Intro to Color Control

Presented by: David Hunter/Katie Stull

Second Tuesday Webinar

March 14, 2023

Part 1: Demystifying Color

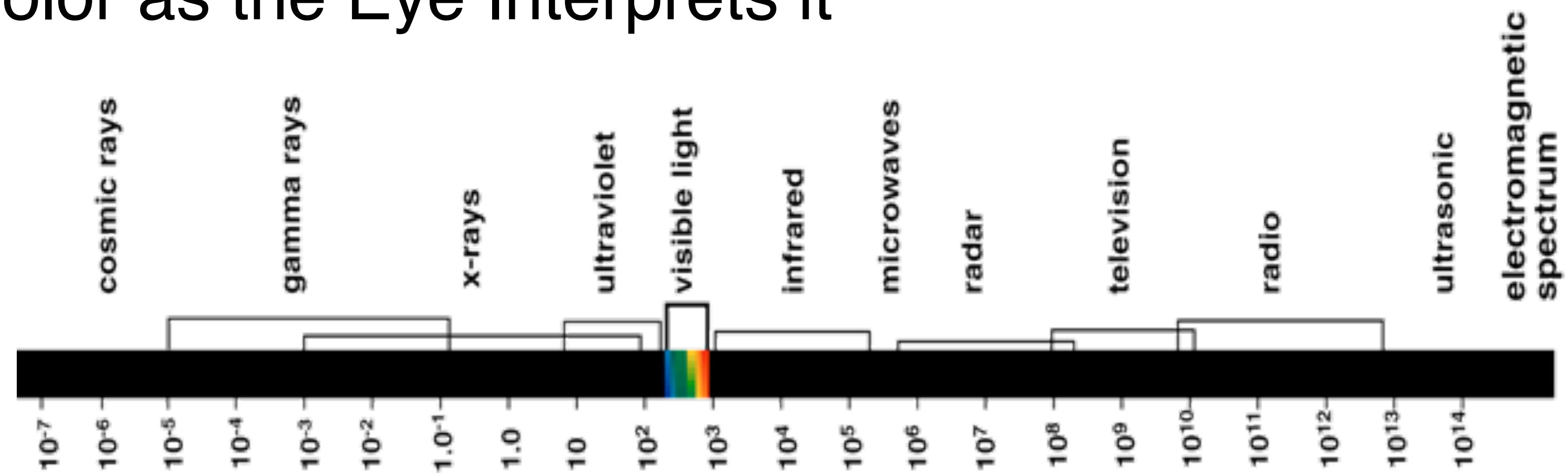
Agenda

- Color Fundamentals
- Terms and Definitions
- Overview of 5 C's of Color Management
- Covering the 1st C- Capturing your Data
- Demonstration and Trial that you can do…

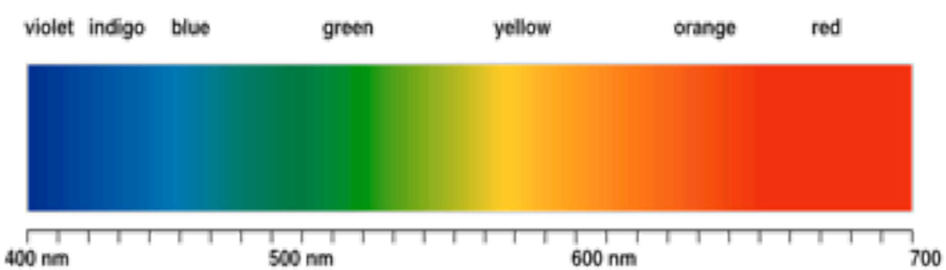
Quantifying Color

Electromagnetic Spectrum

- Color as the Eye Interprets it



R•O•Y•G•B•I•V



ChromaChecker

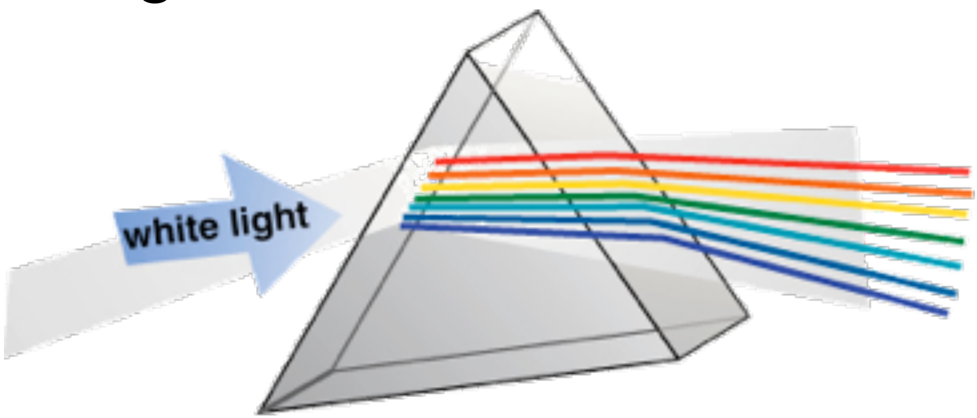
No Light

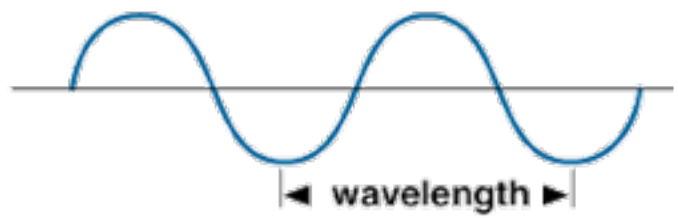
ChromaChecker

Need Light Source (Illuminant)

Prism

- White Light- Composed of all colors of spectrum
- Black Light?



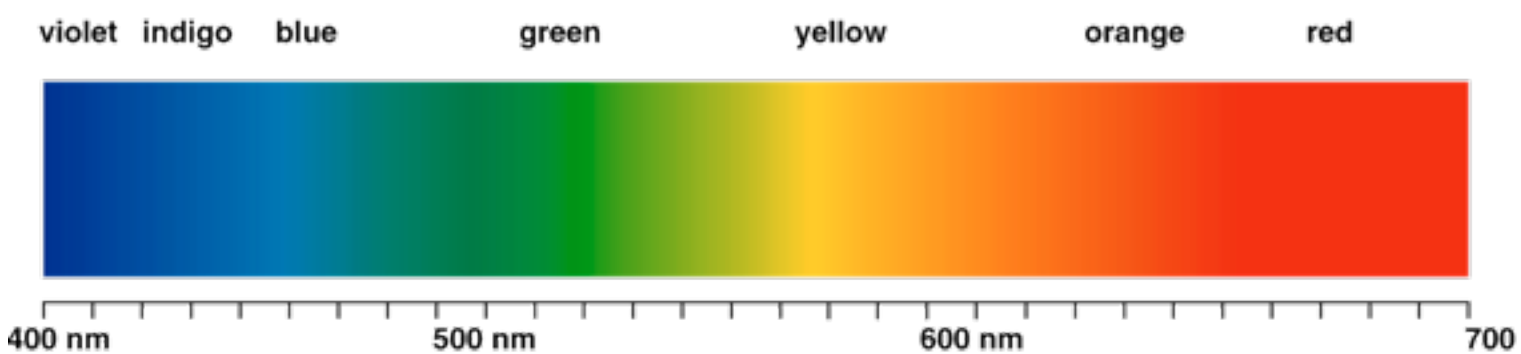


ChromaChecker

Spectral Definition

One Color

- 380-720 NM
- 10 NM increments
- 32 numbers represent one color
- Can predict result of new light source
- Easily Convert to CIE-Lab

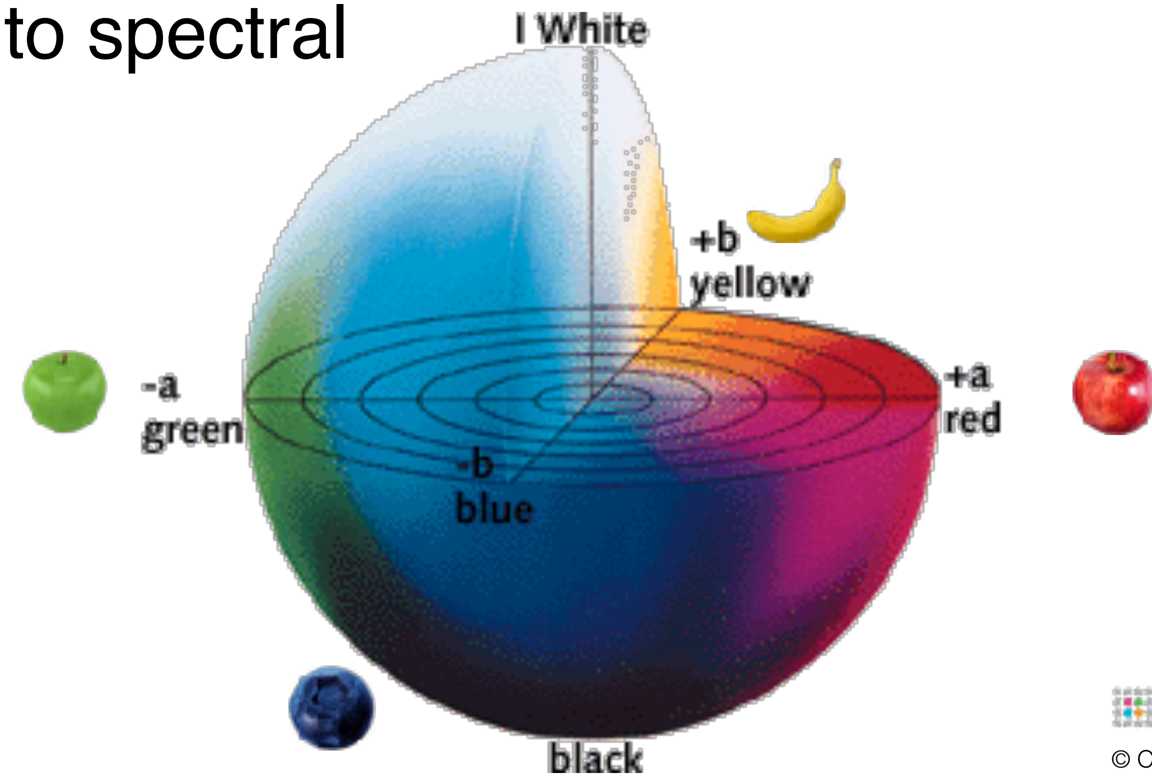


ChromaChecker

CIE-Lab Definition

One Color

- 3 numbers, L* lightness, a* red/green axis, b* yellow/blue
- Illuminant dependent- Only good for 1 Light source
- Can’t convert to spectral

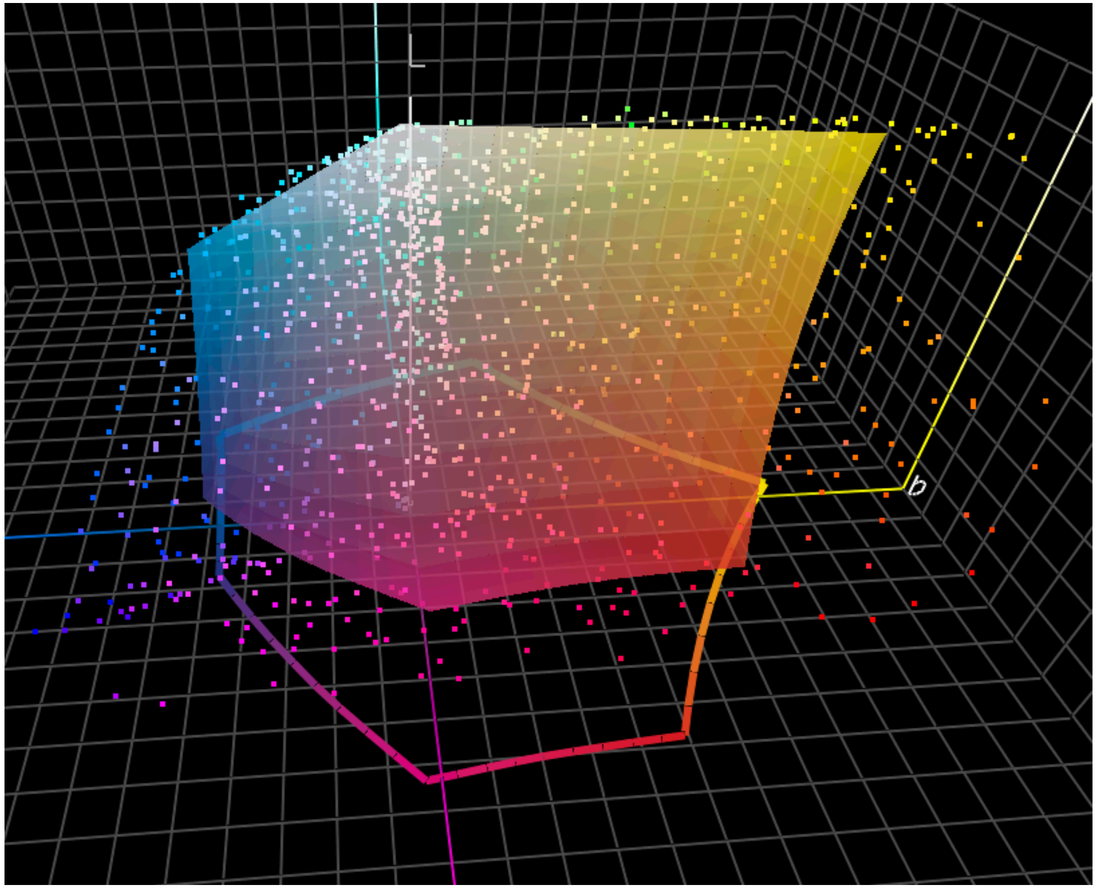


ChromaChecker

Define Printing Gamut and Measured Colors

GRACoL Print Gamut and PMS Colors

- 58% of colors within 2ΔE(00)



ChromaChecker

Summary

Light Affects Color

- Spectral definition is more desired for defining colors
- CIE-Lab is still valuable for editing, correcting colors
- Spectral Prediction for Spots/Tints/Profiles is future

ChromaChecker

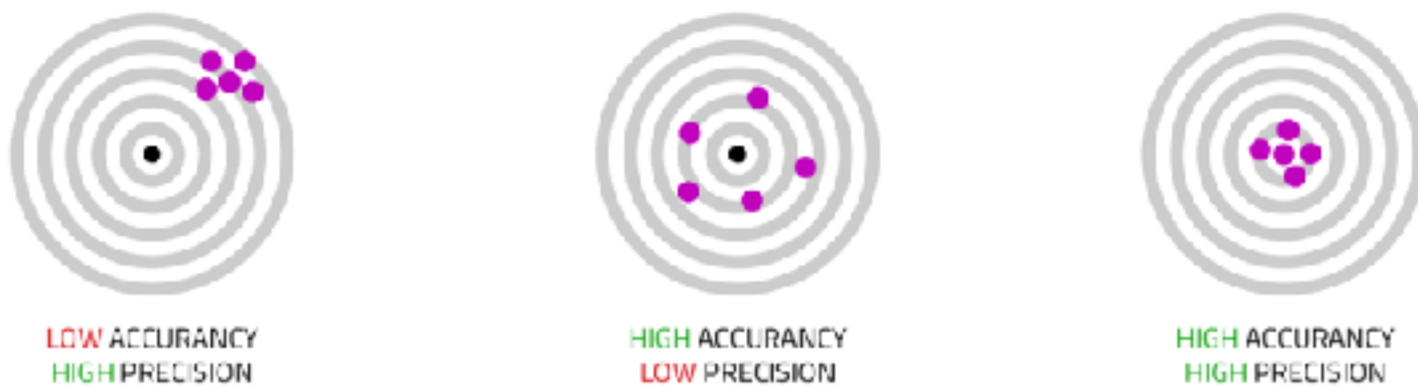
Definitions/Vocabulary

Device Consistency

- Precision
- Process Control- G7
- Shared Visual Appearance
- Delta E metrics for CMYK solids

Device Matching

- Accuracy
- Color Conformance- EF
- Color Match
- E-Factor metrics for pages



ChromaChecker

Color Control Fundamentals

5 C's Color Control

5 C's of Color Control

- **Capture** — collect device (printer, instrument, lighting) 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

Capture

1st C

First of the 5 C's of Color Control

Capture data - measure, collect data all devices

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 results and meet expectations

Capture Data with Measurement Instruments

Quantify color with multiple capabilities

ChromaChecker

Capture- Selecting a Measurement Device

Factors to Consider

- Ease of use- measuring single color? More?
- Level of automation (auto patch/ bar code)
- Substrate material thickness/transparency
- Aperture Size per printed line screen
- Textured material
- Other measurement devices to match
- Price and Accuracy/Precision

ChromaChecker

Capture with Manual Measurements

Manually measure one color at a time

ChromaChecker

Capture with Single Strip Measurements

Measure color bar, patch size dependent on instrument

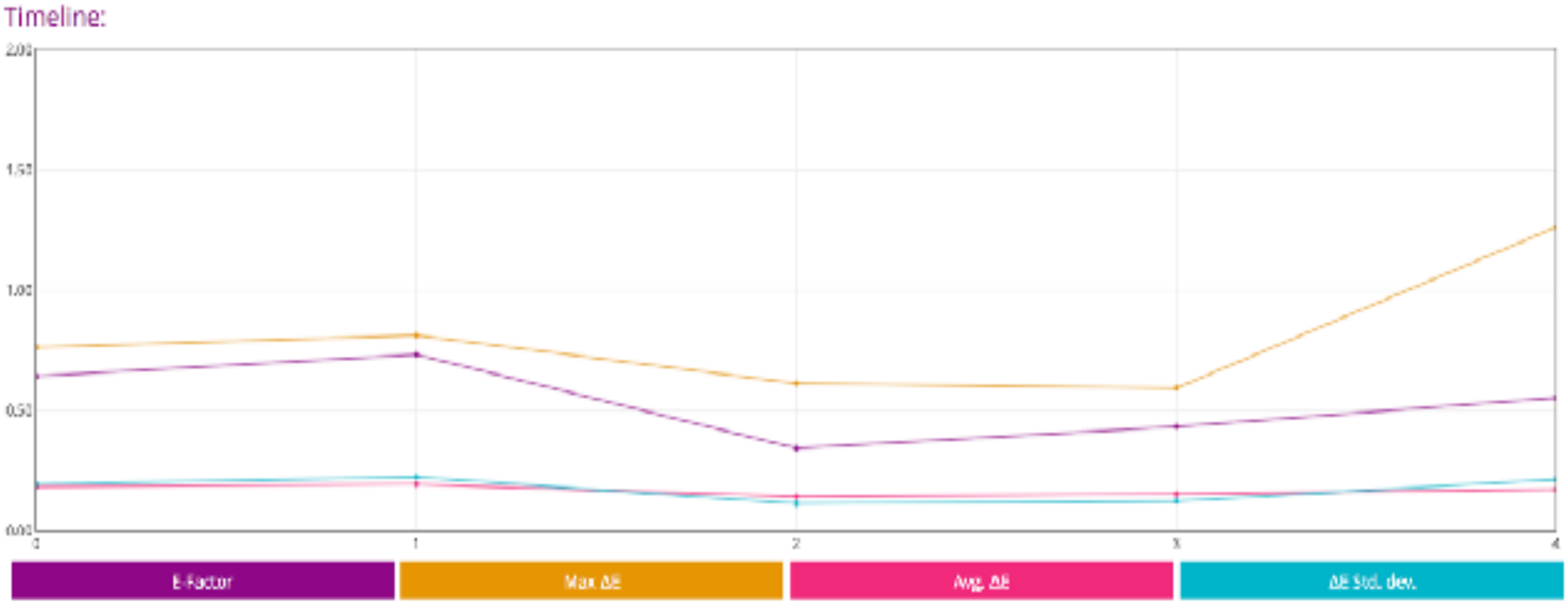
- Calibration (process control) and Conformance applications

ChromaChecker

Capture- How Precise is an Instrument?

Data from measuring 42 patch target multiple times

- Exposes state of "exactness" and "repeatability"



Average: .57

ColorMuse

$50

ChromaChecker

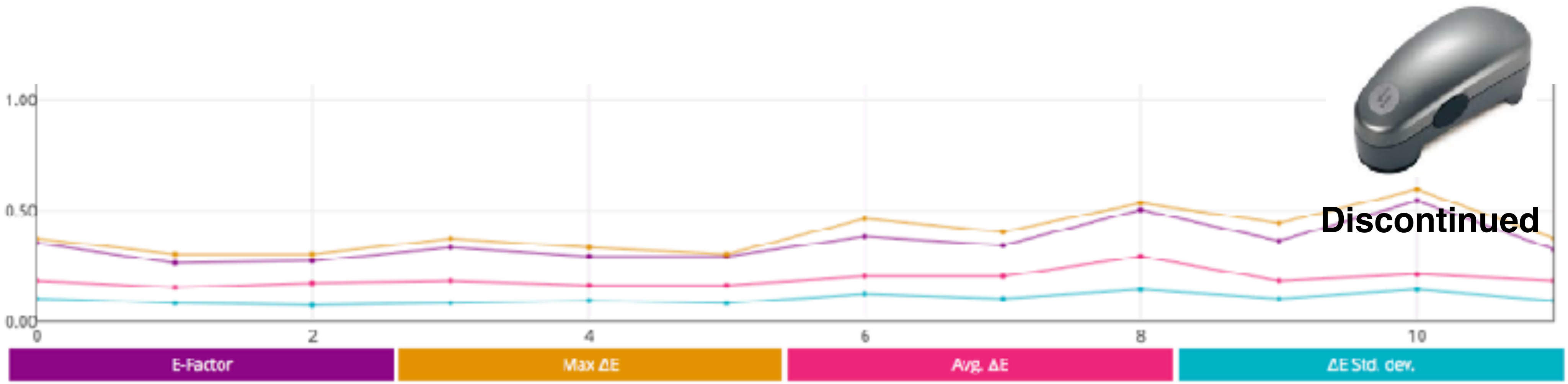
Capture- How Precise is an Instrument?

Data from measuring 42 patch target 12 times

- Exposes state of "exactness" and "repeatability"

Average: .37

i1Pro1



Discontinued

ChromaChecker

Capture- How Precise is an Instrument?

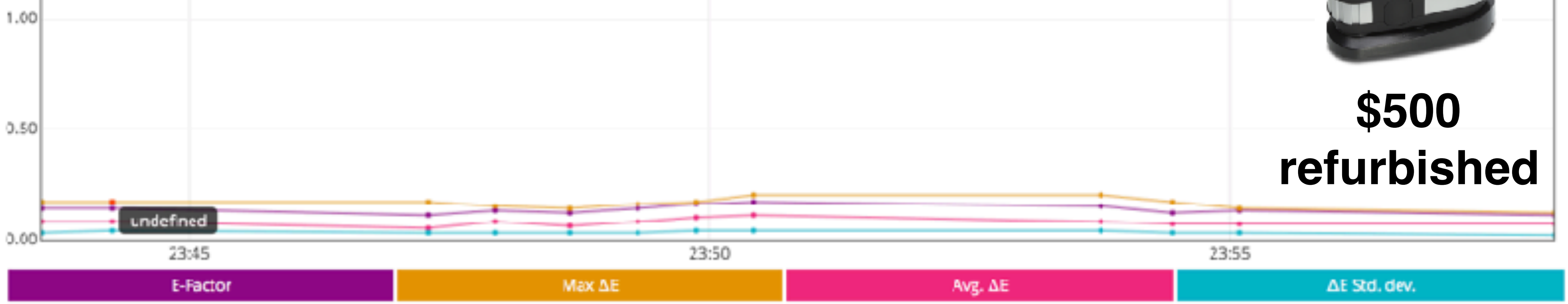
Data from measuring 42 patch target multiple times

- Exposes state of “exactness” and “repeatability”

Average: .14

i1Pro2

$500 refurbished

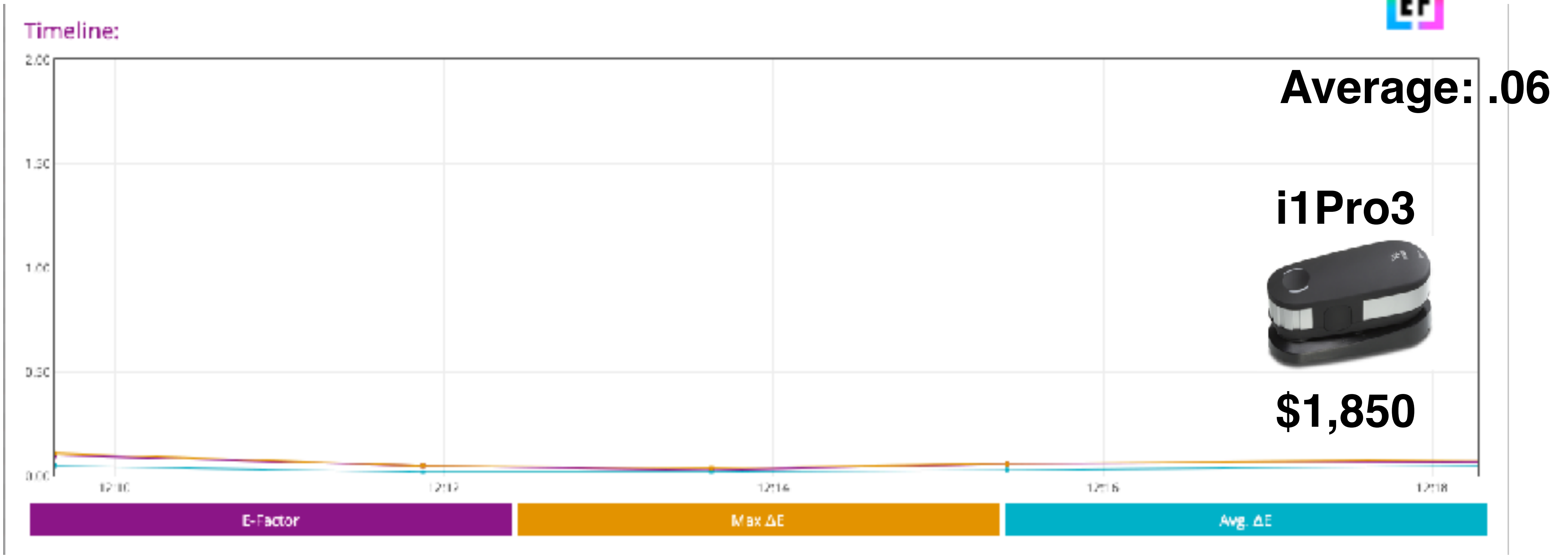


ChromaChecker

Capture- How Precise is an Instrument?

Data from measuring 42 patch target multiple times

- Exposes state of “exactness” and “repeatability”



Capture- How Precise is an Instrument?

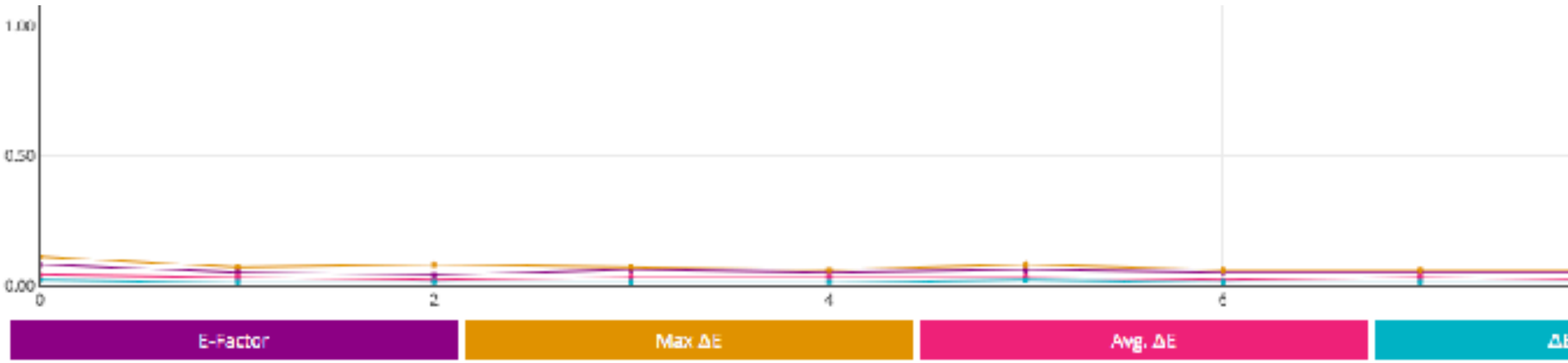
Data from measuring 42 patch target multiple times

- Exposes state of “exactness” and “repeatability”

Average: .05

eXact

$7500



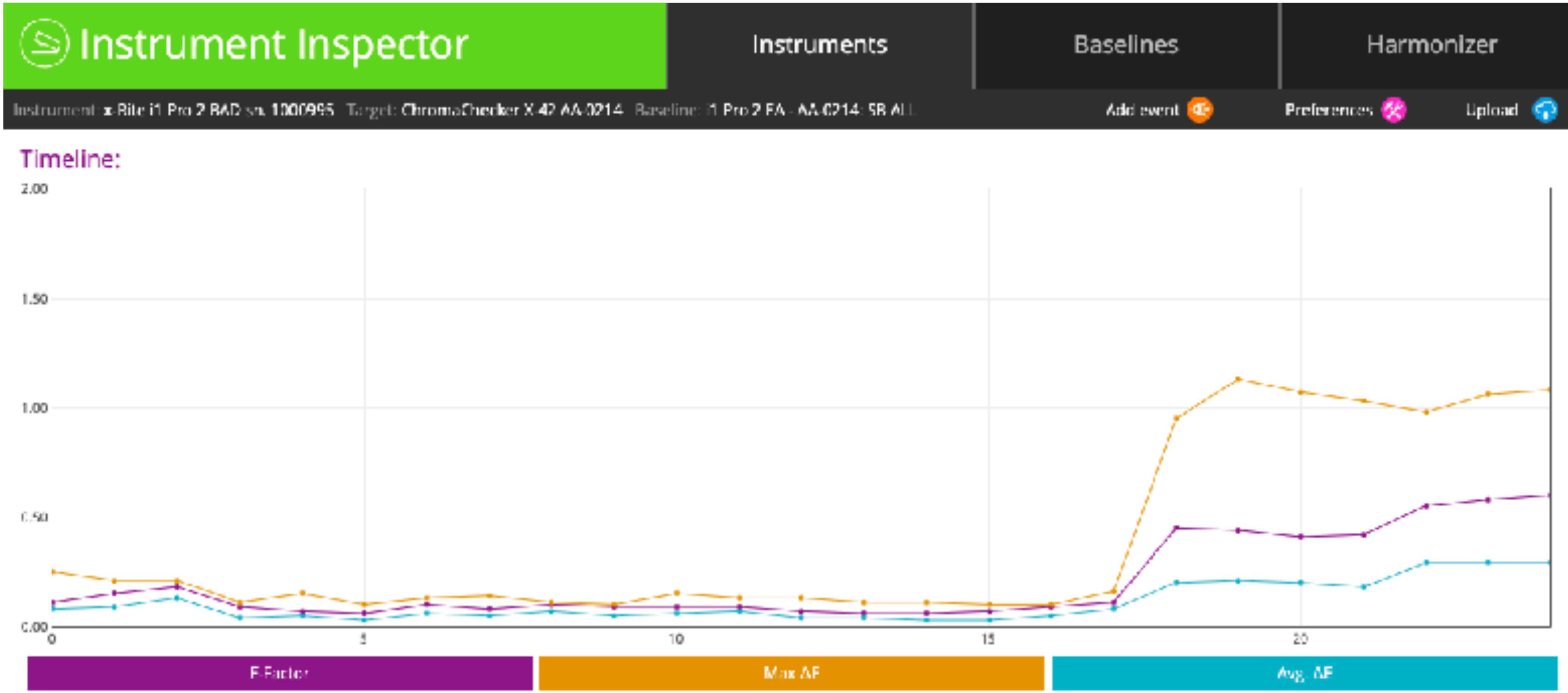
File list:

ChromaChecker

Capture- How Precise is an Instrument?

Data from measuring 42 patch target multiple times

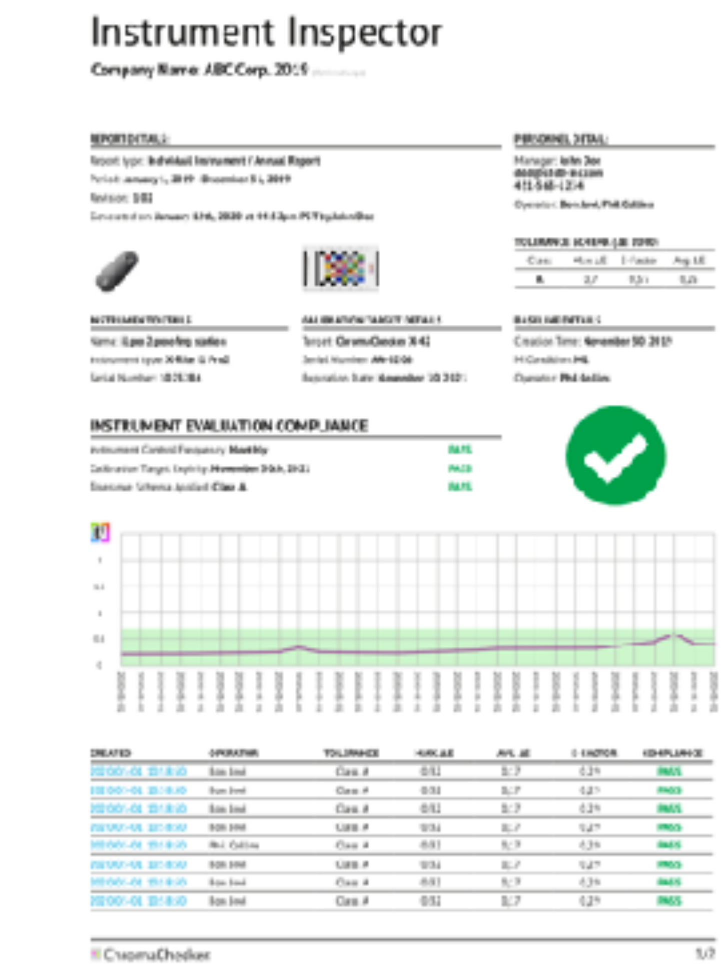
- Exposes state of “accuracy” and “repeatability”



Eliminate Sending Instruments Back Annually?

Prove ISO Compliance and never send back again

- Prove Accuracy of instrument
- Save a lot of money, $750 for i1/yr, +$1000 for Exact/Techkon, more ITX
- Being without instrument for approximately 2 weeks
- No shipping/insurance fees



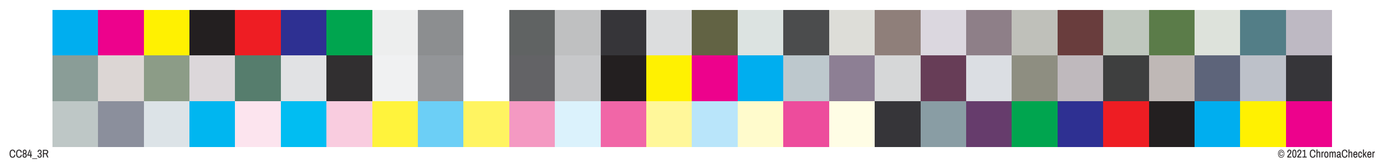
Capture- Understand Measurement Devices

Next Measure Production Printers, any color bar

- Proofer

- Conventional Press

- Digital

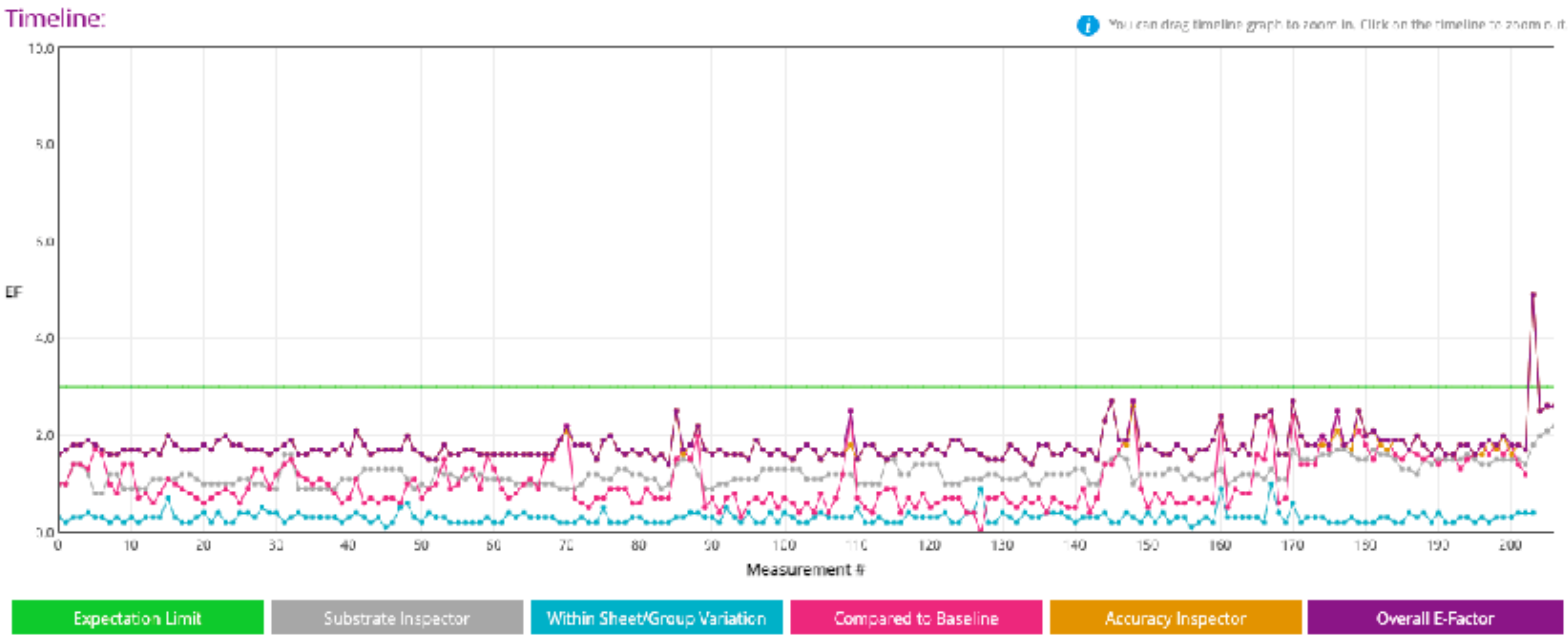


ChromaChecker

Capture- Baseline Production Printing Device

Any Color Bar, formatted for Instrument

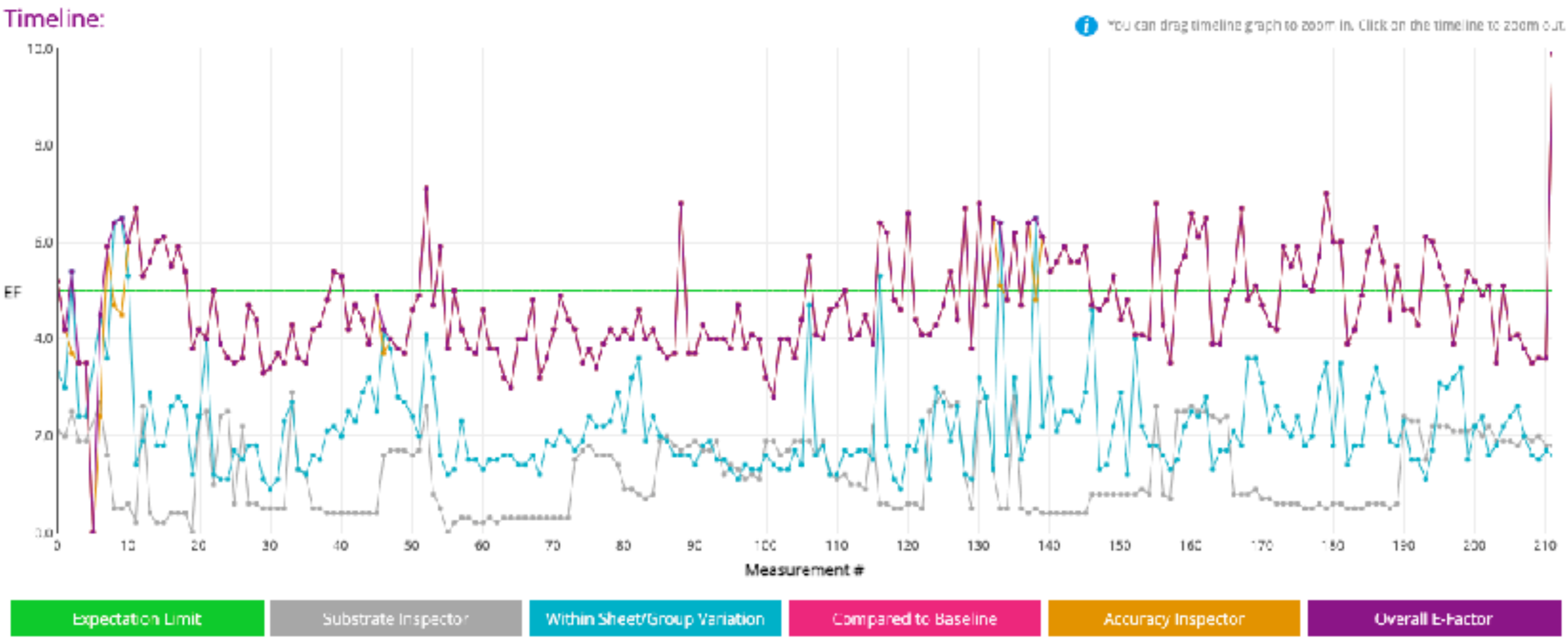
- Exposes state of “accuracy” and “repeatability” of printer



Capture- Baseline Production Printing Device

Any Color Bar, formatted for Instrument

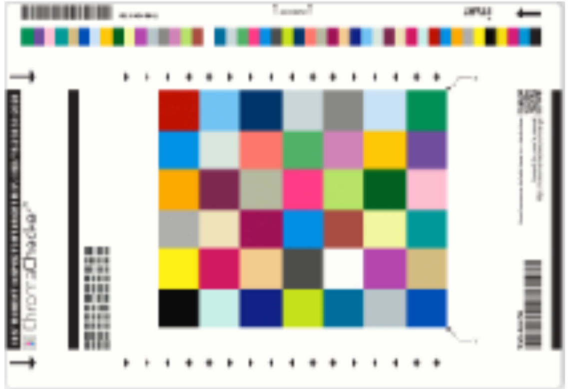
- Exposes state of “accuracy” and “repeatability” of printer



Application Demonstration

Measuring Data Realtime, Production

- Measurement Devices
  - T-42 Target
  - ISO 23031-2020



- Production Printing Devices
  - Any Color Bar

ChromaChecker

Call to action: Download- Print- Measure

Baseline Your Printing devices

- Production Printing Devices
- Assess against GRACoL
- Assess G7 Compliance
- Assess printer to printer match

For step by step instruction scan QR code or visit:
https://chromachecker.com/trial

ChromaChecker

Capture- Summary: 1st C of the 5 Cs

Capture Data and Conformance (verification)

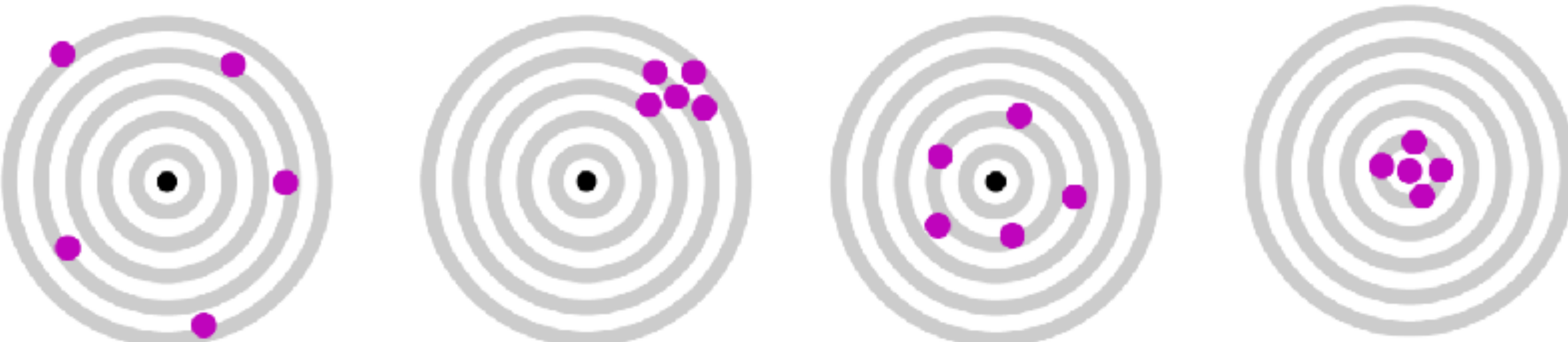
- Capturing data allows for baselining devices
  - Instruments, Printers, Light booths and more
- Determining Production Standards, Tolerances
- Calibration
- Characterization
- Conversion
- Conformance

ChromaChecker

5 C’s determine Quality of Color Match

Need Good Components for all 5 C’s to have best color

- Precision and Accuracy achieved with all 5
- Might not need all 5 C’s depending on your Expectations



No Color Control | **Capture & Calibration** | **+ G7 Curve Calibration** | **+Characterization & Conversion**

ChromaChecker

Capture- Determining Which Device is Required

Considerations based on E-Factor

- Tighter the expectations the more critical the accuracy
- Precision- repeatability/consistency
- Accuracy- in relation to “Master” instrument
- Not always directly related to price

ChromaChecker

Capture- Is Instrument Precise Enough?

E-Factor- Expectations

- Instrument Gauge Factor
- Every Manufacturing Industry has IGF
- ChromaChecker introduces to Print Industry
- Workflow Tolerance:
  - % of precision + cross instrument variation
  - allocate down to 20% to instrument variation

Capture- Interpreting the Data

"Stacking" Effect of Multiple Devices EF

- Multiple instruments measuring same color: Deviation
- Instrument use different technology, lighting, math
- With two Instruments double numbers, three= triple…
- Interpretation of data reveals:
  - (2) i1Pro1 EF = .74, then workflow EF = 3.7
  - (2) i1Pro2 EF = .28, then workflow EF = 1.40
  - (2) eXact EF = .10, then workflow EF = 0.50

ChromaChecker

Capture with Automated Target Measurements

Automated x, y measuring large targets

- Characterization (ICC Profile) targets
- Predefined locations with i1iO
- Bar code incorporated with target for automatic routing

ChromaChecker

Capture- Interpreting the Data

“Stacking” Effect of Multiple Instruments

- Measuring same color differently results in Deviation
- FAIL customer tolerance before print page 1

=Match=

~~=Match=~~

Create Profile Instrument A

Verify Profile Instrument B

Fails!

ChromaChecker

Capture- Interpreting the Data

“Stacking” Effect of Multiple Instruments

- Measuring same color differently results in Deviation
- FAIL customer tolerance before print page 1

=Match=

Compare to Press?
Instrument C

~~=Match=~~

Fails ALSO!

Create Profile
Instrument A

Verify Profile
Instrument B

Fails!

ChromaChecker

Capture- How Accurate is an Instrument?

Comparing how different devices measure color

- Exposes state of “correctness” and closeness to “bullseye”

EF	X-Rite i1 Pro 2 I1_SN307_M0	X-Rite SN317 eXact Exact_SN317_M0
X-Rite i1 Pro 1 Autogenerated baseline 2018-03-01 09:06:44	Workflow = 2.65 H = 1.20 Instrument = 0.53 H = 0.24 Harmonizer = 121% Max = 0.54 Avg. = 0.29	Workflow = 4.85 H = 1.20 Instrument = 0.97 H = 0.24 Harmonizer = 304% Max = 1.17 Avg. = 0.62
X-Rite i1 Pro 2 I1_SN307_M0		Workflow = 3.60 H = 0.95 Instrument = 0.72 H = 0.19 Harmonizer = 279% Max = 0.76 Avg. = 0.42

ChromaChecker

Capture- How Accurate is an Instrument?

Comparing how different devices measure color

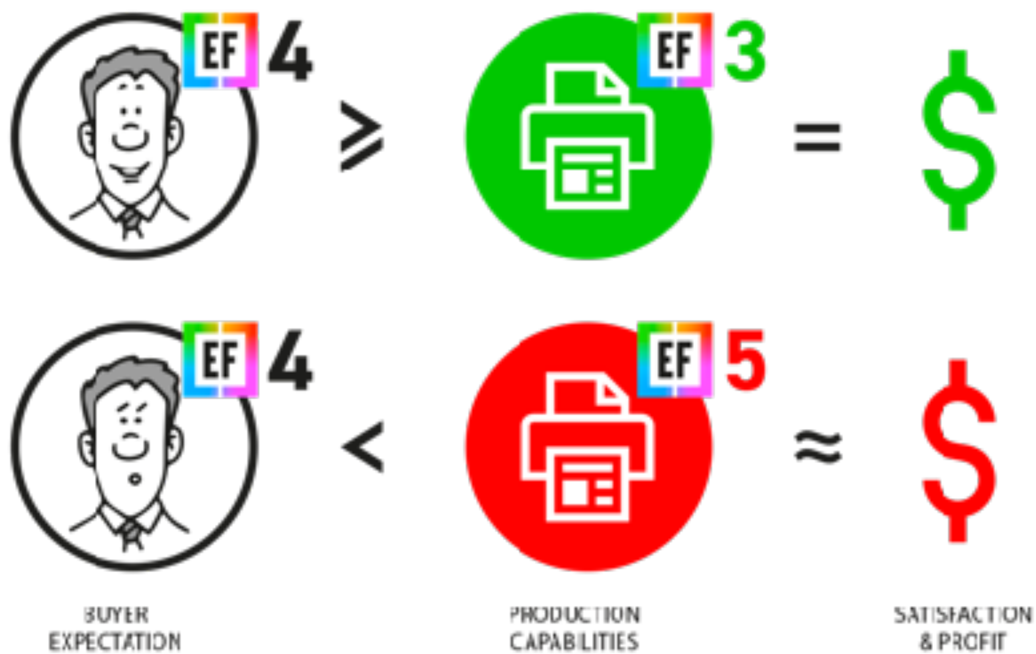
- Exposes state of “correctness” and closeness to “bullseye

If E-Factor Workflow > Tolerance= **PROBLEM**

Capture- Instrument Differences affect Printer E-Factor

If Instrument differences > Tolerance

- Cause the Printer E-Factor to appear to FAIL
- Problem is Instrumentation Differences
- ChromaChecker can minimize this difference: Harmonization



ChromaChecker

Summary: Capture Instrument

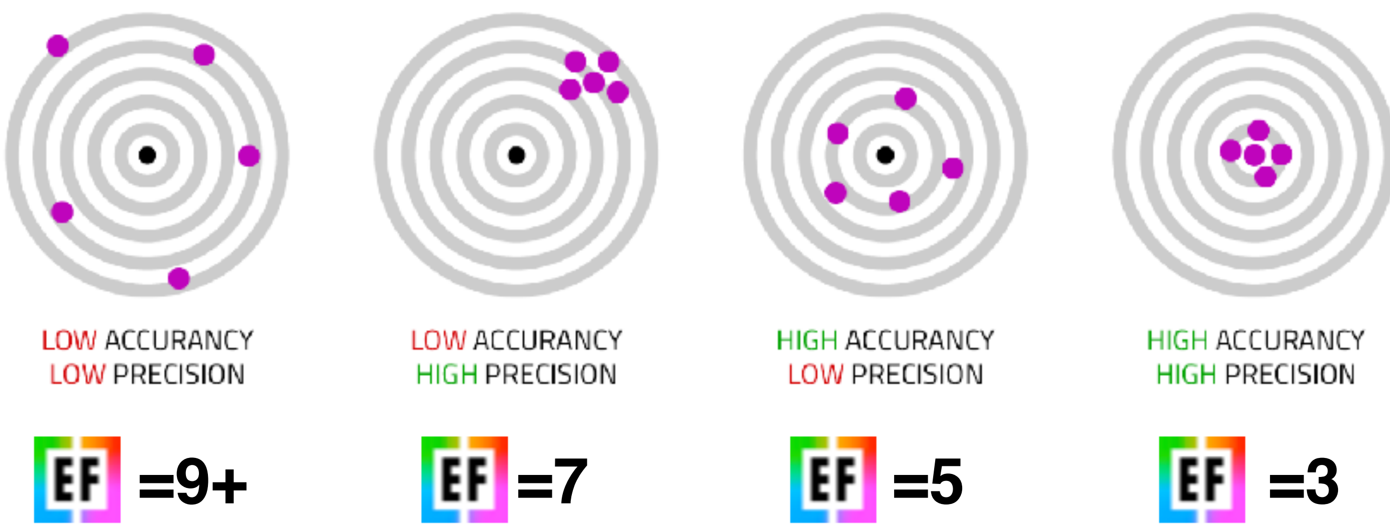
Application and Use Cases

- Multiple instruments measuring same color
- Understand: Capture instruments are different
  - *Even two units one serial number apart…*
- ChromaChecker Instrument Inspector
  - *Assess precision/accuracy each instrument*
  - *Warn when exceeds Tolerance Expectations*
  - *Can Harmonize to minimize differences*

Transition from Graphic Arts to Manufacturing

Taking Raw Materials & Creating Products that Consistently Meet Customer Expectations

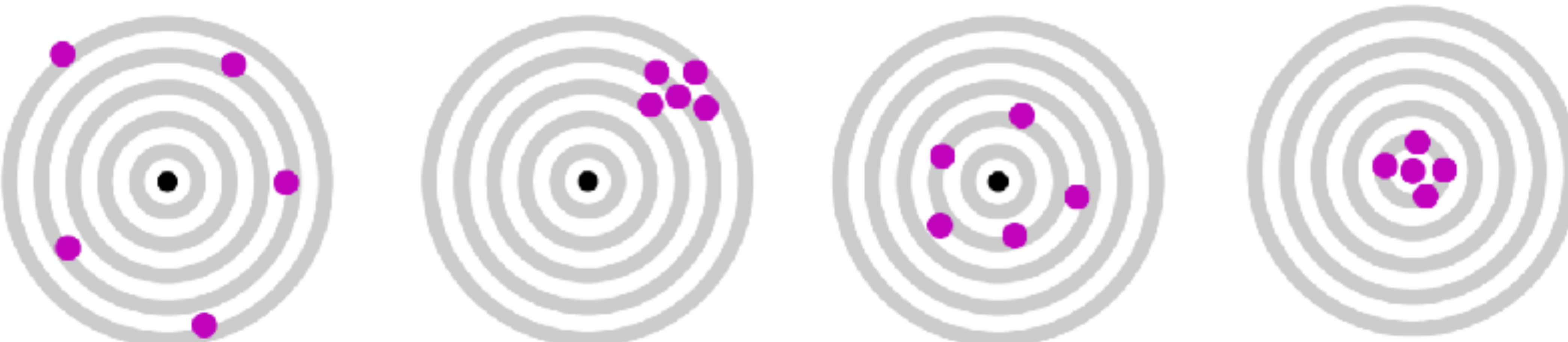
- **Maximum Color Match Requires**- Optimum process control, tighter metrics, optimum color conformance, lower EF



5 C's determine Quality of Color Match

Need Good Components for all 5 C's to have best color

- Precision and Accuracy achieved with all 5
- Might not need all 5 C's depending on your Expectations



No Color Control
=9+

Capture & Calibration
=7

+ G7 Curve
=5

+Characterization & Conversion
=3