Aardenburg

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IMAGING & ARCHIVES

Accelerated Light Fading Test Results

Hp Designjet Z3100 24", Hp 12-ink Vivera Pigment for Z3100, Hahnemühle Photo Rag Pearl 320gsm

Sample # AaI_20080805_SN001

200 Megalux-hours completed

Conservation Display Rating *	
Lower Exposure Limit (Megalux hours)	Upper Exposure limit (Megalux hours)
passing	passing

* Please read document **AaI_2009_0118_TA-01.pdf**, "**An Overview of the AaI&A Conservation Display Ratings**", located on the Documents page of the AaI&A website for an explanation of the conservation display ratings.

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Test Print Prepared by: AaI&A Member, category: Amateur

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About this Report

This report contains light fastness information about a single 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 2). 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.

Understanding the Test Results



AaI_StandardColorSet(v2)forSRGB.tif

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 also round out the distribution of L* lightness values in the test target.

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 presentation of the target images simulates looking at the light-exposed print along side a perfect duplicate of the unexposed original print. The "Before/After" Layer mode takes advantage of Adobe Reader Layer technology. Toggle the "Before/After" layer on and off using the layers feature of Adobe Reader to directly switch between the light exposed print colors and the initial print colors for the image located on the right side of each page. 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. It was a major reason behind the development of the I* metric.

Sample Description

Printer: Hp Designjet Z3100 24”
Ink/colorant: Hp 12-ink Vivera Pigment for Z3100
Paper: Hahnemühle Photo Rag Pearl 320gsm

Sample #: AaI_20080805_SN001
Test Print Submission Category: amateur



AaI_StandardColorSet(v2)forSRGB.tif

Test Image: AaI_StandardColorSet(v2)forSRGB.tif
RIP/Driver settings: PSCS3/Hp driver version 5.1 for Mac
Media Setting: custom media setting (based on Hp Pro Satin paper type, paper thickness = thick, dry time = optimal, ink limits = 100%), more passes, gloss enhancer: whole page, photo black
Printed: August 2, 2008
Original print colors measured on: September 24, 2008
Test started on: October 11, 2008

Profile: n.a. **Rendering Intent:** perceptual
Profile type: custom
Profile Creation Software: Advanced Profiling Solution 1.31

Paper White Color (UV–included versus UV–excluded) and Maximum Printed Black						
Optical Brighteners present? no	L*		a*		b*	
	UV inc	UV exc	UV inc	UV exc	UV inc	UV exc
Maximum Paper White (no colorants printed)	96.0	96.0	0.0	0.0	1.6	1.7
(1) ΔL*, Δa*, Δb* respectively	0.0		0.0		0.1	
(1) Calculated differences, especially for Δb*, indicate the role and magnitude of fluorescence on original paper color						
Maximum Printed black (UV included)	L* = 16.6		a* = 0.6		b* = -1.6	

Light Source: Phillips Colortone F40T12/C50
Filter/Glazing: Sample framed under Glass*
Light Exposure Cycle: 8 hours on, 4 hours off, twice per 24 hours
Average Illuminance during “on” cycle: 11,836 Lux
Average Temperature: 23.2˚C over full test duration, 24.6˚C during light exposure
Average Relative humidity: 59.1%RH full test period, 59.8%RH during light exposure
CIELAB measurements: D50 2˚ observer, Xrite Gretag/Macbeth Spectrolino/Spectroscan

Replicates/Compare to:

No Replicates are available at this time.

Notes/Comments:

* The Phillips Colortone F40T12/C50 fluorescent light source and ordinary glass picture frame glazing yields UVA content and overall spectral power similar to natural 5000˚K daylight entering a window and then striking a print that has been framed by **standard acrylic glazing** rather than ordinary glass. Other light sources and/or different glazing options may yield greater or lesser fade rates (generally, a 2-5x increase in fade rate for direct sunlight compared to UV–excluded sources at the same Lux level). The spectral quality of the light can also affect individual colors differently.

Table to Convert Megalux-hours of Light Exposure to estimated "Years on Display"											
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 the light exposure test 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 print display 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 humidity cycling can cause physical cracks and/or flaking, etc. Handling damage such as scratching, abrasion, tears and creases, and catastrophic damage by smoke, fire, flood, etc., also degrade print quality over time. Thus, as illumination levels are reduced other forms of degradation take on greater proportion of risk and may appear in shorter time intervals.

(1) Eastman Kodak has cited this exposure condition and 90% confidence limit as a rationale for estimating print fading times of traditional color photo materials in typical home display environments. For recent light fading claims regarding its line of pigment-based inkjet printers, Kodak has 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) has standardized its light fastness ratings on 450 lux for 12 hours per day in order to estimate the years on display necessary to reach "noticeable" fading. This average light exposure condition, an assumed 75°F/60%RH temperature and humidity level, and WIR's visually weighted densitometric endpoint criteria set V3.0 has become a de facto industry standard for most predictive light fading estimates in the absence of a published International Standards Organization (ISO) test standard.

100color/100tone



Original Print Colors
(measured before light exposure)



Colors at Zero Megalux-hours of Light Exposure
(same as original print colors)

Hp Designjet Z3100 24", Hp 12-ink Vivera Pigment for Z3100, Hahnemühle Photo Rag Pearl 320gsm

Original Print Colors as Measured and at Start of Test									
				L*		a*		b*	
Column/row	Color Patch	I*Color	ΔE	Before	After	Before	After	Before	After
A1	dark Skin	100	0.0	43.0		14.7		13.3	
B1	light Skin	100	0.0	64.2		19.0		16.6	
C1	blue sky	100	0.0	52.9		-5.9		-19.3	
D1	foliage	100	0.0	46.9		-13.3		24.4	
E1	blue flower	100	0.0	54.5		7.4		-23.3	
F1	bluish green	100	0.0	68.6		-31.2		0.6	
A2	orange	100	0.0	62.6		37.3		56.5	
B2	purplish blue	100	0.0	43.8		4.2		-40.3	
C2	moderate red	100	0.0	53.9		45.7		14.4	
D2	purple	100	0.0	34.4		23.5		-20.8	
E2	yellow green	100	0.0	71.4		-22.7		60.9	
F2	orange yellow	100	0.0	70.5		20.1		70.8	
A3	blue	100	0.0	37.0		1.2		-40.7	
B3	green	100	0.0	56.4		-36.0		33.1	
C3	red	100	0.0	47.0		51.1		24.7	
D3	yellow	100	0.0	78.5		6.6		87.6	
E3	magenta	100	0.0	51.8		45.7		-13.1	
F3	cyan	100	0.0	54.6		-21.7		-23.7	
A4	white	100	0.0	93.3		0.2		1.7	
B4	neutral 8	100	0.0	78.2		0.5		1.4	
C4	neutral 6.5	100	0.0	66.3		0.2		0.0	
D4	neutral 5	100	0.0	53.4		0.5		0.0	
E4	neutral 3.5	100	0.0	42.0		0.4		-1.0	
F4	black	100	0.0	30.2		1.3		-1.4	
A5	paper white	100	0.0	95.9		0.2		1.6	
B5	skin highlight L*=89	100	0.0	86.2		12.4		12.6	
C5	skin highlight L*=75	100	0.0	72.0		21.1		17.8	
D5	skin shadow L*=25	100	0.0	33.4		18.2		17.5	
E5	skin shadow L*=11	100	0.0	22.9		12.3		9.0	
F5	Max Black	100	0.0	16.6		0.6		-1.6	

Summary Results	I*Color	I*tone	ΔE
Average Score for all patches	100	100	0.0
Average Score for the Worst 10% (3 lowest scoring patches)	100	100	0.0



Aardenburg Imaging & Archives

99.4color/98.2tone



Original Print Colors
(measured before light exposure)



Colors after 10 Megalux-hours
light exposure

Hp Designjet Z3100 24", Hp 12-ink Vivera Pigment for Z3100, Hahnemühle Photo Rag Pearl 320gsm

10 Mlux-hrs Light Exposure (i.e., after) Compared to Original Print Colors (i.e., before)

				L*		a*		b*	
Column/row	Color Patch	I*Color	ΔE	Before	After	Before	After	Before	After
A1	dark Skin	100.0	0.4	43.0	43.4	14.7	14.7	13.3	13.2
B1	light Skin	100.0	0.8	64.2	64.9	19.0	18.8	16.6	16.2
C1	blue sky	100.0	0.9	52.9	53.7	-5.9	-6.2	-19.3	-19.1
D1	foliage	100.0	0.5	46.9	47.4	-13.3	-13.4	24.4	24.5
E1	blue flower	98.9	1.1	54.5	55.4	7.4	6.8	-23.3	-22.8
F1	bluish green	100.0	0.8	68.6	69.2	-31.2	-30.9	0.6	0.3
A2	orange	100.0	0.5	62.6	63.1	37.3	37.2	56.5	56.3
B2	purplish blue	99.0	1.1	43.8	44.5	4.2	3.4	-40.3	-39.8
C2	moderate red	100.0	0.7	53.9	54.5	45.7	45.3	14.4	14.7
D2	purple	99.3	0.9	34.4	35.0	23.5	23.0	-20.8	-20.3
E2	yellow green	100.0	0.5	71.4	71.9	-22.7	-22.8	60.9	61.0
F2	orange yellow	100.0	0.6	70.5	71.0	20.1	19.8	70.8	70.8
A3	blue	98.6	1.2	37.0	37.5	1.2	0.3	-40.7	-40.1
B3	green	100.0	0.4	56.4	56.8	-36.0	-35.8	33.1	33.1
C3	red	100.0	0.6	47.0	47.5	51.1	51.0	24.7	25.1
D3	yellow	99.9	0.8	78.5	78.9	6.6	6.3	87.6	88.1
E3	magenta	98.4	1.5	51.8	52.5	45.7	44.9	-13.1	-12.2
F3	cyan	100.0	0.6	54.6	55.1	-21.7	-21.8	-23.7	-23.9
A4	white	95.6	1.0	93.3	93.7	0.2	0.3	1.7	0.7
B4	neutral 8	99.3	0.8	78.2	78.7	0.5	0.5	1.4	0.8
C4	neutral 6.5	100.0	0.6	66.3	66.7	0.2	0.1	0.0	-0.4
D4	neutral 5	100.0	0.5	53.4	53.9	0.5	0.5	0.0	-0.2
E4	neutral 3.5	100.0	0.3	42.0	42.3	0.4	0.3	-1.0	-1.2
F4	black	100.0	0.4	30.2	30.5	1.3	1.2	-1.4	-1.4
A5	paper white	95.3	1.0	95.9	96.2	0.2	0.3	1.6	0.7
B5	skin highlight L*=89	98.4	0.9	86.2	86.6	12.4	12.2	12.6	11.9
C5	skin highlight L*=75	100.0	0.7	72.0	72.6	21.1	20.9	17.8	17.4
D5	skin shadow L*=25	100.0	0.3	33.4	33.7	18.2	18.2	17.5	17.5
E5	skin shadow L*=11	100.0	0.7	22.9	23.4	12.3	12.2	9.0	9.4
F5	Max Black	100.0	0.3	16.6	16.9	0.6	0.6	-1.6	-1.6

Summary Results	I*Color	I*tone	ΔE
Average Score for all patches	99.4	98.2	0.7
Average Score for the Worst 10% (3 lowest scoring patches)	96.4	96.8	1.3



Aardenburg Imaging & Archives

99.0color/97.6tone



Original Print Colors
(measured before light exposure)



Colors after 20 Megalux-hours
light exposure

Hp Designjet Z3100 24", Hp 12-ink Vivera Pigment for Z3100, Hahnemühle Photo Rag Pearl 320gsm

20 Mlux-hrs Light Exposure (i.e., after) Compared to Original Print Colors (i.e., before)

				L*		a*		b*	
Column/row	Color Patch	I*Color	ΔE	Before	After	Before	After	Before	After
A1	dark Skin	100.0	0.6	43.0	43.6	14.7	14.6	13.3	13.2
B1	light Skin	100.0	0.9	64.2	65.1	19.0	18.7	16.6	16.3
C1	blue sky	99.5	1.3	52.9	54.0	-5.9	-6.2	-19.3	-18.8
D1	foliage	100.0	0.6	46.9	47.6	-13.3	-13.3	24.4	24.5
E1	blue flower	97.5	1.6	54.5	55.7	7.4	6.7	-23.3	-22.4
F1	bluish green	99.9	0.9	68.6	69.4	-31.2	-30.8	0.6	0.4
A2	orange	100.0	0.7	62.6	63.3	37.3	37.2	56.5	56.1
B2	purplish blue	97.9	1.6	43.8	44.7	4.2	3.1	-40.3	-39.5
C2	moderate red	99.7	1.0	53.9	54.8	45.7	45.3	14.4	14.9
D2	purple	98.6	1.2	34.4	35.2	23.5	23.0	-20.8	-20.0
E2	yellow green	100.0	0.7	71.4	72.1	-22.7	-22.7	60.9	60.9
F2	orange yellow	100.0	0.8	70.5	71.2	20.1	19.7	70.8	70.9
A3	blue	97.4	1.7	37.0	37.7	1.2	-0.1	-40.7	-39.8
B3	green	100.0	0.8	56.4	57.2	-36.0	-35.7	33.1	33.1
C3	red	99.7	1.0	47.0	47.7	51.1	51.1	24.7	25.4
D3	yellow	99.6	1.0	78.5	79.1	6.6	6.3	87.6	88.4
E3	magenta	97.2	2.1	51.8	52.9	45.7	44.7	-13.1	-11.6
F3	cyan	100.0	0.8	54.6	55.4	-21.7	-21.9	-23.7	-23.7
A4	white	96.1	1.0	93.3	93.8	0.2	0.3	1.7	0.8
B4	neutral 8	100.0	1.0	78.2	79.0	0.5	0.5	1.4	0.9
C4	neutral 6.5	100.0	0.7	66.3	66.9	0.2	0.1	0.0	-0.3
D4	neutral 5	100.0	0.7	53.4	54.2	0.5	0.5	0.0	-0.2
E4	neutral 3.5	100.0	0.5	42.0	42.5	0.4	0.3	-1.0	-1.1
F4	black	100.0	0.5	30.2	30.7	1.3	1.2	-1.4	-1.4
A5	paper white	95.9	1.0	95.9	96.3	0.2	0.3	1.6	0.7
B5	skin highlight L*=89	98.3	1.0	86.2	86.7	12.4	12.1	12.6	11.9
C5	skin highlight L*=75	100.0	1.0	72.0	72.9	21.1	20.8	17.8	17.4
D5	skin shadow L*=25	100.0	0.5	33.4	33.8	18.2	18.2	17.5	17.6
E5	skin shadow L*=11	99.5	0.8	22.9	23.5	12.3	12.3	9.0	9.6
F5	Max Black	100.0	0.2	16.6	16.8	0.6	0.7	-1.6	-1.6

Summary Results	I*Color	I*tone	ΔE
Average Score for all patches	99.2	97.6	0.9
Average Score for the Worst 10% (3 lowest scoring patches)	96.4	94.7	1.8



Aardenburg Imaging & Archives

99.0color/97.1tone



Original Print Colors
(measured before light exposure)



Colors after 30 Megalux-hours
light exposure

Hp Designjet Z3100 24", Hp 12-ink Vivera Pigment for Z3100, Hahnemühle Photo Rag Pearl 320gsm

30 Mlux-hrs Light Exposure (i.e., after) Compared to Original Print Colors (i.e., before)

				L*		a*		b*	
Column/row	Color Patch	I*Color	ΔE	Before	After	Before	After	Before	After
A1	dark Skin	100.0	0.7	43.0	43.7	14.7	14.6	13.3	13.2
B1	light Skin	100.0	1.1	64.2	65.2	19.0	18.7	16.6	16.2
C1	blue sky	98.8	1.4	52.9	54.2	-5.9	-6.3	-19.3	-18.7
D1	foliage	100.0	0.7	46.9	47.7	-13.3	-13.3	24.4	24.5
E1	blue flower	96.5	1.9	54.5	55.9	7.4	6.7	-23.3	-22.2
F1	bluish green	99.8	1.1	68.6	69.5	-31.2	-30.7	0.6	0.5
A2	orange	100.0	0.8	62.6	63.3	37.3	37.3	56.5	56.0
B2	purplish blue	97.1	2.0	43.8	44.9	4.2	2.9	-40.3	-39.2
C2	moderate red	99.5	1.2	53.9	54.9	45.7	45.3	14.4	15.0
D2	purple	98.0	1.5	34.4	35.4	23.5	22.9	-20.8	-19.8
E2	yellow green	100.0	0.8	71.4	72.2	-22.7	-22.7	60.9	61.0
F2	orange yellow	100.0	0.9	70.5	71.3	20.1	19.7	70.8	70.9
A3	blue	96.7	2.0	37.0	37.8	1.2	-0.3	-40.7	-39.6
B3	green	100.0	0.9	56.4	57.2	-36.0	-35.6	33.1	33.2
C3	red	99.7	1.0	47.0	47.8	51.1	51.1	24.7	25.4
D3	yellow	99.3	1.3	78.5	79.2	6.6	6.3	87.6	88.6
E3	magenta	96.5	2.5	51.8	53.0	45.7	44.6	-13.1	-11.3
F3	cyan	100.0	1.0	54.6	55.6	-21.7	-21.9	-23.7	-23.6
A4	white	96.2	1.0	93.3	93.9	0.2	0.3	1.7	0.8
B4	neutral 8	100.0	1.0	78.2	79.1	0.5	0.5	1.4	0.9
C4	neutral 6.5	100.0	0.8	66.3	67.0	0.2	0.1	0.0	-0.3
D4	neutral 5	100.0	0.7	53.4	54.2	0.5	0.4	0.0	-0.1
E4	neutral 3.5	100.0	0.5	42.0	42.6	0.4	0.3	-1.0	-1.1
F4	black	100.0	0.5	30.2	30.7	1.3	1.2	-1.4	-1.3
A5	paper white	95.8	1.0	95.9	96.4	0.2	0.3	1.6	0.7
B5	skin highlight L*=89	97.7	1.1	86.2	86.8	12.4	12.0	12.6	11.8
C5	skin highlight L*=75	100.0	1.1	72.0	72.9	21.1	20.8	17.8	17.3
D5	skin shadow L*=25	100.0	0.6	33.4	33.9	18.2	18.3	17.5	17.7
E5	skin shadow L*=11	98.5	1.0	22.9	23.5	12.3	12.4	9.0	9.7
F5	Max Black	100.0	0.3	16.6	16.8	0.6	0.7	-1.6	-1.5

Summary Results	I*Color	I*tone	ΔE
Average Score for all patches	99.0	97.1	1.1
Average Score for the Worst 10% (3 lowest scoring patches)	96.2	94.0	2.2



Aardenburg Imaging & Archives

98.8color/97.1tone



Original Print Colors
(measured before light exposure)



Colors after 40 Megalux-hours
light exposure

Hp Designjet Z3100 24", Hp 12-ink Vivera Pigment for Z3100, Hahnemühle Photo Rag Pearl 320gsm

40 Mlux-hrs Light Exposure (i.e., after) Compared to Original Print Colors (i.e., before)

				L*		a*		b*	
Column/row	Color Patch	I*Color	ΔE	Before	After	Before	After	Before	After
A1	dark Skin	100.0	0.8	43.0	43.8	14.7	14.5	13.3	13.3
B1	light Skin	100.0	1.2	64.2	65.3	19.0	18.6	16.6	16.2
C1	blue sky	98.0	1.6	52.9	54.3	-5.9	-6.3	-19.3	-18.5
D1	foliage	100.0	0.8	46.9	47.7	-13.3	-13.4	24.4	24.5
E1	blue flower	95.5	2.2	54.5	56.0	7.4	6.5	-23.3	-22.0
F1	bluish green	99.8	1.0	68.6	69.5	-31.2	-30.7	0.6	0.5
A2	orange	99.9	0.9	62.6	63.3	37.3	37.2	56.5	55.9
B2	purplish blue	96.5	2.3	43.8	45.0	4.2	2.8	-40.3	-39.0
C2	moderate red	99.2	1.3	53.9	54.8	45.7	45.2	14.4	15.2
D2	purple	97.9	1.5	34.4	35.4	23.5	22.9	-20.8	-19.8
E2	yellow green	100.0	0.9	71.4	72.2	-22.7	-22.7	60.9	60.9
F2	orange yellow	100.0	0.9	70.5	71.2	20.1	19.7	70.8	70.7
A3	blue	96.0	2.3	37.0	38.0	1.2	-0.5	-40.7	-39.4
B3	green	100.0	0.8	56.4	57.2	-36.0	-35.7	33.1	33.2
C3	red	99.5	1.1	47.0	47.8	51.1	51.0	24.7	25.5
D3	yellow	99.3	1.3	78.5	79.2	6.6	6.2	87.6	88.7
E3	magenta	95.9	2.8	51.8	53.1	45.7	44.4	-13.1	-11.0
F3	cyan	100.0	1.1	54.6	55.7	-21.7	-21.9	-23.7	-23.5
A4	white	96.2	1.0	93.3	93.9	0.2	0.2	1.7	0.8
B4	neutral 8	100.0	1.0	78.2	79.1	0.5	0.4	1.4	1.0
C4	neutral 6.5	100.0	0.9	66.3	67.1	0.2	0.1	0.0	-0.2
D4	neutral 5	100.0	0.8	53.4	54.3	0.5	0.4	0.0	-0.1
E4	neutral 3.5	100.0	0.6	42.0	42.7	0.4	0.2	-1.0	-1.0
F4	black	100.0	0.6	30.2	30.7	1.3	1.2	-1.4	-1.3
A5	paper white	95.9	1.0	95.9	96.4	0.2	0.2	1.6	0.7
B5	skin highlight L*=89	97.3	1.2	86.2	86.9	12.4	11.9	12.6	11.8
C5	skin highlight L*=75	99.9	1.1	72.0	73.0	21.1	20.8	17.8	17.4
D5	skin shadow L*=25	100.0	0.7	33.4	34.0	18.2	18.3	17.5	17.8
E5	skin shadow L*=11	97.9	1.0	22.9	23.4	12.3	12.5	9.0	9.8
F5	Max Black	100.0	0.2	16.6	16.7	0.6	0.7	-1.6	-1.6

Summary Results	I*Color	I*tone	ΔE
Average Score for all patches	98.8	97.1	1.2
Average Score for the Worst 10% (3 lowest scoring patches)	95.8	93.8	2.5



Aardenburg Imaging & Archives

98.6color/96.6tone



Original Print Colors
(measured before light exposure)



Colors after 50 Megalux-hours
light exposure

Hp Designjet Z3100 24", Hp 12-ink Vivera Pigment for Z3100, Hahnemühle Photo Rag Pearl 320gsm

50 Mlux-hrs Light Exposure (i.e., after) Compared to Original Print Colors (i.e., before)

				L*		a*		b*	
Column/row	Color Patch	I*Color	ΔE	Before	After	Before	After	Before	After
A1	dark Skin	100.0	0.7	43.0	43.7	14.7	14.6	13.3	13.4
B1	light Skin	100.0	1.2	64.2	65.3	19.0	18.6	16.6	16.3
C1	blue sky	97.2	1.8	52.9	54.4	-5.9	-6.4	-19.3	-18.4
D1	foliage	100.0	0.8	46.9	47.7	-13.3	-13.4	24.4	24.6
E1	blue flower	94.6	2.4	54.5	56.1	7.4	6.5	-23.3	-21.8
F1	bluish green	99.8	1.1	68.6	69.5	-31.2	-30.7	0.6	0.6
A2	orange	99.9	0.9	62.6	63.3	37.3	37.2	56.5	55.9
B2	purplish blue	95.8	2.5	43.8	45.1	4.2	2.6	-40.3	-38.8
C2	moderate red	99.1	1.3	53.9	54.9	45.7	45.1	14.4	15.2
D2	purple	97.7	1.6	34.4	35.4	23.5	22.9	-20.8	-19.7
E2	yellow green	100.0	0.8	71.4	72.2	-22.7	-22.7	60.9	61.0
F2	orange yellow	100.0	0.9	70.5	71.3	20.1	19.6	70.8	70.9
A3	blue	95.4	2.6	37.0	38.0	1.2	-0.7	-40.7	-39.2
B3	green	100.0	0.8	56.4	57.2	-36.0	-35.7	33.1	33.3
C3	red	99.3	1.2	47.0	47.8	51.1	51.1	24.7	25.6
D3	yellow	98.9	1.6	78.5	79.2	6.6	6.2	87.6	89.1
E3	magenta	95.5	3.0	51.8	53.2	45.7	44.4	-13.1	-10.9
F3	cyan	100.0	1.2	54.6	55.7	-21.7	-22.0	-23.7	-23.4
A4	white	96.4	1.0	93.3	93.9	0.2	0.2	1.7	0.8
B4	neutral 8	100.0	1.0	78.2	79.1	0.5	0.4	1.4	1.0
C4	neutral 6.5	100.0	0.9	66.3	67.2	0.2	0.0	0.0	-0.2
D4	neutral 5	100.0	0.8	53.4	54.2	0.5	0.4	0.0	-0.1
E4	neutral 3.5	100.0	0.6	42.0	42.6	0.4	0.2	-1.0	-1.0
F4	black	100.0	0.5	30.2	30.6	1.3	1.2	-1.4	-1.4
A5	paper white	96.0	1.0	95.9	96.4	0.2	0.2	1.6	0.7
B5	skin highlight L*=89	96.5	1.3	86.2	86.9	12.4	11.9	12.6	11.7
C5	skin highlight L*=75	99.6	1.3	72.0	73.1	21.1	20.7	17.8	17.3
D5	skin shadow L*=25	100.0	0.7	33.4	33.9	18.2	18.4	17.5	17.9
E5	skin shadow L*=11	96.3	1.1	22.9	23.3	12.3	12.6	9.0	10.0
F5	Max Black	100.0	0.1	16.6	16.5	0.6	0.6	-1.6	-1.6

Summary Results	I*Color	I*tone	ΔE
Average Score for all patches	98.6	96.6	1.2
Average Score for the Worst 10% (3 lowest scoring patches)	95.2	92.6	2.7



Aardenburg Imaging & Archives

98.4color/96.4tone



Original Print Colors
(measured before light exposure)



Colors after 60 Megalux-hours
light exposure

Hp Designjet Z3100 24", Hp 12-ink Vivera Pigment for Z3100, Hahnemühle Photo Rag Pearl 320gsm

60 Mlux-hrs Light Exposure (i.e., after) Compared to Original Print Colors (i.e., before)

				L*		a*		b*	
Column/row	Color Patch	I*Color	ΔE	Before	After	Before	After	Before	After
A1	dark Skin	100.0	0.6	43.0	43.6	14.7	14.7	13.3	13.5
B1	light Skin	100.0	1.1	64.2	65.2	19.0	18.7	16.6	16.4
C1	blue sky	96.9	1.8	52.9	54.3	-5.9	-6.4	-19.3	-18.3
D1	foliage	100.0	0.7	46.9	47.6	-13.3	-13.4	24.4	24.6
E1	blue flower	93.9	2.5	54.5	56.0	7.4	6.4	-23.3	-21.6
F1	bluish green	99.8	1.0	68.6	69.4	-31.2	-30.7	0.6	0.7
A2	orange	99.7	0.9	62.6	63.2	37.3	37.2	56.5	55.8
B2	purplish blue	95.2	2.7	43.8	45.0	4.2	2.6	-40.3	-38.5
C2	moderate red	98.7	1.5	53.9	54.8	45.7	45.0	14.4	15.4
D2	purple	97.5	1.6	34.4	35.3	23.5	22.9	-20.8	-19.6
E2	yellow green	100.0	0.7	71.4	72.1	-22.7	-22.7	60.9	60.8
F2	orange yellow	100.0	0.8	70.5	71.2	20.1	19.6	70.8	70.7
A3	blue	95.0	2.7	37.0	37.9	1.2	-0.7	-40.7	-39.0
B3	green	100.0	0.7	56.4	57.1	-36.0	-35.6	33.1	33.1
C3	red	99.1	1.2	47.0	47.6	51.1	51.0	24.7	25.7
D3	yellow	98.7	1.7	78.5	79.0	6.6	6.2	87.6	89.2
E3	magenta	95.0	3.2	51.8	53.1	45.7	44.3	-13.1	-10.6
F3	cyan	100.0	1.1	54.6	55.6	-21.7	-21.9	-23.7	-23.2
A4	white	96.5	0.9	93.3	93.7	0.2	0.2	1.7	0.8
B4	neutral 8	100.0	0.9	78.2	79.0	0.5	0.4	1.4	1.1
C4	neutral 6.5	100.0	0.7	66.3	67.0	0.2	0.0	0.0	-0.1
D4	neutral 5	100.0	0.6	53.4	54.0	0.5	0.4	0.0	0.0
E4	neutral 3.5	100.0	0.4	42.0	42.3	0.4	0.2	-1.0	-1.0
F4	black	100.0	0.2	30.2	30.3	1.3	1.1	-1.4	-1.4
A5	paper white	96.2	0.9	95.9	96.2	0.2	0.2	1.6	0.7
B5	skin highlight L*=89	96.4	1.2	86.2	86.7	12.4	11.8	12.6	11.6
C5	skin highlight L*=75	99.3	1.2	72.0	73.0	21.1	20.6	17.8	17.3
D5	skin shadow L*=25	100.0	0.6	33.4	33.7	18.2	18.4	17.5	17.9
E5	skin shadow L*=11	94.6	1.3	22.9	23.0	12.3	12.7	9.0	10.3
F5	Max Black	100.0	0.5	16.6	16.1	0.6	0.6	-1.6	-1.5

Summary Results	I*Color	I*tone	ΔE
Average Score for all patches	98.4	96.4	1.2
Average Score for the Worst 10% (3 lowest scoring patches)	94.5	92.0	2.9



Aardenburg Imaging & Archives

98.3color/96.2tone



Original Print Colors
(measured before light exposure)



Colors after 70 Megalux-hours
light exposure

Hp Designjet Z3100 24", Hp 12-ink Vivera Pigment for Z3100, Hahnemühle Photo Rag Pearl 320gsm

70 Mlux-hrs Light Exposure (i.e., after) Compared to Original Print Colors (i.e., before)

				L*		a*		b*	
Column/row	Color Patch	I*Color	ΔE	Before	After	Before	After	Before	After
A1	dark Skin	100.0	0.7	43.0	43.8	14.7	14.6	13.3	13.4
B1	light Skin	100.0	1.1	64.2	65.3	19.0	18.7	16.6	16.3
C1	blue sky	96.4	1.9	52.9	54.4	-5.9	-6.4	-19.3	-18.2
D1	foliage	100.0	0.8	46.9	47.7	-13.3	-13.4	24.4	24.7
E1	blue flower	93.2	2.7	54.5	56.1	7.4	6.3	-23.3	-21.4
F1	bluish green	99.6	1.1	68.6	69.5	-31.2	-30.6	0.6	0.8
A2	orange	99.3	1.1	62.6	63.1	37.3	37.3	56.5	55.5
B2	purplish blue	94.7	2.9	43.8	45.0	4.2	2.5	-40.3	-38.2
C2	moderate red	98.8	1.4	53.9	54.8	45.7	45.1	14.4	15.3
D2	purple	97.3	1.6	34.4	35.3	23.5	22.9	-20.8	-19.6
E2	yellow green	100.0	0.6	71.4	72.0	-22.7	-22.7	60.9	61.0
F2	orange yellow	100.0	0.7	70.5	71.0	20.1	19.7	70.8	70.6
A3	blue	94.4	3.0	37.0	38.1	1.2	-0.9	-40.7	-38.8
B3	green	100.0	0.8	56.4	57.1	-36.0	-35.6	33.1	33.2
C3	red	99.3	1.1	47.0	47.6	51.1	51.1	24.7	25.6
D3	yellow	98.5	1.8	78.5	79.0	6.6	6.1	87.6	89.3
E3	magenta	94.6	3.4	51.8	53.1	45.7	44.2	-13.1	-10.5
F3	cyan	99.7	1.2	54.6	55.6	-21.7	-21.9	-23.7	-23.1
A4	white	96.8	0.9	93.3	93.8	0.2	0.2	1.7	0.9
B4	neutral 8	100.0	0.8	78.2	78.9	0.5	0.4	1.4	1.1
C4	neutral 6.5	100.0	0.8	66.3	67.0	0.2	0.0	0.0	-0.1
D4	neutral 5	100.0	0.7	53.4	54.1	0.5	0.4	0.0	0.1
E4	neutral 3.5	100.0	0.5	42.0	42.4	0.4	0.1	-1.0	-0.9
F4	black	100.0	0.2	30.2	30.3	1.3	1.1	-1.4	-1.3
A5	paper white	96.4	0.9	95.9	96.2	0.2	0.2	1.6	0.8
B5	skin highlight L*=89	95.7	1.4	86.2	86.7	12.4	11.8	12.6	11.5
C5	skin highlight L*=75	99.3	1.1	72.0	72.8	21.1	20.7	17.8	17.2
D5	skin shadow L*=25	100.0	0.5	33.4	33.6	18.2	18.5	17.5	17.9
E5	skin shadow L*=11	94.1	1.4	22.9	22.8	12.3	12.7	9.0	10.3
F5	Max Black	100.0	0.3	16.6	16.2	0.6	0.7	-1.6	-1.5

Summary Results	I*Color	I*tone	ΔE
Average Score for all patches	98.3	96.2	1.2
Average Score for the Worst 10% (3 lowest scoring patches)	93.9	91.6	3.1



Aardenburg Imaging & Archives

98.1 color / 95.8 tone



Original Print Colors
(measured before light exposure)



Colors after 80 Megalux-hours
light exposure

Hp Designjet Z3100 24", Hp 12-ink Vivera Pigment for Z3100, Hahnemühle Photo Rag Pearl 320gsm

80 Mlux-hrs Light Exposure (i.e., after) Compared to Original Print Colors (i.e., before)

				L*		a*		b*	
Column/row	Color Patch	I*Color	ΔE	Before	After	Before	After	Before	After
A1	dark Skin	100.0	1.0	43.0	44.0	14.7	14.6	13.3	13.4
B1	light Skin	100.0	1.4	64.2	65.5	19.0	18.6	16.6	16.2
C1	blue sky	95.7	2.2	52.9	54.6	-5.9	-6.3	-19.3	-18.0
D1	foliage	100.0	0.9	46.9	47.8	-13.3	-13.4	24.4	24.7
E1	blue flower	92.4	3.0	54.5	56.5	7.4	6.4	-23.3	-21.2
F1	bluish green	99.3	1.3	68.6	69.6	-31.2	-30.6	0.6	0.8
A2	orange	98.8	1.4	62.6	63.3	37.3	37.3	56.5	55.2
B2	purplish blue	94.2	3.2	43.8	45.3	4.2	2.4	-40.3	-38.1
C2	moderate red	98.5	1.6	53.9	55.0	45.7	45.0	14.4	15.4
D2	purple	96.8	1.9	34.4	35.7	23.5	22.9	-20.8	-19.4
E2	yellow green	100.0	0.9	71.4	72.3	-22.7	-22.7	60.9	60.9
F2	orange yellow	99.9	1.0	70.5	71.3	20.1	19.6	70.8	70.4
A3	blue	94.0	3.2	37.0	38.3	1.2	-0.9	-40.7	-38.6
B3	green	100.0	1.0	56.4	57.4	-36.0	-35.6	33.1	33.2
C3	red	99.2	1.3	47.0	47.8	51.1	51.1	24.7	25.7
D3	yellow	98.4	2.0	78.5	79.2	6.6	6.2	87.6	89.5
E3	magenta	94.2	3.7	51.8	53.5	45.7	44.1	-13.1	-10.3
F3	cyan	99.4	1.5	54.6	55.9	-21.7	-21.9	-23.7	-23.0
A4	white	96.9	1.0	93.3	94.0	0.2	0.2	1.7	0.9
B4	neutral 8	100.0	1.1	78.2	79.3	0.5	0.4	1.4	1.1
C4	neutral 6.5	100.0	1.0	66.3	67.3	0.2	0.0	0.0	0.0
D4	neutral 5	100.0	1.0	53.4	54.4	0.5	0.4	0.0	0.1
E4	neutral 3.5	100.0	0.7	42.0	42.7	0.4	0.2	-1.0	-0.9
F4	black	100.0	0.6	30.2	30.7	1.3	1.2	-1.4	-1.3
A5	paper white	96.5	1.0	95.9	96.5	0.2	0.2	1.6	0.8
B5	skin highlight L*=89	95.1	1.6	86.2	87.0	12.4	11.7	12.6	11.4
C5	skin highlight L*=75	99.0	1.5	72.0	73.2	21.1	20.6	17.8	17.2
D5	skin shadow L*=25	100.0	0.8	33.4	34.0	18.2	18.5	17.5	17.9
E5	skin shadow L*=11	94.0	1.5	22.9	23.3	12.3	12.8	9.0	10.3
F5	Max Black	100.0	0.1	16.6	16.5	0.6	0.7	-1.6	-1.5

Summary Results	I*Color	I*tone	ΔE
Average Score for all patches	98.1	95.8	1.5
Average Score for the Worst 10% (3 lowest scoring patches)	93.5	91.0	3.4

97.9color/95.3tone



Original Print Colors
(measured before light exposure)



Colors after 90 Megalux-hours
light exposure

Hp Designjet Z3100 24", Hp 12-ink Vivera Pigment for Z3100, Hahnemühle Photo Rag Pearl 320gsm

90 Mlux-hrs Light Exposure (i.e., after) Compared to Original Print Colors (i.e., before)

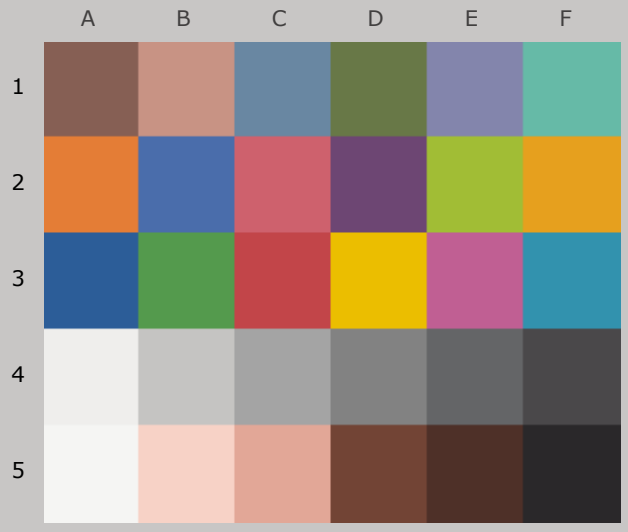
				L*		a*		b*	
Column/row	Color Patch	I*Color	ΔE	Before	After	Before	After	Before	After
A1	dark Skin	100.0	1.1	43.0	44.1	14.7	14.6	13.3	13.3
B1	light Skin	99.7	1.6	64.2	65.7	19.0	18.6	16.6	16.1
C1	blue sky	94.9	2.5	52.9	54.8	-5.9	-6.3	-19.3	-17.8
D1	foliage	100.0	1.1	46.9	47.9	-13.3	-13.4	24.4	24.7
E1	blue flower	91.7	3.3	54.5	56.6	7.4	6.4	-23.3	-21.0
F1	bluish green	98.9	1.5	68.6	69.8	-31.2	-30.5	0.6	0.9
A2	orange	98.6	1.7	62.6	63.5	37.3	37.4	56.5	55.0
B2	purplish blue	93.8	3.5	43.8	45.5	4.2	2.3	-40.3	-37.9
C2	moderate red	98.7	1.7	53.9	55.1	45.7	45.0	14.4	15.4
D2	purple	96.4	2.1	34.4	35.8	23.5	22.9	-20.8	-19.3
E2	yellow green	100.0	1.1	71.4	72.5	-22.7	-22.6	60.9	60.9
F2	orange yellow	100.0	1.1	70.5	71.4	20.1	19.6	70.8	70.6
A3	blue	93.5	3.5	37.0	38.5	1.2	-1.1	-40.7	-38.5
B3	green	100.0	1.2	56.4	57.5	-36.0	-35.4	33.1	33.2
C3	red	99.0	1.4	47.0	47.9	51.1	51.3	24.7	25.8
D3	yellow	98.2	2.3	78.5	79.3	6.6	6.2	87.6	89.7
E3	magenta	93.9	3.9	51.8	53.6	45.7	44.1	-13.1	-10.1
F3	cyan	99.0	1.7	54.6	56.1	-21.7	-21.8	-23.7	-22.9
A4	white	97.8	1.0	93.3	94.1	0.2	0.2	1.7	1.0
B4	neutral 8	100.0	1.2	78.2	79.4	0.5	0.4	1.4	1.2
C4	neutral 6.5	100.0	1.1	66.3	67.4	0.2	0.0	0.0	0.1
D4	neutral 5	100.0	1.1	53.4	54.5	0.5	0.4	0.0	0.2
E4	neutral 3.5	100.0	0.9	42.0	42.8	0.4	0.2	-1.0	-0.8
F4	black	100.0	0.7	30.2	30.8	1.3	1.2	-1.4	-1.2
A5	paper white	97.3	1.0	95.9	96.5	0.2	0.2	1.6	0.8
B5	skin highlight L*=89	94.4	1.8	86.2	87.2	12.4	11.7	12.6	11.3
C5	skin highlight L*=75	98.8	1.7	72.0	73.5	21.1	20.6	17.8	17.1
D5	skin shadow L*=25	99.6	0.9	33.4	34.1	18.2	18.6	17.5	18.0
E5	skin shadow L*=11	92.8	1.7	22.9	23.4	12.3	12.9	9.0	10.5
F5	Max Black	100.0	0.2	16.6	16.5	0.6	0.6	-1.6	-1.4

Summary Results	I*Color	I*tone	ΔE
Average Score for all patches	97.9	95.3	1.6
Average Score for the Worst 10% (3 lowest scoring patches)	92.7	90.6	3.6

97.6color/95.1tone



Original Print Colors
(measured before light exposure)



Colors after 100 Megalux-hours
light exposure

Hp Designjet Z3100 24", Hp 12-ink Vivera Pigment for Z3100, Hahnemühle Photo Rag Pearl 320gsm

100 Mlux-hrs Light Exposure (i.e., after) Compared to Original Print Colors (i.e., before)

				L*		a*		b*	
Column/row	Color Patch	I*Color	ΔE	Before	After	Before	After	Before	After
A1	dark Skin	100.0	1.2	43.0	44.2	14.7	14.5	13.3	13.3
B1	light Skin	99.5	1.6	64.2	65.7	19.0	18.5	16.6	16.1
C1	blue sky	94.4	2.6	52.9	54.9	-5.9	-6.2	-19.3	-17.7
D1	foliage	100.0	1.1	46.9	48.1	-13.3	-13.3	24.4	24.5
E1	blue flower	91.2	3.4	54.5	56.7	7.4	6.4	-23.3	-20.8
F1	bluish green	98.7	1.5	68.6	69.8	-31.2	-30.4	0.6	0.9
A2	orange	98.1	1.9	62.6	63.5	37.3	37.3	56.5	54.7
B2	purplish blue	93.4	3.6	43.8	45.5	4.2	2.3	-40.3	-37.7
C2	moderate red	98.4	1.8	53.9	55.3	45.7	44.9	14.4	15.4
D2	purple	96.4	2.1	34.4	35.8	23.5	22.9	-20.8	-19.2
E2	yellow green	100.0	1.1	71.4	72.4	-22.7	-22.6	60.9	60.6
F2	orange yellow	99.7	1.2	70.5	71.4	20.1	19.6	70.8	70.2
A3	blue	93.2	3.6	37.0	38.5	1.2	-1.1	-40.7	-38.4
B3	green	99.9	1.3	56.4	57.6	-36.0	-35.4	33.1	33.1
C3	red	99.1	1.4	47.0	47.9	51.1	51.1	24.7	25.7
D3	yellow	98.1	2.3	78.5	79.3	6.6	6.2	87.6	89.7
E3	magenta	93.5	4.0	51.8	53.7	45.7	44.0	-13.1	-10.0
F3	cyan	98.6	1.8	54.6	56.2	-21.7	-21.8	-23.7	-22.7
A4	white	97.2	1.0	93.3	94.0	0.2	0.2	1.7	0.9
B4	neutral 8	100.0	1.2	78.2	79.4	0.5	0.4	1.4	1.2
C4	neutral 6.5	100.0	1.1	66.3	67.4	0.2	0.0	0.0	0.1
D4	neutral 5	100.0	1.1	53.4	54.5	0.5	0.4	0.0	0.2
E4	neutral 3.5	100.0	0.9	42.0	42.9	0.4	0.2	-1.0	-0.8
F4	black	100.0	0.7	30.2	30.9	1.3	1.2	-1.4	-1.2
A5	paper white	96.6	1.0	95.9	96.5	0.2	0.2	1.6	0.8
B5	skin highlight L*=89	93.7	1.9	86.2	87.2	12.4	11.7	12.6	11.2
C5	skin highlight L*=75	98.2	1.9	72.0	73.6	21.1	20.5	17.8	17.0
D5	skin shadow L*=25	99.6	0.9	33.4	34.1	18.2	18.6	17.5	18.0
E5	skin shadow L*=11	92.0	1.8	22.9	23.5	12.3	12.9	9.0	10.6
F5	Max Black	100.0	0.2	16.6	16.6	0.6	0.7	-1.6	-1.5

Summary Results	I*Color	I*tone	ΔE
Average Score for all patches	97.6	95.1	1.7
Average Score for the Worst 10% (3 lowest scoring patches)	92.1	90.1	3.8



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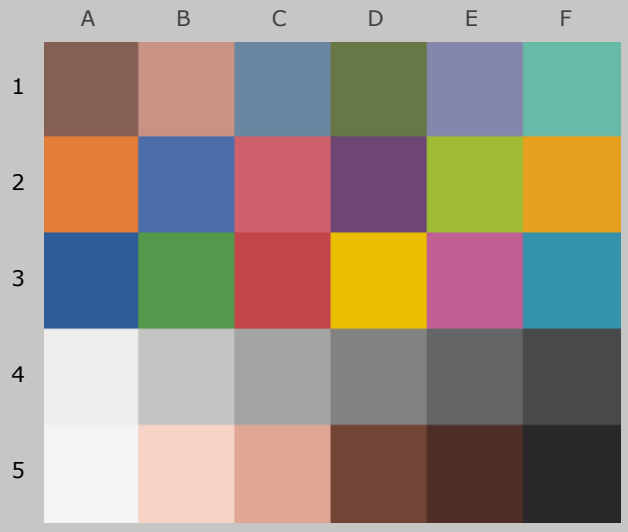
97.3color/94.8tone



Original Print Colors
(measured before light exposure)



Colors after 120 Megalux-hours
light exposure

Hp Designjet Z3100 24", Hp 12-ink Vivera Pigment for Z3100, Hahnemühle Photo Rag Pearl 320gsm

120 Mlux-hrs Light Exposure (i.e., after) Compared to Original Print Colors (i.e., before)

				L*		a*		b*	
Column/row	Color Patch	I*Color	ΔE	Before	After	Before	After	Before	After
A1	dark Skin	100.0	1.2	43.0	44.2	14.7	14.5	13.3	13.4
B1	light Skin	100.0	1.6	64.2	65.7	19.0	18.6	16.6	16.2
C1	blue sky	92.5	2.9	52.9	55.0	-5.9	-6.2	-19.3	-17.3
D1	foliage	100.0	1.0	46.9	48.0	-13.3	-13.3	24.4	24.6
E1	blue flower	89.6	3.7	54.5	56.7	7.4	6.4	-23.3	-20.4
F1	bluish green	97.9	1.6	68.6	69.7	-31.2	-30.2	0.6	1.1
A2	orange	97.3	2.5	62.6	63.4	37.3	37.2	56.5	54.1
B2	purplish blue	92.1	4.1	43.8	45.6	4.2	2.3	-40.3	-37.1
C2	moderate red	97.7	2.1	53.9	55.3	45.7	44.8	14.4	15.8
D2	purple	95.8	2.2	34.4	35.6	23.5	23.0	-20.8	-19.0
E2	yellow green	99.9	1.0	71.4	72.3	-22.7	-22.5	60.9	60.4
F2	orange yellow	99.1	1.4	70.5	71.2	20.1	19.5	70.8	69.7
A3	blue	92.3	3.9	37.0	38.4	1.2	-1.2	-40.7	-37.9
B3	green	99.6	1.2	56.4	57.4	-36.0	-35.3	33.1	32.9
C3	red	98.9	1.4	47.0	47.9	51.1	51.0	24.7	25.9
D3	yellow	97.9	2.4	78.5	79.2	6.6	6.1	87.6	89.9
E3	magenta	92.6	4.4	51.8	53.6	45.7	43.9	-13.1	-9.6
F3	cyan	97.5	1.9	54.6	56.0	-21.7	-21.6	-23.7	-22.4
A4	white	98.8	0.8	93.3	93.9	0.2	0.2	1.7	1.1
B4	neutral 8	100.0	1.1	78.2	79.2	0.5	0.4	1.4	1.4
C4	neutral 6.5	100.0	1.0	66.3	67.3	0.2	0.0	0.0	0.3
D4	neutral 5	100.0	1.0	53.4	54.3	0.5	0.4	0.0	0.4
E4	neutral 3.5	100.0	0.8	42.0	42.6	0.4	0.2	-1.0	-0.6
F4	black	100.0	0.4	30.2	30.5	1.3	1.2	-1.4	-1.2
A5	paper white	98.1	0.8	95.9	96.3	0.2	0.2	1.6	0.9
B5	skin highlight L*=89	93.1	1.9	86.2	86.9	12.4	11.7	12.6	11.1
C5	skin highlight L*=75	98.1	1.7	72.0	73.4	21.1	20.5	17.8	17.0
D5	skin shadow L*=25	99.4	0.9	33.4	34.0	18.2	18.6	17.5	18.0
E5	skin shadow L*=11	91.7	1.8	22.9	23.1	12.3	13.0	9.0	10.6
F5	Max Black	100.0	0.3	16.6	16.5	0.6	0.6	-1.6	-1.3

Summary Results	I*Color	I*tone	ΔE
Average Score for all patches	97.3	94.8	1.8
Average Score for the Worst 10% (3 lowest scoring patches)	91.1	88.9	4.1



Aardenburg Imaging & Archives

96.9color/93.9tone



Original Print Colors
(measured before light exposure)



Colors after 140 Megalux-hours
light exposure

Hp Designjet Z3100 24", Hp 12-ink Vivera Pigment for Z3100, Hahnemühle Photo Rag Pearl 320gsm

140 Mlux-hrs Light Exposure (i.e., after) Compared to Original Print Colors (i.e., before)

				L*		a*		b*	
Column/row	Color Patch	I*Color	ΔE	Before	After	Before	After	Before	After
A1	dark Skin	100.0	1.7	43.0	44.7	14.7	14.4	13.3	13.2
B1	light Skin	99.0	2.2	64.2	66.2	19.0	18.5	16.6	16.0
C1	blue sky	90.8	3.5	52.9	55.5	-5.9	-6.0	-19.3	-17.0
D1	foliage	100.0	1.5	46.9	48.4	-13.3	-13.1	24.4	24.2
E1	blue flower	87.7	4.5	54.5	57.3	7.4	6.6	-23.3	-19.9
F1	bluish green	97.2	2.1	68.6	70.2	-31.2	-30.0	0.6	1.2
A2	orange	95.7	3.6	62.6	63.8	37.3	37.3	56.5	53.1
B2	purplish blue	91.2	4.7	43.8	46.2	4.2	2.2	-40.3	-36.8
C2	moderate red	97.7	2.4	53.9	55.8	45.7	44.7	14.4	15.7
D2	purple	93.9	3.2	34.4	36.5	23.5	22.8	-20.8	-18.5
E2	yellow green	99.1	1.7	71.4	72.7	-22.7	-22.4	60.9	59.9
F2	orange yellow	98.3	2.2	70.5	71.8	20.1	19.4	70.8	69.2
A3	blue	91.5	4.4	37.0	39.0	1.2	-1.3	-40.7	-37.6
B3	green	99.0	1.7	56.4	57.9	-36.0	-35.1	33.1	32.7
C3	red	99.0	1.8	47.0	48.5	51.1	51.1	24.7	25.8
D3	yellow	98.2	2.3	78.5	79.5	6.6	6.1	87.6	89.6
E3	magenta	91.9	5.0	51.8	54.2	45.7	43.8	-13.1	-9.2
F3	cyan	96.7	2.4	54.6	56.5	-21.7	-21.5	-23.7	-22.1
A4	white	99.7	1.0	93.3	94.1	0.2	0.2	1.7	1.1
B4	neutral 8	100.0	1.4	78.2	79.6	0.5	0.4	1.4	1.5
C4	neutral 6.5	100.0	1.4	66.3	67.6	0.2	0.1	0.0	0.4
D4	neutral 5	99.9	1.4	53.4	54.7	0.5	0.4	0.0	0.5
E4	neutral 3.5	99.8	1.2	42.0	43.2	0.4	0.2	-1.0	-0.5
F4	black	100.0	1.1	30.2	31.3	1.3	1.2	-1.4	-1.0
A5	paper white	98.8	0.9	95.9	96.6	0.2	0.2	1.6	1.0
B5	skin highlight L*=89	91.7	2.3	86.2	87.4	12.4	11.6	12.6	10.8
C5	skin highlight L*=75	97.6	2.3	72.0	73.9	21.1	20.5	17.8	16.8
D5	skin shadow L*=25	100.0	1.2	33.4	34.5	18.2	18.6	17.5	17.8
E5	skin shadow L*=11	92.3	1.9	22.9	23.9	12.3	12.9	9.0	10.6
F5	Max Black	100.0	0.9	16.6	17.4	0.6	0.6	-1.6	-1.3

Summary Results	I*Color	I*tone	ΔE
Average Score for all patches	96.9	93.9	2.3
Average Score for the Worst 10% (3 lowest scoring patches)	89.9	87.3	4.7



Aardenburg Imaging & Archives

96.5$_{color}$/93.6$_{tone}$



Original Print Colors
(measured before light exposure)



Colors after 160 Megalux-hours
light exposure

Hp Designjet Z3100 24", Hp 12-ink Vivera Pigment for Z3100, Hahnemühle Photo Rag Pearl 320gsm

160 Mlux-hrs Light Exposure (i.e., after) Compared to Original Print Colors (i.e., before)

				L*		a*		b*	
Column/row	Color Patch	I*Color	ΔE	Before	After	Before	After	Before	After
A1	dark Skin	100.0	1.6	43.0	44.6	14.7	14.5	13.3	13.3
B1	light Skin	99.0	2.1	64.2	66.2	19.0	18.5	16.6	16.0
C1	blue sky	90.3	3.5	52.9	55.5	-5.9	-6.1	-19.3	-16.8
D1	foliage	100.0	1.4	46.9	48.3	-13.3	-13.2	24.4	24.3
E1	blue flower	86.8	4.7	54.5	57.4	7.4	6.6	-23.3	-19.7
F1	bluish green	97.0	2.1	68.6	70.2	-31.2	-30.0	0.6	1.3
A2	orange	95.1	4.0	62.6	63.9	37.3	37.3	56.5	52.6
B2	purplish blue	90.5	5.0	43.8	46.2	4.2	2.0	-40.3	-36.5
C2	moderate red	97.3	2.6	53.9	55.9	45.7	44.6	14.4	15.8
D2	purple	93.7	3.2	34.4	36.5	23.5	23.0	-20.8	-18.3
E2	yellow green	98.9	1.8	71.4	72.8	-22.7	-22.5	60.9	59.7
F2	orange yellow	98.2	2.3	70.5	71.9	20.1	19.3	70.8	69.1
A3	blue	90.7	4.8	37.0	39.1	1.2	-1.5	-40.7	-37.3
B3	green	98.6	1.9	56.4	57.9	-36.0	-35.0	33.1	32.4
C3	red	98.6	1.9	47.0	48.5	51.1	51.1	24.7	26.0
D3	yellow	97.8	2.6	78.5	79.5	6.6	6.1	87.6	89.9
E3	magenta	91.4	5.2	51.8	54.3	45.7	43.8	-13.1	-9.0
F3	cyan	96.0	2.7	54.6	56.6	-21.7	-21.5	-23.7	-21.9
A4	white	99.7	0.9	93.3	94.0	0.2	0.1	1.7	1.1
B4	neutral 8	100.0	1.3	78.2	79.5	0.5	0.4	1.4	1.5
C4	neutral 6.5	100.0	1.4	66.3	67.6	0.2	0.1	0.0	0.4
D4	neutral 5	99.3	1.4	53.4	54.7	0.5	0.4	0.0	0.5
E4	neutral 3.5	99.4	1.3	42.0	43.2	0.4	0.2	-1.0	-0.5
F4	black	100.0	1.0	30.2	31.1	1.3	1.2	-1.4	-1.0
A5	paper white	98.9	0.8	95.9	96.5	0.2	0.2	1.6	1.0
B5	skin highlight L*=89	90.6	2.5	86.2	87.4	12.4	11.6	12.6	10.6
C5	skin highlight L*=75	97.3	2.3	72.0	73.9	21.1	20.5	17.8	16.7
D5	skin shadow L*=25	99.4	1.3	33.4	34.5	18.2	18.7	17.5	17.9
E5	skin shadow L*=11	89.4	2.2	22.9	23.5	12.3	13.1	9.0	11.0
F5	Max Black	100.0	0.6	16.6	17.0	0.6	0.7	-1.6	-1.2

Summary Results	I*Color	I*tone	ΔE
Average Score for all patches	96.5	93.6	2.4
Average Score for the Worst 10% (3 lowest scoring patches)	88.8	86.2	5.0



Aardenburg Imaging & Archives

96.1 color / 92.7 tone



Original Print Colors
(measured before light exposure)



Colors after 180 Megalux-hours
light exposure

Hp Designjet Z3100 24", Hp 12-ink Vivera Pigment for Z3100, Hahnemühle Photo Rag Pearl 320gsm

180 Mlux-hrs Light Exposure (i.e., after) Compared to Original Print Colors (i.e., before)

				L*		a*		b*	
Column/row	Color Patch	I*Color	ΔE	Before	After	Before	After	Before	After
A1	dark Skin	100.0	1.6	43.0	44.7	14.7	14.5	13.3	13.2
B1	light Skin	98.7	2.2	64.2	66.2	19.0	18.6	16.6	15.8
C1	blue sky	89.6	3.8	52.9	55.7	-5.9	-5.9	-19.3	-16.7
D1	foliage	100.0	1.4	46.9	48.4	-13.3	-13.3	24.4	24.3
E1	blue flower	86.3	4.9	54.5	57.6	7.4	6.7	-23.3	-19.5
F1	bluish green	97.1	2.1	68.6	70.1	-31.2	-30.0	0.6	1.3
A2	orange	94.1	4.6	62.6	63.7	37.3	37.3	56.5	52.0
B2	purplish blue	90.2	5.2	43.8	46.5	4.2	2.0	-40.3	-36.4
C2	moderate red	97.4	2.7	53.9	56.0	45.7	44.7	14.4	15.8
D2	purple	94.2	3.1	34.4	36.5	23.5	23.2	-20.8	-18.5
E2	yellow green	98.6	2.0	71.4	72.7	-22.7	-22.5	60.9	59.5
F2	orange yellow	97.7	2.6	70.5	71.9	20.1	19.3	70.8	68.7
A3	blue	90.4	5.0	37.0	39.3	1.2	-1.6	-40.7	-37.2
B3	green	98.6	2.0	56.4	58.0	-36.0	-35.0	33.1	32.4
C3	red	98.6	2.0	47.0	48.5	51.1	51.3	24.7	26.0
D3	yellow	97.7	2.7	78.5	79.5	6.6	6.0	87.6	90.1
E3	magenta	91.4	5.4	51.8	54.6	45.7	43.8	-13.1	-9.0
F3	cyan	95.8	2.9	54.6	56.8	-21.7	-21.4	-23.7	-21.8
A4	white	98.0	1.0	93.3	94.1	0.2	0.1	1.7	1.0
B4	neutral 8	100.0	1.4	78.2	79.6	0.5	0.4	1.4	1.5
C4	neutral 6.5	100.0	1.5	66.3	67.7	0.2	0.1	0.0	0.4
D4	neutral 5	99.4	1.5	53.4	54.9	0.5	0.4	0.0	0.5
E4	neutral 3.5	99.4	1.3	42.0	43.2	0.4	0.2	-1.0	-0.5
F4	black	100.0	1.1	30.2	31.2	1.3	1.2	-1.4	-1.0
A5	paper white	97.2	1.0	95.9	96.5	0.2	0.1	1.6	0.8
B5	skin highlight L*=89	88.6	2.9	86.2	87.5	12.4	11.5	12.6	10.3
C5	skin highlight L*=75	96.0	2.8	72.0	74.3	21.1	20.4	17.8	16.3
D5	skin shadow L*=25	98.6	1.4	33.4	34.6	18.2	18.8	17.5	18.0
E5	skin shadow L*=11	88.1	2.5	22.9	23.8	12.3	13.2	9.0	11.1
F5	Max Black	100.0	0.5	16.6	16.9	0.6	0.7	-1.6	-1.3

Summary Results	I*Color	I*tone	ΔE
Average Score for all patches	96.1	92.7	2.5
Average Score for the Worst 10% (3 lowest scoring patches)	87.7	83.8	5.2



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95.6color/92.3tone



Original Print Colors
(measured before light exposure)



Colors after 200 Megalux-hours
light exposure

Hp Designjet Z3100 24", Hp 12-ink Vivera Pigment for Z3100, Hahnemühle Photo Rag Pearl 320gsm

200 Mlux-hrs Light Exposure (i.e., after) Compared to Original Print Colors (i.e., before)

				L*		a*		b*	
Column/row	Color Patch	I*Color	ΔE	Before	After	Before	After	Before	After
A1	dark Skin	100.0	1.8	43.0	44.8	14.7	14.6	13.3	13.2
B1	light Skin	98.3	2.5	64.2	66.6	19.0	18.5	16.6	15.8
C1	blue sky	88.3	4.1	52.9	55.9	-5.9	-5.8	-19.3	-16.4
D1	foliage	100.0	1.6	46.9	48.5	-13.3	-13.2	24.4	24.2
E1	blue flower	85.1	5.3	54.5	57.8	7.4	6.8	-23.3	-19.2
F1	bluish green	96.5	2.3	68.6	70.3	-31.2	-29.9	0.6	1.4
A2	orange	93.2	5.2	62.6	64.0	37.3	37.5	56.5	51.4
B2	purplish blue	89.5	5.5	43.8	46.6	4.2	2.0	-40.3	-36.1
C2	moderate red	97.2	2.9	53.9	56.1	45.7	44.7	14.4	16.0
D2	purple	93.3	3.5	34.4	36.7	23.5	23.3	-20.8	-18.2
E2	yellow green	98.4	2.2	71.4	73.0	-22.7	-22.5	60.9	59.4
F2	orange yellow	97.4	2.9	70.5	72.1	20.1	19.3	70.8	68.5
A3	blue	90.0	5.2	37.0	39.4	1.2	-1.6	-40.7	-37.0
B3	green	98.3	2.2	56.4	58.2	-36.0	-34.9	33.1	32.2
C3	red	98.3	2.3	47.0	48.8	51.1	51.4	24.7	26.2
D3	yellow	97.5	2.9	78.5	79.6	6.6	6.0	87.6	90.2
E3	magenta	90.9	5.7	51.8	54.8	45.7	43.9	-13.1	-8.7
F3	cyan	94.9	3.1	54.6	56.9	-21.7	-21.3	-23.7	-21.6
A4	white	99.8	0.9	93.3	94.1	0.2	0.2	1.7	1.2
B4	neutral 8	100.0	1.4	78.2	79.6	0.5	0.4	1.4	1.6
C4	neutral 6.5	98.9	1.6	66.3	67.8	0.2	0.1	0.0	0.6
D4	neutral 5	97.9	1.7	53.4	55.0	0.5	0.4	0.0	0.7
E4	neutral 3.5	98.1	1.5	42.0	43.3	0.4	0.2	-1.0	-0.4
F4	black	100.0	1.1	30.2	31.2	1.3	1.2	-1.4	-0.9
A5	paper white	98.6	0.8	95.9	96.5	0.2	0.2	1.6	1.0
B5	skin highlight L*=89	87.4	3.1	86.2	87.6	12.4	11.5	12.6	10.1
C5	skin highlight L*=75	95.7	3.0	72.0	74.4	21.1	20.4	17.8	16.2
D5	skin shadow L*=25	99.4	1.6	33.4	34.9	18.2	18.8	17.5	17.8
E5	skin shadow L*=11	86.1	2.9	22.9	24.1	12.3	13.4	9.0	11.4
F5	Max Black	100.0	0.6	16.6	16.9	0.6	0.7	-1.6	-1.2

Summary Results	I*Color	I*tone	ΔE
Average Score for all patches	95.6	92.3	2.7
Average Score for the Worst 10% (3 lowest scoring patches)	86.2	83.6	5.5



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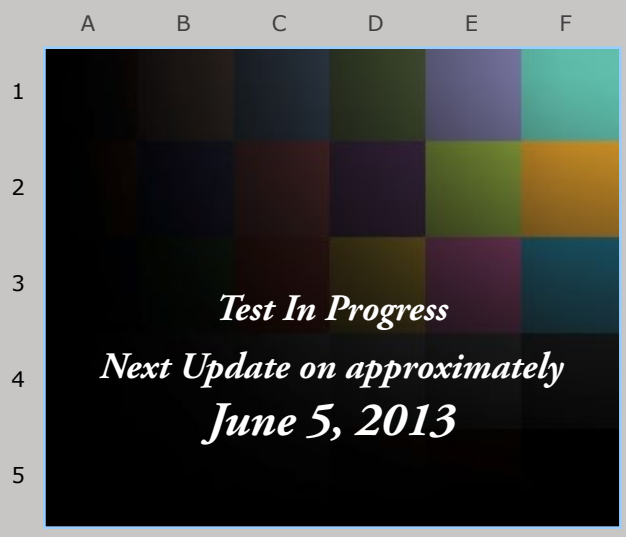
Original Print Colors
(measured before light exposure)



Next update is for 250 Megalux-hours
light exposure

Hp Designjet Z3100 24", Hp 12-ink Vivera Pigment for Z3100,
Hahnemühle Photo Rag Pearl 320gsm

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