Analytical Study to achieve Exact Visual Appearance of Printed Products

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Abstract— The vision sensitivity of human plays significant roll in first impression and acceptance of any printed item. The printing service sector which caters promotional media, magazine, brand products - brand identity always have threat to get rejection because of visual difference between real life and printed appearance of product. The print production processing have many stages and many printing processes to give productive out put of job according to requirement and commercial viability. G7 methodology strives to or give guidelines to achieve min. variation in colour I.e. Delta E, or in other words to achieve visually same printing out put taken from different printing processes.

Index Terms— Delta E, G7 methodology, G7 master, G7 Expert, G7 Professional, GRACoL, SWOP, Gray Balance, Tone Curve, Gray Value, CIELAB, Neutral Print Density Curve

1 Introduction

From the first era of development of print industry the every printer tries to maintain and deliver the output print color exactly like the visual appearance of real life products. With developing technology and engineering in printing industry, different printing processes were developed to achieve these targets. The interactivity of printing industry and developed processes again upgraded the targets, like the different printing process output must achieve the same visual similarities in between output and real life visual impact of product. To achieve these targets the quality control methods, specification standards are developed from initial stages of LAB values to ISO standard targets.

In this lineup, G7 term got introduced in quality targets, to achieve neutral levels of Gray. G7 is a target guidelines or specification targets which controls Gray balance in print reproduction and achieved the visual similarities in printing process. Networking or wired data transmission at workplace in printing process follows internet work flows, which demands the print output developed in prepress department must exactly match with output at press. For quality assurance of machine output the specifications targets are authorized by American National Standard Institute and Administration for Graphic Art Technology Standards

2 G7 Concept

The fundamental concept of following G7 specification is to match output, print by print with the given original. G7 expert methods or methodology of G7 gives easy-to-follow set of instructions and creates platform for implementation of any standards for any additional factor for quality control.

The impact point of G7 methodology can be stated as,

A) G7 controls grayscale reproduction and appearance, calibrate CMYK reproduction device for standard specifications.

B) It assurances visual similarities in output from multiple devices and consistently hit design color targets.

C) G7 methodology works independently to every device for density curve, grey balance, delta calibration considering change in substrate, colorants, prepress and press Technology etc.

D) G7 methodology insurance alignment of all print features, process, substrate to achieve the visual targets.

2.1 G7 work on three different level

1) G7 Master certification is given to the print production press who control graphical reproduction process and colour quality. It is an international certification which assures colour quality repeatability and consistency in print output standards to customers and on other hand it gives commersial benefits to service provider as increase in production, reduction in resource consumption, increase in acceptance rate by clients.

2) G7 Expert certification is given to individual person who gives external support to printing press for G7 implementation. G7 Expert certification is given after successful completion of work flow or test tasks, having skillful expertise in the area of colour calibration, management, print process production and quality control with utilization of G7 methodology, the certified expert person is able to run analyzing and correcting color print problems.

3) G7 Professional certification is given to individual person who is part/employee of the printing press and he leads the project and work with hand in hand along with G7 Expert for implementation of G7 methodology. The G7 professional is responsible to establish/maintain and calibrate all press room machines/equipment as per G7 requirement so they can be examined and certified by G7 expert during certification process of G7 Master for printing press.

ISO and G7 comparison state that; with development of Technology there are many ways to develop color characteristics and develop many ways to achieve print characteristics. Organizations like GRACOL and SWOP develop sets of instruction to achieve color characteristics. The original ISO standard control colour print by specifying tone value curve. Control colour profile and natural gray value develop technical standard which describes method of adjustment of color reproduction in printing system to match set of characterization data. GRACOL and SWOP create specification instructions to control neutral curve that is gray balance in print image which ultimately gives the desired end result; which is an almost identical appearance when the compatible print outputs compared from

different print devices.

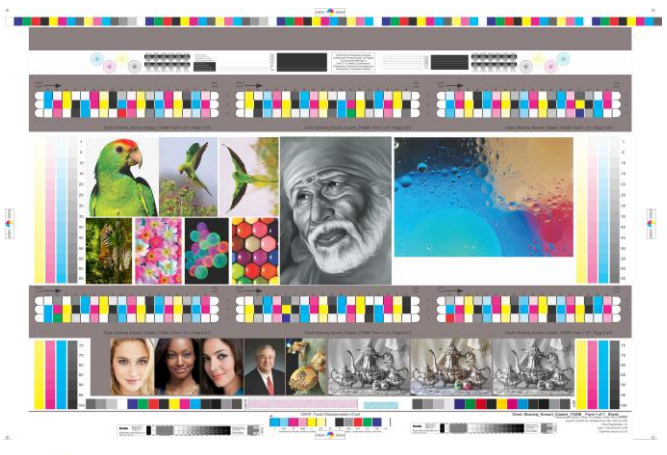
For sustainable development of printing press; service provider strives to have measurable, predictable and controlled management which gives business advantage. The client base will turn automatically for quick, consistent and reliable printed product.

The standard Test Print Elements are required for Grayscale Compliance under G7 Certification. Grayscale compliance indicates a output device/machine is calibrated to the basic G7 definition of constant neutral grayscale appearance, but does not indicate whether the device is using standard colorants or matches a standard color space. G7 compliance is reported using color differences calculated from the CIELAB color space. L* differences indicate differences in lightness or neutral print density between the device measurement and the G7 aim. F* differences indicate gray balance differences or cast errors. Neutral Print Density Curve (NPDC), it is an alternative method for measuring and assessing lightness, using the visual (black) density filter of a reflection Densitometer.

3 Machine Experimental Setup

For Experimental setup to demonstrate workflow of achieving Gray level targets for G7 ,the test chart printed;

1	Setup – Commercial Printing Press
2	Device – Komori Ethrone 29
3	Device Condition – 18 x 23 inch
4	Offset Press - Sheetfed, 4 Colour Printing
5	Offset Press Sequence – KCMY
6	Substrate Type – Coated 250 gsm
7	Process Inks Response Origin Measured chart: Coated 175AM
8	Process Ink – Oil Base Process inks – Sigwerk_ultra series
9	Plate Setup – CTCP- 48 channel – 2400dpi3
10	Screening – Linear Curve – AM screening – 30degree moiré - 175 to 200lpi



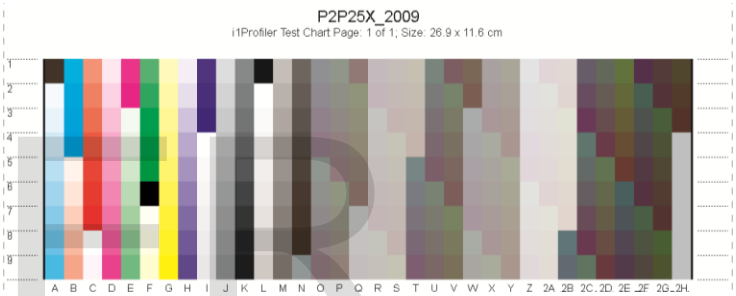
3.1 Test Print

3 Print Analysis

3.1 CMY Gray Ramp Lightness and Gray Balance

The following table compares CIELAB lightness and gray balance metrics of the device response to those of the G7 aim, for CMYK tints in row E of the P2P25 or P2P51 chart.

P2P25 Chart



P2P51 Chart

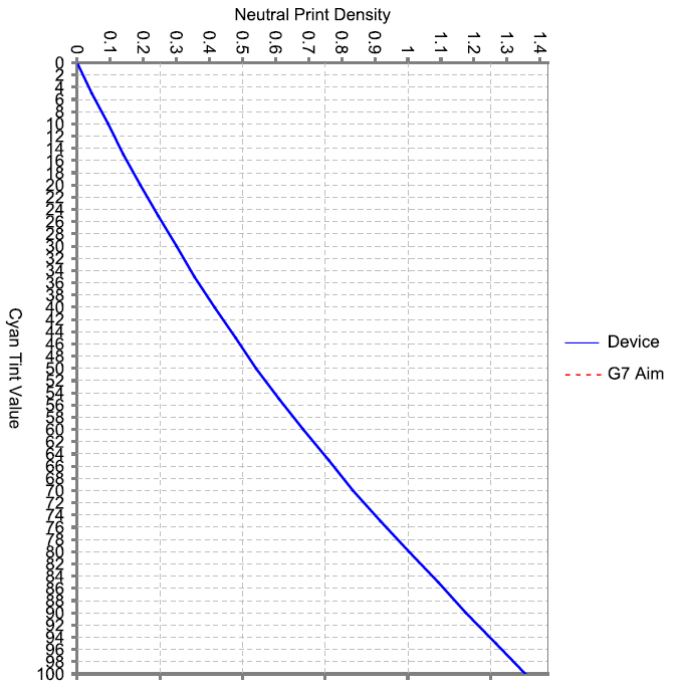
Lightness and gray balance comparison of CMY gray ramp tints

			G7 Aim			Output						
	dL	dF	L*	a*	b*	L*	a*	b*	C	M	Y	K
	0.0	0.0	90.7	0.7	-1.0	90.7	0.7	-1.0	0	0	0	0
	0.1	0.1	89.3	0.6	-1.1	89.4	0.5	-1.1	2.0	1.2	1.2	0
	0.2	0.1	87.7	0.6	-1.0	87.9	0.5	-1.0	3.9	2.8	2.8	0
	0.3	0.2	86.1	0.6	-1.0	86.4	0.5	-0.9	5.9	4.3	4.3	0
	0.4	0.2	84.8	0.5	-1.1	85.1	0.3	-1.0	7.8	5.5	5.5	0
	0.4	0.3	82.9	0.6	-1.0	83.3	0.3	-0.8	10.2	7.5	7.5	0
	0.5	0.5	79.4	0.6	-0.9	79.9	0.2	-0.6	14.9	11.0	11.0	0
	0.6	0.7	75.6	0.5	-0.9	76.2	0.2	-0.3	20.0	14.9	14.9	0
	0.5	0.9	71.9	0.5	-0.8	72.5	0.2	0.0	25.1	18.8	18.8	0
	0.4	1.3	68.2	0.6	-0.6	68.6	0.4	0.6	30.2	23.1	23.1	0
	0.3	1.6	64.9	0.6	-0.5	65.2	0.5	1.1	34.9	27.1	27.1	0
	0.1	2.1	61.3	0.6	-0.5	61.4	0.7	1.6	40.0	31.4	31.4	0
	0.1	2.7	57.9	0.5	-0.5	57.8	0.8	2.1	45.1	35.7	35.7	0
	0.3	3.3	54.6	0.5	-0.5	54.4	1.0	2.8	49.8	40.0	40.0	0
	0.5	4.0	51.0	0.6	-0.3	50.6	1.5	3.6	54.9	45.1	45.1	0
	0.6	4.7	47.5	0.6	-0.2	46.9	1.9	4.3	60.0	50.2	50.2	0
	0.7	5.5	44.1	0.5	-0.3	43.4	2.2	4.9	65.1	55.3	55.3	0
	0.7	6.1	40.9	0.4	-0.3	40.1	2.6	5.5	69.8	60.4	60.4	0
	0.6	6.8	37.4	0.2	-0.4	36.8	3.0	5.9	74.9	65.9	65.9	0
	0.5	7.5	34.0	0.0	-0.4	33.5	3.6	6.2	80.0	71.8	71.8	0
	0.2	8.2	30.6	-0.1	-0.5	30.3	4.4	6.4	85.1	78.0	78.0	0
	0.0	8.9	27.5	-0.2	-0.4	27.5	5.4	6.5	89.8	84.3	84.3	0
	0.1	9.7	24.3	0.0	-0.1	24.4	7.2	6.5	94.9	92.2	92.2	0
	0.1	10.4	22.6	0.0	0.0	22.7	8.3	6.3	98.0	96.9	96.9	0
	0.0	11.0	21.7	0.0	0.0	21.7	9.2	6.1	100	100	100	0

3.2 CMY Gray Ramp Density

The following graph plots the neutral print density of the device CMY gray ramp, compared to the G7 aim.

CMY Gray Ramp Density



3.3 Black Ramp Lightness

The following table compares CIELAB lightness of the device response to that of the G7 aim, for K-only tints in row D of the P2P25 or P2P51 chart.

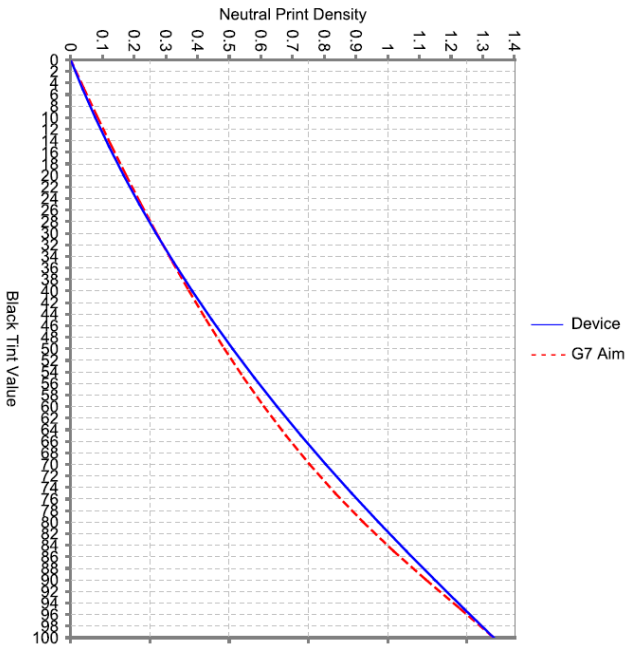
Lightness comparison of Black ramp tints

			G7 Aim			Output						
	dL	dF	L*	a*	b*	L*	a*	b*	C	M	Y	K
	0.0	-	90.7	-	-	90.7	0.7	-1.0	0	0	0	0
	0.2	-	89.3	-	-	89.5	0.7	-1.0	0	0	0	2.0
	0.3	-	88.0	-	-	88.3	0.6	-1.0	0	0	0	3.9
	0.4	-	86.7	-	-	87.1	0.6	-1.0	0	0	0	5.9
	0.5	-	85.4	-	-	85.9	0.5	-1.1	0	0	0	7.8
	0.6	-	83.8	-	-	84.4	0.5	-1.1	0	0	0	10.2
	0.6	-	80.6	-	-	81.3	0.4	-1.1	0	0	0	14.9
	0.6	-	77.3	-	-	77.8	0.3	-1.1	0	0	0	20.0
	0.4	-	73.9	-	-	74.3	0.2	-1.1	0	0	0	25.1
	0.1	-	70.5	-	-	70.6	0.2	-1.0	0	0	0	30.2
	0.2	-	67.4	-	-	67.2	0.1	-0.9	0	0	0	34.9
	0.6	-	64.1	-	-	63.5	0.1	-0.8	0	0	0	40.0
	1.0	-	60.8	-	-	59.7	0.0	-0.7	0	0	0	45.1
	1.4	-	57.7	-	-	56.2	0.0	-0.5	0	0	0	49.8
	1.8	-	54.3	-	-	52.5	0.0	-0.3	0	0	0	54.9
	2.1	-	50.8	-	-	48.7	0.0	-0.1	0	0	0	60.0
	2.3	-	47.3	-	-	45.0	0.1	0.2	0	0	0	65.1
	2.3	-	44.0	-	-	41.7	0.1	0.4	0	0	0	69.8
	2.2	-	40.3	-	-	38.1	0.1	0.7	0	0	0	74.9
	1.9	-	36.5	-	-	34.6	0.2	1.0	0	0	0	80.0
	1.5	-	32.7	-	-	31.3	0.3	1.4	0	0	0	85.1
	1.0	-	29.3	-	-	28.3	0.3	1.7	0	0	0	89.8
	0.4	-	25.6	-	-	25.2	0.4	2.1	0	0	0	94.9
	0.1	-	23.5	-	-	23.4	0.5	2.4	0	0	0	98.0
	0.0	-	22.3	-	-	22.3	0.5	2.5	0	0	0	100

3.4 Black Ramp Density

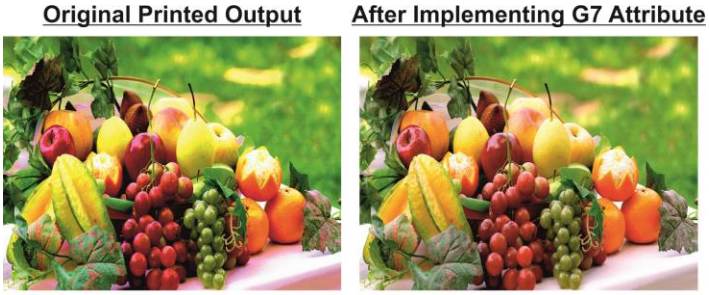
The following graph plots the neutral print density of the device Black ramp, compared to the G7 aim.

Black Ramp Density

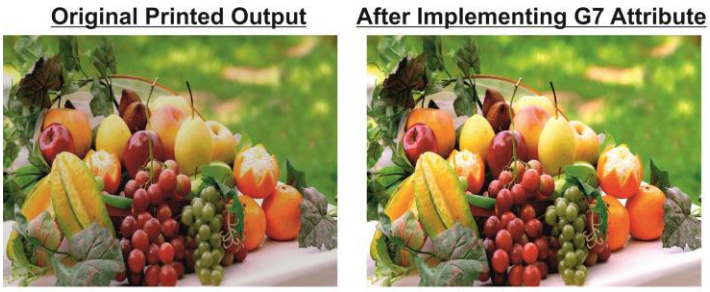


4 Conclusion

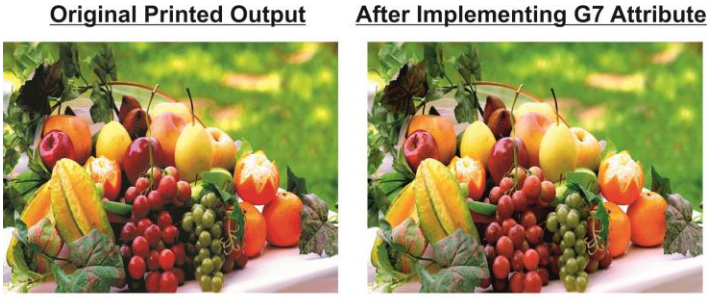
The human vision sensitivity to subtle changes in grays, so If gray balance is so important in every stage of imaging, in color perception, display devices as monitor and it is one of the most important things to aim for on printing press. G7 is a method for press-friendly printing curves that are gray balanced giving platform for implementation of any standard as SWOP, GRACoL or ISO. This implementation method has most important benefit; the print consistency from press to press in output. The press running standard condition may varies from SWOP to GRACoL workflows but the gray balance and consistent curves show visual similarities in printed output. That's the biggest reason to calibrate press to G7 to get different printing process output looking as similar as possible so that you can select the output methods for received job as per your commercial viability.



Digital - Electrophotography Process Laser Printing



Digital - Inkjet Printing Process



Conventional Lithographic Printing - Offset

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