



Expanded Gamut Shoot-Out: Real Systems, Real Results

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Advisors

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COLOR20

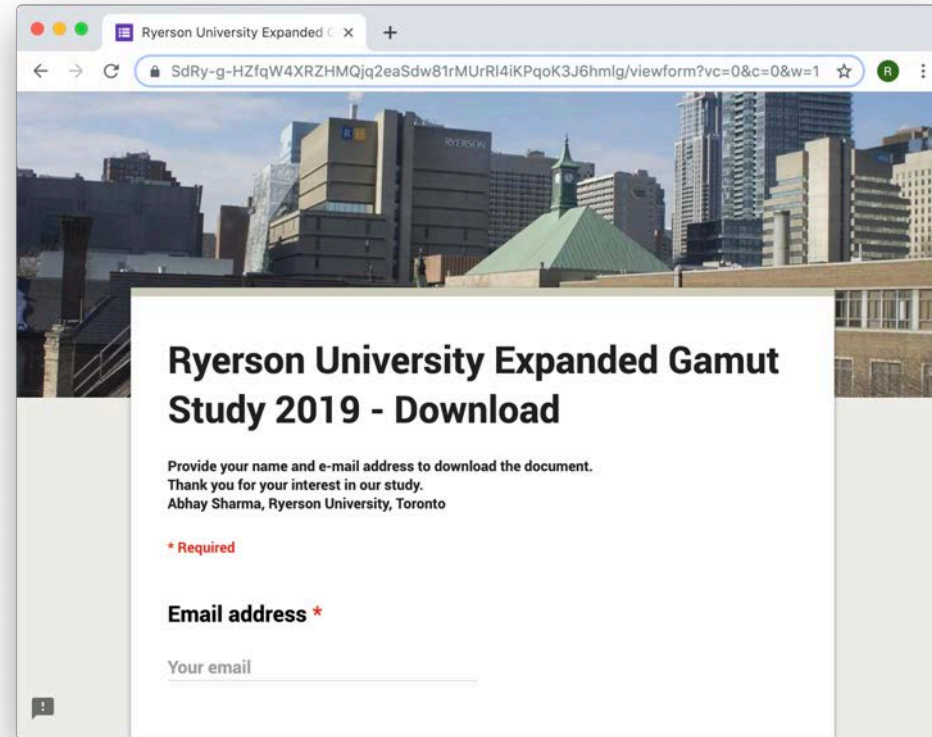
get the answers here



Ryerson
University

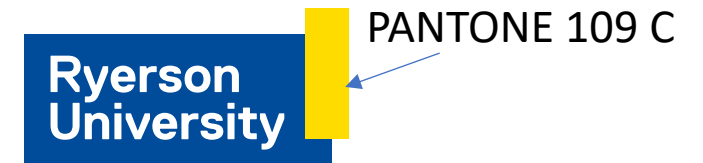
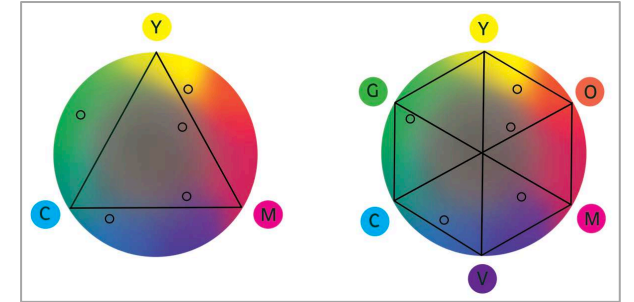
Comprehensive Report – 450+ downloads

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

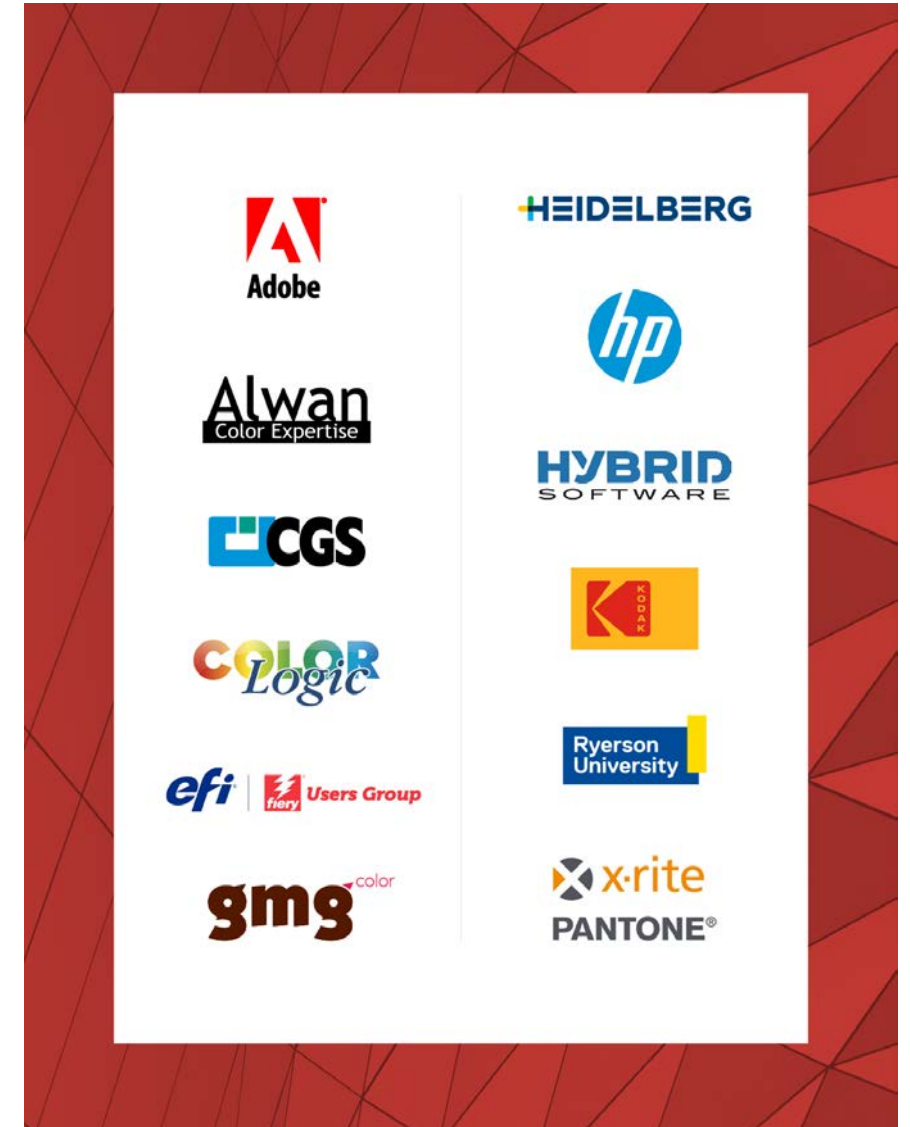
- efi Fiery XF (Command WorkStation) – Epson P9000
- SmartStream Production Pro – HP Indigo 7900

Color Management Solutions

- X-Rite i1Profiler

Expanded Gamut Tools

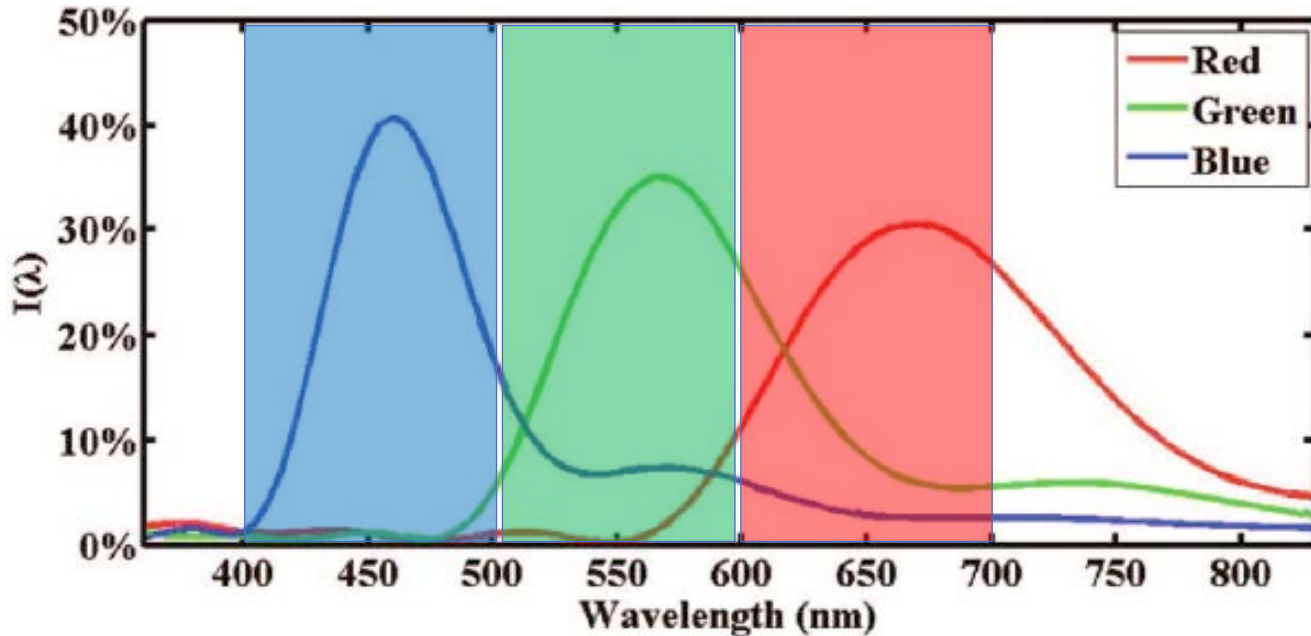
- PANTONE Color Manager, Adobe Acrobat Pro, Adobe Photoshop



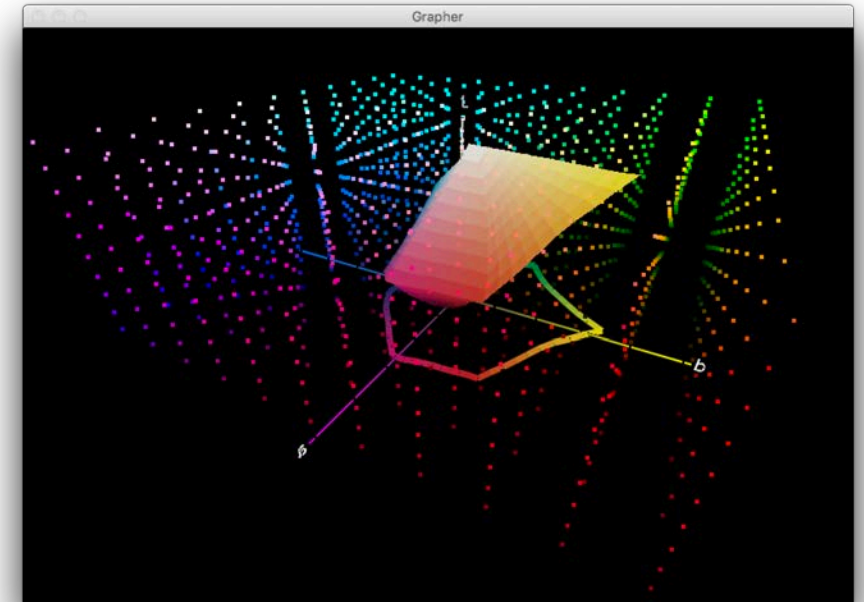
Why do we need Expanded Gamut?

- because imaging systems are imperfect

Printing inks and dyes



CMYK color gamut is small



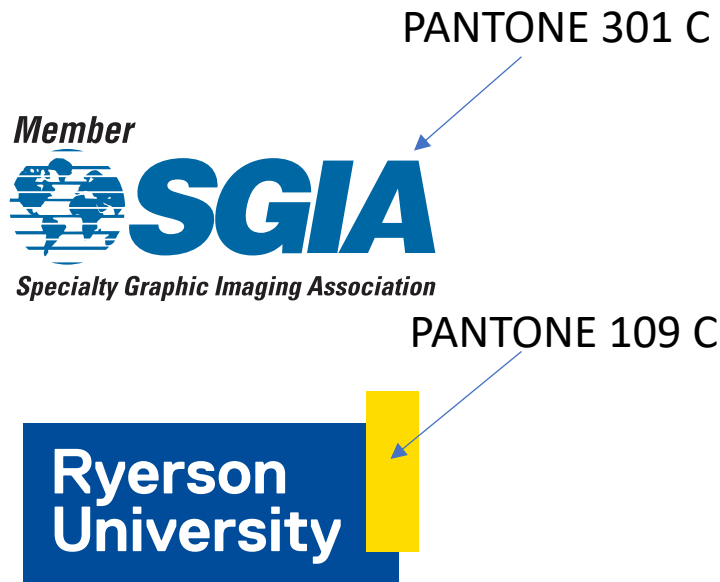
Color
negative
film



What are the Use Cases for Expanded Gamut?



1. Spot Colors

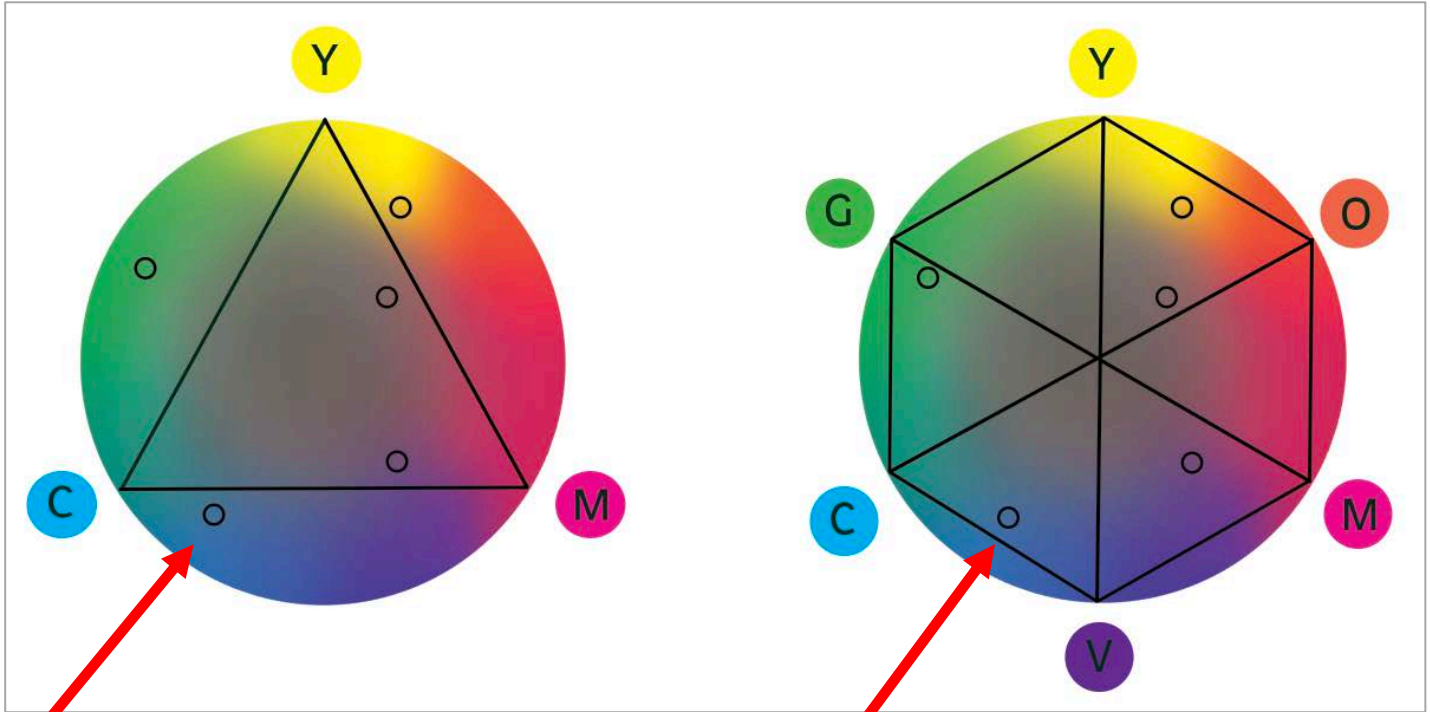
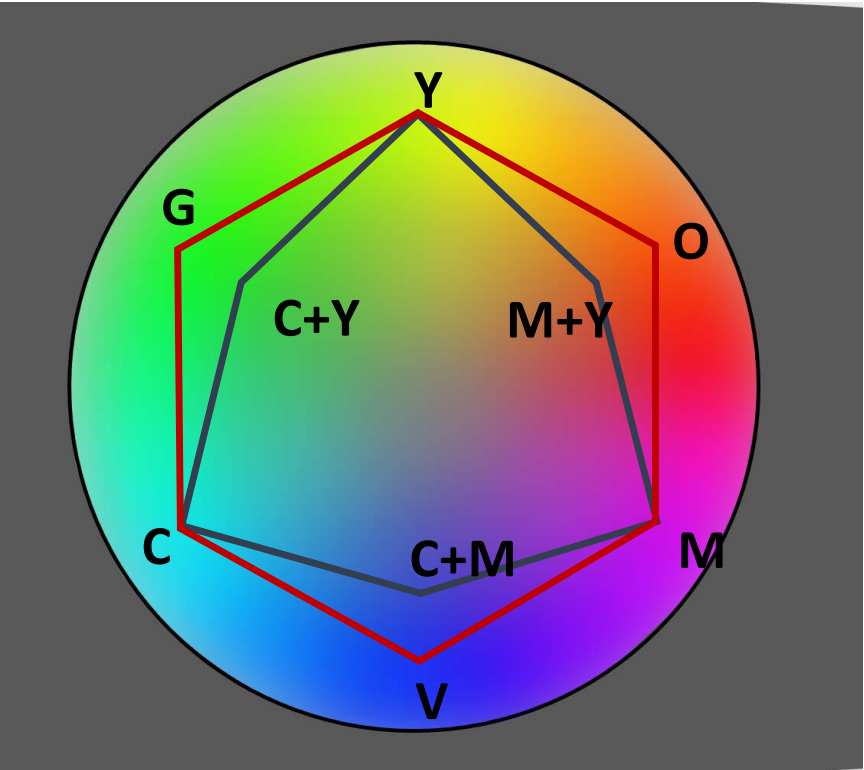


Expanded gamut is most urgently needed in spot color reproduction for labels and package printing.

2. Images



Orange, Green, Violet - expands the colorspace

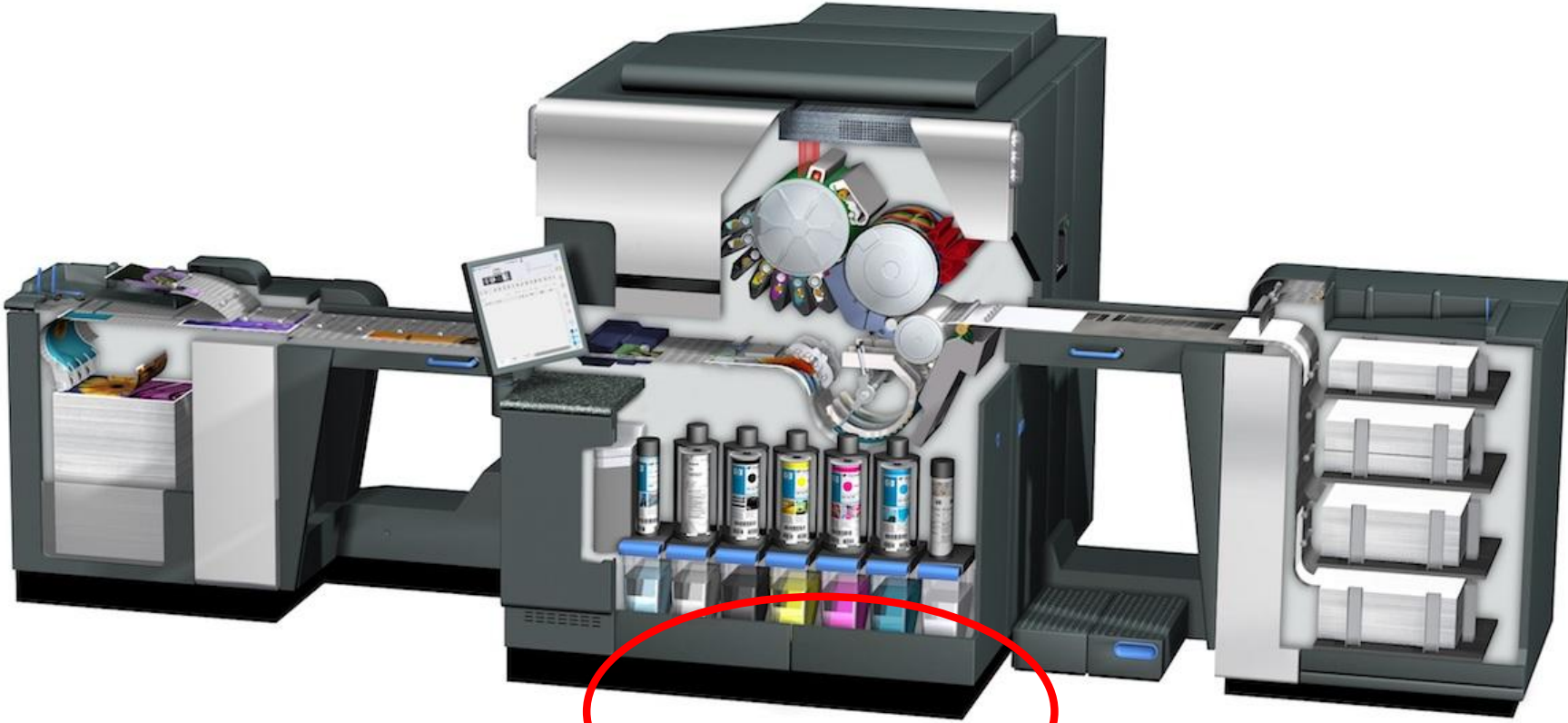


Colors are out of gamut

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)

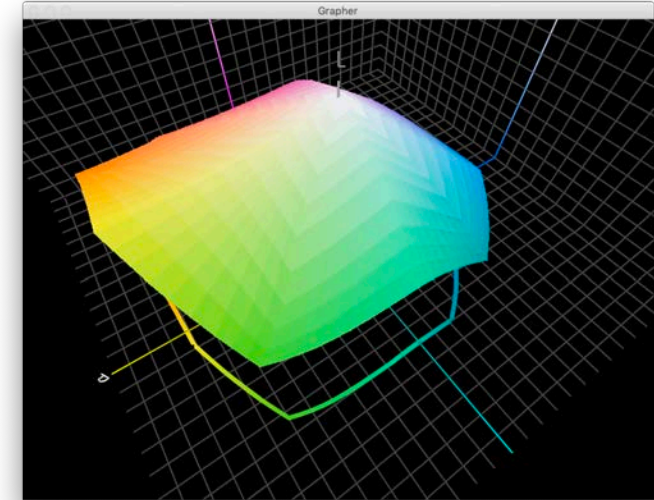


The Epson SureColor P9000
with CMYK + OGV

CMYK – OGV ink set



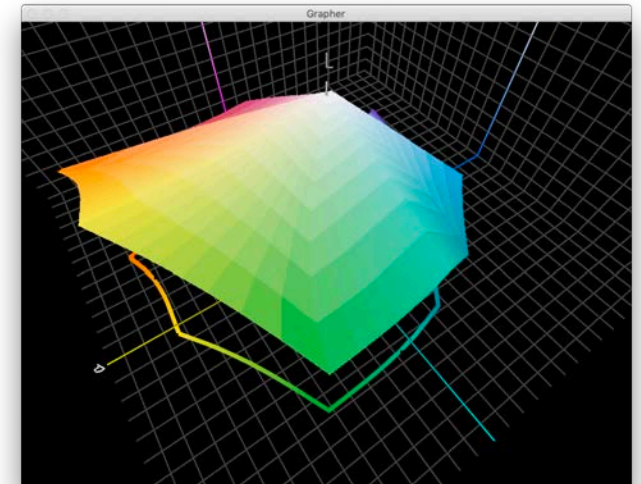
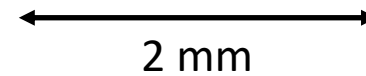
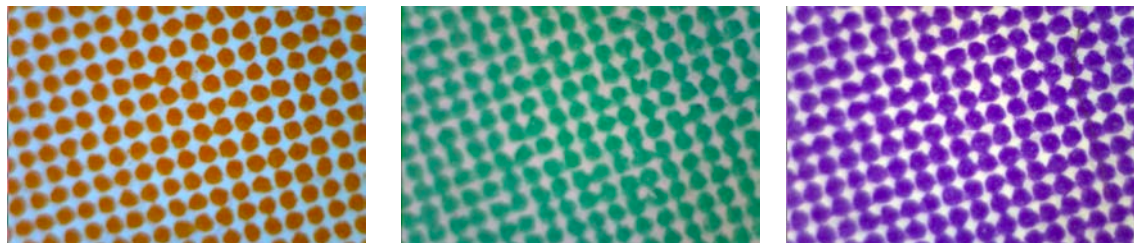
Epson SureColor P9000

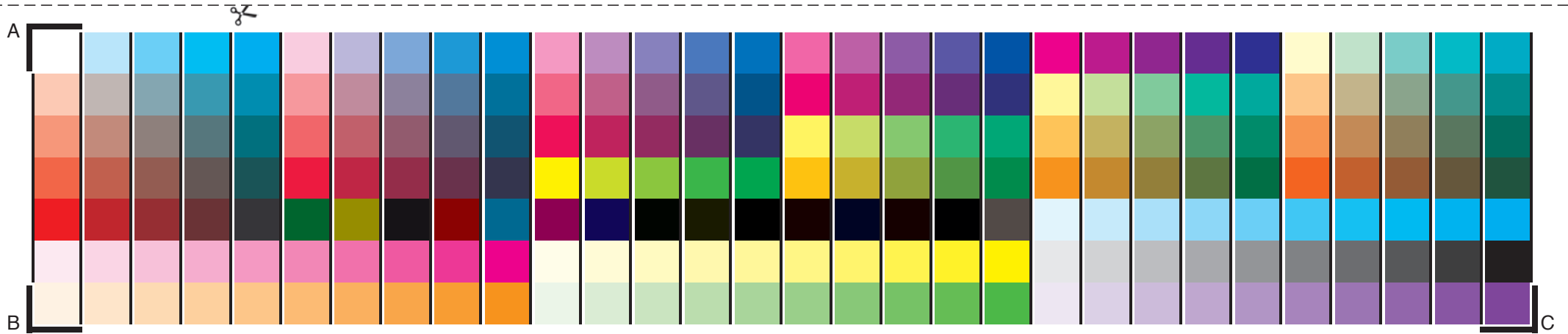


Microscopy reveals the OGV inks which increases the color gamut



HP Indigo 7900

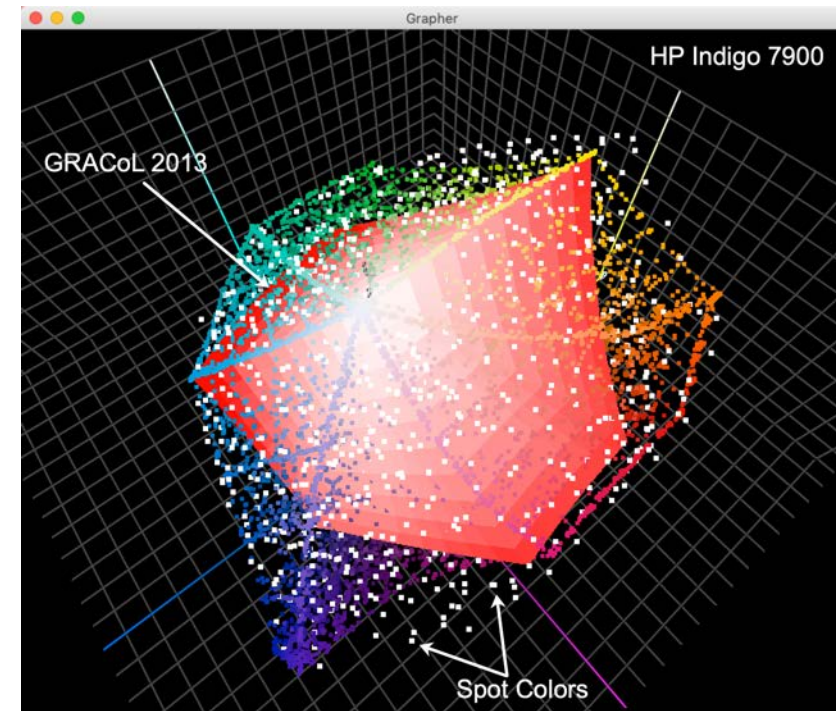
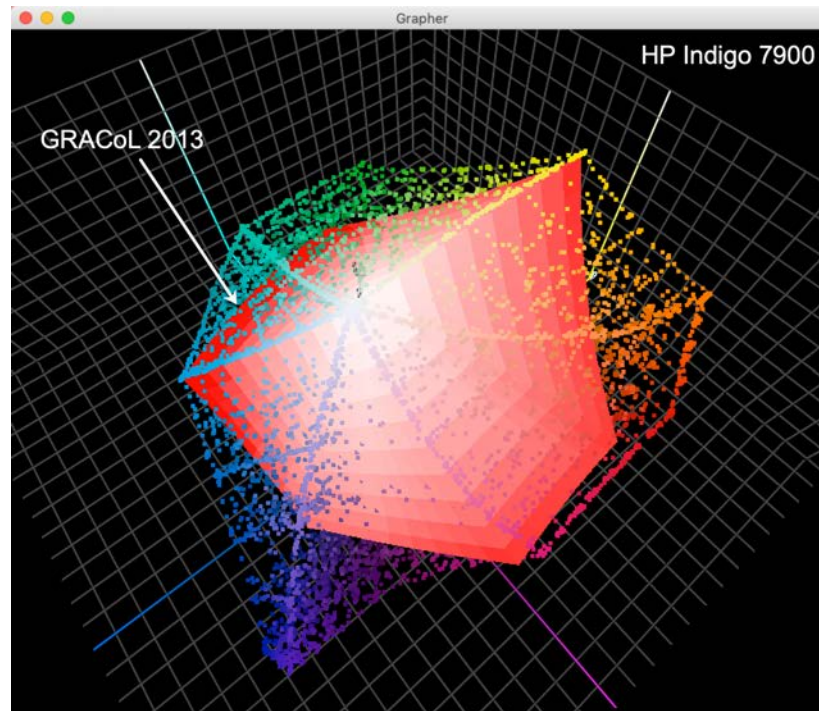
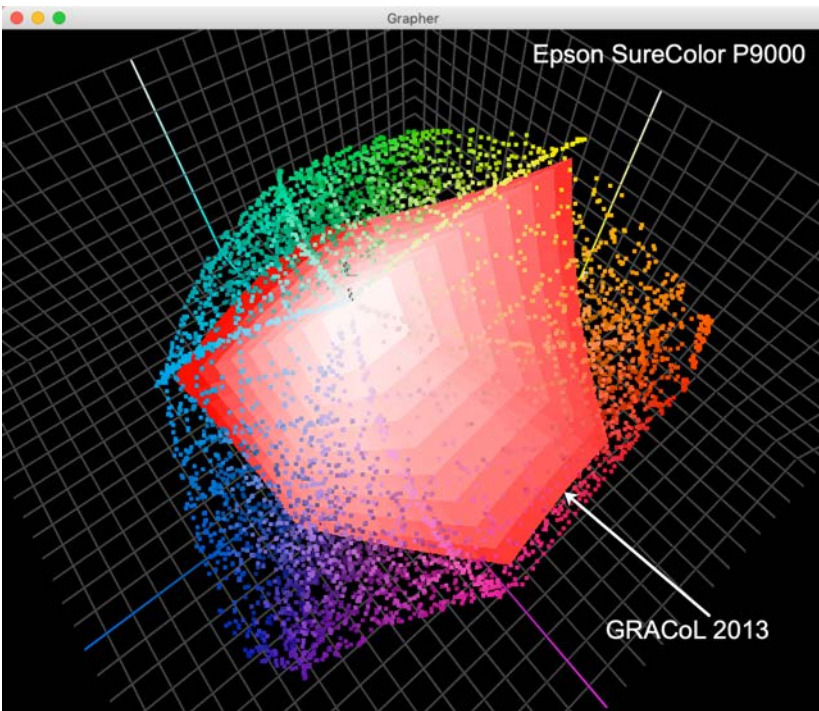




In EG we use CMYK-OGV to make all the other colors



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**

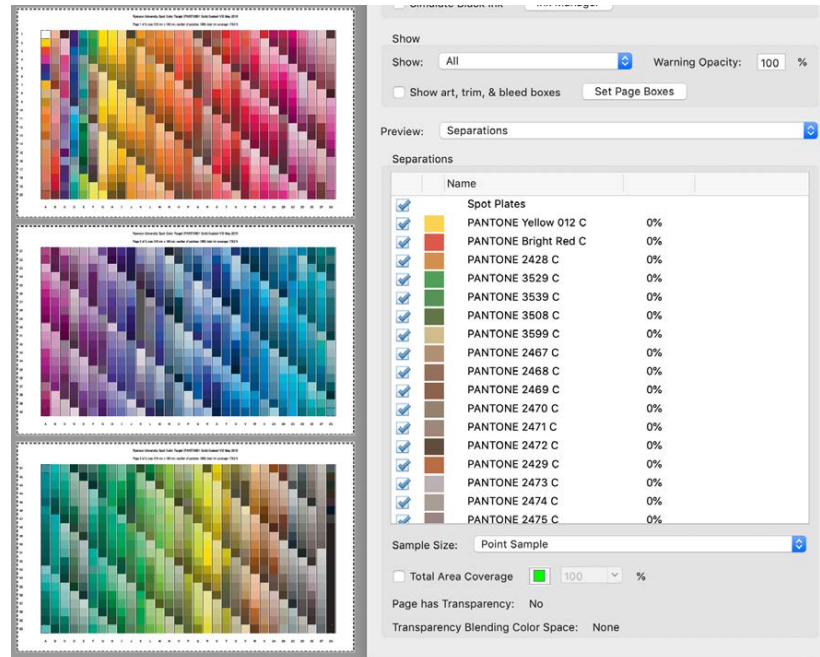


Overview.....

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



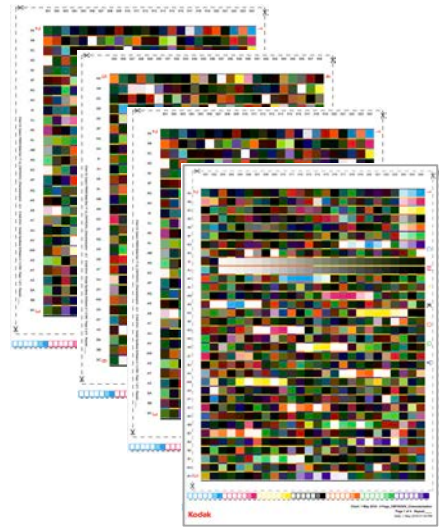
Epson SureColor P9000 (CMYK-OGV)



HP Indigo 7900 (CMYK-OGV)



Printing PANTONE+ Solid Coated in CMYKOGV



4-page chart i1iO format

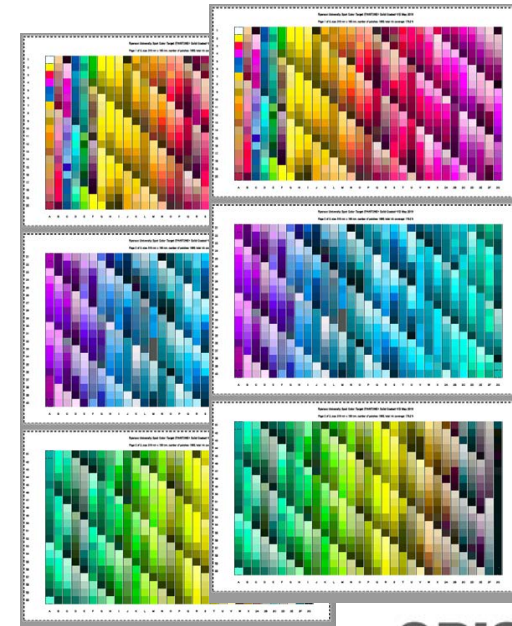
Epson SureColor P9000 CE



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

```

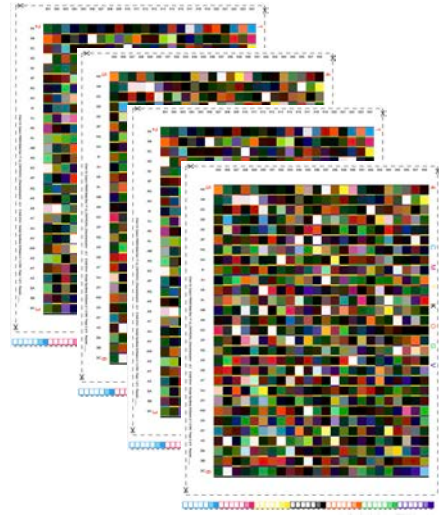
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<<<B=97/<<C=0
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Name="PANTONE 2433 C"
Id="89861113-7186-11E3-9830-EDA7CF7D4AE"
Guid="33A4C339-7997-4E94-8064-2C9A122E5908"
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ProfileSpecification="ICCB"
    
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Note: i1Pro2 is same as above



CIEDE2000 for 1846 PANTONE+ Solid Coated library

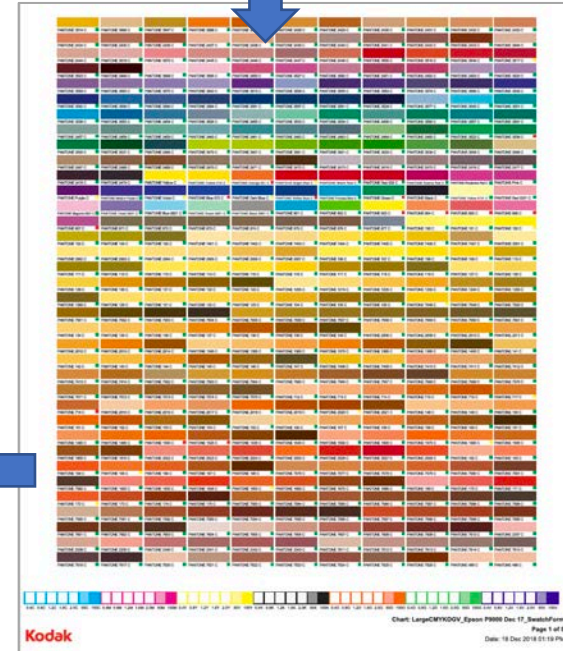
Real Results with Kodak Spotless



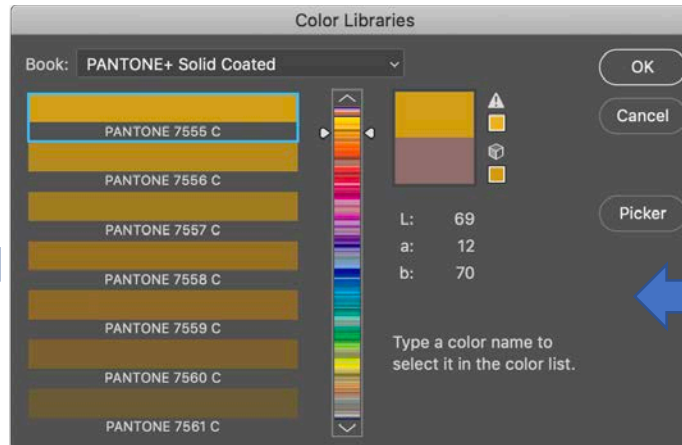
Epson SureColor P9000



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PANTONE 2415 C	36.2 99.0 0.0 5.2 0.0 0.0 0.0	36.11 64.15 -23.61
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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
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
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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



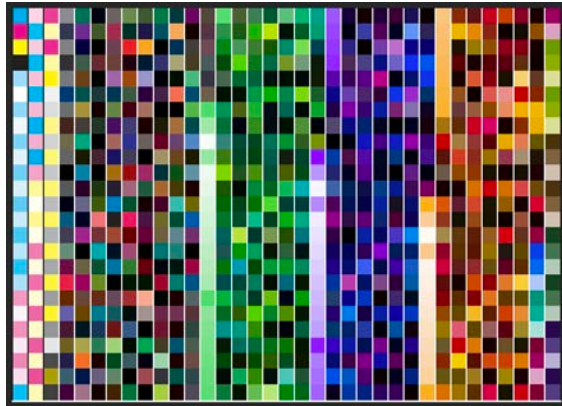
Spot color
PANTONE 7555 C

CIED2000
0.54



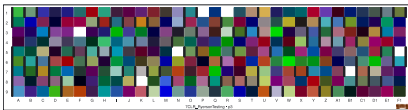
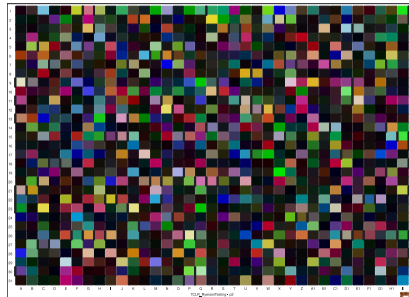
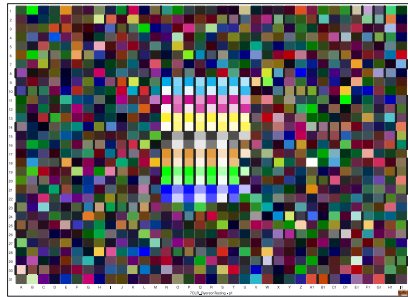
With permission and thanks to William Li, Stephen Zmetana, Kodak

Charts can vary between vendors



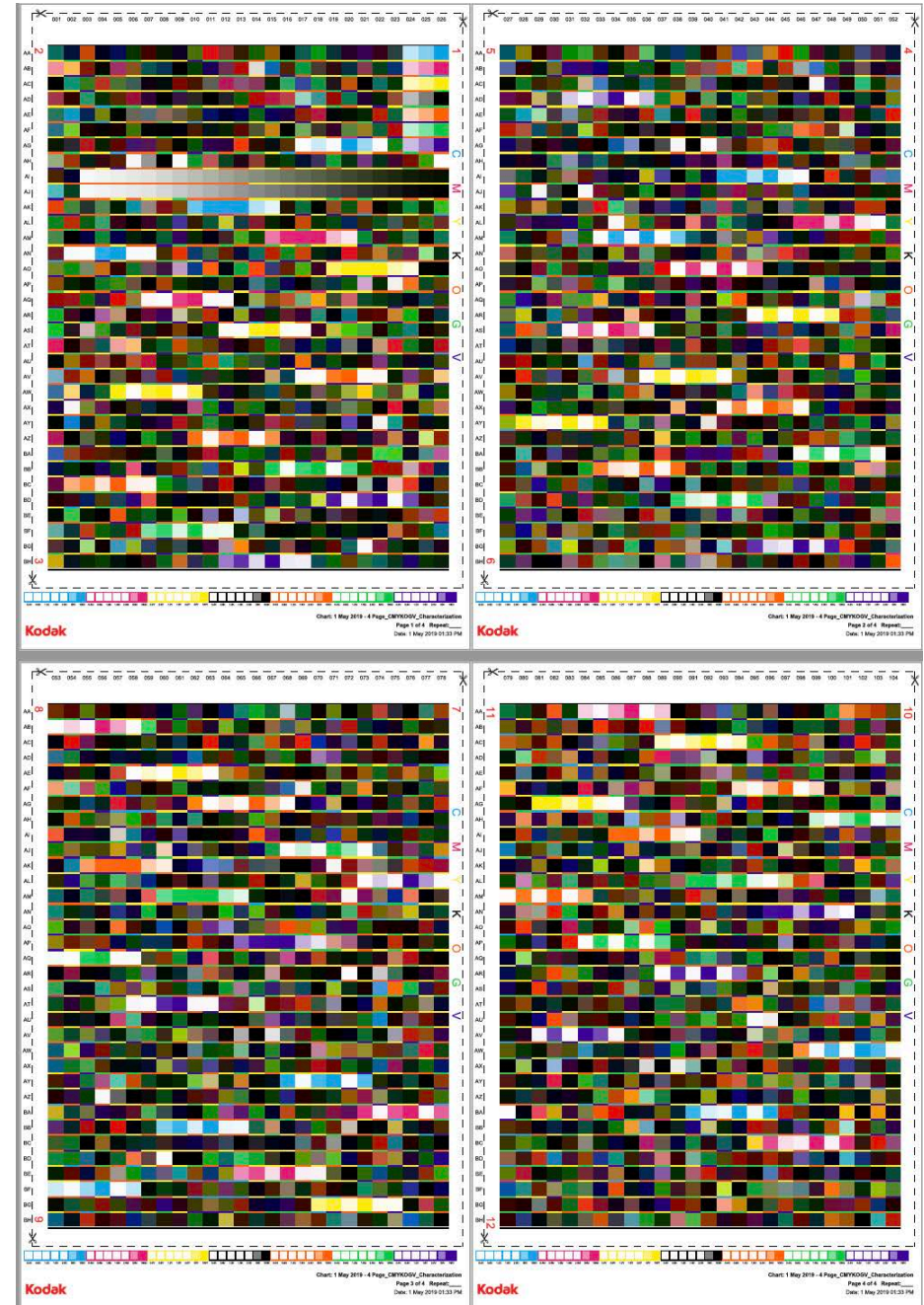
Kodak Spotless
KSS 2.01
4 pages

AlwanHydra_7C_875p_ProfilingChart_Xrite_iO
1 page!



GMG OpenColor 2.2.1
2.5 pages

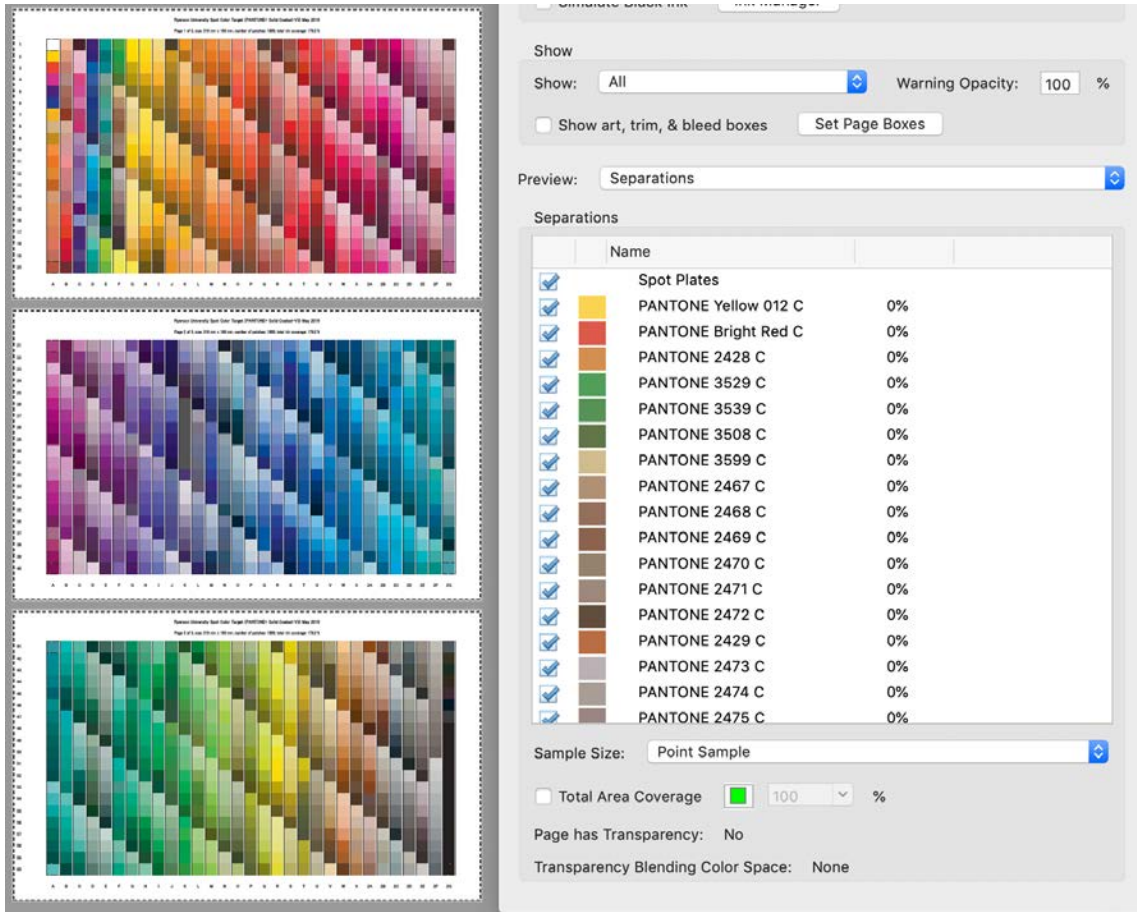
There is no IT8.7/4
standard yet.



Converting spot channels to CMYK-OGV

If we have a file like this...

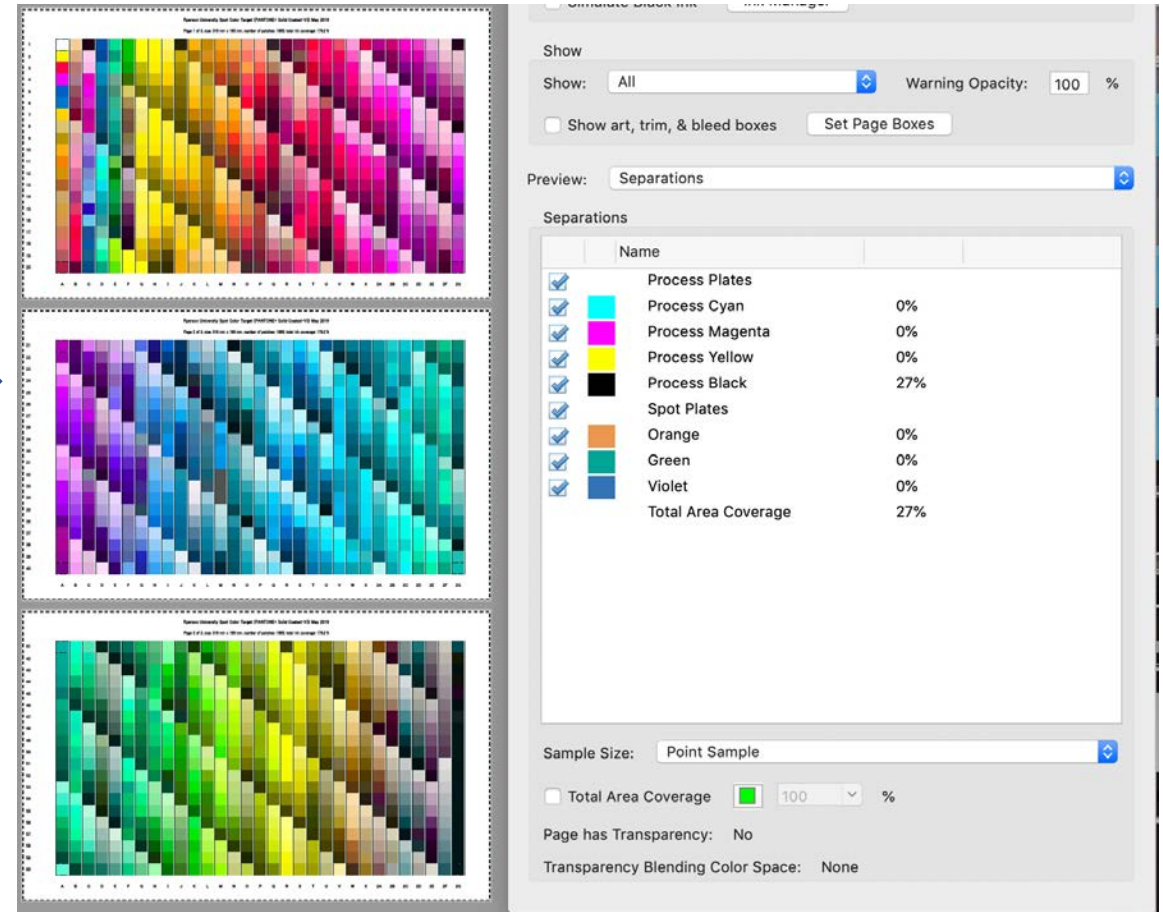
...we can convert it into inking values.



Adobe Acrobat's Separations panel for a file with 15 spot channels. The 'Show' dropdown is set to 'All' and 'Warning Opacity' is 100%. The 'Preview' dropdown is set to 'Separations'. The 'Separations' table lists 15 spot plates, all with 0% coverage.

Name	Coverage
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 3599 C	0%
PANTONE 2467 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

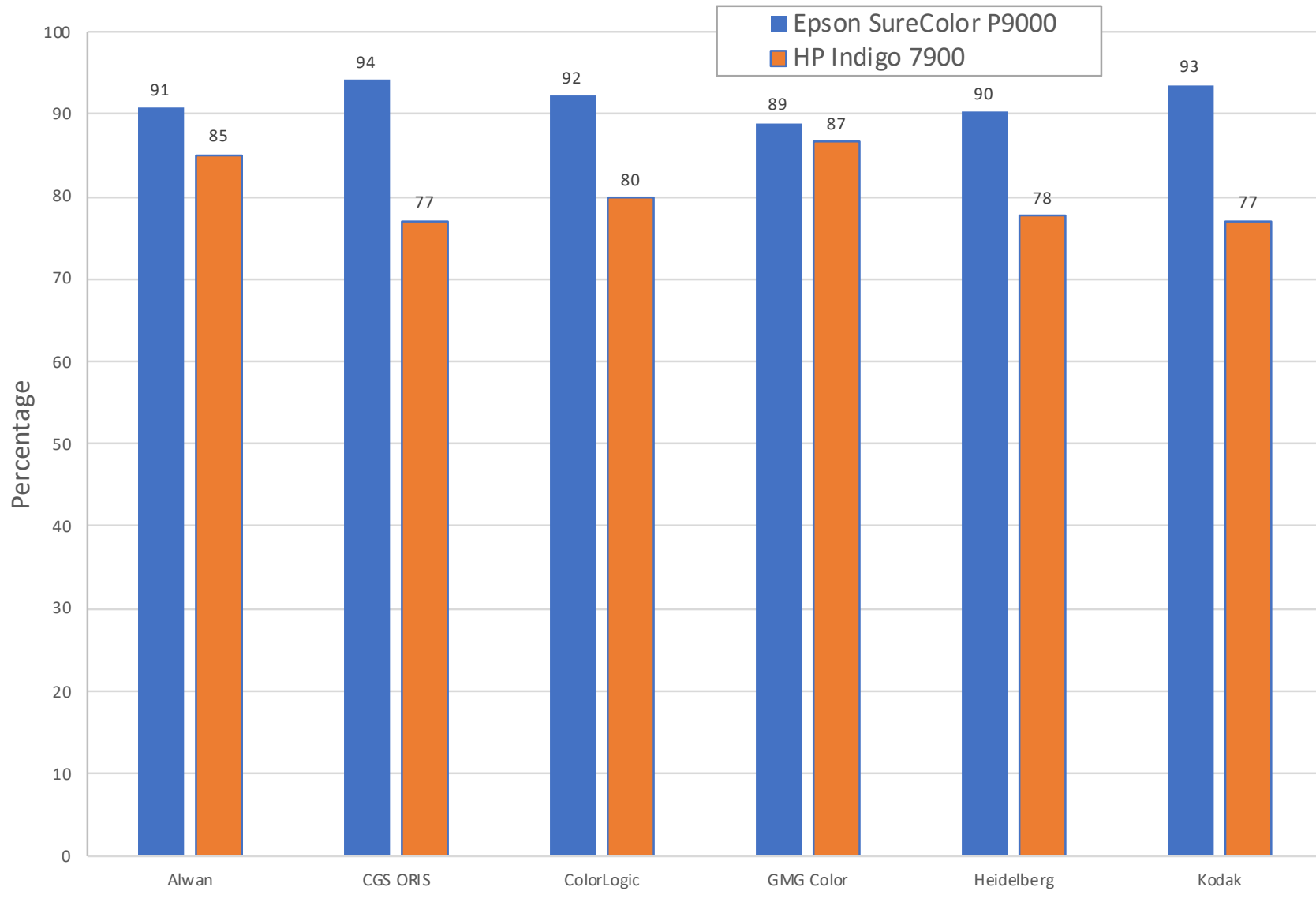


Adobe Acrobat's Separations panel for the same file after conversion to CMYK-OGV. The 'Show' dropdown is set to 'All' and 'Warning Opacity' is 100%. The 'Preview' dropdown is set to 'Separations'. The 'Separations' table lists 10 process plates and 2 spot plates, with a total area coverage of 27%.

Name	Coverage
Process Plates	
Process Cyan	0%
Process Magenta	0%
Process Yellow	0%
Process Black	27%
Spot Plates	
Orange	0%
Green	0%
Violet	0%
Total Area Coverage	27%

Sample Size: Point Sample
Total Area Coverage: 100%
Page has Transparency: No
Transparency Blending Color Space: None

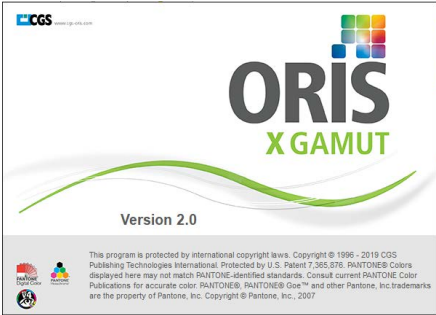
Percentage of spot colors < 2.0 CIEDE2000



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

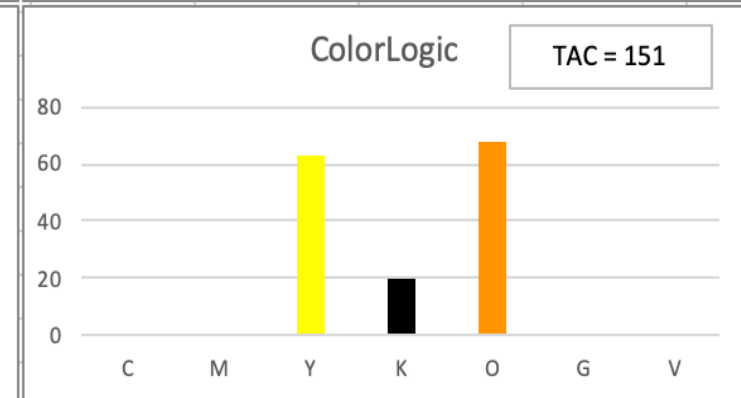
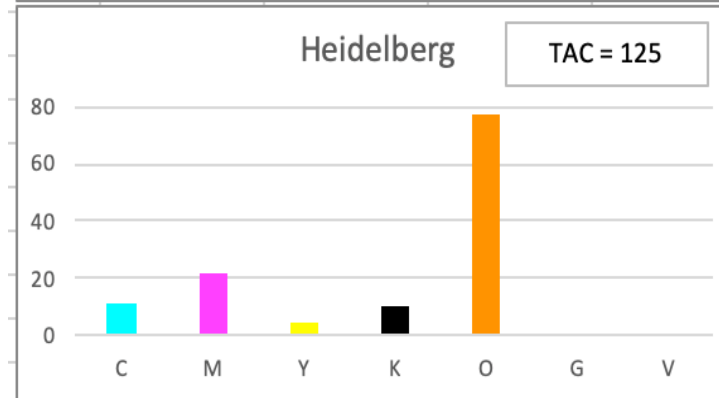
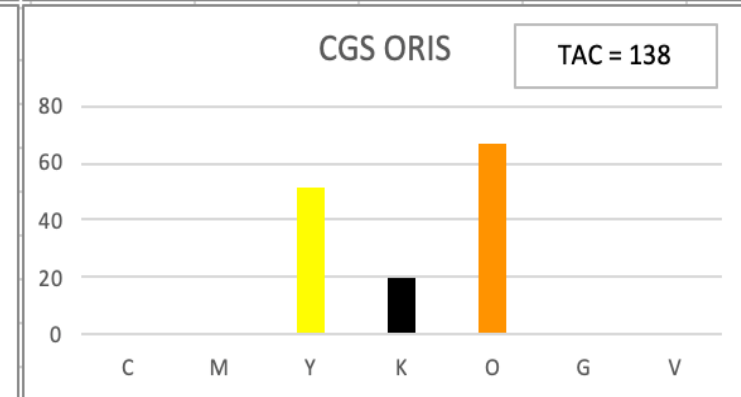
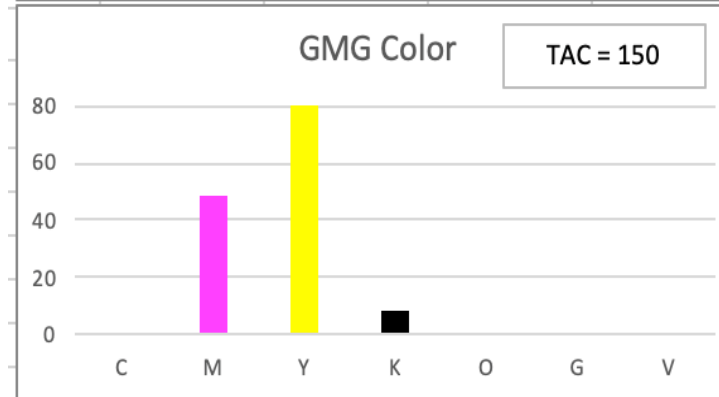
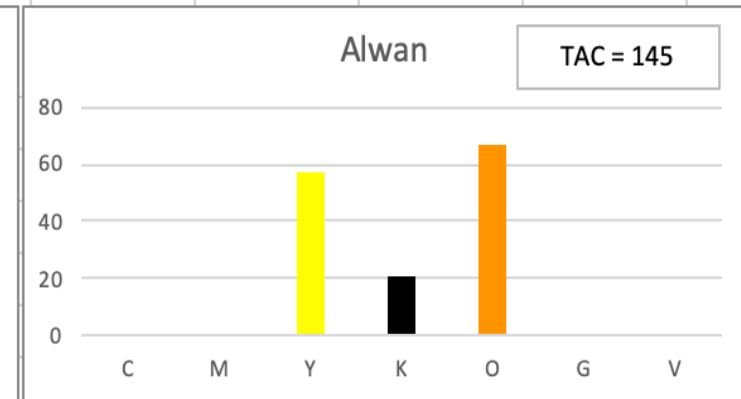
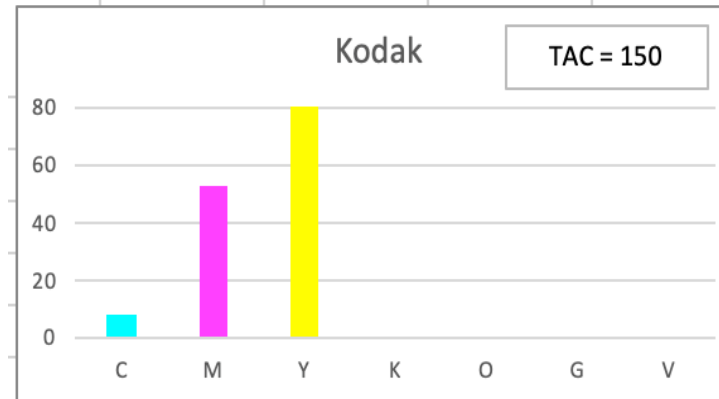
Create swatchbook Control measurement... Refine Reset

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!

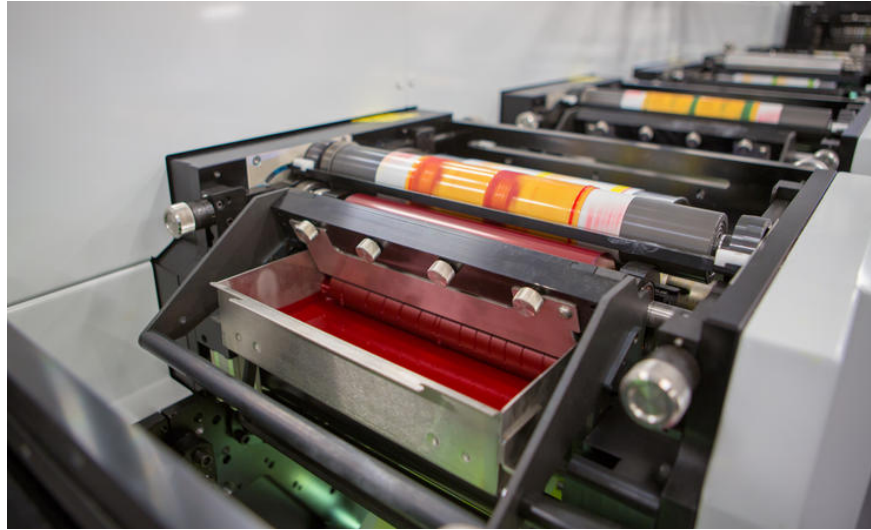


PANTONE 2573 C	2 pts PANTONE Rub. Red	12.5
	2 pts PANTONE Violet	12.5
	12 pts PANTONE Trans.Wt.	75.0



- 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



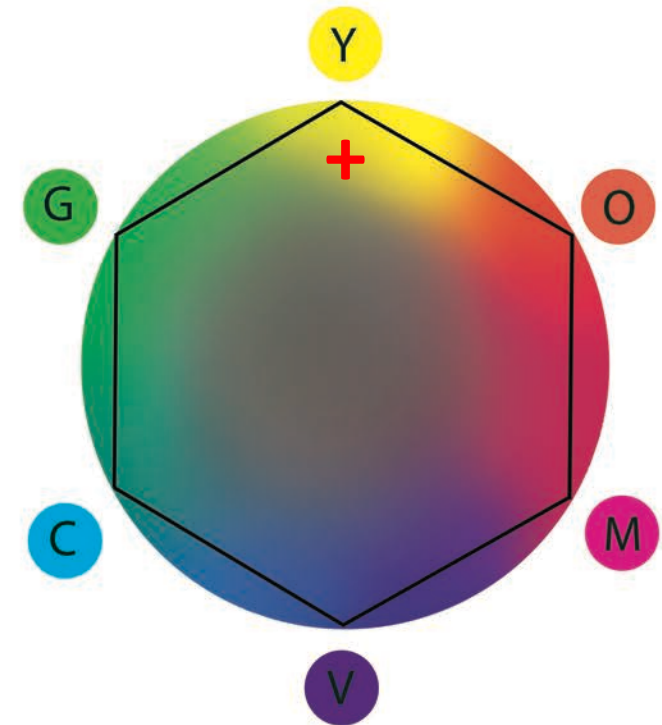
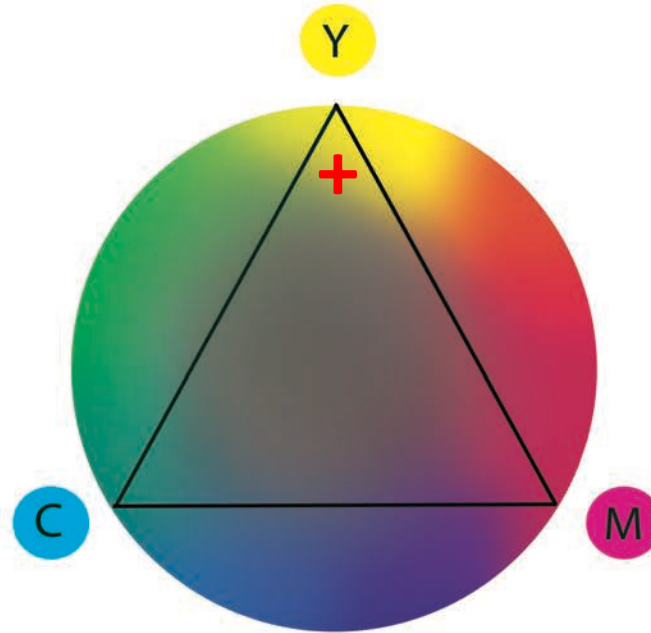
Expanded Gamut printing allows for a new fixed palette of CMYK-OGV inks that become the “process colors”. The fixed CMYK-OGV stays in the press, we only change plates, and the designer can select from any spot color they want....

Selling EG to your press operator..... “I can’t control 4 inks, how can I control 7!”

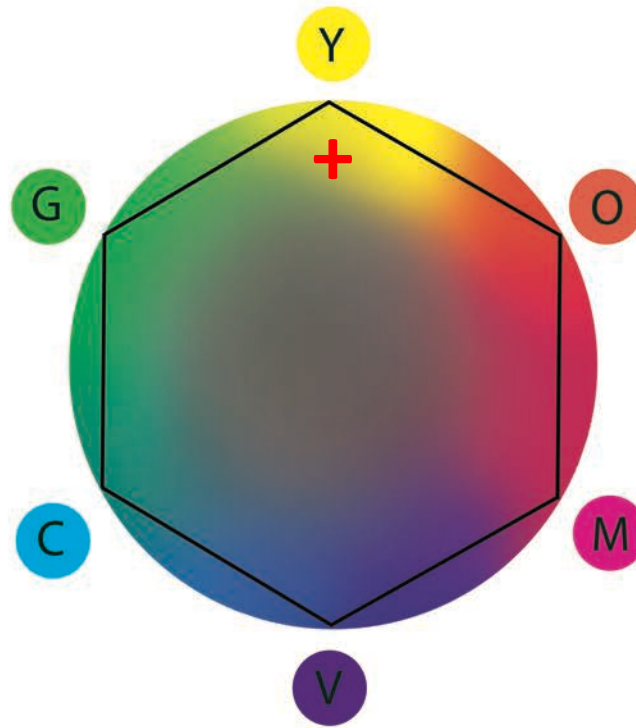
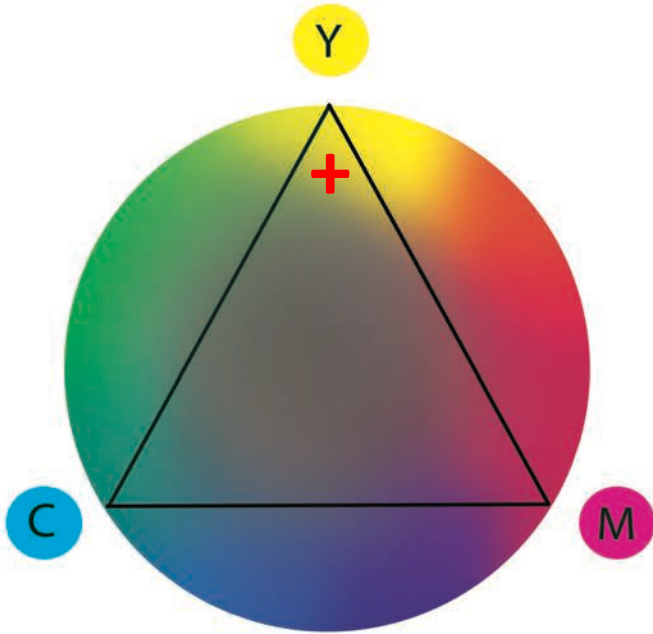
In EG no color needs all 7 inks at the same time.

In EG maximum 3 inks are used.

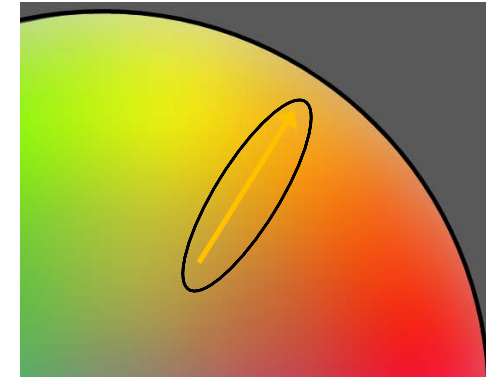
And, the 2 or 3 inks are closer to the required color, so press drift has minimal visual effect.



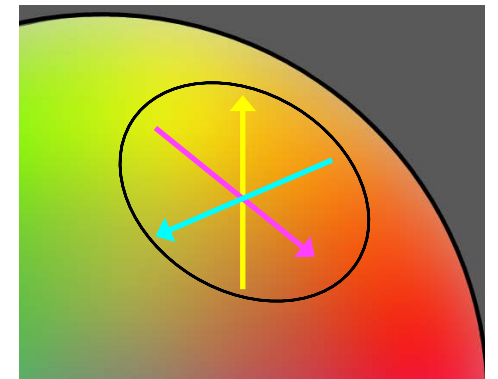
CMYK-OGV printing is easier to control



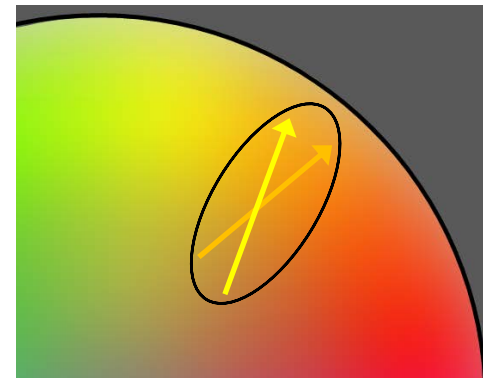
Single spot
color ink



CMYK
overprint



CMYK-OGV
overprint

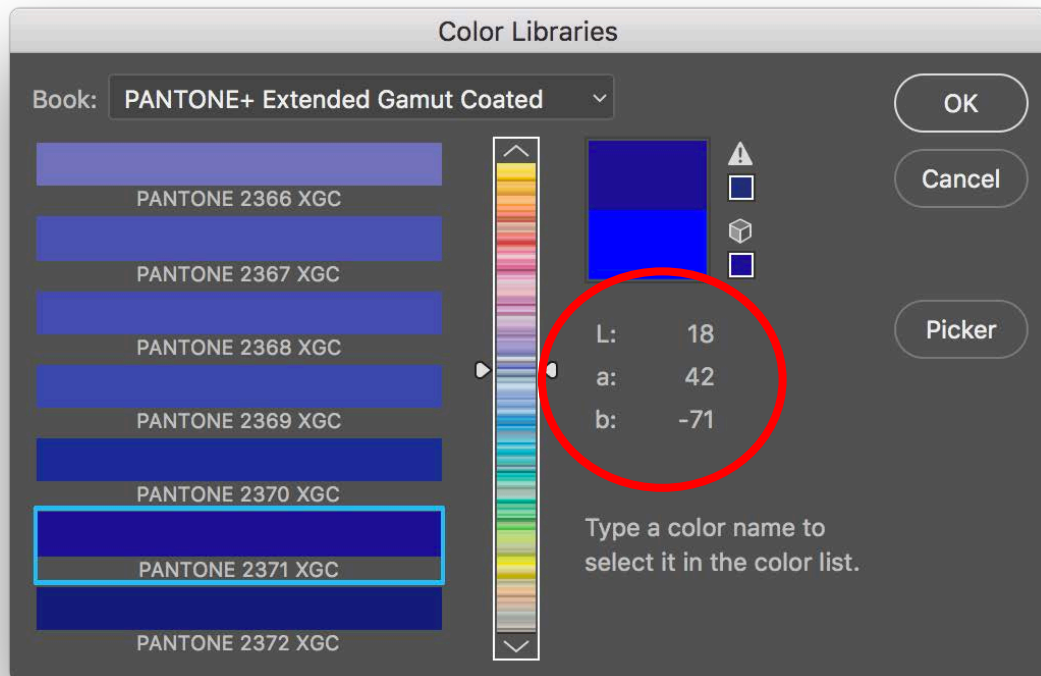


A single spot color ink may vary only in density, causing minimal shift.
A CMYK overprint can vary, causing huge hue and saturation shifts.
CMYK-OGV uses only nearest 2-3 colorants causing minimal hue shift.

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

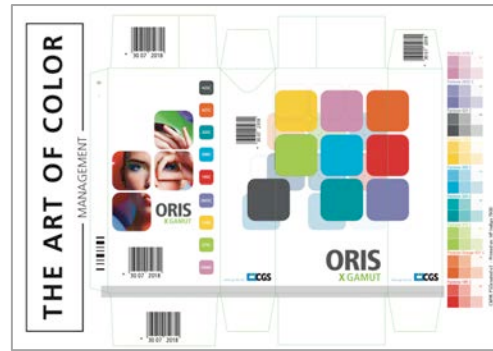


Commercial Edition EG inks



Epson SureColor P9000

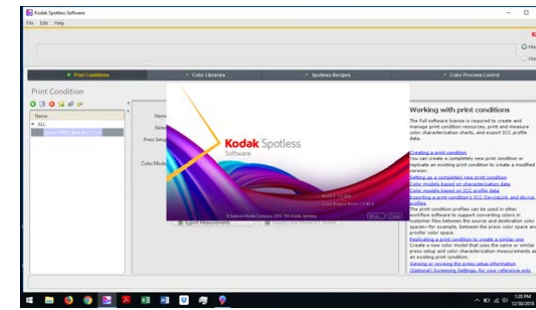
Label Printing Package Printing



ORIS X GAMUT



Software



Kodak Spotless

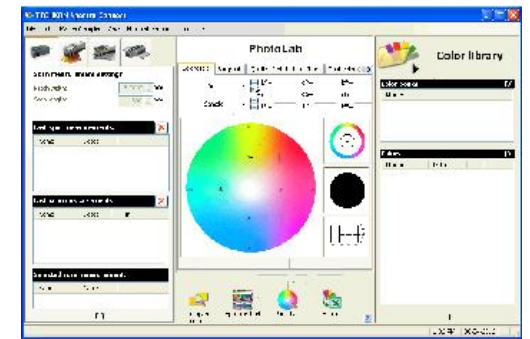


PANTONE EXTENDED
GAMUT Guide

SpectroDens4 Spectro Connect



SpectroDens4



Spectro Connect 2.7

Ryerson University Study 2019 and 2020



Fogra Multicolor Forum 2018 and January, 2020

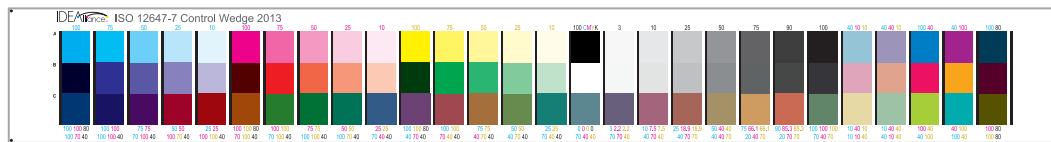


Idealliance Control Strips

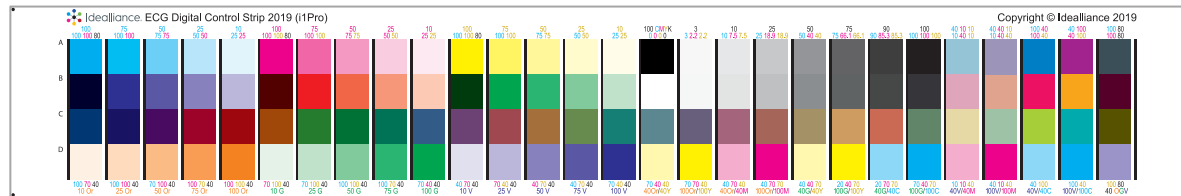
Idealliance 2-row Control Strip 2009 - CMYK



Idealliance 3-row Control Strip 2013 – CMYK



Idealliance ECG Digital Control Strip 2019 – CMYK OGV



Fogra Media Wedges

1
2
3

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

Fogra MediaWedge Multicolor 5C® V1 Copyright: Fogra 2018 Liz.: 1FO04032019 User: Ryerson University

1
2
3

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

Fogra MediaWedge Multicolor 6C® V1 Copyright: Fogra 2018 Liz.: 1FO04032019 User: Ryerson University

1
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4

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

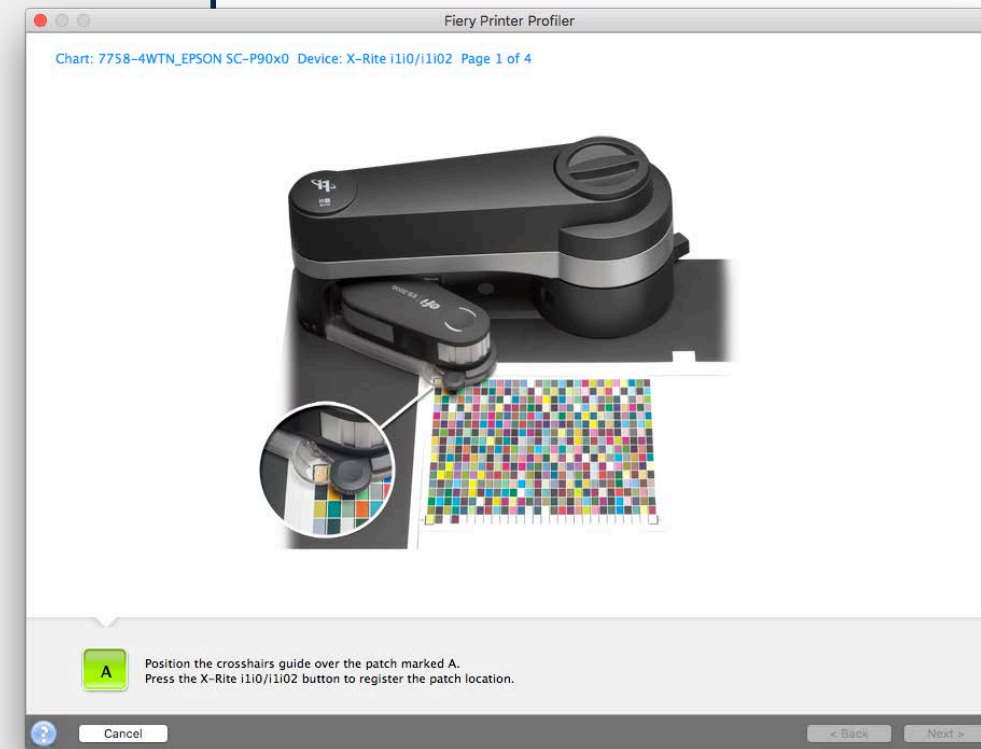
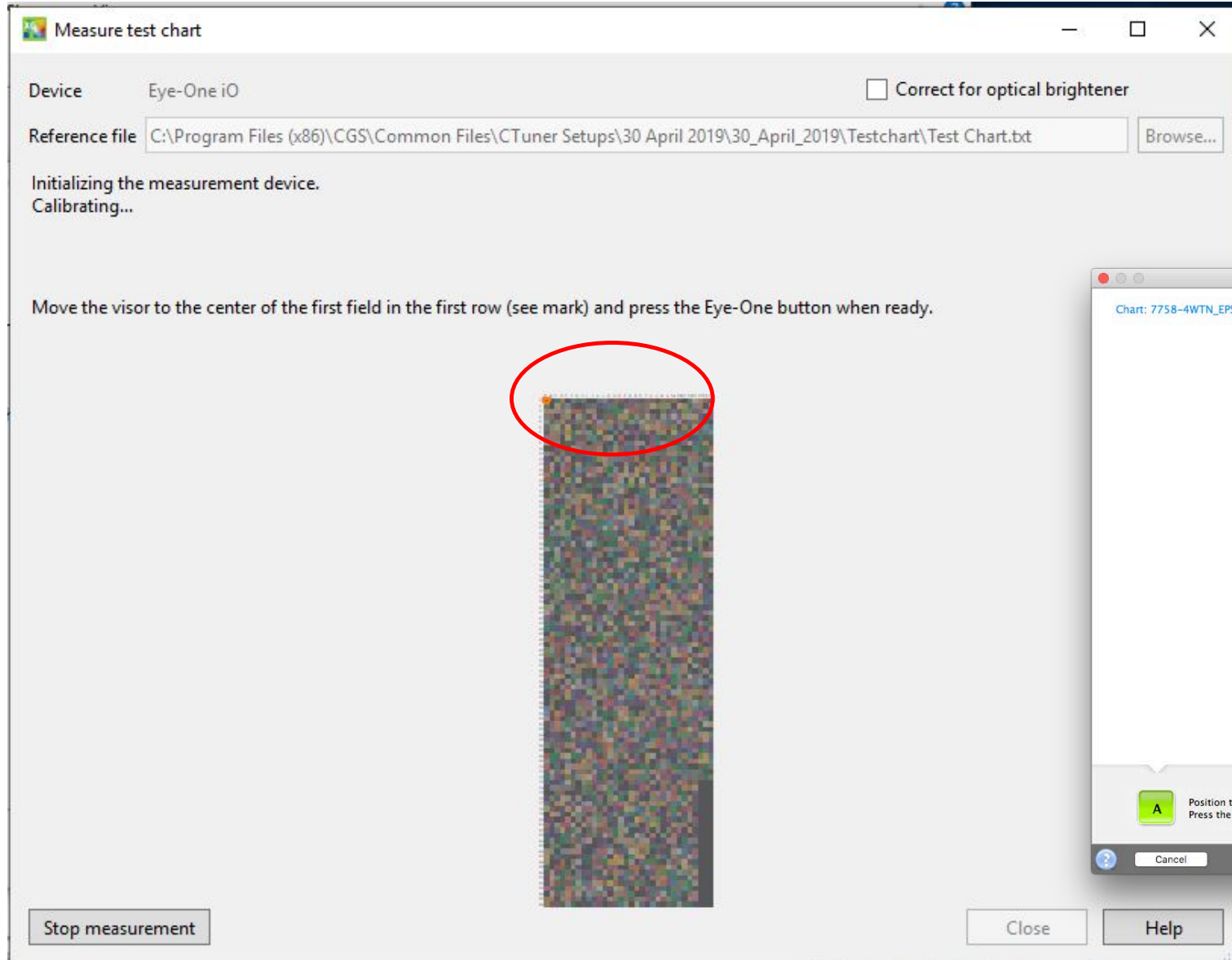
Fogra MediaWedge Multicolor 7C® V1 Copyright: Fogra 2018 Liz.: 1FO04032019 User: Ryerson University

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A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

Fogra MediaWedge Multicolor 8C® V1 Copyright: Fogra 2018 Liz.: 1FO04032019 User: Ryerson University

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 %

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	
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 3509 C	0%
<input checked="" type="checkbox"/> PANTONE 2447 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%
Process Plates	
<input checked="" type="checkbox"/> Process Cyan	11%
<input checked="" type="checkbox"/> Process Magenta	2%
<input checked="" type="checkbox"/> Process Yellow	48%
<input checked="" type="checkbox"/> Process Black	0%
Spot Plates	
<input checked="" type="checkbox"/> PANTONE 3514 C	0%
<input checked="" type="checkbox"/> PANTONE 3596 C	0%
<input checked="" type="checkbox"/> PANTONE 2433 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 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

Show

Show: All Warning Opacity: 100 %

Show art, trim, & bleed boxes Set Page Boxes

Preview: Separations

Separations

Name	
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 3509 C	0%
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<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%
Process Plates	
<input checked="" type="checkbox"/> Process Cyan	11%
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<input checked="" type="checkbox"/> Process Yellow	48%
<input checked="" type="checkbox"/> Process Black	0%
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<input checked="" type="checkbox"/> PANTONE 3514 C	0%
<input checked="" type="checkbox"/> PANTONE 3596 C	0%
<input checked="" type="checkbox"/> PANTONE 2433 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 2473 C	0%
<input checked="" type="checkbox"/> PANTONE 2474 C	0%
<input checked="" type="checkbox"/> PANTONE 2475 C	0%

Sample Size: Point Sample

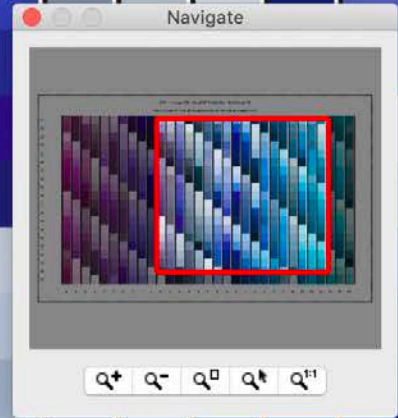
Total Area Coverage 100 %

Page has Transparency: No

Transparency Blending Color Space: None

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

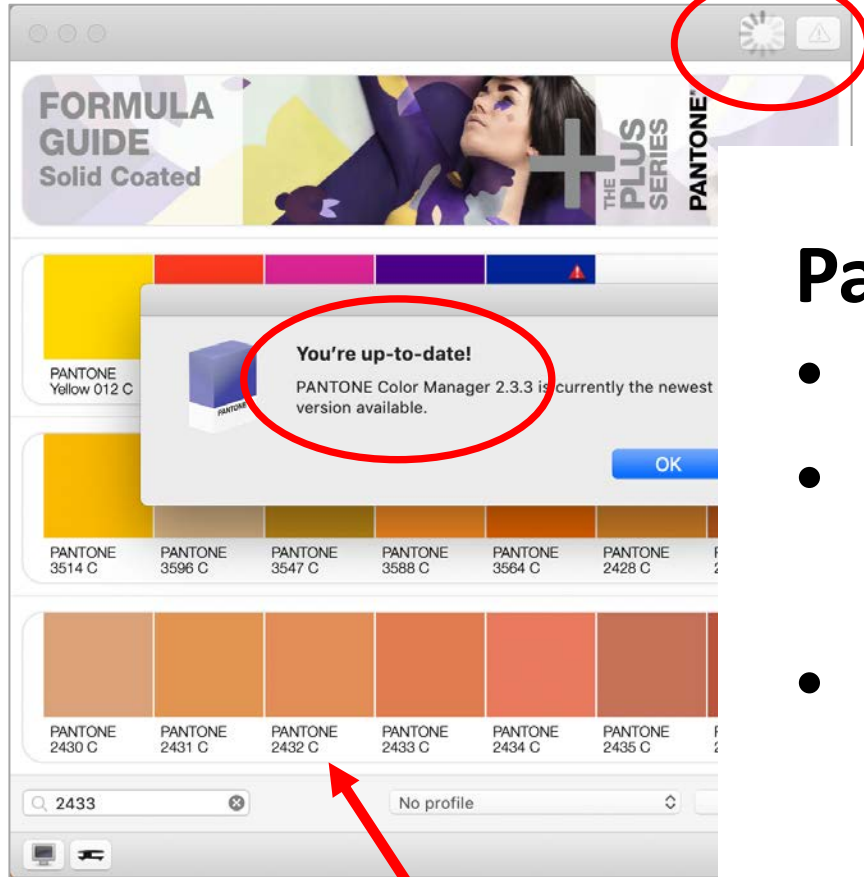
PACKZ

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License Agreement

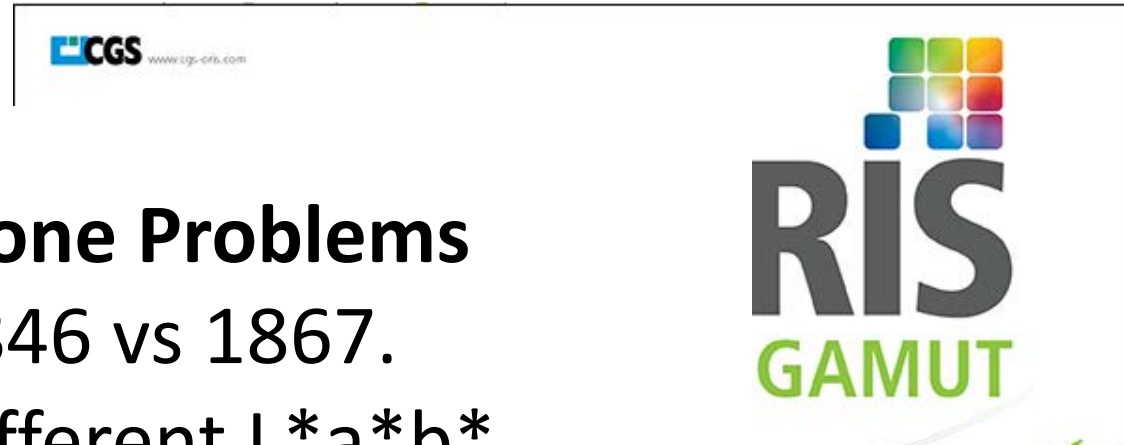
PANTONE Color Manager (\$99)

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

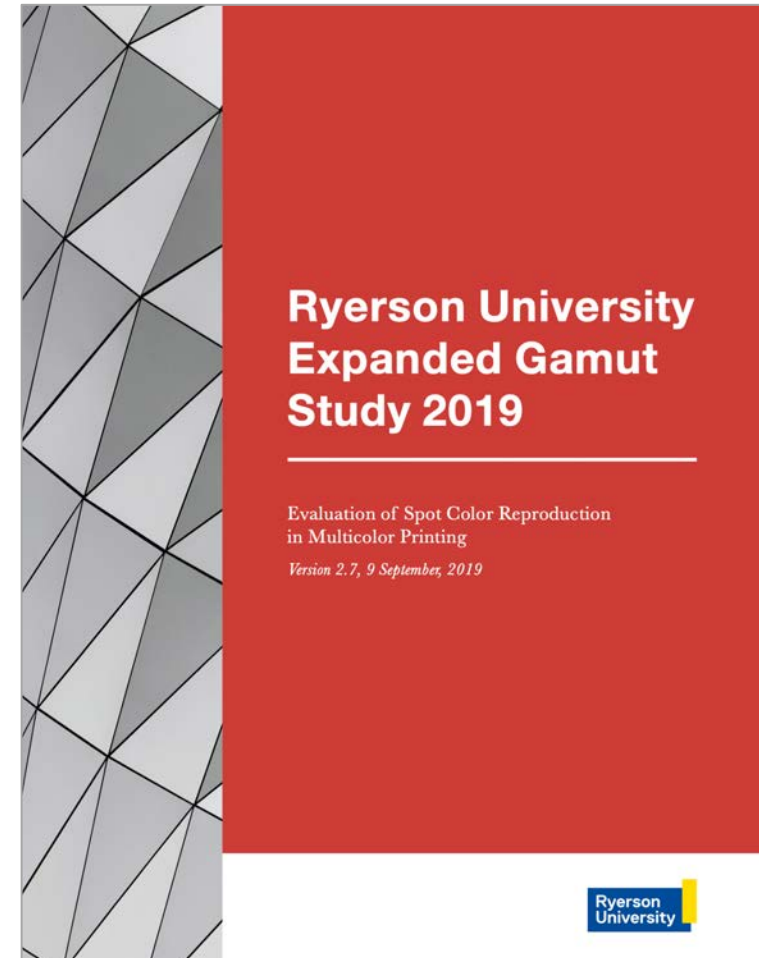
Libraries

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

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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****

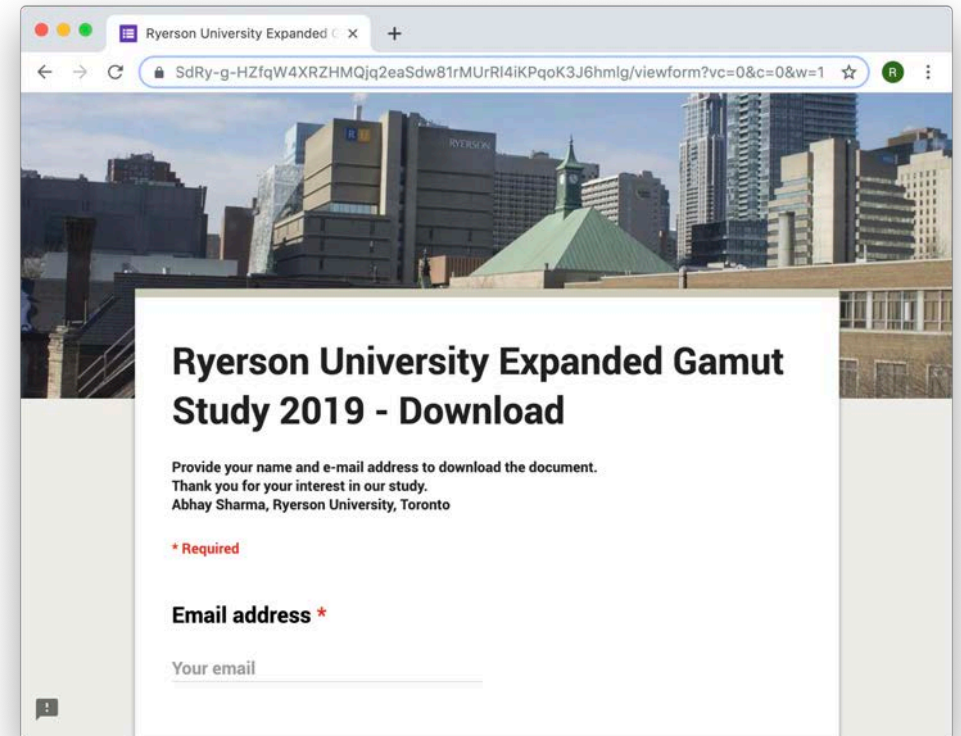
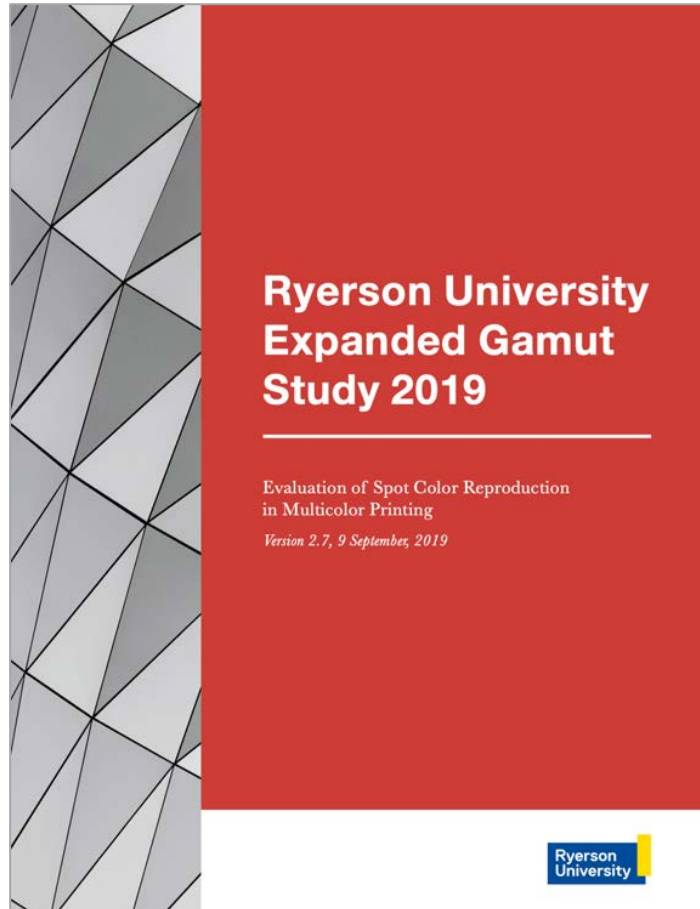
Thank you

tinyurl.com/ExpandedGamut



COLOR20

get the answers here



Abhay Sharma

Ryerson University