Calibration

2nd C

Presented by: David Hunter

Second of the 5 C's of Color Control

Capture — collect your data

Calibration- make printer 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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Quantifying Color Differences

Without Data- No Idea What is Happening

- Capture Data to understand Print Properties
- Choose measurement device based on need/price
- Conformance to Production Standard
- Measure print to understand salable vs waste

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How to Determine What is Waste?

Print that isn't Salable…

- What visual difference is too different for customer to accept?
  - 1= Proofer
  - 2= Digital Press
  - 3= Offset Press

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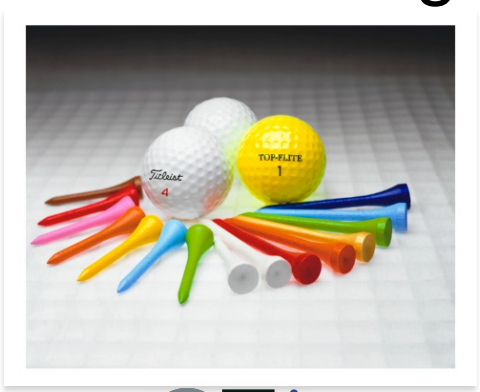
Quantify Differences- Print

What Type of Color Match?

- Match for specific individual brand colors: Spot Color

- Match between pages and or images: Process Color



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Quantify Differences- Print

What Type of Color Match?

- Match for specific individual brand colors: Spot Color
  - **ΔE (delta E**) quantifies spot difference
  - Bigger the number, bigger the difference

- Match between pages and or images: Process Color
  - **E-Factor** (EF)- quantifies process color difference
  - Bigger the number, bigger the difference
  - Think ΔE for process colors, same relative difference

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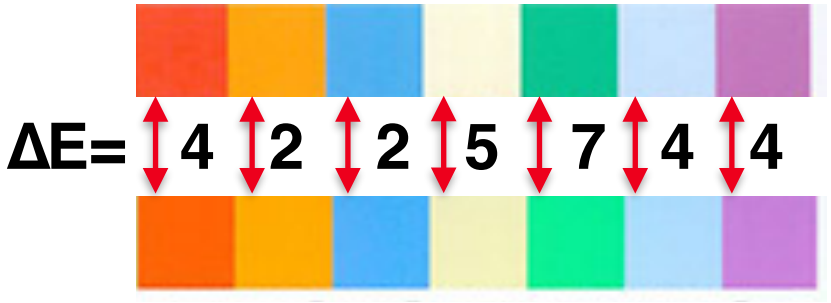
Printing Color, Quantify Differences

What Type of Color Match?

- Match for specific individual brand colors: Spot Color



- Match between pages and or images: Process Color

EF = 3

EF = 6

G7 G7 G7 ChromaChecker

Technical Definition: E-Factor

95% of colors are within that delta E

- Used to quantify page, and image differences (not spot)
- Requires at least 60 different patch color definitions
- Compares the patch definitions and sort highest delta E
  - *95% worst delta E is the E-Factor*
  - *CRF at 95th percentile ΔE 2000*
  - *Defined in G7 Color Space tolerances and TR016*
- Co-relates great with spot color delta E differences
- Lower the number= Closer color match, better match

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Printing Color, Need to Understand Boundarys

Know if Print is "Salable"

- In play vs. out of bounds
- Tribal Knowledge related to customer expectations
  - *If no history, no tribal knowledge- large risk for loss*
- Quantify Print Result using Metric for Color Difference
  - *Eliminates human subjectivity, people see color differently*
  - *Single color comparison use: delta E (ΔE)*
  - *Pictures and Documents use: E-Factor*
- Lower the number= Closer color match, better match

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Calibration Agenda

Important C- without Consistency- No Color Matching

- Stabilize the process!!!!
- How to determine how much and what type of process control
- How to quantify printing device variations?
- How to build calibration schedules
- Is Calibration enough?

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Calibration and Process Control

- **Definition of Process Control**

  Ensuring a device/**process** is predictable, stable, and consistently operates at a **target** level of performance, with only normal variation…

- **But, what's the definition of…**

  Target *level of Performance?* ***Normal*** *variation?*

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Calibration: How Often

It Depends on…

- Expectations for Salability
  - *Tighter the expectations, the more often calibration performed*
  - *More calibration equals more cost (less production, more downtime)*
- Rate of drift of Device
  - *Different devices have different characteristics*
  - *Temperature and humidity influences on print performance*
  - *Variation of consumables: substrates, inks, toners, blankets*
- Need to Test Rate of Drift using **Conformance** Software
  - *Reports drift over time in E-Factor*

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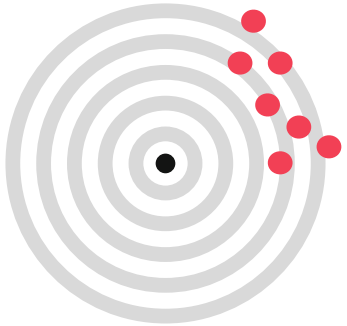
Calibration: How Often?

It Depends: Target Level of Performance/Normal Variation

- Target Performance relates to Expectations for Salability
  - *Tighter the expectations, the more often calibration performed*

- What is “normal” variation or rate of change for each device?
  - *Variation of consumables/substrates, and Temp/Humidity changes*



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Calibration: How Often?

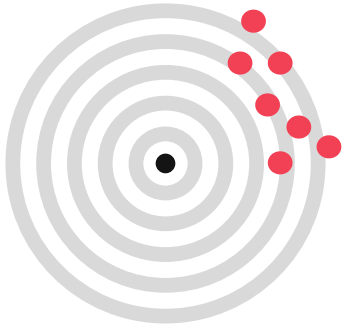
It Depends: Target Level of Performance/Normal Variation

- Target Performance relates to Expectations for Salability
  - *Tighter the expectations, the more often calibration performed*

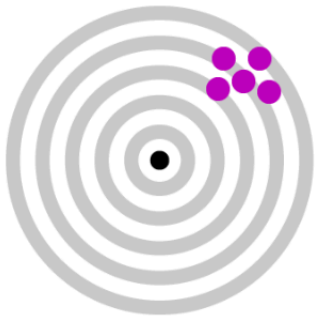
EF = 6

EF = 2

- What is “normal” variation or rate of change for each device?
  - *Variation of consumables/substrates, and Temp/Humidity changes*



EF = 7



EF = 3

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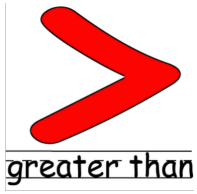
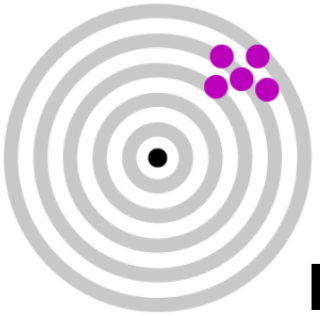
Calibration: How Often?

Target Level of Performance > Normal Variation= Success

EF = 6



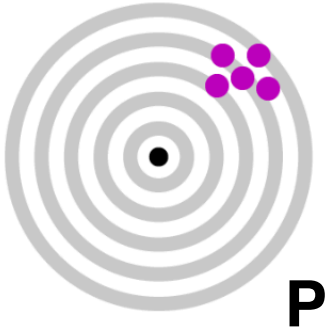


EF = 3

Expectations **Printed Results**

Target Level of Performance < Normal Variation= Failure

EF = 2



EF = 3

Expectations **Printed Results**

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How Often to Calibrate?

Calibration Once a Week- Normal Variation…

- Print color page every day/hour/minute over time
- Quantify E-Factor Difference of the prints over time
- Include Calibration schedule to understand if it needs more

EF = 5 | EF = 7 | EF = 5

Monday | **Tuesday** | **Wednesday** | **Thursday**

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Calibration for Workflow

Required to ensure Precision (Consistency)

- Calibration for Digital Printing devices (to itself)
  - *Usually built into RIP for output device*
  - *Brings printer back to known, reproducible condition*
- Calibration for Measurement Instruments
- Platesetter- Ensure repeatability over time
- *Optionally*- Calibrate Printing device to G7 condition
  - *Adjust gray balance and NPDC to hit G7 Gray criteria*
  - *ChromaChecker can perform this*

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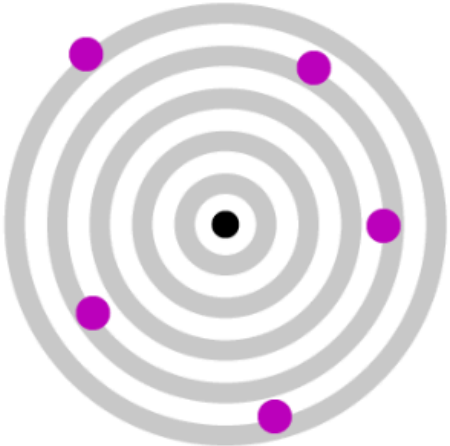
Calibration is Required for Consistency

- **No consistency, no control**
- Calibration stabilizes & brings device back to “normal"
- If device constantly “drifting”, no hope of color accuracy

No Precision



LOW ACCURANCY
LOW PRECISION

LOW ACCURANCY
HIGH PRECISION

Precision

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Quantify Printer Variation

Understanding what is “normal” printer variation

- What types of printer variation?
- What affects printer variation?
- What variables need to be considered and controlled?
  - *Depends on print technology*
- What metric can we use to determine consistency?
- How to monitor your printer consistency?

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• Calibration- Schedule based on Variation

Three types of Variation:

1. Within page uniformity- Variation within one sheet

2. Between page repeatability- Variation from sheet to sheet;

3. Between job reproducability- Variation from job to job;

What Affects Printer Consistency/Precision

What affects print variation of output

- Lack of preventative maintenance- run until it breaks mentality
- Consumable changes (paper/coatings/ink/toner)
- Volume of printed pages
- Temperature, Humidity, Dew Point variation

What procedures help compensate for variation

- Preventative maintenance schedules- Proactive assessment
- Calibration procedures and timing
- Goal is to bring device back to baseline condition

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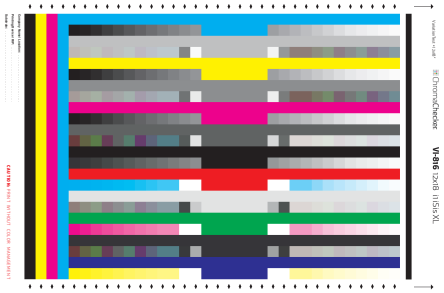
ChromaChecker Published Procedures

Assessing Normal Variation for any Print Technology

- Many variation issues are not disclosed, hard to tell
  - *Within page uniformity unacceptable*



  - *First 50 prints shift color with some print technologies*

50th print is 2 ΔE different from first print

- ChromaChecker Benchmark PDFs and directions

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Never Average Measurement Data w/o Compare

Every one states to Average…

- If one bad measurement- can wreck average
- Use Variation tool
- Understand differences are small, before average done
- When Averaging- need Ave and Max Error saved with file

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Quantify Printer Variation Summary

Critical to understand “normal” printer variation

- What types of printer variation? Within, between page/job
- What affects printer variation? Depends on print technology
- What variables need to be considered and controlled?
  - *Depends on print process*
- What metric can we use to determine consistency? EF
- How to monitor your printer consistency? Color Conformance!

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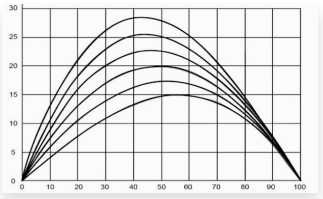
DIFFERENT TYPES OF CALIBRATION PROCEDURES

Dependent on Goal and Workflow

- Device Calibration — Make device consistent
  - Built into RIP, adjust tint ramps of CMYK to baseline

- G7 Calibration methodology
  - RIP/3rd software adjust CMYK tonality for gray balance and NPDC
  - Provides a “shared appearance” not color matching

- TVI Calibration methodology
  - RIP/3rd software adjust CMYK tonality for TVI match



ISO 12647-2 TVI Curves

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When to use which methodology?

- Ensure processes are consistent and calibrated:
  - Platesetter/Imagesetter is consistent
  - Printing process: consistent densities, and tonality (pressures)
- G7 Calibration methodology / TVI calibration methodology
  - RIP/3rd software adjust CMYK tonality for gray balance and NPDC
  - Creates new press curve (substrate based) add in workflow
  - Provides a “shared appearance” not color matching
  - Expected E-Factor to reference: between 4-6 if consumables good
  - If better match required — create ICC profile after press is G7

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When to use which methodology?

- Ensure processes are consistent and calibrated:
  - Platesetter/Imagesetter is consistent
  - Printing process: consistent densities, and tonality (pressures)
- Create ICC Profiles for substrate types
  - Once printer is consistent - then create ICC Profile if necessary

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Actual Scenario- Assessing Print

Print same target, every day for a week…

File list:

Measurement	# Sheet	Created	ICC	ΔE	ΔE	TVI	G7					
tarpon2_Apr10 P	3	2023-04-10 15:38	ICC	✖	✖	✖	✔	✖	✖	±1.1	±2.7	4.5	4.5
tarpon2_Apr9 P	2	2023-04-10 14:11	ICC	✖	✖	✖	✔	✔	✔	±1.2	±2.5	4.1	4.1
tarpon2_Apr8 P	1	2023-04-10 14:08	ICC	✖	✖	✖	✔	✖	✖	±1.2	±3.3	4.6	4.6
tarpon2_Apr7 P	2	2023-04-07 13:05	ICC	✖	✖	✖	✔	✔	✔	±1.0	±2.1	4.4	4.4
tarpon2_apr4 P	2	2023-04-05 12:57	ICC	✖	✖	✖	✔	✖	✖	±3.6	±3.1	5.7	5.7
tarpon2_4-5 P	2	2023-04-05 12:47	ICC	✖	✖	✖	✔	✖	✖	±1.3	±1.9	4.5	4.5
tarpon2-Apr-3 P	1	2023-04-05 11:23	ICC	✖	✖	✖	✔	✖	✔	±0.9	±0.6	4.5	4.5

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When to use What Methodology?

Digital Printing Processes: Digital Press/Large Format

- Ensure printer is calibrated: RIP supported
- Optional G7 Calibration methodology
  - *If Expectations are "pleasing color," 5+ E-Factor- only G7*
  - *If Expectations are demanding, skip G7- create Characterization*
- Create Characterization ICC Profile
  - *Make immediately after calibration*
  - *Configure ICC Profiles for proper conversion in workflow*

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Calibration Summary

Color Control Starts with Calibrating all devices

- Process Control requires defined expectations of Result
- Expectations determine how much, what type process control
- Every type of device should be Calibrated
- Methods quantify variation and to build calibration schedules
- Is calibration control enough, or Characterization required…

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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

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