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Tested System:
ID#: 325

Printer: HP Z3200PS

Inks/Colorants: HP Vivera with Chromata Red

Media: Moab Entrada Natural 300gsm

Coating(s): no additional coating

Sample set: AaI_20170514_SN001

Testing Status: 200 Megalux hours total light exposure
Testing is complete - there are no more updates

Conservation Display Ratings (CDR) Summary to Date:

Sample(s) exposed to light, measured immediately
Lower limit: >200 Megalux hours, Light fade testing is complete
Upper limit: >200 Megalux hours, Light fade testing is complete

Light exposed samples measured after 1 to 2 years dark storage
Lower limit: excellent condition, not exceeding lower CDR limit
Upper limit: excellent condition, not exceeding lower CDR limit

Dark Storage control sample, no light exposure, measured after 2 years
Lower limit: excellent condition, not exceeding lower CDR limit
Upper limit: excellent condition, not exceeding upper CDR limit

*Note: a CDR with narrow range (typically less than 2:1) indicates relatively even overall fading of the image. A wide range indicates faster fading in certain local colors/tones prior to general fading of most colors/tones in the entire image. Compare ratings for different systems directly and/or use the table on page 2 to estimate time (years) on display.

* Please read document AaI_2009_0118_TA-01.pdf, **"An Overview of the AaI&A Conservation Display Ratings"**,

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Section I: Process Description

This section contains a description of the tested print process, typically comprised of an inkjet printer, a specific set of inks, and a specific choice of media. However, the test report may also describe other photographic and/or photomechanical printing processes such as conventional chromogenic color processes, alternative B&W processes, dye subimation, xerographic processes, etc., and the tested samples may also include additional coatings or laminates applied to the print surface at a later stage in the fabrication. This section may also contain illustrations and other documentation about the the process as well.

HP Z3200PS, HP Vivera with Chromata Red, Moab Entrada Natural 300gsm, no additional coating

Sample Set:	**AaI_20170514_SN001**	**Batch #:**	P1
Printer:	HP Z3200PS		
Ink:	HP Vivera with Chromata Red		
Media:	Moab Entrada Natural 300gsm		
Coating(s):	no additional coating		
Test Print Prepared by:	AaI&A		
Printed:	May 14, 2017		
Initial Print colors measured	May 23, 2017		
Test Started:	May 23, 2017		
Test Image:	AaI_StandardColorSet(v2)forSRGB.tif		
RIP/Driver settings:	quality = best, maximum detail, more passes		
Media Setting	Moab Entrada Natural 300gsm Preset from Fine Art Matte Paper (more ink)		
Profile:	AaI_Z3200_Entrada Nat_MER_Bcc.icc		
Profile type:	custom		
Rendering intent:	perceptual		

Paper White and Maximum Printed Black Values (M0 readings)

Optical brighteners Present? *no*	**L***		**a***		**b***	
	UV inc	UV exc	UV inc	UV exc	UV inc	UV exc
M0 Media Whitepoint Color ISO 13655-2009:	98.1	98.1	-0.2	-0.2	1.9	1.9
	UV-inc/UV-exc ΔL*, Δa*, Δb* respectively					
	0.0		0.0		0.0	
L* = 98.1	*Calculated differences, especially for Δb*, indicate the role and magnitude of fluorescence on original paper color*					
a* = -0.2						
b* = 1.9						

Maximum Printed Black	**L***	**a***	**b***	Optical Density (Dmax)
	16.8	0.5	1.3	1.64

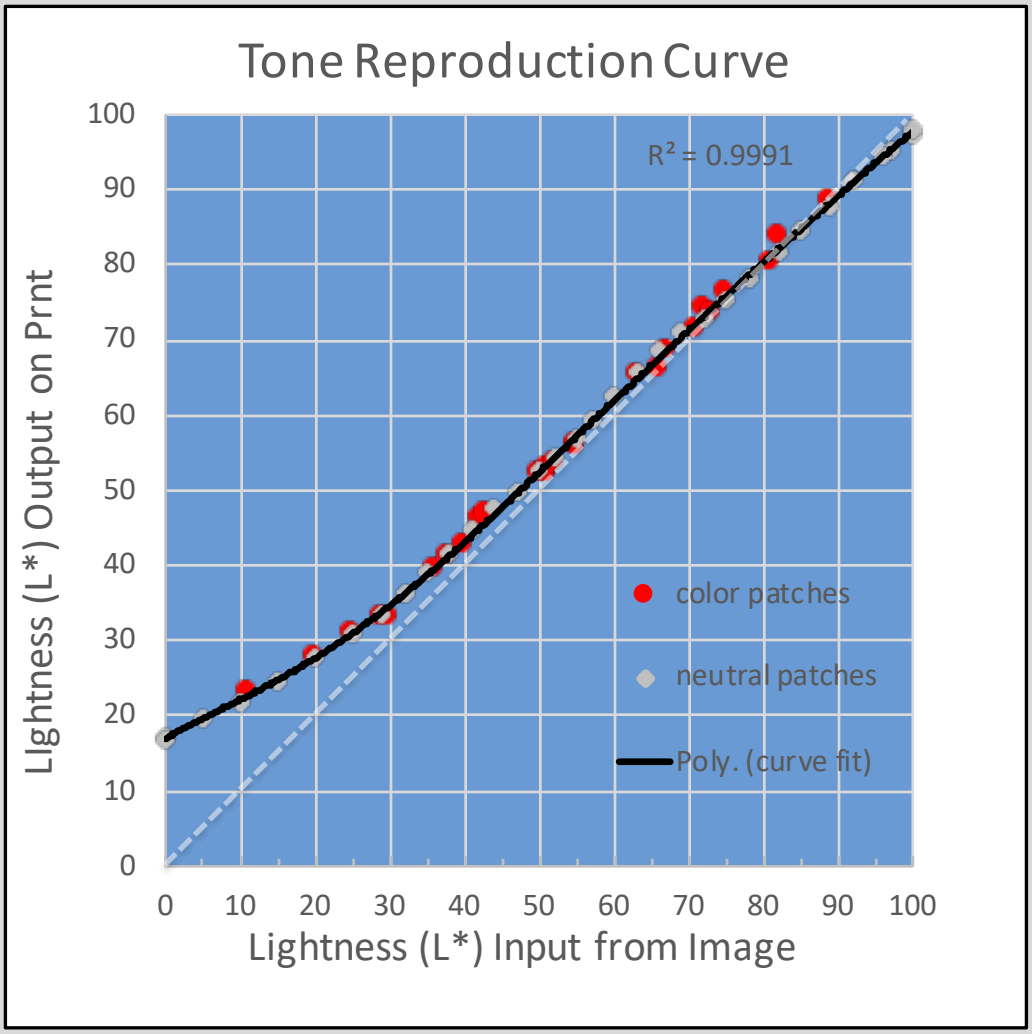
Paper White and Maximum Printed Black Values (M1 readings)

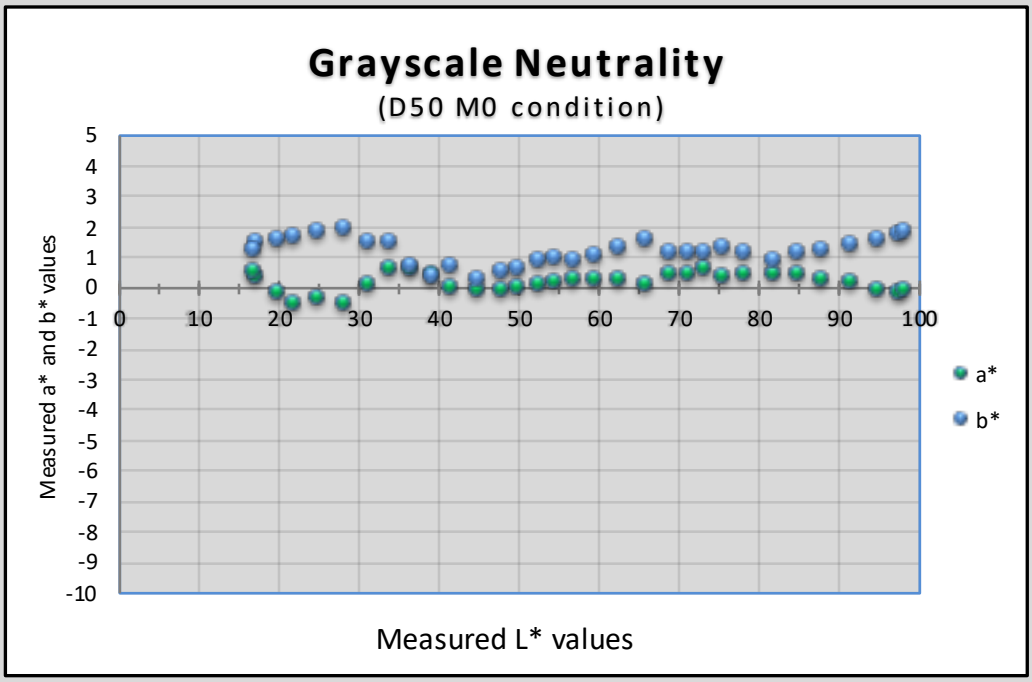
	L*		**a***		**b***	
	UV inc	UV exc	UV inc	UV exc	UV inc	UV exc
M1 Media Whitepoint Color ISO 13655-2009:	98.1	98.1	-0.2	-0.2	1.9	1.9
	UV-inc/UV-exc ΔL*, Δa*, Δb* respectively					
	0.0		0.0		0.0	
L* = 98.1	*Calculated differences, especially for Δb*, indicate the role and magnitude of fluorescence on original paper color*					
a* = -0.2						
b* = 1.9						

Maximum Printed Black	**L***	**a***	**b***	Optical Density (Dmax)
	16.8	0.6	1.1	1.64

Light source:	Phillips Colortone F40T12/C50 – 5000˚K full spectrum fluorescent. Color rendering Index (CRI) =92)
Light Exposure Cycle:	~12klux illumination, 24 hours per day
Average Temperature:	25.4˚C over full test duration, 25.5˚C during light exposure.
Average Relative humidity:	53.3%RH over full test duration, 53.1%RH during light exposure.
CIELAB measurements:	D50 2˚ observer, Xrite i1Pro2, M0,M1, and M2 conditions where applicable

Initial Image Reproduction – Tone Curve and Grayscale Neutrality

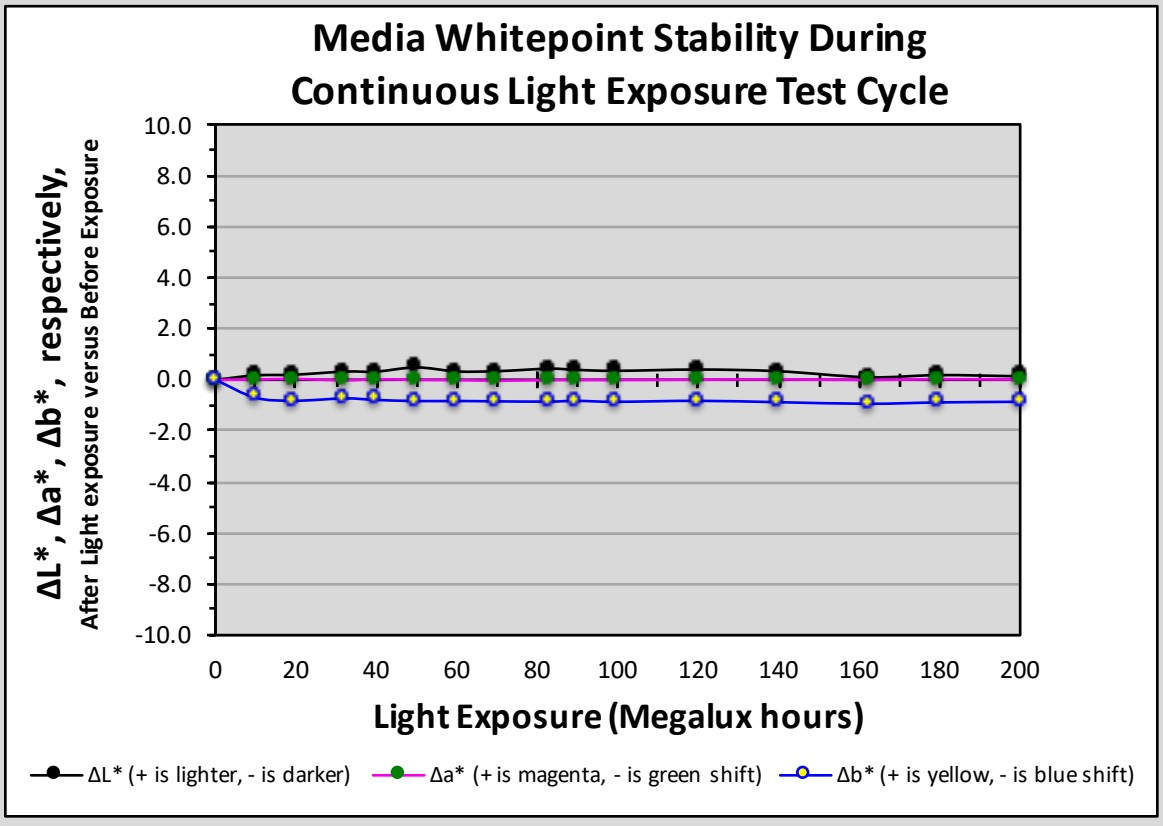


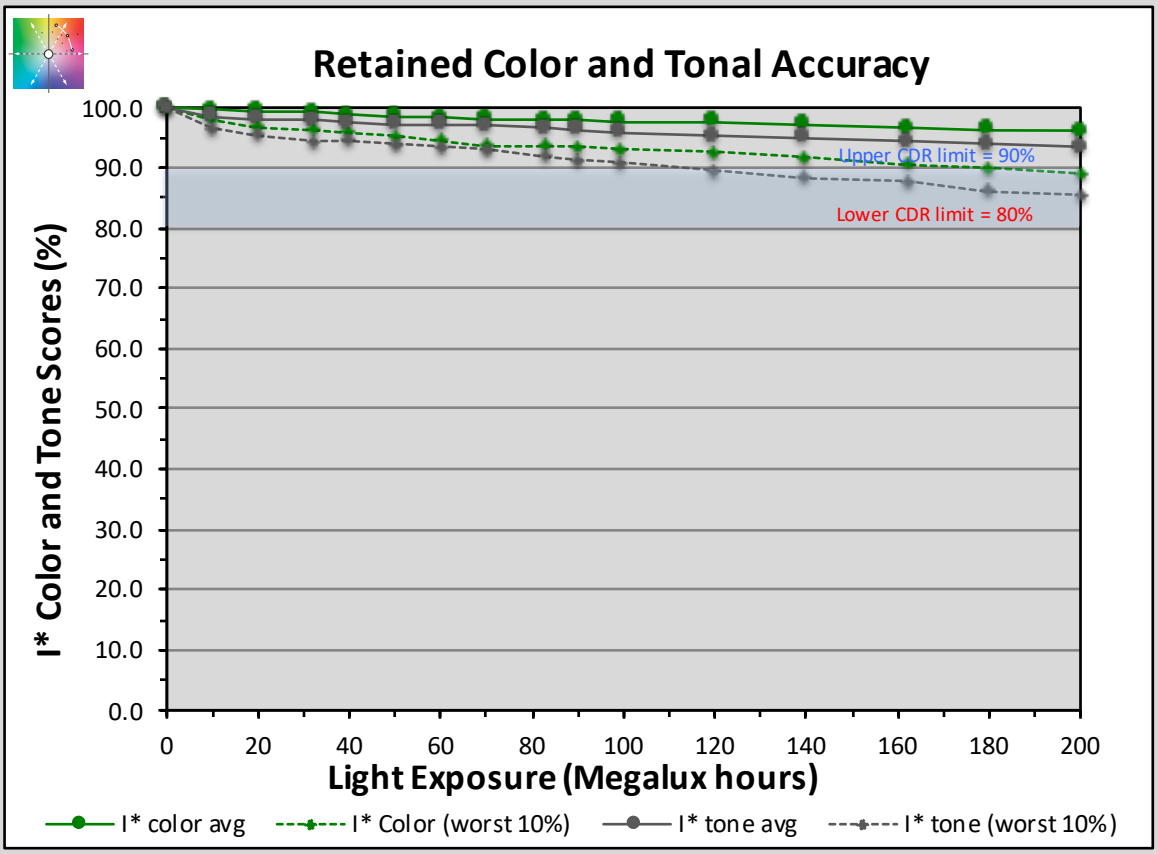


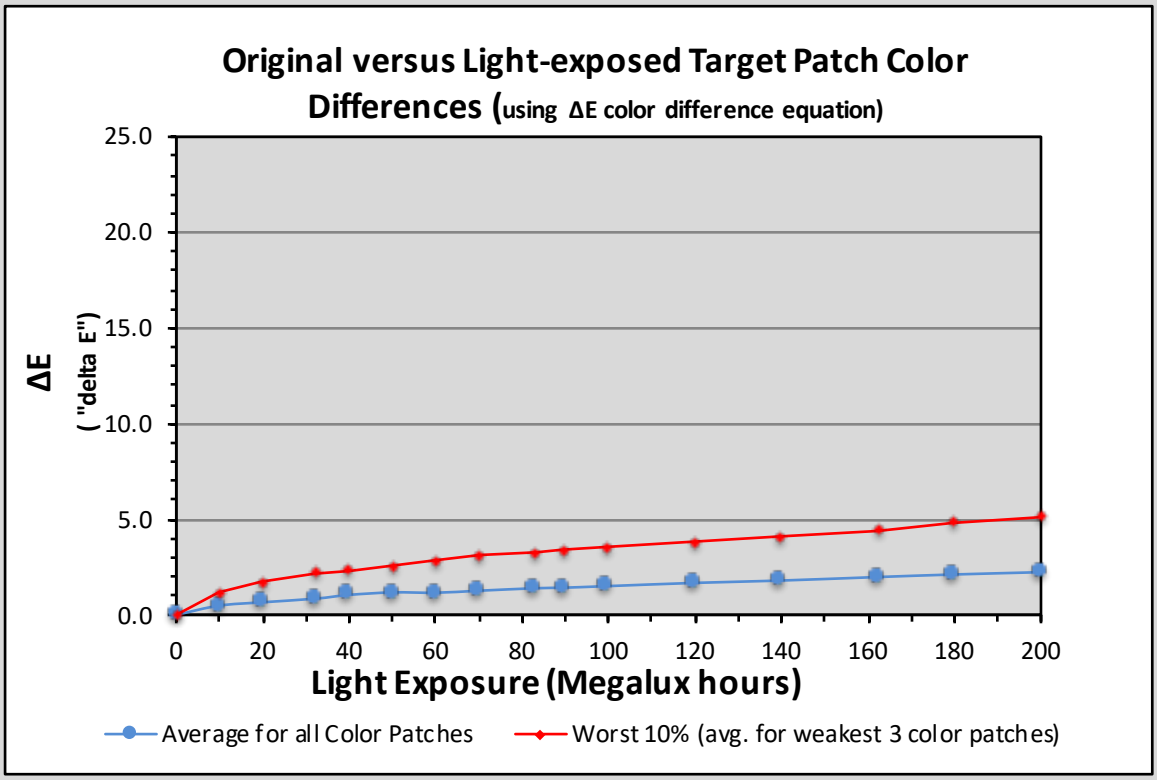
Section II: Accelerated Light Fade test results

This section of the report contains the light exposure test results measured immediately after each exposure interval is completed. Samples are pulled directly from the light fade test unit, measured within a few hours using an Xrite i1 Pro2 spectrophotometer, and then returned to the test unit for additional ongoing exposure. This methodolody is a traditional scientific approach to light fastness testing of photographic materials, and provides insight to the fade resistance of the image forming colorants as well as the fade and discoloration resistance of the media when exposed to continuous illumination on display. However, it does not acccount for any photochemical reaction products which may require longer time periods at ambient room temperature and relative humidity levels to form additional staining or yelowing appearance. Some reaction products are metastable and thus light bleachable, appearing and/or reappearing only over time when the print is displayed under significantly lower average illumination levels or stored in the dark when not continuously on display. See section III for test conditions designed to track this other potential media yellowing issue.

HP Z3200PS, HP Vivera with Chromata Red, Moab Entrada Natural 300gsm, no additional coating

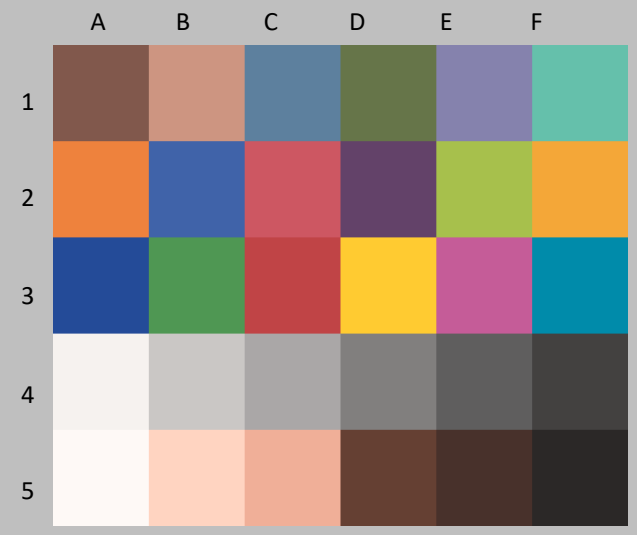




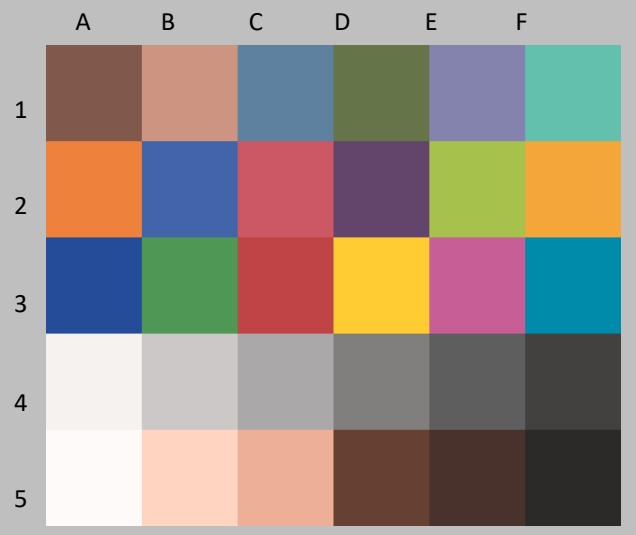


HP Z3200PS, HP Vivera with Chromata Red, Moab Entrada Natural 300gsm, no additional coating

Printer: HP Z3200PS **Ink:** HP Vivera with Chromata Red **Media:** Moab Entrada Natural 300gsm, no additional coating



Original Print Colors before light exposure



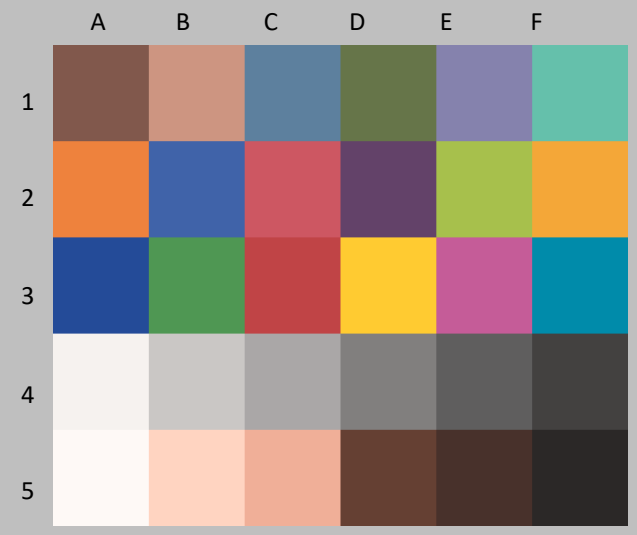
Colors After light exposure

				L*		a*		b*	
Patch #	Description	I* Color	ΔE	Before	After	Before	After	Before	After
A1	Dark Skin	100.0	0.5	41.4	41.6	15.4	15.2	14.2	13.8
B1	Light Skin	100.0	0.4	66.5	66.6	17.5	17.4	19.3	19.0
C1	Blue sky	100.0	0.5	52.3	52.7	-4.7	-5.0	-19.9	-19.7
D1	Foliage	100.0	0.2	47.1	47.2	-14.1	-14.1	21.9	21.8
E1	blue flower	98.7	0.9	56.1	56.5	9.6	9.0	-22.1	-21.5
F1	bluish green	100.0	0.3	71.7	71.9	-33.5	-33.5	1.7	1.4
A1	orange	100.0	0.4	65.5	65.6	35.0	34.9	54.1	53.7
B2	purplish blue	99.0	1.0	42.8	43.2	9.0	8.3	-41.1	-40.4
C2	moderate red	99.9	0.6	52.4	52.7	46.5	46.0	16.7	16.8
D2	purple	99.8	0.6	33.5	33.8	20.8	20.5	-17.4	-16.9
E2	yellow green	100.0	0.2	73.9	73.9	-26.1	-26.1	53.8	53.6
F2	orange yellow	100.0	0.3	74.6	74.6	18.4	18.4	65.3	65.0
A3	blue	100.0	0.3	33.5	33.6	14.0	13.8	-46.0	-45.9
B3	green	100.0	0.3	56.4	56.4	-38.3	-38.1	28.5	28.3
C3	red	100.0	0.3	46.6	46.8	49.0	48.7	26.0	26.1
D3	yellow	100.0	0.2	84.2	84.3	3.6	3.5	76.8	76.7
E3	magenta	97.9	1.6	53.9	54.4	47.9	46.9	-12.6	-11.5
F3	cyan	100.0	0.3	52.6	52.7	-26.9	-27.0	-26.7	-27.0
A4	white	98.7	0.6	95.6	95.7	-0.2	-0.2	2.3	1.7
B4	neutral 8	100.0	0.5	80.5	80.7	-0.2	-0.2	1.4	1.0
C4	neutral 6.5	100.0	0.3	69.1	69.2	0.0	-0.1	0.7	0.4
D4	neutral 5	100.0	0.2	53.3	53.4	0.1	0.0	1.1	0.9
E4	neutral 3.5	100.0	0.4	39.8	40.1	0.1	0.0	-0.2	-0.3
F4	black	100.0	0.1	28.0	28.0	-0.2	-0.2	1.3	1.2
A5	paper white	97.9	0.7	98.1	98.3	-0.2	-0.2	2.0	1.3
B5	Skin highlight L*=88	99.3	0.7	88.8	89.0	14.0	13.7	16.2	15.6
C5	Skin highlight L* =75	100.0	0.5	76.7	76.9	19.6	19.5	21.3	20.8
D5	Skin shadow L*=28	100.0	0.1	31.0	31.1	13.9	13.9	13.6	13.6
E5	Skin shadow L*=13	100.0	0.6	23.1	23.6	9.1	8.9	8.4	8.0
F5	Maximum Black	100.0	0.7	16.9	17.6	0.5	0.5	1.0	1.0

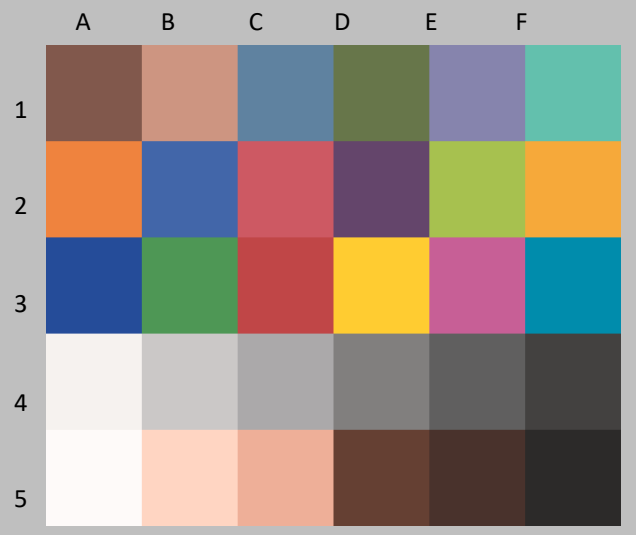
Summary Results	I* Color	I* tone	ΔE
Average Score for all patches	99.7	98.5	0.5
Worst 10% (3 lowest scoring patches)	98.2	96.6	1.2

10 Megalux hours

Printer: HP Z3200PS **Ink:** HP Vivera with Chromata Red **Media:** Moab Entrada Natural 300gsm, no additional coating



Original Print Colors before light exposure



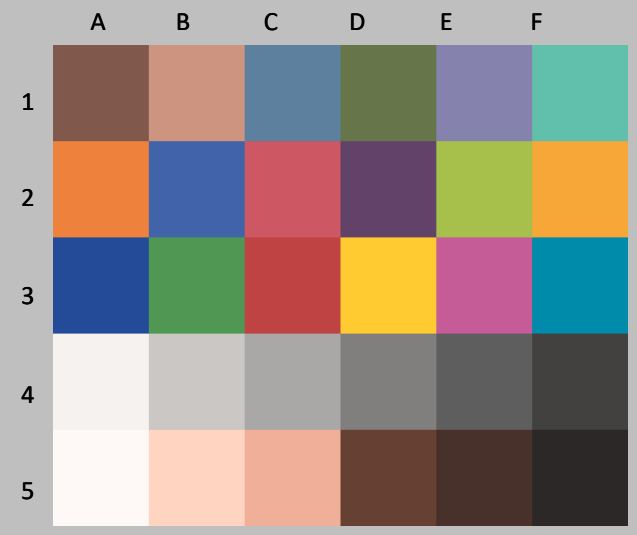
Colors After light exposure

Patch #	Description	I* Color	ΔE	L* Before	L* After	a* Before	a* After	b* Before	b* After
A1	Dark Skin	100.0	0.6	41.4	41.8	15.4	15.1	14.2	13.8
B1	Light Skin	99.9	0.6	66.5	66.8	17.5	17.2	19.3	18.9
C1	Blue sky	99.7	0.8	52.3	52.8	-4.7	-5.1	-19.9	-19.6
D1	Foliage	100.0	0.3	47.1	47.3	-14.1	-14.0	21.9	21.8
E1	blue flower	97.2	1.3	56.1	56.7	9.6	8.8	-22.1	-21.2
F1	bluish green	100.0	0.4	71.7	71.9	-33.5	-33.4	1.7	1.4
A1	orange	99.9	0.6	65.5	65.7	35.0	34.7	54.1	53.6
B2	purplish blue	98.0	1.5	42.8	43.4	9.0	8.1	-41.1	-40.1
C2	moderate red	99.3	1.0	52.4	52.9	46.5	45.7	16.7	16.7
D2	purple	98.7	1.0	33.5	34.0	20.8	20.3	-17.4	-16.7
E2	yellow green	100.0	0.4	73.9	74.0	-26.1	-26.0	53.8	53.5
F2	orange yellow	100.0	0.4	74.6	74.7	18.4	18.2	65.3	64.9
A3	blue	100.0	0.5	33.5	33.8	14.0	13.6	-46.0	-45.8
B3	green	100.0	0.4	56.4	56.5	-38.3	-38.0	28.5	28.3
C3	red	99.9	0.7	46.6	47.0	49.0	48.4	26.0	25.9
D3	yellow	100.0	0.3	84.2	84.4	3.6	3.4	76.8	76.7
E3	magenta	96.7	2.3	53.9	54.6	47.9	46.6	-12.6	-11.0
F3	cyan	100.0	0.4	52.6	52.8	-26.9	-26.9	-26.7	-27.0
A4	white	97.4	0.8	95.6	95.8	-0.2	-0.2	2.3	1.6
B4	neutral 8	100.0	0.5	80.5	80.8	-0.2	-0.2	1.4	1.0
C4	neutral 6.5	100.0	0.4	69.1	69.3	0.0	-0.1	0.7	0.4
D4	neutral 5	100.0	0.3	53.3	53.5	0.1	0.0	1.1	0.9
E4	neutral 3.5	100.0	0.4	39.8	40.2	0.1	0.0	-0.2	-0.2
F4	black	100.0	0.0	28.0	28.0	-0.2	-0.2	1.3	1.3
A5	paper white	96.6	0.8	98.1	98.3	-0.2	-0.2	2.0	1.2
B5	Skin highlight L*=88	98.3	0.9	88.8	89.1	14.0	13.5	16.2	15.5
C5	Skin highlight L* =75	99.4	0.7	76.7	77.0	19.6	19.3	21.3	20.7
D5	Skin shadow L*=28	100.0	0.2	31.0	31.2	13.9	13.9	13.6	13.6
E5	Skin shadow L*=13	100.0	0.6	23.1	23.6	9.1	8.8	8.4	8.3
F5	Maximum Black	100.0	0.7	16.9	17.6	0.5	0.4	1.0	1.2

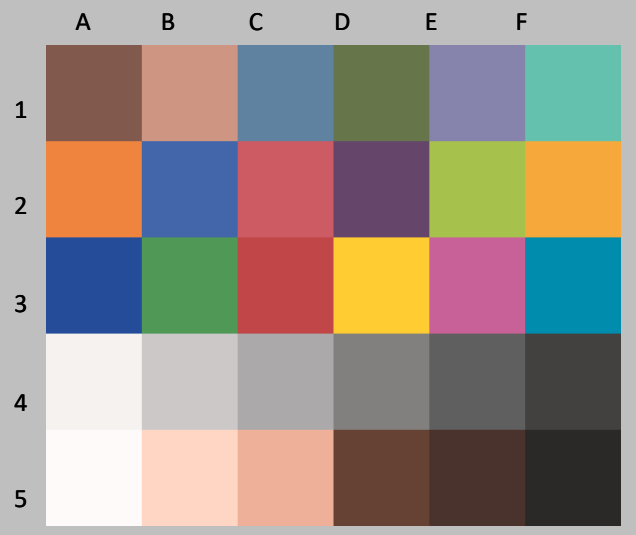
Summary Results	I* Color	I* tone	ΔE
Average Score for all patches	99.4	98.1	0.7
Worst 10% (3 lowest scoring patches)	96.8	95.4	1.7

20 Megalux hours

Printer: HP Z3200PS **Ink:** HP Vivera with Chromata Red **Media:** Moab Entrada Natural 300gsm, no additional coating



Original Print Colors before light exposure



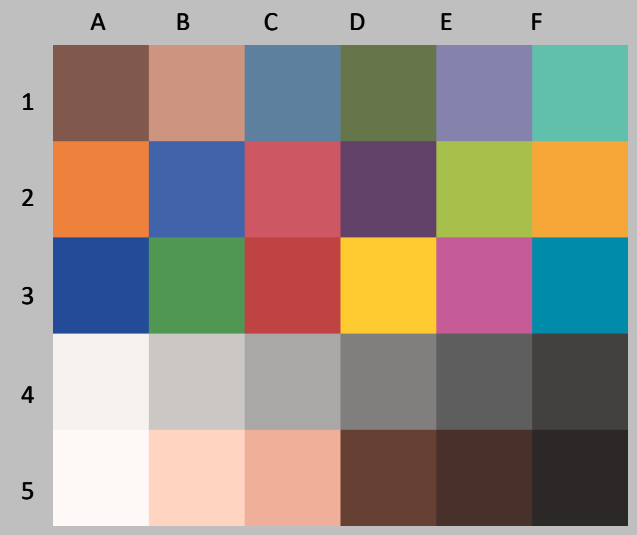
Colors After light exposure

				L*		a*		b*	
Patch #	Description	I* Color	ΔE	Before	After	Before	After	Before	After
A1	Dark Skin	99.1	0.9	41.4	42.0	15.4	15.0	14.3	13.7
B1	Light Skin	99.2	0.8	66.5	67.0	17.4	17.0	19.7	19.1
C1	Blue sky	99.5	0.9	52.4	53.0	-4.7	-5.2	-19.9	-19.5
D1	Foliage	100.0	0.5	47.3	47.6	-14.3	-14.2	22.4	22.1
E1	blue flower	96.4	1.6	56.2	57.0	9.6	8.7	-22.0	-21.0
F1	bluish green	100.0	0.5	71.8	72.1	-33.6	-33.4	1.8	1.5
A1	orange	99.8	0.7	65.7	66.0	34.8	34.3	54.4	53.9
B2	purplish blue	96.7	2.1	42.7	43.6	9.0	7.8	-41.2	-39.8
C2	moderate red	98.9	1.3	52.5	53.2	46.5	45.5	17.0	16.9
D2	purple	98.0	1.3	33.5	34.2	20.8	20.2	-17.2	-16.4
E2	yellow green	100.0	0.5	73.9	74.1	-26.1	-26.1	53.9	53.5
F2	orange yellow	99.9	0.7	74.5	74.8	18.6	18.2	65.4	65.0
A3	blue	99.2	1.0	33.2	33.7	14.2	13.5	-46.3	-45.7
B3	green	100.0	0.6	56.4	56.7	-38.5	-38.2	28.7	28.3
C3	red	99.1	1.1	46.6	47.1	49.3	48.5	26.7	26.1
D3	yellow	100.0	0.6	84.3	84.6	3.6	3.3	77.1	76.6
E3	magenta	95.7	2.8	53.9	54.9	48.0	46.5	-12.7	-10.6
F3	cyan	100.0	0.4	52.6	53.0	-27.1	-27.1	-26.9	-27.1
A4	white	98.2	0.7	95.6	95.9	-0.2	-0.3	2.4	1.7
B4	neutral 8	100.0	0.5	80.6	80.9	-0.2	-0.2	1.4	0.9
C4	neutral 6.5	100.0	0.4	69.0	69.3	-0.1	-0.1	0.6	0.4
D4	neutral 5	100.0	0.4	53.3	53.7	0.1	0.0	1.1	0.9
E4	neutral 3.5	100.0	0.4	39.8	40.2	0.1	0.0	-0.1	-0.2
F4	black	100.0	0.3	27.8	28.0	-0.2	-0.3	1.4	1.5
A5	paper white	97.6	0.8	98.1	98.4	-0.2	-0.2	1.9	1.2
B5	Skin highlight L*=88	98.7	0.9	88.9	89.4	13.8	13.3	16.3	15.7
C5	Skin highlight L* =75	99.3	0.9	76.8	77.3	19.6	19.1	21.4	20.9
D5	Skin shadow L*=28	100.0	0.5	31.2	31.6	14.0	13.8	13.7	13.7
E5	Skin shadow L*=13	100.0	0.7	23.2	23.7	9.2	8.8	8.4	8.4
F5	Maximum Black	100.0	0.5	16.8	17.3	0.5	0.4	1.4	1.4

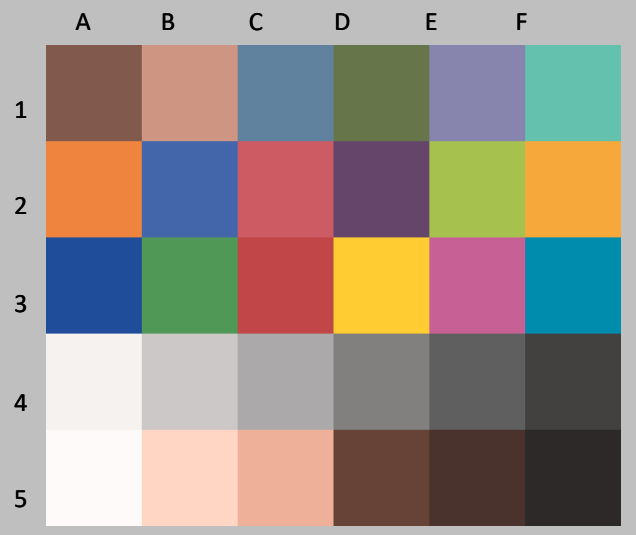
Summary Results	I* Color	I* tone	ΔE
Average Score for all patches	99.2	97.8	0.8
Worst 10% (3 lowest scoring patches)	96.3	94.3	2.2

30 Megalux hours

Printer: HP Z3200PS **Ink:** HP Vivera with Chromata Red **Media:** Moab Entrada Natural 300gsm, no additional coating



Original Print Colors before light exposure



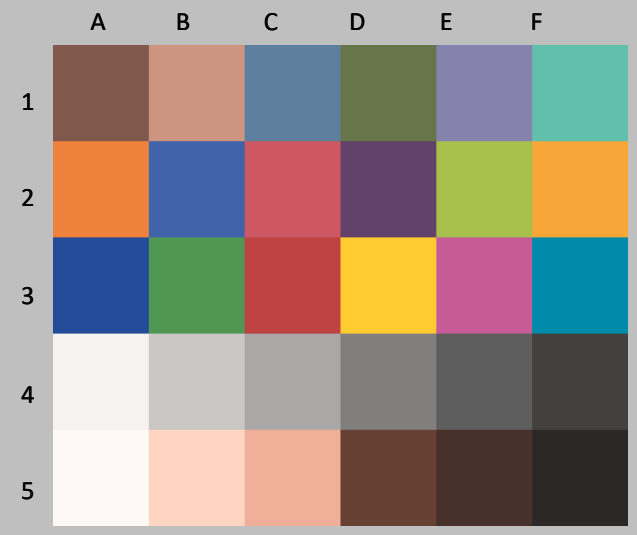
Colors After light exposure

Patch #	Description	I* Color	ΔE	L* Before	L* After	a* Before	a* After	b* Before	b* After
A1	Dark Skin	98.3	1.1	41.4	42.1	15.4	15.0	14.3	13.5
B1	Light Skin	98.1	1.1	66.5	67.0	17.4	17.0	19.7	18.8
C1	Blue sky	99.4	1.0	52.4	53.2	-4.7	-5.2	-19.9	-19.5
D1	Foliage	99.3	0.9	47.3	47.8	-14.3	-14.0	22.4	21.7
E1	blue flower	95.8	1.8	56.2	57.2	9.6	8.6	-22.0	-20.9
F1	bluish green	99.5	0.8	71.8	72.2	-33.6	-33.1	1.8	1.4
A1	orange	99.2	1.1	65.7	66.1	34.8	34.2	54.4	53.5
B2	purplish blue	96.7	2.1	42.7	43.6	9.0	7.7	-41.2	-39.8
C2	moderate red	98.1	1.7	52.5	53.3	46.5	45.2	17.0	16.4
D2	purple	98.1	1.4	33.5	34.4	20.8	20.1	-17.2	-16.5
E2	yellow green	99.9	0.6	73.9	74.2	-26.1	-25.8	53.9	53.5
F2	orange yellow	99.6	0.8	74.5	74.9	18.6	18.1	65.4	64.8
A3	blue	98.8	1.3	33.2	33.9	14.2	13.3	-46.3	-45.7
B3	green	99.7	0.7	56.4	56.7	-38.5	-38.1	28.7	28.2
C3	red	98.3	1.6	46.6	47.2	49.3	48.4	26.7	25.6
D3	yellow	99.9	0.6	84.3	84.6	3.6	3.4	77.1	76.6
E3	magenta	95.2	3.1	53.9	55.0	48.0	46.2	-12.7	-10.4
F3	cyan	100.0	0.5	52.6	53.1	-27.1	-27.0	-26.9	-27.1
A4	white	96.7	0.9	95.6	95.9	-0.2	-0.2	2.4	1.6
B4	neutral 8	100.0	0.7	80.6	81.0	-0.2	-0.2	1.4	0.9
C4	neutral 6.5	100.0	0.6	69.0	69.5	-0.1	0.0	0.6	0.4
D4	neutral 5	100.0	0.6	53.3	53.8	0.1	0.1	1.1	0.9
E4	neutral 3.5	100.0	0.5	39.8	40.3	0.1	0.0	-0.1	-0.3
F4	black	100.0	0.4	27.8	28.1	-0.2	-0.2	1.4	1.2
A5	paper white	96.9	0.9	98.1	98.4	-0.2	-0.1	1.9	1.1
B5	Skin highlight L*=88	97.2	1.2	88.9	89.5	13.8	13.0	16.3	15.5
C5	Skin highlight L* =75	98.0	1.2	76.8	77.3	19.6	19.0	21.4	20.5
D5	Skin shadow L*=28	99.7	0.7	31.2	31.6	14.0	13.7	13.7	13.3
E5	Skin shadow L*=13	100.0	1.0	23.2	24.0	9.2	8.9	8.4	8.1
F5	Maximum Black	100.0	0.5	16.8	17.1	0.5	0.6	1.4	1.0

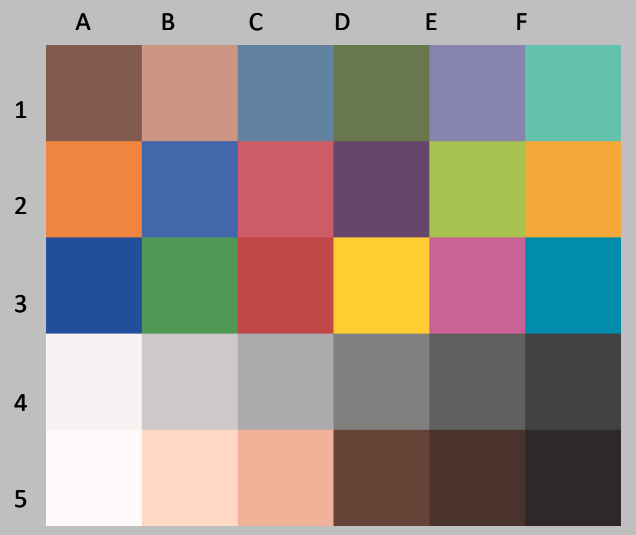
Summary Results	I* Color	I* tone	ΔE
Average Score for all patches	98.7	97.5	1.0
Worst 10% (3 lowest scoring patches)	95.9	94.5	2.3

40 Megalux hours

Printer: HP Z3200PS **Ink:** HP Vivera with Chromata Red **Media:** Moab Entrada Natural 300gsm, no additional coating



Original Print Colors before light exposure



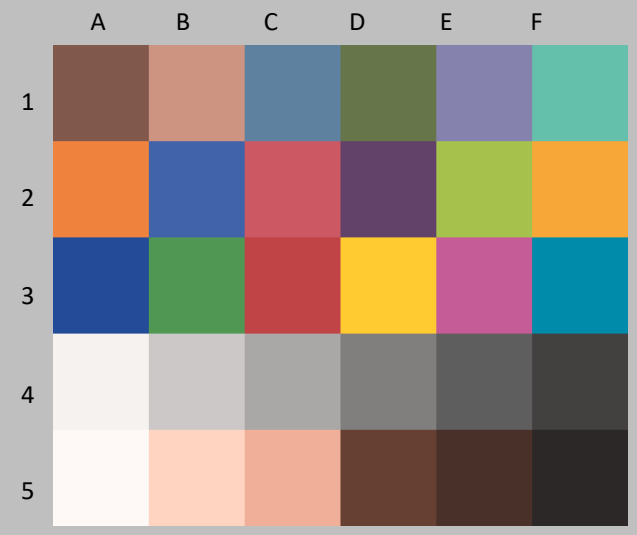
Colors After light exposure

				L*		a*		b*	
Patch #	Description	I* Color	ΔE	Before	After	Before	After	Before	After
A1	Dark Skin	98.0	1.2	41.4	42.2	15.4	14.9	14.3	13.5
B1	Light Skin	97.9	1.3	66.5	67.2	17.4	16.8	19.7	18.8
C1	Blue sky	99.0	1.2	52.4	53.3	-4.7	-5.2	-19.9	-19.4
D1	Foliage	99.6	0.8	47.3	47.8	-14.3	-14.0	22.4	21.8
E1	blue flower	95.2	2.0	56.2	57.4	9.6	8.5	-22.0	-20.8
F1	bluish green	99.6	0.8	71.8	72.3	-33.6	-33.2	1.8	1.3
A1	orange	99.1	1.2	65.7	66.3	34.8	34.1	54.4	53.6
B2	purplish blue	96.3	2.3	42.7	43.8	9.0	7.6	-41.2	-39.7
C2	moderate red	98.1	1.8	52.5	53.6	46.5	45.2	17.0	16.5
D2	purple	97.4	1.6	33.5	34.6	20.8	20.0	-17.2	-16.3
E2	yellow green	99.8	0.7	73.9	74.3	-26.1	-26.0	53.9	53.4
F2	orange yellow	99.6	1.0	74.5	75.1	18.6	17.9	65.4	65.0
A3	blue	99.0	1.3	33.2	34.0	14.2	13.3	-46.3	-45.8
B3	green	99.8	0.8	56.4	56.8	-38.5	-38.2	28.7	28.2
C3	red	98.0	1.8	46.6	47.4	49.3	48.3	26.7	25.5
D3	yellow	99.9	0.8	84.3	84.7	3.6	3.3	77.1	76.6
E3	magenta	94.8	3.4	53.9	55.2	48.0	46.2	-12.7	-10.1
F3	cyan	100.0	0.6	52.6	53.1	-27.1	-27.0	-26.9	-27.2
A4	white	95.5	1.0	95.6	96.0	-0.2	-0.2	2.4	1.4
B4	neutral 8	98.9	0.9	80.6	81.2	-0.2	-0.2	1.4	0.7
C4	neutral 6.5	100.0	0.7	69.0	69.6	-0.1	-0.1	0.6	0.4
D4	neutral 5	100.0	0.7	53.3	53.9	0.1	0.1	1.1	0.8
E4	neutral 3.5	100.0	0.6	39.8	40.4	0.1	0.0	-0.1	-0.3
F4	black	100.0	0.5	27.8	28.3	-0.2	-0.3	1.4	1.2
A5	paper white	96.5	1.0	98.1	98.6	-0.2	-0.2	1.9	1.1
B5	Skin highlight L*=88	96.8	1.4	88.9	89.7	13.8	12.9	16.3	15.5
C5	Skin highlight L* =75	97.9	1.3	76.8	77.5	19.6	18.9	21.4	20.6
D5	Skin shadow L*=28	99.4	0.8	31.2	31.6	14.0	13.6	13.7	13.3
E5	Skin shadow L*=13	98.9	1.1	23.2	24.1	9.2	8.9	8.4	7.9
F5	Maximum Black	99.5	0.7	16.8	17.2	0.5	0.6	1.4	0.8

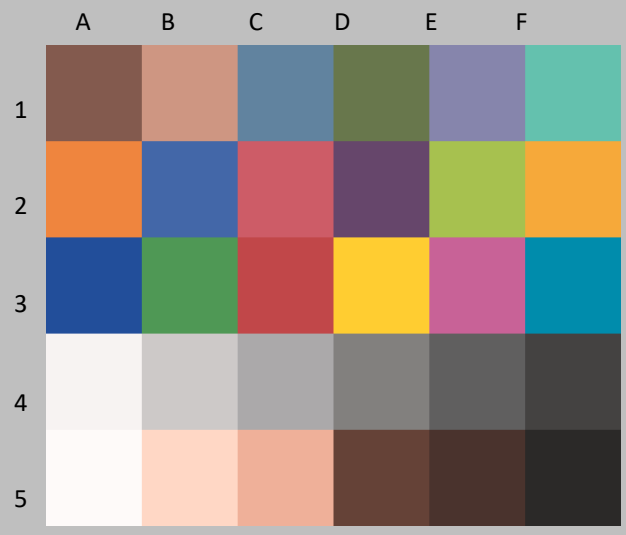
Summary Results	I* Color	I* tone	ΔE
Average Score for all patches	98.5	97.3	1.2
Worst 10% (3 lowest scoring patches)	95.2	93.8	2.6

50 Megalux hours

Printer: HP Z3200PS **Ink:** HP Vivera with Chromata Red **Media:** Moab Entrada Natural 300gsm, no additional coating



Original Print Colors before light exposure



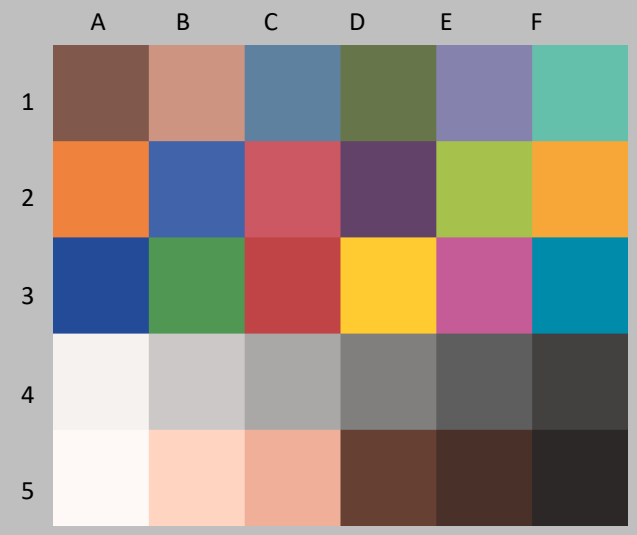
Colors After light exposure

Patch #	Description	I* Color	ΔE	L* Before	L* After	a* Before	a* After	b* Before	b* After
A1	Dark Skin	97.9	1.3	41.4	42.2	15.5	14.9	14.3	13.6
B1	Light Skin	98.3	1.2	66.5	67.2	17.4	16.7	19.5	18.8
C1	Blue sky	97.9	1.3	52.4	53.3	-4.7	-5.3	-19.9	-19.2
D1	Foliage	100.0	0.7	47.3	47.8	-14.2	-14.0	22.3	21.8
E1	blue flower	93.9	2.3	56.2	57.4	9.6	8.5	-22.1	-20.5
F1	bluish green	100.0	0.6	71.9	72.3	-33.3	-33.1	1.8	1.4
A1	orange	98.9	1.3	65.8	66.2	34.9	33.9	54.3	53.5
B2	purplish blue	95.8	2.5	42.8	43.8	9.0	7.5	-41.1	-39.4
C2	moderate red	98.1	1.8	52.5	53.6	46.4	45.0	16.7	16.5
D2	purple	96.5	1.8	33.5	34.6	20.8	19.9	-17.3	-16.2
E2	yellow green	99.9	0.6	73.9	74.3	-25.9	-25.9	53.9	53.3
F2	orange yellow	99.5	1.0	74.5	75.0	18.5	17.8	65.3	64.9
A3	blue	98.3	1.5	33.3	34.1	14.2	13.1	-46.3	-45.5
B3	green	100.0	0.6	56.4	56.8	-38.3	-38.1	28.6	28.2
C3	red	98.3	1.7	46.6	47.4	49.3	48.1	26.3	25.5
D3	yellow	99.7	0.8	84.3	84.7	3.7	3.2	77.0	76.5
E3	magenta	94.2	3.6	53.9	55.3	47.9	46.0	-12.6	-9.9
F3	cyan	100.0	0.5	52.7	53.1	-27.1	-27.0	-26.9	-27.1
A4	white	96.2	0.9	95.5	95.9	-0.2	-0.2	2.3	1.4
B4	neutral 8	100.0	0.6	80.7	81.1	-0.2	-0.2	1.3	0.8
C4	neutral 6.5	100.0	0.5	69.2	69.6	0.0	-0.1	0.7	0.4
D4	neutral 5	100.0	0.6	53.4	53.9	0.1	0.0	1.0	0.8
E4	neutral 3.5	100.0	0.6	39.9	40.5	0.1	0.0	-0.1	-0.2
F4	black	100.0	0.5	27.8	28.3	-0.2	-0.3	1.4	1.4
A5	paper white	96.5	0.9	98.1	98.4	-0.1	-0.2	1.9	1.0
B5	Skin highlight L*=88	96.4	1.4	89.0	89.6	13.7	12.8	16.3	15.4
C5	Skin highlight L* =75	97.8	1.3	76.8	77.4	19.6	18.8	21.2	20.5
D5	Skin shadow L*=28	99.8	0.7	31.2	31.6	14.0	13.5	13.7	13.5
E5	Skin shadow L*=13	98.5	1.1	23.3	24.1	9.2	8.7	8.8	8.3
F5	Maximum Black	100.0	0.5	16.8	17.3	0.5	0.4	1.4	1.3

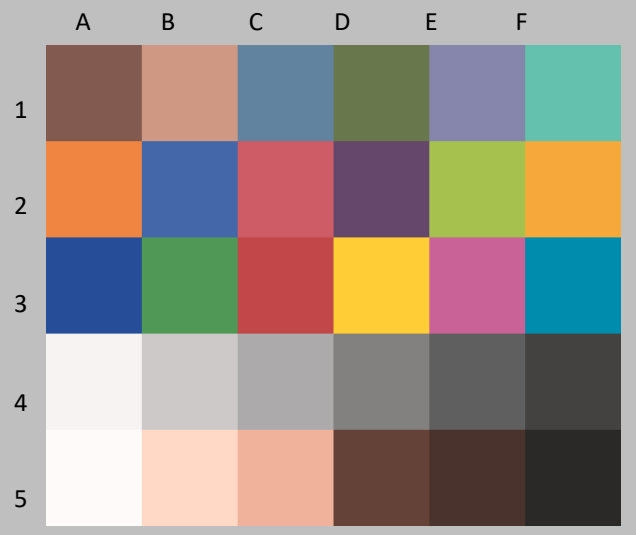
Summary Results	I* Color	I* tone	ΔE
Average Score for all patches	98.4	97.1	1.2
Worst 10% (3 lowest scoring patches)	94.7	93.5	2.8

62.6 Megalux hours

Printer: HP Z3200PS **Ink:** HP Vivera with Chromata Red **Media:** Moab Entrada Natural 300gsm, no additional coating



Original Print Colors before light exposure



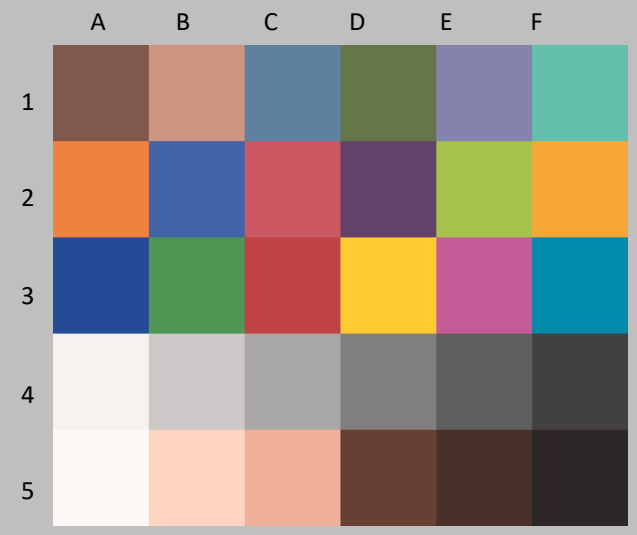
Colors After light exposure

				L*		a*		b*	
Patch #	Description	I* Color	ΔE	Before	After	Before	After	Before	After
A1	Dark Skin	98.4	1.3	41.4	42.4	15.5	14.8	14.3	13.5
B1	Light Skin	98.8	1.0	66.5	67.3	17.4	16.7	19.5	18.8
C1	Blue sky	97.2	1.5	52.4	53.4	-4.7	-5.3	-19.9	-19.1
D1	Foliage	99.9	0.7	47.3	47.8	-14.2	-14.0	22.3	21.6
E1	blue flower	92.9	2.5	56.2	57.4	9.6	8.4	-22.1	-20.3
F1	bluish green	99.8	0.6	71.9	72.2	-33.3	-33.0	1.8	1.3
A1	orange	98.5	1.5	65.8	66.2	34.9	33.7	54.3	53.3
B2	purplish blue	94.7	2.9	42.8	43.8	9.0	7.4	-41.1	-39.1
C2	moderate red	97.4	2.1	52.5	53.6	46.4	44.7	16.7	16.4
D2	purple	95.4	2.1	33.5	34.8	20.8	19.7	-17.3	-15.9
E2	yellow green	99.2	1.0	73.9	74.2	-25.9	-25.8	53.9	52.9
F2	orange yellow	99.4	1.0	74.5	75.0	18.5	17.7	65.3	64.6
A3	blue	98.3	1.5	33.3	34.1	14.2	13.0	-46.3	-45.4
B3	green	99.6	0.8	56.4	56.8	-38.3	-38.1	28.6	28.0
C3	red	97.6	2.1	46.6	47.5	49.3	48.0	26.3	25.4
D3	yellow	99.5	0.9	84.3	84.7	3.7	3.1	77.0	76.3
E3	magenta	93.8	3.9	53.9	55.4	47.9	45.8	-12.6	-9.7
F3	cyan	100.0	0.5	52.7	53.1	-27.1	-27.0	-26.9	-27.1
A4	white	97.4	0.8	95.5	95.9	-0.2	-0.2	2.3	1.4
B4	neutral 8	99.7	0.7	80.7	81.1	-0.2	-0.2	1.3	0.8
C4	neutral 6.5	100.0	0.6	69.2	69.6	0.0	-0.1	0.7	0.4
D4	neutral 5	100.0	0.6	53.4	54.0	0.1	0.0	1.0	0.8
E4	neutral 3.5	100.0	0.5	39.9	40.5	0.1	0.0	-0.1	-0.3
F4	black	100.0	0.4	27.8	28.3	-0.2	-0.3	1.4	1.3
A5	paper white	96.4	0.9	98.1	98.4	-0.1	-0.2	1.9	1.0
B5	Skin highlight L*=88	95.2	1.6	89.0	89.7	13.7	12.7	16.3	15.2
C5	Skin highlight L* =75	97.5	1.4	76.8	77.5	19.6	18.6	21.2	20.4
D5	Skin shadow L*=28	99.1	0.8	31.2	31.7	14.0	13.4	13.7	13.4
E5	Skin shadow L*=13	97.8	1.1	23.3	24.0	9.2	8.8	8.8	8.2
F5	Maximum Black	100.0	0.4	16.8	17.2	0.5	0.5	1.4	1.1

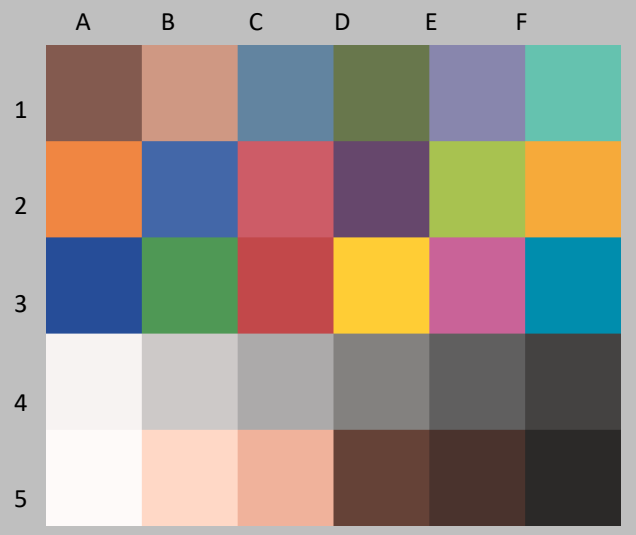
Summary Results	I* Color	I* tone	ΔE
Average Score for all patches	98.1	96.9	1.3
Worst 10% (3 lowest scoring patches)	93.8	92.9	3.1

70 Megalux hours

Printer: HP Z3200PS **Ink:** HP Vivera with Chromata Red **Media:** Moab Entrada Natural 300gsm, no additional coating



Original Print Colors before light exposure



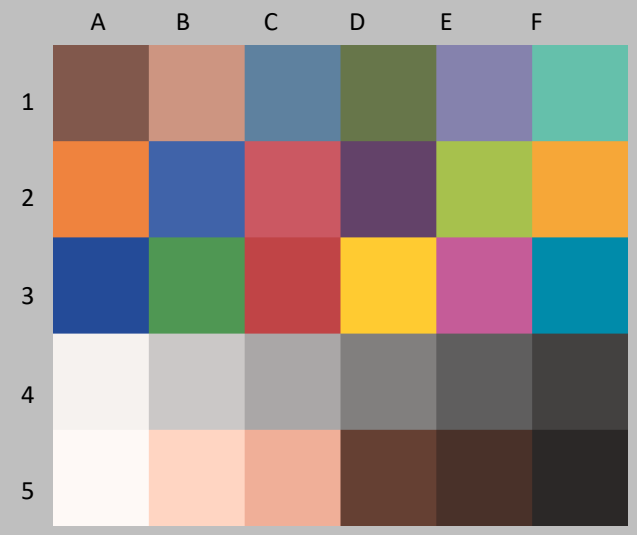
Colors After light exposure

				L*		a*		b*	
Patch #	Description	I* Color	ΔE	Before	After	Before	After	Before	After
A1	Dark Skin	97.3	1.6	41.4	42.5	15.5	14.8	14.3	13.5
B1	Light Skin	97.7	1.4	66.5	67.4	17.4	16.6	19.5	18.7
C1	Blue sky	97.3	1.6	52.4	53.6	-4.7	-5.3	-19.9	-19.1
D1	Foliage	99.3	1.0	47.3	48.0	-14.2	-14.0	22.3	21.6
E1	blue flower	92.8	2.7	56.2	57.7	9.6	8.4	-22.1	-20.2
F1	bluish green	100.0	0.8	71.9	72.5	-33.3	-33.0	1.8	1.4
A1	orange	98.3	1.7	65.8	66.5	34.9	33.6	54.3	53.3
B2	purplish blue	95.1	2.9	42.8	44.1	9.0	7.3	-41.1	-39.2
C2	moderate red	97.6	2.2	52.5	53.9	46.4	44.7	16.7	16.4
D2	purple	96.1	2.0	33.5	34.8	20.8	19.9	-17.3	-16.1
E2	yellow green	99.5	0.9	73.9	74.4	-25.9	-25.9	53.9	53.1
F2	orange yellow	99.1	1.3	74.5	75.2	18.5	17.6	65.3	64.7
A3	blue	97.9	1.8	33.3	34.2	14.2	13.0	-46.3	-45.4
B3	green	99.8	0.8	56.4	57.0	-38.3	-38.1	28.6	28.1
C3	red	97.7	2.1	46.6	47.7	49.3	47.8	26.3	25.3
D3	yellow	99.3	1.2	84.3	84.8	3.7	3.1	77.0	76.1
E3	magenta	93.4	4.1	53.9	55.6	47.9	45.7	-12.6	-9.6
F3	cyan	100.0	0.6	52.7	53.3	-27.1	-27.1	-26.9	-27.0
A4	white	96.0	1.0	95.5	96.0	-0.2	-0.2	2.3	1.4
B4	neutral 8	100.0	0.7	80.7	81.2	-0.2	-0.2	1.3	0.8
C4	neutral 6.5	100.0	0.7	69.2	69.8	0.0	-0.1	0.7	0.4
D4	neutral 5	100.0	0.8	53.4	54.1	0.1	0.0	1.0	0.8
E4	neutral 3.5	100.0	0.7	39.9	40.5	0.1	0.0	-0.1	-0.2
F4	black	100.0	0.5	27.8	28.3	-0.2	-0.3	1.4	1.3
A5	paper white	96.3	1.0	98.1	98.5	-0.1	-0.2	1.9	1.0
B5	Skin highlight L*=88	95.4	1.7	89.0	89.7	13.7	12.6	16.3	15.2
C5	Skin highlight L* =75	97.1	1.6	76.8	77.6	19.6	18.5	21.2	20.4
D5	Skin shadow L*=28	99.6	0.8	31.2	31.7	14.0	13.4	13.7	13.4
E5	Skin shadow L*=13	97.5	1.1	23.3	24.0	9.2	8.7	8.8	8.1
F5	Maximum Black	100.0	0.5	16.8	17.2	0.5	0.5	1.4	1.1

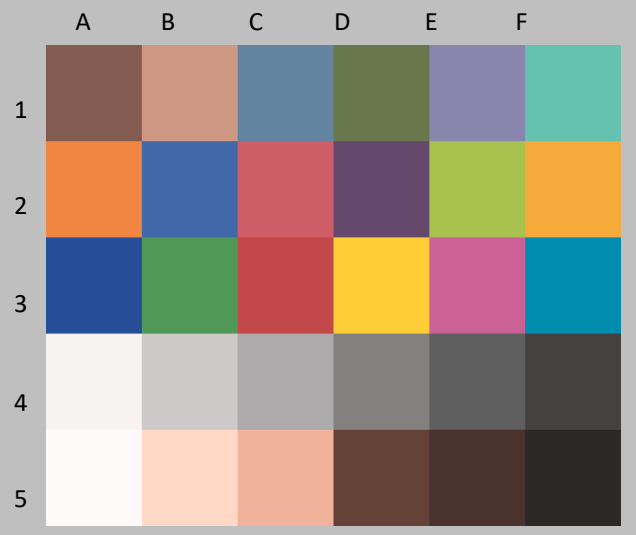
Summary Results	I* Color	I* tone	ΔE
Average Score for all patches	98.0	96.5	1.4
Worst 10% (3 lowest scoring patches)	93.8	91.9	3.2

80 Megalux hours

Printer: HP Z3200PS **Ink:** HP Vivera with Chromata Red **Media:** Moab Entrada Natural 300gsm, no additional coating



Original Print Colors before light exposure



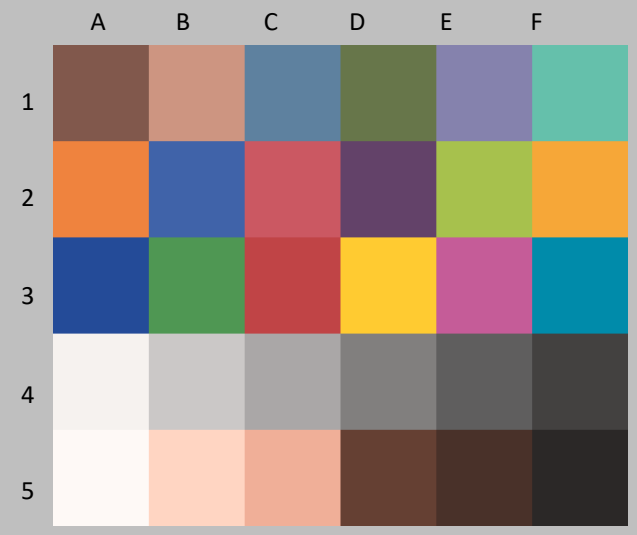
Colors After light exposure

Patch #	Description	I* Color	ΔE	L* Before	L* After	a* Before	a* After	b* Before	b* After
A1	Dark Skin	96.9	1.7	41.4	42.6	15.5	14.7	14.3	13.4
B1	Light Skin	97.4	1.5	66.5	67.5	17.4	16.6	19.5	18.7
C1	Blue sky	97.1	1.6	52.4	53.6	-4.7	-5.3	-19.9	-19.0
D1	Foliage	99.0	1.0	47.3	48.0	-14.2	-14.0	22.3	21.5
E1	blue flower	92.5	2.8	56.2	57.8	9.6	8.4	-22.1	-20.1
F1	bluish green	99.8	0.8	71.9	72.5	-33.3	-32.9	1.8	1.3
A1	orange	98.1	1.8	65.8	66.5	34.9	33.6	54.3	53.1
B2	purplish blue	94.9	3.0	42.8	44.1	9.0	7.3	-41.1	-39.1
C2	moderate red	97.5	2.3	52.5	54.0	46.4	44.7	16.7	16.3
D2	purple	96.1	2.1	33.5	34.9	20.8	20.0	-17.3	-16.0
E2	yellow green	99.4	1.0	73.9	74.4	-25.9	-25.9	53.9	53.0
F2	orange yellow	99.0	1.4	74.5	75.2	18.5	17.6	65.3	64.5
A3	blue	97.6	1.9	33.3	34.2	14.2	12.9	-46.3	-45.3
B3	green	99.6	0.9	56.4	56.9	-38.3	-38.1	28.6	28.0
C3	red	97.8	2.1	46.6	47.7	49.3	47.9	26.3	25.3
D3	yellow	99.3	1.2	84.3	84.8	3.7	3.1	77.0	76.1
E3	magenta	93.1	4.3	53.9	55.7	47.9	45.6	-12.6	-9.5
F3	cyan	100.0	0.6	52.7	53.3	-27.1	-27.0	-26.9	-27.0
A4	white	96.6	0.9	95.5	96.0	-0.2	-0.2	2.3	1.5
B4	neutral 8	100.0	0.6	80.7	81.2	-0.2	-0.2	1.3	0.9
C4	neutral 6.5	100.0	0.6	69.2	69.7	0.0	-0.1	0.7	0.5
D4	neutral 5	100.0	0.8	53.4	54.1	0.1	0.0	1.0	0.8
E4	neutral 3.5	100.0	0.7	39.9	40.6	0.1	0.0	-0.1	-0.2
F4	black	100.0	0.5	27.8	28.3	-0.2	-0.3	1.4	1.4
A5	paper white	96.6	0.9	98.1	98.5	-0.1	-0.2	1.9	1.0
B5	Skin highlight L*=88	95.1	1.7	89.0	89.7	13.7	12.6	16.3	15.2
C5	Skin highlight L* =75	96.9	1.7	76.8	77.6	19.6	18.5	21.2	20.3
D5	Skin shadow L*=28	99.7	0.8	31.2	31.8	14.0	13.5	13.7	13.4
E5	Skin shadow L*=13	98.1	1.1	23.3	24.1	9.2	8.8	8.8	8.2
F5	Maximum Black	100.0	0.3	16.8	17.1	0.5	0.5	1.4	1.2

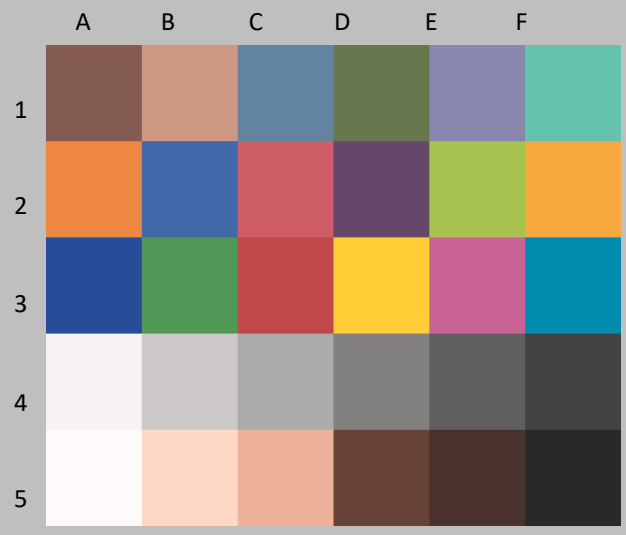
Summary Results	I* Color	I* tone	ΔE
Average Score for all patches	97.9	96.2	1.4
Worst 10% (3 lowest scoring patches)	93.5	91.3	3.4

90 Megalux hours

Printer: HP Z3200PS **Ink:** HP Vivera with Chromata Red **Media:** Moab Entrada Natural 300gsm, no additional coating



Original Print Colors before light exposure



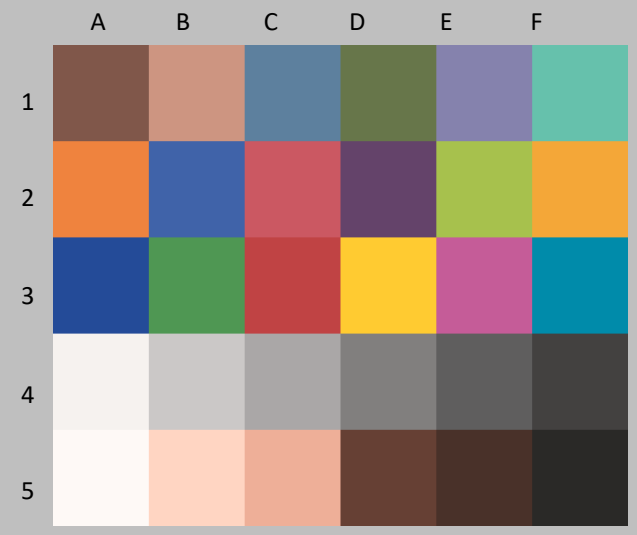
Colors After light exposure

				L*		a*		b*	
Patch #	Description	I* Color	ΔE	Before	After	Before	After	Before	After
A1	Dark Skin	97.3	1.6	41.4	42.6	15.5	14.7	14.3	13.5
B1	Light Skin	97.2	1.6	66.5	67.5	17.4	16.4	19.5	18.7
C1	Blue sky	96.6	1.7	52.4	53.7	-4.7	-5.3	-19.9	-18.9
D1	Foliage	98.9	1.1	47.3	48.0	-14.2	-14.0	22.3	21.5
E1	blue flower	91.6	3.0	56.2	57.8	9.6	8.4	-22.1	-19.9
F1	bluish green	99.6	0.8	71.9	72.5	-33.3	-32.9	1.8	1.3
A1	orange	97.9	2.0	65.8	66.5	34.9	33.5	54.3	53.1
B2	purplish blue	94.6	3.1	42.8	44.2	9.0	7.3	-41.1	-38.8
C2	moderate red	97.2	2.4	52.5	54.0	46.4	44.5	16.7	16.4
D2	purple	95.8	2.2	33.5	34.9	20.8	20.0	-17.3	-15.9
E2	yellow green	99.2	1.1	73.9	74.4	-25.9	-25.9	53.9	52.9
F2	orange yellow	98.7	1.5	74.5	75.2	18.5	17.5	65.3	64.3
A3	blue	97.1	2.1	33.3	34.3	14.2	12.8	-46.3	-45.0
B3	green	99.4	1.0	56.4	56.9	-38.3	-38.1	28.6	27.8
C3	red	97.4	2.3	46.6	47.8	49.3	47.7	26.3	25.2
D3	yellow	99.1	1.3	84.3	84.8	3.7	3.1	77.0	76.0
E3	magenta	92.8	4.5	53.9	55.7	47.9	45.6	-12.6	-9.3
F3	cyan	100.0	0.6	52.7	53.3	-27.1	-27.0	-26.9	-27.0
A4	white	96.6	0.9	95.5	96.0	-0.2	-0.2	2.3	1.5
B4	neutral 8	100.0	0.6	80.7	81.2	-0.2	-0.2	1.3	0.9
C4	neutral 6.5	100.0	0.6	69.2	69.7	0.0	0.0	0.7	0.5
D4	neutral 5	100.0	0.8	53.4	54.1	0.1	0.0	1.0	0.8
E4	neutral 3.5	100.0	0.7	39.9	40.6	0.1	0.0	-0.1	-0.2
F4	black	100.0	0.5	27.8	28.3	-0.2	-0.3	1.4	1.3
A5	paper white	96.2	0.9	98.1	98.4	-0.1	-0.1	1.9	1.0
B5	Skin highlight L*=88	94.8	1.8	89.0	89.7	13.7	12.5	16.3	15.2
C5	Skin highlight L* =75	96.2	1.9	76.8	77.7	19.6	18.3	21.2	20.3
D5	Skin shadow L*=28	99.8	0.8	31.2	31.8	14.0	13.5	13.7	13.4
E5	Skin shadow L*=13	97.4	1.1	23.3	24.0	9.2	8.7	8.8	8.2
F5	Maximum Black	100.0	0.3	16.8	17.1	0.5	0.4	1.4	1.2

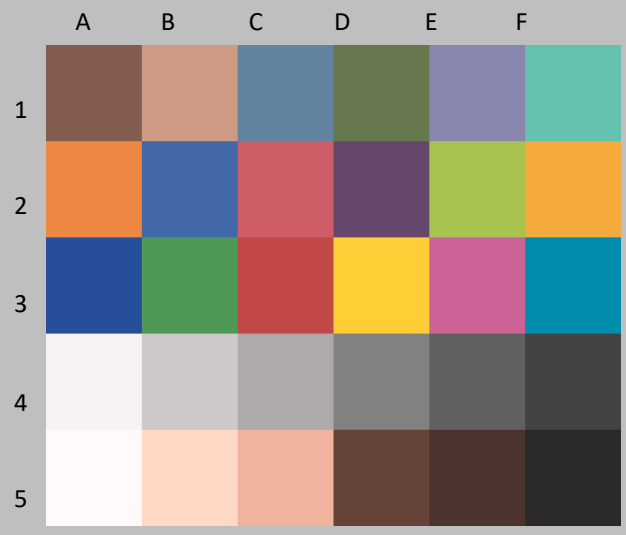
Summary Results	I* Color	I* tone	ΔE
Average Score for all patches	97.7	96.0	1.5
Worst 10% (3 lowest scoring patches)	93.0	90.8	3.5

100 Megalux hours

Printer: HP Z3200PS **Ink:** HP Vivera with Chromata Red **Media:** Moab Entrada Natural 300gsm, no additional coating



Original Print Colors before light exposure



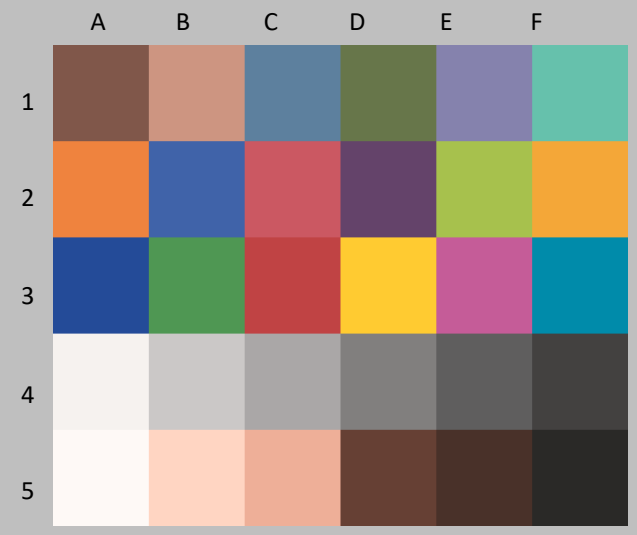
Colors After light exposure

Patch #	Description	I* Color	ΔE	L* Before	L* After	a* Before	a* After	b* Before	b* After
A1	Dark Skin	98.0	1.7	41.4	42.8	15.4	14.6	14.1	13.5
B1	Light Skin	97.3	1.7	66.6	67.8	17.3	16.3	19.3	18.6
C1	Blue sky	96.3	1.9	52.3	53.8	-4.7	-5.2	-20.0	-18.9
D1	Foliage	99.5	0.9	47.4	48.1	-14.2	-14.1	22.1	21.5
E1	blue flower	91.4	3.2	56.2	58.0	9.6	8.4	-22.1	-19.8
F1	bluish green	99.5	0.9	72.0	72.7	-33.3	-33.0	1.7	1.2
A1	orange	97.7	2.2	65.8	66.7	34.7	33.2	54.4	53.0
B2	purplish blue	94.0	3.4	42.8	44.4	9.2	7.3	-41.2	-38.8
C2	moderate red	97.0	2.6	52.5	54.3	46.5	44.5	16.7	16.4
D2	purple	95.3	2.4	33.6	35.2	20.7	19.9	-17.4	-15.8
E2	yellow green	98.7	1.4	74.0	74.6	-26.0	-26.0	53.9	52.6
F2	orange yellow	98.4	1.8	74.6	75.5	18.4	17.2	65.1	64.1
A3	blue	97.3	2.1	33.4	34.4	14.0	12.7	-46.3	-45.0
B3	green	99.1	1.2	56.4	57.1	-38.3	-38.1	28.7	27.7
C3	red	97.5	2.4	46.6	48.0	49.4	47.8	26.6	25.5
D3	yellow	98.7	1.6	84.3	84.9	3.7	2.9	77.0	75.7
E3	magenta	92.6	4.7	53.9	56.1	47.9	45.6	-12.6	-9.2
F3	cyan	100.0	0.7	52.7	53.4	-27.0	-27.0	-26.9	-27.0
A4	white	97.1	0.9	95.6	96.1	-0.2	-0.2	2.2	1.4
B4	neutral 8	100.0	0.7	80.7	81.3	-0.3	-0.3	1.3	0.9
C4	neutral 6.5	100.0	0.8	69.1	69.8	-0.1	-0.1	0.7	0.5
D4	neutral 5	100.0	0.9	53.4	54.3	0.1	0.0	1.0	0.9
E4	neutral 3.5	100.0	0.8	40.0	40.8	0.1	0.0	-0.2	-0.2
F4	black	100.0	0.6	28.0	28.6	-0.3	-0.3	1.4	1.3
A5	paper white	96.6	0.9	98.1	98.5	-0.1	-0.1	1.8	1.0
B5	Skin highlight L*=88	93.6	2.1	89.0	90.0	13.7	12.4	16.4	15.1
C5	Skin highlight L* =75	96.0	2.0	76.9	78.0	19.4	18.1	21.3	20.3
D5	Skin shadow L*=28	98.5	1.2	31.3	32.1	14.0	13.5	13.8	13.2
E5	Skin shadow L*=13	96.9	1.4	23.3	24.5	9.3	8.7	8.7	8.0
F5	Maximum Black	100.0	1.0	16.9	17.8	0.5	0.4	1.3	1.0

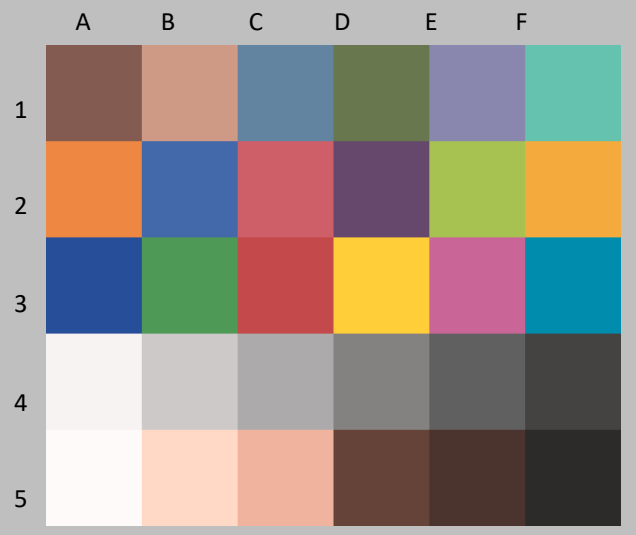
Summary Results	I* Color	I* tone	ΔE
Average Score for all patches	97.6	95.3	1.7
Worst 10% (3 lowest scoring patches)	92.5	89.4	3.8

120 Megalux hours

Printer: HP Z3200PS **Ink:** HP Vivera with Chromata Red **Media:** Moab Entrada Natural 300gsm, no additional coating



Original Print Colors before light exposure



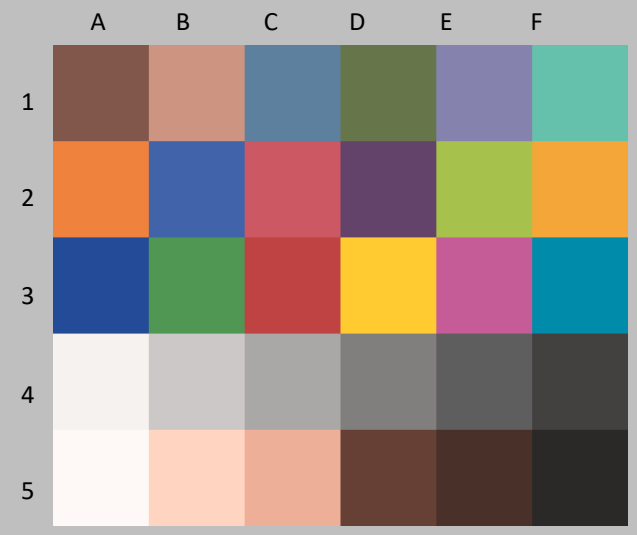
Colors After light exposure

				L*		a*		b*	
Patch #	Description	I* Color	ΔE	Before	After	Before	After	Before	After
A1	Dark Skin	97.5	1.8	41.4	42.8	15.4	14.5	14.1	13.5
B1	Light Skin	96.7	1.9	66.6	67.9	17.3	16.2	19.3	18.4
C1	Blue sky	95.7	2.1	52.3	53.9	-4.7	-5.3	-20.0	-18.7
D1	Foliage	99.1	1.0	47.4	48.0	-14.2	-14.0	22.1	21.4
E1	blue flower	90.3	3.5	56.2	58.1	9.6	8.3	-22.1	-19.6
F1	bluish green	99.4	0.9	72.0	72.5	-33.3	-33.1	1.7	1.1
A1	orange	97.1	2.6	65.8	66.7	34.7	33.0	54.4	52.7
B2	purplish blue	93.4	3.7	42.8	44.5	9.2	7.2	-41.2	-38.6
C2	moderate red	96.7	2.8	52.5	54.4	46.5	44.4	16.7	16.3
D2	purple	94.9	2.5	33.6	35.2	20.7	19.8	-17.4	-15.7
E2	yellow green	98.4	1.5	74.0	74.5	-26.0	-25.8	53.9	52.5
F2	orange yellow	98.0	2.0	74.6	75.5	18.4	17.0	65.1	63.9
A3	blue	97.1	2.2	33.4	34.4	14.0	12.7	-46.3	-44.9
B3	green	98.8	1.3	56.4	57.1	-38.3	-38.1	28.7	27.6
C3	red	97.0	2.7	46.6	48.1	49.4	47.7	26.6	25.2
D3	yellow	98.4	1.8	84.3	84.9	3.7	2.8	77.0	75.5
E3	magenta	92.0	5.1	53.9	56.2	47.9	45.3	-12.6	-8.9
F3	cyan	100.0	0.8	52.7	53.4	-27.0	-26.9	-26.9	-26.8
A4	white	97.4	0.9	95.6	96.0	-0.2	-0.2	2.2	1.4
B4	neutral 8	100.0	0.7	80.7	81.3	-0.3	-0.2	1.3	0.9
C4	neutral 6.5	100.0	0.8	69.1	69.9	-0.1	-0.1	0.7	0.5
D4	neutral 5	100.0	1.0	53.4	54.4	0.1	0.1	1.0	0.9
E4	neutral 3.5	100.0	0.7	40.0	40.7	0.1	0.0	-0.2	-0.2
F4	black	100.0	0.6	28.0	28.5	-0.3	-0.3	1.4	1.3
A5	paper white	96.0	0.9	98.1	98.4	-0.1	-0.1	1.8	1.0
B5	Skin highlight L*=88	92.7	2.3	89.0	89.9	13.7	12.3	16.4	14.9
C5	Skin highlight L* =75	95.3	2.2	76.9	78.0	19.4	18.1	21.3	20.0
D5	Skin shadow L*=28	97.5	1.3	31.3	32.2	14.0	13.2	13.8	13.2
E5	Skin shadow L*=13	97.3	1.4	23.3	24.4	9.3	8.7	8.7	8.2
F5	Maximum Black	100.0	1.1	16.9	17.9	0.5	0.4	1.3	1.2

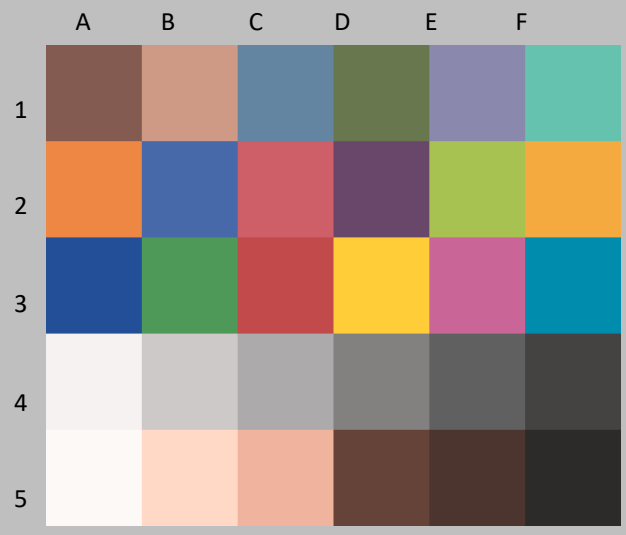
Summary Results	I* Color	I* tone	ΔE
Average Score for all patches	97.2	95.0	1.8
Worst 10% (3 lowest scoring patches)	91.7	88.4	4.1

140 Megalux hours

Printer: HP Z3200PS **Ink:** HP Vivera with Chromata Red **Media:** Moab Entrada Natural 300gsm, no additional coating



Original Print Colors before light exposure



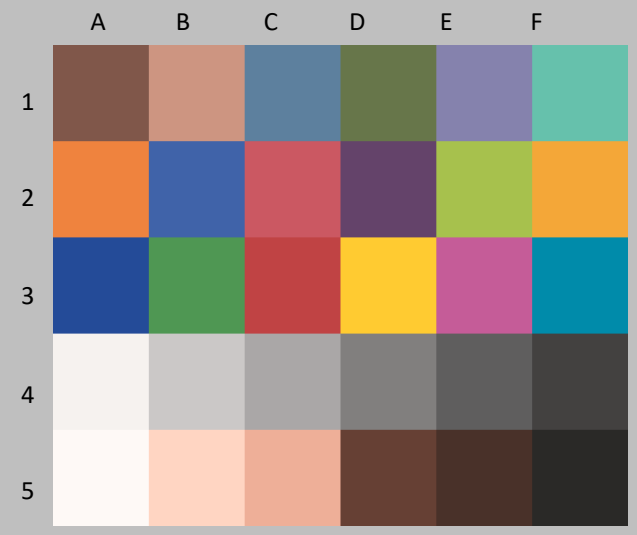
Colors After light exposure

Patch #	Description	I* Color	ΔE	L* Before	L* After	a* Before	a* After	b* Before	b* After
A1	Dark Skin	97.1	1.9	41.4	42.9	15.4	14.5	14.1	13.4
B1	Light Skin	96.3	2.0	66.6	67.9	17.3	16.1	19.3	18.4
C1	Blue sky	94.8	2.2	52.3	54.0	-4.7	-5.3	-20.0	-18.6
D1	Foliage	98.1	1.2	47.4	48.0	-14.2	-14.0	22.1	21.2
E1	blue flower	89.1	3.8	56.2	58.3	9.6	8.3	-22.1	-19.3
F1	bluish green	99.1	1.0	72.0	72.6	-33.3	-32.9	1.7	1.1
A1	orange	96.4	2.9	65.8	66.7	34.7	32.8	54.4	52.3
B2	purplish blue	92.4	4.2	42.8	44.7	9.2	7.1	-41.2	-38.1
C2	moderate red	96.1	3.1	52.5	54.5	46.5	44.1	16.7	16.2
D2	purple	93.9	2.8	33.6	35.4	20.7	19.7	-17.4	-15.5
E2	yellow green	97.7	1.9	74.0	74.5	-26.0	-25.9	53.9	52.0
F2	orange yellow	97.3	2.5	74.6	75.4	18.4	16.8	65.1	63.4
A3	blue	96.3	2.6	33.4	34.5	14.0	12.4	-46.3	-44.6
B3	green	98.1	1.5	56.4	57.1	-38.3	-37.9	28.7	27.3
C3	red	96.5	3.0	46.6	48.2	49.4	47.5	26.6	25.0
D3	yellow	97.8	2.3	84.3	84.8	3.7	2.7	77.0	75.0
E3	magenta	91.5	5.3	53.9	56.2	47.9	45.1	-12.6	-8.8
F3	cyan	100.0	0.7	52.7	53.4	-27.0	-26.9	-26.9	-26.8
A4	white	96.2	0.9	95.6	95.8	-0.2	-0.2	2.2	1.3
B4	neutral 8	100.0	0.6	80.7	81.1	-0.3	-0.3	1.3	0.9
C4	neutral 6.5	100.0	0.7	69.1	69.8	-0.1	-0.1	0.7	0.5
D4	neutral 5	100.0	0.9	53.4	54.3	0.1	0.0	1.0	0.8
E4	neutral 3.5	100.0	0.8	40.0	40.7	0.1	0.0	-0.2	-0.3
F4	black	100.0	0.6	28.0	28.5	-0.3	-0.3	1.4	1.3
A5	paper white	95.4	0.9	98.1	98.2	-0.1	-0.1	1.8	0.9
B5	Skin highlight L*=88	91.5	2.5	89.0	89.8	13.7	12.1	16.4	14.7
C5	Skin highlight L* =75	94.2	2.4	76.9	78.0	19.4	17.8	21.3	19.8
D5	Skin shadow L*=28	97.4	1.4	31.3	32.2	14.0	13.3	13.8	13.0
E5	Skin shadow L*=13	95.1	1.6	23.3	24.5	9.3	8.7	8.7	7.8
F5	Maximum Black	100.0	1.2	16.9	18.0	0.5	0.5	1.3	0.8

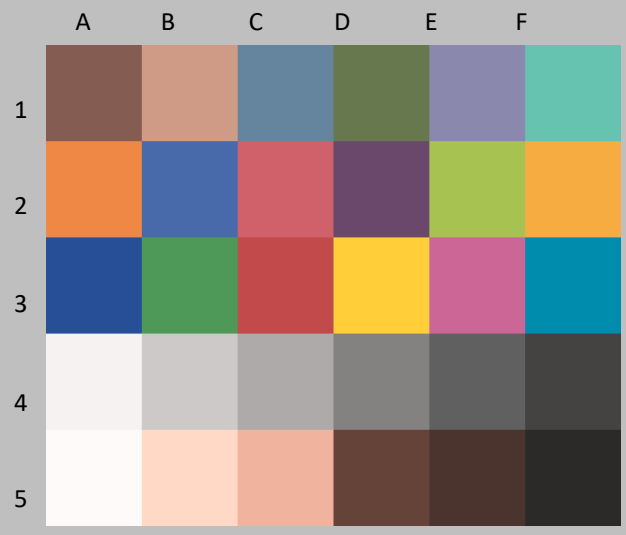
Summary Results	I* Color	I* tone	ΔE
Average Score for all patches	96.6	94.4	2.0
Worst 10% (3 lowest scoring patches)	90.7	87.7	4.4

160 Megalux hours

Printer: HP Z3200PS **Ink:** HP Vivera with Chromata Red **Media:** Moab Entrada Natural 300gsm, no additional coating



Original Print Colors before light exposure



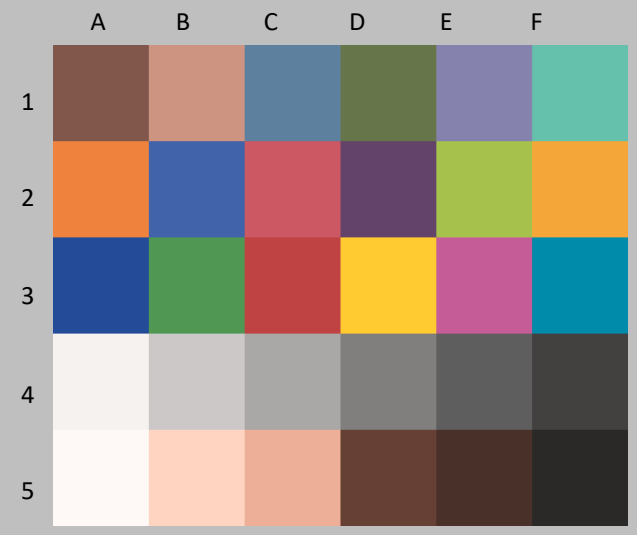
Colors After light exposure

Patch #	Description	I* Color	ΔE	L* Before	L* After	a* Before	a* After	b* Before	b* After
A1	Dark Skin	97.3	2.0	41.4	43.1	15.4	14.5	14.1	13.4
B1	Light Skin	96.1	2.1	66.6	68.1	17.3	16.1	19.3	18.4
C1	Blue sky	94.0	2.5	52.3	54.1	-4.7	-5.2	-20.0	-18.4
D1	Foliage	97.5	1.4	47.4	48.1	-14.2	-13.9	22.1	21.0
E1	blue flower	87.5	4.2	56.2	58.5	9.6	8.2	-22.1	-18.9
F1	bluish green	99.1	1.1	72.0	72.8	-33.3	-32.9	1.7	1.0
A1	orange	96.2	3.1	65.8	66.9	34.7	32.7	54.4	52.2
B2	purplish blue	91.6	4.6	42.8	44.9	9.2	6.9	-41.2	-37.8
C2	moderate red	95.7	3.5	52.5	54.8	46.5	43.9	16.7	16.2
D2	purple	93.5	3.0	33.6	35.6	20.7	19.7	-17.4	-15.3
E2	yellow green	97.4	2.2	74.0	74.6	-26.0	-25.8	53.9	51.8
F2	orange yellow	97.1	2.6	74.6	75.6	18.4	16.8	65.1	63.3
A3	blue	95.9	2.8	33.4	34.6	14.0	12.3	-46.3	-44.5
B3	green	98.1	1.6	56.4	57.2	-38.3	-38.0	28.7	27.3
C3	red	96.5	3.1	46.6	48.4	49.4	47.4	26.6	25.1
D3	yellow	97.7	2.4	84.3	84.9	3.7	2.7	77.0	74.9
E3	magenta	90.9	5.6	53.9	56.5	47.9	45.1	-12.6	-8.5
F3	cyan	100.0	0.8	52.7	53.4	-27.0	-27.0	-26.9	-26.7
A4	white	96.9	0.8	95.6	95.9	-0.2	-0.2	2.2	1.4
B4	neutral 8	100.0	0.6	80.7	81.2	-0.3	-0.3	1.3	1.0
C4	neutral 6.5	100.0	0.8	69.1	69.9	-0.1	-0.1	0.7	0.6
D4	neutral 5	100.0	0.9	53.4	54.4	0.1	0.0	1.0	0.9
E4	neutral 3.5	100.0	0.8	40.0	40.8	0.1	0.0	-0.2	-0.2
F4	black	100.0	0.6	28.0	28.6	-0.3	-0.3	1.4	1.3
A5	paper white	95.9	0.9	98.1	98.3	-0.1	-0.1	1.8	0.9
B5	Skin highlight L*=88	91.4	2.5	89.0	90.0	13.7	12.0	16.4	14.7
C5	Skin highlight L* =75	94.0	2.6	76.9	78.1	19.4	17.7	21.3	19.8
D5	Skin shadow L*=28	97.3	1.4	31.3	32.2	14.0	13.3	13.8	13.0
E5	Skin shadow L*=13	95.6	1.5	23.3	24.4	9.3	8.7	8.7	7.9
F5	Maximum Black	100.0	1.0	16.9	17.8	0.5	0.4	1.3	1.0

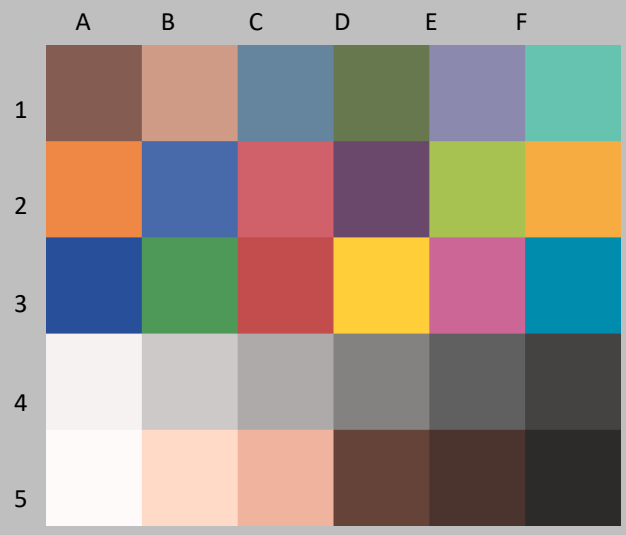
Summary Results	I* Color	I* tone	ΔE
Average Score for all patches	96.4	93.9	2.1
Worst 10% (3 lowest scoring patches)	89.9	86.2	4.8

180 Megalux hours

Printer: HP Z3200PS **Ink:** HP Vivera with Chromata Red **Media:** Moab Entrada Natural 300gsm, no additional coating



Original Print Colors before light exposure



Colors After light exposure

				L*		a*		b*	
Patch #	Description	I* Color	ΔE	Before	After	Before	After	Before	After
A1	Dark Skin	97.2	2.2	41.4	43.2	15.4	14.5	14.1	13.5
B1	Light Skin	95.7	2.3	66.6	68.2	17.3	16.0	19.3	18.3
C1	Blue sky	93.0	2.7	52.3	54.3	-4.7	-5.2	-20.0	-18.1
D1	Foliage	97.3	1.5	47.4	48.2	-14.2	-13.9	22.1	20.9
E1	blue flower	86.4	4.6	56.2	58.7	9.6	8.2	-22.1	-18.6
F1	bluish green	99.1	1.1	72.0	72.8	-33.3	-32.8	1.7	1.1
A1	orange	96.0	3.3	65.8	67.0	34.7	32.6	54.4	52.1
B2	purplish blue	91.1	4.8	42.8	45.1	9.2	6.9	-41.2	-37.6
C2	moderate red	95.6	3.6	52.5	54.9	46.5	43.8	16.7	16.2
D2	purple	92.9	3.2	33.6	35.7	20.7	19.7	-17.4	-15.2
E2	yellow green	96.9	2.4	74.0	74.6	-26.0	-25.8	53.9	51.6
F2	orange yellow	96.8	2.8	74.6	75.6	18.4	16.7	65.1	63.1
A3	blue	95.4	3.1	33.4	34.8	14.0	12.1	-46.3	-44.3
B3	green	97.8	1.7	56.4	57.2	-38.3	-38.0	28.7	27.2
C3	red	96.4	3.2	46.6	48.5	49.4	47.4	26.6	25.1
D3	yellow	97.5	2.6	84.3	84.9	3.7	2.6	77.0	74.8
E3	magenta	90.4	5.9	53.9	56.6	47.9	44.9	-12.6	-8.2
F3	cyan	100.0	0.8	52.7	53.5	-27.0	-27.0	-26.9	-26.7
A4	white	96.8	0.8	95.6	95.8	-0.2	-0.2	2.2	1.4
B4	neutral 8	100.0	0.6	80.7	81.3	-0.3	-0.3	1.3	1.1
C4	neutral 6.5	100.0	0.8	69.1	69.9	-0.1	-0.1	0.7	0.7
D4	neutral 5	100.0	1.0	53.4	54.4	0.1	0.0	1.0	1.0
E4	neutral 3.5	100.0	0.9	40.0	40.9	0.1	0.0	-0.2	-0.1
F4	black	100.0	0.6	28.0	28.5	-0.3	-0.3	1.4	1.4
A5	paper white	96.2	0.9	98.1	98.2	-0.1	-0.1	1.8	1.0
B5	Skin highlight L*=88	90.4	2.7	89.0	90.0	13.7	11.9	16.4	14.6
C5	Skin highlight L* =75	93.4	2.7	76.9	78.2	19.4	17.6	21.3	19.8
D5	Skin shadow L*=28	97.6	1.4	31.3	32.3	14.0	13.3	13.8	13.1
E5	Skin shadow L*=13	96.1	1.5	23.3	24.5	9.3	8.7	8.7	7.9
F5	Maximum Black	100.0	1.1	16.9	18.0	0.5	0.4	1.3	1.1

Summary Results	I* Color	I* tone	ΔE
Average Score for all patches	96.2	93.5	2.2
Worst 10% (3 lowest scoring patches)	89.1	85.5	5.1

200 Megalux hours

Section III: Light Induced Low-intensity Staining Test Results

This section presents test results for samples that are retired from the light fade testing unit to dark storage (0 lux,~21˚C, 50% RH) at five discreet exposure intervals (0 luxhrs, i.e., the dark storage control sample, 20 Mluxhrs, 50 Mluxhrs, 100 Mluxhrs, and 200 Mluxhrs). All of the sample image targets were printed at the same time on the same sheet of media to ensure maximum uniformity of the sample set. Also, reference measurements were initially made for each individual target to account for any minor printer output variations withn the complete sample set. The retired targets undergo a series of remeasurements at specified intervals (6 months, 1year, 2 years, etc.) from the time each sample was retired to dark storage. I* color and tonal accuracy scores and Conservation Display ratings decrease while Δb* values increase if the media shows ongoing light-induced post-exposure yellowing. The dark storage control sample (see section IV) reveals if any humidity-induced colorant shifts, thermal aging, and/or gas contaimination is also contributing to color appearance changes over time.

AaI 30 Patch Color Target

I* Color (Average) Summary

Light Exposure (Mluxhrs)	Years of Dark Storage Time after exposure						
	0	0.5	1	2	3	4	5
0	100.0	100.0	100.0	100.0			
20	99.4	99.5	99.5	99.4			
50	98.5	98.9	98.8	98.7			
100	97.7	97.9	97.9				

values in red exceed Conservation Display Rating *Upper* limit

I* Color (Worst 10%) Summary

Light Exposure (Mluxhrs)	Years of Dark Storage Time after exposure						
	0	0.5	1	2	3	4	5
0	100.0	100.0	100.0	100.0			
20	96.8	96.8	96.8	96.2			
50	95.2	95.0	94.4	94.0			
100	93.0	92.6	92.4				

values in red exceed Conservation Display Rating *Lower* limit

I* Tone (Average) Summary

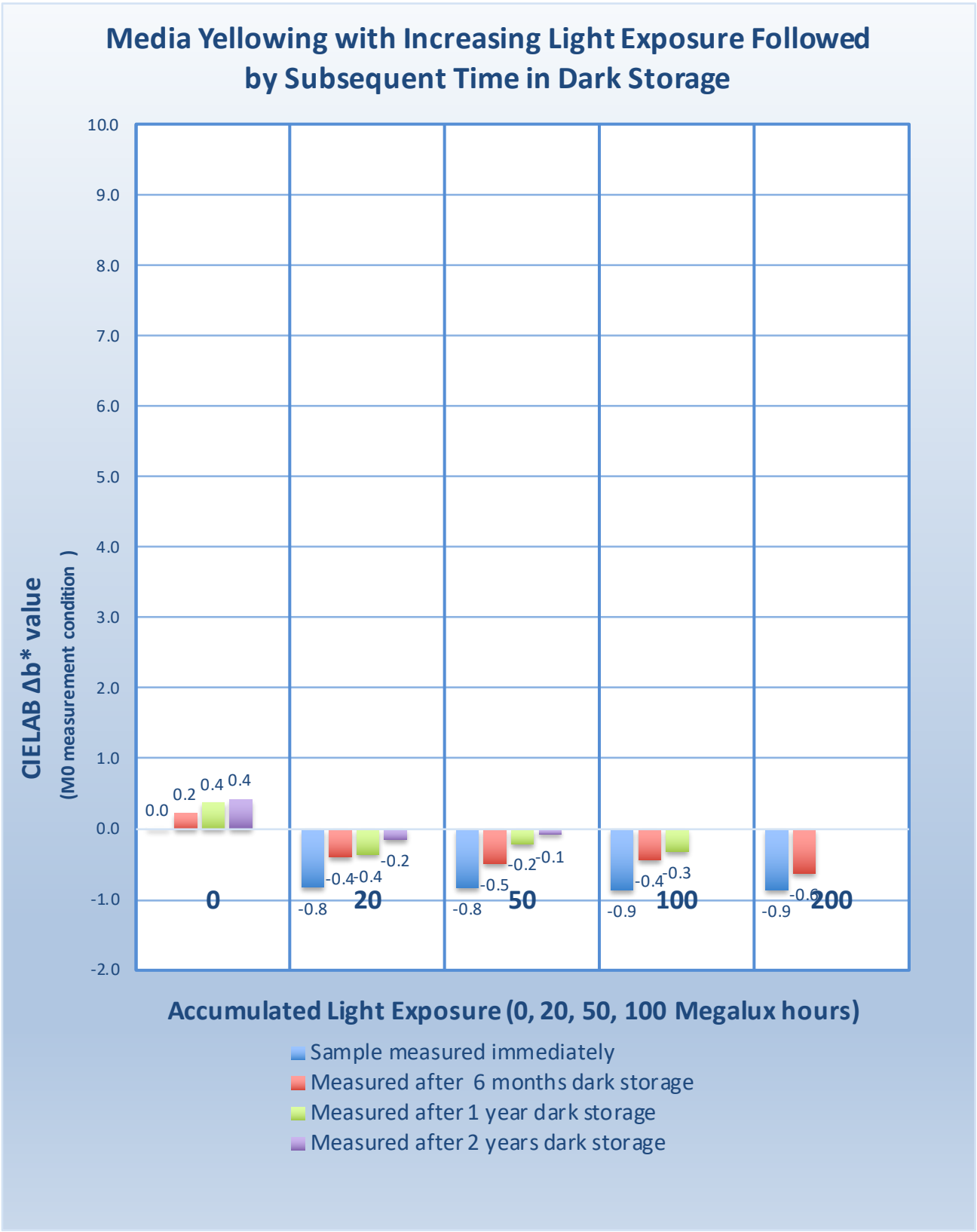
Light Exposure (Mluxhrs)	Years of Dark Storage Time after exposure						
	0	0.5	1	2	3	4	5
0	100.0	99.1	99.0	98.7			
20	98.1	98.0	98.0	98.0			
50	97.3	97.3	97.1	97.1			
100	96.0	95.9	95.9				

values in red exceed Conservation Display Rating Upper limit

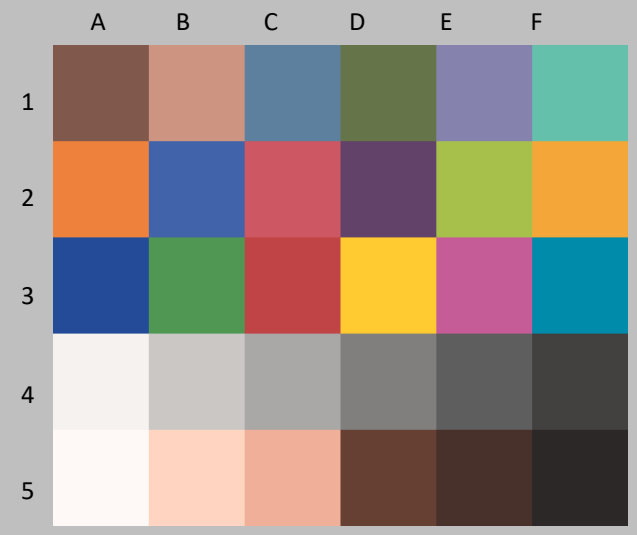
I* Tone (Worst 10%) Summary

Light Exposure (Mluxhrs)	Years of Dark Storage Time after exposure						
	0	0.5	1	2	3	4	5
0	100.0	97.8	97.5	96.5			
20	95.4	95.3	95.3	95.3			
50	93.8	93.5	93.0	92.9			
100	90.8	90.5	90.3				

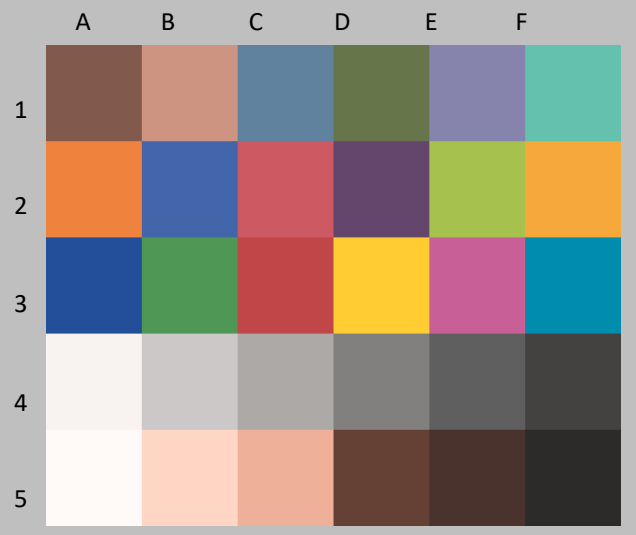
values in red exceed Conservation Display Rating *Lower* limit


Media Yellowing with Increasing Light Exposure Followed by Subsequent Time in Dark Storage
CIELAB Δb* value
(M0 measurement condition)
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
0.0
0.2
0.4
0.4
0
-0.8
-0.4
-0.4
-0.2
20
-0.8
-0.5
-0.2
-0.1
50
-0.9
-0.4
-0.3
100
-0.9
-0.5
200
Accumulated Light Exposure (0, 20, 50, 100 Megalux hours)
Sample measured immediately
Measured after 6 months dark storage
Measured after 1 year dark storage
Measured after 2 years dark storage

Printer: HP Z3200PS **Ink:** HP Vivera with Chromata Red **Media:** Moab Entrada Natural 300gsm, no additional coating



Original Print Colors before light exposure



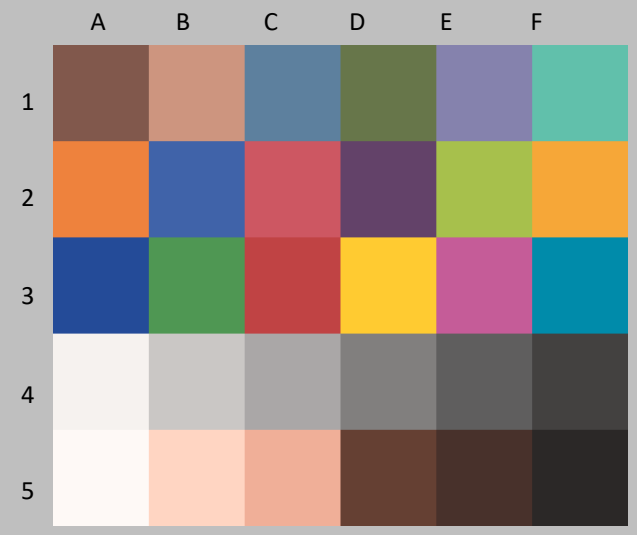
Colors after both light exposure + dark storage

				L*		a*		b*	
Patch #	Description	I* Color	ΔE	Before	After	Before	After	Before	After
A1	Dark Skin	99.4	0.8	41.4	41.9	15.4	15.0	14.2	13.7
B1	Light Skin	100.0	0.6	66.5	66.9	17.5	17.2	19.3	18.9
C1	Blue sky	99.2	0.9	52.3	52.9	-4.7	-5.1	-19.9	-19.4
D1	Foliage	100.0	0.4	47.1	47.4	-14.1	-14.0	21.9	21.7
E1	blue flower	96.6	1.5	56.1	56.8	9.6	8.8	-22.1	-21.0
F1	bluish green	100.0	0.4	71.7	72.0	-33.5	-33.4	1.7	1.5
A1	orange	99.8	0.7	65.5	65.8	35.0	34.7	54.1	53.5
B2	purplish blue	97.6	1.6	42.8	43.4	9.0	8.0	-41.1	-40.0
C2	moderate red	99.4	1.0	52.4	53.0	46.5	45.7	16.7	16.8
D2	purple	98.4	1.1	33.5	34.2	20.8	20.3	-17.4	-16.6
E2	yellow green	100.0	0.4	73.9	74.1	-26.1	-26.1	53.8	53.5
F2	orange yellow	100.0	0.6	74.6	74.9	18.4	18.1	65.3	64.8
A3	blue	99.6	0.8	33.5	33.9	14.0	13.5	-46.0	-45.5
B3	green	100.0	0.5	56.4	56.6	-38.3	-38.0	28.5	28.2
C3	red	99.9	0.7	46.6	47.1	49.0	48.4	26.0	25.9
D3	yellow	100.0	0.4	84.2	84.5	3.6	3.4	76.8	76.6
E3	magenta	96.1	2.6	53.9	54.8	47.9	46.5	-12.6	-10.6
F3	cyan	100.0	0.3	52.6	52.9	-26.9	-26.9	-26.7	-26.9
A4	white	100.0	0.5	95.6	95.9	-0.2	-0.3	2.3	2.0
B4	neutral 8	100.0	0.4	80.5	80.9	-0.2	-0.2	1.4	1.2
C4	neutral 6.5	100.0	0.3	69.1	69.3	0.0	-0.1	0.7	0.6
D4	neutral 5	100.0	0.3	53.3	53.6	0.1	0.0	1.1	1.0
E4	neutral 3.5	100.0	0.5	39.8	40.3	0.1	0.0	-0.2	-0.2
F4	black	100.0	0.1	28.0	28.1	-0.2	-0.2	1.3	1.4
A5	paper white	100.0	0.5	98.1	98.4	-0.2	-0.2	2.0	1.6
B5	Skin highlight L*=88	98.8	0.9	88.8	89.2	14.0	13.4	16.2	15.8
C5	Skin highlight L* =75	99.7	0.7	76.7	77.1	19.6	19.3	21.3	20.8
D5	Skin shadow L*=28	100.0	0.5	31.0	31.4	13.9	13.7	13.6	13.4
E5	Skin shadow L*=13	100.0	0.8	23.1	23.8	9.1	8.9	8.4	8.2
F5	Maximum Black	100.0	1.0	16.9	17.9	0.5	0.5	1.0	1.0

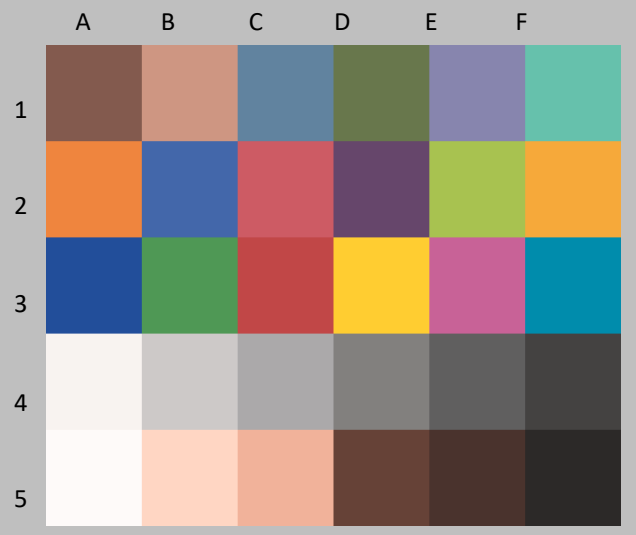
Summary Results	I* Color	I* tone	ΔE
Average Score for all patches	99.5	98.0	0.7
Worst 10% (3 lowest scoring patches)	96.8	95.3	1.9

20 Mluxhrs + 6 months

Printer: HP Z3200PS **Ink:** HP Vivera with Chromata Red **Media:** Moab Entrada Natural 300gsm, no additional coating



Original Print Colors before light exposure



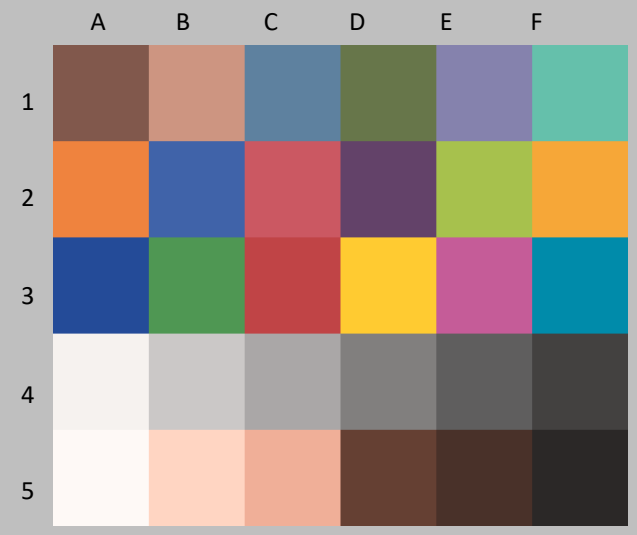
Colors after both light exposure + dark storage

				L*		a*		b*	
Patch #	Description	I* Color	ΔE	Before	After	Before	After	Before	After
A1	Dark Skin	98.8	1.1	41.4	42.3	15.4	14.9	14.3	13.7
B1	Light Skin	99.0	1.0	66.5	67.2	17.4	16.9	19.7	19.1
C1	Blue sky	98.2	1.3	52.4	53.3	-4.7	-5.2	-19.9	-19.2
D1	Foliage	100.0	0.7	47.3	47.8	-14.3	-14.2	22.4	21.9
E1	blue flower	94.4	2.2	56.2	57.3	9.6	8.5	-22.0	-20.5
F1	bluish green	100.0	0.6	71.8	72.2	-33.6	-33.3	1.8	1.5
A1	orange	99.1	1.2	65.7	66.2	34.8	34.1	54.4	53.6
B2	purplish blue	96.1	2.4	42.7	43.8	9.0	7.6	-41.2	-39.6
C2	moderate red	98.6	1.6	52.5	53.5	46.5	45.4	17.0	16.9
D2	purple	97.0	1.7	33.5	34.5	20.8	20.0	-17.2	-16.2
E2	yellow green	100.0	0.7	73.9	74.3	-26.1	-26.1	53.9	53.4
F2	orange yellow	99.6	0.9	74.5	75.1	18.6	18.1	65.4	64.8
A3	blue	98.7	1.3	33.2	34.0	14.2	13.3	-46.3	-45.6
B3	green	99.9	0.7	56.4	56.9	-38.5	-38.3	28.7	28.2
C3	red	98.4	1.6	46.6	47.3	49.3	48.2	26.7	25.8
D3	yellow	99.9	0.8	84.3	84.8	3.6	3.2	77.1	76.6
E3	magenta	94.6	3.5	53.9	55.3	48.0	46.3	-12.7	-10.0
F3	cyan	100.0	0.5	52.6	53.1	-27.1	-27.1	-26.9	-27.0
A4	white	100.0	0.6	95.6	96.0	-0.2	-0.3	2.4	1.9
B4	neutral 8	100.0	0.5	80.6	81.0	-0.2	-0.3	1.4	1.1
C4	neutral 6.5	100.0	0.5	69.0	69.5	-0.1	-0.1	0.6	0.5
D4	neutral 5	100.0	0.6	53.3	53.9	0.1	0.0	1.1	0.9
E4	neutral 3.5	100.0	0.6	39.8	40.4	0.1	0.0	-0.1	-0.2
F4	black	100.0	0.4	27.8	28.2	-0.2	-0.3	1.4	1.4
A5	paper white	100.0	0.6	98.1	98.5	-0.2	-0.2	1.9	1.4
B5	Skin highlight L*=88	97.6	1.2	88.9	89.6	13.8	13.1	16.3	15.6
C5	Skin highlight L* =75	98.6	1.1	76.8	77.5	19.6	18.9	21.4	20.8
D5	Skin shadow L*=28	99.9	0.8	31.2	31.8	14.0	13.6	13.7	13.4
E5	Skin shadow L*=13	100.0	0.8	23.2	23.9	9.2	8.9	8.4	8.2
F5	Maximum Black	100.0	0.5	16.8	17.3	0.5	0.5	1.4	1.2

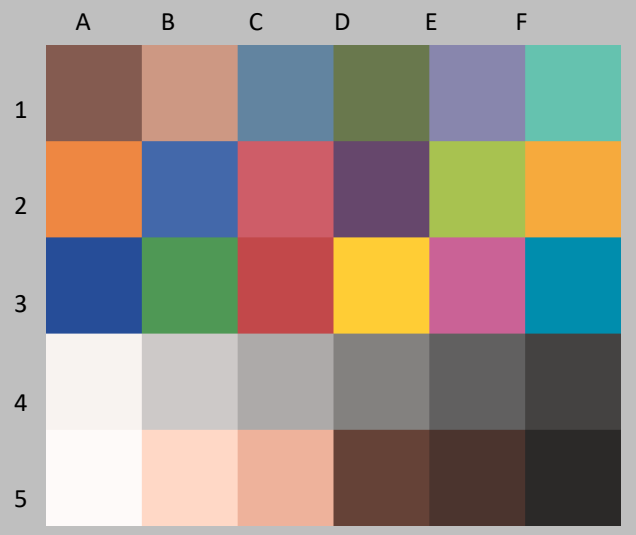
Summary Results	I* Color	I* tone	ΔE
Average Score for all patches	98.9	97.3	1.1
Worst 10% (3 lowest scoring patches)	95.0	93.5	2.7

50 Mluxhrs + 6 months

Printer: HP Z3200PS **Ink:** HP Vivera with Chromata Red **Media:** Moab Entrada Natural 300gsm, no additional coating



Original Print Colors before light exposure



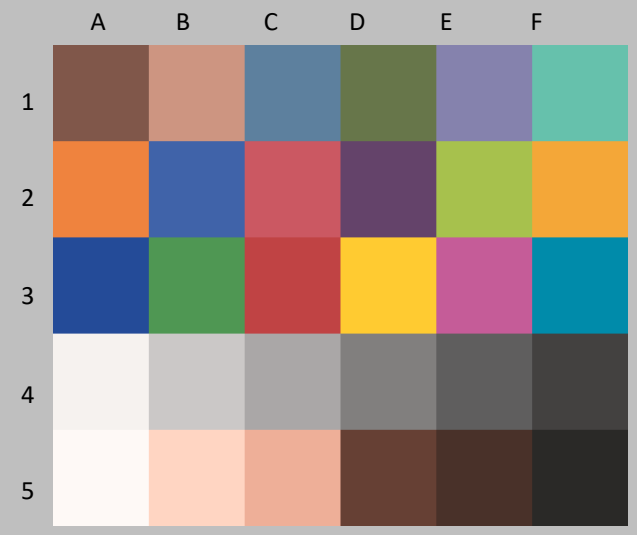
Colors after both light exposure + dark storage

Patch #	Description	I* Color	ΔE	L* Before	L* After	a* Before	a* After	b* Before	b* After
A1	Dark Skin	97.2	1.7	41.4	42.7	15.5	14.7	14.3	13.5
B1	Light Skin	97.5	1.5	66.5	67.5	17.4	16.5	19.5	18.8
C1	Blue sky	96.1	1.8	52.4	53.7	-4.7	-5.3	-19.9	-18.8
D1	Foliage	99.0	1.1	47.3	48.0	-14.2	-14.0	22.3	21.5
E1	blue flower	91.1	3.1	56.2	57.8	9.6	8.4	-22.1	-19.7
F1	bluish green	99.9	0.8	71.9	72.5	-33.3	-32.9	1.8	1.4
A1	orange	97.9	2.0	65.8	66.5	34.9	33.5	54.3	53.1
B2	purplish blue	94.1	3.3	42.8	44.2	9.0	7.2	-41.1	-38.7
C2	moderate red	97.3	2.4	52.5	54.0	46.4	44.6	16.7	16.4
D2	purple	95.4	2.3	33.5	35.0	20.8	19.9	-17.3	-15.8
E2	yellow green	99.2	1.1	73.9	74.4	-25.9	-25.8	53.9	52.9
F2	orange yellow	98.7	1.5	74.5	75.2	18.5	17.6	65.3	64.3
A3	blue	97.1	2.2	33.3	34.3	14.2	12.7	-46.3	-45.0
B3	green	99.5	0.9	56.4	56.9	-38.3	-38.0	28.6	27.9
C3	red	97.3	2.3	46.6	47.8	49.3	47.7	26.3	25.1
D3	yellow	99.0	1.4	84.3	84.8	3.7	3.1	77.0	75.9
E3	magenta	92.5	4.6	53.9	55.8	47.9	45.6	-12.6	-9.1
F3	cyan	100.0	0.6	52.7	53.3	-27.1	-27.0	-26.9	-26.9
A4	white	100.0	0.6	95.5	95.9	-0.2	-0.3	2.3	1.8
B4	neutral 8	100.0	0.5	80.7	81.1	-0.2	-0.2	1.3	1.1
C4	neutral 6.5	100.0	0.6	69.2	69.7	0.0	-0.1	0.7	0.6
D4	neutral 5	100.0	0.8	53.4	54.1	0.1	0.0	1.0	0.9
E4	neutral 3.5	100.0	0.7	39.9	40.6	0.1	0.0	-0.1	-0.2
F4	black	100.0	0.5	27.8	28.3	-0.2	-0.3	1.4	1.3
A5	paper white	100.0	0.5	98.1	98.4	-0.1	-0.2	1.9	1.4
B5	Skin highlight L*=88	95.3	1.7	89.0	89.7	13.7	12.5	16.3	15.4
C5	Skin highlight L* =75	96.6	1.8	76.8	77.7	19.6	18.4	21.2	20.4
D5	Skin shadow L*=28	99.2	1.0	31.2	31.9	14.0	13.4	13.7	13.4
E5	Skin shadow L*=13	98.0	1.2	23.3	24.2	9.2	8.7	8.8	8.2
F5	Maximum Black	100.0	0.4	16.8	17.1	0.5	0.5	1.4	1.2

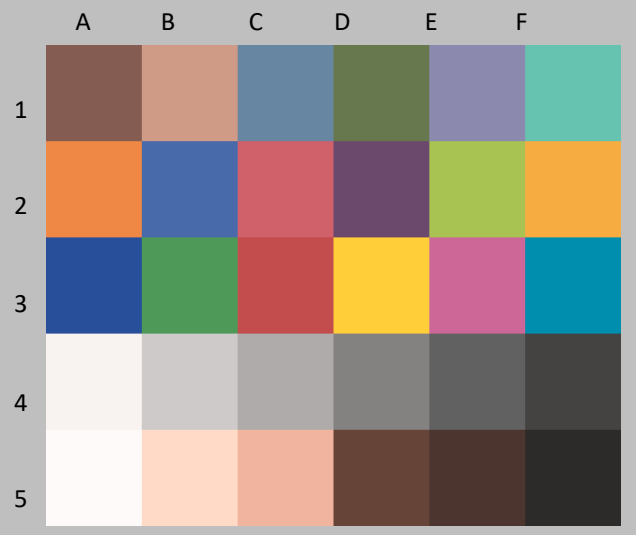
Summary Results	I* Color	I* tone	ΔE
Average Score for all patches	97.9	95.9	1.5
Worst 10% (3 lowest scoring patches)	92.6	90.5	3.7

100 Mluxhrs + 6 months

Printer: HP Z3200PS **Ink:** HP Vivera with Chromata Red **Media:** Moab Entrada Natural 300gsm, no additional coating



Original Print Colors before light exposure



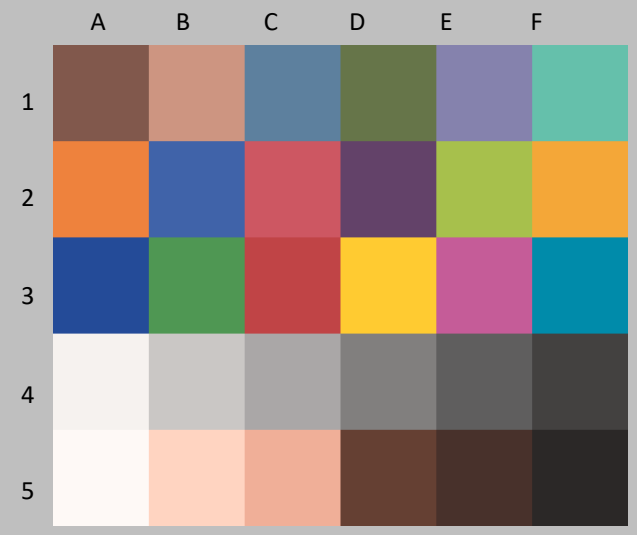
Colors after both light exposure + dark storage

				L*		a*		b*	
Patch #	Description	I* Color	ΔE	Before	After	Before	After	Before	After
A1	Dark Skin	96.9	2.3	41.4	43.3	15.4	14.4	14.1	13.4
B1	Light Skin	95.9	2.3	66.6	68.3	17.3	16.0	19.3	18.4
C1	Blue sky	92.9	2.8	52.3	54.4	-4.7	-5.2	-20.0	-18.1
D1	Foliage	96.8	1.6	47.4	48.3	-14.2	-13.9	22.1	20.8
E1	blue flower	86.3	4.7	56.2	58.8	9.6	8.2	-22.1	-18.6
F1	bluish green	99.2	1.1	72.0	72.9	-33.3	-32.9	1.7	1.1
A1	orange	96.0	3.4	65.8	67.1	34.7	32.6	54.4	52.1
B2	purplish blue	90.9	5.0	42.8	45.2	9.2	6.8	-41.2	-37.5
C2	moderate red	95.8	3.6	52.5	55.1	46.5	43.9	16.7	16.2
D2	purple	92.9	3.3	33.6	35.9	20.7	19.6	-17.4	-15.2
E2	yellow green	96.9	2.5	74.0	74.8	-26.0	-25.7	53.9	51.5
F2	orange yellow	96.8	2.9	74.6	75.8	18.4	16.7	65.1	63.1
A3	blue	95.5	3.1	33.4	34.9	14.0	12.2	-46.3	-44.3
B3	green	97.9	1.8	56.4	57.4	-38.3	-38.1	28.7	27.2
C3	red	96.5	3.3	46.6	48.7	49.4	47.5	26.6	25.0
D3	yellow	97.6	2.5	84.3	85.2	3.7	2.6	77.0	74.9
E3	magenta	90.3	6.0	53.9	56.8	47.9	45.0	-12.6	-8.2
F3	cyan	100.0	1.0	52.7	53.6	-27.0	-27.0	-26.9	-26.7
A4	white	99.6	0.7	95.6	96.1	-0.2	-0.2	2.2	1.6
B4	neutral 8	100.0	0.8	80.7	81.5	-0.3	-0.3	1.3	1.2
C4	neutral 6.5	100.0	1.0	69.1	70.1	-0.1	-0.1	0.7	0.7
D4	neutral 5	100.0	1.2	53.4	54.6	0.1	0.0	1.0	1.0
E4	neutral 3.5	100.0	1.1	40.0	41.0	0.1	0.0	-0.2	-0.2
F4	black	100.0	0.8	28.0	28.7	-0.3	-0.2	1.4	1.3
A5	paper white	98.7	0.7	98.1	98.5	-0.1	-0.2	1.8	1.2
B5	Skin highlight L*=88	90.8	2.7	89.0	90.2	13.7	11.9	16.4	14.7
C5	Skin highlight L* =75	93.7	2.8	76.9	78.4	19.4	17.6	21.3	19.8
D5	Skin shadow L*=28	96.9	1.6	31.3	32.4	14.0	13.2	13.8	13.0
E5	Skin shadow L*=13	94.9	1.8	23.3	24.7	9.3	8.6	8.7	7.8
F5	Maximum Black	100.0	1.1	16.9	18.0	0.5	0.4	1.3	1.0

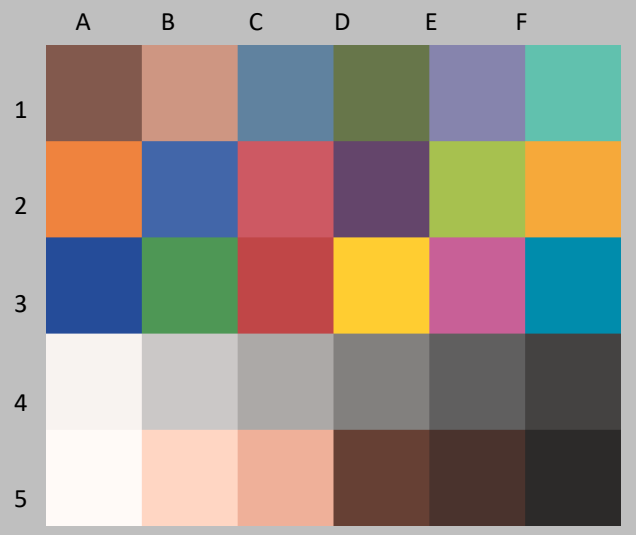
Summary Results	I* Color	I* tone	ΔE
Average Score for all patches	96.3	93.3	2.3
Worst 10% (3 lowest scoring patches)	89.2	85.3	5.2

200 Mluxhrs + 6 months

Printer: HP Z3200PS **Ink:** HP Vivera with Chromata Red **Media:** Moab Entrada Natural 300gsm, no additional coating



Original Print Colors before light exposure



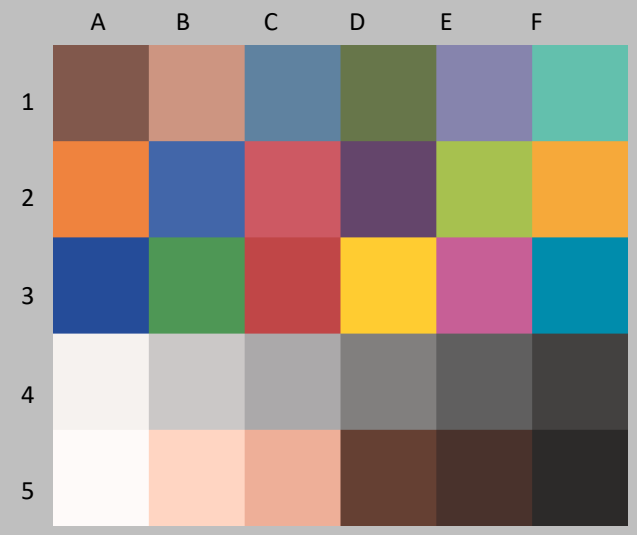
Colors after both light exposure + dark storage

				L*		a*		b*	
Patch #	Description	I* Color	ΔE	Before	After	Before	After	Before	After
A1	Dark Skin	100.0	0.7	41.4	41.9	15.4	15.1	14.2	13.8
B1	Light Skin	100.0	0.6	66.5	66.9	17.5	17.2	19.3	19.0
C1	Blue sky	99.3	0.9	52.3	52.9	-4.7	-5.1	-19.9	-19.4
D1	Foliage	100.0	0.5	47.1	47.4	-14.1	-14.0	21.9	21.7
E1	blue flower	96.6	1.5	56.1	56.8	9.6	8.8	-22.1	-21.0
F1	bluish green	100.0	0.4	71.7	72.0	-33.5	-33.5	1.7	1.5
A1	orange	99.8	0.7	65.5	65.8	35.0	34.7	54.1	53.5
B2	purplish blue	97.6	1.7	42.8	43.5	9.0	8.0	-41.1	-39.9
C2	moderate red	99.3	1.1	52.4	53.1	46.5	45.7	16.7	17.0
D2	purple	98.4	1.1	33.5	34.2	20.8	20.3	-17.4	-16.6
E2	yellow green	100.0	0.4	73.9	74.1	-26.1	-26.1	53.8	53.4
F2	orange yellow	100.0	0.5	74.6	74.9	18.4	18.3	65.3	64.9
A3	blue	99.8	0.7	33.5	33.9	14.0	13.5	-46.0	-45.6
B3	green	100.0	0.4	56.4	56.6	-38.3	-38.1	28.5	28.2
C3	red	100.0	0.7	46.6	47.1	49.0	48.5	26.0	26.0
D3	yellow	100.0	0.4	84.2	84.6	3.6	3.4	76.8	76.7
E3	magenta	96.2	2.5	53.9	54.8	47.9	46.7	-12.6	-10.6
F3	cyan	100.0	0.4	52.6	52.9	-26.9	-27.0	-26.7	-26.9
A4	white	100.0	0.5	95.6	95.9	-0.2	-0.3	2.3	2.0
B4	neutral 8	100.0	0.4	80.5	80.9	-0.2	-0.2	1.4	1.2
C4	neutral 6.5	100.0	0.3	69.1	69.4	0.0	-0.1	0.7	0.5
D4	neutral 5	100.0	0.3	53.3	53.6	0.1	0.0	1.1	1.0
E4	neutral 3.5	100.0	0.5	39.8	40.3	0.1	0.0	-0.2	-0.2
F4	black	100.0	0.2	28.0	28.2	-0.2	-0.2	1.3	1.2
A5	paper white	100.0	0.5	98.1	98.4	-0.2	-0.3	2.0	1.7
B5	Skin highlight L*=88	99.4	0.8	88.8	89.3	14.0	13.5	16.2	15.8
C5	Skin highlight L* =75	100.0	0.6	76.7	77.1	19.6	19.3	21.3	20.9
D5	Skin shadow L*=28	100.0	0.4	31.0	31.3	13.9	13.8	13.6	13.6
E5	Skin shadow L*=13	100.0	0.8	23.1	23.8	9.1	8.7	8.4	8.3
F5	Maximum Black	100.0	0.8	16.9	17.7	0.5	0.4	1.0	1.1

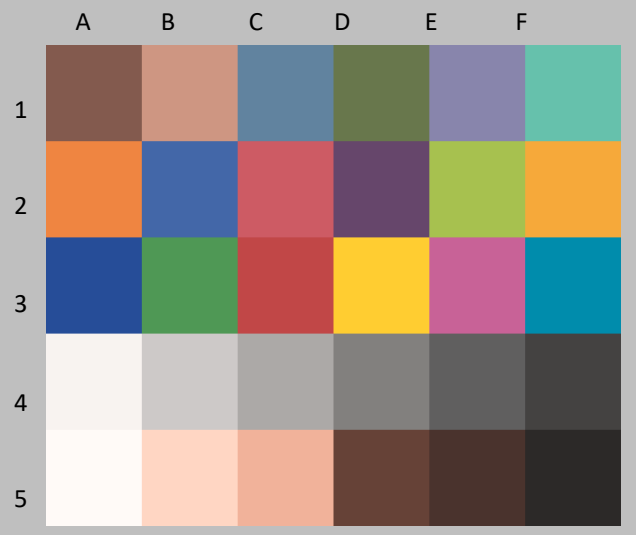
Summary Results	I* Color	I* tone	ΔE
Average Score for all patches	99.5	98.0	0.7
Worst 10% (3 lowest scoring patches)	96.8	95.3	1.9

20 Mluxhrs + 1 year

Printer: HP Z3200PS **Ink:** HP Vivera with Chromata Red **Media:** Moab Entrada Natural 300gsm, no additional coating



Original Print Colors before light exposure



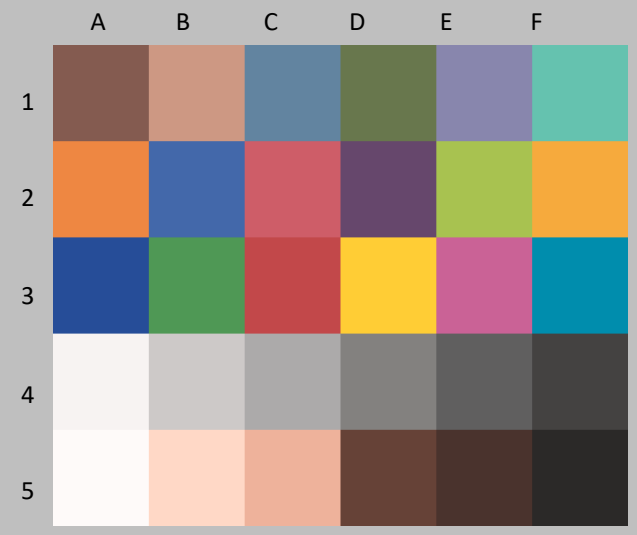
Colors after both light exposure + dark storage

				L*		a*		b*	
Patch #	Description	I* Color	ΔE	Before	After	Before	After	Before	After
A1	Dark Skin	98.4	1.2	41.4	42.3	15.4	14.8	14.3	13.7
B1	Light Skin	98.9	1.0	66.5	67.2	17.4	16.8	19.7	19.2
C1	Blue sky	97.9	1.3	52.4	53.3	-4.7	-5.2	-19.9	-19.1
D1	Foliage	100.0	0.7	47.3	47.8	-14.3	-14.2	22.4	21.9
E1	blue flower	93.8	2.3	56.2	57.3	9.6	8.5	-22.0	-20.3
F1	bluish green	100.0	0.5	71.8	72.2	-33.6	-33.4	1.8	1.5
A1	orange	98.9	1.3	65.7	66.2	34.8	34.0	54.4	53.5
B2	purplish blue	95.5	2.6	42.7	43.8	9.0	7.5	-41.2	-39.4
C2	moderate red	98.4	1.7	52.5	53.5	46.5	45.3	17.0	16.9
D2	purple	96.7	1.8	33.5	34.5	20.8	20.0	-17.2	-16.1
E2	yellow green	99.9	0.7	73.9	74.2	-26.1	-26.1	53.9	53.4
F2	orange yellow	99.4	1.0	74.5	75.0	18.6	18.0	65.4	64.7
A3	blue	98.3	1.5	33.2	34.0	14.2	13.2	-46.3	-45.4
B3	green	99.8	0.8	56.4	56.8	-38.5	-38.2	28.7	28.2
C3	red	98.1	1.7	46.6	47.3	49.3	48.1	26.7	25.8
D3	yellow	99.8	0.8	84.3	84.8	3.6	3.2	77.1	76.5
E3	magenta	94.0	3.7	53.9	55.3	48.0	46.1	-12.7	-9.8
F3	cyan	100.0	0.4	52.6	53.1	-27.1	-27.0	-26.9	-26.9
A4	white	100.0	0.4	95.6	95.9	-0.2	-0.3	2.4	2.2
B4	neutral 8	100.0	0.5	80.6	81.0	-0.2	-0.3	1.4	1.3
C4	neutral 6.5	100.0	0.5	69.0	69.5	-0.1	-0.1	0.6	0.6
D4	neutral 5	100.0	0.6	53.3	53.9	0.1	0.0	1.1	1.0
E4	neutral 3.5	100.0	0.7	39.8	40.5	0.1	0.0	-0.1	-0.2
F4	black	100.0	0.5	27.8	28.3	-0.2	-0.3	1.4	1.4
A5	paper white	100.0	0.4	98.1	98.4	-0.2	-0.2	1.9	1.7
B5	Skin highlight L*=88	98.0	1.1	88.9	89.5	13.8	13.0	16.3	15.8
C5	Skin highlight L* =75	98.6	1.1	76.8	77.5	19.6	18.9	21.4	20.9
D5	Skin shadow L*=28	99.2	1.0	31.2	31.9	14.0	13.6	13.7	13.2
E5	Skin shadow L*=13	100.0	0.8	23.2	23.9	9.2	8.8	8.4	8.3
F5	Maximum Black	100.0	0.6	16.8	17.4	0.5	0.5	1.4	1.1

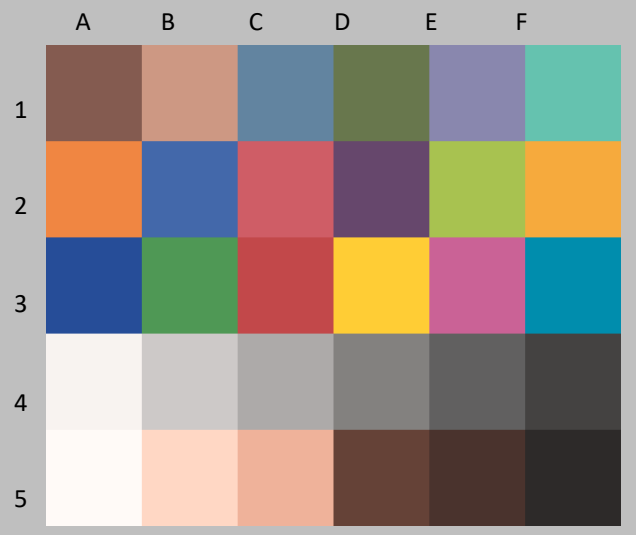
Summary Results	I* Color	I* tone	ΔE
Average Score for all patches	98.8	97.1	1.1
Worst 10% (3 lowest scoring patches)	94.4	93.0	2.9

50 Mluxhrs + 1 year

Printer: HP Z3200PS **Ink:** HP Vivera with Chromata Red **Media:** Moab Entrada Natural 300gsm, no additional coating



Original Print Colors before light exposure



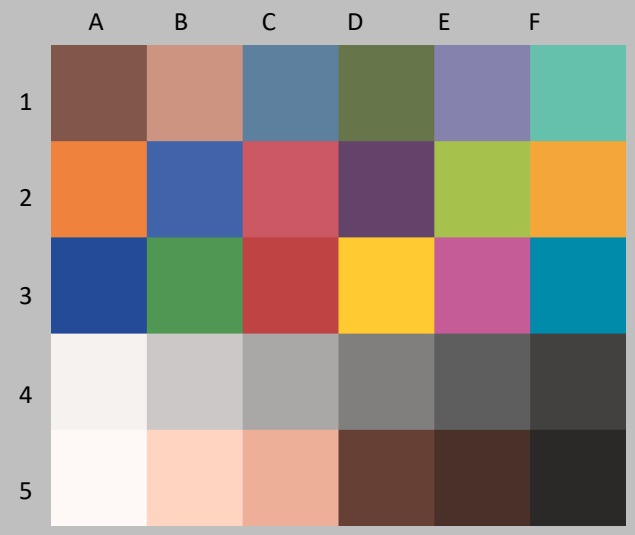
Colors after both light exposure + dark storage

				L*		a*		b*	
Patch #	Description	I* Color	ΔE	Before	After	Before	After	Before	After
A1	Dark Skin	96.8	1.8	41.4	42.7	15.5	14.7	14.3	13.4
B1	Light Skin	97.3	1.5	66.5	67.4	17.4	16.5	19.5	18.8
C1	Blue sky	95.8	1.9	52.4	53.7	-4.7	-5.3	-19.9	-18.7
D1	Foliage	98.4	1.2	47.3	48.0	-14.2	-13.9	22.3	21.4
E1	blue flower	91.0	3.2	56.2	57.9	9.6	8.4	-22.1	-19.7
F1	bluish green	100.0	0.8	71.9	72.5	-33.3	-32.9	1.8	1.4
A1	orange	97.7	2.1	65.8	66.6	34.9	33.5	54.3	52.9
B2	purplish blue	94.1	3.3	42.8	44.2	9.0	7.2	-41.1	-38.7
C2	moderate red	97.3	2.4	52.5	54.1	46.4	44.6	16.7	16.5
D2	purple	95.1	2.4	33.5	35.1	20.8	19.9	-17.3	-15.8
E2	yellow green	98.9	1.2	73.9	74.4	-25.9	-25.8	53.9	52.7
F2	orange yellow	98.6	1.6	74.5	75.3	18.5	17.5	65.3	64.3
A3	blue	97.2	2.1	33.3	34.3	14.2	12.8	-46.3	-45.1
B3	green	99.3	1.1	56.4	57.0	-38.3	-38.0	28.6	27.8
C3	red	97.6	2.2	46.6	47.9	49.3	47.8	26.3	25.3
D3	yellow	98.9	1.5	84.3	84.8	3.7	3.1	77.0	75.7
E3	magenta	92.2	4.7	53.9	55.8	47.9	45.6	-12.6	-9.0
F3	cyan	100.0	0.6	52.7	53.3	-27.1	-27.0	-26.9	-26.8
A4	white	100.0	0.6	95.5	95.9	-0.2	-0.2	2.3	1.9
B4	neutral 8	100.0	0.5	80.7	81.2	-0.2	-0.2	1.3	1.1
C4	neutral 6.5	100.0	0.6	69.2	69.7	0.0	-0.1	0.7	0.7
D4	neutral 5	100.0	0.7	53.4	54.1	0.1	0.0	1.0	0.9
E4	neutral 3.5	100.0	0.7	39.9	40.6	0.1	0.0	-0.1	-0.2
F4	black	100.0	0.6	27.8	28.4	-0.2	-0.3	1.4	1.3
A5	paper white	100.0	0.5	98.1	98.4	-0.1	-0.2	1.9	1.5
B5	Skin highlight L*=88	96.0	1.5	89.0	89.7	13.7	12.6	16.3	15.5
C5	Skin highlight L* =75	97.0	1.6	76.8	77.7	19.6	18.4	21.2	20.6
D5	Skin shadow L*=28	99.3	0.9	31.2	31.9	14.0	13.4	13.7	13.3
E5	Skin shadow L*=13	97.1	1.2	23.3	24.1	9.2	8.7	8.8	8.1
F5	Maximum Black	100.0	0.8	16.8	17.5	0.5	0.5	1.4	1.0

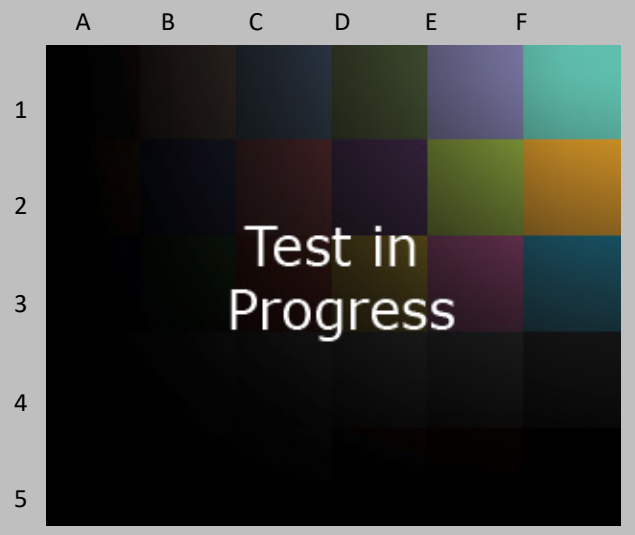
Summary Results	I* Color	I* tone	ΔE
Average Score for all patches	97.9	95.9	1.5
Worst 10% (3 lowest scoring patches)	92.4	90.3	3.7

100 Mluxhrs + 1 year

Printer: HP Z3200PS **Ink:** HP Vivera with Chromata Red **Media:** Moab Entrada Natural 300gsm, no additional coating



Original Print Colors before light exposure



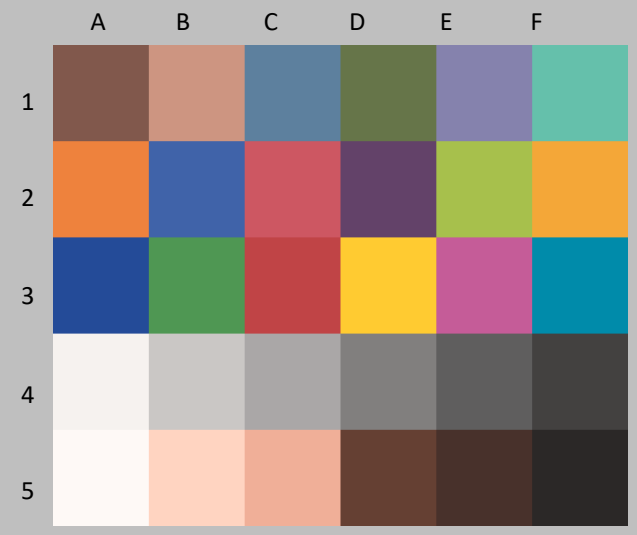
Colors after both light exposure + dark storage

Patch #	Description	I* Color	ΔE	L* Before	L* After	a* Before	a* After	b* Before	b* After
A1	Dark Skin			41.4		15.4		14.1	
B1	Light Skin			66.6		17.3		19.3	
C1	Blue sky			52.3		-4.7		-20.0	
D1	Foliage			47.4		-14.2		22.1	
E1	blue flower			56.2		9.6		-22.1	
F1	bluish green			72.0		-33.3		1.7	
A1	orange			65.8		34.7		54.4	
B2	purplish blue			42.8		9.2		-41.2	
C2	moderate red			52.5		46.5		16.7	
D2	purple			33.6		20.7		-17.4	
E2	yellow green			74.0		-26.0		53.9	
F2	orange yellow			74.6		18.4		65.1	
A3	blue			33.4		14.0		-46.3	
B3	green			56.4		-38.3		28.7	
C3	red			46.6		49.4		26.6	
D3	yellow			84.3		3.7		77.0	
E3	magenta			53.9		47.9		-12.6	
F3	cyan			52.7		-27.0		-26.9	
A4	white			95.6		-0.2		2.2	
B4	neutral 8			80.7		-0.3		1.3	
C4	neutral 6.5			69.1		-0.1		0.7	
D4	neutral 5			53.4		0.1		1.0	
E4	neutral 3.5			40.0		0.1		-0.2	
F4	black			28.0		-0.3		1.4	
A5	paper white			98.1		-0.1		1.8	
B5	Skin highlight L*=88			89.0		13.7		16.4	
C5	Skin highlight L* =75			76.9		19.4		21.3	
D5	Skin shadow L*=28			31.3		14.0		13.8	
E5	Skin shadow L*=13			23.3		9.3		8.7	
F5	Maximum Black			16.9		0.5		1.3	

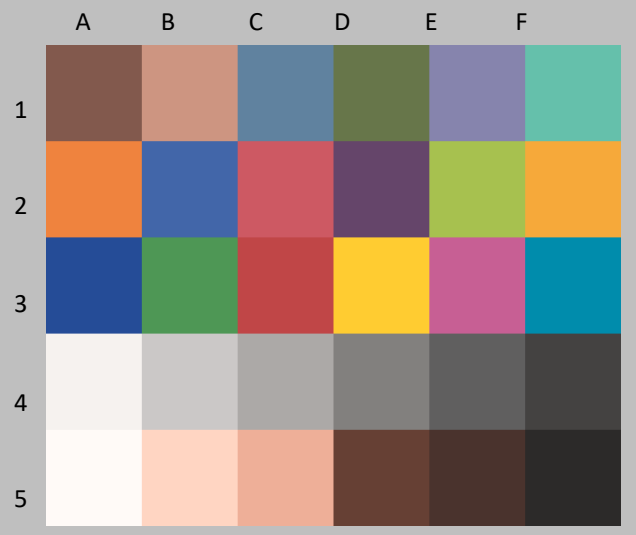
Summary Results	I* Color	I* tone	ΔE
Average Score for all patches			
Worst 10% (3 lowest scoring patches)			

200 Mluxhrs + 1 year

Printer: HP Z3200PS **Ink:** HP Vivera with Chromata Red **Media:** Moab Entrada Natural 300gsm, no additional coating



Original Print Colors before light exposure



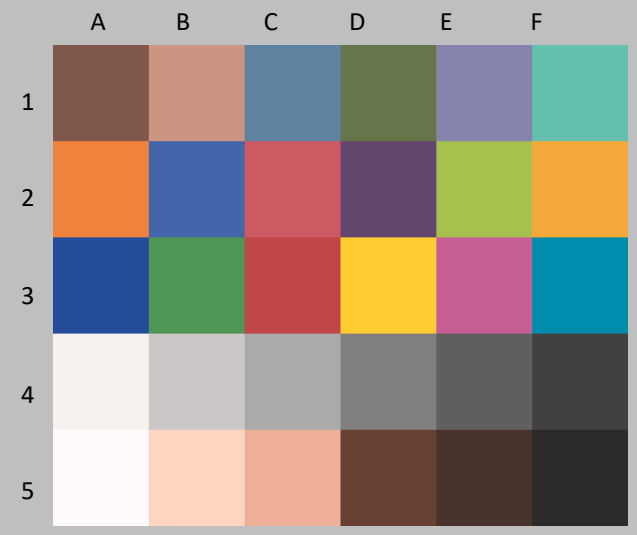
Colors after both light exposure + dark storage

Patch #	Description	I* Color	ΔE	L* Before	L* After	a* Before	a* After	b* Before	b* After
A1	Dark Skin	99.9	0.8	41.4	42.0	15.4	15.0	14.2	13.8
B1	Light Skin	100.0	0.6	66.5	66.9	17.5	17.1	19.3	19.1
C1	Blue sky	98.7	0.9	52.3	52.8	-4.7	-5.2	-19.9	-19.3
D1	Foliage	100.0	0.4	47.1	47.4	-14.1	-14.1	21.9	21.8
E1	blue flower	95.8	1.6	56.1	56.7	9.6	8.7	-22.1	-20.8
F1	bluish green	100.0	0.3	71.7	71.9	-33.5	-33.5	1.7	1.6
A1	orange	99.9	0.7	65.5	65.8	35.0	34.6	54.1	53.6
B2	purplish blue	97.0	1.9	42.8	43.4	9.0	7.9	-41.1	-39.7
C2	moderate red	99.0	1.2	52.4	53.0	46.5	45.6	16.7	17.1
D2	purple	97.8	1.3	33.5	34.1	20.8	20.3	-17.4	-16.4
E2	yellow green	100.0	0.4	73.9	74.0	-26.1	-26.0	53.8	53.4
F2	orange yellow	100.0	0.6	74.6	74.8	18.4	18.2	65.3	64.8
A3	blue	99.4	0.8	33.5	33.8	14.0	13.5	-46.0	-45.4
B3	green	100.0	0.4	56.4	56.6	-38.3	-38.1	28.5	28.3
C3	red	99.9	0.7	46.6	47.1	49.0	48.4	26.0	26.1
D3	yellow	100.0	0.3	84.2	84.4	3.6	3.4	76.8	76.6
E3	magenta	95.7	2.7	53.9	54.7	47.9	46.5	-12.6	-10.4
F3	cyan	100.0	0.2	52.6	52.8	-26.9	-27.0	-26.7	-26.8
A4	white	100.0	0.3	95.6	95.8	-0.2	-0.3	2.3	2.2
B4	neutral 8	100.0	0.3	80.5	80.8	-0.2	-0.3	1.4	1.4
C4	neutral 6.5	100.0	0.2	69.1	69.2	0.0	-0.1	0.7	0.7
D4	neutral 5	100.0	0.3	53.3	53.5	0.1	0.0	1.1	1.1
E4	neutral 3.5	100.0	0.5	39.8	40.3	0.1	0.0	-0.2	-0.1
F4	black	100.0	0.1	28.0	28.1	-0.2	-0.2	1.3	1.4
A5	paper white	100.0	0.2	98.1	98.3	-0.2	-0.3	2.0	1.9
B5	Skin highlight L*=88	99.4	0.7	88.8	89.2	14.0	13.4	16.2	16.0
C5	Skin highlight L* =75	100.0	0.6	76.7	77.0	19.6	19.2	21.3	21.0
D5	Skin shadow L*=28	100.0	0.3	31.0	31.3	13.9	13.8	13.6	13.7
E5	Skin shadow L*=13	100.0	0.8	23.1	23.8	9.1	8.7	8.4	8.3
F5	Maximum Black	100.0	0.8	16.9	17.7	0.5	0.4	1.0	1.2

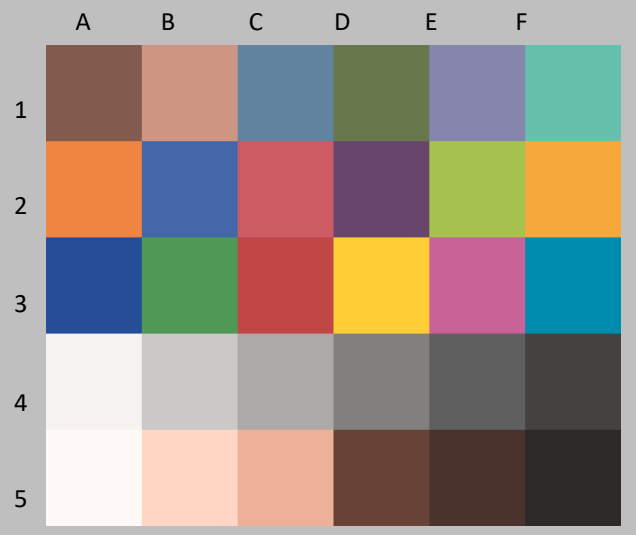
Summary Results	I* Color	I* tone	ΔE
Average Score for all patches	99.4	98.0	0.7
Worst 10% (3 lowest scoring patches)	96.2	95.3	2.1

20 Mluxhrs + 2 years

Printer: HP Z3200PS **Ink:** HP Vivera with Chromata Red **Media:** Moab Entrada Natural 300gsm, no additional coating



Original Print Colors before light exposure



Colors after both light exposure + dark storage

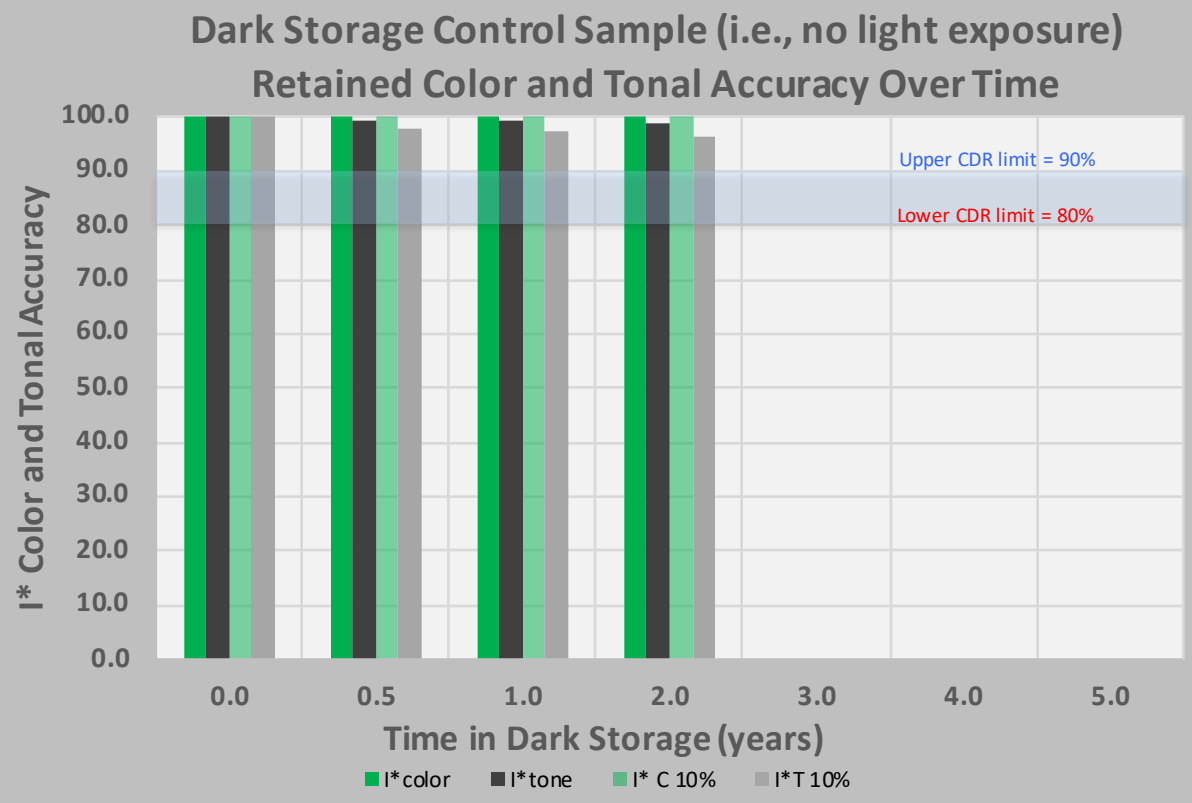
				L*		a*		b*	
Patch #	Description	I* Color	ΔE	Before	After	Before	After	Before	After
A1	Dark Skin	98.1	1.2	41.4	42.3	15.4	14.8	14.3	13.6
B1	Light Skin	98.9	1.0	66.5	67.1	17.4	16.8	19.7	19.2
C1	Blue sky	97.4	1.4	52.4	53.2	-4.7	-5.3	-19.9	-19.0
D1	Foliage	99.7	0.8	47.3	47.8	-14.3	-14.1	22.4	21.8
E1	blue flower	93.4	2.4	56.2	57.3	9.6	8.5	-22.0	-20.2
F1	bluish green	100.0	0.5	71.8	72.1	-33.6	-33.3	1.8	1.6
A1	orange	98.7	1.4	65.7	66.2	34.8	33.9	54.4	53.3
B2	purplish blue	95.0	2.8	42.7	43.8	9.0	7.4	-41.2	-39.1
C2	moderate red	97.9	1.8	52.5	53.5	46.5	45.0	17.0	16.8
D2	purple	96.5	1.8	33.5	34.5	20.8	20.0	-17.2	-16.1
E2	yellow green	99.8	0.7	73.9	74.2	-26.1	-26.1	53.9	53.3
F2	orange yellow	99.4	1.0	74.5	75.0	18.6	17.9	65.4	64.7
A3	blue	98.0	1.7	33.2	34.0	14.2	13.1	-46.3	-45.2
B3	green	99.6	0.8	56.4	56.8	-38.5	-38.1	28.7	28.1
C3	red	97.8	1.9	46.6	47.3	49.3	47.9	26.7	25.7
D3	yellow	99.7	0.8	84.3	84.7	3.6	3.3	77.1	76.5
E3	magenta	93.7	3.9	53.9	55.3	48.0	46.0	-12.7	-9.7
F3	cyan	100.0	0.4	52.6	53.0	-27.1	-27.1	-26.9	-26.8
A4	white	100.0	0.3	95.6	95.8	-0.2	-0.3	2.4	2.3
B4	neutral 8	100.0	0.4	80.6	81.0	-0.2	-0.3	1.4	1.4
C4	neutral 6.5	100.0	0.5	69.0	69.4	-0.1	-0.1	0.6	0.7
D4	neutral 5	100.0	0.6	53.3	53.9	0.1	0.0	1.1	1.0
E4	neutral 3.5	100.0	0.7	39.8	40.5	0.1	0.0	-0.1	-0.2
F4	black	100.0	0.6	27.8	28.3	-0.2	-0.3	1.4	1.4
A5	paper white	100.0	0.2	98.1	98.3	-0.2	-0.3	1.9	1.9
B5	Skin highlight L*=88	98.0	1.1	88.9	89.5	13.8	13.0	16.3	15.9
C5	Skin highlight L* =75	98.4	1.1	76.8	77.4	19.6	18.7	21.4	21.0
D5	Skin shadow L*=28	99.8	0.9	31.2	31.9	14.0	13.6	13.7	13.4
E5	Skin shadow L*=13	100.0	0.9	23.2	23.9	9.2	8.8	8.4	8.2
F5	Maximum Black	100.0	0.7	16.8	17.4	0.5	0.5	1.4	1.2

Summary Results	I* Color	I* tone	ΔE
Average Score for all patches	98.7	97.1	1.1
Worst 10% (3 lowest scoring patches)	94.0	92.9	3.0

50 Mluxhrs + 2 years

Section IV: Ongoing Dark Storage Test Results

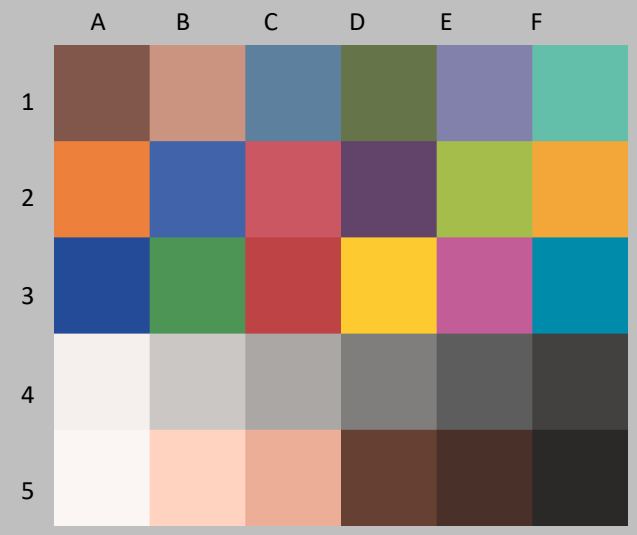
This section of the report tracks a sample of this print process (i.e., printer/ink/media) that remains in an amibient room temperature/moderate RH dark storage environment and has not been subjected to light exposure tests like the other samples. It is essentially a "control" sample that will remain in natural aging conditions (e.g., photo album storage) while the other light fastness tests are ongoing, and then in the Aardenburg Archives under simliar conditions indefinitely along with the retired light fade samples. The chart below will be rescaled to longer time intervals once total acumulated storage time exceeds 5 years.



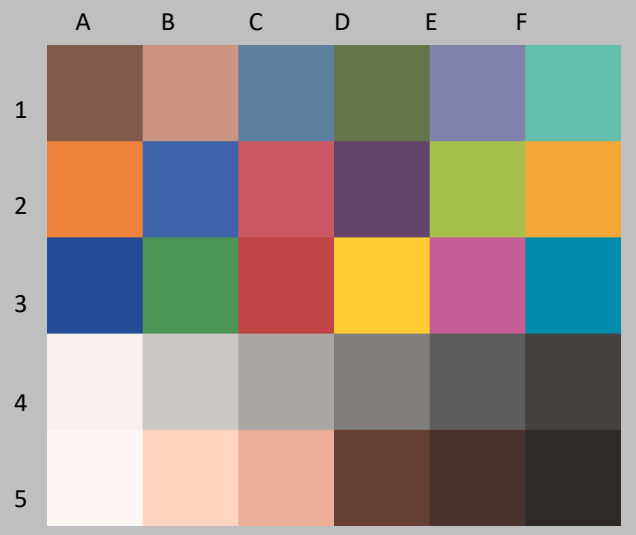
Time in Storage Summary for Dark Storage Control Sample

Years	*I*color (worst 10%)*	*I* Tone (10%)*	I* Color	I* tone	ΔE avg.	ΔE (worst 10%)
0.0	100.0	*100.0*	100.0	100.0	0.0	0.0
0.5	100.0	*97.8*	100.0	99.1	0.3	0.5
1.0	100.0	*97.5*	100.0	99.0	0.3	0.6
2.0	100.0	*96.5*	100.0	98.7	0.4	0.7
3.0						
4.0						
5.0						

Printer: HP Z3200PS **Ink:** HP Vivera with Chromata Red **Media:** Moab Entrada Natural 300gsm, no additional coating



Original Print Colors before light exposure



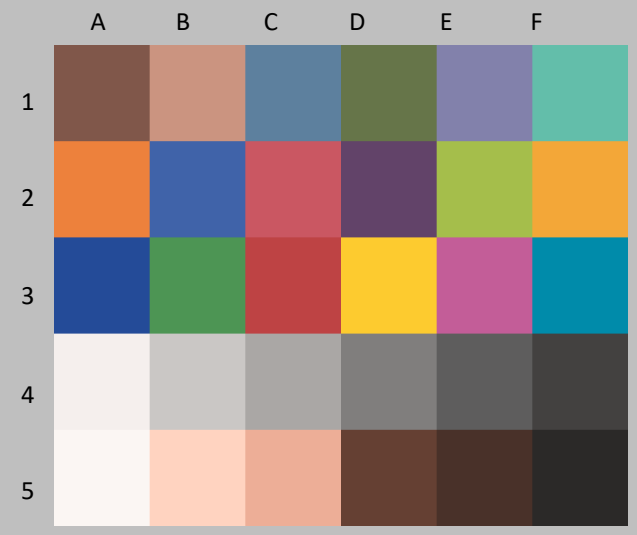
Colors after additional time in dark storage

Patch #	Description	I* Color	ΔE	L* Before	L* After	a* Before	a* After	b* Before	b* After
A1	Dark Skin	100.0	0.5	41.3	41.5	15.4	15.2	14.3	14.0
B1	Light Skin	100.0	0.2	66.2	66.3	17.3	17.2	19.1	19.1
C1	Blue sky	100.0	0.2	52.2	52.2	-4.6	-4.6	-20.0	-19.8
D1	Foliage	100.0	0.2	47.1	47.2	-14.2	-14.2	22.3	22.2
E1	blue flower	100.0	0.2	55.8	55.9	9.3	9.4	-22.1	-21.9
F1	bluish green	100.0	0.0	71.4	71.4	-33.3	-33.3	1.6	1.6
A1	orange	100.0	0.3	65.3	65.3	34.9	34.9	54.0	53.8
B2	purplish blue	100.0	0.3	42.6	42.7	8.9	8.8	-40.9	-40.7
C2	moderate red	100.0	0.4	52.3	52.5	46.2	46.0	16.6	16.4
D2	purple	100.0	0.3	33.2	33.4	20.4	20.4	-17.4	-17.3
E2	yellow green	100.0	0.1	73.5	73.6	-25.9	-25.9	53.6	53.5
F2	orange yellow	100.0	0.2	74.1	74.3	18.0	18.0	64.9	64.7
A3	blue	100.0	0.5	33.2	33.5	14.0	13.8	-46.1	-45.8
B3	green	100.0	0.3	56.0	56.2	-38.2	-38.1	28.5	28.2
C3	red	100.0	0.4	46.3	46.6	49.0	48.8	26.2	25.9
D3	yellow	100.0	0.3	83.9	84.2	3.4	3.3	76.7	76.7
E3	magenta	100.0	0.4	53.6	53.9	47.2	47.2	-12.5	-12.2
F3	cyan	100.0	0.2	52.4	52.5	-26.9	-26.9	-26.7	-26.6
A4	white	100.0	0.3	95.1	95.2	-0.3	-0.3	2.2	2.5
B4	neutral 8	100.0	0.2	80.2	80.3	-0.2	-0.2	1.3	1.5
C4	neutral 6.5	100.0	0.2	68.6	68.7	-0.1	-0.1	0.7	0.8
D4	neutral 5	100.0	0.2	53.0	53.2	0.1	0.1	1.0	1.0
E4	neutral 3.5	100.0	0.2	39.5	39.7	0.0	0.0	-0.1	-0.2
F4	black	100.0	0.4	27.8	28.1	-0.4	-0.3	1.5	1.2
A5	paper white	100.0	0.3	97.4	97.7	-0.2	-0.2	1.8	2.0
B5	Skin highlight L*=88	100.0	0.3	88.3	88.6	13.4	13.5	15.7	15.9
C5	Skin highlight L* =75	100.0	0.2	76.3	76.5	19.2	19.2	20.7	20.9
D5	Skin shadow L*=28	100.0	0.4	31.1	31.3	14.0	14.0	13.9	13.6
E5	Skin shadow L*=13	100.0	0.4	23.2	23.6	9.4	9.4	8.7	8.4
F5	Maximum Black	100.0	0.6	17.2	17.7	0.4	0.5	1.5	1.1

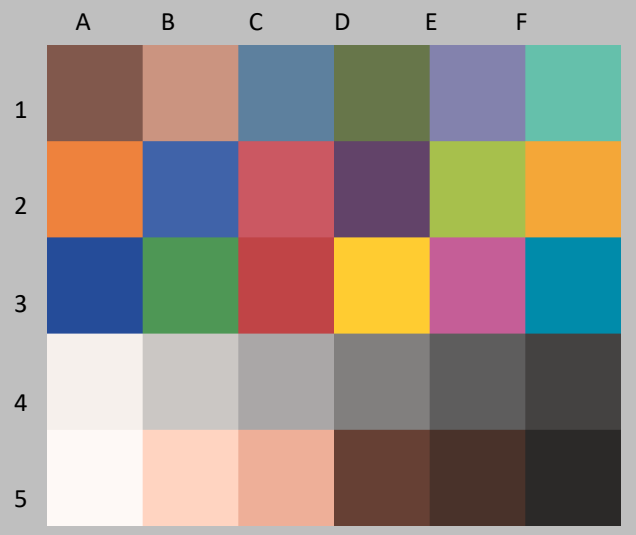
Summary Results	I* Color	I* tone	ΔE
Average Score for all patches	100.0	99.1	0.3
Worst 10% (3 lowest scoring patches)	100.0	97.8	0.5

DS Control at 6 months

Printer: HP Z3200PS **Ink:** HP Vivera with Chromata Red **Media:** Moab Entrada Natural 300gsm, no additional coating



Original Print Colors before light exposure



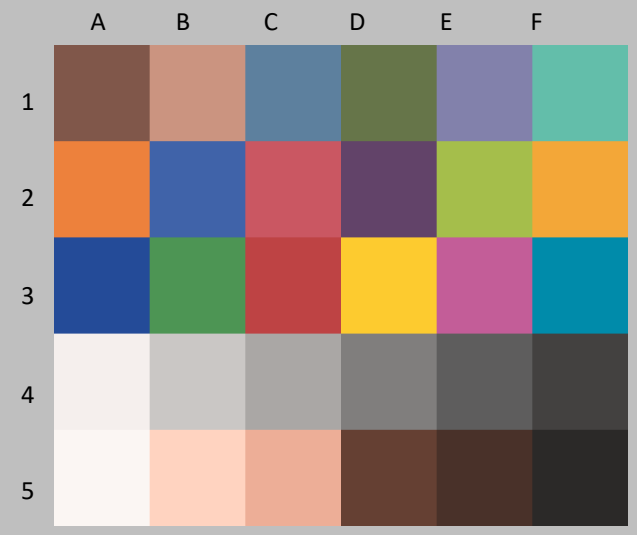
Colors after additional time in dark storage

Patch #	Description	I* Color	ΔE	L* Before	L* After	a* Before	a* After	b* Before	b* After
A1	Dark Skin	100.0	0.4	41.3	41.5	15.4	15.2	14.3	14.0
B1	Light Skin	100.0	0.1	66.2	66.3	17.3	17.3	19.1	19.2
C1	Blue sky	100.0	0.2	52.2	52.3	-4.6	-4.7	-20.0	-19.8
D1	Foliage	100.0	0.3	47.1	47.3	-14.2	-14.1	22.3	22.2
E1	blue flower	100.0	0.3	55.8	56.0	9.3	9.3	-22.1	-22.0
F1	bluish green	100.0	0.2	71.4	71.6	-33.3	-33.4	1.6	1.7
A1	orange	100.0	0.3	65.3	65.5	34.9	35.0	54.0	53.9
B2	purplish blue	100.0	0.3	42.6	42.8	8.9	8.8	-40.9	-40.7
C2	moderate red	100.0	0.3	52.3	52.5	46.2	46.1	16.6	16.5
D2	purple	100.0	0.3	33.2	33.5	20.4	20.4	-17.4	-17.3
E2	yellow green	100.0	0.3	73.5	73.8	-25.9	-25.8	53.6	53.7
F2	orange yellow	100.0	0.3	74.1	74.4	18.0	18.1	64.9	64.8
A3	blue	100.0	0.5	33.2	33.5	14.0	13.8	-46.1	-45.9
B3	green	100.0	0.3	56.0	56.3	-38.2	-38.1	28.5	28.5
C3	red	100.0	0.4	46.3	46.6	49.0	48.9	26.2	26.0
D3	yellow	100.0	0.5	83.9	84.3	3.4	3.5	76.7	76.9
E3	magenta	100.0	0.4	53.6	54.0	47.2	47.3	-12.5	-12.3
F3	cyan	100.0	0.4	52.4	52.7	-26.9	-27.0	-26.7	-26.5
A4	white	100.0	0.5	95.1	95.4	-0.3	-0.3	2.2	2.6
B4	neutral 8	100.0	0.4	80.2	80.5	-0.2	-0.2	1.3	1.6
C4	neutral 6.5	100.0	0.3	68.6	68.9	-0.1	-0.1	0.7	0.9
D4	neutral 5	100.0	0.3	53.0	53.2	0.1	0.0	1.0	1.2
E4	neutral 3.5	100.0	0.3	39.5	39.8	0.0	0.0	-0.1	-0.1
F4	black	100.0	0.3	27.8	28.1	-0.4	-0.3	1.5	1.4
A5	paper white	100.0	0.7	97.4	97.9	-0.2	-0.2	1.8	2.1
B5	Skin highlight L*=88	100.0	0.6	88.3	88.7	13.4	13.6	15.7	16.1
C5	Skin highlight L* =75	100.0	0.4	76.3	76.7	19.2	19.2	20.7	21.0
D5	Skin shadow L*=28	100.0	0.2	31.1	31.3	14.0	14.0	13.9	14.0
E5	Skin shadow L*=13	100.0	0.3	23.2	23.5	9.4	9.4	8.7	8.9
F5	Maximum Black	100.0	0.2	17.2	17.4	0.4	0.4	1.5	1.4

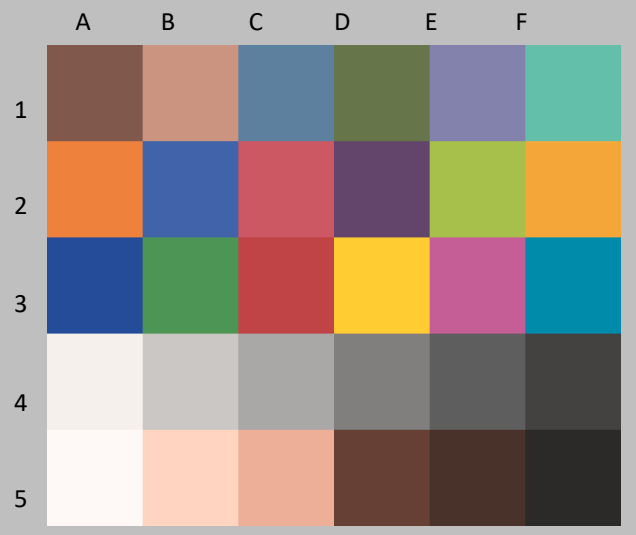
Summary Results	I* Color	I* tone	ΔE
Average Score for all patches	100.0	99.0	0.3
Worst 10% (3 lowest scoring patches)	100.0	97.5	0.6

DS Control at 1 year

Printer: HP Z3200PS **Ink:** HP Vivera with Chromata Red **Media:** Moab Entrada Natural 300gsm, no additional coating



Original Print Colors before light exposure



Colors after additional time in dark storage

Patch #	Description	I* Color	ΔE	L* Before	L* After	a* Before	a* After	b* Before	b* After
A1	Dark Skin	100.0	0.6	41.3	41.6	15.4	15.1	14.3	13.9
B1	Light Skin	100.0	0.2	66.2	66.3	17.3	17.2	19.1	19.3
C1	Blue sky	100.0	0.3	52.2	52.3	-4.6	-4.6	-20.0	-19.7
D1	Foliage	100.0	0.4	47.1	47.4	-14.2	-14.1	22.3	22.0
E1	blue flower	100.0	0.4	55.8	56.0	9.3	9.4	-22.1	-21.8
F1	bluish green	100.0	0.2	71.4	71.6	-33.3	-33.4	1.6	1.6
A1	orange	100.0	0.3	65.3	65.6	34.9	34.9	54.0	53.9
B2	purplish blue	100.0	0.4	42.6	42.8	8.9	8.9	-40.9	-40.6
C2	moderate red	100.0	0.3	52.3	52.6	46.2	46.1	16.6	16.6
D2	purple	100.0	0.4	33.2	33.6	20.4	20.4	-17.4	-17.2
E2	yellow green	100.0	0.3	73.5	73.8	-25.9	-25.9	53.6	53.5
F2	orange yellow	100.0	0.3	74.1	74.4	18.0	18.1	64.9	64.8
A3	blue	100.0	0.6	33.2	33.6	14.0	13.8	-46.1	-45.8
B3	green	100.0	0.3	56.0	56.3	-38.2	-38.1	28.5	28.3
C3	red	100.0	0.4	46.3	46.7	49.0	48.9	26.2	26.1
D3	yellow	100.0	0.4	83.9	84.3	3.4	3.4	76.7	76.7
E3	magenta	100.0	0.6	53.6	54.0	47.2	47.2	-12.5	-12.1
F3	cyan	100.0	0.3	52.4	52.6	-26.9	-26.9	-26.7	-26.6
A4	white	100.0	0.6	95.1	95.4	-0.3	-0.3	2.2	2.7
B4	neutral 8	100.0	0.4	80.2	80.5	-0.2	-0.2	1.3	1.6
C4	neutral 6.5	100.0	0.4	68.6	69.0	-0.1	-0.1	0.7	0.9
D4	neutral 5	100.0	0.4	53.0	53.3	0.1	0.0	1.0	1.1
E4	neutral 3.5	100.0	0.3	39.5	39.8	0.0	0.0	-0.1	-0.1
F4	black	100.0	0.5	27.8	28.2	-0.4	-0.3	1.5	1.3
A5	paper white	100.0	0.7	97.4	98.0	-0.2	-0.3	1.8	2.2
B5	Skin highlight L*=88	100.0	0.7	88.3	88.9	13.4	13.5	15.7	16.1
C5	Skin highlight L* =75	100.0	0.5	76.3	76.8	19.2	19.3	20.7	21.1
D5	Skin shadow L*=28	100.0	0.4	31.1	31.5	14.0	14.0	13.9	13.7
E5	Skin shadow L*=13	100.0	0.4	23.2	23.7	9.4	9.4	8.7	8.6
F5	Maximum Black	100.0	0.5	17.2	17.5	0.4	0.5	1.5	1.1

Summary Results	I* Color	I* tone	ΔE
Average Score for all patches	100.0	98.7	0.4
Worst 10% (3 lowest scoring patches)	100.0	96.5	0.7

DS Control at 2 years

Section V: Comments and Conclusions

Initial Print Quality:

Moab Entrada Natural 300gsm is highly recommended for use with the HP 3200PS printer and HP's OEM Vivera ink set. This combination of printer/ink/media produces highly lightfast pigment prints with excellent whitepoint, good maximum black density, and accurate color and tone reproduction on a lovely smooth matte finish surface. Entrada Natural 300gsm is also double-side coated (both cut sheet and rolls which is rare). The double-side coating symmetry also gives Entrada Natural 300gsm excellent physical print flatness properties.

Print Longevity:

Moab Entrada Rag Natural exhibits a very slight initial light bleaching of its media whitepoint color, shifting towards a "cooler white" within the first 10 Megalux hours in text, but then it stops changing further. This color change detected by the spectrophotometer is so negligible it would indeed go unnoticed by the viewer. Most importantly, the OBA-free Entrada Natural paper (not to be confused with Entrada Bright which has OBAs) has not suffered from any media yellowing during the ongoing light fade testing, nor in dark storage to date after the 20, 50, and 100 Megalux hour exposed samples were retired to dark storage. The testing is ongoing.

The dark storage control sample also remains visually unchanged 2 years after it was printed. Sample monitoring continues.

With 200 Megalux hours of total light exposure, light fade testing is complete. This printer/ink/media combination has a Conservation Display rating (CDR) greater than 200 Megalux hours for both lower and upper CDR limits. It will ensure that this printer/ink/media combination can withstand over a century of continuous display time framed under glass or acrylic glazing and with illumination levels as high as 500 lux for 12 hours per day without any noticeable light-induced changes to image quality.

Compare this result to ID# 322 which uses a lighter weight version of Moab Entrada Natural and is printed on an Epson SureColor P600 printer using Epson UltraChrome HD inks.

Comments and conclusions will be updated as the dark storage testing continues.

Mark H. McCormick-Goodhart
Director, Aardenburg Imaging & Archives

Table to Convert Megalux-hours of Light Exposure to estimated "Years on Display" Light Fastness Ratings.											
Indoor Light Levels for Print Display		Multiply Mlux-hrs by	Megalux-hours in test									
Light Exposure	**Description**		**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**
≤ 10 Lux 24 hours per day	Interior rooms, storage areas, or hallways without windows, illuminated sparingly by artificial lighting	**11.42**	114	228	342	457	571	685	799	913	1027	1142
50 Lux 12 hours per day	"Museum Standard" display condition	**4.57**	46	91	137	183	228	274	325	365	411	457
120 Lux 12 hours per day "Kodak Display Years" (1)	Average home illumination level for photos is ~ 60 lux. 90% of all displayed photos do not exceed 120 lux (1).	**1.90**	19	38	57	76	95	114	133	152	171	190
228 Lux 12 hours per day	Relatively bright home or office. Note the simple 1:1 relationship between "years on display" and Mlux-hr values at this condition.	**1.00**	10	20	30	40	50	60	70	80	90	100
450 Lux 12 hours per day "WIR Display Years" (2) Also equals 500 lux for 11.8 hours per day	A bright home or commercial office building illumination level is 200-500 lux. Also, good illumination for color critical viewing and color matching tasks begins at about 500 lux.	**0.51**	5	10	15	20	25	30	35	41	46	51
2000 Lux 12 hours per day	Commercial Gallery. Also, critical color evaluation standards call for 2000 lux and a D50 illumination source.	**0.114**	1.1	2.3	3.4	4.6	5.7	6.8	8.0	9.1	10.3	11.4
5000 Lux 12 hours per day	E.g., Sunlight through a window striking print at an angle.	**0.046**	0.5	0.9	1.4	1.8	2.3	2.7	3.2	3.7	4.1	4.6
10,000 Lux 12 hours per day	South-facing window in U.S.A. , e.g., storefront display with photos directly facing window.	**0.023**	0.2	0.5	0.7	0.9	1.1	1.4	1.6	1.8	2.1	2.3

Light levels commonly encountered in the real world fluctuate widely throughout indoor print display environments and produce large variations in how long it takes for artwork to acquire light-induced damage. Use this table as a guide to estimate how many "years on display" (denoted in red text) it takes to accumulate an equivalent light exposure dosage. Review the test results to decide which Megalux-hour dose has caused fading to your level of concern (e.g., just noticeable, easily noticeable, objectionable, etc.). Then choose the "Light Exposure" description that best represents how your print is likely to be displayed. You may want to obtain a lux meter and make some measurements in your own display environment!

Note that as the years of display time increase, light-induced fading can be eclipsed by other serious aging mechanisms such as fading and/or staining caused by heat, humidity, and air pollutants. Mould damage can also occur at high humidity. Even when colorants remain water fast, direct contact with liquids may result in physical deformation and staining of the substrate. Also, temperature and especially strong seasonal humidity fluctuations can cause physical cracks and/or flaking, etc., over time. Handling damage such as scratching, abrasion, tears and creases, and catastrophic damage by smoke, fire, flood, etc., also destroy print quality over time. Thus, as illumination levels are reduced other forms of print degradation take on greater probability of occurrence.

(1) Eastman Kodak cited this exposure condition with a 90% confidence limit as a rationale for estimating print fading times of traditional color photo materials in typical home display environments. However, for light fading claims regarding its line of pigment-based inkjet printers, Kodak adopted the higher level of 450lux/12 hours per day which is also used by Wilhelm Imaging Research, Inc. (See below).

(2) Wilhelm Imaging Research (WIR) standardized its light fastness ratings on 450 lux for 12 hours per day in order to estimate the years on display necessary to reach "easily noticeable" fading. This average daily light exposure dosage, at an assumed 75˚F/60%RH temperature and humidity level, has become a de facto industry standard for most industry-sponsored predictive "years of life" light fading estimates in the absence of a published International Standards Organization (ISO) test standard. The table above readily shows how much error occurs in such "print lifetime" predictions as actual real world light levels for prints on display routinely deviate above and below the assumed 450 lux intensity value.

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About this Report

This report contains light fastness information about a sample test print produced by a specific digital printing system. "System" refers to all hardware, software, and materials used to make the finished print. The hardware, software, material components, and printmaker's skills contribute to the final image quality and image permanence. The tested sample is made with current or recently discontinued stocks of commercially available products unless otherwise stated. Each sample has been prepared by Aardenburg Imaging & Archives or one of its members in accordance with customary print making practices unless otherwise noted. The sample may also contain additional finishing materials such as overcoats and laminates which are also noted when used. Finally, the sample has been tested under standardized conditions that are defined on the Sample Description page (see page 4). AaI&A makes every effort to ensure but cannot guarantee that the samples are properly identified and documented and that test results are accurate. For this reason, AaI&A also strives to test independently produced sample replicates in order to increase sampling confidence and to provide information on process variability. Please compare the results in this report to replicate test samples when the data become available.



The magnitude and visual appearance of fading depends not only on the chosen printing system but the chosen image as well. In other words, different images are comprised of different colors, and the fading relationships between those colors dictate how the image will look as it fades. The sample print in this test report was made by reproducing the digital image shown on the left. It contains 30 standard colors. 24 of the colors are colorimetrically matched to the Macbeth ColorChecker™ chart viewed under D50 illumination. The remaining six colors supplement the ColorChecker™ array with four additional skin tone colors, one patch for paper white, and another for maximum black. The additional colors

Information about the fading characteristics of the product is provided in three ways:

1) You can visually assess the fading. The target images reproduced in this report are digitally reconstructed from the spectrally measured color data rather than scanning or otherwise reproducing the physical print by conventional techniques. This method ensures a colorimetrically accurate representation of the print appearance as the print fades. A calibrated monitor is recommended to experience the best possible reproduction of the test sample appearance. The side-by-side "before and after" presentation of the target images simulates looking at a perfect copy of the unexposed original print along side the same print after light exposure. You can also use Adobe Reader's full screen mode to cycle through the pages and "animate" the fading.

2) I* Color and tonal accuracy scores are reported. This report includes I* metric scores that compare the color and tonal relationships of the light exposed samples to the color and tonal relationships existing in the original print prior to light exposure. Perfect I* scores of 100% can be approached when no significant fading occurs. Average scores above 90% generally indicate excellent retention of original quality, 80% good, 70% fair, etc., but your conclusions may vary depending on your image quality requirements. I* color rates the retained color accuracy (hue and chroma) while I* tone rates the retained tonal accuracy (lightness and contrast). The score is on a percentile scale where 100% is a perfect match between the comparison image (e.g., "after" light exposure) and the reference image (e.g., "before" any light exposure). 0% I* color means no color accuracy is left. 0% I* tone means essentially no tonality remains and all image information content is lost. Negative I* values have significance as well and contribute to the average I* score when they occur. Negative I* color values mean false color has occurred, for example, when a skin tone turns green or a neutral gray becomes distinctly colorful. Negative I* tone scores mean visual contrast between colors has become inverted (i.e., like the tonal relationships in a photographic film negative). Serious image quality problems must arise before false colors and/or tones appear. For more information on the I* metric, please refer to the AaI&A web site.

3) Color changes are also reported using the classic color difference model, ΔE. Note that ΔE values lose perceptual scaling significance when they become large (e.g., > 15). Also, the ΔE equation does not unambiguously measure changes in image contrast. This limitation is generally not a problem for paints and textiles, but can be a serious oversight when evaluating photographic images. Properly tracking changes in image contrast was a major reason behind the development of the I* metric.

Table I: The Conservation Display Rating Criteria Set	
Upper Exposure limit (calculated from the average score for all sampled colors)	Overall average I* Color score ≥ 90% and overall average I* tone score ≥ 90%
Lower Exposure limit (calculated from the average score for the worst 10% of the sampled colors)	I* Color score for worst ten percent of sampled colors ≥ 80% and I* tone score for worst ten percent of sampled colors ≥ 80%
Physical Properties Requirement	No cracking, crazing, flaking, delamination, or physical deformation of image receiver layer observed during the ***conservation display rated*** exposure range.
"Worst ten percent" refers to those 10% of the color samples from within the sampled image population that exhibit the greatest amount of change.	

The I* metric was conceived as a colorimetric algorithm to measure and track changes in image color and tonal accuracy with respect to an original reference image.[1,2] It scores the retained color and tonal accuracy on a percentile scale from a state of perfect matching (i.e., 100%) to a state of no color and tonal accuracy (i.e., 0%). It also scores any state where false rendering of the reference image tone and color quality has occurred (i.e., negative I* values for color and tone which signify falsely substituted colors and/or tonal reversals). The I* metric is an excellent foundation upon which to build criteria for acceptable change in color and tonal accuracy.

For more information on the Aardenburg Conservation Display ratings, please see the article entitled: : "An Overview of the Aardenburg Imaging Conservation Display Ratings".

Other relevant articles are:

1) Mark McCormick-Goodhart, Henry Wilhelm, and Dmitriy Shklyarov,"A 'Retained Image Appearance' Metric For Full Tonal Scale, Colorimetric Evaluation of Photographic Image Stability," IS&T's NIP20: International Conference on Digital Printing Technologies, Final Program and Proceedings, IS&T, Springfield, VA, October 3–November 5, 2004, pp. 680–688.

2) Mark H. McCormick-Goodhart, "An Introduction to the I* Metric," Aardenburg Imaging & Archives, February 7, 2007

These papers and more are available in PDF format on the documents page of the Aardenburg website:

https://www.aardenburg-imaging.com/documents/