



Introductions

Presented by: David Hunter

ChromaChecker Team here at the Event

2024 Team:



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PRESIDENT



Pierre
TECHNICAL SERVICES



Larry
CUSTOMER SUCCESS



Beth
OFFICE MANAGER



Krzysztof
CHIEF ARCHITECT



Zbigniew
UI DESIGN



Dominik
LEAD DEVELOPMENT



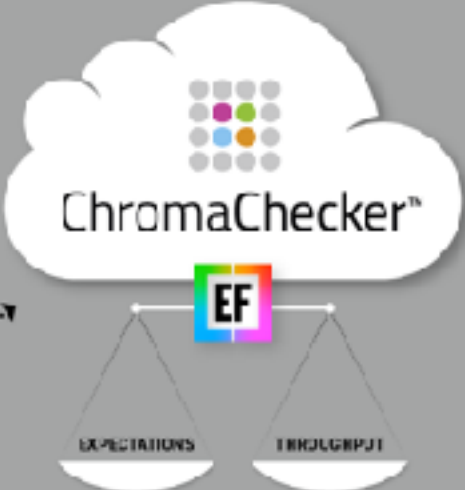
Krzysztof
OO APPS DEVELOPER



Jan
OO APPS DEVELOPER

COLOR CONFORMANCE PLATFORM

QUALITY CONTROL



PRODUCTION PROCESS





Without Standards, There Are No Problems: Setting Expectations for Scalability

Presented by: David Hunter

Spring 2022

Without Standards, There Are No Problems

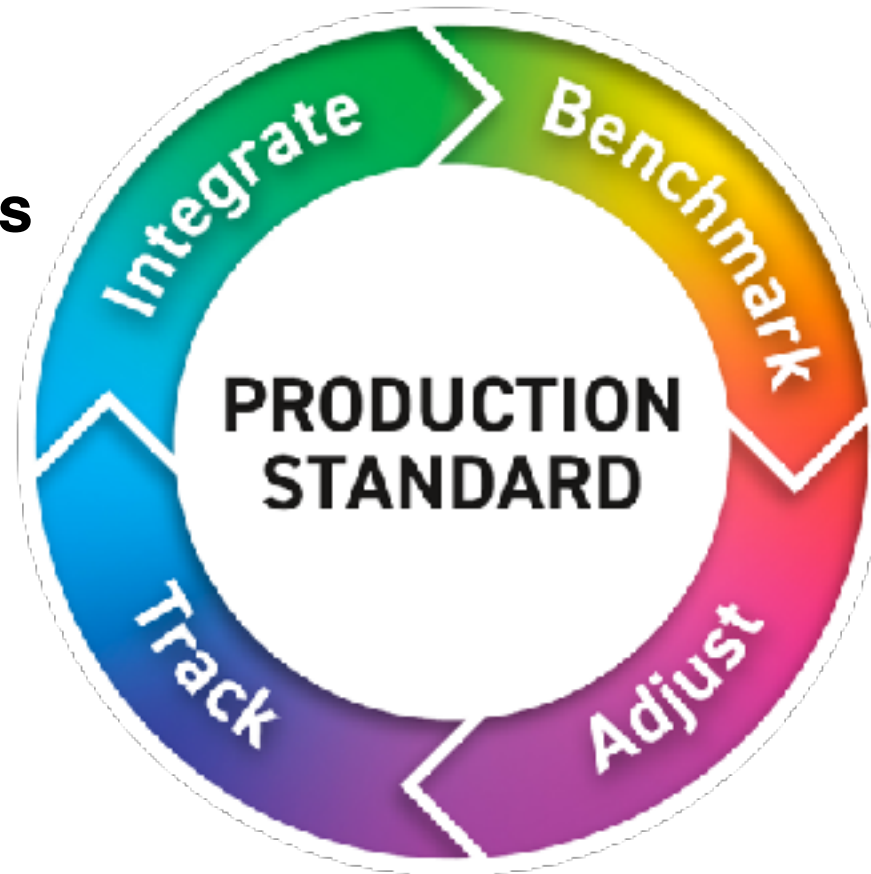
Agenda:

- ◆ What is a Production Standard?
- ◆ Process Control vs Color Conformance
- ◆ Optional Metrics for a Production Standard
- ◆ What Users are using as Production Standard
- ◆ Apply Production Standard to Reference and other printers

ChromaChecker 5 Step Color Conformance

Define Production Standard

**Integrate
new Printers**



**Benchmark
Printers**

**Track
Printers**

**Adjust
Printer**

ChromaChecker 5 Step Color Conformance

Rethink Print Quality!

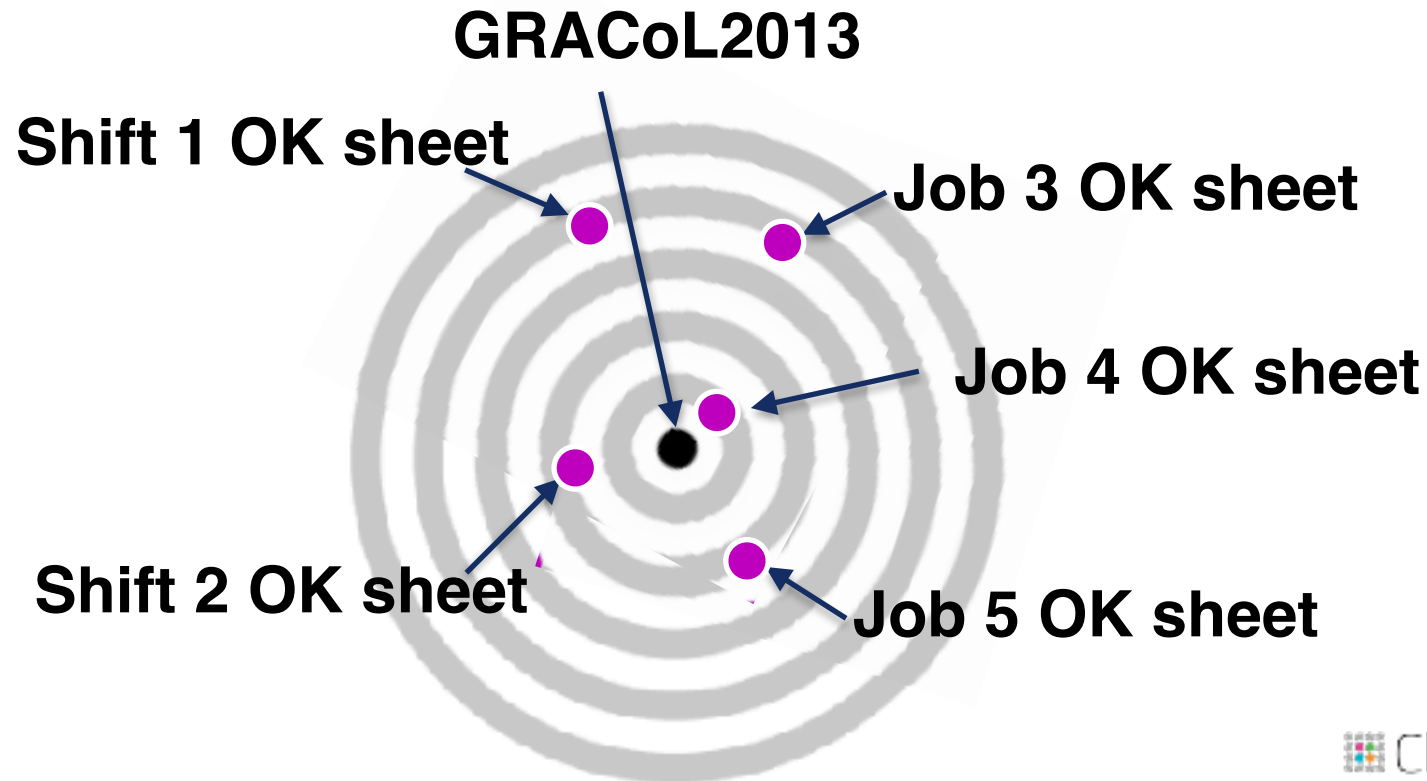
- 1. What should be happening (in production)? Compared to standard**
2. What is actual condition (right now in production)? Benchmark
3. Is there a gap (between current and standard)? Adjust
4. What is being done to close the gap? Track
5. Introducing new equipment to your shop... Ensure it matches

Do you have a shop standard? That is communicated to all operators, customer service, sales people, and customers? Does everyone obey?

Gaps affecting Color Quality

What is a Color *Match*?

- ◆ Same Operator: 5:00pm on Friday vs 9:00am on Tuesday?



Gaps affecting Color Quality

What is a Color Match?

- ◆ Same Operator: 5:00pm on Friday vs 9:00am on Tuesday?
- ◆ First shift vs. third shift
- ◆ Sales vs. Production
- ◆ Digital vs. Offset Operator
- ◆ Digital **substrate** vs. Large format substrate
- ◆ **Instrument** on Digital Press vs Large Format
- ◆ **Lighting** in Digital vs. Large Format
- ◆ **Brand color** rendering as spot vs. digital simulation

Gaps affecting Color Quality

What is a Color Match?

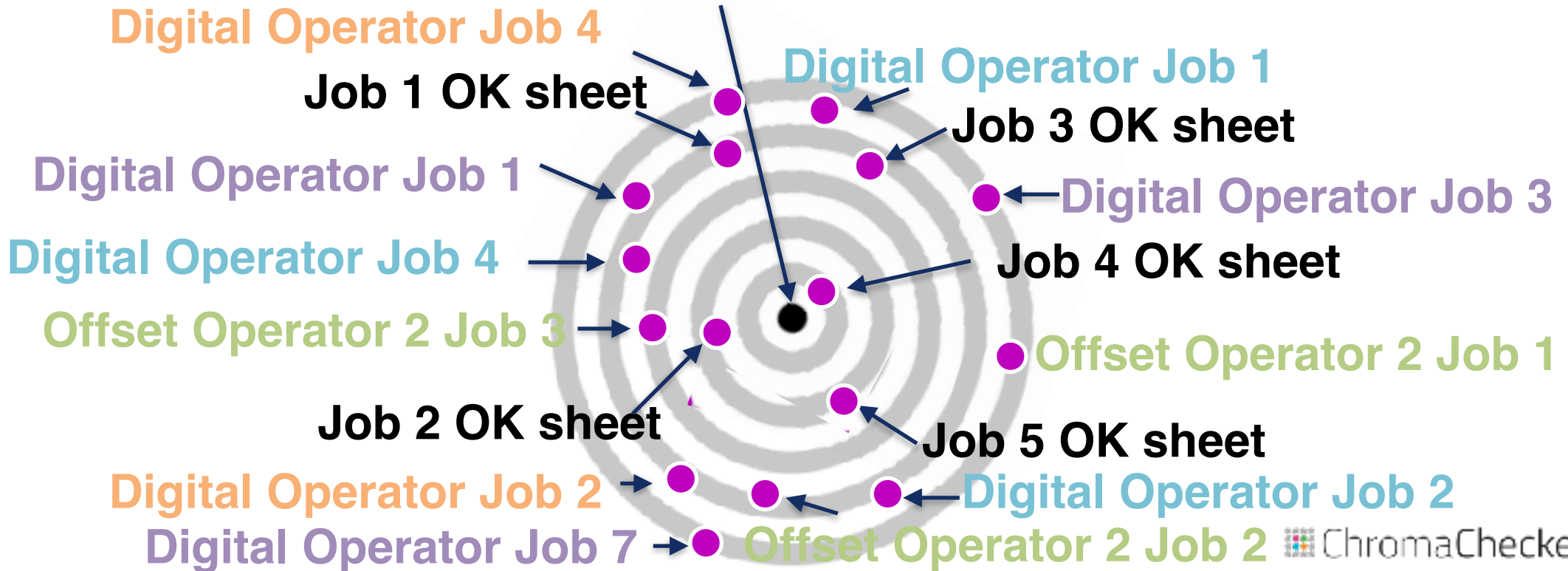
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GRACoL2013



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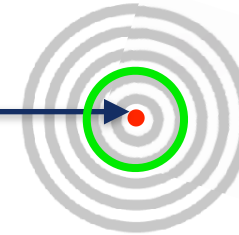
Production Standards

Digital Work

◆ Three Types of Work:

1. High Quality Marketing: **GRACoL2013**

Reference

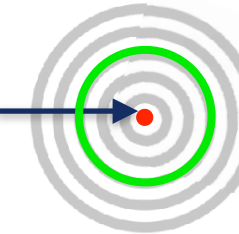


Production Standard

EF < 4.5 ✓

2. Lower Quality

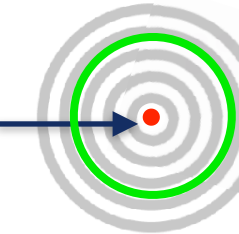
GRACoL2013_UNC



EF < 6 ✓

3. Transactional (lowest end)

Custom CRPC 2.5



EF < 7 ✓

What is Color Conformance? Standards...

Manufacturing- “Taking Raw Materials & Creating Products that Consistently and Repeatedly Meet Customer Expectations”

A) G7 Process Control- Ensuring a process is predictable, stable, and provides **shared visual appearance**

B) Color Conformance- Manufacturing a color **match** which meets a customer’s color expectations, producing salable goods

What is Color Conformance? Standards...

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Process color

ΔE (00)

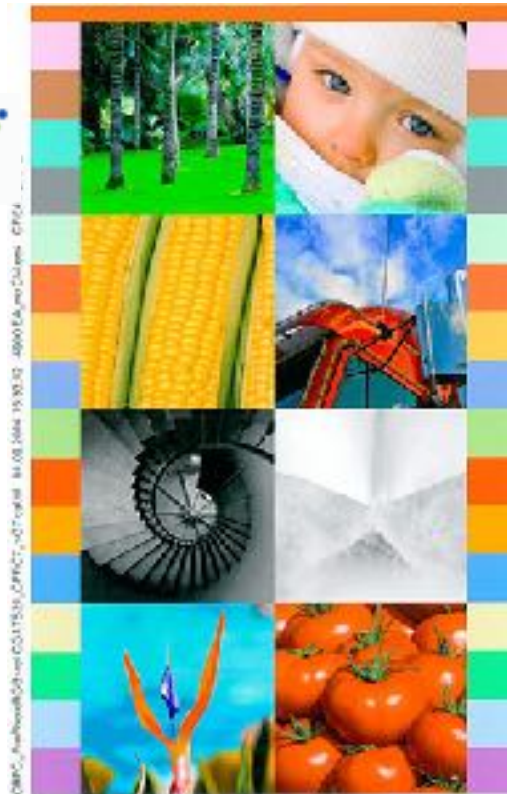
Brand color

Ever Pass G7 But Color Not Salable?

G7 Process Control is NOT Color Conformance

- ◆ PC is Operational- keep device operating within accepted variation
- ◆ Color Conformance- Is it Salable? E-Factor Exercise Online or Print

G7



G7

Both Prints Pass G7
Not Acceptable Match

EF = 6.6

Implement Daily/Job Production Standard?

Requires Assessment to Determine Pass  or Fail 

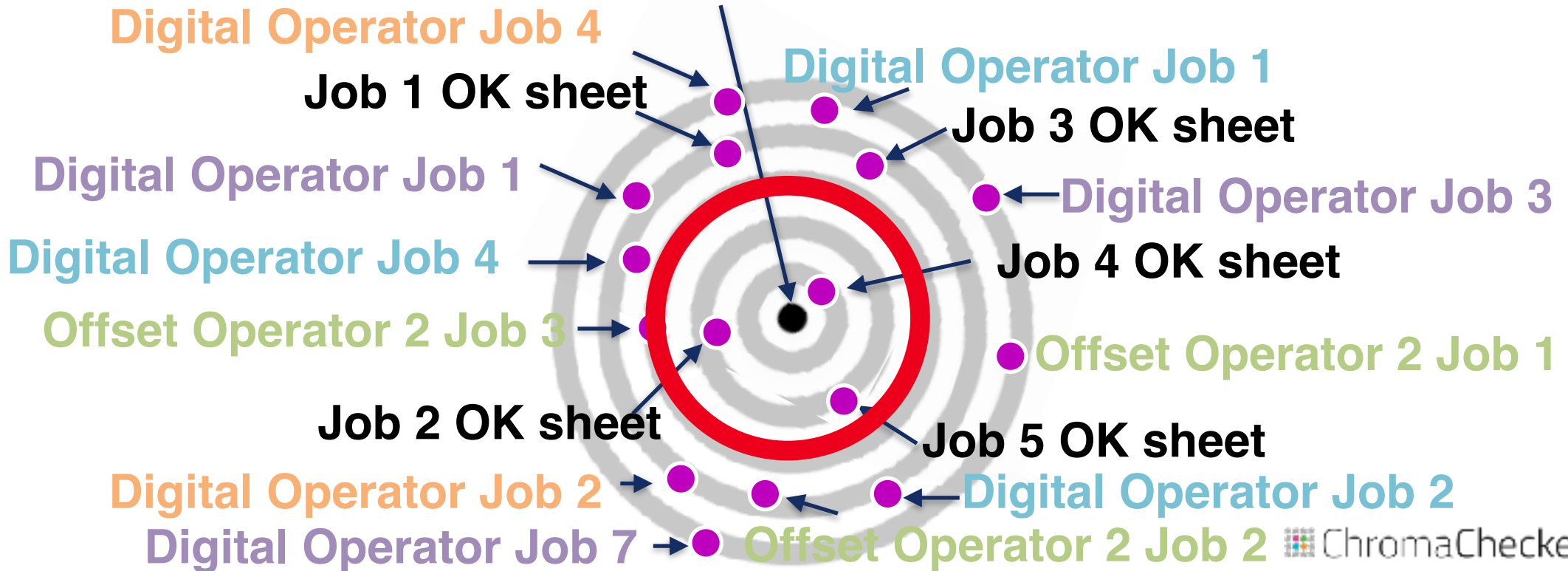
- ◆ Defines what is Waste vs Salable print
- ◆ Negotiate based on informed decisions versus assumptions
- ◆ Avoids unrealistic expectations (which causes printer \$\$\$)
- ◆ Great KPI to differentiate equipment performance

Applying Production Standard

Eliminate Subjectivity

- ◆ Minimum quality requirement for salable print

GRACoL2013

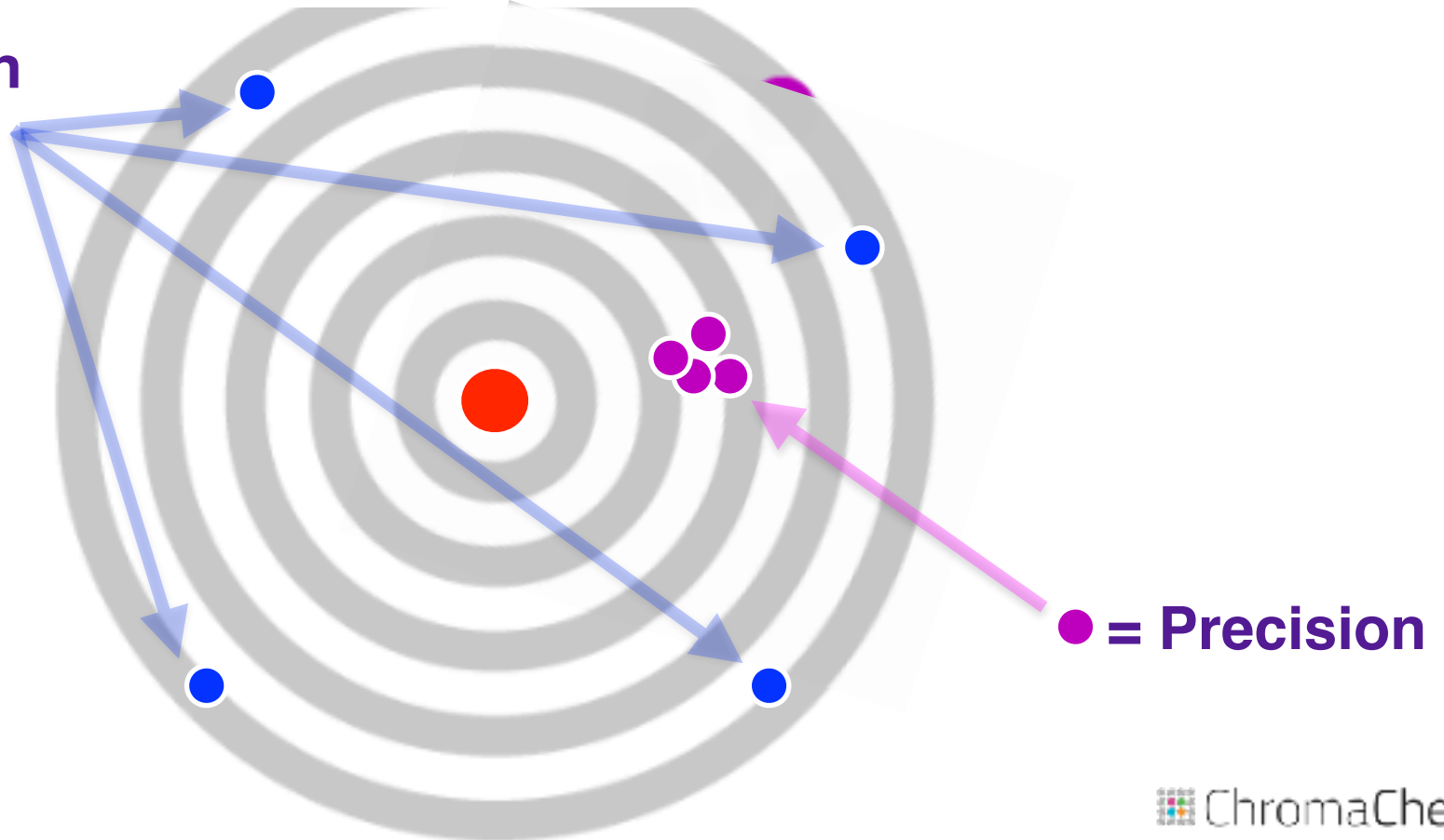


Precision versus Accuracy- Both Critical

Precision required before Accuracy

◆ Consistency within Page, Between Page, Between Jobs

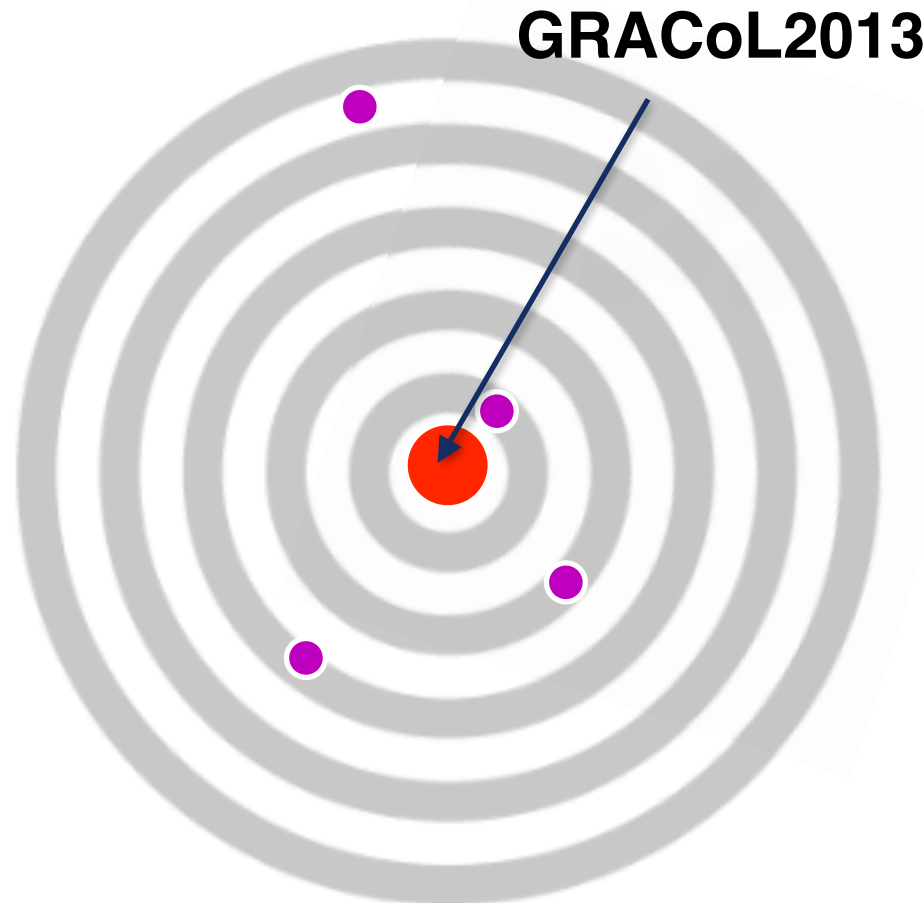
● = Imprecision



Accuracy to Reference Condition

Bullseye- Industry Reference Condition (GRACoL)

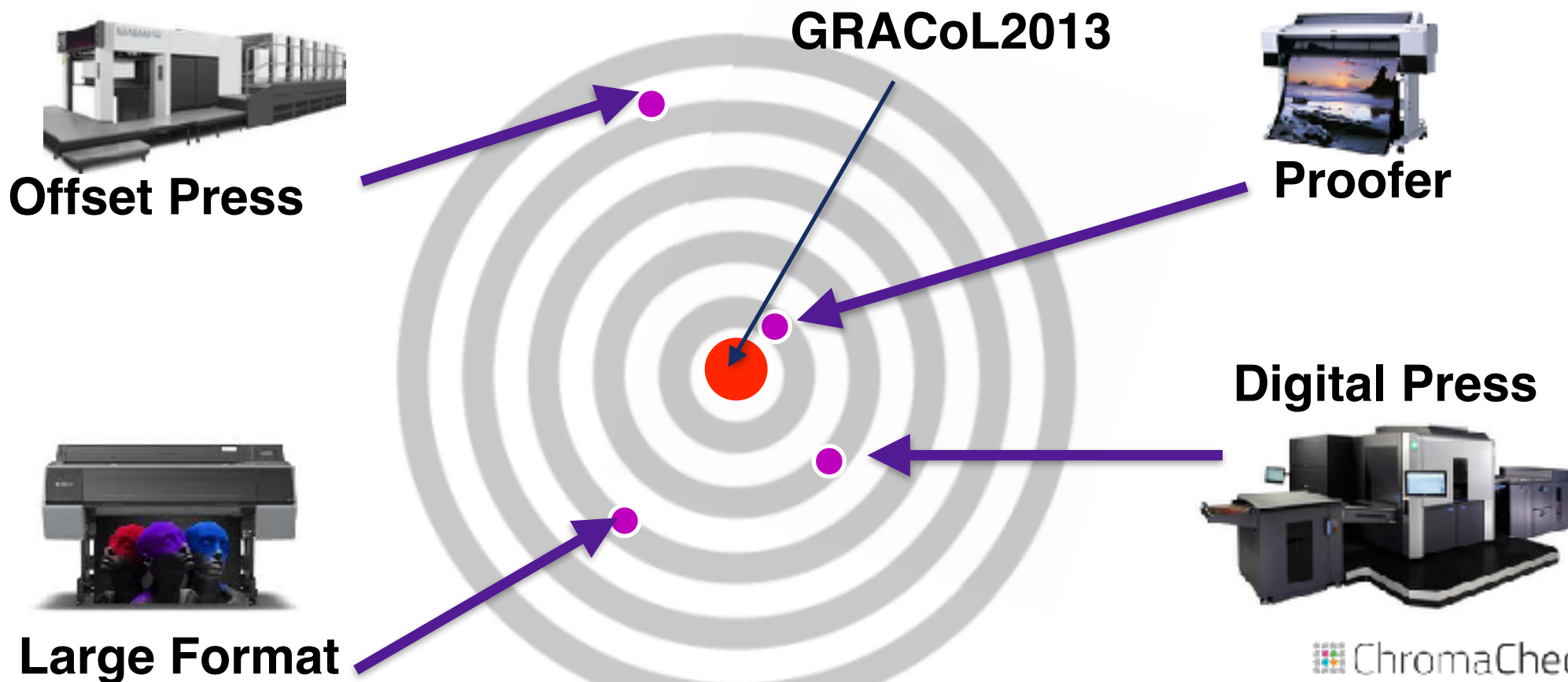
- ◆ How Close is Close Enough: Salable vs Waste



Accuracy to Reference Condition

Bullseye- Industry Reference Condition (GRACoL)

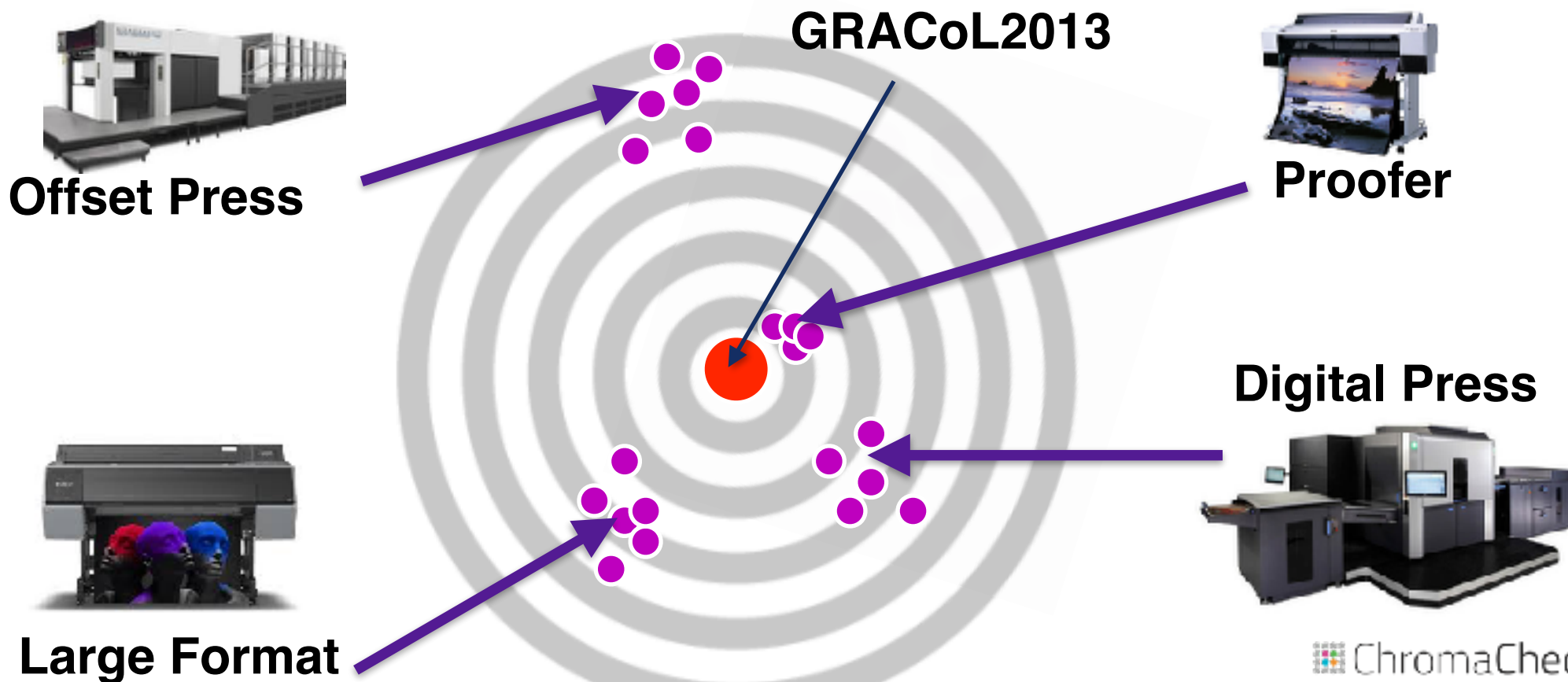
◆ How Close is Close Enough: Salable vs Waste



Device Precision and Accuracy

Bullseye- Industry Reference Condition (GRACoL)

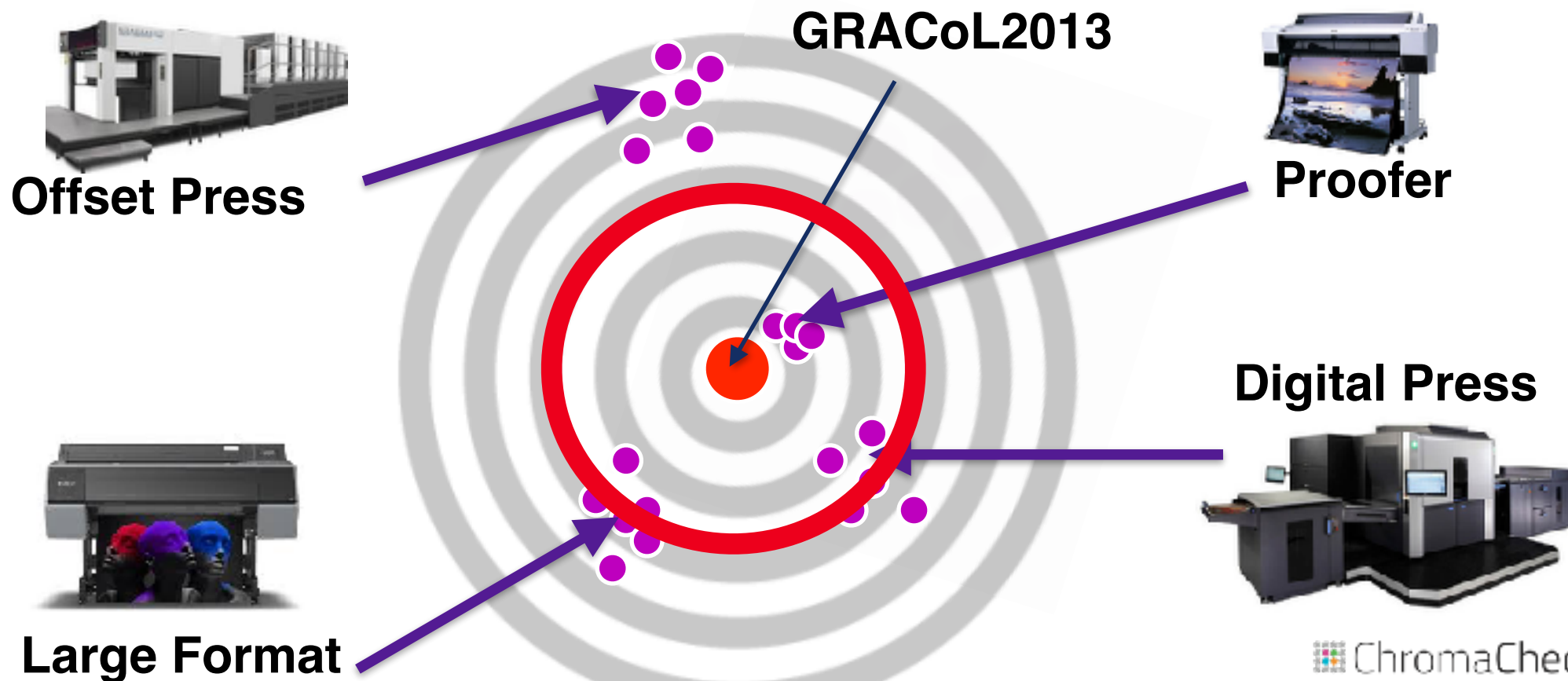
◆ How Precise and Accurate to Reference



Apply Production Standard- Every Job/Day

Bullseye- Industry Reference Condition (GRACoL)

◆ How Close is Close Enough: Salable vs Waste



Apply Production Standard- Every Job/Day

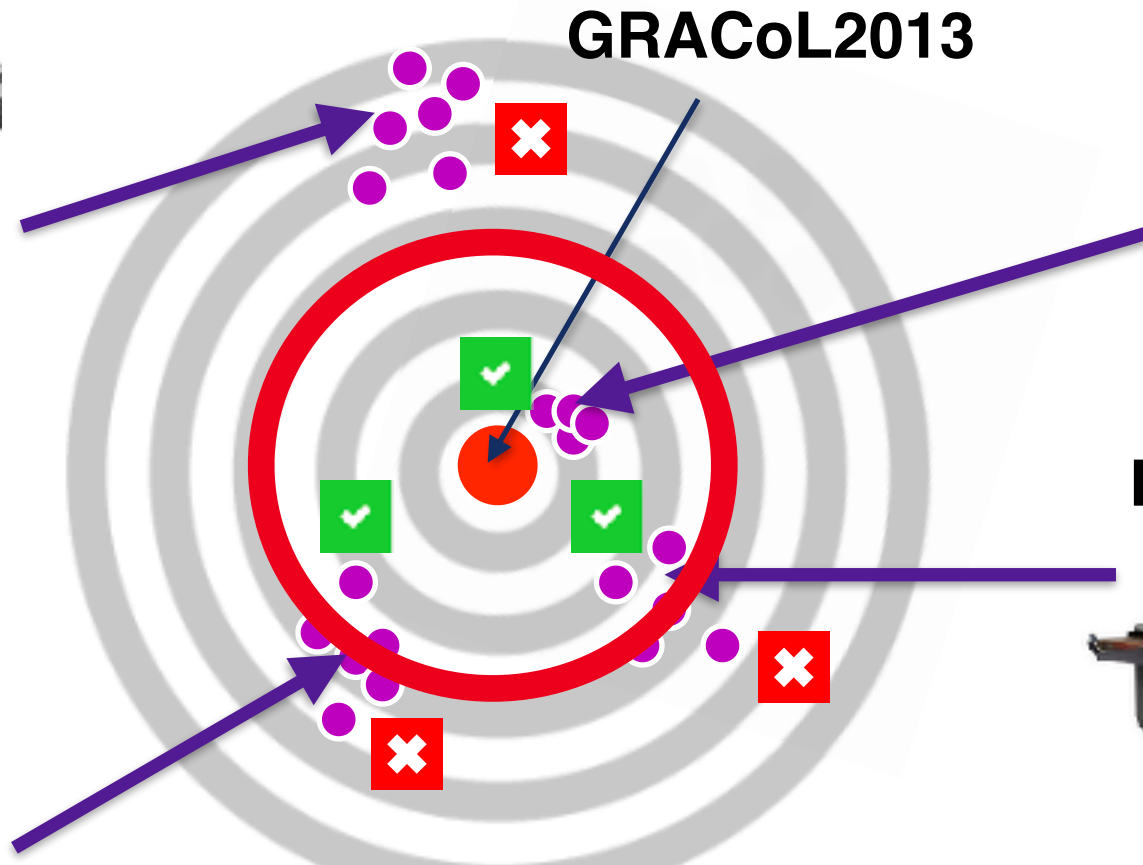
Pass/Fail Criteria based on Salable/Acceptable Result



GRACoL2013



Proofer



Digital Press



Determine Production Standard Metric...

Requires Assessment to Determine Pass  or Fail 

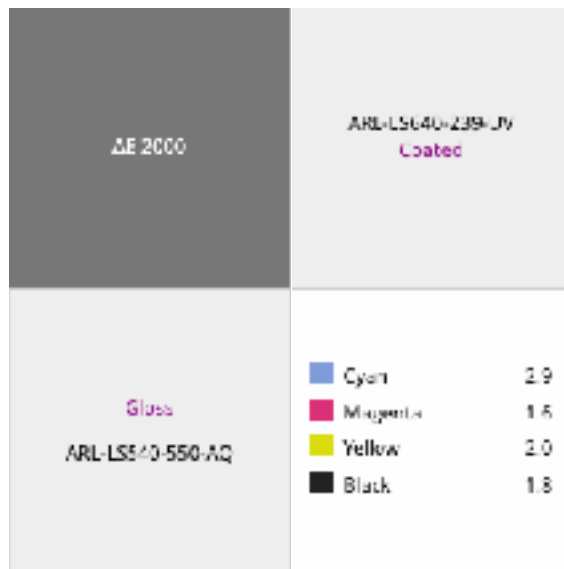
- ◆ Work for any Printing Process
- ◆ Co-relate to Human Expectations (Definition Quality)
- ◆ Easy to understand and apply
- ◆ Assess both Precision and Accuracy

How Are Production Standards Applied Today

98% Printers don't use Print Quality System- every...

- ◆ Visual Match between press and proof= **Subjective**
- ◆ Density is not color metric- doesn't guarantee color match

Two Presses- Same Density and TVI... very different color



How Are Production Standards Applied Today

98% Printers don't use Print Quality System- every...

- ◆ Visual Match between press and proof= **Subjective**
- ◆ Density is not color metric- doesn't guarantee color match
- ◆ Meeting ISO Standards (ie 12647-2)
- ◆ Meeting a minimum score (ie 85% from Score card system)
- ◆ G7 Specifications- Gray, Targeted, Color Space
- ◆ Fogra PSD Level A, B or C quality level

- ◆ ISO, G7, Fogra PSD- prove once a year... **NOT** every day, every job

How Are Production Standards Applied Today

98% Printers don't use Print Quality System- every...

- ◆ Visual Match between press and proof= **Subjective**
- ◆ Meeting ISO Standards (ie 12647-2)
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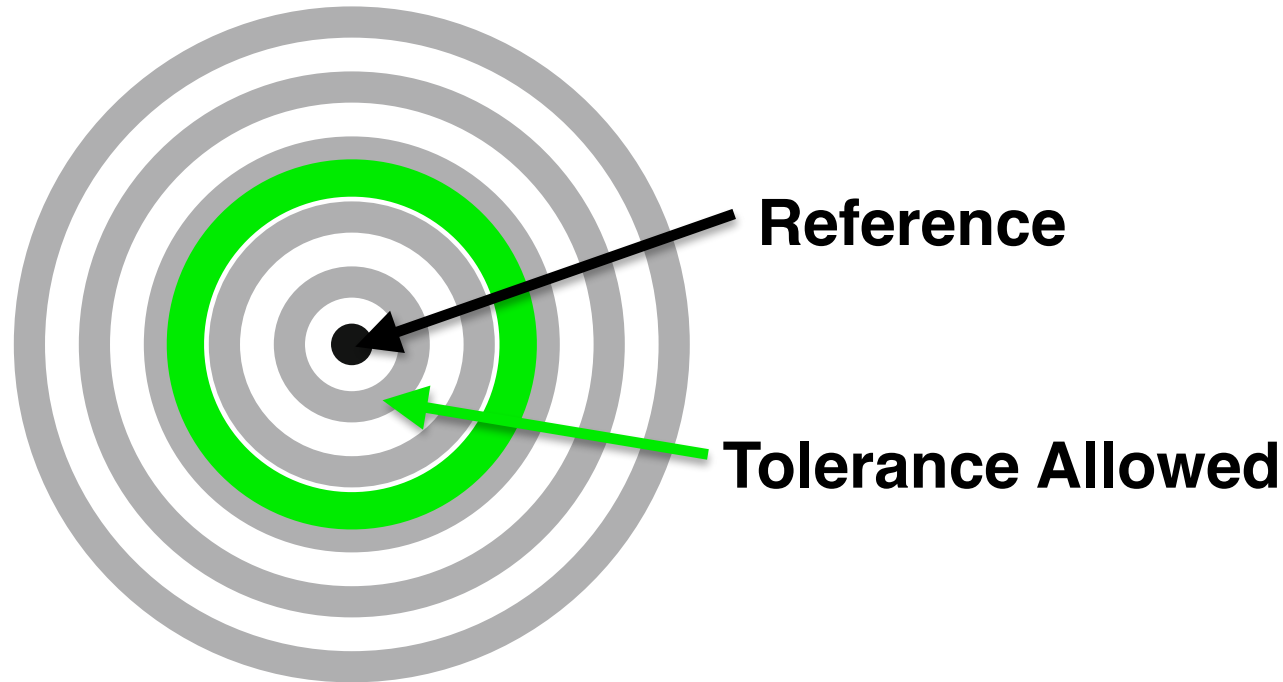
But:

- ◆ Only PSD co-relates human expectations, assess precision/accuracy
 - ◆ But only recommended for digital print
- ◆ None easy to understand and apply

What if...

Could use One Number to Assess Salability/Waste


- ◆ Assess customer's expectations (E-Factor ) with a number



- ◆ If production is inside tolerance= Salable, outside= Waste
- ◆ Assess Accuracy and Precision (***Consistency***)

What if... Real Production Standard

Could use One Number to Assess Salability/Waste

- ◆ Assess customer's expectations (E-Factor ) with a number
- ◆ Compare difference between print and reference aim
- ◆ Compare within and between page differences
- ◆ Compare any two printing devices to one another
- ◆ Communicate to entire organization, sales, managers operators
- ◆ Allow for different tolerances for different levels of print processes
- ◆ Understand Noticeable Difference vs *Acceptable Difference*

Quantifying Color Differences: Numerically

What type of Color Match

- ◆ Match specific brand colors: Spot colors



- ◆ Match between pages or presses : Process colors



G7



G7




G7

ChromaChecker

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Quantifying Color Differences: Numerically

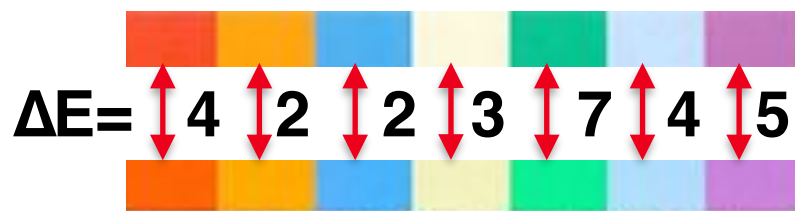
What type of Color Match

- ◆ Match specific brand colors: Spot colors
 - ◆ ΔE (delta E) quantifies spot differences: two colors to one another
 - ◆ Bigger the number, bigger the difference, 1 is unrealistic
- ◆ Match between pages or presses : Process colors
 - ◆ E-Factor  Quantifies process color differences
 - ◆ Bigger the number, bigger the difference, 1 is unrealistic
 - ◆ Think ΔE for process colors- same relative differences

Quantifying Color Differences: Numerically

What type of Color Match

- ◆ Match specific brand colors: Spot colors



- ◆ Match between pages or presses : Process colors



G7



G7



G7

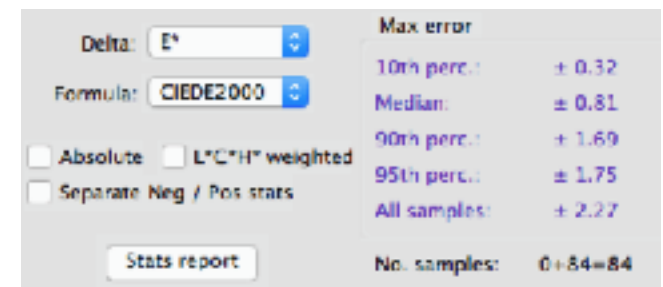
Technical Definition: = 95th Percentile ΔE

95% of colors are within that ΔE , 5% are more

- ◆ Used to quantify all colors on page, and images
- ◆ First defines in TAGA Paper 2001: author: Robert Chung et al
- ◆ Compares patch differences and sorts highest ΔE to lowest
 - ◆ CRF at 95th percentile ΔE (00)
 - ◆ Key metric in G7 Color Space, Fogra PSD (human expectations)



GRACoL2013 vs “Large Format”

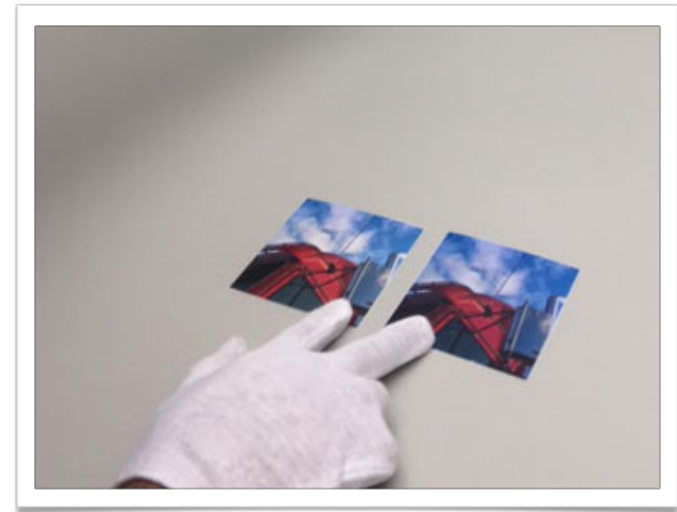
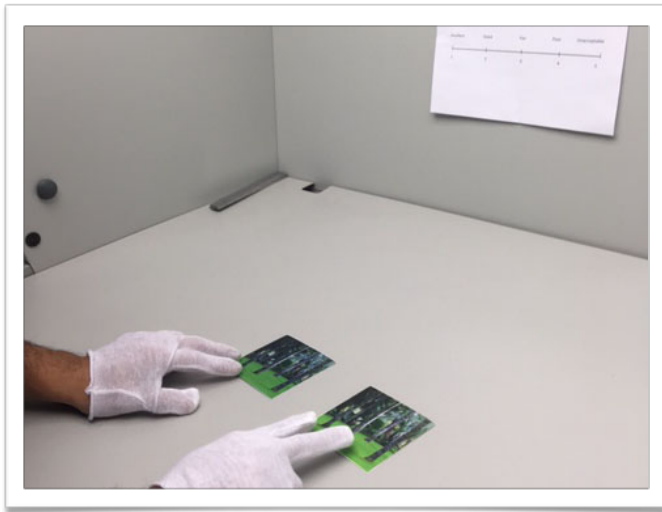


- ◆ Requires at least 60 different patch values

But what are Customer Expectations?

Industry Survey (TAGA 2017 Research Results)

- ◆ 200+ Industry personnel surveyed their expectations
- ◆ 80 random paired comparisons with different E-Factors, D50 light
- ◆ Grade the matches: Excellent, Good, Fair, Poor, Unacceptable



But what are Customer Expectations?

Industry Survey (TAGA 2017 Research Results)

◆ Defined Expectations of Industry:



- *E-Factor: 1-3 = Good or Excellent Match by vast majority*
- *E-Factor: 3-8 = Disagreement on Acceptability*
- *E-Factor: 8+ = **Unacceptable by vast majority***

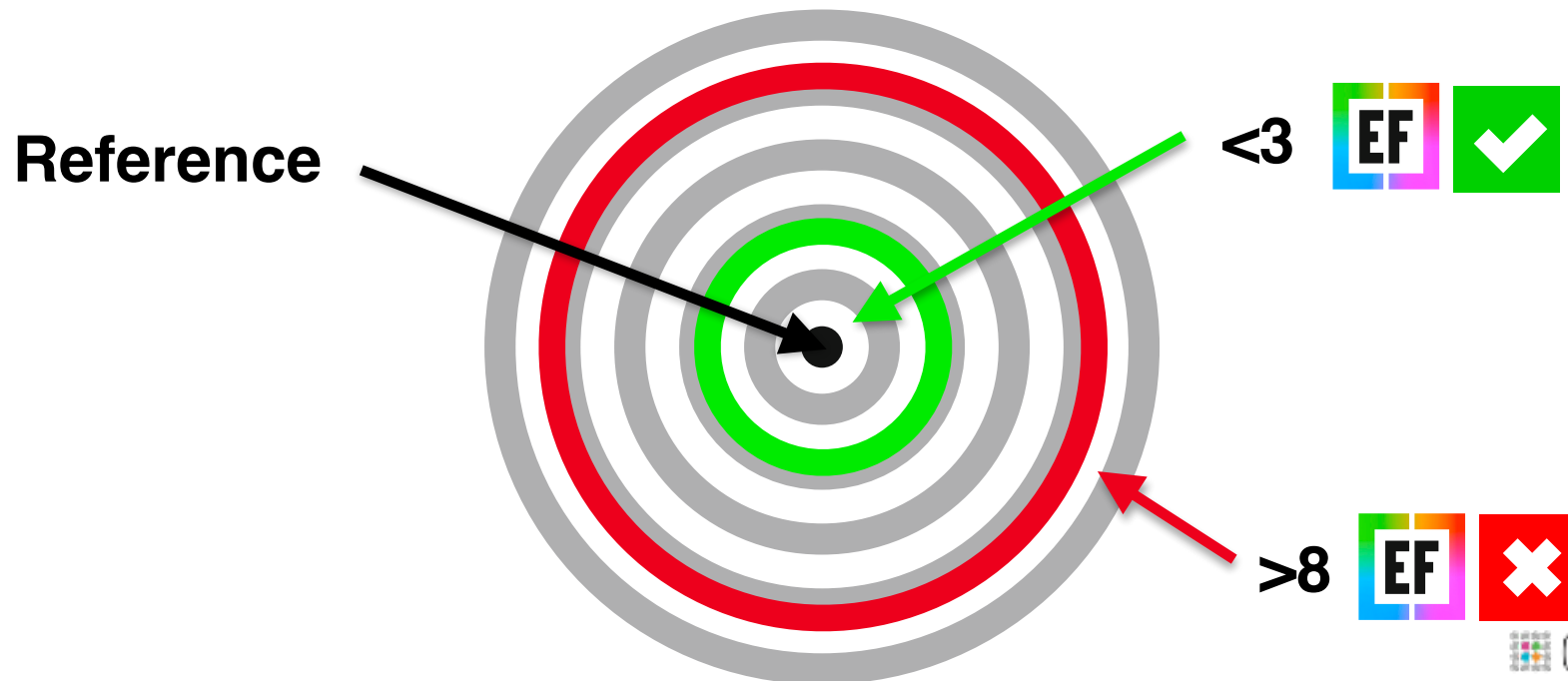
Published TAGA 2017, Chung, Federovski, Urbain, Hunter

Elena Federovski after tabulating ANOVA Statistics: “In my 30 years researching color, I have never seen a metric so closely co-relate human color expectations!”

Range of Acceptability




Industry Survey (TAGA 2017 Research Results)

- ◆ Defined Expectations of Industry:
 - 85%+ Print Buyers accept <3 
 - 95%+ Print Buyers will not accept >8 

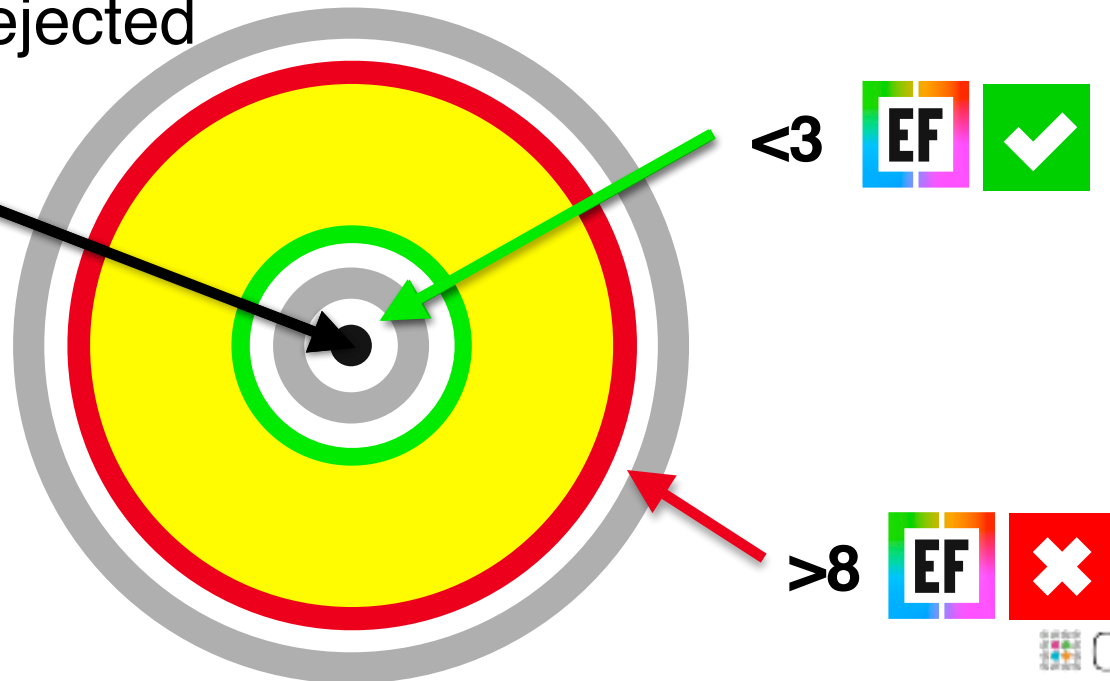


Interpretation

First time can use one number to determine Waste

- ◆ If  >8 = Waste
- ◆ Danger Zone- Between 3 and 8 
- ◆ Most Printers today manufacture between 3 and 8 
- ◆ Any print could be rejected

Reference



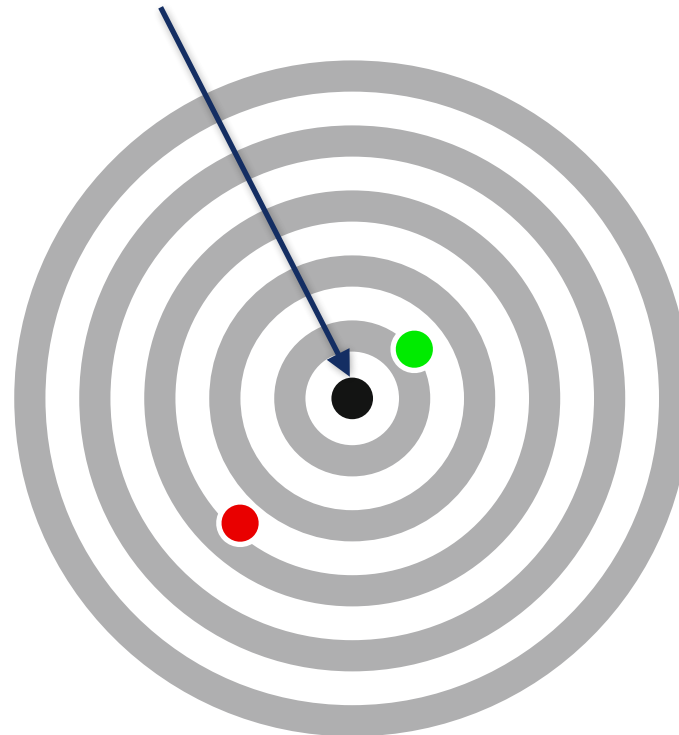
How Close are Printers Matching GRACoL?

Just because they are G7, doesn't tell us how close

◆ Doesn't even tell us which one is better (**closer**)...



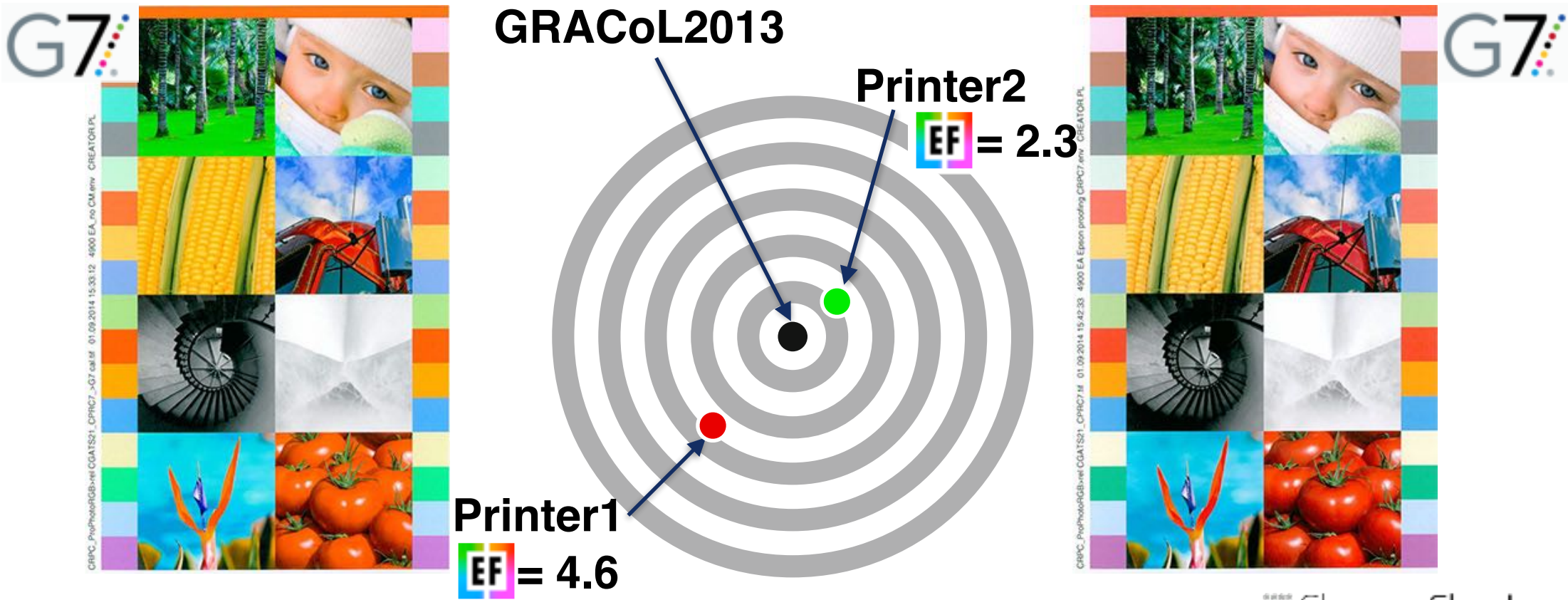
GRACoL2013



How Close are Printers Matching GRACoL?

E-Factor Defines how close each are to GRACoL

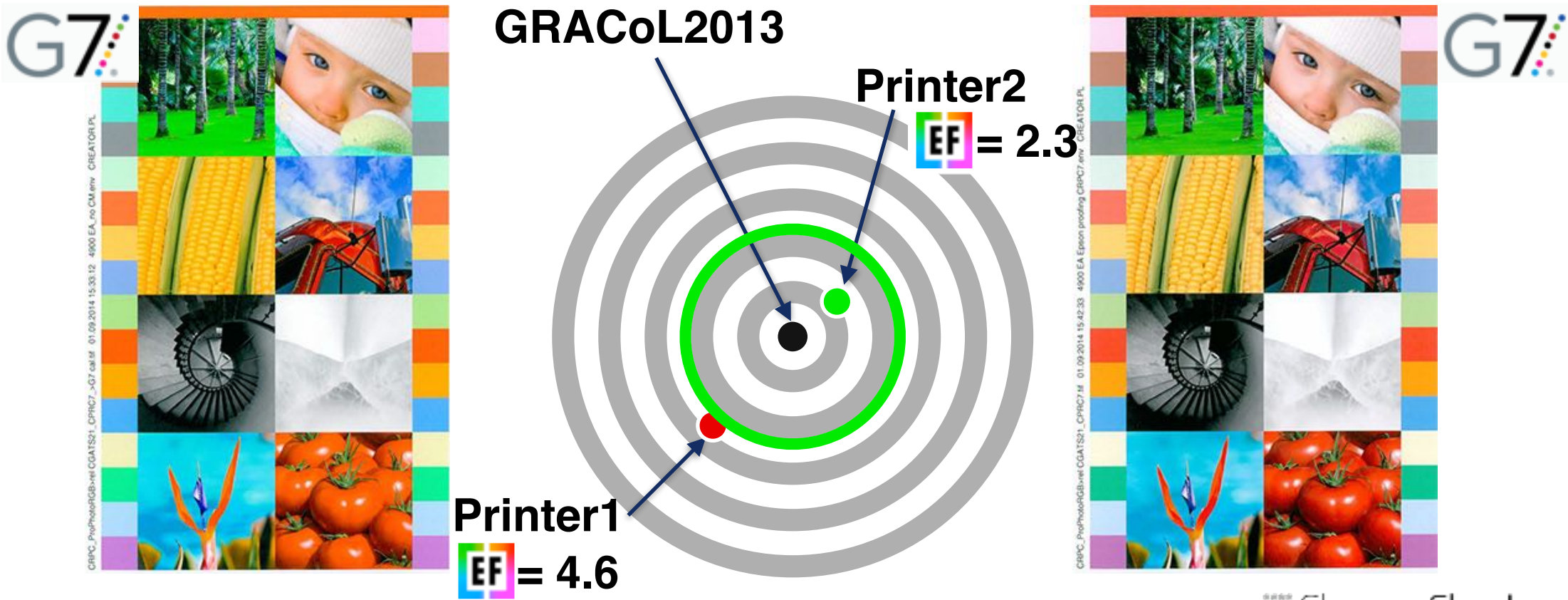
- ◆ G7 compliance is not a reasonable production standard



How Close are Printers Matching GRACoL?

E-Factor Allows For Production Standard

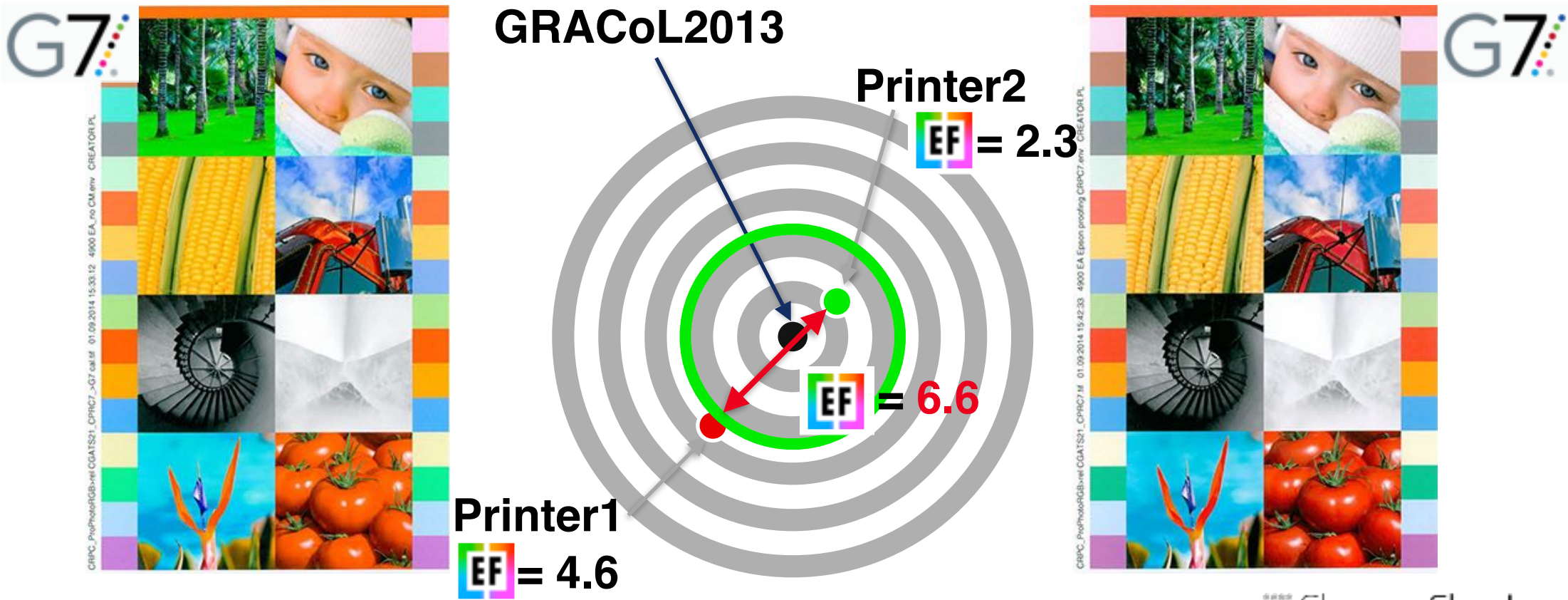
- ◆ Determine which printers are manufacturing salable goods vs waste



How Close Printers Matching Each Other?

E-Factor Allows For Production Standard

- ◆ Determine which printers are manufacturing salable goods vs waste



Rethink Approach to Print Production

Road Map to Analytics Based Print Manufacturing

GRAPHIC ARTS

PRINT MANUFACTURING

SUBJECTIVE PERSONAL-BASED JUDGMENT

METRIC-BASED JUDGMENT SCIENTIFIC

VISUAL ASSESSMENT • COMPARATIVE COLOR MEASUREMENT • ADVANCED COLOR CONFORMANCE



VISUAL

Personal perception-based comparison to physical standard

- no knowledge required
- expensive and time-consuming personal supervision
- dependent on the person
- lighting conditions related
- uncontrolled metamerism
- no repeatability
- initial swatch-book inaccuracy
- instability of color samples (aging, dirt)

BASIC INSTRUMENTAL

Instrument-based comparison to physical standard

- numerically expressed color differences
- expensive and time-consuming personal supervision
- uncontrolled metamerism
- initial swatch-book inaccuracy
- instability of color samples (aging, dirt)
- different substrates / OBAs
- unpredictable issues of

COLORIMETRIC AIM

Instrument-based comparison to colorimetric standard

- numerically expressed color differences
- stable color definition
- exchangeable color definition
- the possibility of remote control
- limited color definition
- only one lighting condition specified
- uncontrolled metamerism

SPECTRAL AIM

Instrument-based comparison to spectral standard

- numerically expressed color differences
- spot colors, SCTV, CxF/X-4 compliant
- exchangeable color definition
- lighting condition independent
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EF = 8+

EF = 6-8

EF = 4-5

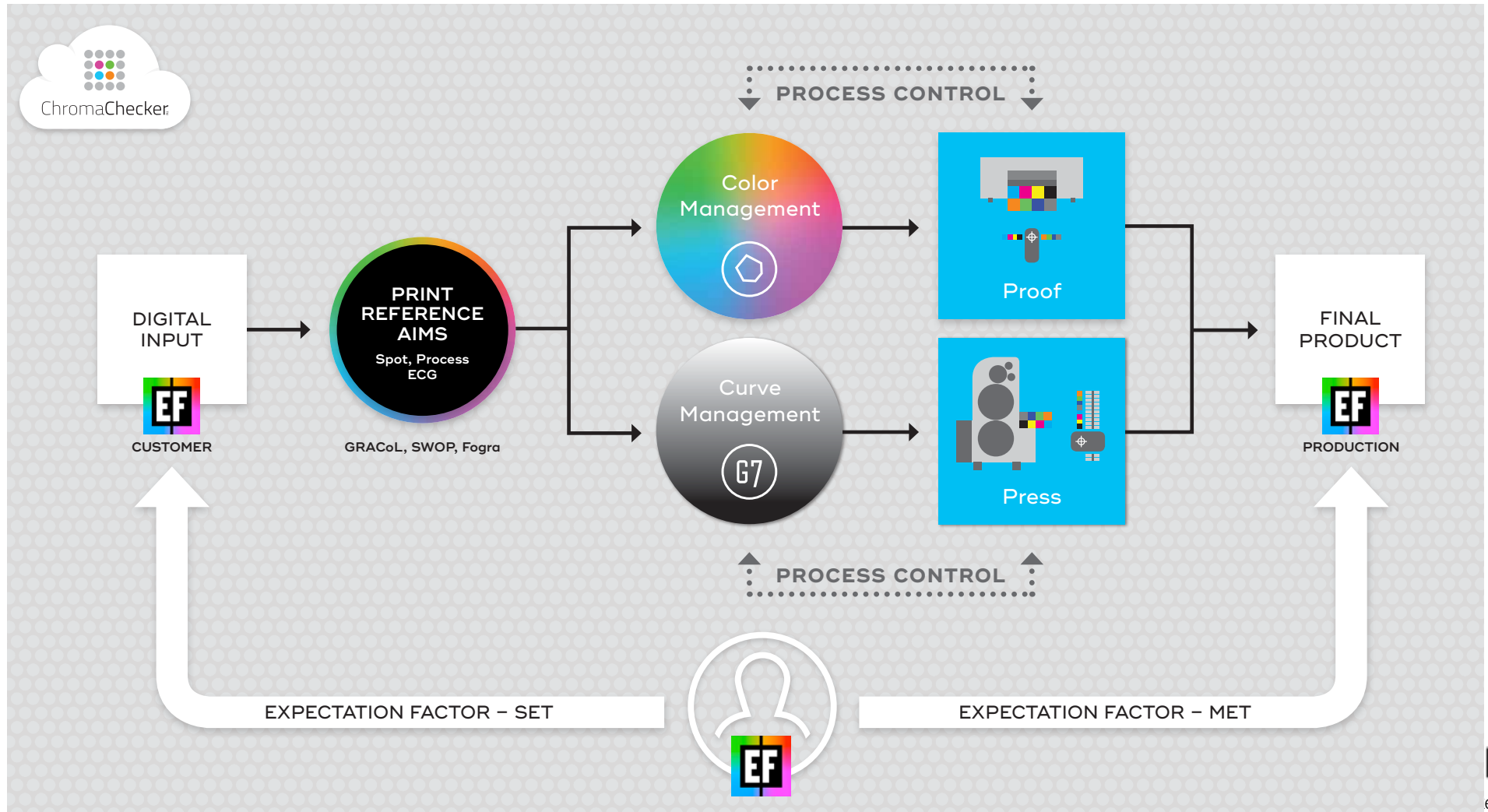
EF = 3-4

ChromaChecker

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Color Conformance Platform

Defines type, level, routine for process control



Link Color Expectations to Print Capabilities

E-Factor defines if Printer can deliver salable color

◆ Production Standard for Operator, Managers, Customers



Customize Production Standards

Conventional Press Production Standard:

◆ Multiple Tiers - Lead Operator to desired Results

1. Pass if color is precise on sheet (balanced) 

2. Pass if balance and solids are right color 

3. Run number of jobs to collect data for G7 Curve

4. Pass if balance, solids and TVI at 50% is correct (for G7 Gray) 

5. Pass if balance, solids, TVI at 50% and E-Factor is correct 

Digital Press Production Standard:

◆ E-Factor is correct: Pass 

Spot Color Production Tolerances

Spot Color Exercise and Spot Variator Tool

- ◆ Simulate what different ΔE Formulas and Levels looks like

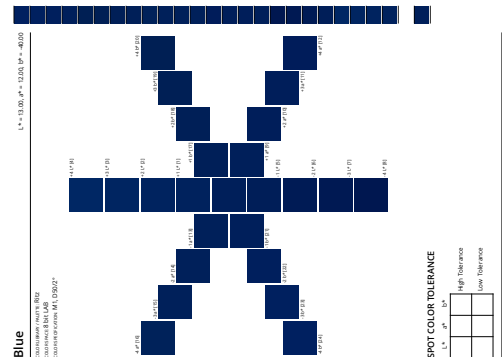


Spot Variator
M07_2F 2000 = 3



Snowflake (NEW)

- ◆ Ability to print accurate color and visually set ΔL , Δa , Δb values



Operator Friendly- Production Standard

ChromaChecker Capture, print target, measure:

◆ **Green is salable, Red is not**

The screenshot displays the ChromaChecker software interface. At the top is a 'Print Inspector' window with a blue header and several icons. Below the header are controls for 'Mode' (Scan), 'Patch width' (8), and '11 min'. There are buttons for 'Recalibrate' and 'Substrate'. Below these are input fields for 'Job Name', 'Customer', 'Sheet nr' (5), and 'Production'. Further down are 'Track' (170g CO 750x530 Furbart_Glassy) and 'Template' (MinC7 exAct 8 mm).

Below the 'Print Inspector' is a color calibration bar with various color patches. The main dashboard features a green sidebar on the left with a checkmark icon, a timer (00:33), and other icons. The central area shows a target image with a green center and the value '2.2 [5]'. To the right are four measurement sections:

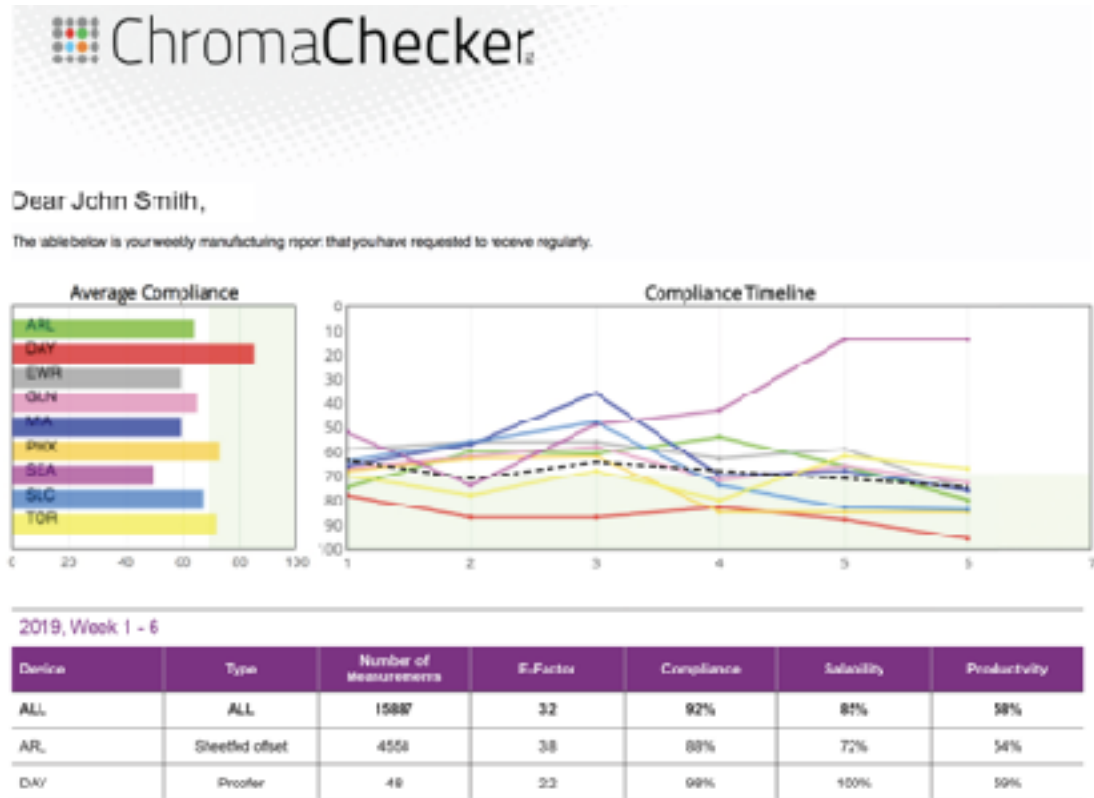
- F Factor:** Two color patches with values 2.2 and 2.1, both marked with green checkmarks.
- Solids - Optimal Density:** Four color patches (blue, magenta, yellow, black) with values 1.0, 2.2 (0.13D), 1.9 (0.06D), and 2.7, all marked with green checkmarks.
- Overprints - G700:** Four color patches (red, green, blue, black) with values 1.4, 2.5, 3.0, and 6.4, all marked with green checkmarks.
- IVI / Dot Gain:** Four dot patterns with values 1.4, 2.5, 3.0, and 6.4, all marked with green checkmarks.

At the bottom is a navigation bar with buttons for 'Capture', 'Timeline', 'Inkzones', and 'Summary', along with a printer icon.

Continuous Improvement Weekly Reports

Reporting Salability- Key Performance Indicator

- ◆ Production Standard for Printers, Managers, Customer Reports
 - ◆ KPI per press
 - ◆ Dotted line= Average
 - ◆ Below line or Above?
 - ◆ 8 week trend line
 - ◆ Only see printers that you are responsible
 - ◆ Company wide initiative
 - ◆ Report emailed weekly

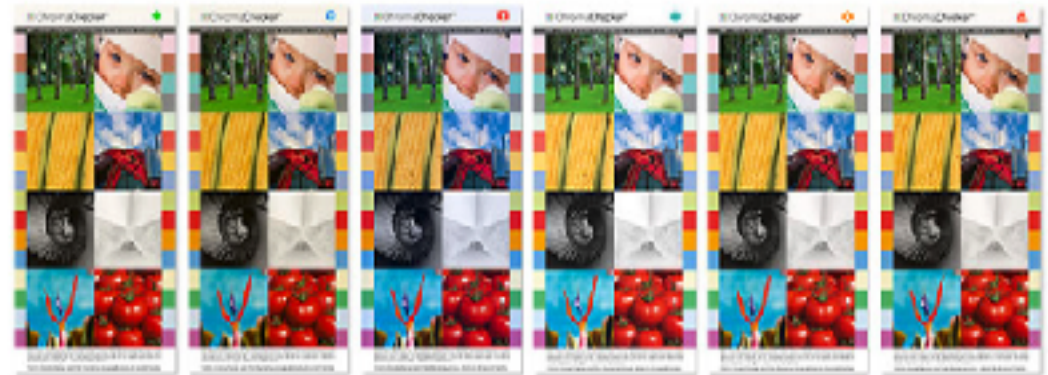


How to Define Production Standard

- **What is your E-Factor (web or hard copy)**

What is Personal E-Factor™ Exercise?

This is a set of six pages.



Each page is marked with one of the icons:



Summary: Without Standards- No Problems

ChromaChecker Supports Any Standard

- ◆ Apply Production Standard for Printers, Managers, Customers
- ◆ Eliminate Waste, Increase Precision and Accuracy
- ◆ Eliminate conflicts between sales/customers and print room
- ◆ ChromaChecker can use any metric(s) for Production Standards
- ◆ E-Factor- 95th Percentile ΔE (00) Co-relates expectations to print
- ◆ Weekly Company Reports based on eliminating waste- Profitability

How Close is Close Enough- Web version

- **What is your E-Factor (Expectations)**

The screenshot shows the 'PERSONAL E-FACTOR TEST' interface. At the top, there are navigation tabs for 'Physical exercise', 'On-line exercise' (which is selected), and 'Buy online'. Below the tabs, the page title is 'HOME PERSONAL E-FACTOR TEST'. A instruction reads: 'Do not judge if you see a difference (you should see a difference between every target, you want to judge where you would "accept" the difference.)'. The main content area is a 4x4 grid of image pairs. The first row shows a forest scene and a baby's face. The second row shows corn cobs and a red tractor. The third row shows a black and white spiral and a white mountain. The fourth row shows a colorful bird and red tomatoes. To the right of the grid, there is a 'Next example' button with a right-pointing arrow. Below that, a section titled 'WHAT YOU CAN SEE NOW:' contains the text: 'The picture on the right is of the same lightness, and the hue has yellow / green cast.' Underneath, there is a 'Background:' label and a dropdown menu currently set to 'gray'. At the bottom right, there are two sections: 'Classic:' and 'Other examples:', each with a grid of small thumbnail images.

How Close is Close Enough

■ What is your E-Factor (Expectations)

Your e-Factor is 3.

You expect high quality, you need to be very particular on what printer you work with to reproduce your work. Very few printers can maintain an E-Factor of 3. Excellent training and excellent equipment and maintenance procedures have to be implemented in order for a Printer to reproduce work on production output devices to an E-Factor of 3. Color management and process control have to be fully integrated and indoctrinated throughout the print facility. Ideally color optimization software should be implemented fully into the workflow. Less than 10% of printing productions meet this level of quality today. Search printers on the IDEAlliance web site for G7 Color Space printers that can provide an E-Factor of 3. Most Digital Presses cannot maintain an E-Factor of 3.

The logo features the word "E-FACTOR" in a stylized font where the "E" is composed of four colored segments (green, blue, red, purple). To the right of "FACTOR" is a large white number "3".



Start new



Order physical exercise

■ Scales from 1-9 E-Factor

Our Customers Are Our Best Advertising

Real Customer Quotes

- ◆ “ChromaChecker’s E-Factor allows us to know which printers can meet our customers expectations” (Print Broker with 50+ printers)
- ◆ “ChromaChecker’s E-Factor has eliminated **waste** from our production floor, I don’t know how we survived without it”
- ◆ “ChromaChecker’s E-Factor allows everyone to communicate color issues quickly with no guessing what the other person is sharing”
- ◆ “ChromaChecker’s E-Factor allows management to know how all print manufacturing is performing at all times- invaluable”

Characterized Reference Printing Conditions

7 Reference Conditions (Substrates)

- 4 Coated stocks, 3 Uncoated stocks

