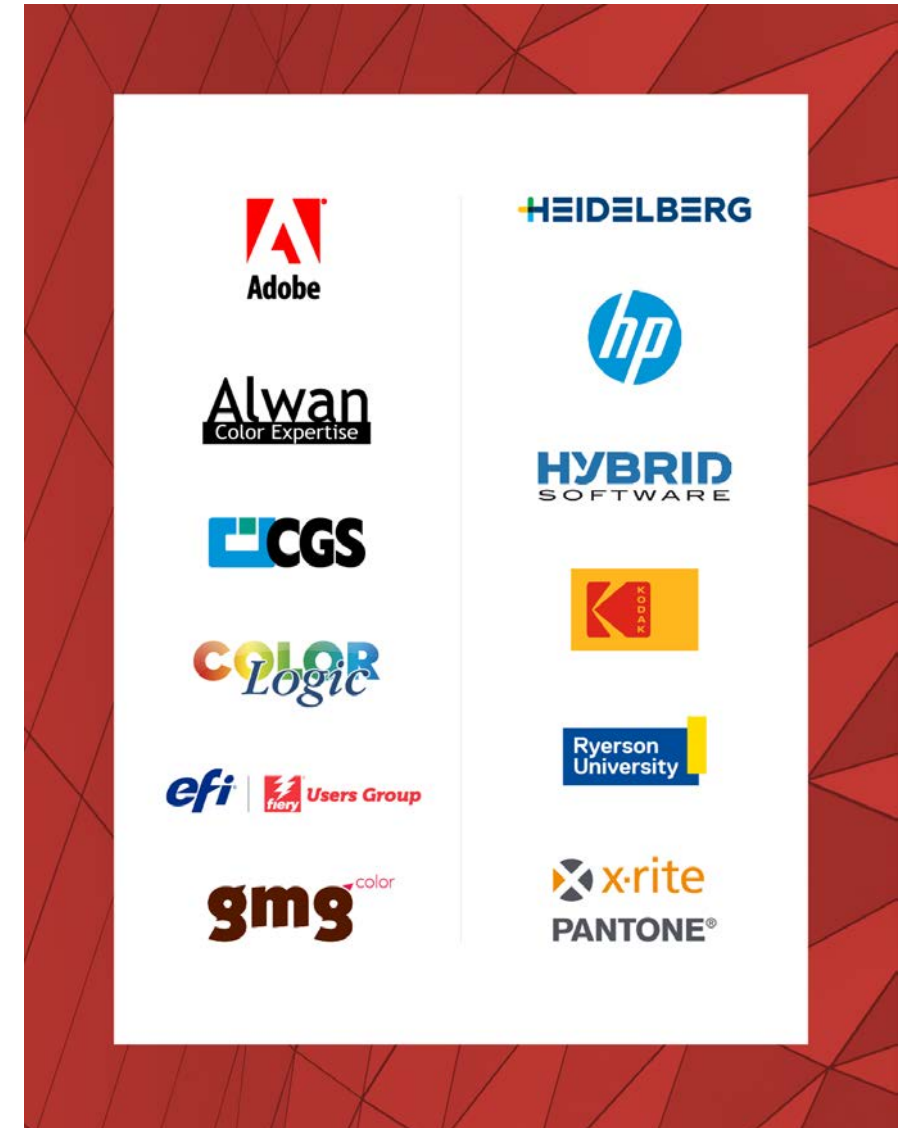
- efi Fiery XF (Command WorkStation) – Epson P9000
- SmartStream Production Pro – HP Indigo 7900

## Color Management Solutions

- X-Rite i1Profiler

## Expanded Gamut Tools

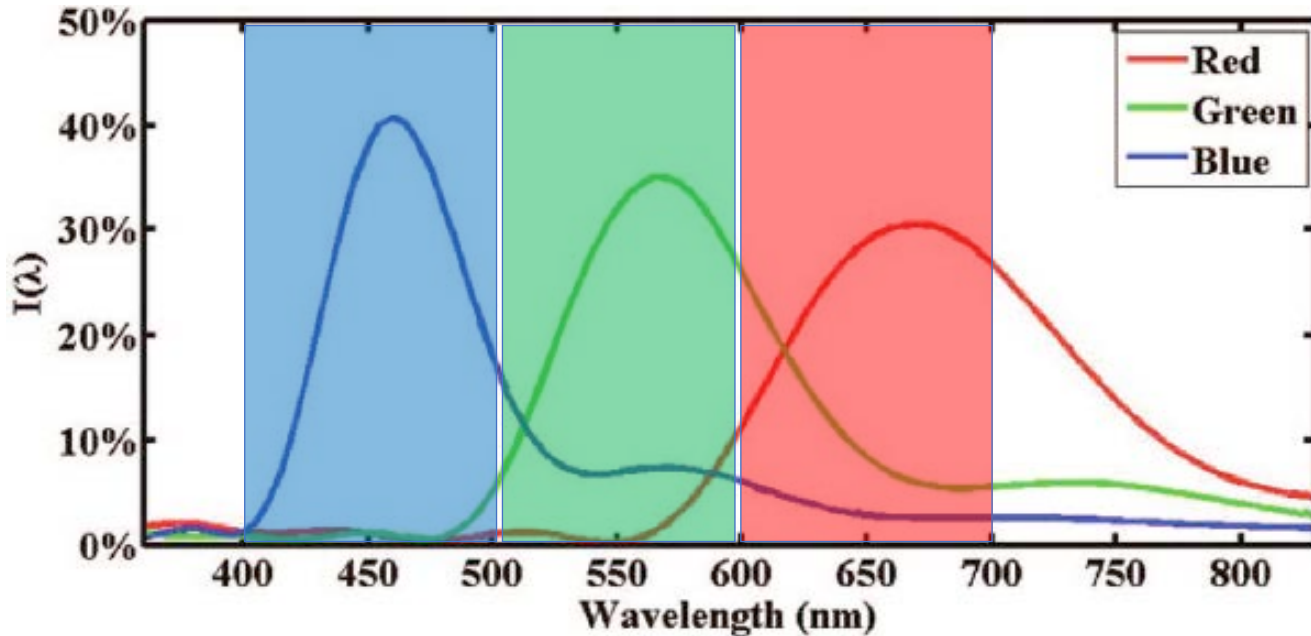
- PANTONE Color Manager, Adobe Acrobat Pro, Adobe Photoshop



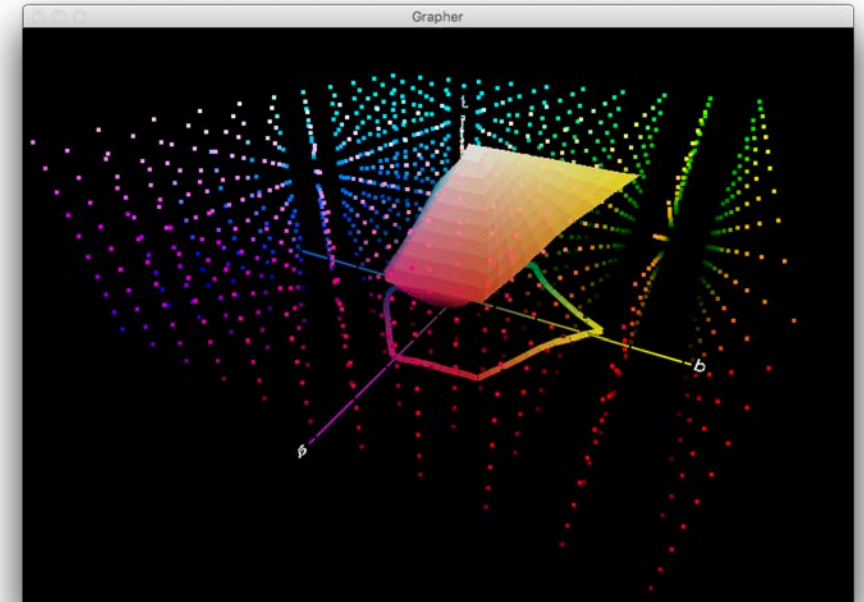
# Why do we need Expanded Gamut?

- because imaging systems are imperfect

Printing inks and dyes



CMYK color gamut is small



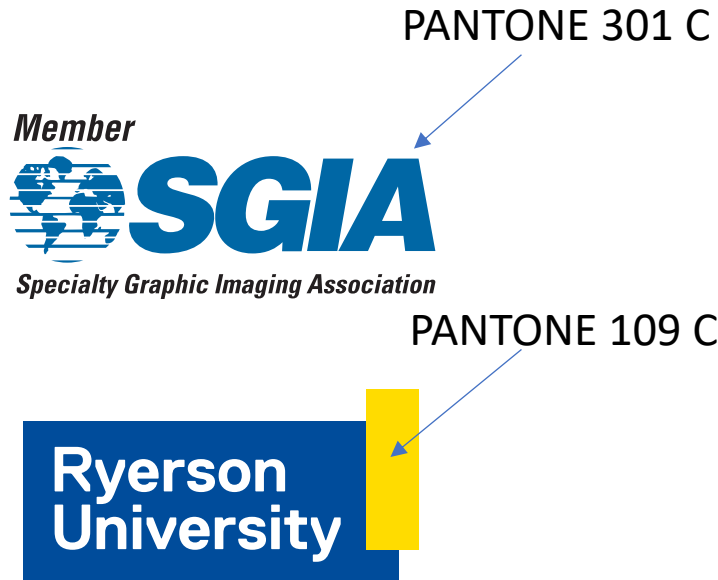
Color  
negative  
film



# What are the Use Cases for Expanded Gamut?



## 1. Spot Colors

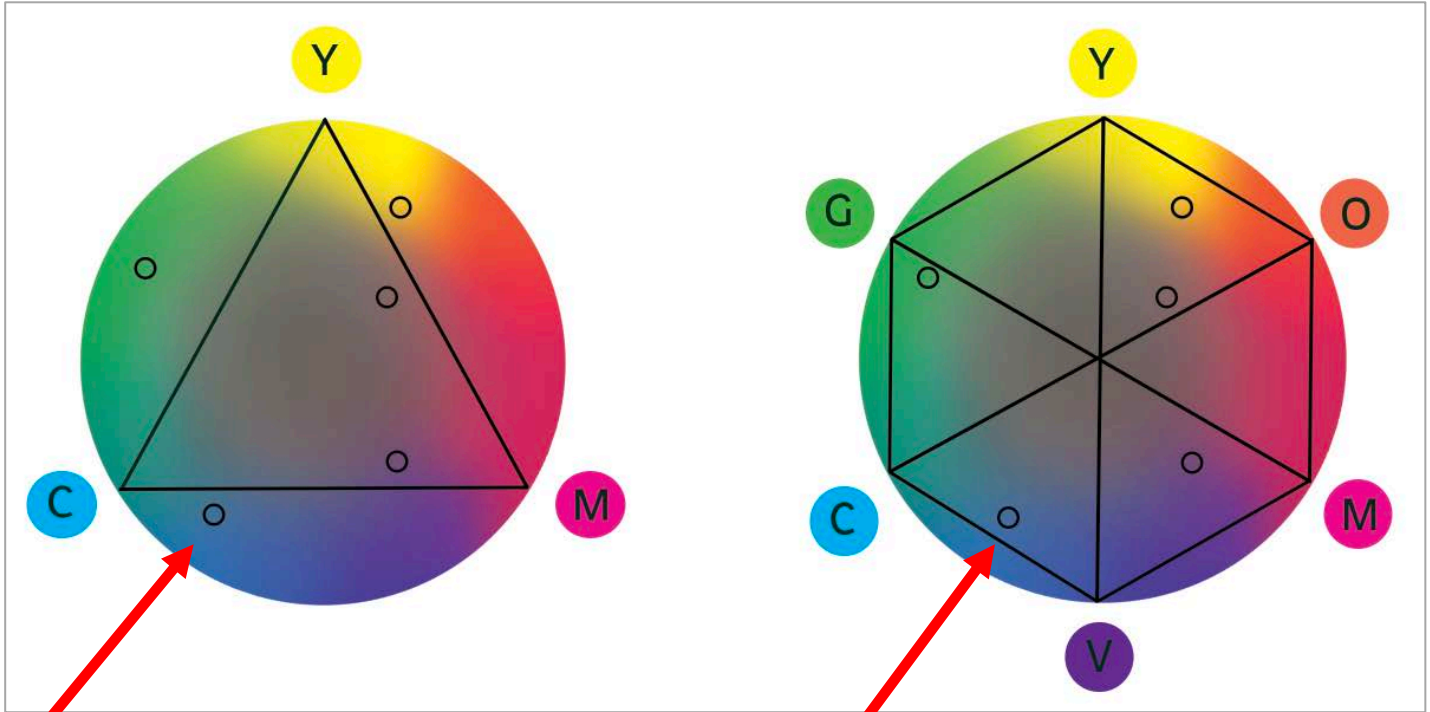
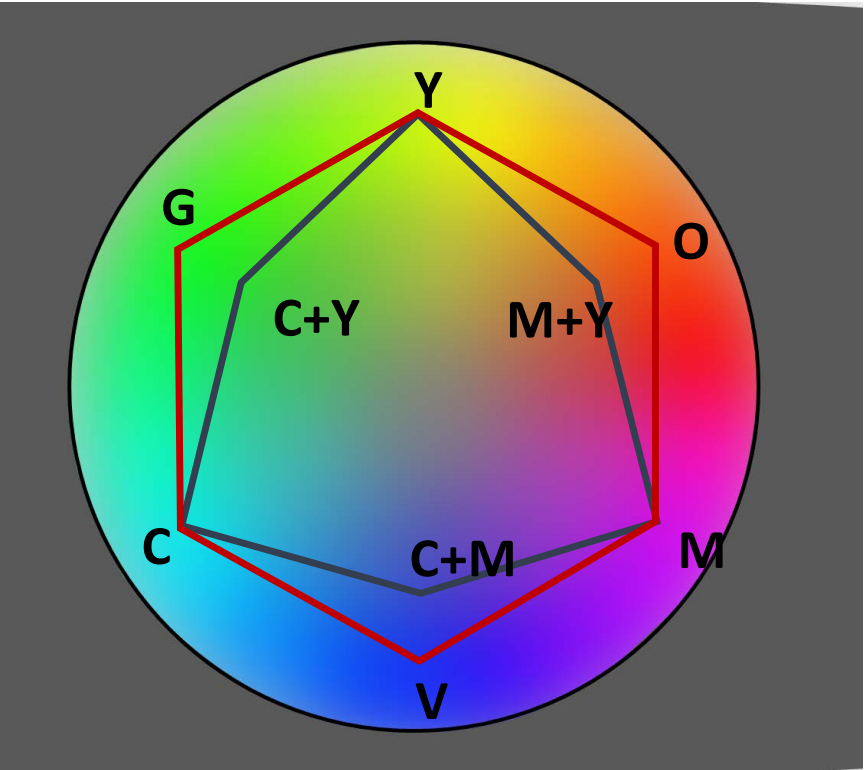


Expanded gamut is most urgently needed in spot color reproduction for labels and package printing.

## 2. Images



# Orange, Green, Violet - expands the colorspace



Colors are out of gamut

More colors are in-gamut of a CMYK-OGV print process



# HP Indigo 7900 – Alpharetta, Atlanta

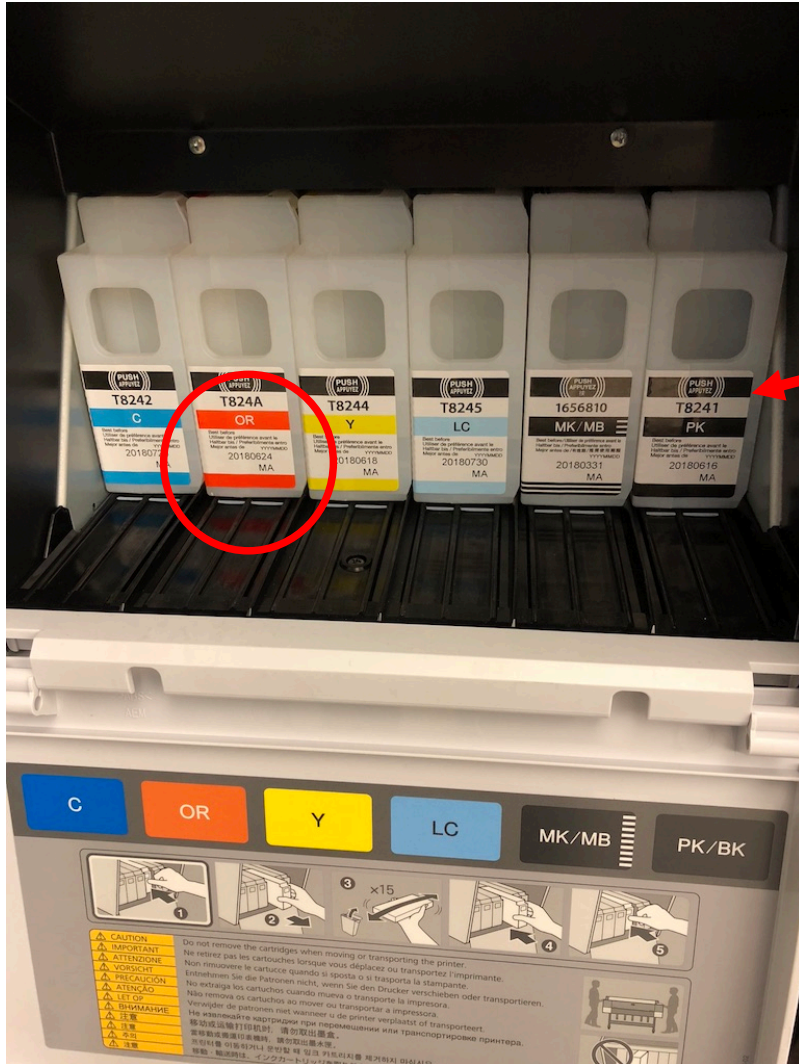


7 stations in the HP Indigo 7900





# Epson SureColor P9000 (C-M-Y-K) and (O-G-V)



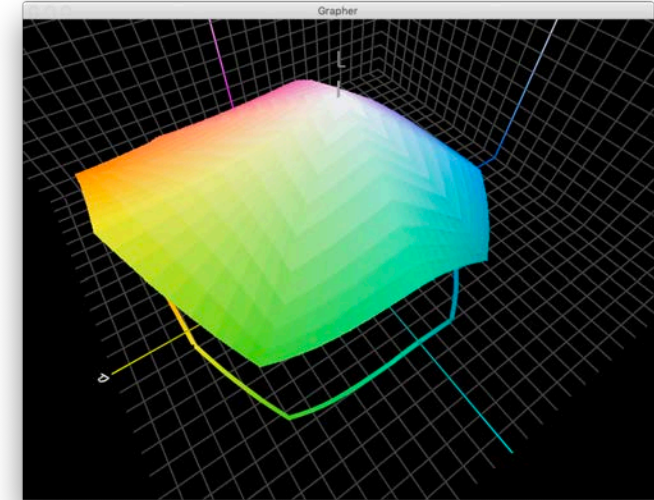
The Epson SureColor P9000  
with CMYK + OGV



# CMYK – OGV ink set



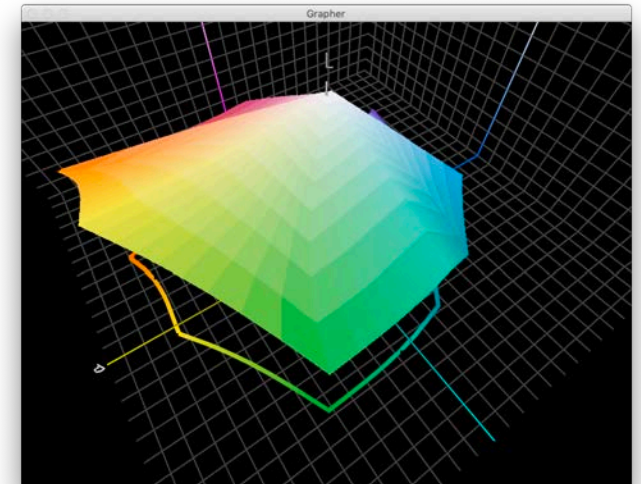
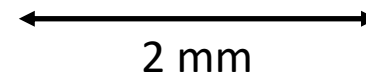
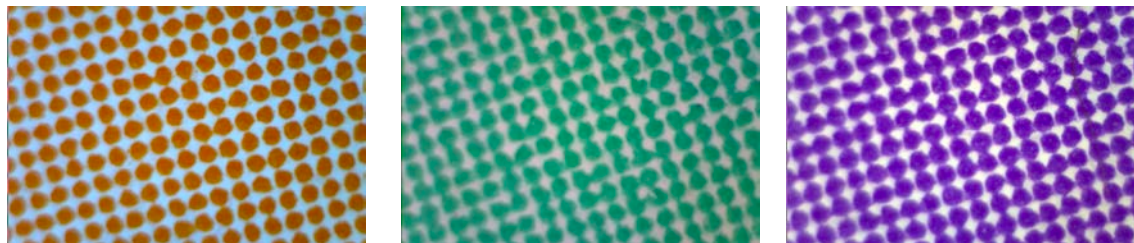
Epson SureColor P9000

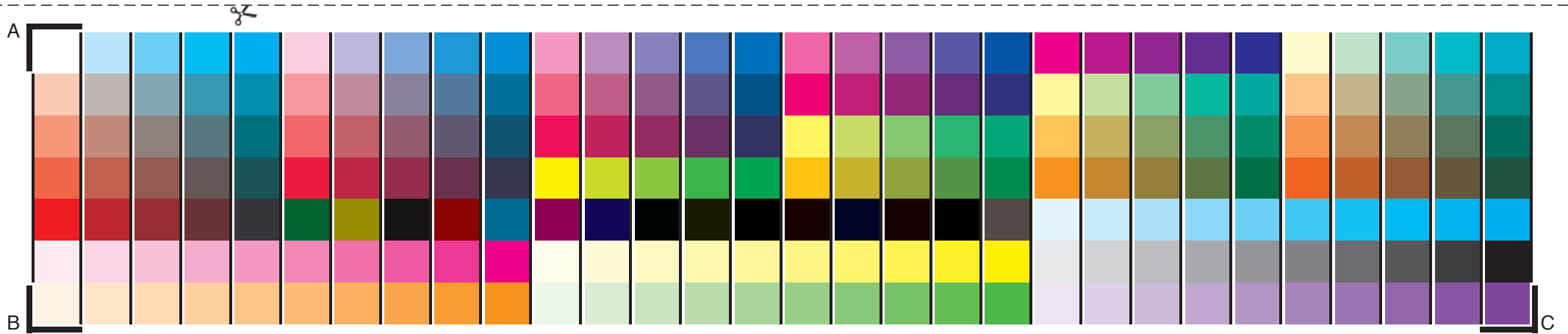


Microscopy reveals the OGV inks which increases the color gamut



HP Indigo 7900





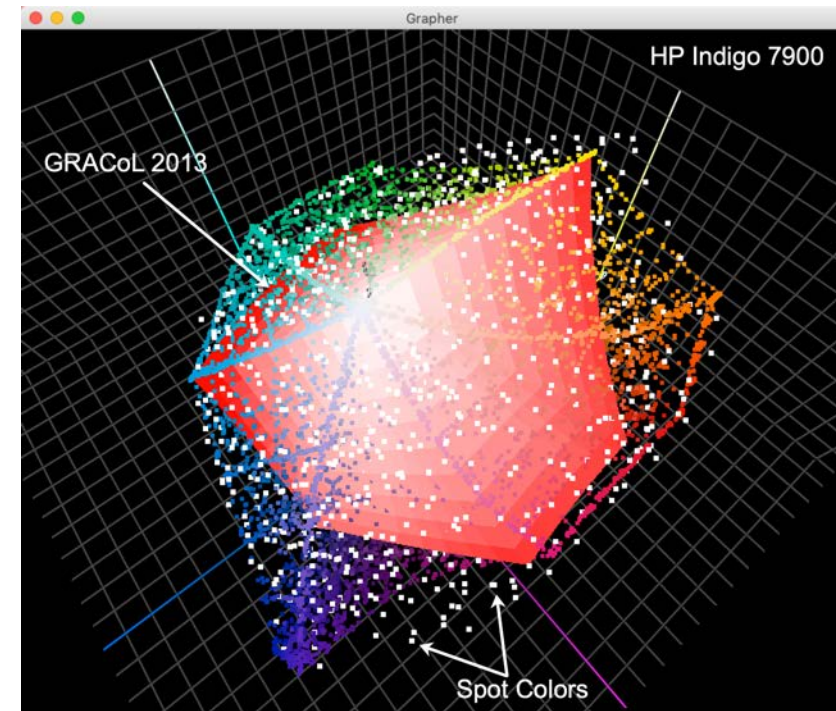
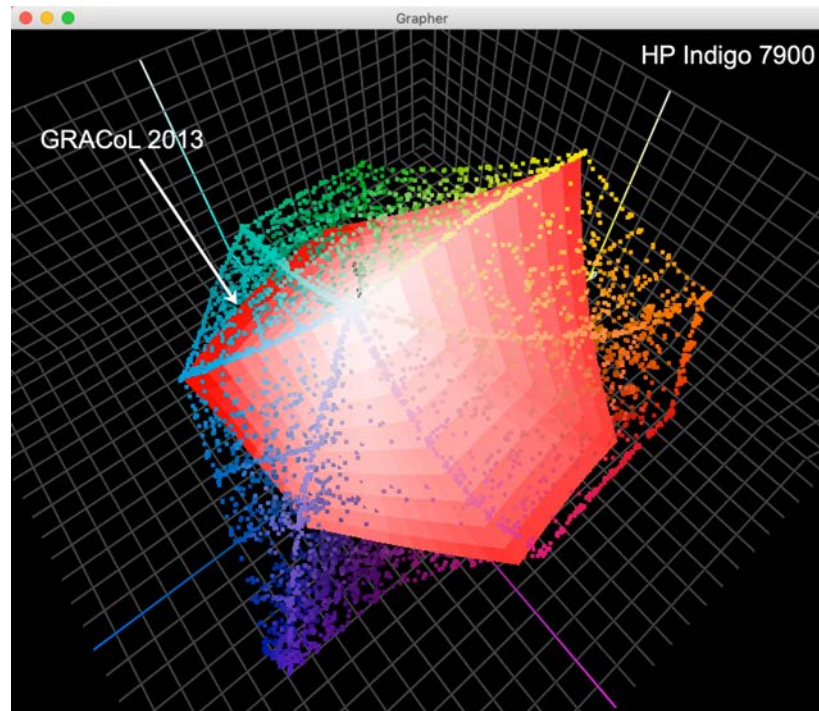
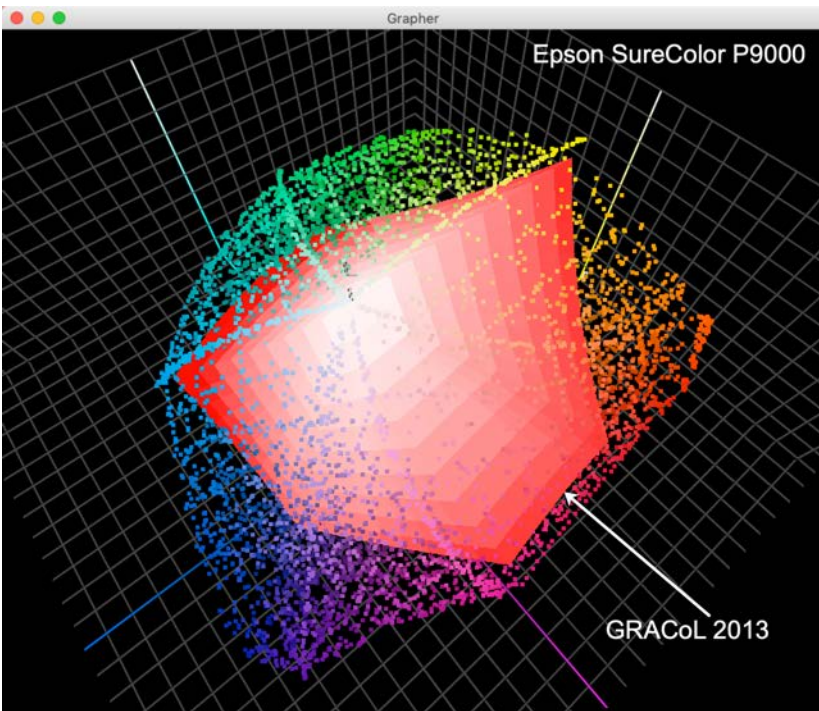
In EG we use CMYK-OGV to make all the other colors



Page: 1/1  
Color Space: CMYKOGV  
Chart Name: QualityControl\_7CLR  
Device Name: IO  
Creation Date: 11:51:48 30-4-2019



# CMYK-OGV is bigger than GRACoL and SWOP?



- The Epson P9000 is bigger than GRACoL 2013
- The HP Indigo is bigger than GRACoL 2013
- **Most PANTONE spot colors are realizable**

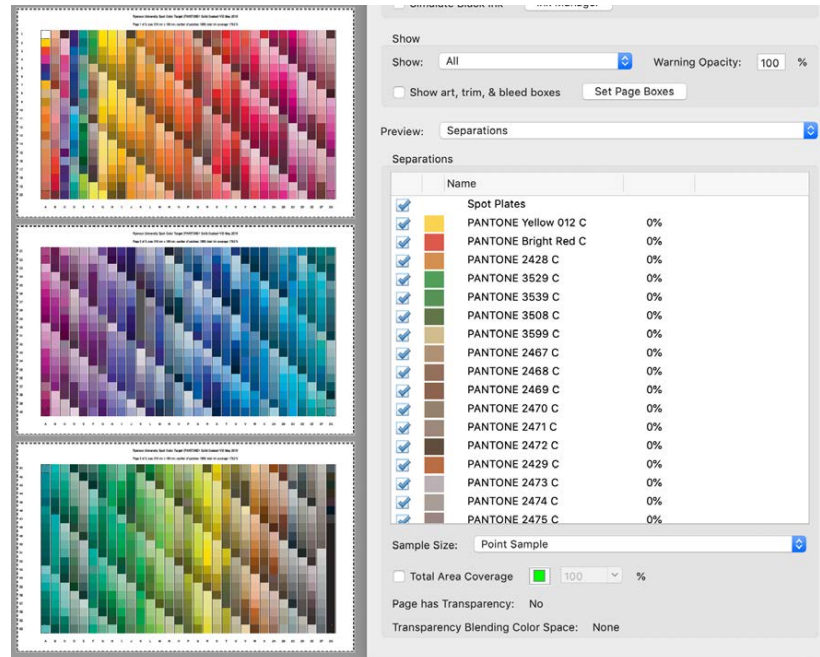


# Overview.....

We took 1846 values of the PANTONE+ Solid Coated library



Put them into a 3-page pdf (using CGS ORIS X GAMUT)



Printed using Alwan, CGS ORIS, ColorLogic, GMG Color, Heidelberg, Kodak



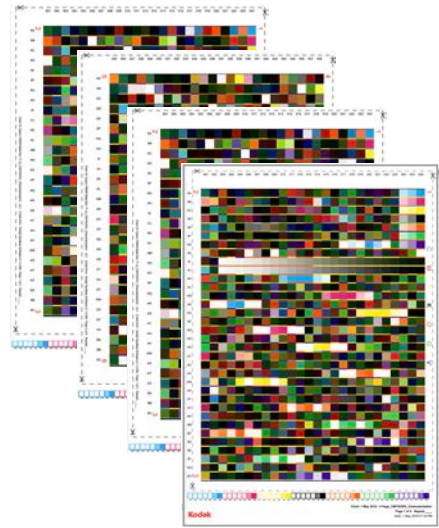
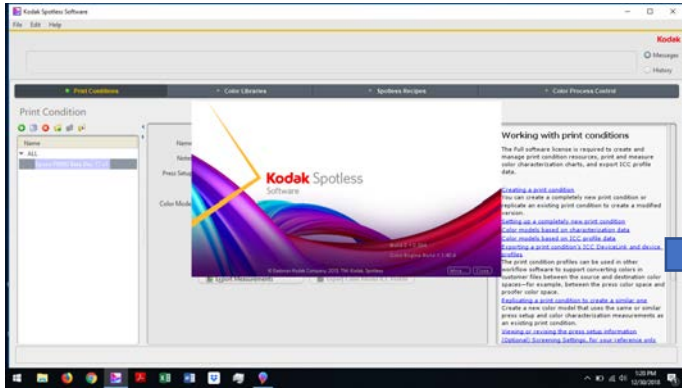
Epson SureColor P9000 (CMYK-OGV)



HP Indigo 7900 (CMYK-OGV)



# Printing PANTONE+ Solid Coated in CMYKOGV



4-page chart i1iO format

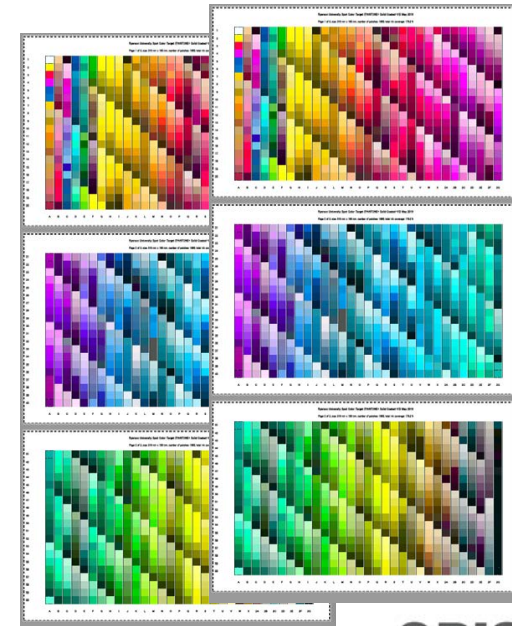
Epson SureColor P9000 CE



Name	Recipe (CMYKOGV %)	Target L*a*b*
PANTONE 2415 C	36.2 99.0 0.0 5.2 0.0 0.0 0.0	36.11 64.15 -23.61
PANTONE 2425 C	0.0 98.9 0.0 40.7 0.0 0.0 98.6	29.74 55.01 -18.17
PANTONE 243 C	0.0 26.0 0.0 0.0 0.0 0.0 6.9	80.67 24.89 -14.18
PANTONE 244 C	0.0 35.4 0.0 0.0 0.0 0.0 17.0	73.60 36.48 -20.42
PANTONE 245 C	0.0 45.8 0.0 0.0 0.0 0.0 27.6	66.50 47.05 -26.13
PANTONE 246 C	0.0 74.1 0.0 0.0 0.0 0.0 57.4	49.00 71.35 -33.52
PANTONE 247 C	0.0 79.4 0.0 0.1 0.0 0.0 66.9	45.20 69.70 -31.89
PANTONE 248 C	35.9 92.1 0.0 0.0 0.0 0.0 0.0	40.13 62.35 -28.29
PANTONE 249 C	32.5 85.7 0.0 44.7 0.0 0.0 0.0	32.96 44.66 -18.43
PANTONE 7646 C	0.0 43.5 2.5 43.9 0.0 0.0 0.0	53.35 27.30 -4.09

PANTONE

CMYKOGV



PANTONE+ Solid Coated-V3.cxf

```

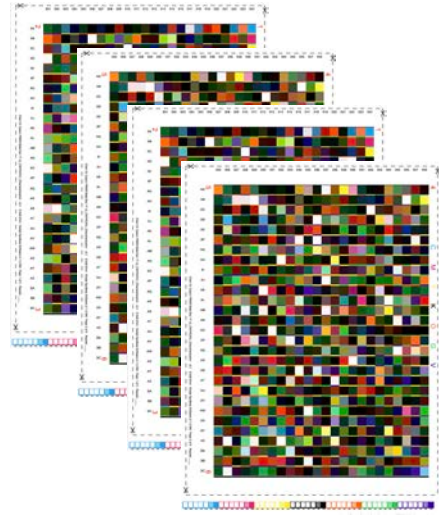
PANTONE+ Solid Coated-V3.cxf
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<<:G>144/</cc:G>
<<:B>97/</cc:B>
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</cc:DeviceColorValues>
</cc:Object>
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Id="09861113-7186-11E3-9830-EDA7CF7D4AE"
Guid="33A46C39-5997-4E94-8064-2C9A122E5908"
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<<:A>36.09/</cc:A>
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<<:G>144/</cc:G>
<<:B>91/</cc:B>
</cc:ColorSRGB>
</cc:ColorValues>
</cc:DeviceColorValues>
<<:ColorRGB Color Specification="CS"
ProfileSpecification="ICCB"
    
```

Note: i1Pro2 is same as above

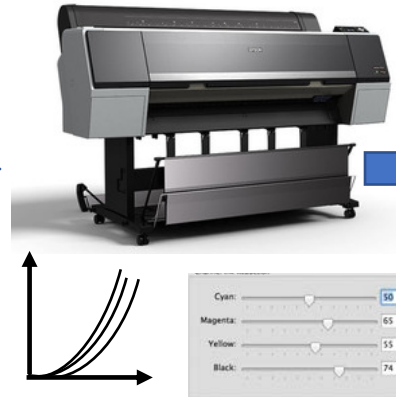


CIEDE2000 for 1846 PANTONE+ Solid Coated library

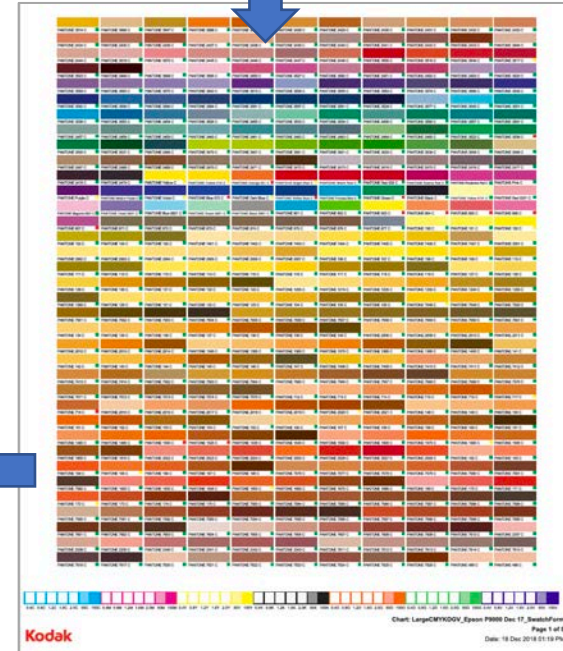
# Real Results with Kodak Spotless



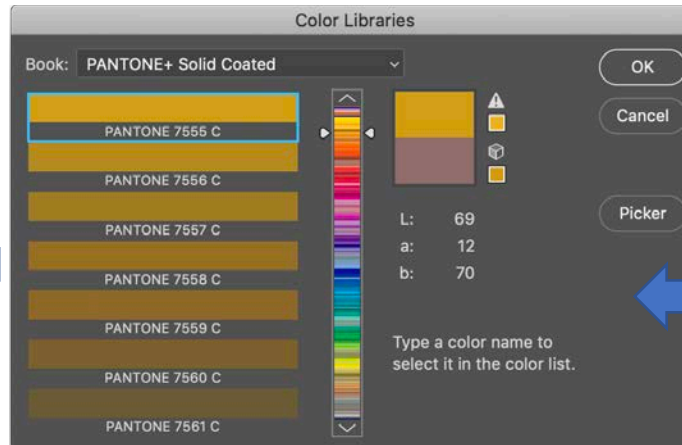
Epson SureColor P9000



Name	Recipe (CMYKOGV %)	Target L*a*b*
PANTONE 2415 C	36.2 99.0 0.0 5.2 0.0 0.0 0.0	36.11 64.15 -23.61
PANTONE 2425 C	0.0 98.9 0.0 40.7 0.0 0.0 98.6	29.74 55.01 -18.17
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PANTONE 245 C	0.0 45.8 0.0 0.0 0.0 0.0 27.6	66.50 47.05 -26.13
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PANTONE 249 C	32.5 85.7 0.0 44.7 0.0 0.0 0.0	32.96 44.66 -18.43
PANTONE 7646 C	0.0 43.5 2.5 43.9 0.0 0.0 0.0	53.35 27.30 -4.09



Photoshop CC 2018



Spot color

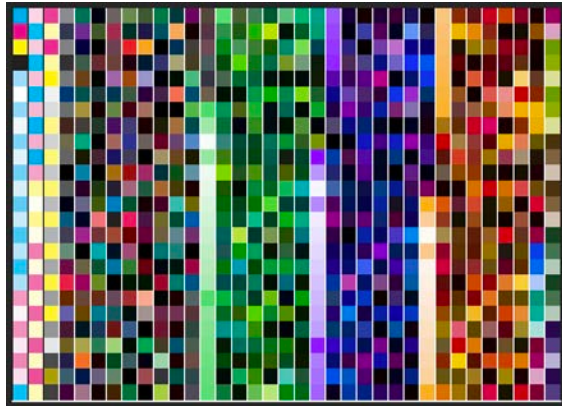
CIEDE2000

PANTONE 7555 C

0.54

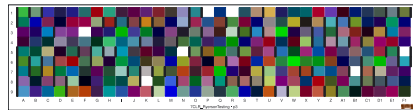
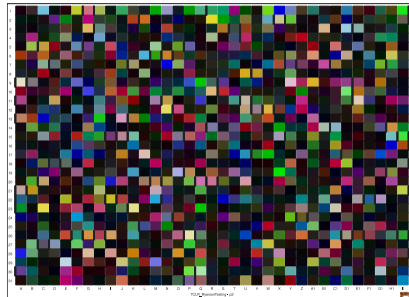
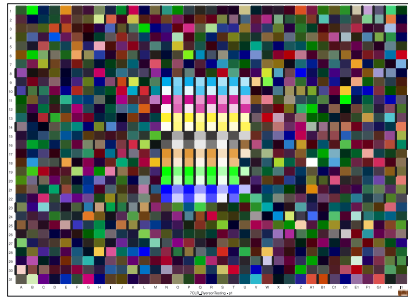
With permission and thanks to William Li, Stephen Zmetana, Kodak

# Charts can vary between vendors



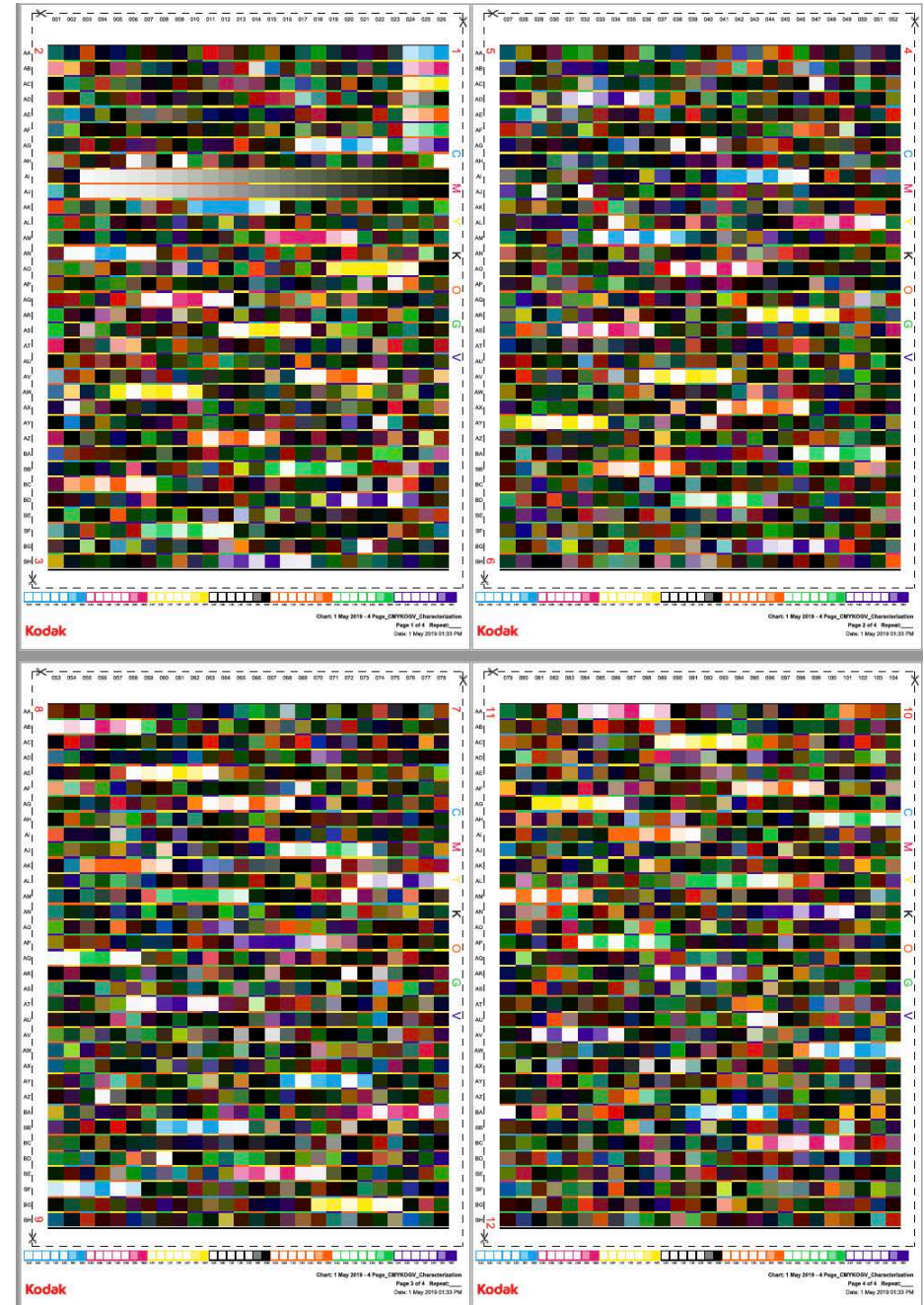
Kodak Spotless  
KSS 2.01  
4 pages

AlwanHydra\_7C\_875p\_ProfilingChart\_Xrite\_iO  
1 page!



GMG OpenColor 2.2.1  
2.5 pages

There is no IT8.7/4  
standard yet.

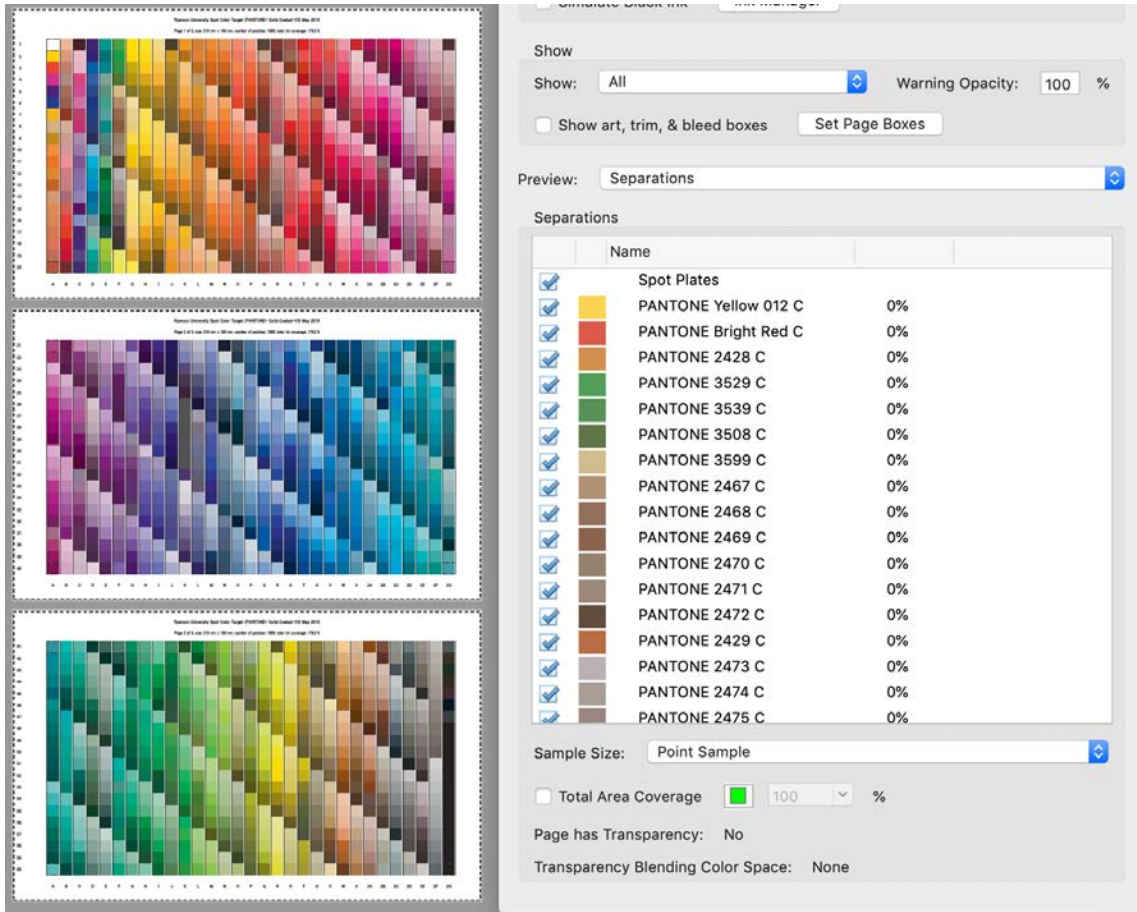




# Converting spot channels to CMYK-OGV

If we have a file like this...

...we can convert it into inking values.



Separations

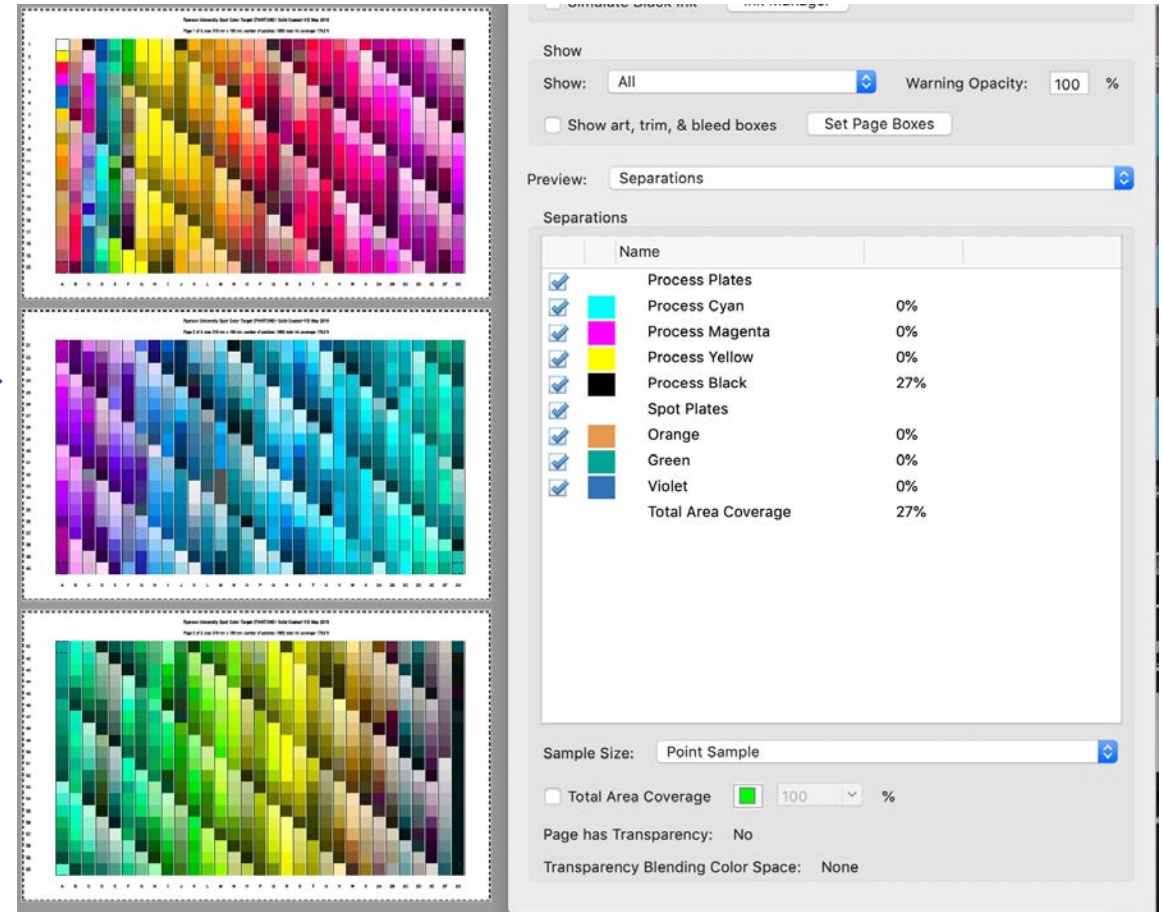
Name	0%
Spot Plates	
<input checked="" type="checkbox"/> PANTONE Yellow 012 C	0%
<input checked="" type="checkbox"/> PANTONE Bright Red C	0%
<input checked="" type="checkbox"/> PANTONE 2428 C	0%
<input checked="" type="checkbox"/> PANTONE 3529 C	0%
<input checked="" type="checkbox"/> PANTONE 3539 C	0%
<input checked="" type="checkbox"/> PANTONE 3508 C	0%
<input checked="" type="checkbox"/> PANTONE 3599 C	0%
<input checked="" type="checkbox"/> PANTONE 2467 C	0%
<input checked="" type="checkbox"/> PANTONE 2468 C	0%
<input checked="" type="checkbox"/> PANTONE 2469 C	0%
<input checked="" type="checkbox"/> PANTONE 2470 C	0%
<input checked="" type="checkbox"/> PANTONE 2471 C	0%
<input checked="" type="checkbox"/> PANTONE 2472 C	0%
<input checked="" type="checkbox"/> PANTONE 2429 C	0%
<input checked="" type="checkbox"/> PANTONE 2473 C	0%
<input checked="" type="checkbox"/> PANTONE 2474 C	0%
<input checked="" type="checkbox"/> PANTONE 2475 C	0%

Sample Size: Point Sample

Total Area Coverage: 100 %

Page has Transparency: No

Transparency Blending Color Space: None



Separations

Name	0%
Process Plates	
<input checked="" type="checkbox"/> Process Cyan	0%
<input checked="" type="checkbox"/> Process Magenta	0%
<input checked="" type="checkbox"/> Process Yellow	0%
<input checked="" type="checkbox"/> Process Black	27%
Spot Plates	
<input checked="" type="checkbox"/> Orange	0%
<input checked="" type="checkbox"/> Green	0%
<input checked="" type="checkbox"/> Violet	0%
Total Area Coverage	27%

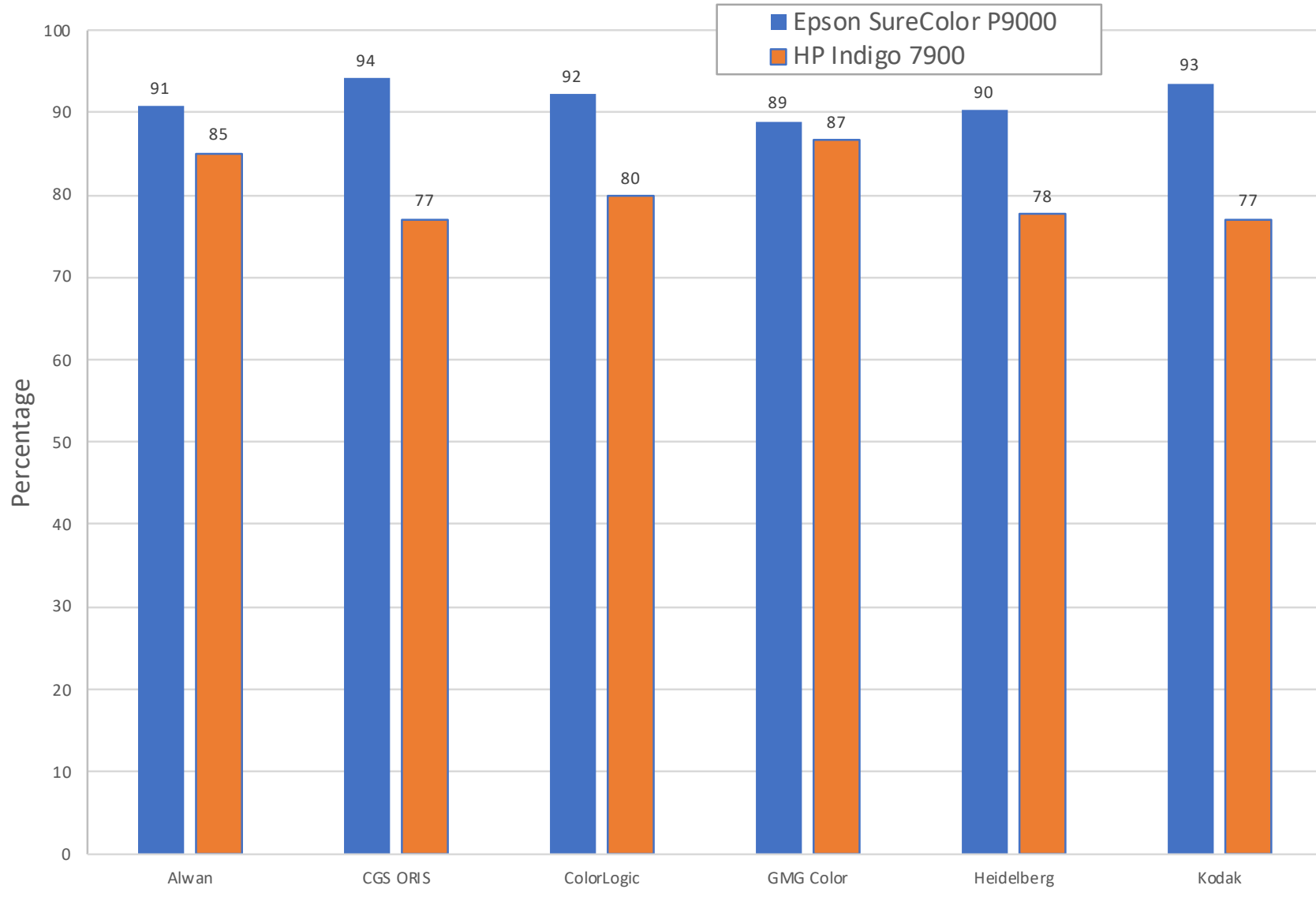
Sample Size: Point Sample

Total Area Coverage: 100 %

Page has Transparency: No

Transparency Blending Color Space: None

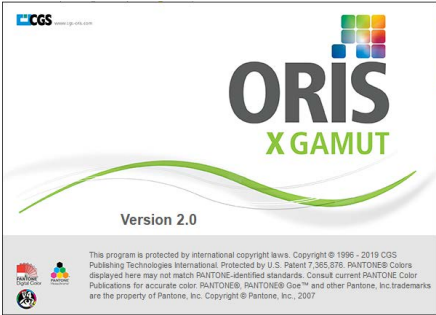
## Percentage of spot colors < 2.0 CIEDE2000



## PANTONE+ Solid Coated Library

Epson P9000 – 89-94%  
HP Indigo – 77-87%

- Devices have an expanded gamut – inks, paper, printing
- Charts are able to capture the gamut
- Software is able to make a valid recipe
- Stable printing process



## ORIS X Gamut

- 127 C is a yellow, made from Y and O.
- If drift – same color!

Spot Color Correction

File: ogram Files (x86)\CGS\Common Files\CTuner Setups\PDF color correction\Walk Through April 8\Spotcolor\PANTONE+ Solid Coated-V3\_M2.scgx

Device profile: \Program Files (x86)\CGS\Common Files\CTuner Setups\PDF color correction\Walk Through April 8\Measurement\Measurement 11 March v1.txt

Comment: D50 2° Measurement methode UV cut filter (M2)

Search: 127 < > 1/1867 selected

Color	Info	L	a	b	C	M	Y	K	Or	Gr	Vi	Opacity	Level	dE2000	Strict	Std.
PANTONE 117 C	S	66.2	11.9	78.6	0.0	0.0	75.8	16.6	16.3	0.0	0.0	0.0	1	2.19		
PANTONE 118 C	S	58.1	9.0	66.3	0.0	0.0	71.7	28.6	16.7	0.0	0.0	0.0	1	1.10		
PANTONE 119 C	S	49.7	2.4	45.8	0.0	0.0	66.9	49.1	6.5	0.0	0.0	0.0	1	0.48		
PANTONE 127 C	S	88.3	-0.9	56.7	0.0	0.0	47.6	0.0	8.7	0.0	0.0	0.0	1	0.47		
PANTONE 128 C	S	86.2	1.9	67.5	0.0	0.0	54.5	0.0	11.6	0.0	0.0	0.0	1	0.96		
PANTONE 129 C	S	84.8	3.9	71.9	0.0	0.0	57.2	2.5	12.7	0.0	0.0	0.0	1	1.56		
PANTONE 130 C	S	75.3	22.1	82.9	0.0	0.0	54.9	3.9	30.0	0.0	0.0	0.0	1	1.50		

-- Import spot color -- Import ORIS CxF Cloud Overprint Calculate

Spot Color

New... Duplicate... Change... Dot gain Define spot colors visually

Delete Rename... Gradation... Delete dot gain Create CxF/X4 color wedge

All Spot Colors

Optimize iteratively Optimize Optimize multichannel Dot gain

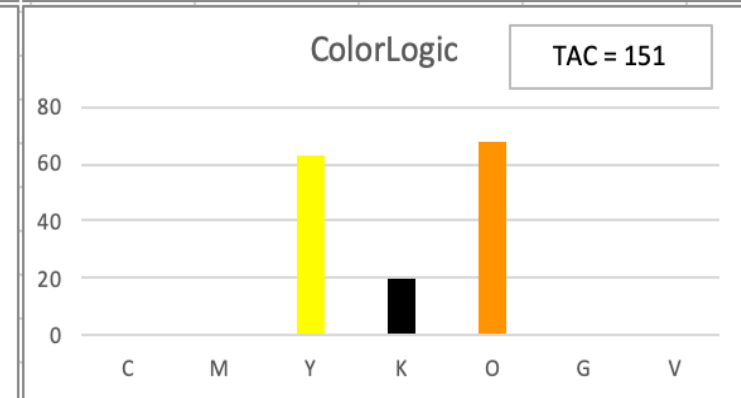
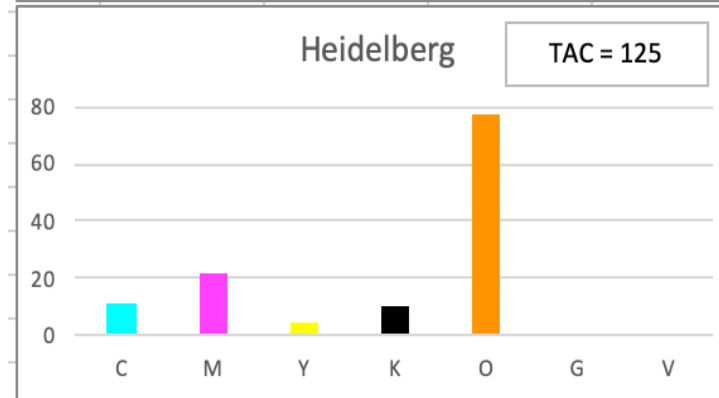
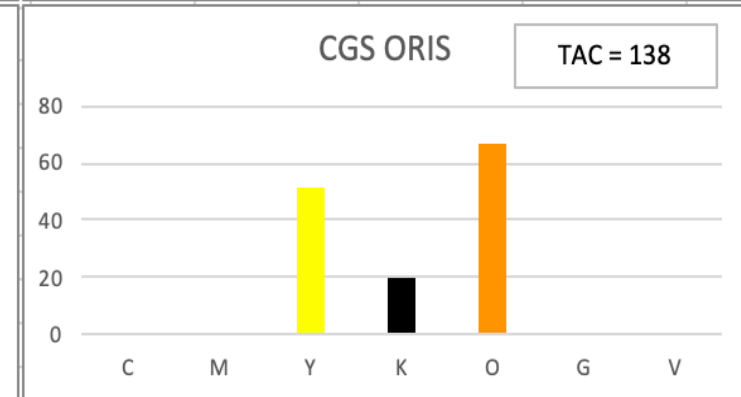
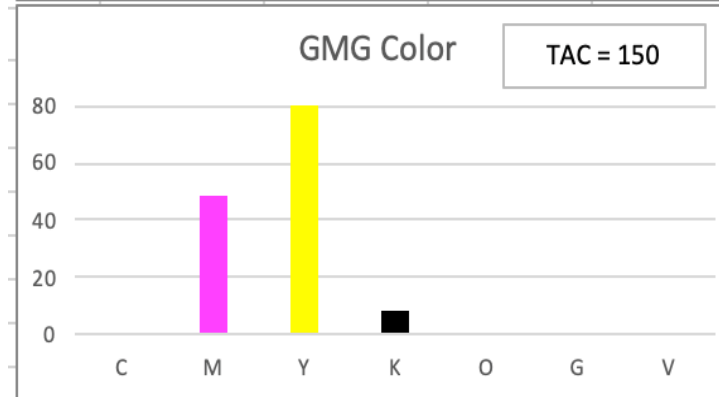
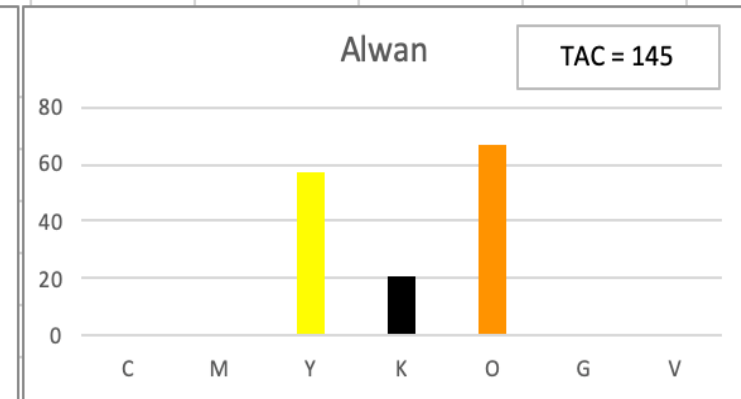
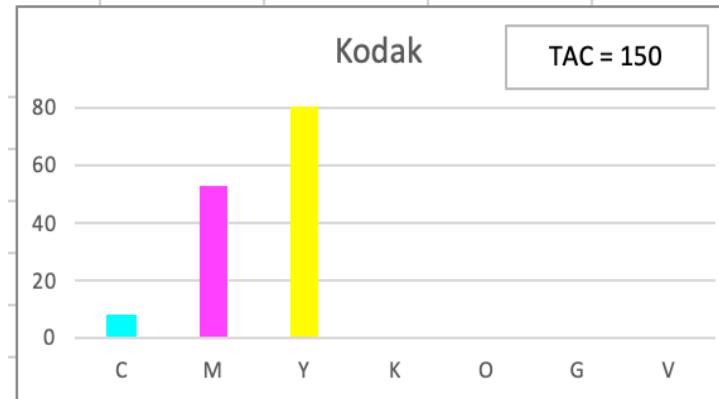
Create swatchbook Control measurement... Refine Reset

Save Save as... OK Cancel Help

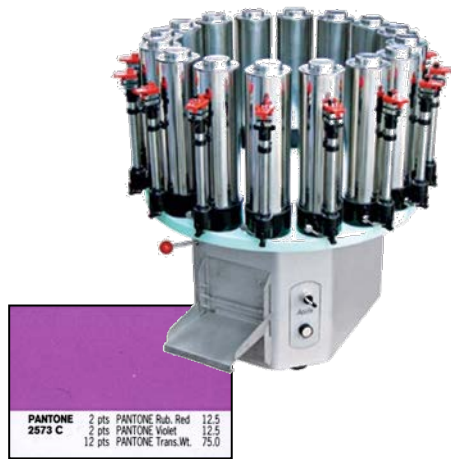
# Analysis of Inking Values



- Redundancy – GCR/UCR for 7-colors!
- Alwan, CGS ORIS, ColorLogic used Orange
- Kodak and GMG Color used CMYK
- Heidelberg used 5 colorants
- All mixes made the same color
- Stability on conventional press
- Digital printing there are click charges



# Printing with a spot color ink – you can't be serious!

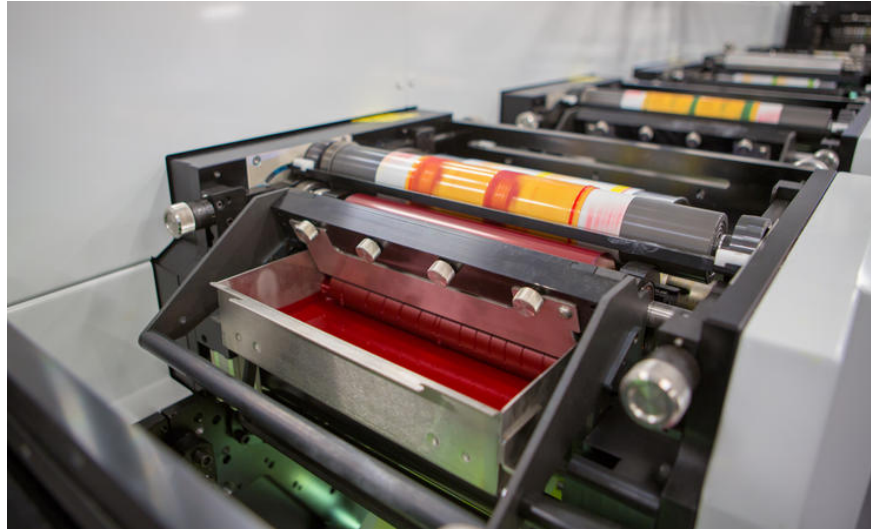


<b>PANTONE</b> <b>2573 C</b>	2 pts. PANTONE Rub. Red	12.5
	2 pts. PANTONE Violet	12.5
	12 pts. PANTONE Trans.Wt.	75.0



- The designer selects a spot color.
- Ink is ordered and formulated for the customer job.
- The ink quantity needs to be estimated and match the run length.
- We wait until we have received the ink to print the job.
- The customer cannot increase the print run – not enough ink.
- The ink is put into its own printing unit.
- After the job, the unit is washed up, ink change for next spot color.
- Left over ink is stored, in case customer needs this color again!
- Need same swatch book as designer.
- You can't be serious?

# Reduce washup and press changes in package printing



Expanded Gamut printing allows for a new fixed palette of CMYK-OGV inks that become the “process colors”. The fixed CMYK-OGV stays in the press, we only change plates, and the designer can select from any spot color they want....

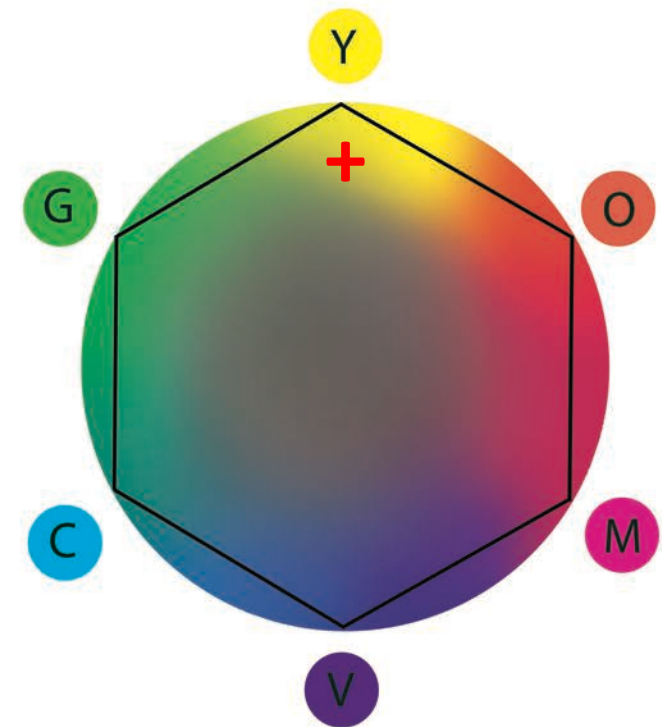
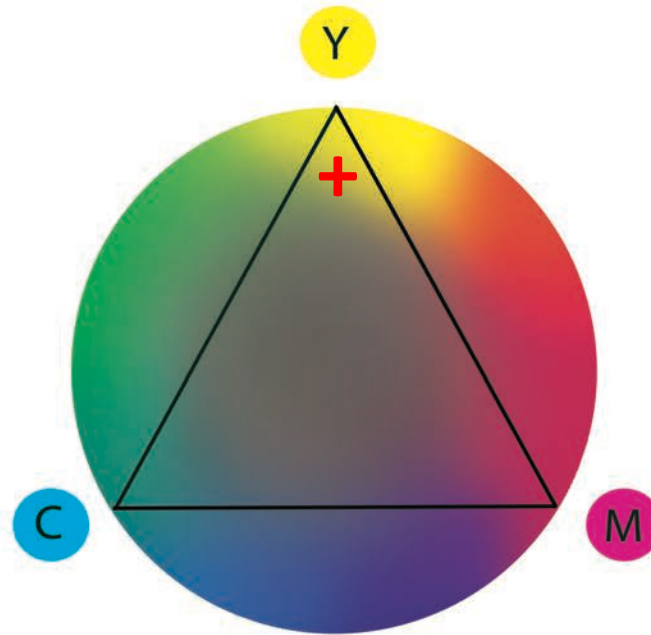
# Selling EG to your press operator.....

“I can’t control 4 inks, how can I control 7!”

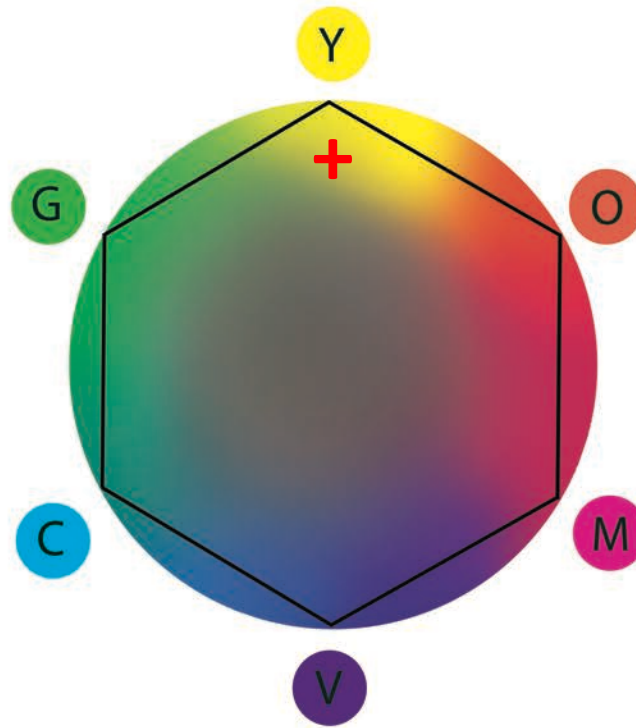
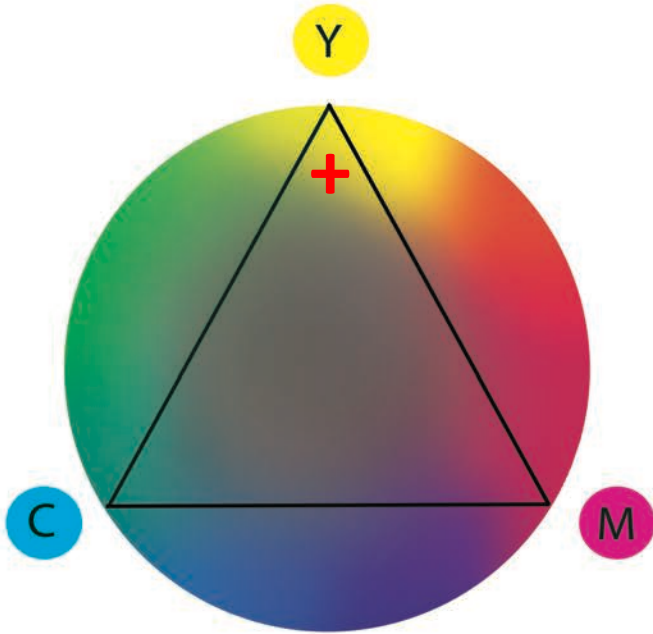
In EG no color needs all 7 inks at the same time.

In EG maximum 3 inks are used.

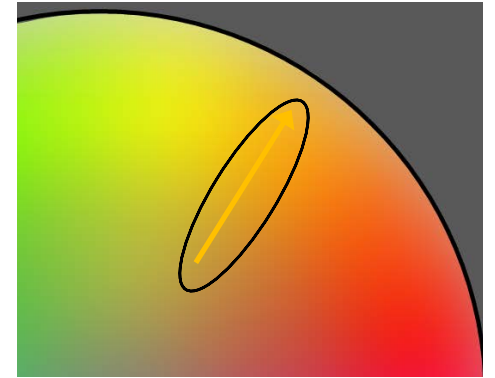
And, the 2 or 3 inks are closer to the required color, so press drift has minimal visual effect.



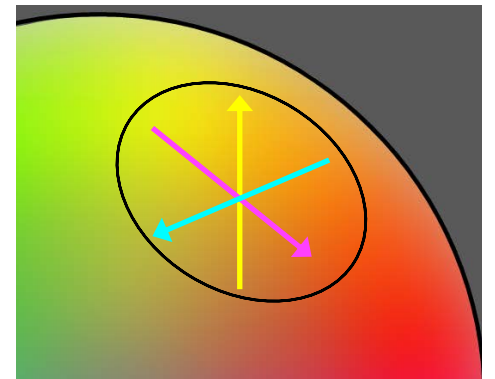
# CMYK-OGV printing is easier to control



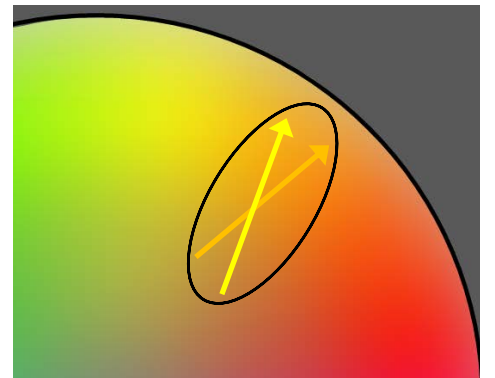
Single spot  
color ink



CMYK  
overprint



CMYK-OGV  
overprint



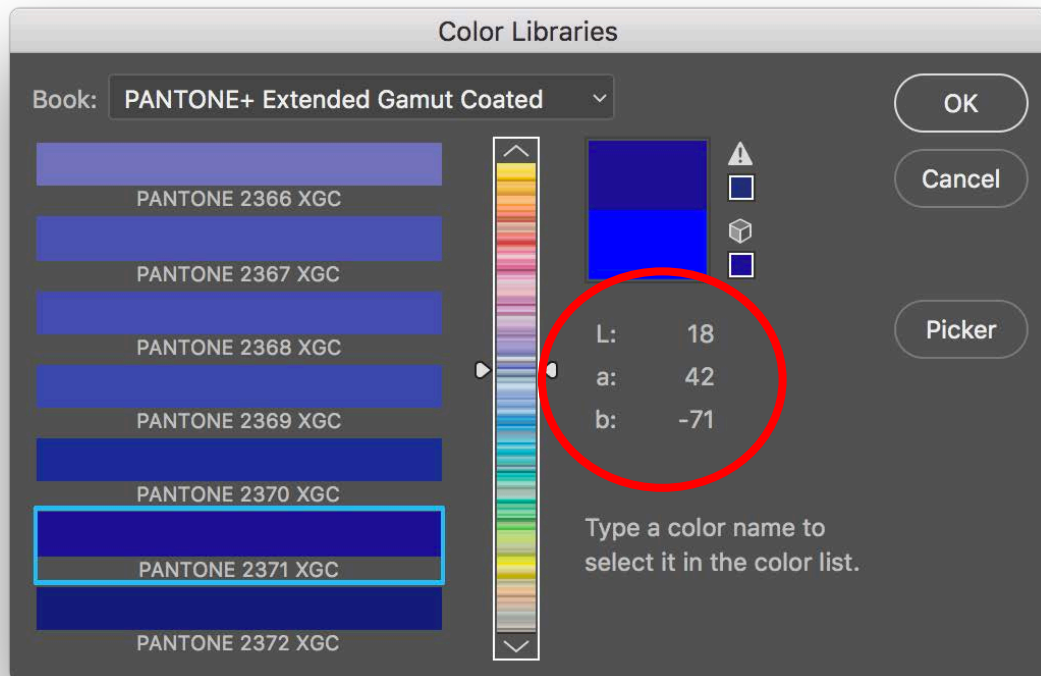
A single spot color ink may vary only in density, causing minimal shift.  
A CMYK overprint can vary, causing huge hue and saturation shifts.  
CMYK-OGV uses only nearest 2-3 colorants causing minimal hue shift.



# Accuracy of PANTONE+ EXTENDED GAMUT Guide

I measured PANTONE 2371 C in an EXTENDED GAMUT Guide with a SpectroDens4, and the L\*a\*b\* value measured from the swatch book agrees with Photoshop to 0.73 CIEDE2000!!!!

...and every swatch in the whole book is made from 3 inks only



CMYK - OGV



CMYK + Spot



CMYK



CMYK + OGV

CMYK – OGV  
7 “process” colors

No ink changes

Comco Cadet  
narrow-web flexo  
press

# Benefits of Expanded Gamut Printing for Spot Colors

- More spot colors in gamut
- Less spot color inks/inventory
- Less wash up time
- Ganging up jobs
- Better control on press
- Ink savings
- Higher accuracy

We are sitting on a revolution in printing



# Important Statement

*“An expanded gamut system can avoid the overhead of printing with spot color inks, and replace them with a fixed set of expanded gamut inks while still achieving the customer's requested color.”*

Barbara Braun-Metz, CEO, ColorLogic GmbH



# What do I need to implement EG?

## Inkjet Proofer



Commercial Edition EG inks



Epson SureColor P9000

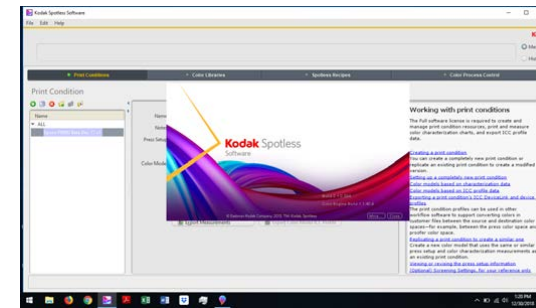
## Label Printing Package Printing



ORIS X GAMUT



## Software



Kodak Spotless

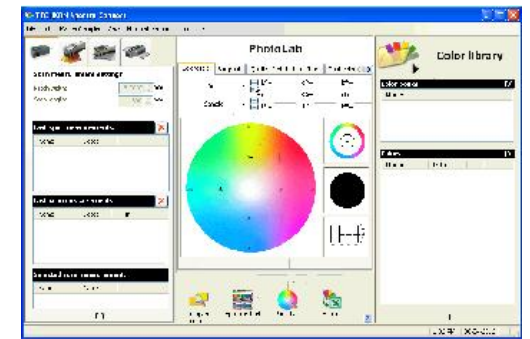


PANTONE EXTENDED  
GAMUT Guide

## SpectroDens4 Spectro Connect



SpectroDens4



Spectro Connect 2.7

# Ryerson University Study 2019 and 2020



# Fogra Multicolor Forum 2018 and January, 2020

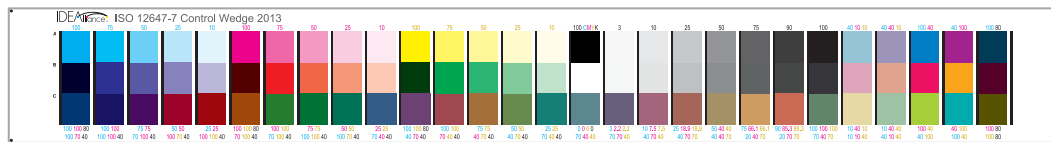


# Idealliance Control Strips

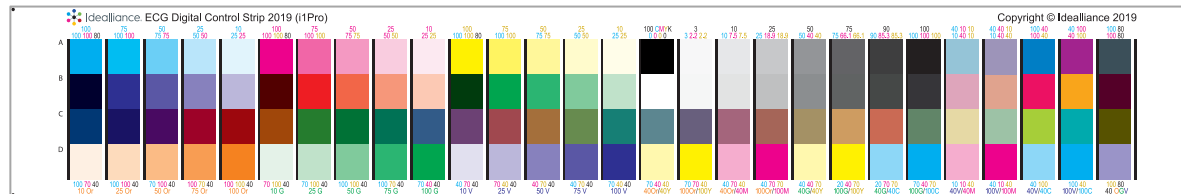
## Idealliance 2-row Control Strip 2009 - CMYK



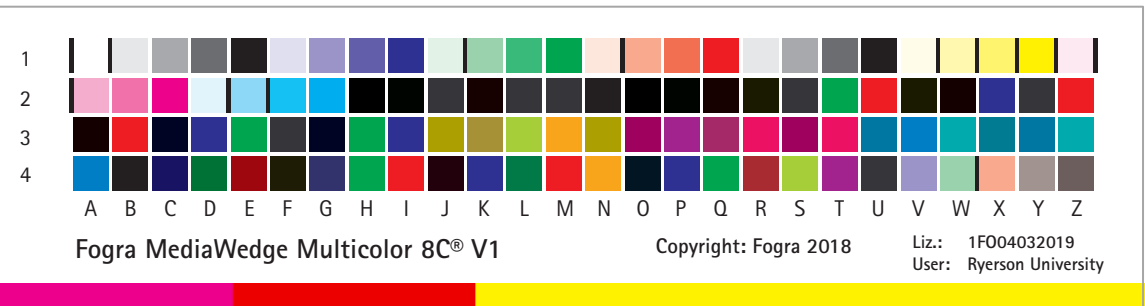
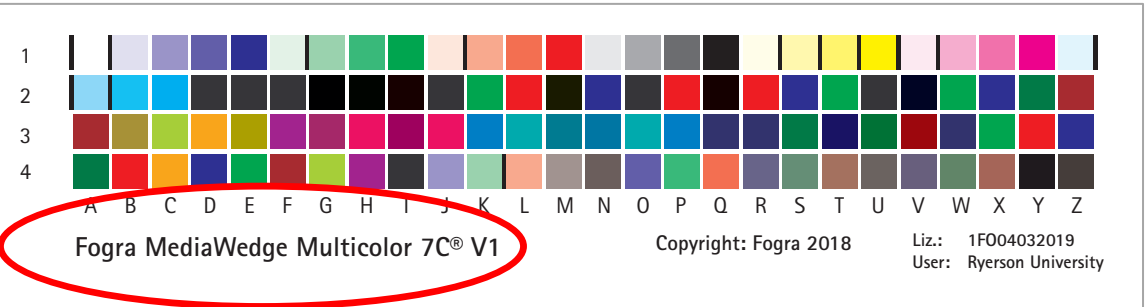
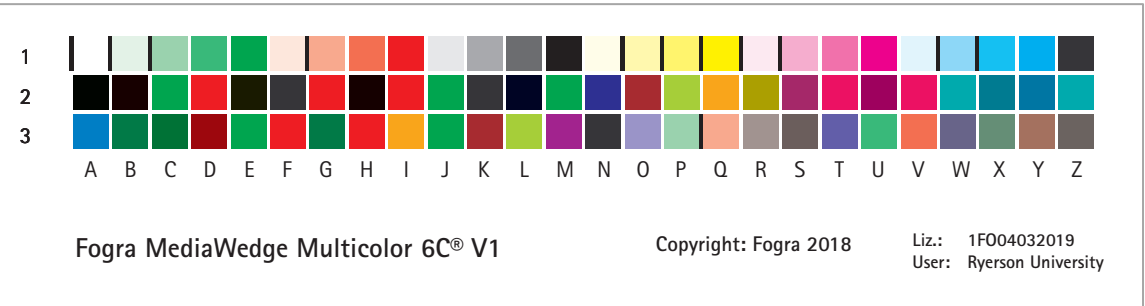
## Idealliance 3-row Control Strip 2013 - CMYK



## Idealliance ECG Digital Control Strip 2019 - CMYK OGV

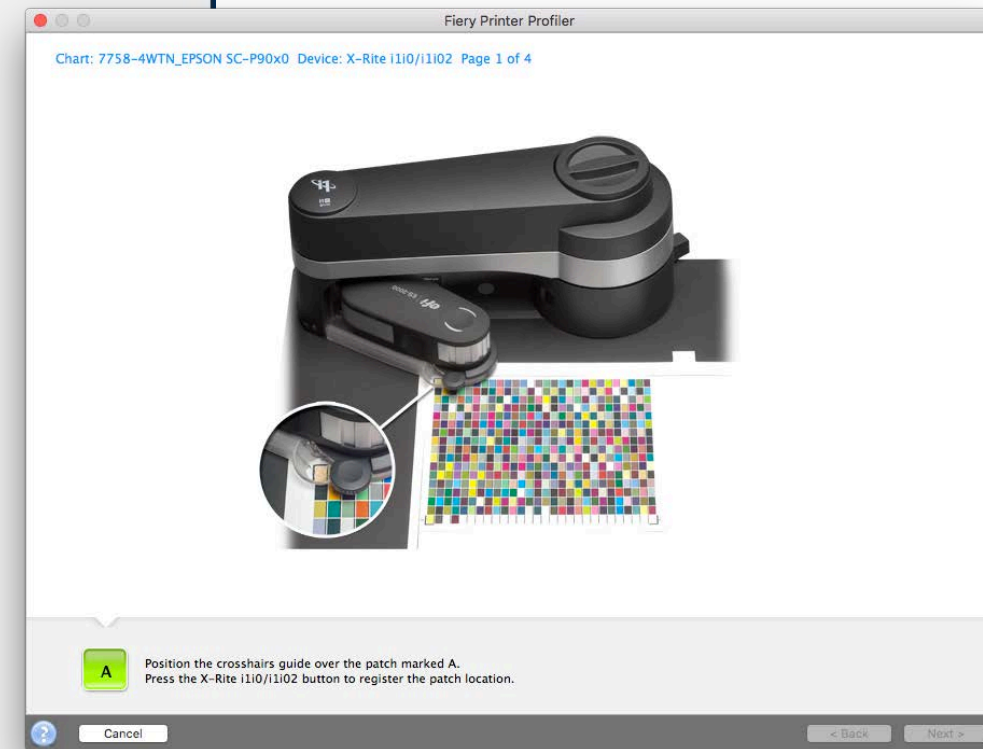
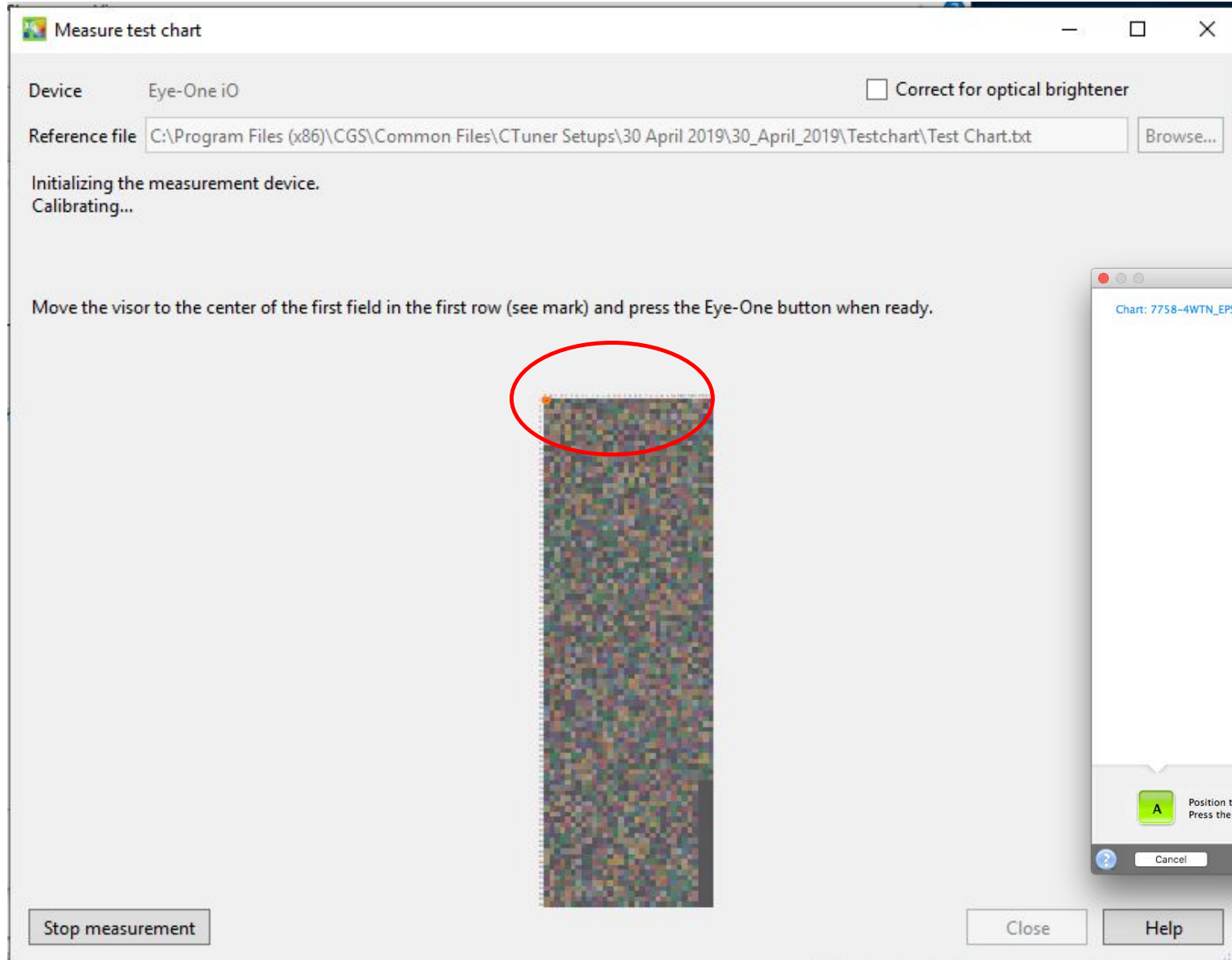


# Fogra Media Wedges





# User Experience



# Acrobat Pro cannot show all spot channels!!!!

- Acrobat Pro can only show ~ 30 spot color names.
- The cursor for other spot channels shows CMYK.

Print Production

Spot Color Target - Default

Page 1 of 3, size: 228 mm x 158 mm, number of patches: 1920, total ink coverage: 100 %

Spot Color Target - Default

Page 2 of 3, size: 228 mm x 158 mm, number of patches: 1920, total ink coverage: 100 %

Output Preview

Simulate

Simulation Profile: U.S. Web Coated (SWOP) v2

Simulate Overprinting Page has Overprint: Yes

Simulate Paper Color  Set Page Background Color

Simulate Black Ink Ink Manager

Show

Show: All Warning Opacity: 100 %

Show art, trim, & bleed boxes Set Page Boxes

Preview: Separations

Separations

Name	
Process Plates	
Process Cyan	11%
Process Magenta	2%
Process Yellow	48%
Process Black	0%
Spot Plates	
PANTONE 3514 C	0%
PANTONE 3596 C	0%
PANTONE 2433 C	0%
PANTONE 2468 C	0%
PANTONE 2469 C	0%
PANTONE 2470 C	0%
PANTONE 2471 C	0%
PANTONE 2472 C	0%
PANTONE 2473 C	0%
PANTONE 2474 C	0%
PANTONE 2475 C	0%

Sample Size: Point Sample

Total Area Coverage 100 %

Page has Transparency: No

Transparency Blending Color Space: None

Show: All Warning Opacity: 100 %

Show art, trim, & bleed boxes Set Page Boxes

Preview: Separations

Separations

Name	
Spot Plates	
PANTONE Yellow 012 C	0%
PANTONE Bright Red C	0%
PANTONE 2428 C	0%
PANTONE 3529 C	0%
PANTONE 3539 C	0%
PANTONE 3508 C	0%
PANTONE 3509 C	0%
PANTONE 2447 C	0%
PANTONE 2468 C	0%
PANTONE 2469 C	0%
PANTONE 2470 C	0%
PANTONE 2471 C	0%
PANTONE 2472 C	0%
PANTONE 2429 C	0%
PANTONE 2473 C	0%
PANTONE 2474 C	0%
PANTONE 2475 C	0%

Sample Size: Point Sample

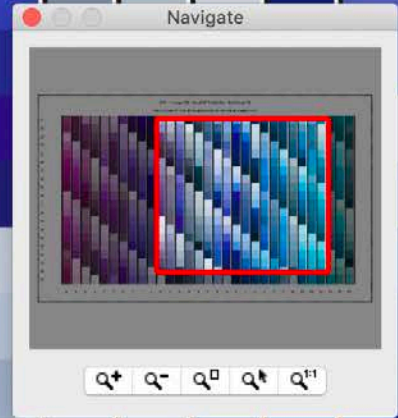
Total Area Coverage 100 %

Page has Transparency: No

Transparency Blending Color Space: None

GMG - HP Indigo 7900 - May 28 2019 (PANTONE+ Solid Coated-V3).pdf

PACKZ came to the rescue...



PANTONE 2174 C 100.000%  
100.000%

Assets

Name	Type
PANTONE 2174 C	Spot
PANTONE 2175 C	Spot
PANTONE 2381 C	Spot
PANTONE 2382 C	Spot
PANTONE 2383 C	Spot
PANTONE 2384 C	Spot
PANTONE 2386 C	Spot
PANTONE 2387 C	Spot
PANTONE 2388 C	Spot
PANTONE 297 C	Spot
PANTONE 298 C	Spot
PANTONE 299 C	Spot
PANTONE 300 C	Spot
PANTONE 301 C	Spot

About PACKZ

PACKZ 5.1.4 build 55  
Copyright © Hybrid Software 2018, All Rights Reserved

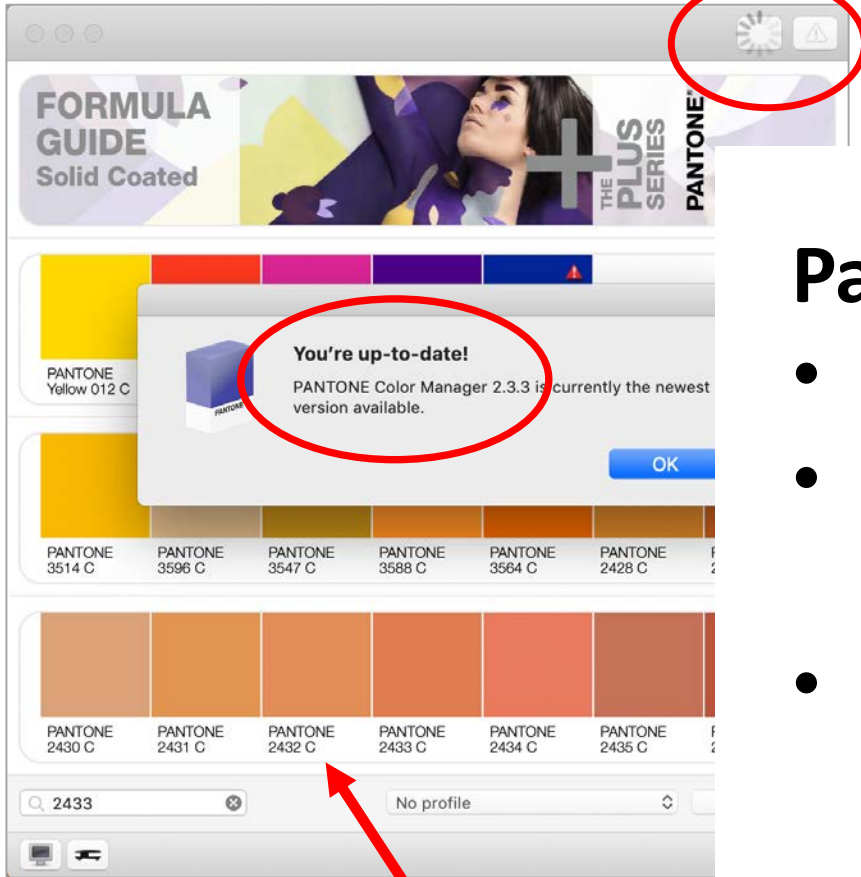
# PACKZ

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License Agreement

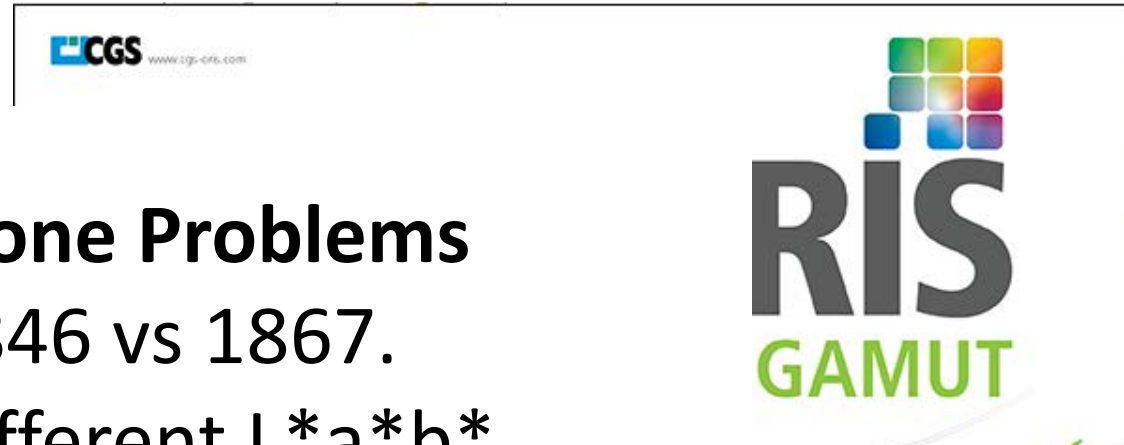
# PANTONE Color Manager (\$99)

# Vendor Licenced Libraries



## Pantone Problems

- 1846 vs 1867.
- Different L\*a\*b\* values.
- Color Manager has a bug and never finishes updating!



Sample Size: Point Sample Sample: All Layers Show Sampling Ring

GMG Oranges.jpg @ 33.3% (RGB/8/Preview) \*

### Convert to Profile Advanced

Source Space  
Profile: sRGB IEC61966-2.1

- Destination Space
- Gray Profile: Working Gray - Dot Gain 20%
  - RGB Profile: Working RGB - sRGB IEC61966-2.1
  - LAB
  - CMYK Profile: Working CMYK - U.S. Web Coated (SWOP) v2
  - Multichannel Profile: Chart 2033 Patches
  - Device Link Profile:
  - Abstract Profile: Black & White

Conversion Options

Engine: Adobe (ACE)

Intent: Relative Colorimetric

Use Black Point Compensation

Use Dither

Flatten Image to Preserve Appearance

OK  
Cancel  
Preview  
Basic

#### Channels

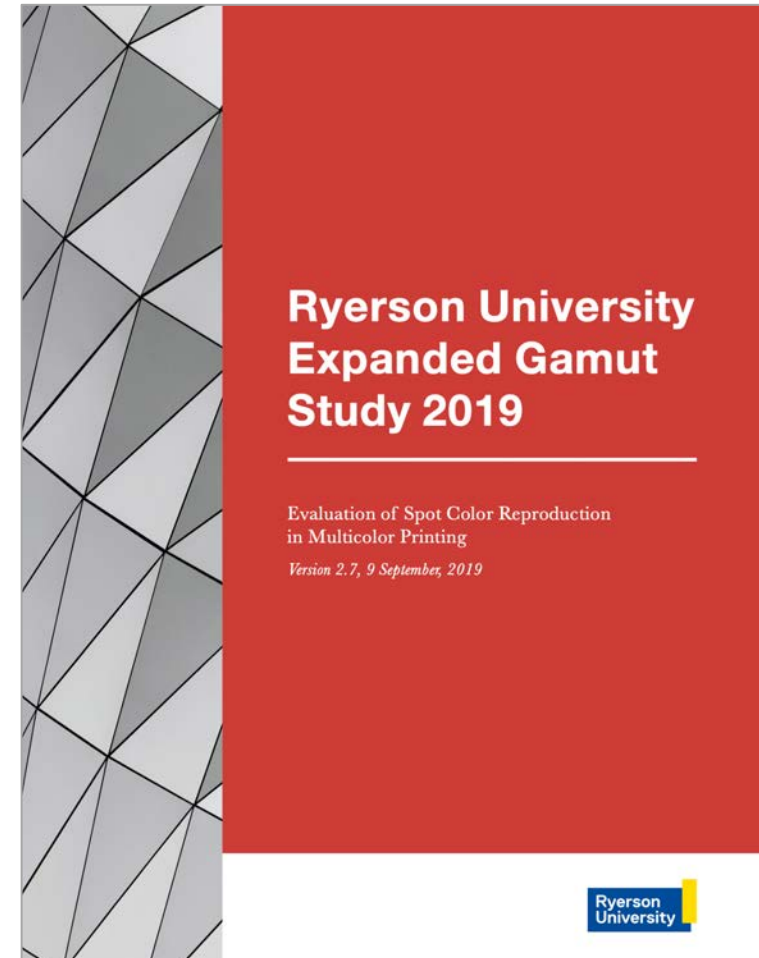
<input checked="" type="checkbox"/>	RGB	⌘2
<input checked="" type="checkbox"/>	Red	⌘3
<input checked="" type="checkbox"/>	Green	⌘4
<input checked="" type="checkbox"/>	Blue	⌘5

Swatches  
Libraries  
Adjustments

# Thank you to the companies in our study

- ALWAN
- CGS ORIS \*
- ColorLogic
- GMG Color
- Heidelberg
- Kodak

\* Provided tool for use in study



# Acknowledgements

Advisors - Roger Breton, Marc Levine, John Seymour, Bill Pope

HP Indigo - Paul McCarthy, Doug Blake, Cecilia Santos, Tim Stefl

Epson – Roy Bohnen

X-Rite – Ray Cheydleur, Jay Kelbley, Jason Campbell

Printing Industries of America – Joe Marin, Jim Workman

**\*\*All our participants, vendors and partners\*\***

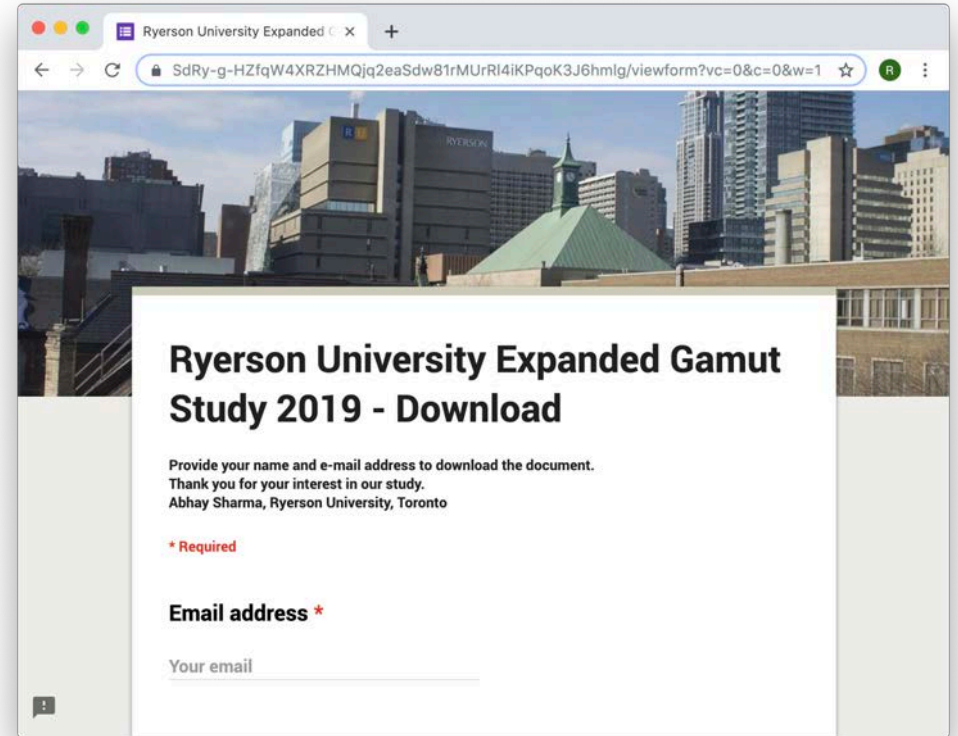
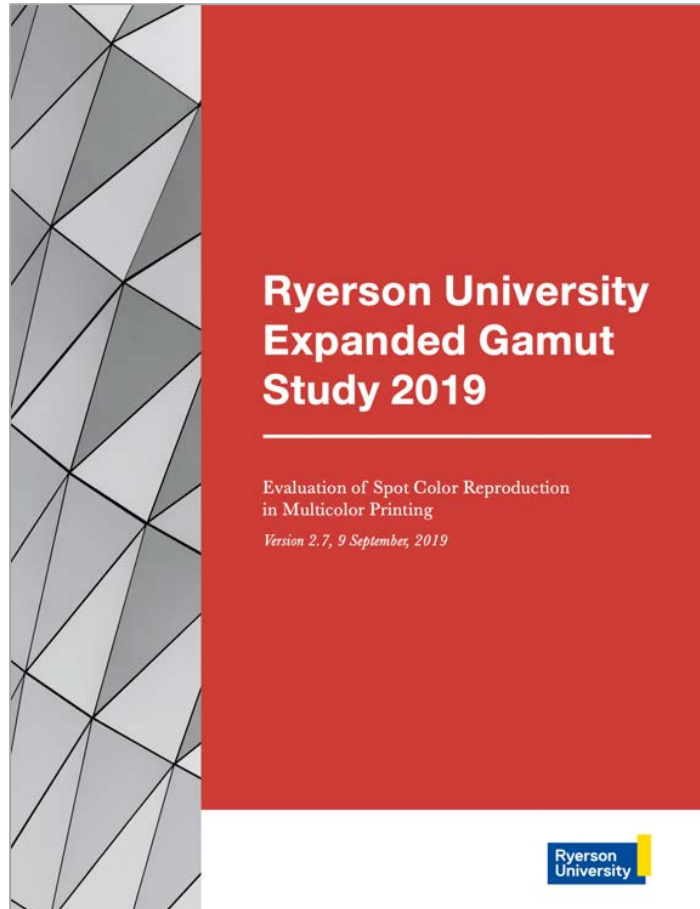
# Thank you

[tinyurl.com/ExpandedGamut](https://tinyurl.com/ExpandedGamut)



## COLOR20

get the answers here



Abhay Sharma

**Ryerson University**