Characterization

3rd C

Presented by: David Hunter

#3 Characterization (ICC Profile Creation)

Third of the 5 C's of Color Control

Capture — assess instrumentation capabilities

Calibration- make device consistent to itself & over time

Characterization — define device gamuts & create profile

Conversion — map one gamut to another in the workflow

Conformance — verify new results and meet expectations

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#3 Characterization (ICC Profile Creation)

Steps:

1. Verify Printer is stable and consistent, calibrated and ink limit
2. Qualify substrates- Print target on all important substrates
   - *Use ChromaChecker substrate qualifier to group substrates per EF*
3. Choose Characterization software
4. Choose profile target (IT8 7/5) compatible w/capture device
5. Print multiple times immediately after calibration done
6. Measure multiple targets, compare differences, average
7. Create ICC Profile using correct settings
   - *Defining Black replacement of CMY, Black start, TAC limit*

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Characterization (ICC Profile Creation)

Characterization process is demanding- Requires:

- Ensuring printing devices are precise and repeatable
- Assess/grouping effect of paper stock on color result
- Using ICC Profile creation software to create profile(s)
- Understand how to configure ICC profiles in workflow

- **Benefits**- More accurate result over any type of calibration

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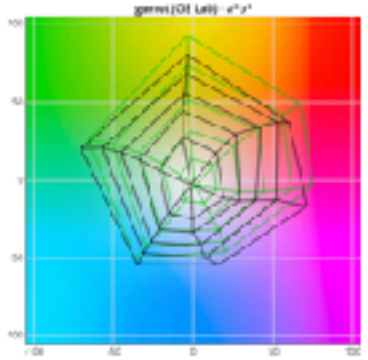
Characterization (ICC Profile Creation)

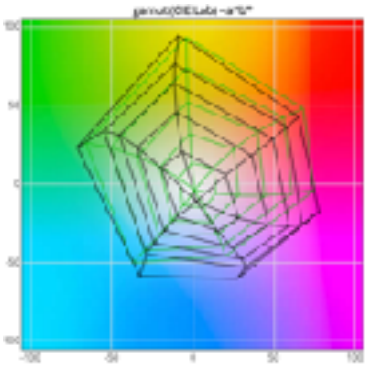
Defines Color Space of Printing Condition

- Defines gamut (range of color) of ink, substrate, calibration



C M Y K

3. 62. 19. 0



C M Y K

3. 62. 19. 0

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Characterization (ICC Profile Creation)

Defines Color Space of Printing Condition

- Each device speaks a different language- define language
- Defines gamut (range of color) of ink, substrate, calibration
- Each substrate affects printed gamut/condition
- Qualify most frequently used substrates:
  - *Determine substrates that share similar color gamut*
  - *Reduces number of profiles to create, easier to manage*
  - *Relevant to E-Factor, tighter tolerance the more profiles*

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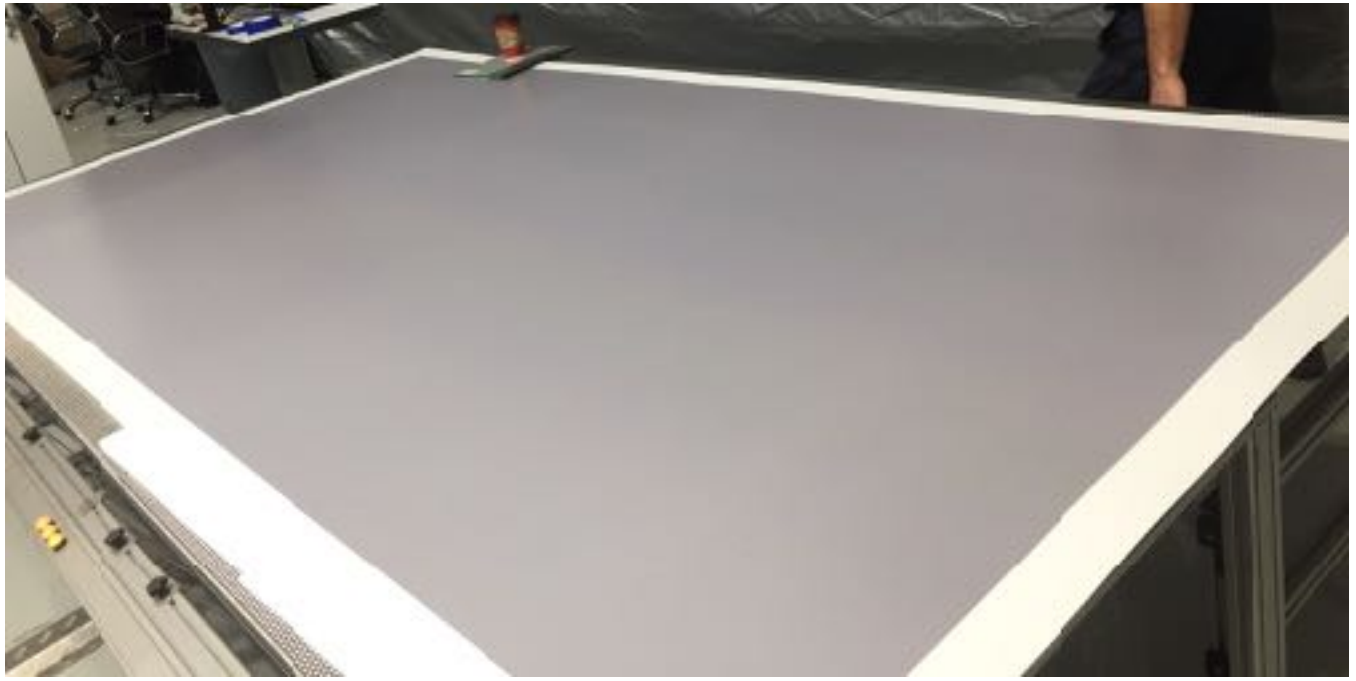
Characterization Steps

Baseline Printing devices

- Understand variation of printer by baselining
- Within Page Uniformity, Between Page, Between Job
- Fix any mechanically induced variations before profiling



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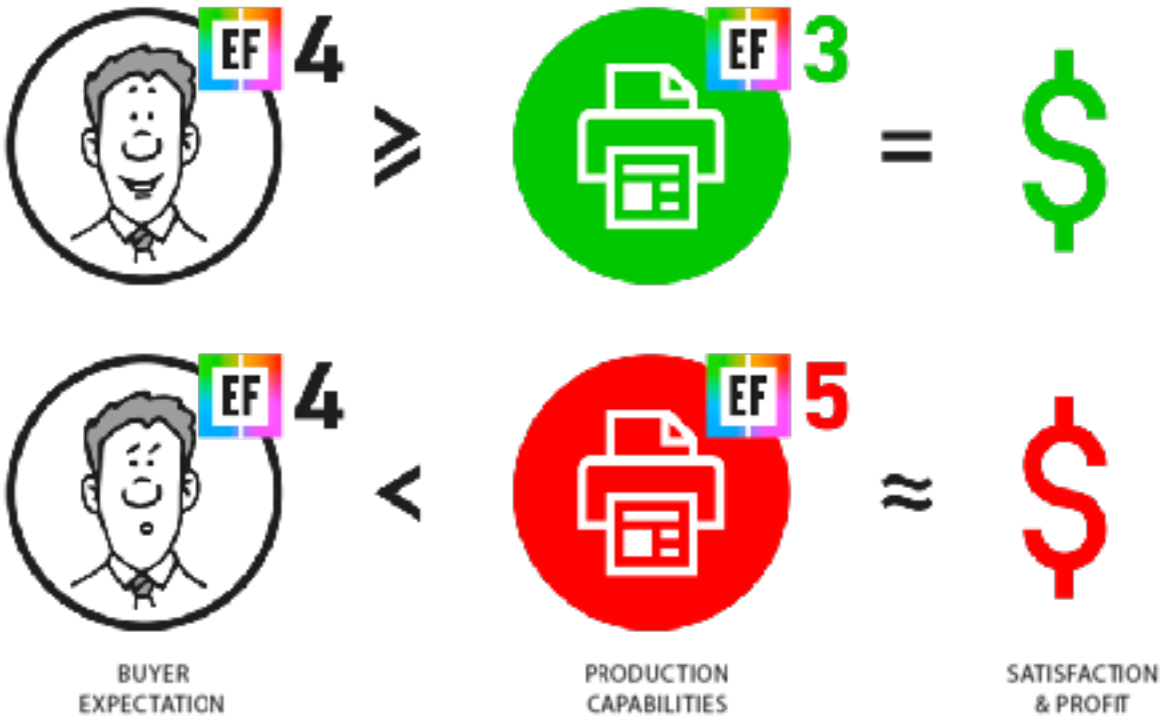
Conformance- is it Salable?

Summary/Result of all 5 C's - is the print salable?

- Does Print meet customer expectations (E-Factor)?
- Provide Job reports proving to customer job success



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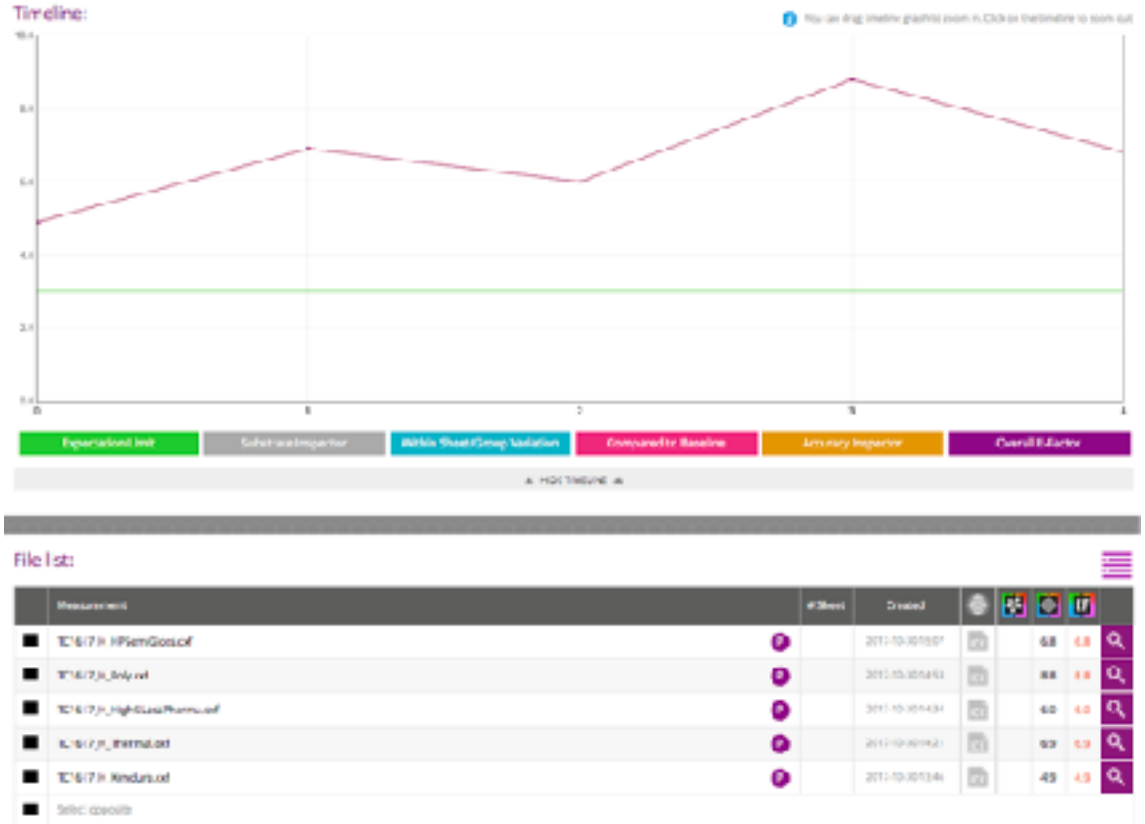
Qualifying Substrate Color affect on Print

Steps:

1. Qualify substrates- Print target on all important substrates
   - *Use ChromaChecker substrate qualifier to group substrates per EF*



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Qualifying Substrate Color affect on Print

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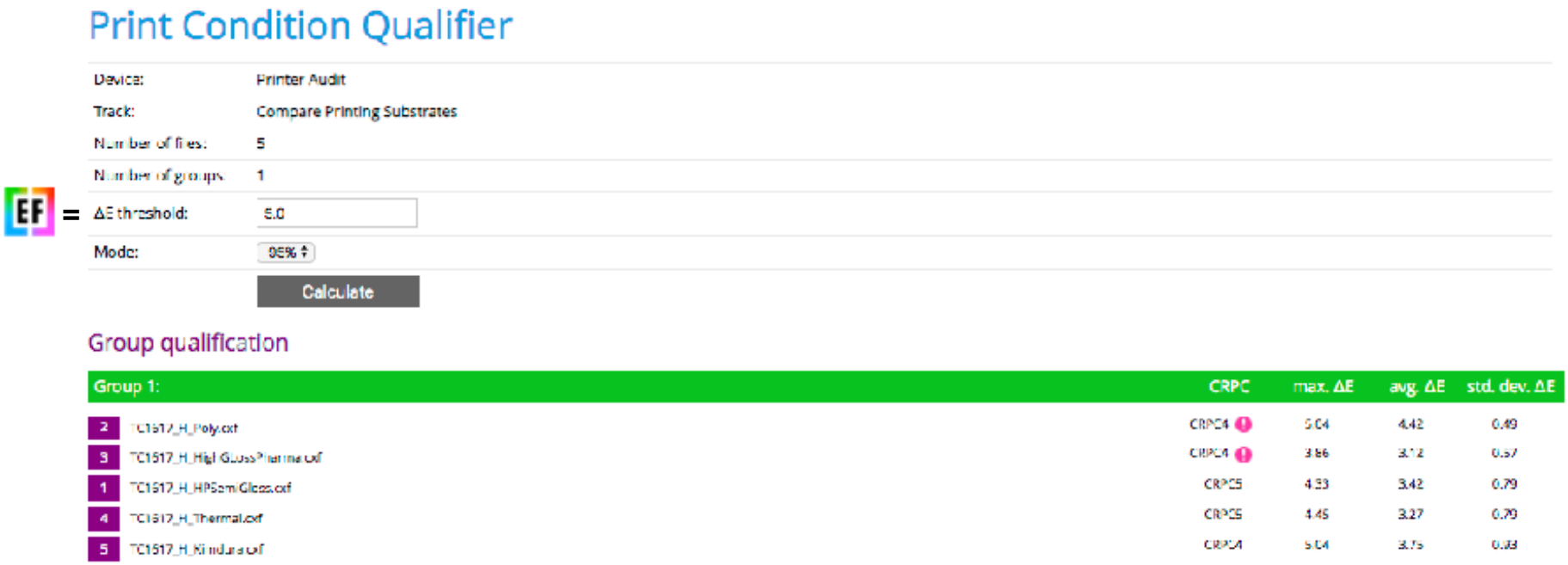

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Qualifying Substrate Color affect on Print

Steps:

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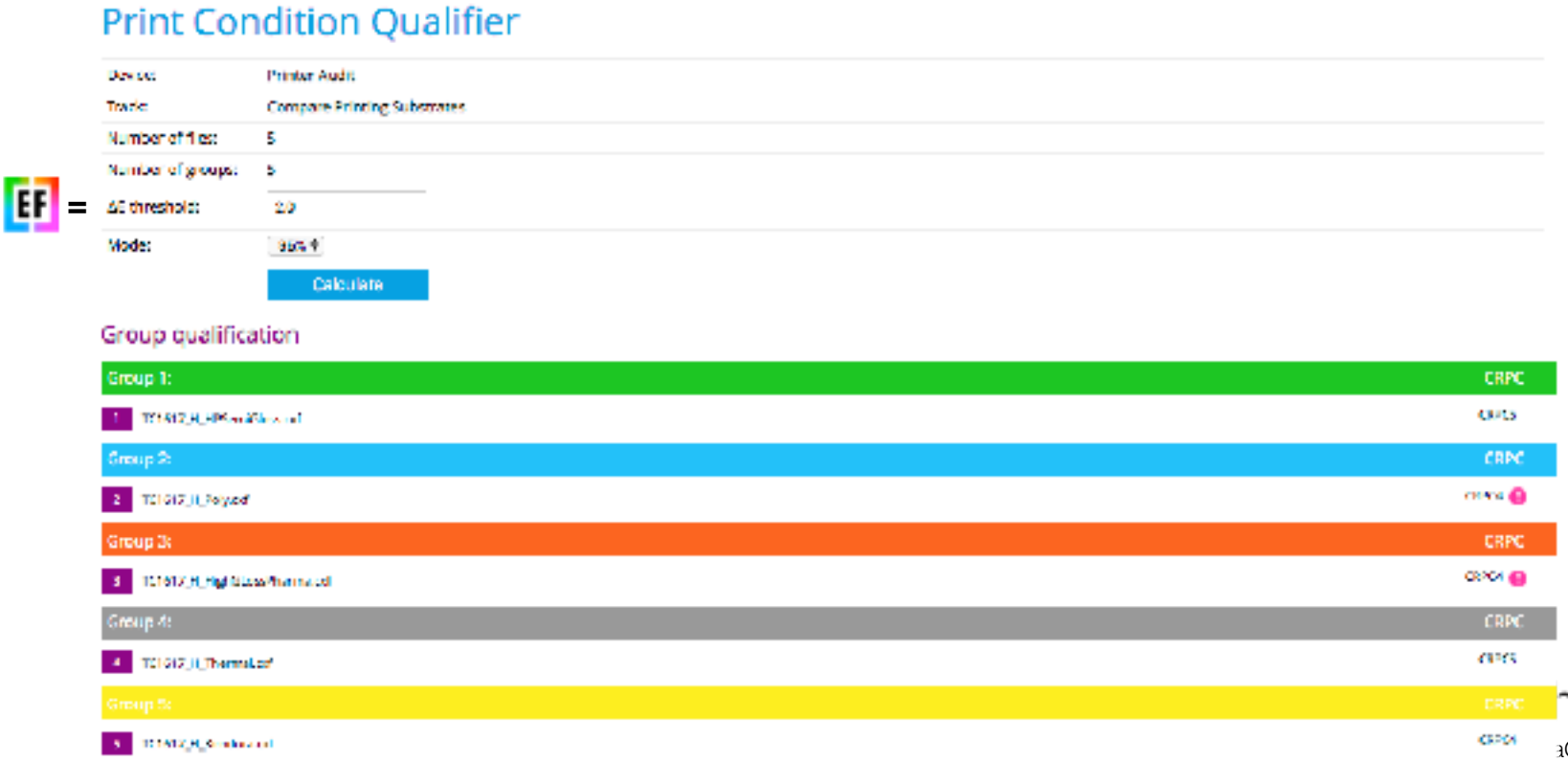

Characterization (ICC Profile Creation)

Steps:

1. Qualify substrates- Print target on all important substrates
   - *Use ChromaChecker substrate qualifier to group substrates per EF*
2. Choose Characterization software to use: ChromaChecker

ChromaChecker

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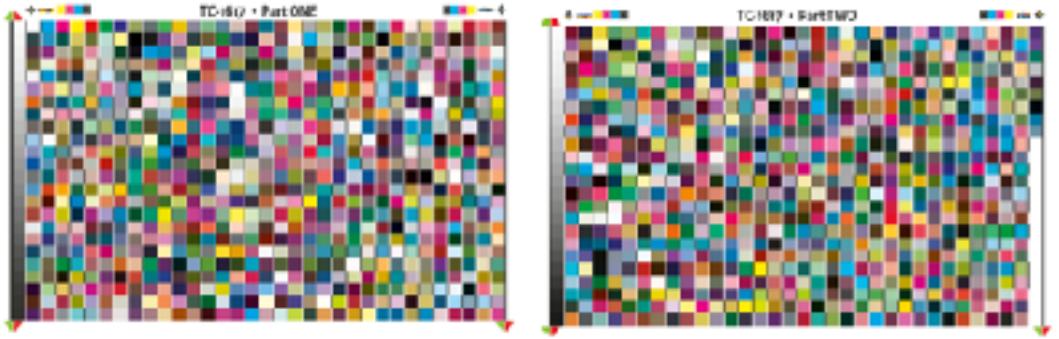
Characterization (ICC Profile Creation)

Steps:

1. Qualify substrates- Print target on all important substrates
   - *Use ChromaChecker substrate qualifier to group substrates per EF*
2. Choose Characterization software (ChromaChecker)
3. Choose print target (IT8 7/5) compatible w/capture device

iSIS & FD9 target



i1iO & Barbieri target

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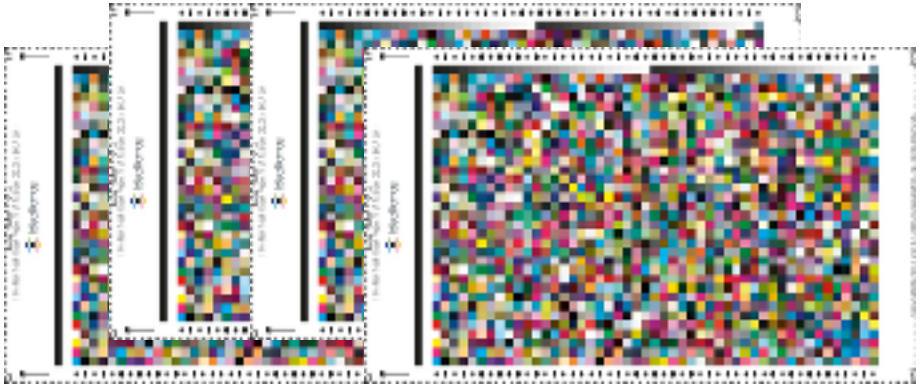
Characterization (ICC Profile Creation)

Steps:

1. Qualify substrates- Print target on all important substrates
   - *Use ChromaChecker substrate qualifier to group substrates per EF*
2. Choose Characterization software (ChromaChecker)
3. Choose print target (IT8 7/5) compatible w/capture device
4. Print multiple times immediately after calibration done
   1. Ensure color management turned off in RIP, Record Calibrations



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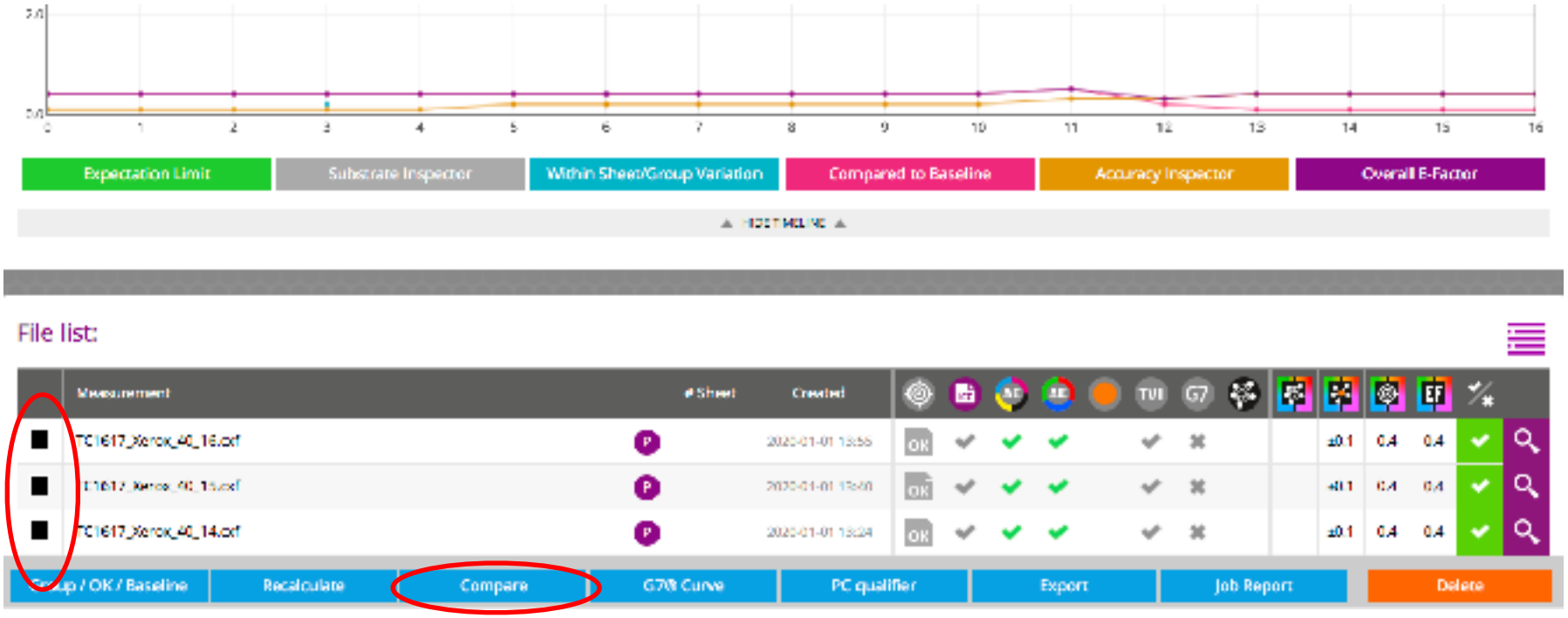
Characterization (ICC Profile Creation)

Steps:

5. Measure multiple targets, **Compare** differences, Average



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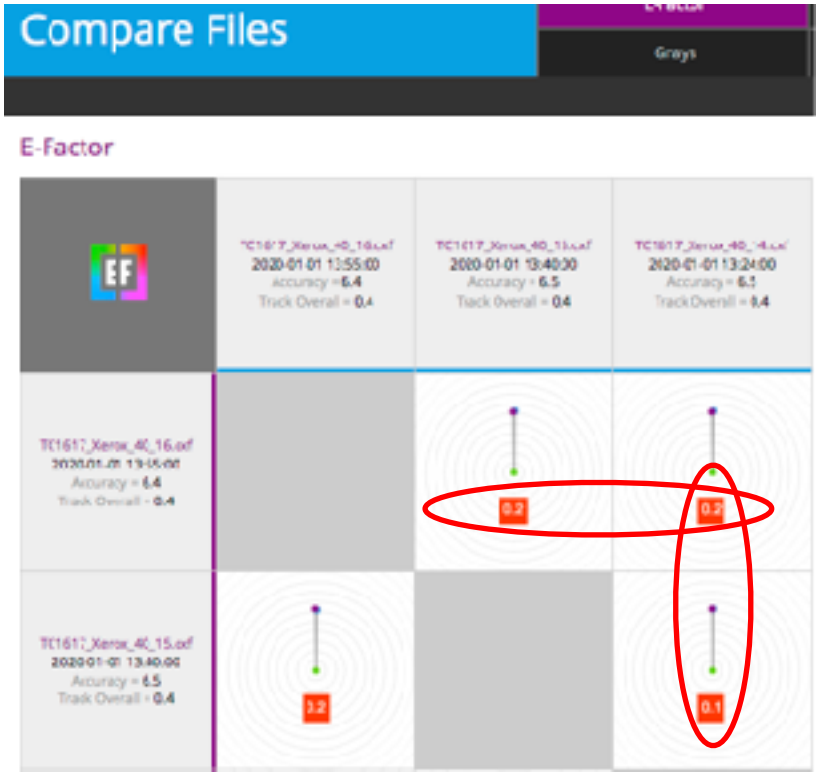
Characterization (ICC Profile Creation)

Steps:

5. Measure multiple targets, **Compare differences**

All values are within acceptable E-Factor values= .2



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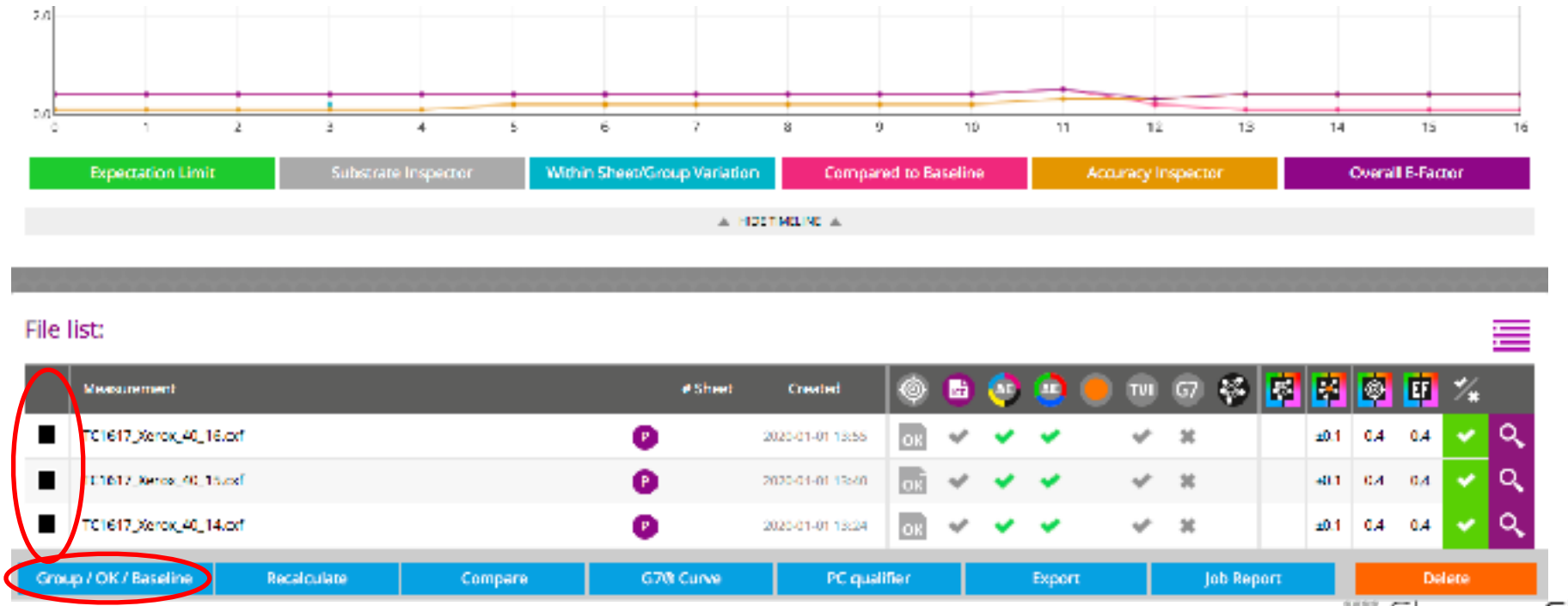
Characterization (ICC Profile Creation)

Steps:

5. Measure multiple targets, Compare differences, **Average**

   *Choose **Group**- it will average all measurements*



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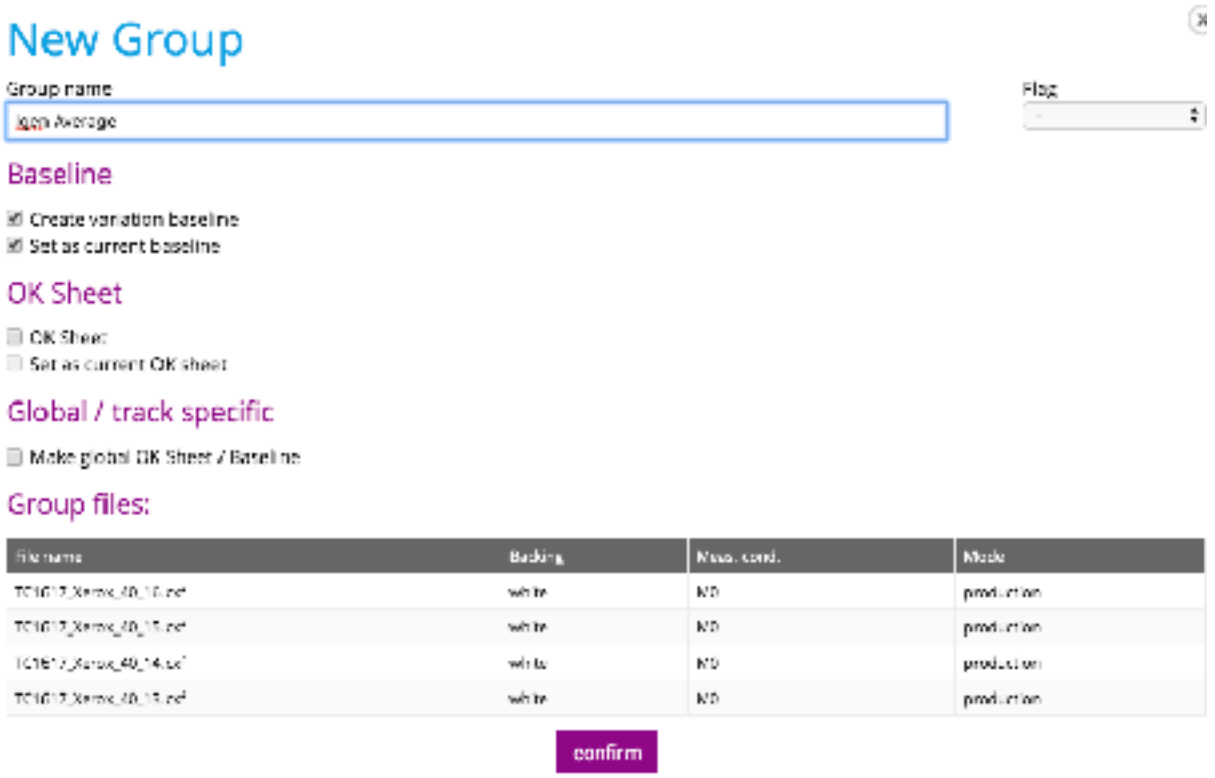
Characterization (ICC Profile Creation)

Steps:

5. Measure multiple targets, Compare differences, **Average**

   Name Group- Confirm



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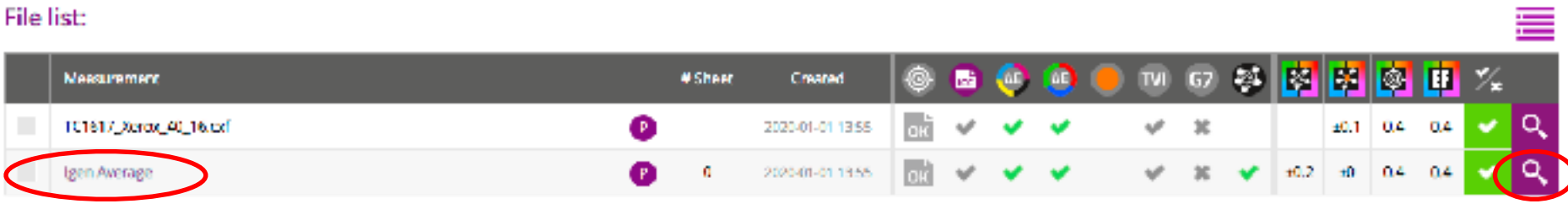
Characterization (ICC Profile Creation)

Steps:

6. Create ICC Profile for given print condition (substrate)

   Click *on magnifying glass:*



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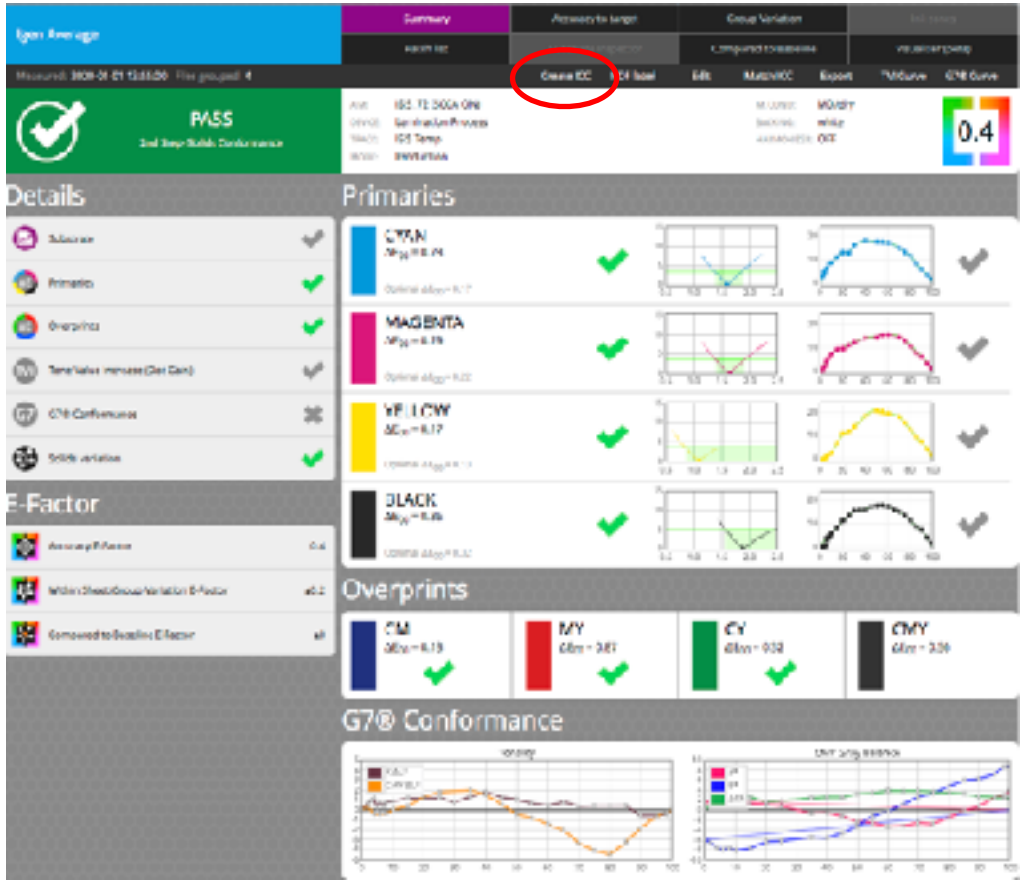
Characterization (ICC Profile Creation)

Steps:

6. Create ICC Profile for given print condition (substrate)



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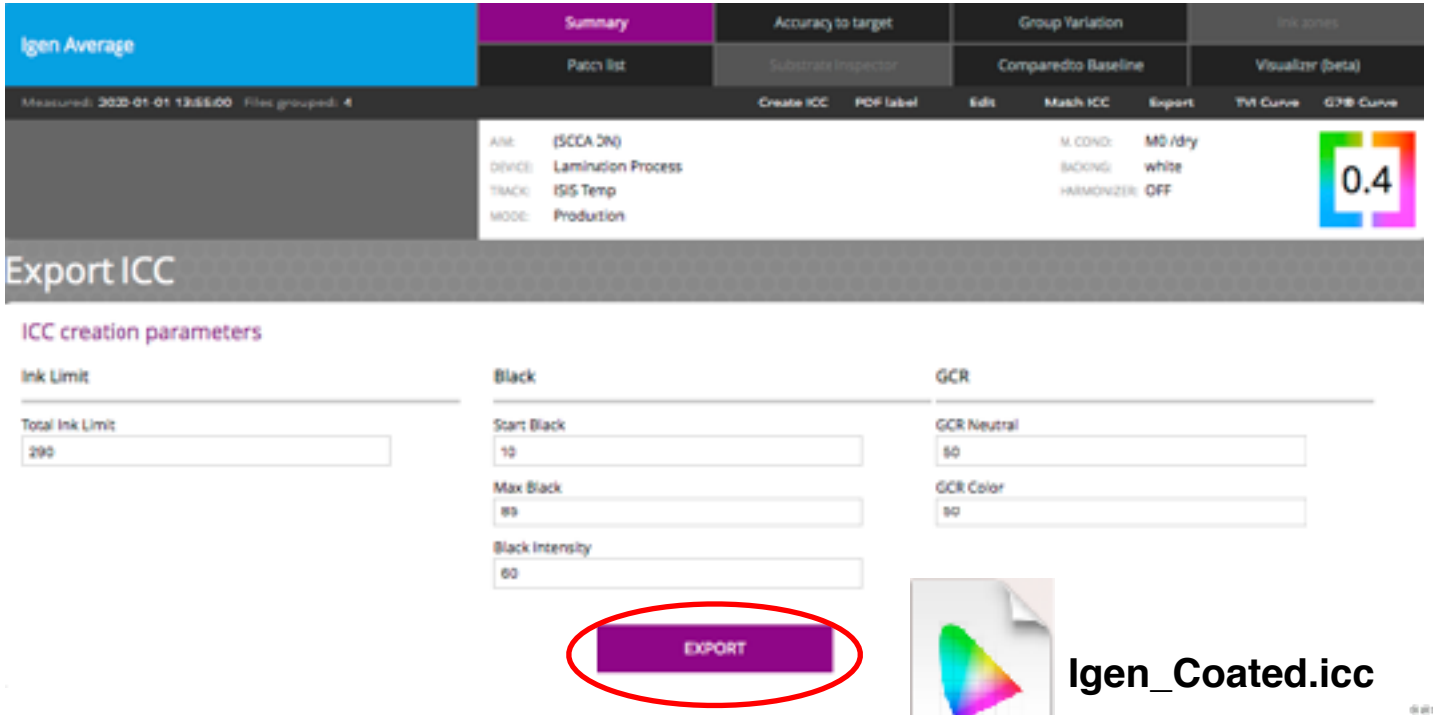
Characterization (ICC Profile Creation)

Steps:

6. Create ICC Profile for given print condition (substrate)

Customize ICC Profile settings if necessary- ***Export ICC Profile***



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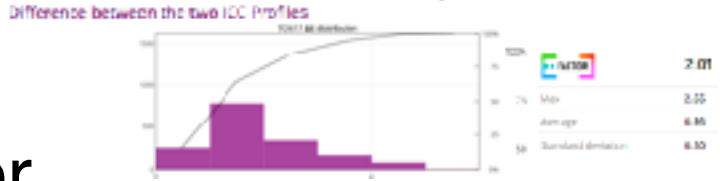
ICC Profile Inspector (Optional Assessments)

Evaluate Many Aspects of ICC Profiles

- Gamut Size

- Profile Match Integrity (LAB Round trip calculation)

- Profile Comparisons- Gamut and Color Rendering



- More… Review ICC Profile Inspector

ICC Profile Inspector

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Characterization Summary

Planning and Execution is Critical for Success

- Qualify how many profiles to create based on substrates
- Choose correct target for print
- Choose correct measurement device- same as for QC
- Measure multiple targets precisely
- Compare measurements, make sure they are precise
- Create ICC Profile, evaluate integrity
- Next, you will load in your workflow conversion tools

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Qualifying Multiple Similar Printers/Paper

Multiple Printers- Same Substrate- Multiple Profiles?

- Share one profile across 10+ printers
- Only need one workflow sending to all 10+ printers
- Only need to maintain one ICC Profile
- Perform normal maintenance to keep consistency
- Measure each printer every 4 hours to ensure conformance

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Making Multiple Printers Match

Ensure Printer Settings are Identical

- Print profile target on each printer
- Measure all targets with same or similar instrument
- Compare all results- if any are out of E-Factor- Recheck

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Easy mode ΔE 2000	Baltoro_Coated_Dec2020	Baltoro_GP_Bolse28	Baltoro_IL_Bolse28	Baltoro_SignalHill_XeroxPaper	Baltoro_Newville_4_8	Baltoro_Summer_Uncoated
Baltoro_Coated_Dec2020		E-factor 10.49 Max 12.52 Average 5.34 Std. dev. 2.87 Details	E-factor 10.27 Max 12.82 Average 4.49 Std. dev. 3.01 Details	E-factor 12.00 Max 15.77 Average 5.20 Std. dev. 3.48 Details	E-factor 11.52 Max 15.18 Average 4.95 Std. dev. 3.22 Details	E-factor 11.75 Max 15.08 Average 4.84 Std. dev. 3.38 Details
Baltoro_GP_Bolse28	E-factor 10.49 Max 12.52 Average 5.34 Std. dev. 2.87 Details		E-factor 3.20 Max 4.37 Average 2.11 Std. dev. 0.68 Details	E-factor 3.85 Max 6.47 Average 1.97 Std. dev. 0.91 Details	E-factor 3.33 Max 7.04 Average 1.90 Std. dev. 0.85 Details	E-factor 5.27 Max 7.60 Average 3.07 Std. dev. 1.25 Details
Baltoro_IL_Bolse28	E-factor 10.27 Max 12.82 Average 4.49 Std. dev. 3.01 Details	E-factor 3.25 Max 4.37 Average 2.11 Std. dev. 0.68 Details		E-factor 3.10 Max 6.39 Average 1.71 Std. dev. 0.77 Details	E-factor 2.24 Max 6.63 Average 1.10 Std. dev. 0.66 Details	E-factor 3.20 Max 5.85 Average 1.60 Std. dev. 0.88 Details
Baltoro_SignalHill_XeroxPaper	E-factor 12.00 Max 15.77 Average 5.20 Std. dev. 3.48 Details	E-factor 3.85 Max 6.47 Average 1.97 Std. dev. 0.91 Details	E-factor 3.10 Max 6.39 Average 1.71 Std. dev. 0.77 Details		E-factor 2.00 Max 6.23 Average 1.21 Std. dev. 0.50 Details	E-factor 2.90 Max 4.42 Average 1.80 Std. dev. 0.64 Details
Baltoro_Newville_4_8	E-factor 11.52 Max 15.18 Average 4.95 Std. dev. 3.22 Details	E-factor 3.33 Max 7.04 Average 1.90 Std. dev. 0.85 Details	E-factor 2.24 Max 6.63 Average 1.10 Std. dev. 0.66 Details	E-factor 2.00 Max 6.23 Average 1.21 Std. dev. 0.50 Details		E-factor 2.65 Max 6.91 Average 1.50 Std. dev. 0.65 Details

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Conversion

4th C

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

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Conversion Requirements- RIP or Server

Make Conversion work… Requires Workflow software:

- 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

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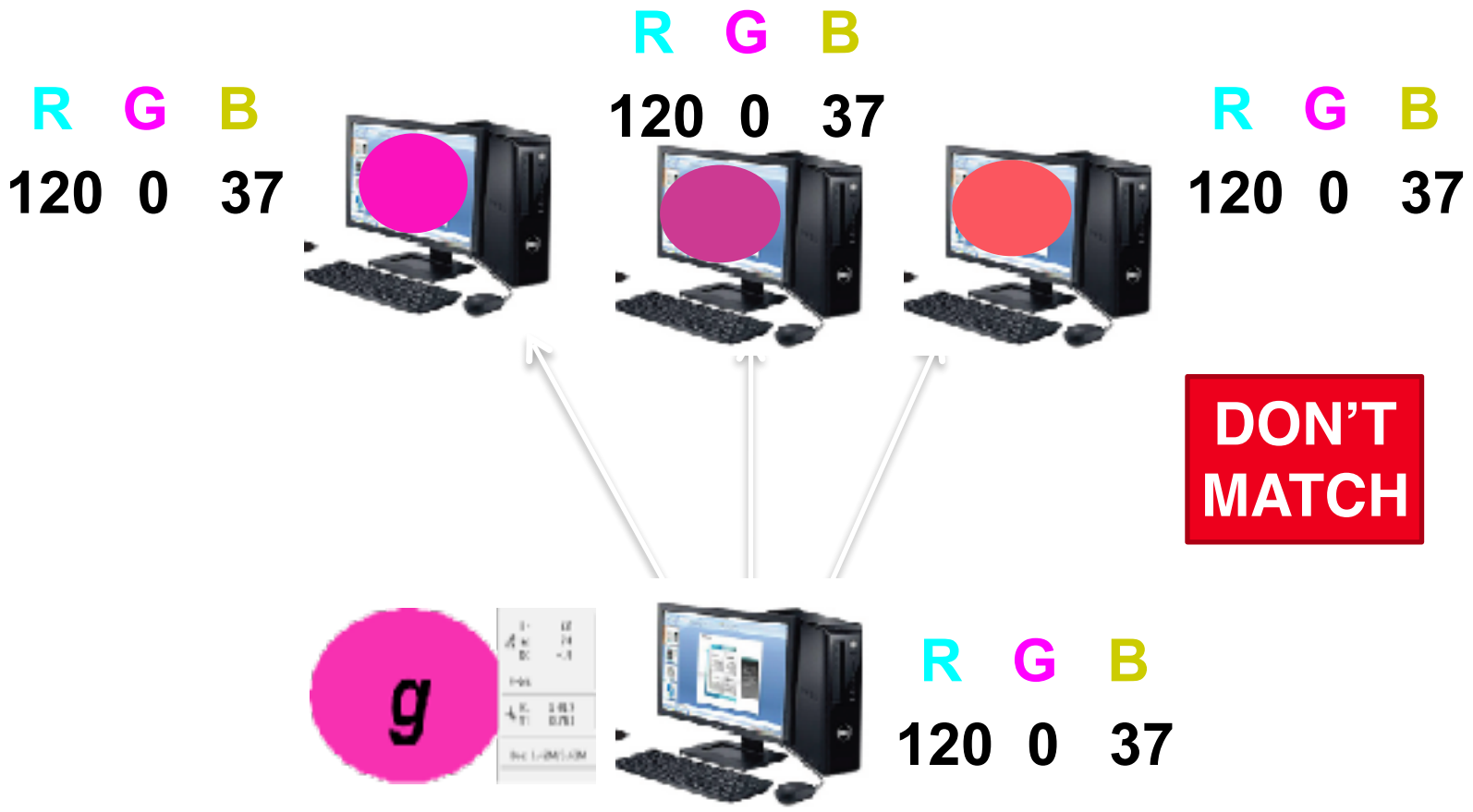
Problem- Conversion of Colors

Every Device Renders Color Differently

- Need to Convert to using custom ICC Profiles



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Problem- Conversion of Colors

Every Device Renders Color Differently

- Need to Convert to different ICC Profiles

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

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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

DON'T MATCH

C M Y K
3, 62, 19, 0

C M Y K
3, 62, 19, 0

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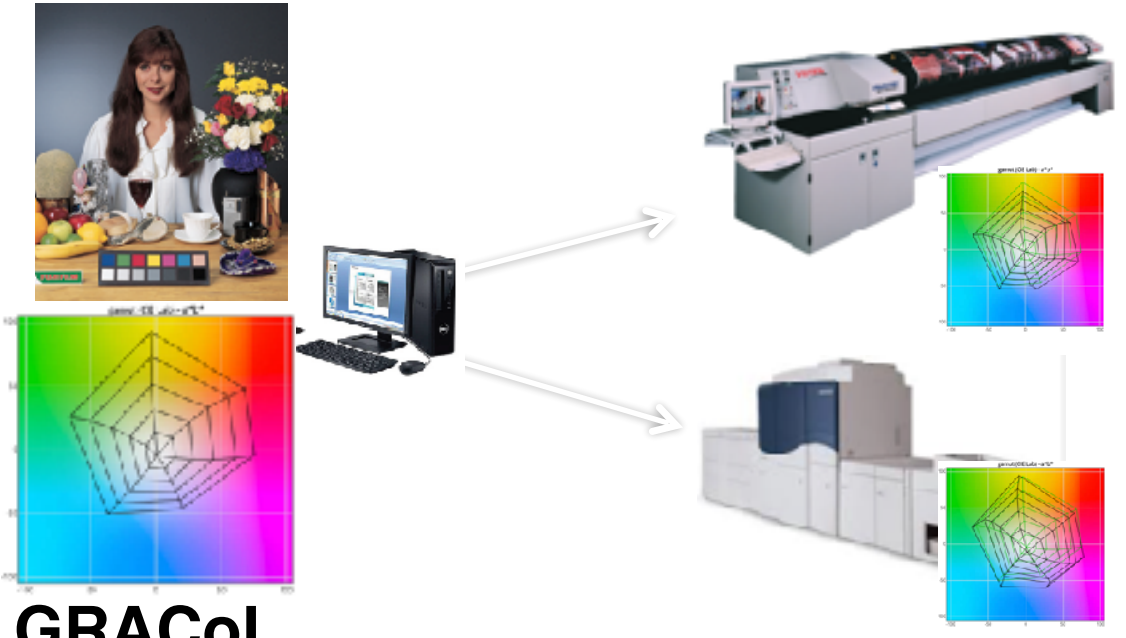
Conversion of Pages- Strategic Issues

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

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



GRACoL

C M Y K

6, 74, 0, 0

C M Y K

3, 62, 19, 0

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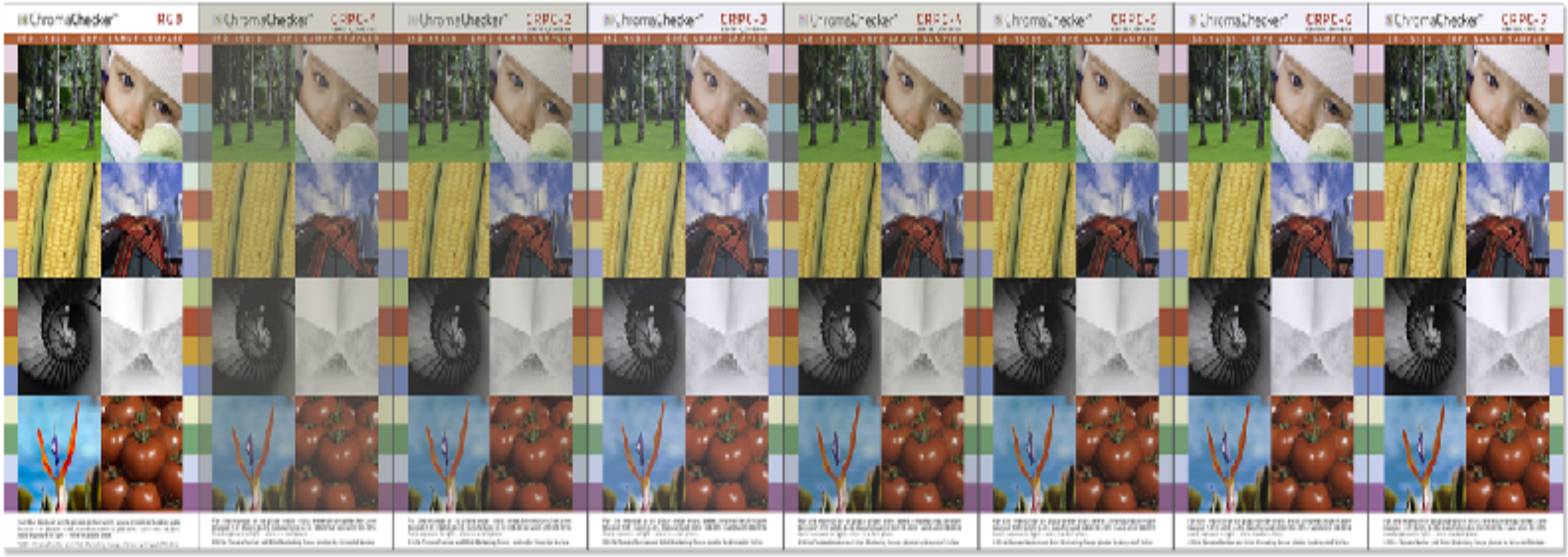
Shared Visual (Common Color) Appearance

Maximize Gamut for Each Printer (Keep G7 Compliance)

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



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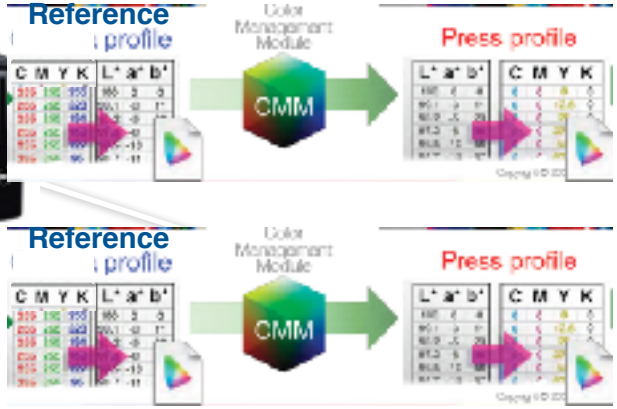
Details = Conversion of Images and PDFs

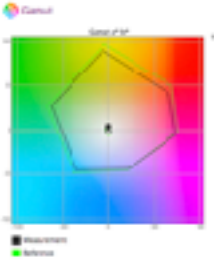
Characterization Defines Gamuts (Languages): Convert

- Goal- Maximize the Original Colors

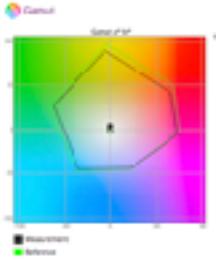
Input/Source Profile **Output/Destination Profile**



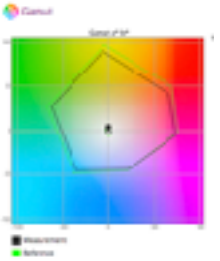
Vutek



Large Gamut Profile



iGen



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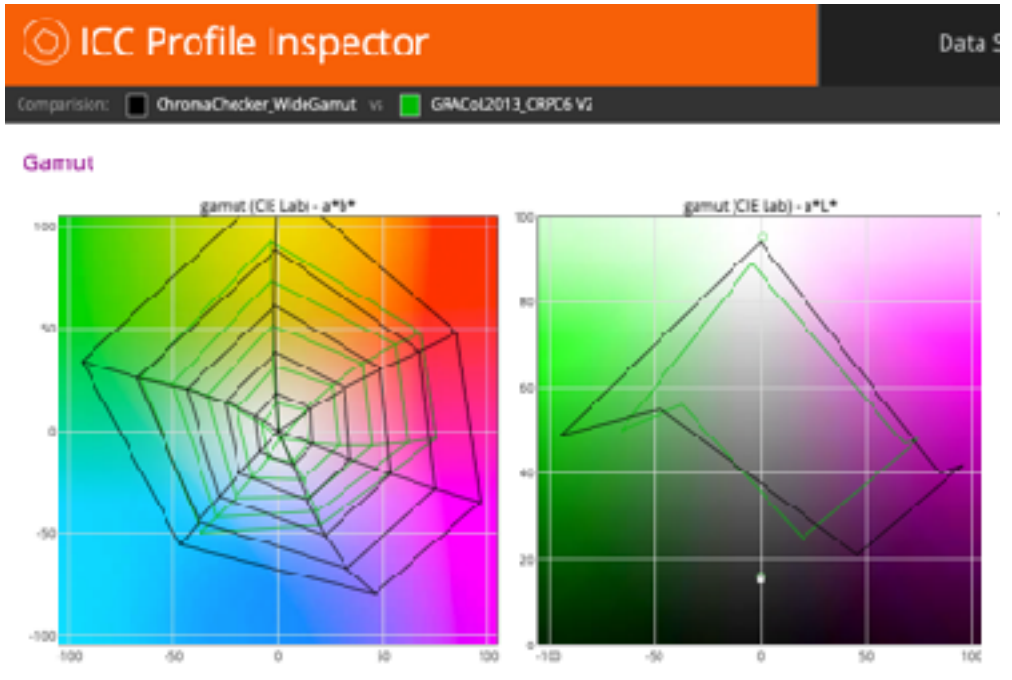
Two Popular Large Gamut CMYK Profiles

Use as INPUT Profile to Maximize Print Result

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



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Assign Wide Gamut CMYK to Existing CMYK

Use as INPUT Profile to Maximize Print Result

- ChromaChecker Wide Gamut or PrintWide (G7 Compliant)

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Two Popular Large Gamut CMYK Profiles

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Two Popular Large Gamut CMYK Profiles

Original CMYK (USWebSWOP)

Assign PrintWide CMYK

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Two Popular Large Gamut CMYK Profiles

Original CMYK (USWebSWOP)

Assign ChromaChecker Wide

ChromaChecker

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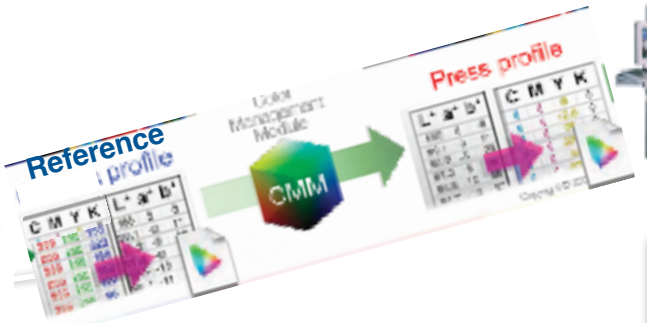
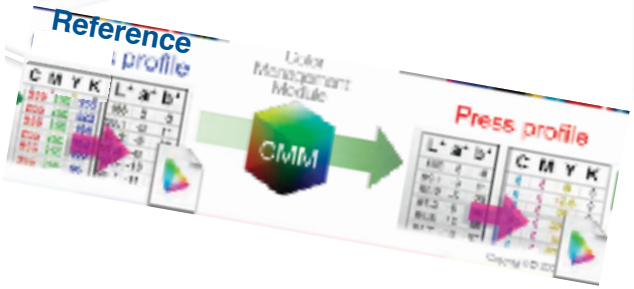
Maximize Color Conversion for Pages

Goal- Maximize Original Color

DON'T MATCH

Assign Large Gamut Profile





Shared Appearance

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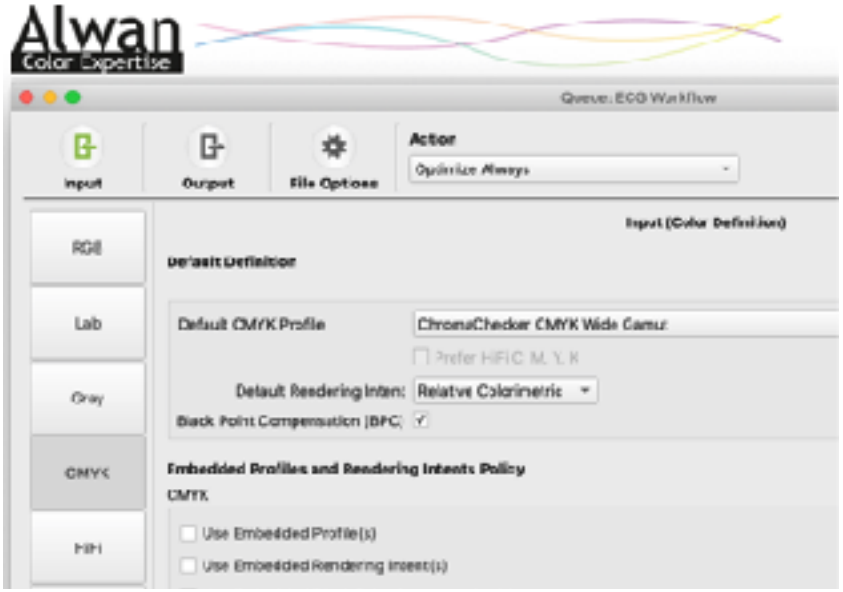
Steps:

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

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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

Result: Printer will be G7 Compliant, good hue angles

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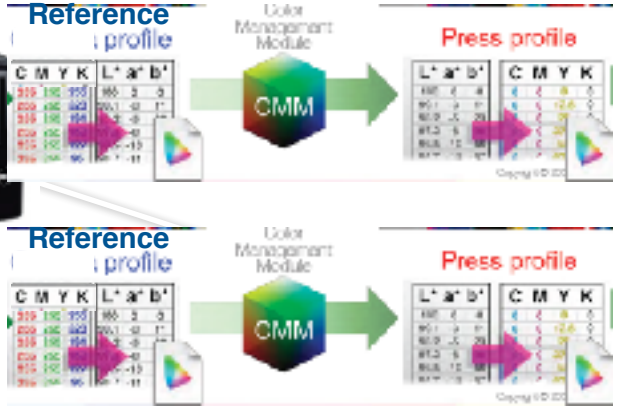
Color Matching- Simulation Procedures

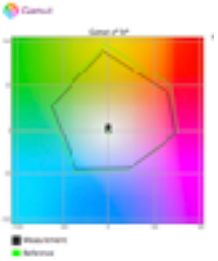
Goal Match Original Colors

- Simulate GRACoL- Output gamut larger than GRACoL

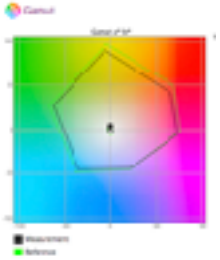
Input/Source Profile **Output/Destination Profile**



Vutek



GRACoL Profile



iGen

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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

DO MATCH

C M Y K

10, 53, 9, 0

C M Y K

6, 74, 11, 0

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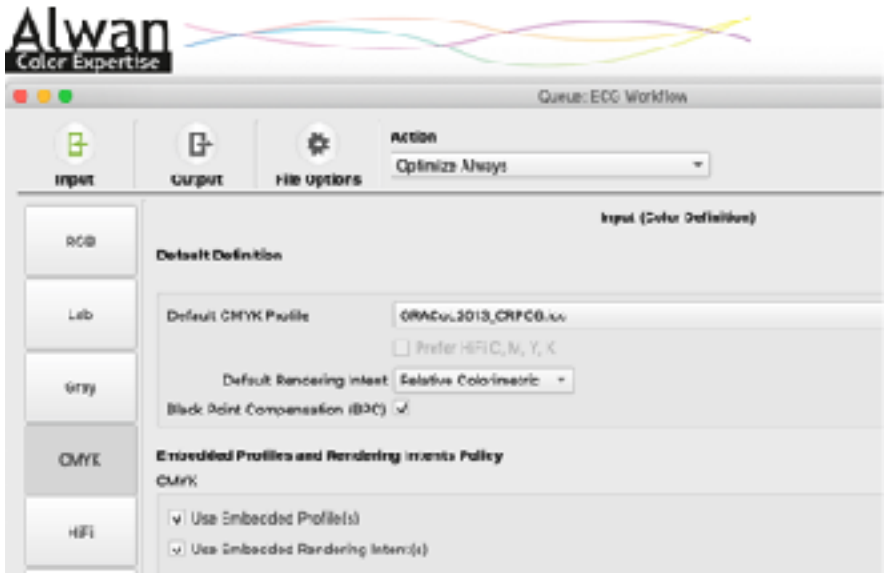
Steps:

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

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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
- Rendering Intent: Colorimetric/Hybrid/Absolute (paper)

Result: Printer will be G7 Compliant, good hue angles

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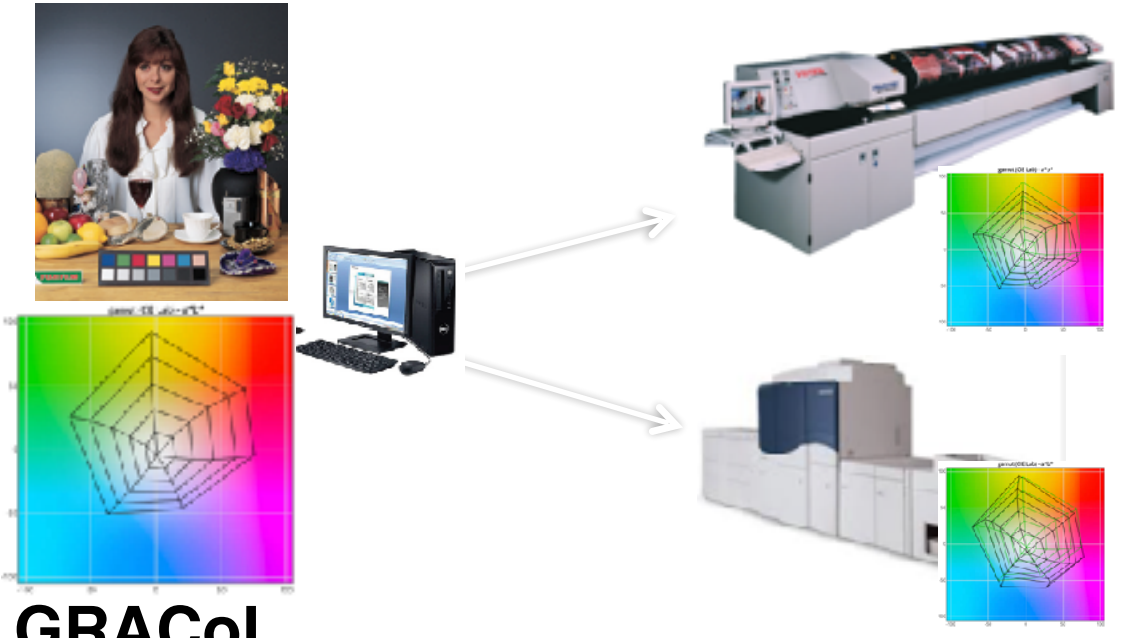
Color Conversions- Pages vs Brand Colors

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



C M Y K

6, 74, 0, 0

DO MATCH

C M Y K

3, 62, 19, 0

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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)

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

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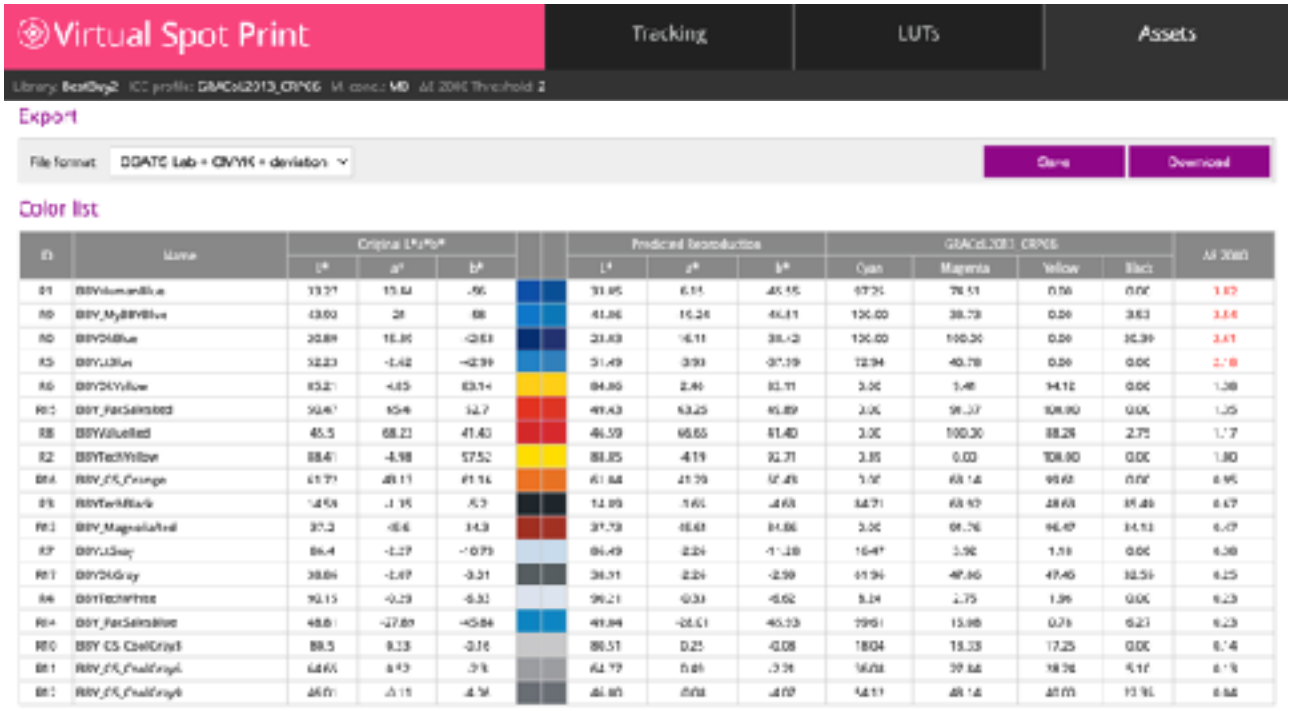
Brand Color Conversions

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:



Out of Gamut

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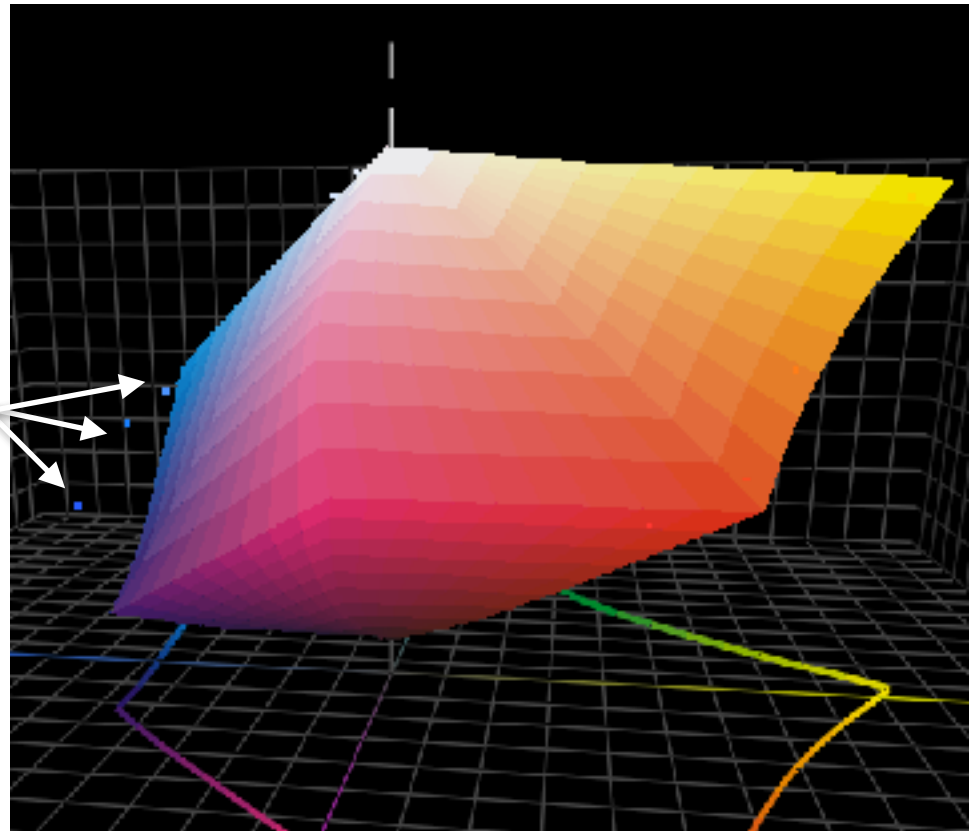
Brand Color Conversions

Ensure Key Brand Colors are in Printer Gamut

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

Out of Gamut



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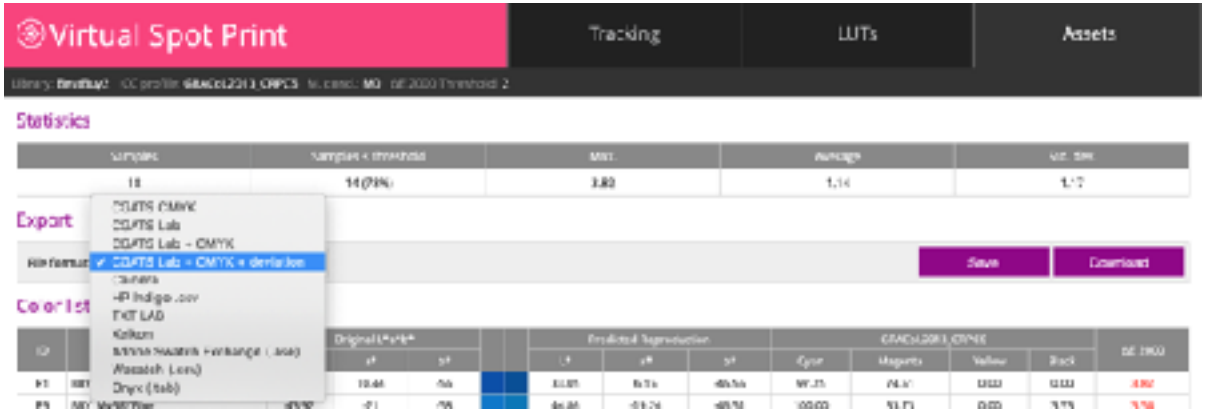
Brand Color Steps

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



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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

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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
- Optimize your ICC Profile Procedures
- Configure your workflows for Optimum Conversions
- Verify Results, Different Tracks for different conditions

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Conformance

5th C

Presented by: David Hunter

STEPS TO DEFINING PROCESS DISCIPLINE

How to meet or exceed E-Factor?

Fifth 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

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Conformance of Workflow

Assess that Salable color is Manufactured

- Goal- Reproduce the Original Color

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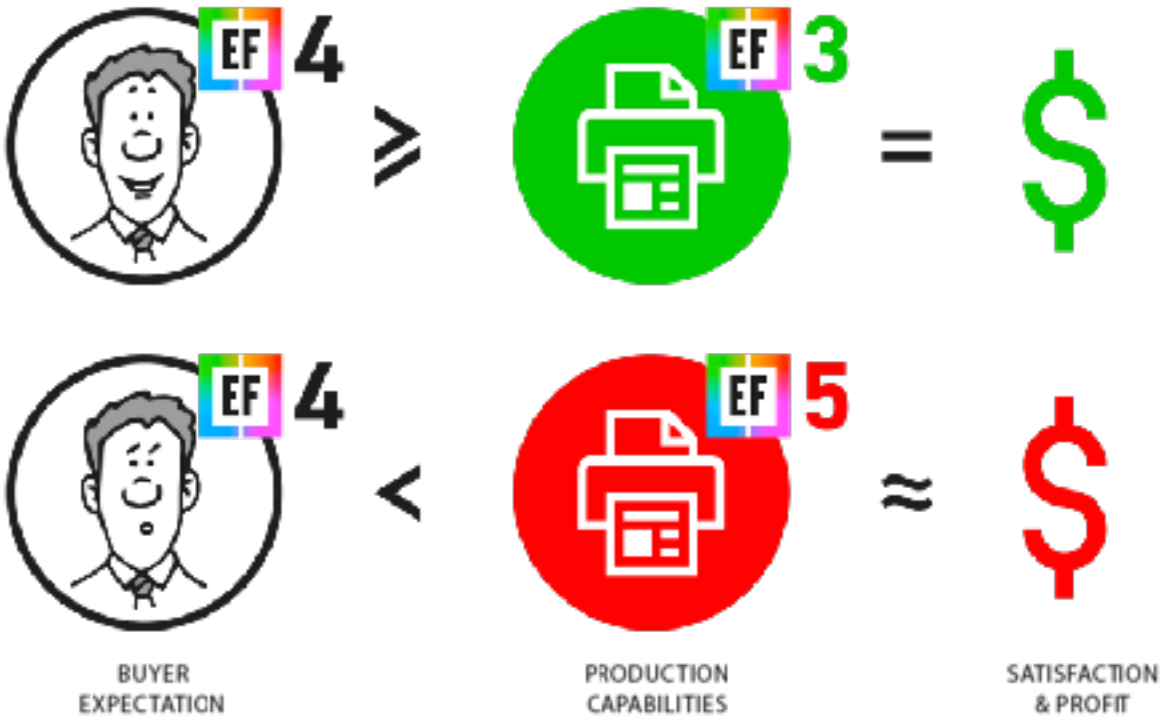
Conformance- is it Salable?

Summary/Result of all 5 C's - is the print salable?

- Does Print meet customer expectations (E-Factor)?
- Provide Job reports proving to customer job success



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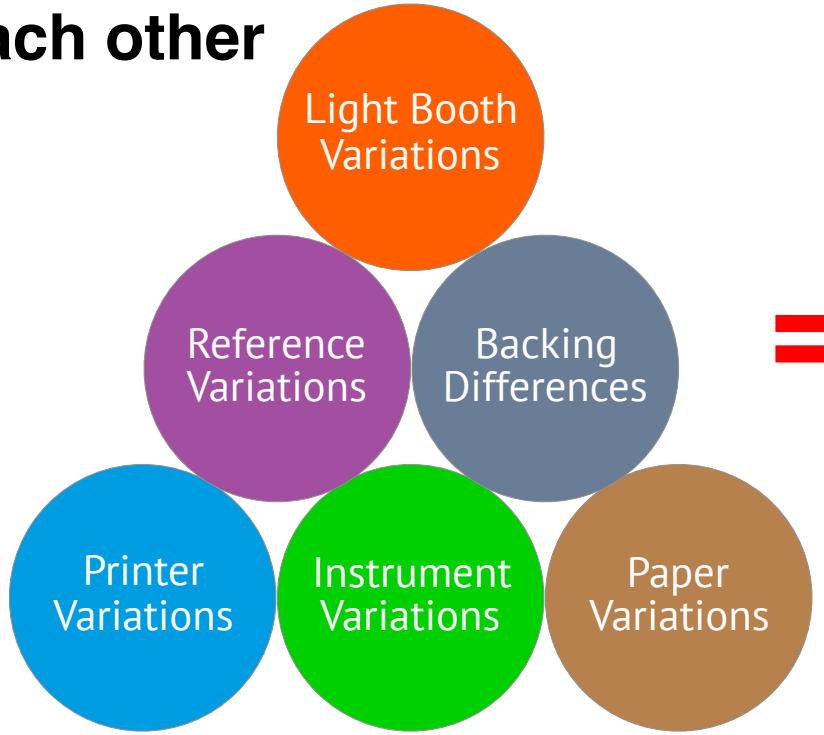
Each Variable Stacks on Top of Each Other

Cumulative Process:

- Each Workflow Component is tracked using **ΔE** or **E-Factor**
- **They all stack on each other**



or 12 EF

= 8 EF

or 5 EF

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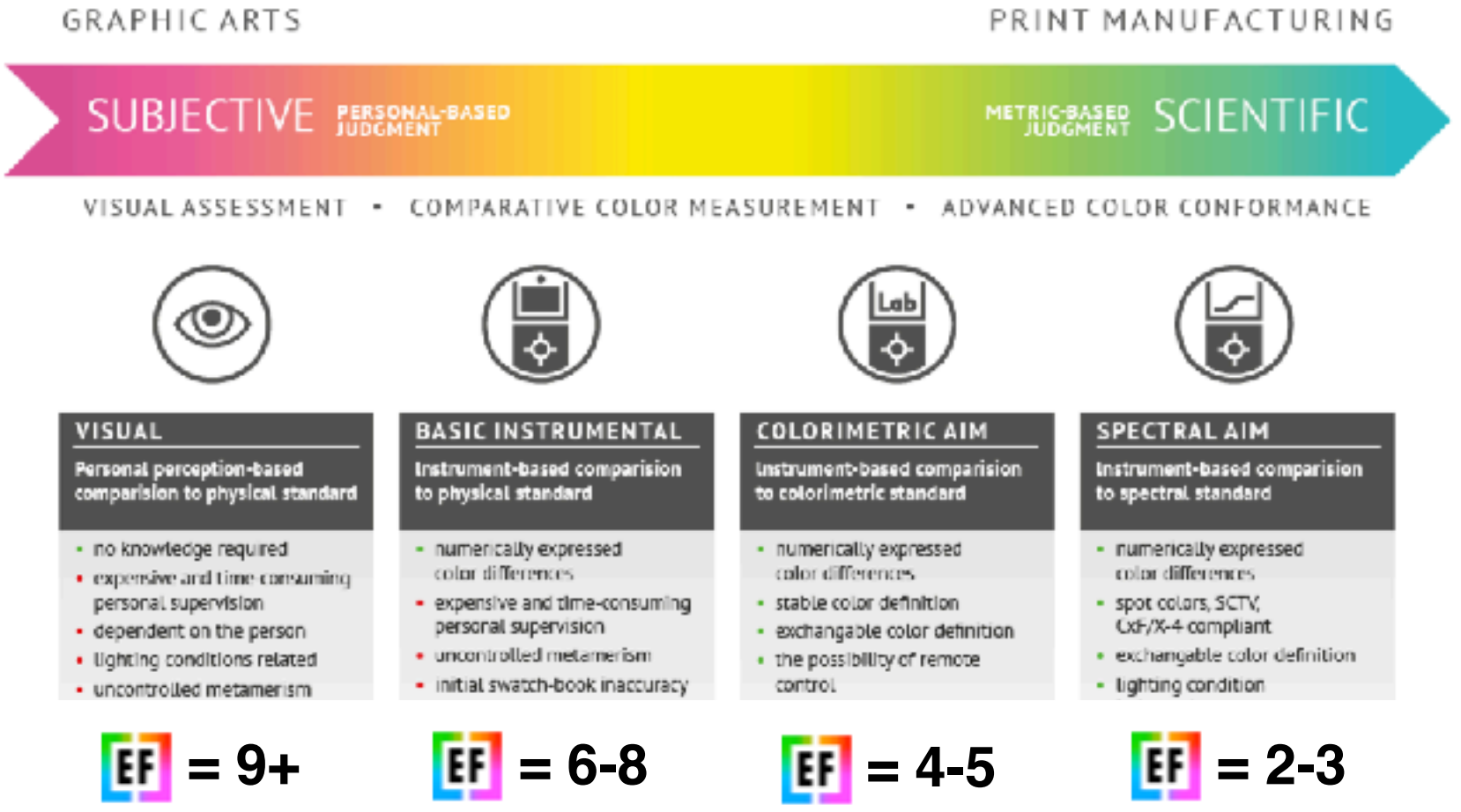
Salable Print Manufacturing

Road Map to Analytics Based Print Manufacturing



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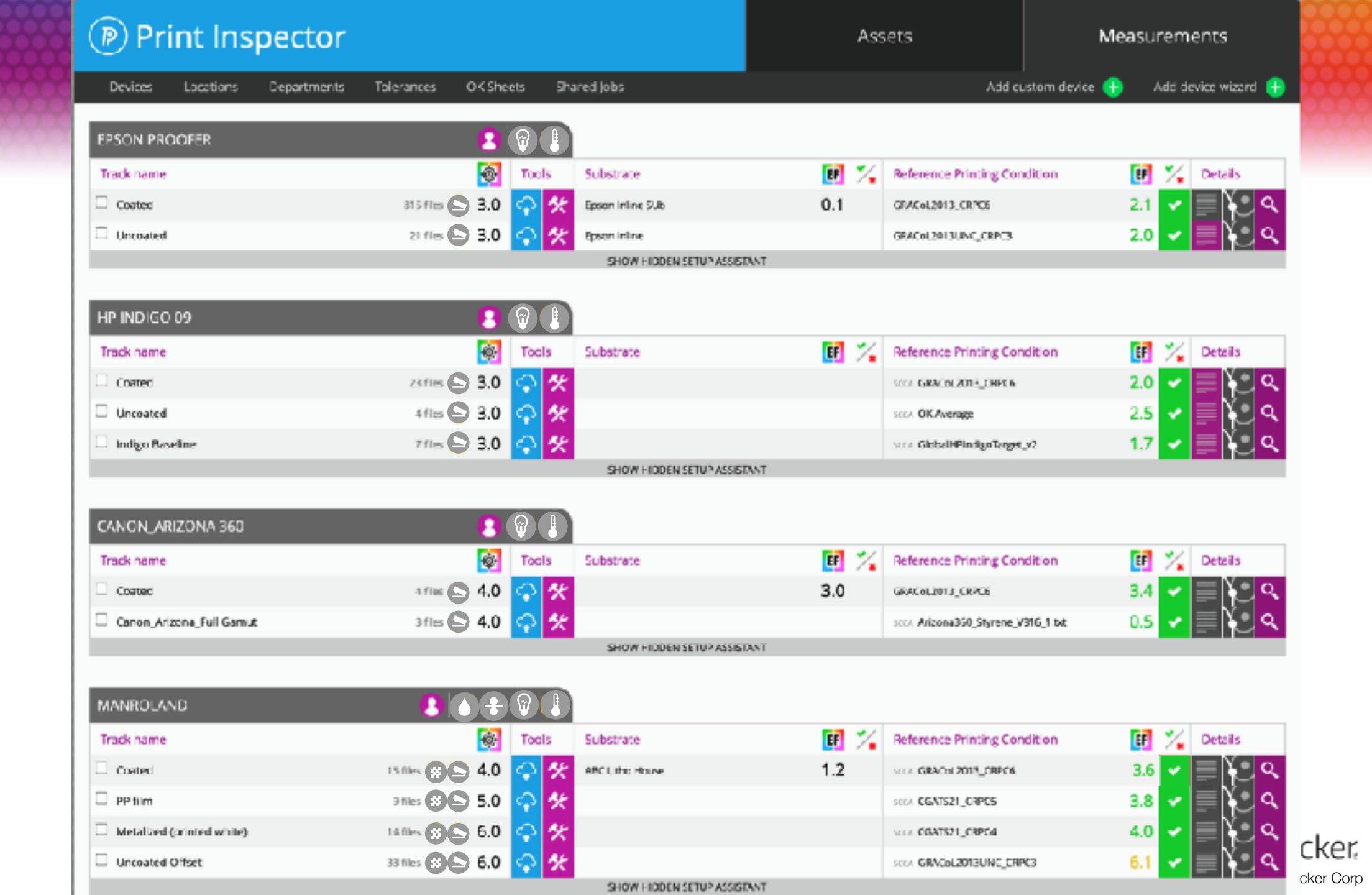
Print Inspector
Assets
Measurements
Devices
Locations
Departments
Tolerances
OK Sheets
Shared Jobs
Add custom device
Add device wizard
EPSON PROOFER
Track name
Tools
Substrate
Reference Printing Condition
Details
Coated
315 files
3.0
Epson Inline SUb
0.1
GRACoL2013_CRPC6
2.1
Uncoated
21 files
3.0
Epson Inline
GRACoL2013UNC_CRPC3
2.0
SHOW HIDDEN SETUP ASSISTANT
HP INDIGO 09
Track name
Tools
Substrate
Reference Printing Condition
Details
Coated
23 files
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GRACoL2013_CRPC6
2.0
Uncoated
4 files
3.0
OK Average
2.5
Indigo Baseline
7 files
3.0
GlobalHPIndigoTarget_v2
1.7
SHOW HIDDEN SETUP ASSISTANT
CANON_ARIZONA 360
Track name
Tools
Substrate
Reference Printing Condition
Details
Coated
4 files
4.0
3.0
GRACoL2013_CRPC6
3.4
Canon_Arizona_Full Gamut
3 files
4.0
Arizona360_Styrene_V31G_1.txt
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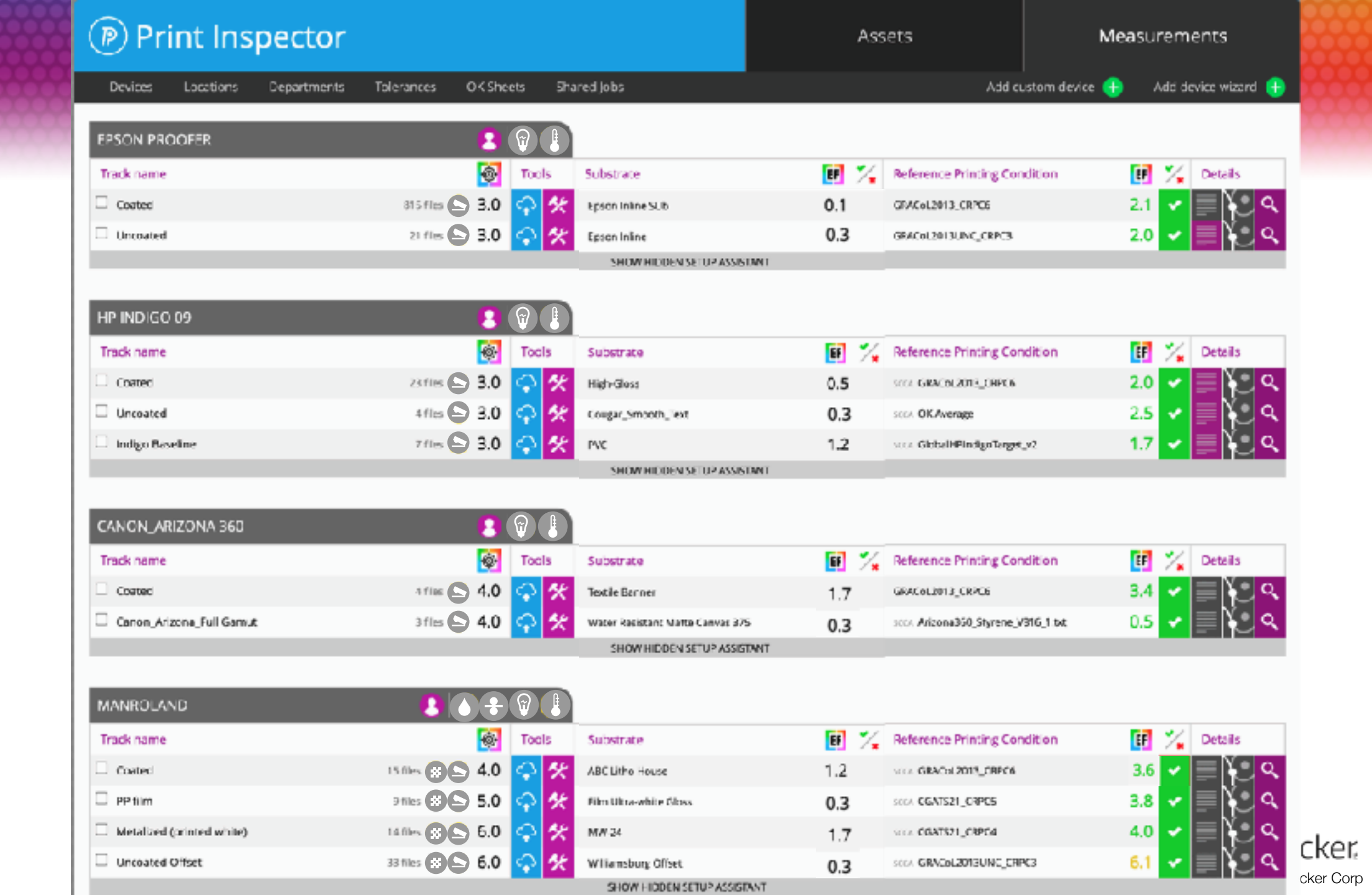
SHOW HIDDEN SETUP ASSISTANT
MANROLAND
Track name
Tools
Substrate
Reference Printing Condition
Details
Coated
15 files
4.0
ABC Litho House
1.2
GRACoL2013_CRPC6
3.6
PP film
9 files
5.0
CGATS21_CRPC5
3.8
Metalized (printed white)
14 files
6.0
CGATS21_CRPC4
4.0
Uncoated Offset
33 files
6.0
GRACoL2013UNC_CRPC3
6.1
SHOW HIDDEN SETUP ASSISTANT



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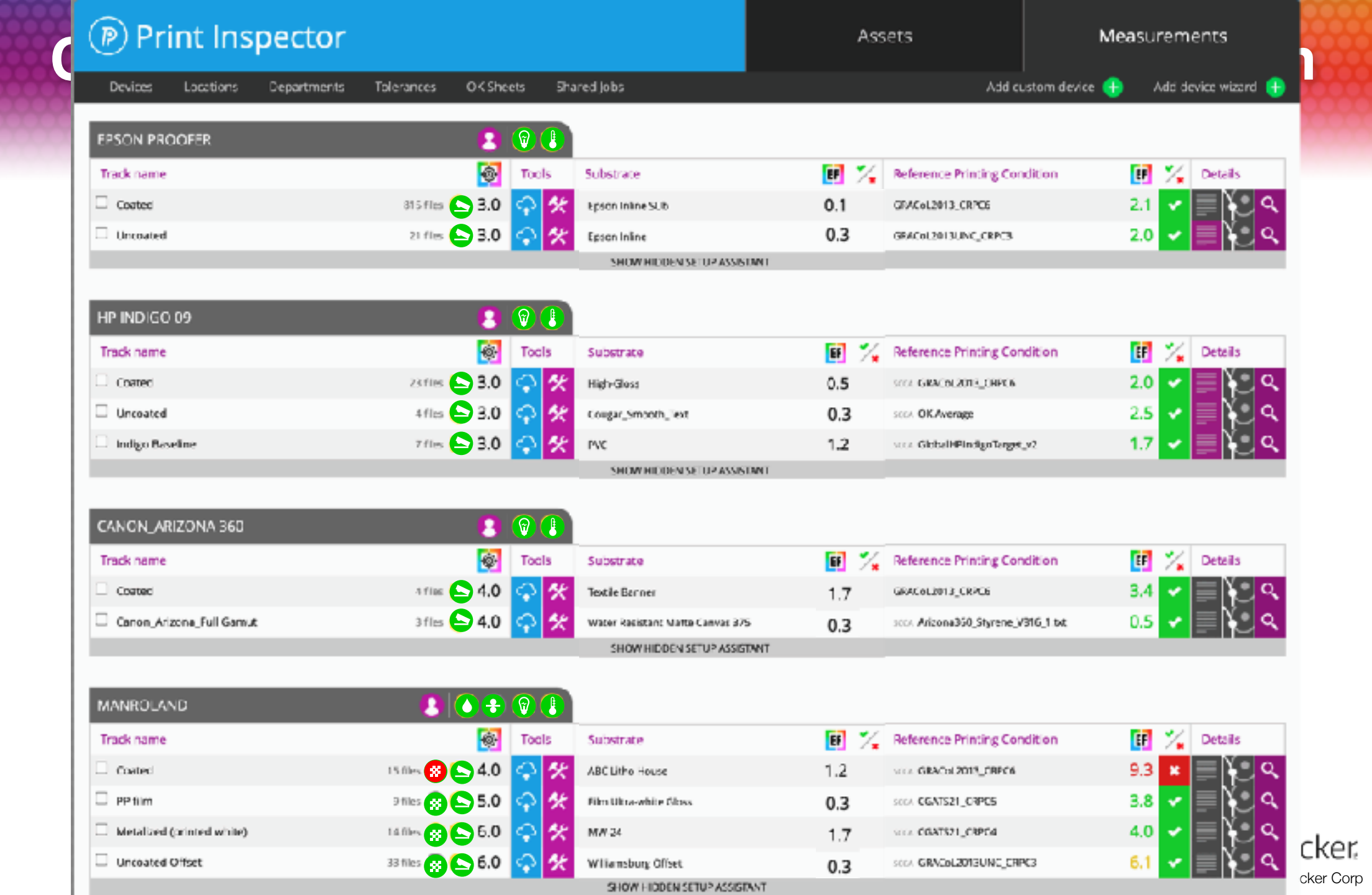
Print Inspector
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Devices
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Tolerances
OK Sheets
Shared Jobs
Add custom device
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High-Gloss
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GRACoL2013_CRPC6
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Uncoated
4 files
3.0
Cougar_Smooth_Text
0.3
OK Average
2.5
Indigo Baseline
7 files
3.0
PVC
1.2
GlobalHPIndigoTarget_v2
1.7
SHOW HIDDEN SETUP ASSISTANT
CANON_ARIZONA 360
Track name
Tools
Substrate
Reference Printing Condition
Details
Coated
4 files
4.0
Textile Banner
1.7
GRACoL2013_CRPC6
3.4
Canon_Arizona_Full Gamut
3 files
4.0
Water Resistant Matte Canvas 375
0.3
Arizona360_Styrene_V31G_1.txt
0.5
SHOW HIDDEN SETUP ASSISTANT
MANROLAND
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Substrate
Reference Printing Condition
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Coated
15 files
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ABC Litho House
1.2
GRACoL2013_CRPC6
9.3
PP film
9 files
5.0
Film Ultra-white Gloss
0.3
CGATS21_CRPC5
3.8
Metalized (printed white)
14 files
6.0
MW 24
1.7
CGATS21_CRPC4
4.0
Uncoated Offset
33 files
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Williamsburg Offset
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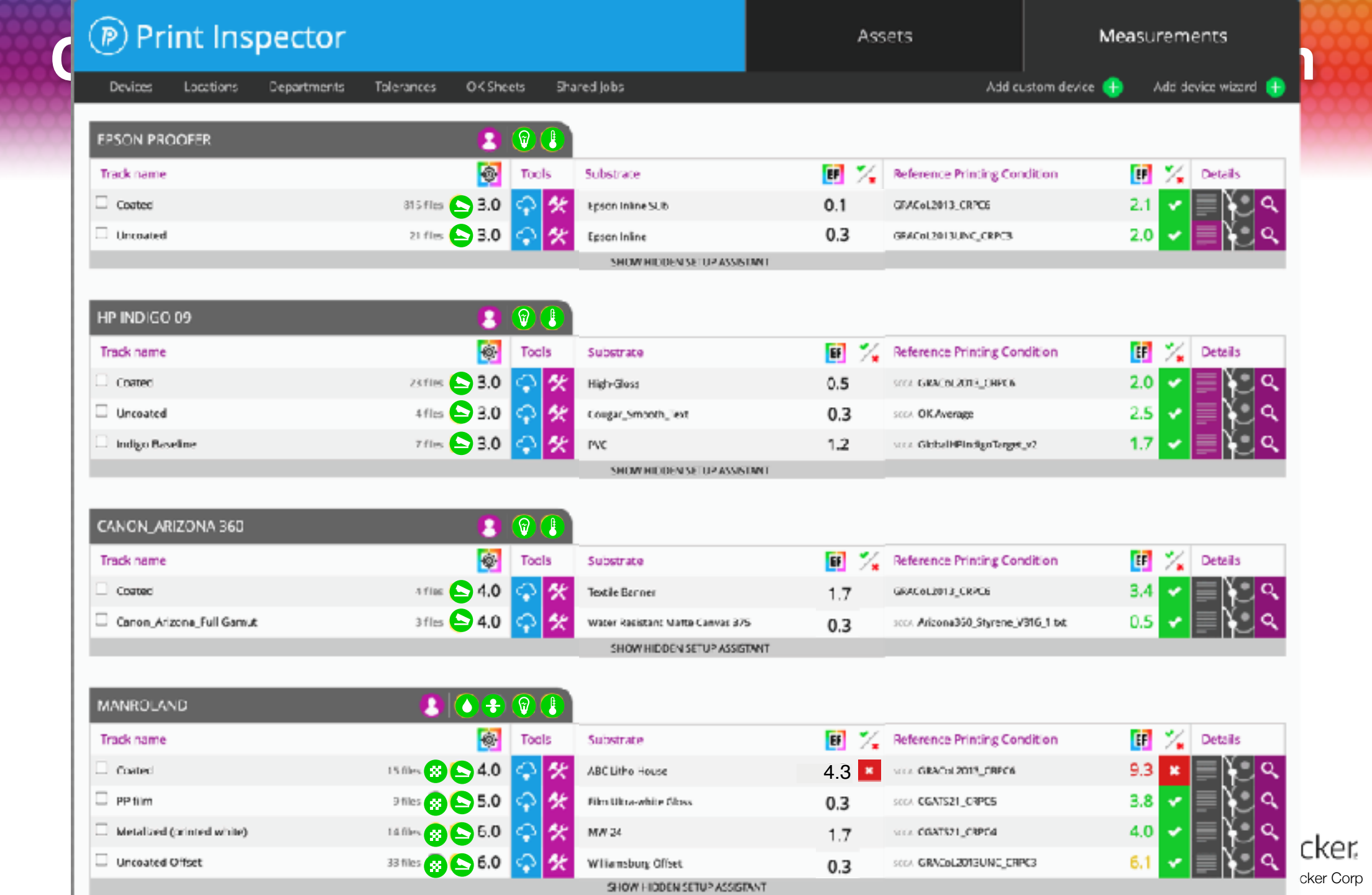
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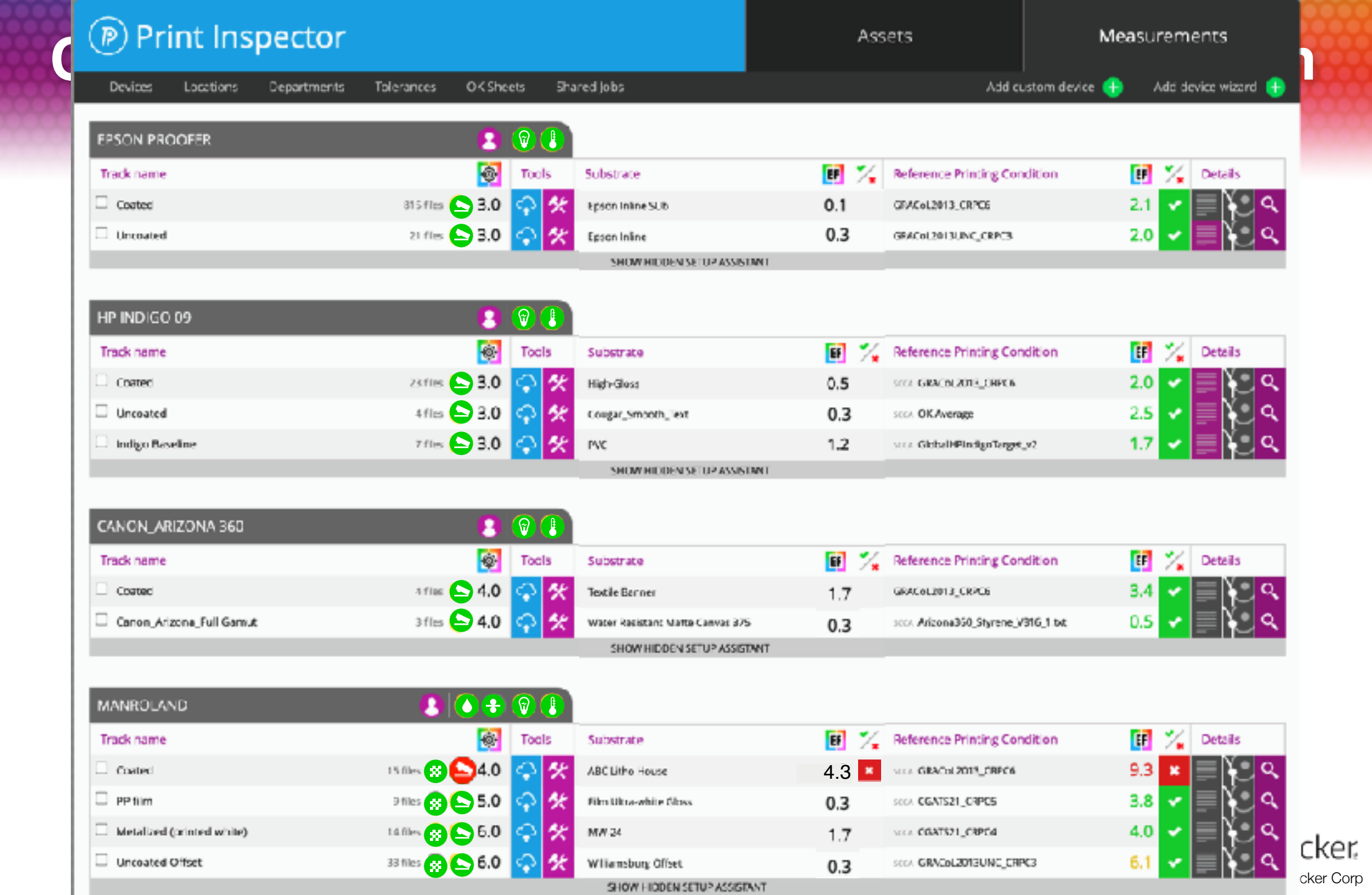
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EPSON PROOFER
Track name
Tools
Substrate
Reference Printing Condition
Details
Coated 815 files 3.0 Epson Inline SUb 0.1 GRACoL2013_CRPC6 2.1
Uncoated 21 files 3.0 Epson Inline 0.3 GRACoL2013UNC_CRPC3 2.0
SHOW HIDDEN SETUP ASSISTANT
HP INDIGO 09
Track name
Tools
Substrate
Reference Printing Condition
Details
Coated 23 files 3.0 High-Gloss 0.5 GRACoL2013_CRPC6 2.0
Uncoated 4 files 3.0 Cougar_Smooth_Text 0.3 OK Average 2.5
Indigo Baseline 7 files 3.0 PVC 1.2 GlobalHPIndigoTarget_v2 1.7
SHOW HIDDEN SETUP ASSISTANT
CANON_ARIZONA 360
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Tools
Substrate
Reference Printing Condition
Details
Coated 4 files 4.0 Textile Banner 1.7 GRACoL2013_CRPC6 3.4
Canon_Arizona_Full Gamut 3 files 4.0 Water Resistant Matte Canvas 375 0.3 Arizona360_Styrene_V31G_1.txt 0.5
SHOW HIDDEN SETUP ASSISTANT
MANROLAND
Track name
Tools
Substrate
Reference Printing Condition
Details
Coated 15 files 4.0 ABC Litho House 4.3 GRACoL2013_CRPC6 9.3
PP film 9 files 5.0 Film Ultra-white Gloss 0.3 CGATS21_CRPC5 3.8
Metalized (printed white) 14 files 6.0 MW 24 1.7 CGATS21_CRPC4 4.0
Uncoated Offset 33 files 6.0 Williamsburg Offset 0.3 GRACoL2013UNC_CRPC3 6.1
SHOW HIDDEN SETUP ASSISTANT

Color Control
Define Conformance

Presented by: David Hunter

5 C'S OF COLOR CONTROL AGENDA

Process Discipline for each color printer

Conformance — assess where your printers are at...

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

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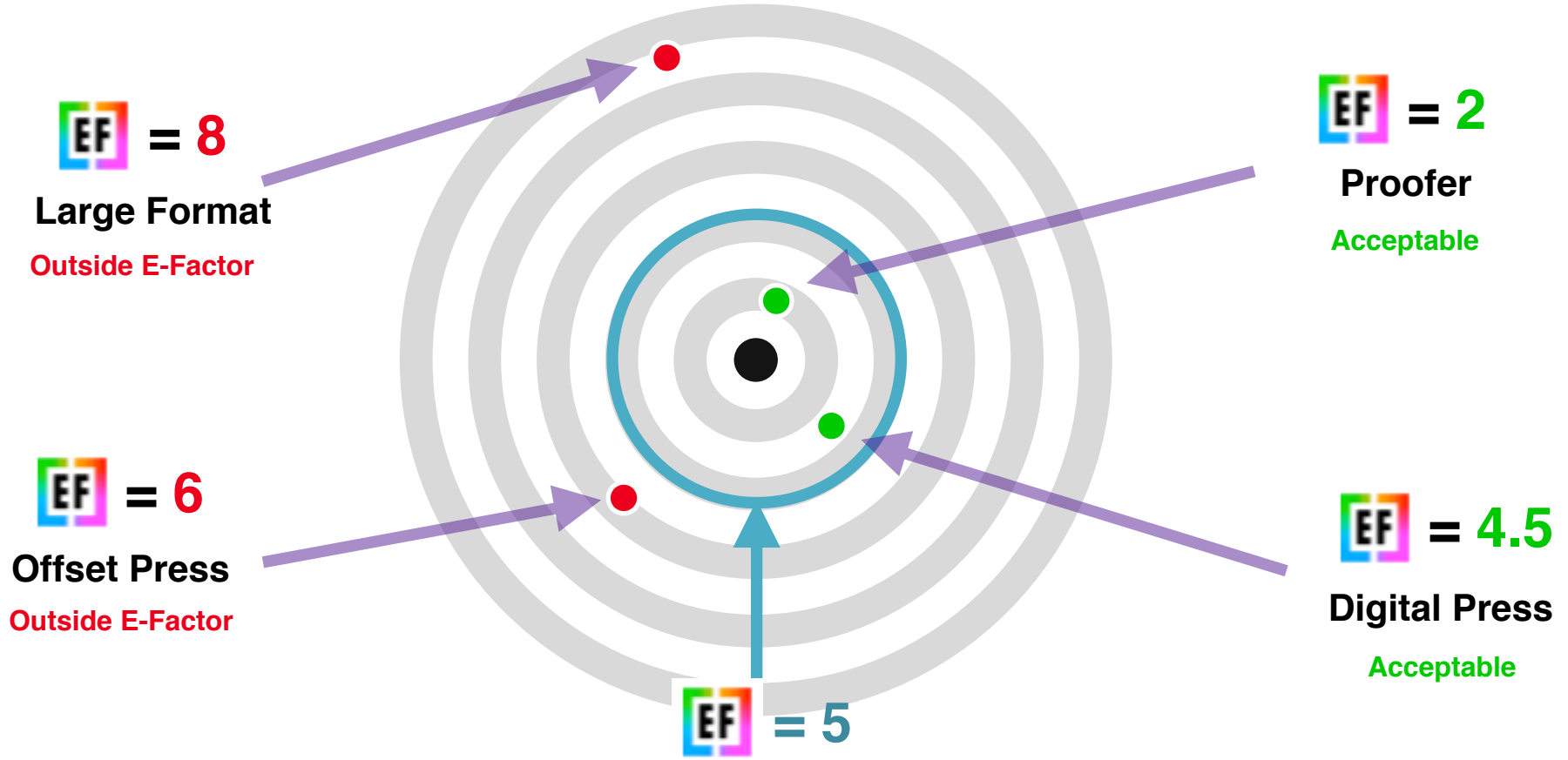
HOW CLOSE IS “CLOSE ENOUGH”?

What’s your color “match” Expectation Factor



Expectation Factor EF is the distance from the bullseye which is salable

Conformance Expectations

Quantify Color Expectations

- Baseline how printing devices are performing
- Visually understand where printers are at today
- Determine if you need to improve any of them
- Look at 5C's to improve printers if required
- Prioritize resources based on expectations

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Conformance Expectations

Baseline Kit Purpose

- Visual images to assess color expectations
  - Compare to GRACoL* and to one another
- Easily measure using CC Capture
  - Will assess E-Factor and G7 compliance
  - Works with most measurement instruments
  - Works on Mac or Windows
- Includes PDF (to print) and software to measure

* Requires E-Factor Exercise ($99) to compare to GRACoL

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Conformance Expectations

Baseline Printing Devices

- Register and Download Benchmark App and files
- Print ChromaChecker PDF out on all printers
  - Use Normal Production settings
- Measure using CC Capture
- Record E-Factor value at top
- Lower E-Factor- closer to GRACoL
- Compare to one another

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Video Showing How to Use CC Capture S/W

Measure the 3 row target

- Result:

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Determine Conformance Expectations

Visually compare prints to one another

- EF number shows how different from GRACoL*

Proofer

EF = 2

Large Format

EF = 8

Digital Press

EF = 4.5

GRACoL Sample

Included with E-Factor Exercise

$99

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Determine Expectations

Compare prints to reference and one another

- E-Factor Difference to GRACoL

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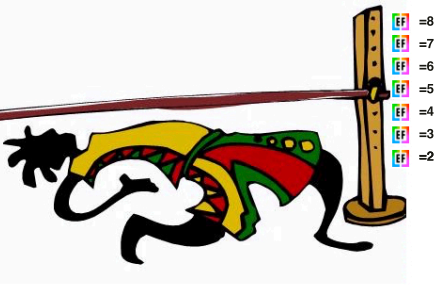
Determine E-Factor: Expectations

Factors to Consider

- Different customers have different expectations
- Evaluate how satisfied current customers are
- Nothing wrong with having high E-Factor if salable
- Start with higher E-Factor, reduce if necessary
  - Don’t set the bar to hard to begin with
  - Will lose support of operators and staff
  - Need to provide more time, tools, training to lower



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