Aardenburg

144



IMAGING & ARCHIVES

Accelerated Light Fading Test Results

Epson Stylus Pro 9800, Cone Piezotone™ (split tone Sepia/Selenium with Portfolio Black) ink, Hahnemühle Photo Rag 308 gsm paper

Sample # AaI_20090223_SN005

200 Megalux-hours completed

Conservation Display Rating *	
Lower Exposure Limit (Megalux hours)	Upper Exposure limit (Megalux hours)
88	88

* 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.

Document #: AaI_20090223_SN005Lf.pdf Rev: March 4, 2013
Test Print Prepared by: AaI&A Member

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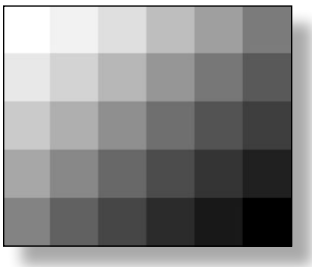
For more information please contact: info@aardenburg-imaging.com

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_StandardB&Wset(v2).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 printing the digital image shown on the left. This image is designed specifically for monochrome printing applications. It contains 30 neutral colors ranging from maximum white (L*= 100, a*= 0, b*= 0) to maximum black (L* = 0, a*= 0, b*= 0). Any hue and chroma observed in the "Original Print Colors" were achieved by the printmaker's selection of media, RIP/driver settings, and choice of inks installed in the printer. The actual sample appearance reproduced in this report is digitally mastered from the colorimetric measurements of the test sample.

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.

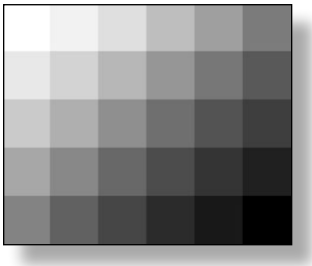
2) ***I* Color and tonal accuracy scores are reported.*** This report includes I* metric scores that compare the color and tonal relationships of the light exposed samples to the color and tonal relationships existing in the original print prior to light exposure. Perfect I* scores of 100% can be approached 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: Epson Stylus Pro 9800
Ink: Cone Piezotone™ (split tone Sepia/Selenium with Portfolio Black)
Paper: Hahnemühle Photo Rag 308 gsm

Sample #: AaI_20090223_SN005
Test Print Prepared by: AaI&A Member



AaI_StandardB&Wset(v2).tif

Test Image: AaI_StandardB&Wset(v2).tif
RIP/Driver settings: Ergosoft StudioPrint version 12
Media Setting: n.a.

Printed: February 23, 2009
Original print colors measured on: May 3, 2009
Test started on: May 4, 2009

Profile: n.a. **Rendering Intent:** n.a.
Profile type: custom
Profile Creation Software: n.a.

Paper White Color (UV–included versus UV–excluded) and Maximum Printed Black						
Optical Brighteners present? yes**	L*		a*		b*	
	UV inc	UV exc	UV inc	UV exc	UV inc	UV exc
Maximum Paper White (no colorants printed)	96.6	96.7	0.9	0.4	0.0	1.6
(1) ΔL*, Δa*, Δb* respectively	0.1		0.5		1.6	
(1) Calculated differences, especially for Δb*, indicate the role and magnitude of fluorescence on original paper color						
Maximum Printed black (UV included)	L* = 14.1		a* = 0.7		b* = 0.5	

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: 11,055 Lux
Average Temperature: 23.7˚C over full test duration, 25.2˚C during light exposure
Average Relative humidity: 58.8%RH full test period, 58.9%RH during light exposure
CIELAB measurements: D50 2˚ observer, Xrite Gretag/Macbeth Spectrolino/Spectroscan

Replicates/Compare to:

No Replicates are available at this time.

Comparison: AaI_20090223_SN001 – uses Cone Piezotone™ (Selenium Tone with Portfolio Black)
AaI_20090223_SN003 – uses Cone Piezotone™ (CarbonSepia Tone with Portfolio Black)
AaI_20090415_SN007 – uses Cone Piezotone™ (Carbon Sepia Tone with Museum Black)

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.

** OBAs in paper core, little or none in image receiver layer.

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

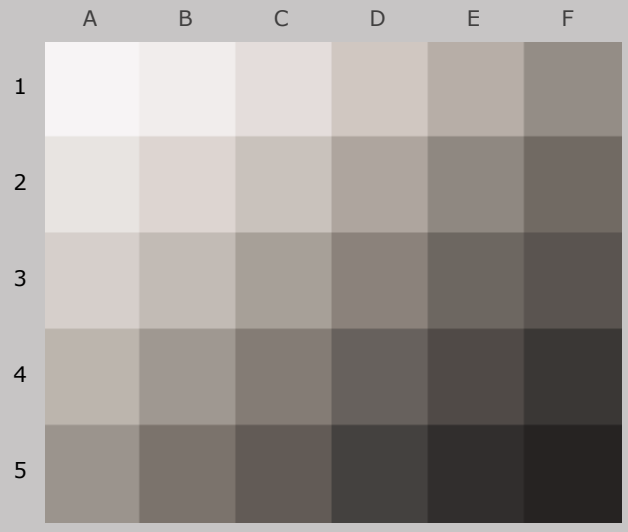
Light levels commonly encountered in the real world fluctuate widely throughout indoor print display environments and produce large variations in how long it takes for artwork to acquire light-induced damage. Use this table as a guide to estimate how many "years on display" (denoted in red text) it takes 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.

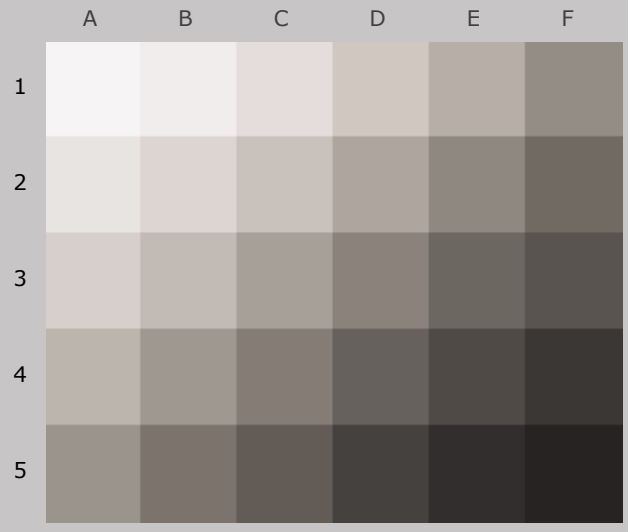
(1) Eastman Kodak has cited this exposure condition and 90% confidence limit as a rationale for estimating print fading times of traditional color photo materials in typical home display environments. For recent light fading claims regarding its line of pigment-based inkjet printers, Kodak has adopted 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)

Epson Stylus Pro 9800, Cone Piezotone™ (split tone Sepia/Selenium with Portfolio Black) ink, Hahnemühle Photo Rag 308 gsm paper

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	Media White	100.0	0.0	96.6		0.9		0.2	
B1	Highlight L* = 96	100.0	0.0	94.1		1.2		0.9	
C1	Highlight L* = 89	100.0	0.0	88.8		1.5		2.3	
D1	Highlight L* = 78	100.0	0.0	81.0		2.0		3.8	
E1	Midtone L* = 66	100.0	0.0	71.6		2.3		4.9	
F1	Midtone L* = 52	100.0	0.0	59.2		2.4		5.1	
A2	Highlight L* = 92	100.0	0.0	90.9		1.4		1.8	
B2	Highlight L* = 85	100.0	0.0	85.9		1.7		2.9	
C2	Highlight L* = 75	100.0	0.0	78.7		2.1		4.2	
D2	Midtone L* = 63	100.0	0.0	68.7		2.4		5.0	
E2	Midtone L* = 50	100.0	0.0	57.4		2.4		5.1	
F2	Midtone L* = 38	100.0	0.0	45.7		2.2		4.7	
A3	Highlight L* = 82	100.0	0.0	83.7		1.9		3.4	
B3	Midtone L* = 72	100.0	0.0	76.4		2.2		4.5	
C3	Midtone L* = 60	100.0	0.0	66.4		2.4		5.2	
D3	Midtone L* = 47	100.0	0.0	54.7		2.3		5.0	
E3	Midtone L* = 35	100.0	0.0	43.7		2.2		4.5	
F3	Shadow L* = 25	100.0	0.0	36.1		1.8		3.5	
A4	Midtone L* = 69	100.0	0.0	74.3		2.3		4.7	
B4	Midtone L* = 57	100.0	0.0	63.4		2.4		5.1	
C4	Midtone L* = 45	100.0	0.0	52.5		2.3		5.0	
D4	Midtone L* = 32	100.0	0.0	41.6		2.1		4.2	
E4	Shadow L* = 20	100.0	0.0	32.3		1.6		2.9	
F4	Shadow L* = 10	100.0	0.0	23.6		1.1		1.6	
A5	Midtone L* = 55	100.0	0.0	61.8		2.4		5.1	
B5	Midtone L* = 41	100.0	0.0	49.2		2.3		4.9	
C5	Shadow L* = 29	100.0	0.0	39.4		1.9		3.9	
D5	Shadow L* = 15	100.0	0.0	28.0		1.4		2.2	
E5	Shadow L* = 5	100.0	0.0	19.2		0.9		1.2	
F5	Max Black	100.0	0.0	14.1		0.7		0.5	

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



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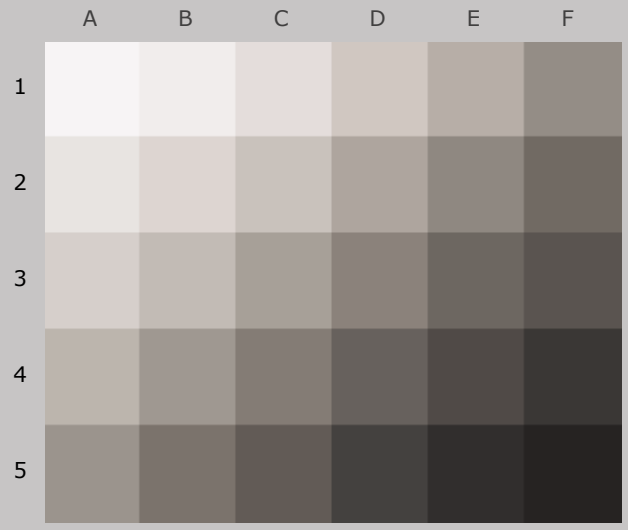
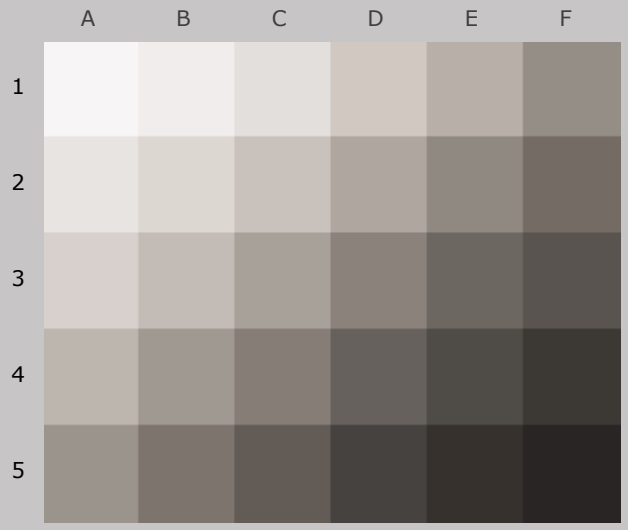
98.8color/98.1tone



Original Print Colors
(measured before light exposure)



Colors after 10 Megalux-hours
light exposure

Epson Stylus Pro 9800, Cone Piezotone™ (split tone Sepia/Selenium with Portfolio Black) ink, Hahnemühle Photo Rag 308 gsm paper

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	Media White	100.0	0.5	96.6	96.9	0.9	0.7	0.2	-0.2
B1	Highlight L* = 96	100.0	0.5	94.1	94.3	1.2	0.9	0.9	0.6
C1	Highlight L* = 89	100.0	0.6	88.8	89.1	1.5	1.2	2.3	2.0
D1	Highlight L* = 78	100.0	0.5	81.0	81.3	2.0	1.6	3.8	3.6
E1	Midtone L* = 66	100.0	0.7	71.6	72.1	2.3	2.0	4.9	4.7
F1	Midtone L* = 52	100.0	0.4	59.2	59.5	2.4	2.1	5.1	5.0
A2	Highlight L* = 92	100.0	0.5	90.9	91.2	1.4	1.1	1.8	1.5
B2	Highlight L* = 85	100.0	0.5	85.9	86.2	1.7	1.4	2.9	2.7
C2	Highlight L* = 75	100.0	0.5	78.7	79.0	2.1	1.7	4.2	3.9
D2	Midtone L* = 63	100.0	0.5	68.7	69.1	2.4	2.1	5.0	4.9
E2	Midtone L* = 50	100.0	0.4	57.4	57.7	2.4	2.1	5.1	5.0
F2	Midtone L* = 38	100.0	0.3	45.7	46.0	2.2	2.1	4.7	4.6
A3	Highlight L* = 82	100.0	0.5	83.7	84.0	1.9	1.5	3.4	3.2
B3	Midtone L* = 72	100.0	0.5	76.4	76.7	2.2	1.8	4.5	4.3
C3	Midtone L* = 60	100.0	0.5	66.4	66.7	2.4	2.1	5.2	5.0
D3	Midtone L* = 47	100.0	0.3	54.7	54.9	2.3	2.1	5.0	4.9
E3	Midtone L* = 35	100.0	0.3	43.7	43.9	2.2	2.0	4.5	4.4
F3	Shadow L* = 25	100.0	0.2	36.1	36.2	1.8	1.7	3.5	3.4
A4	Midtone L* = 69	100.0	0.5	74.3	74.6	2.3	1.9	4.7	4.6
B4	Midtone L* = 57	100.0	0.4	63.4	63.7	2.4	2.1	5.1	5.0
C4	Midtone L* = 45	100.0	0.4	52.5	52.8	2.3	2.1	5.0	4.9
D4	Midtone L* = 32	100.0	0.2	41.6	41.7	2.1	1.9	4.2	4.1
E4	Shadow L* = 20	100.0	0.2	32.3	32.4	1.6	1.5	2.9	2.8
F4	Shadow L* = 10	93.9	1.3	23.6	24.4	1.1	1.4	1.6	2.6
A5	Midtone L* = 55	100.0	0.4	61.8	62.1	2.4	2.1	5.1	5.0
B5	Midtone L* = 41	100.0	0.3	49.2	49.4	2.3	2.1	4.9	4.8
C5	Shadow L* = 29	100.0	0.1	39.4	39.4	1.9	1.8	3.9	3.8
D5	Shadow L* = 15	100.0	0.1	28.0	28.0	1.4	1.3	2.2	2.1
E5	Shadow L* = 5	80.5	2.9	19.2	20.9	0.9	1.6	1.2	3.4
F5	Max Black	89.1	1.9	14.1	15.2	0.7	1.3	0.5	1.9

Summary Results	I*Color	I*tone	ΔE
Average Score for all patches	98.8	98.1	0.6
Average Score for the Worst 10% (3 lowest scoring patches)	87.9	92.6	2.0



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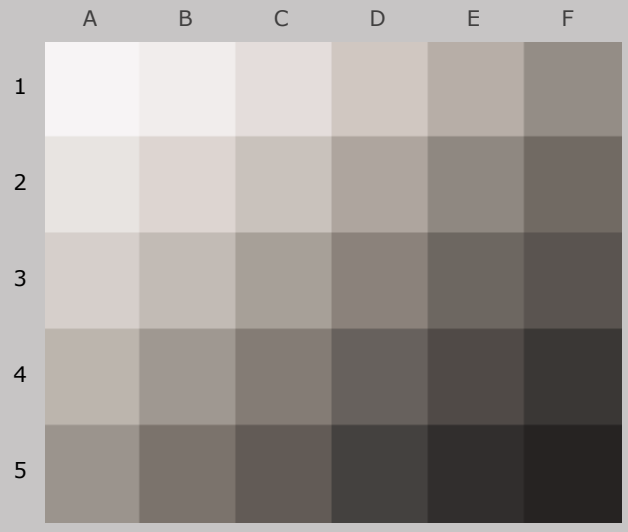
97.9color/97.5tone



Original Print Colors
(measured before light exposure)



Colors after 20 Megalux-hours
light exposure

Epson Stylus Pro 9800, Cone Piezotone™ (split tone Sepia/Selenium with Portfolio Black) ink, Hahnemühle Photo Rag 308 gsm paper

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	Media White	100.0	0.5	96.6	97.0	0.9	0.6	0.2	0.1
B1	Highlight L* = 96	100.0	0.6	94.1	94.4	1.2	0.7	0.9	0.9
C1	Highlight L* = 89	99.3	0.7	88.8	89.2	1.5	0.9	2.3	2.2
D1	Highlight L* = 78	98.4	0.8	81.0	81.4	2.0	1.3	3.8	3.8
E1	Midtone L* = 66	97.9	1.0	71.6	72.3	2.3	1.6	4.9	4.9
F1	Midtone L* = 52	99.2	0.7	59.2	59.6	2.4	1.8	5.1	5.1
A2	Highlight L* = 92	99.7	0.7	90.9	91.2	1.4	0.9	1.8	1.7
B2	Highlight L* = 85	98.8	0.7	85.9	86.3	1.7	1.1	2.9	3.0
C2	Highlight L* = 75	98.0	0.8	78.7	79.1	2.1	1.4	4.2	4.2
D2	Midtone L* = 63	98.3	0.8	68.7	69.3	2.4	1.7	5.0	5.1
E2	Midtone L* = 50	99.8	0.6	57.4	57.8	2.4	1.9	5.1	5.1
F2	Midtone L* = 38	100.0	0.5	45.7	46.0	2.2	1.9	4.7	4.7
A3	Highlight L* = 82	98.6	0.8	83.7	84.1	1.9	1.2	3.4	3.4
B3	Midtone L* = 72	98.4	0.8	76.4	76.8	2.2	1.5	4.5	4.5
C3	Midtone L* = 60	98.3	0.8	66.4	66.9	2.4	1.8	5.2	5.2
D3	Midtone L* = 47	100.0	0.6	54.7	55.0	2.3	1.9	5.0	5.1
E3	Midtone L* = 35	100.0	0.4	43.7	44.0	2.2	1.8	4.5	4.5
F3	Shadow L* = 25	100.0	0.3	36.1	36.2	1.8	1.5	3.5	3.4
A4	Midtone L* = 69	98.4	0.8	74.3	74.6	2.3	1.6	4.7	4.8
B4	Midtone L* = 57	99.1	0.7	63.4	63.9	2.4	1.8	5.1	5.2
C4	Midtone L* = 45	100.0	0.6	52.5	52.8	2.3	1.9	5.0	5.0
D4	Midtone L* = 32	100.0	0.4	41.6	41.8	2.1	1.7	4.2	4.3
E4	Shadow L* = 20	100.0	0.3	32.3	32.4	1.6	1.3	2.9	2.9
F4	Shadow L* = 10	92.9	1.5	23.6	24.5	1.1	1.3	1.6	2.8
A5	Midtone L* = 55	99.5	0.7	61.8	62.2	2.4	1.9	5.1	5.2
B5	Midtone L* = 41	100.0	0.5	49.2	49.4	2.3	1.9	4.9	4.9
C5	Shadow L* = 29	100.0	0.3	39.4	39.4	1.9	1.6	3.9	3.9
D5	Shadow L* = 15	100.0	0.2	28.0	28.0	1.4	1.2	2.2	2.1
E5	Shadow L* = 5	75.9	3.5	19.2	21.3	0.9	1.5	1.2	3.9
F5	Max Black	85.0	2.5	14.1	15.6	0.7	1.2	0.5	2.4

Summary Results	I*Color	I*tone	ΔE
Average Score for all patches	97.9	97.5	0.8
Average Score for the Worst 10% (3 lowest scoring patches)	84.6	90.6	2.5



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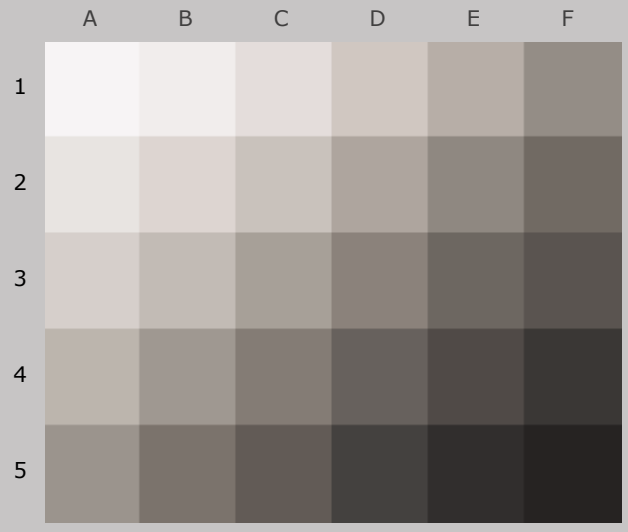
96.4color/96.7tone



Original Print Colors
(measured before light exposure)



Colors after 30 Megalux-hours
light exposure

Epson Stylus Pro 9800, Cone Piezotone™ (split tone Sepia/Selenium with Portfolio Black) ink, Hahnemühle Photo Rag 308 gsm paper

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	Media White	100.0	0.6	96.6	97.0	0.9	0.6	0.2	0.2
B1	Highlight L* = 96	99.9	0.7	94.1	94.5	1.2	0.7	0.9	1.0
C1	Highlight L* = 89	98.0	0.9	88.8	89.5	1.5	0.8	2.3	2.4
D1	Highlight L* = 78	96.0	1.1	81.0	81.7	2.0	1.1	3.8	4.0
E1	Midtone L* = 66	95.2	1.5	71.6	72.7	2.3	1.4	4.9	5.1
F1	Midtone L* = 52	96.7	1.1	59.2	59.9	2.4	1.6	5.1	5.3
A2	Highlight L* = 92	98.5	0.9	90.9	91.5	1.4	0.7	1.8	1.9
B2	Highlight L* = 85	96.8	1.0	85.9	86.5	1.7	0.9	2.9	3.1
C2	Highlight L* = 75	95.5	1.2	78.7	79.4	2.1	1.2	4.2	4.4
D2	Midtone L* = 63	95.4	1.3	68.7	69.7	2.4	1.5	5.0	5.3
E2	Midtone L* = 50	97.1	1.1	57.4	58.2	2.4	1.6	5.1	5.3
F2	Midtone L* = 38	99.0	0.9	45.7	46.4	2.2	1.7	4.7	4.9
A3	Highlight L* = 82	96.4	1.1	83.7	84.4	1.9	1.0	3.4	3.6
B3	Midtone L* = 72	95.7	1.2	76.4	77.1	2.2	1.3	4.5	4.7
C3	Midtone L* = 60	95.7	1.3	66.4	67.3	2.4	1.6	5.2	5.4
D3	Midtone L* = 47	97.6	1.0	54.7	55.3	2.3	1.7	5.0	5.2
E3	Midtone L* = 35	99.4	0.8	43.7	44.4	2.2	1.7	4.5	4.7
F3	Shadow L* = 25	100.0	0.5	36.1	36.4	1.8	1.4	3.5	3.5
A4	Midtone L* = 69	95.7	1.2	74.3	75.0	2.3	1.4	4.7	5.0
B4	Midtone L* = 57	96.3	1.2	63.4	64.3	2.4	1.6	5.1	5.4
C4	Midtone L* = 45	98.2	1.0	52.5	53.2	2.3	1.7	5.0	5.2
D4	Midtone L* = 32	100.0	0.7	41.6	42.1	2.1	1.6	4.2	4.4
E4	Shadow L* = 20	100.0	0.5	32.3	32.7	1.6	1.3	2.9	3.0
F4	Shadow L* = 10	92.4	1.7	23.6	24.8	1.1	1.2	1.6	2.8
A5	Midtone L* = 55	96.9	1.1	61.8	62.6	2.4	1.7	5.1	5.4
B5	Midtone L* = 41	98.8	0.9	49.2	49.8	2.3	1.7	4.9	5.1
C5	Shadow L* = 29	100.0	0.6	39.4	39.7	1.9	1.5	3.9	4.1
D5	Shadow L* = 15	100.0	0.4	28.0	28.2	1.4	1.1	2.2	2.2
E5	Shadow L* = 5	76.4	3.7	19.2	21.7	0.9	1.4	1.2	3.9
F5	Max Black	83.6	2.8	14.1	16.0	0.7	1.2	0.5	2.5

Summary Results	I*Color	I*tone	ΔE
Average Score for all patches	96.4	96.7	1.1
Average Score for the Worst 10% (3 lowest scoring patches)	84.1	89.7	2.7



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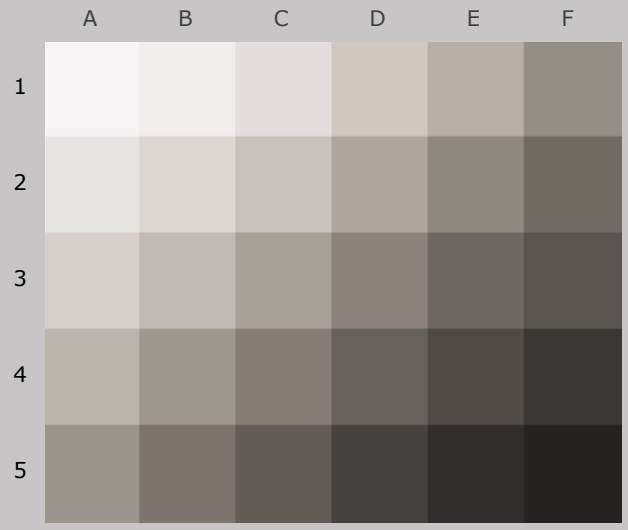
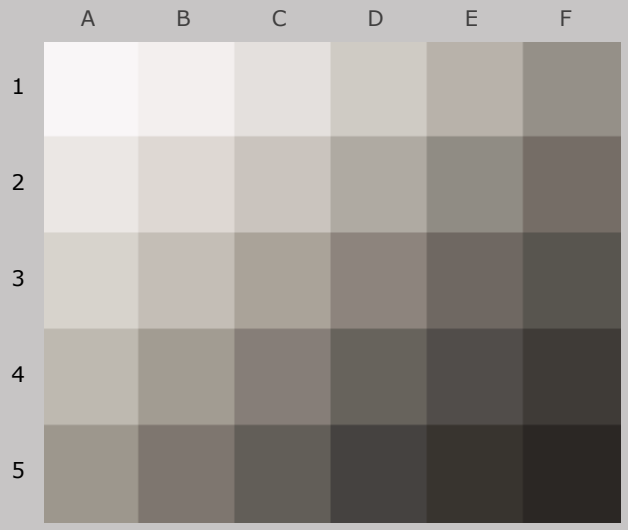
94.9color/96.2tone



Original Print Colors
(measured before light exposure)



Colors after 40 Megalux-hours
light exposure

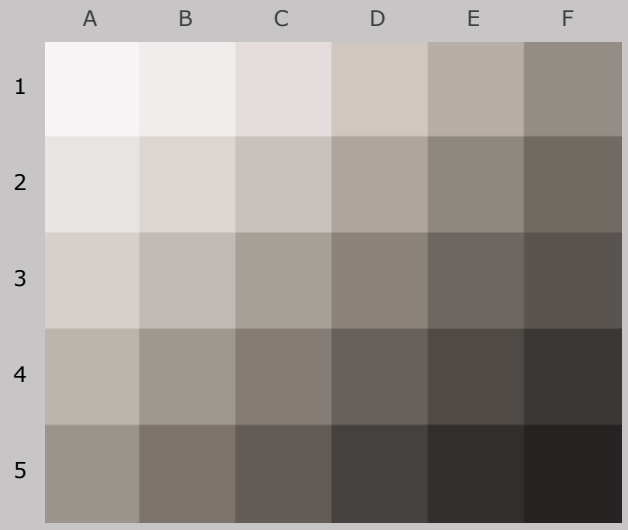
Epson Stylus Pro 9800, Cone Piezotone™ (split tone Sepia/Selenium with Portfolio Black) ink, Hahnemühle Photo Rag 308 gsm paper

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

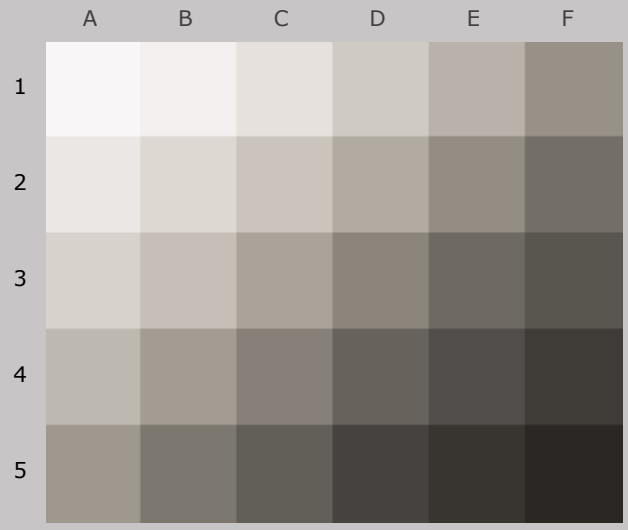
				L*		a*		b*	
Column/row	Color Patch	I*Color	ΔE	Before	After	Before	After	Before	After
A1	Media White	100.0	0.7	96.6	97.1	0.9	0.6	0.2	0.3
B1	Highlight L* = 96	99.1	0.8	94.1	94.6	1.2	0.6	0.9	1.1
C1	Highlight L* = 89	96.8	1.1	88.8	89.6	1.5	0.7	2.3	2.5
D1	Highlight L* = 78	94.3	1.4	81.0	81.9	2.0	1.0	3.8	4.1
E1	Midtone L* = 66	93.1	1.7	71.6	72.9	2.3	1.2	4.9	5.2
F1	Midtone L* = 52	94.4	1.4	59.2	60.2	2.4	1.4	5.1	5.5
A2	Highlight L* = 92	97.5	1.0	90.9	91.6	1.4	0.7	1.8	2.0
B2	Highlight L* = 85	95.4	1.2	85.9	86.7	1.7	0.8	2.9	3.2
C2	Highlight L* = 75	93.7	1.5	78.7	79.7	2.1	1.0	4.2	4.5
D2	Midtone L* = 63	93.2	1.6	68.7	69.9	2.4	1.3	5.0	5.4
E2	Midtone L* = 50	94.8	1.4	57.4	58.4	2.4	1.4	5.1	5.4
F2	Midtone L* = 38	97.2	1.2	45.7	46.6	2.2	1.5	4.7	5.0
A3	Highlight L* = 82	95.0	1.3	83.7	84.6	1.9	0.9	3.4	3.7
B3	Midtone L* = 72	93.7	1.5	76.4	77.4	2.2	1.1	4.5	4.8
C3	Midtone L* = 60	93.5	1.6	66.4	67.5	2.4	1.4	5.2	5.6
D3	Midtone L* = 47	95.7	1.3	54.7	55.7	2.3	1.5	5.0	5.4
E3	Midtone L* = 35	97.6	1.1	43.7	44.6	2.2	1.5	4.5	4.8
F3	Shadow L* = 25	99.3	0.8	36.1	36.7	1.8	1.2	3.5	3.6
A4	Midtone L* = 69	93.6	1.5	74.3	75.3	2.3	1.2	4.7	5.1
B4	Midtone L* = 57	94.0	1.5	63.4	64.5	2.4	1.4	5.1	5.5
C4	Midtone L* = 45	96.0	1.3	52.5	53.5	2.3	1.5	5.0	5.4
D4	Midtone L* = 32	98.1	1.0	41.6	42.3	2.1	1.5	4.2	4.5
E4	Shadow L* = 20	100.0	0.8	32.3	32.8	1.6	1.1	2.9	3.1
F4	Shadow L* = 10	92.5	1.9	23.6	25.0	1.1	1.1	1.6	2.8
A5	Midtone L* = 55	94.7	1.4	61.8	62.9	2.4	1.5	5.1	5.5
B5	Midtone L* = 41	96.6	1.2	49.2	50.1	2.3	1.5	4.9	5.2
C5	Shadow L* = 29	98.7	0.9	39.4	40.0	1.9	1.4	3.9	4.2
D5	Shadow L* = 15	100.0	0.5	28.0	28.3	1.4	1.0	2.2	2.3
E5	Shadow L* = 5	76.7	3.8	19.2	21.9	0.9	1.3	1.2	3.8
F5	Max Black	82.8	2.9	14.1	16.0	0.7	1.2	0.5	2.6

Summary Results	I*Color	I*tone	ΔE
Average Score for all patches	94.9	96.2	1.4
Average Score for the Worst 10% (3 lowest scoring patches)	84.0	89.9	2.9

93.5color/95.9tone



Original Print Colors
(measured before light exposure)



Colors after 50 Megalux-hours
light exposure

Epson Stylus Pro 9800, Cone Piezotone™ (split tone Sepia/Selenium with Portfolio Black) ink, Hahnemühle Photo Rag 308 gsm paper

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	Media White	99.8	0.7	96.6	97.1	0.9	0.5	0.2	0.5
B1	Highlight L* = 96	98.3	0.9	94.1	94.7	1.2	0.6	0.9	1.3
C1	Highlight L* = 89	95.8	1.2	88.8	89.6	1.5	0.7	2.3	2.6
D1	Highlight L* = 78	92.9	1.5	81.0	82.0	2.0	0.9	3.8	4.2
E1	Midtone L* = 66	91.2	2.0	71.6	73.0	2.3	1.1	4.9	5.4
F1	Midtone L* = 52	92.3	1.7	59.2	60.3	2.4	1.2	5.1	5.6
A2	Highlight L* = 92	96.6	1.1	90.9	91.6	1.4	0.6	1.8	2.1
B2	Highlight L* = 85	94.3	1.4	85.9	86.8	1.7	0.8	2.9	3.4
C2	Highlight L* = 75	92.1	1.7	78.7	79.8	2.1	0.9	4.2	4.6
D2	Midtone L* = 63	91.2	1.9	68.7	70.0	2.4	1.1	5.0	5.6
E2	Midtone L* = 50	92.7	1.7	57.4	58.6	2.4	1.3	5.1	5.6
F2	Midtone L* = 38	95.4	1.4	45.7	46.7	2.2	1.4	4.7	5.1
A3	Highlight L* = 82	93.5	1.5	83.7	84.7	1.9	0.8	3.4	3.8
B3	Midtone L* = 72	91.9	1.7	76.4	77.5	2.2	1.0	4.5	5.0
C3	Midtone L* = 60	91.5	1.8	66.4	67.6	2.4	1.2	5.2	5.7
D3	Midtone L* = 47	93.5	1.6	54.7	55.8	2.3	1.4	5.0	5.5
E3	Midtone L* = 35	95.8	1.3	43.7	44.6	2.2	1.4	4.5	4.9
F3	Shadow L* = 25	97.8	1.0	36.1	36.8	1.8	1.1	3.5	3.8
A4	Midtone L* = 69	91.7	1.7	74.3	75.4	2.3	1.1	4.7	5.2
B4	Midtone L* = 57	92.1	1.8	63.4	64.7	2.4	1.3	5.1	5.7
C4	Midtone L* = 45	94.2	1.5	52.5	53.6	2.3	1.4	5.0	5.5
D4	Midtone L* = 32	96.3	1.2	41.6	42.5	2.1	1.3	4.2	4.6
E4	Shadow L* = 20	98.4	0.9	32.3	32.9	1.6	1.0	2.9	3.1
F4	Shadow L* = 10	92.5	2.0	23.6	25.1	1.1	1.0	1.6	2.8
A5	Midtone L* = 55	92.6	1.7	61.8	63.0	2.4	1.3	5.1	5.7
B5	Midtone L* = 41	94.9	1.5	49.2	50.2	2.3	1.4	4.9	5.3
C5	Shadow L* = 29	96.8	1.1	39.4	40.0	1.9	1.2	3.9	4.3
D5	Shadow L* = 15	99.8	0.7	28.0	28.4	1.4	0.9	2.2	2.4
E5	Shadow L* = 5	77.3	4.0	19.2	22.1	0.9	1.2	1.2	3.8
F5	Max Black	82.1	3.0	14.1	16.1	0.7	1.2	0.5	2.7

Summary Results	I*Color	I*tone	ΔE
Average Score for all patches	93.5	95.9	1.6
Average Score for the Worst 10% (3 lowest scoring patches)	83.5	89.0	3.0



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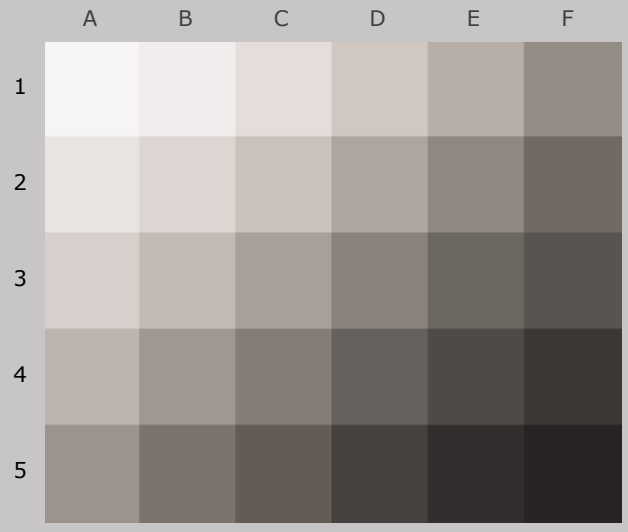
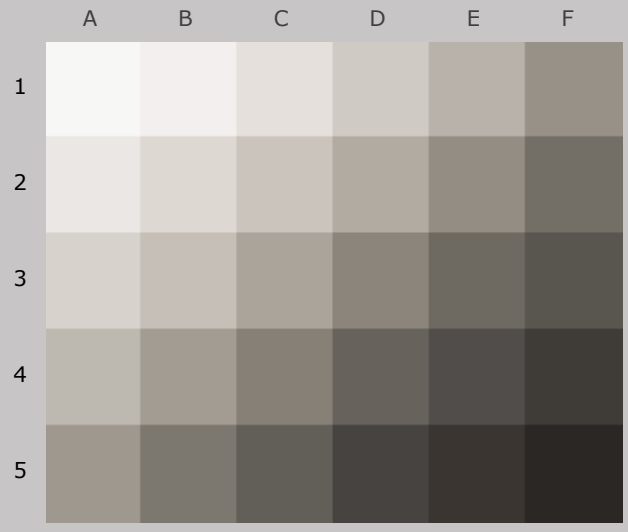
92.2color/95.8tone



Original Print Colors
(measured before light exposure)



Colors after 60 Megalux-hours
light exposure

Epson Stylus Pro 9800, Cone Piezotone™ (split tone Sepia/Selenium with Portfolio Black) ink, Hahnemühle Photo Rag 308 gsm paper

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	Media White	98.4	0.8	96.6	97.1	0.9	0.5	0.2	0.6
B1	Highlight L* = 96	97.0	1.0	94.1	94.6	1.2	0.5	0.9	1.4
C1	Highlight L* = 89	94.7	1.3	88.8	89.6	1.5	0.6	2.3	2.7
D1	Highlight L* = 78	91.6	1.6	81.0	82.0	2.0	0.8	3.8	4.3
E1	Midtone L* = 66	89.7	2.1	71.6	73.0	2.3	0.9	4.9	5.4
F1	Midtone L* = 52	90.6	1.8	59.2	60.4	2.4	1.1	5.1	5.6
A2	Highlight L* = 92	95.4	1.2	90.9	91.6	1.4	0.6	1.8	2.3
B2	Highlight L* = 85	93.1	1.5	85.9	86.8	1.7	0.7	2.9	3.5
C2	Highlight L* = 75	90.7	1.8	78.7	79.8	2.1	0.8	4.2	4.7
D2	Midtone L* = 63	89.6	2.0	68.7	70.1	2.4	1.0	5.0	5.6
E2	Midtone L* = 50	91.1	1.8	57.4	58.7	2.4	1.2	5.1	5.7
F2	Midtone L* = 38	93.7	1.6	45.7	46.8	2.2	1.3	4.7	5.2
A3	Highlight L* = 82	92.4	1.6	83.7	84.7	1.9	0.7	3.4	3.9
B3	Midtone L* = 72	90.6	1.8	76.4	77.5	2.2	0.9	4.5	5.0
C3	Midtone L* = 60	89.8	1.9	66.4	67.7	2.4	1.1	5.2	5.8
D3	Midtone L* = 47	91.9	1.7	54.7	55.9	2.3	1.2	5.0	5.6
E3	Midtone L* = 35	94.2	1.4	43.7	44.7	2.2	1.2	4.5	5.0
F3	Shadow L* = 25	96.2	1.2	36.1	36.9	1.8	1.0	3.5	3.8
A4	Midtone L* = 69	90.1	1.9	74.3	75.4	2.3	1.0	4.7	5.3
B4	Midtone L* = 57	90.3	1.9	63.4	64.7	2.4	1.1	5.1	5.7
C4	Midtone L* = 45	92.5	1.7	52.5	53.7	2.3	1.3	5.0	5.5
D4	Midtone L* = 32	94.7	1.4	41.6	42.5	2.1	1.2	4.2	4.7
E4	Shadow L* = 20	97.2	1.0	32.3	33.0	1.6	0.9	2.9	3.2
F4	Shadow L* = 10	93.0	2.0	23.6	25.2	1.1	0.9	1.6	2.8
A5	Midtone L* = 55	91.0	1.8	61.8	63.1	2.4	1.2	5.1	5.7
B5	Midtone L* = 41	93.2	1.6	49.2	50.3	2.3	1.3	4.9	5.4
C5	Shadow L* = 29	95.4	1.2	39.4	40.1	1.9	1.1	3.9	4.3
D5	Shadow L* = 15	98.5	0.8	28.0	28.5	1.4	0.8	2.2	2.4
E5	Shadow L* = 5	77.5	4.0	19.2	22.2	0.9	1.1	1.2	3.8
F5	Max Black	82.4	3.1	14.1	16.3	0.7	1.2	0.5	2.6

Summary Results	I*Color	I*tone	ΔE
Average Score for all patches	92.2	95.8	1.7
Average Score for the Worst 10% (3 lowest scoring patches)	83.2	89.1	3.0



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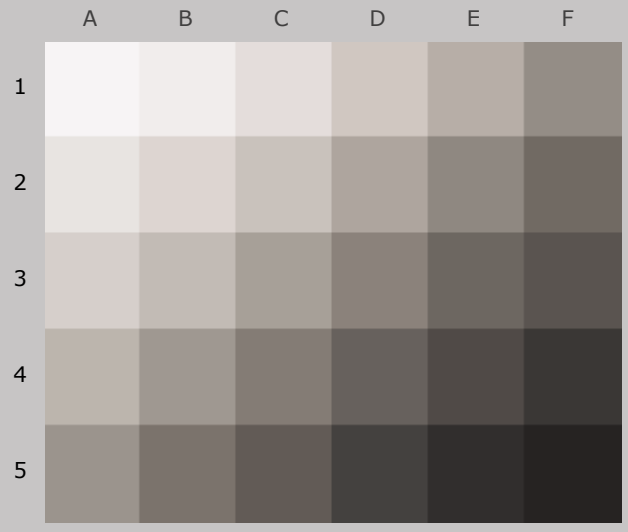
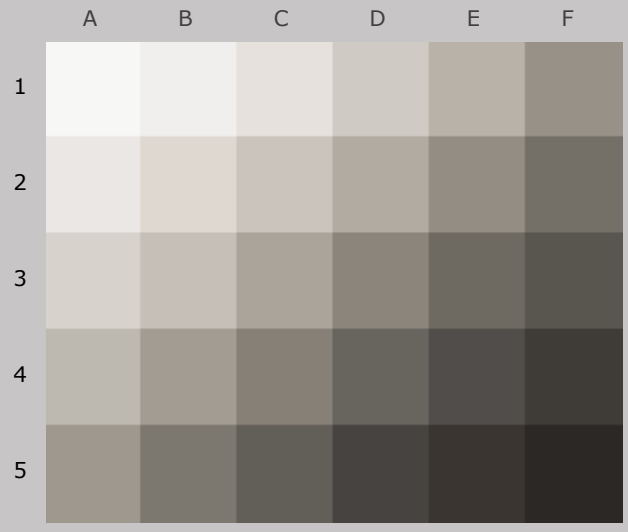
91.3$_{color}$/95.9$_{tone}$



Original Print Colors
(measured before light exposure)



Colors after 70 Megalux-hours
light exposure

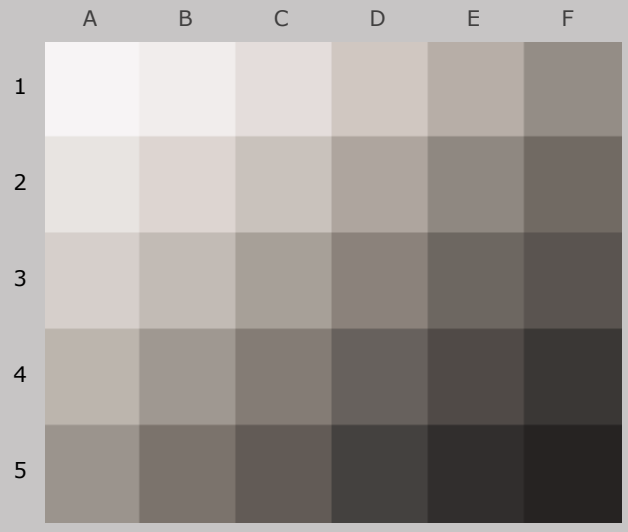
Epson Stylus Pro 9800, Cone Piezotone™ (split tone Sepia/Selenium with Portfolio Black) ink, Hahnemühle Photo Rag 308 gsm paper

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

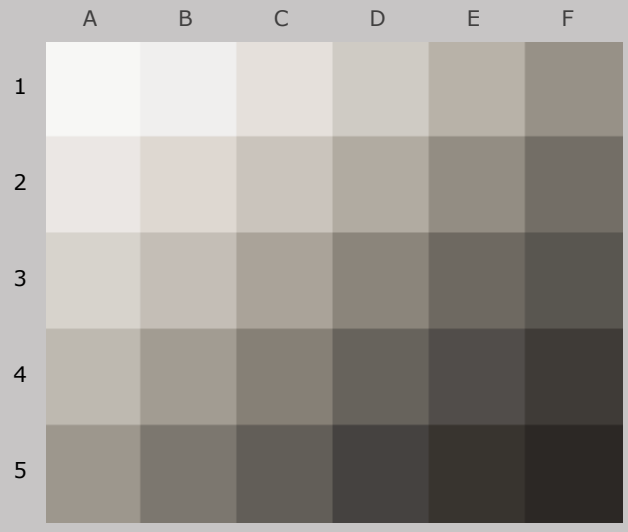
				L*		a*		b*	
Column/row	Color Patch	I*Color	ΔE	Before	After	Before	After	Before	After
A1	Media White	97.8	0.9	96.6	97.1	0.9	0.4	0.2	0.7
B1	Highlight L* = 96	96.5	1.0	94.1	94.7	1.2	0.5	0.9	1.4
C1	Highlight L* = 89	94.2	1.3	88.8	89.6	1.5	0.6	2.3	2.8
D1	Highlight L* = 78	90.9	1.7	81.0	82.0	2.0	0.7	3.8	4.4
E1	Midtone L* = 66	88.7	2.1	71.6	73.0	2.3	0.9	4.9	5.5
F1	Midtone L* = 52	89.4	1.9	59.2	60.4	2.4	1.0	5.1	5.7
A2	Highlight L* = 92	94.9	1.2	90.9	91.6	1.4	0.5	1.8	2.3
B2	Highlight L* = 85	92.6	1.5	85.9	86.8	1.7	0.6	2.9	3.5
C2	Highlight L* = 75	89.9	1.8	78.7	79.8	2.1	0.8	4.2	4.8
D2	Midtone L* = 63	88.5	2.1	68.7	70.0	2.4	0.9	5.0	5.7
E2	Midtone L* = 50	89.8	2.0	57.4	58.7	2.4	1.1	5.1	5.7
F2	Midtone L* = 38	92.3	1.7	45.7	46.9	2.2	1.1	4.7	5.2
A3	Highlight L* = 82	91.7	1.6	83.7	84.7	1.9	0.7	3.4	4.0
B3	Midtone L* = 72	89.7	1.8	76.4	77.5	2.2	0.9	4.5	5.1
C3	Midtone L* = 60	88.8	2.0	66.4	67.7	2.4	1.0	5.2	5.8
D3	Midtone L* = 47	90.5	1.8	54.7	55.9	2.3	1.1	5.0	5.6
E3	Midtone L* = 35	92.7	1.6	43.7	44.7	2.2	1.1	4.5	5.0
F3	Shadow L* = 25	95.0	1.3	36.1	37.0	1.8	0.9	3.5	3.9
A4	Midtone L* = 69	89.3	1.9	74.3	75.4	2.3	0.9	4.7	5.4
B4	Midtone L* = 57	89.3	2.0	63.4	64.7	2.4	1.0	5.1	5.8
C4	Midtone L* = 45	91.1	1.8	52.5	53.7	2.3	1.1	5.0	5.6
D4	Midtone L* = 32	93.4	1.5	41.6	42.6	2.1	1.1	4.2	4.7
E4	Shadow L* = 20	96.3	1.2	32.3	33.0	1.6	0.8	2.9	3.2
F4	Shadow L* = 10	92.6	2.1	23.6	25.3	1.1	0.8	1.6	2.8
A5	Midtone L* = 55	89.7	1.9	61.8	63.1	2.4	1.1	5.1	5.8
B5	Midtone L* = 41	91.9	1.7	49.2	50.3	2.3	1.2	4.9	5.4
C5	Shadow L* = 29	94.1	1.3	39.4	40.2	1.9	1.0	3.9	4.4
D5	Shadow L* = 15	97.9	0.9	28.0	28.5	1.4	0.7	2.2	2.4
E5	Shadow L* = 5	77.8	4.0	19.2	22.2	0.9	1.0	1.2	3.8
F5	Max Black	81.1	3.2	14.1	16.4	0.7	1.1	0.5	2.8

Summary Results	I*Color	I*tone	ΔE
Average Score for all patches	91.3	95.9	1.8
Average Score for the Worst 10% (3 lowest scoring patches)	82.5	89.0	3.1

90.7 color / 96.0 tone



Original Print Colors
(measured before light exposure)



Colors after 80 Megalux-hours
light exposure

Epson Stylus Pro 9800, Cone Piezotone™ (split tone Sepia/Selenium with Portfolio Black) ink, Hahnemühle Photo Rag 308 gsm paper

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	Media White	97.5	0.9	96.6	97.1	0.9	0.4	0.2	0.7
B1	Highlight L* = 96	96.1	1.0	94.1	94.6	1.2	0.5	0.9	1.5
C1	Highlight L* = 89	93.9	1.3	88.8	89.6	1.5	0.6	2.3	2.8
D1	Highlight L* = 78	90.4	1.7	81.0	81.9	2.0	0.7	3.8	4.4
E1	Midtone L* = 66	88.1	2.1	71.6	73.0	2.3	0.8	4.9	5.5
F1	Midtone L* = 52	88.5	1.9	59.2	60.3	2.4	0.9	5.1	5.7
A2	Highlight L* = 92	94.4	1.3	90.9	91.6	1.4	0.5	1.8	2.3
B2	Highlight L* = 85	92.2	1.5	85.9	86.7	1.7	0.6	2.9	3.5
C2	Highlight L* = 75	89.4	1.8	78.7	79.7	2.1	0.7	4.2	4.8
D2	Midtone L* = 63	87.8	2.1	68.7	70.0	2.4	0.8	5.0	5.7
E2	Midtone L* = 50	88.7	2.0	57.4	58.6	2.4	0.9	5.1	5.7
F2	Midtone L* = 38	91.1	1.8	45.7	46.9	2.2	1.0	4.7	5.3
A3	Highlight L* = 82	91.2	1.6	83.7	84.6	1.9	0.7	3.4	4.0
B3	Midtone L* = 72	89.1	1.8	76.4	77.4	2.2	0.8	4.5	5.1
C3	Midtone L* = 60	88.0	2.0	66.4	67.6	2.4	0.9	5.2	5.8
D3	Midtone L* = 47	89.6	1.8	54.7	55.8	2.3	1.0	5.0	5.6
E3	Midtone L* = 35	91.9	1.6	43.7	44.7	2.2	1.0	4.5	5.0
F3	Shadow L* = 25	93.8	1.3	36.1	36.8	1.8	0.7	3.5	3.8
A4	Midtone L* = 69	88.7	1.9	74.3	75.2	2.3	0.9	4.7	5.4
B4	Midtone L* = 57	88.5	2.0	63.4	64.6	2.4	1.0	5.1	5.8
C4	Midtone L* = 45	90.1	1.8	52.5	53.6	2.3	1.0	5.0	5.6
D4	Midtone L* = 32	92.4	1.5	41.6	42.5	2.1	1.0	4.2	4.7
E4	Shadow L* = 20	95.2	1.3	32.3	33.1	1.6	0.7	2.9	3.2
F4	Shadow L* = 10	92.3	2.1	23.6	25.3	1.1	0.7	1.6	2.8
A5	Midtone L* = 55	88.9	1.9	61.8	62.9	2.4	1.0	5.1	5.8
B5	Midtone L* = 41	90.9	1.7	49.2	50.2	2.3	1.0	4.9	5.4
C5	Shadow L* = 29	93.2	1.3	39.4	40.0	1.9	0.9	3.9	4.3
D5	Shadow L* = 15	96.7	0.9	28.0	28.3	1.4	0.6	2.2	2.4
E5	Shadow L* = 5	79.1	3.8	19.2	22.1	0.9	0.9	1.2	3.6
F5	Max Black	82.0	3.2	14.1	16.4	0.7	1.0	0.5	2.7

Summary Results	I*Color	I*tone	ΔE
Average Score for all patches	90.7	96.0	1.8
Average Score for the Worst 10% (3 lowest scoring patches)	83.0	89.4	3.0



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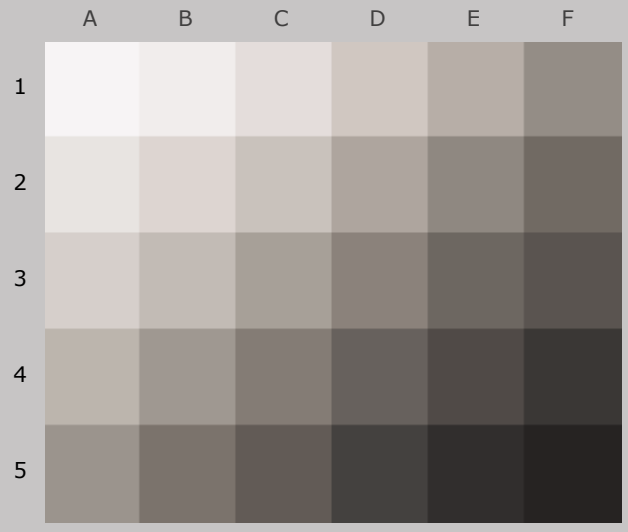
89.8color/95.4tone



Original Print Colors
(measured before light exposure)



Colors after 90 Megalux-hours
light exposure

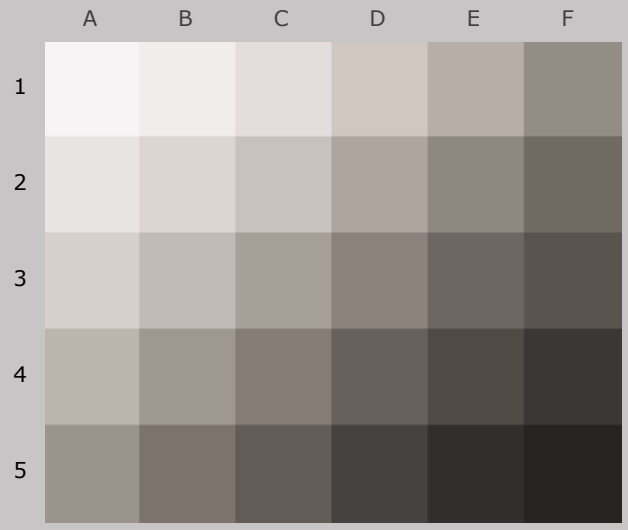
Epson Stylus Pro 9800, Cone Piezotone™ (split tone Sepia/Selenium with Portfolio Black) ink, Hahnemühle Photo Rag 308 gsm paper

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

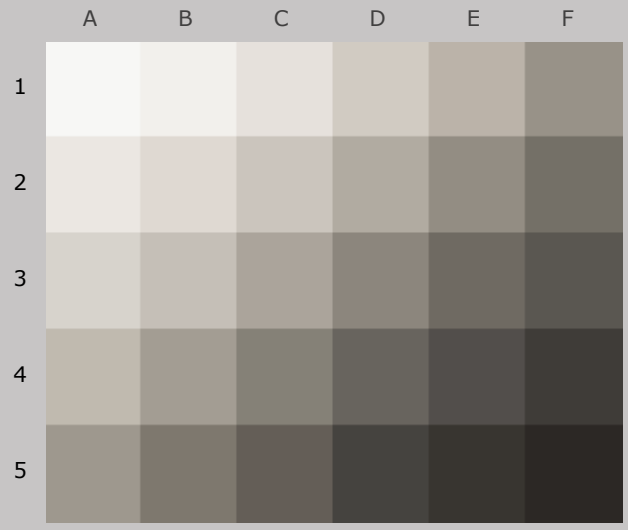
				L*		a*		b*	
Column/row	Color Patch	I*Color	ΔE	Before	After	Before	After	Before	After
A1	Media White	96.0	1.1	96.6	97.2	0.9	0.4	0.2	0.9
B1	Highlight L* = 96	95.0	1.2	94.1	94.8	1.2	0.4	0.9	1.6
C1	Highlight L* = 89	92.9	1.5	88.8	89.8	1.5	0.5	2.3	3.0
D1	Highlight L* = 78	89.4	1.9	81.0	82.2	2.0	0.7	3.8	4.6
E1	Midtone L* = 66	87.4	2.4	71.6	73.3	2.3	0.8	4.9	5.6
F1	Midtone L* = 52	87.5	2.3	59.2	60.7	2.4	0.9	5.1	5.9
A2	Highlight L* = 92	93.7	1.4	90.9	91.8	1.4	0.5	1.8	2.4
B2	Highlight L* = 85	91.5	1.7	85.9	86.9	1.7	0.6	2.9	3.6
C2	Highlight L* = 75	88.7	2.1	78.7	80.0	2.1	0.7	4.2	4.9
D2	Midtone L* = 63	87.0	2.4	68.7	70.4	2.4	0.8	5.0	5.8
E2	Midtone L* = 50	87.7	2.3	57.4	59.0	2.4	0.9	5.1	5.8
F2	Midtone L* = 38	90.1	2.2	45.7	47.3	2.2	1.0	4.7	5.4
A3	Highlight L* = 82	90.4	1.9	83.7	84.9	1.9	0.6	3.4	4.1
B3	Midtone L* = 72	88.4	2.1	76.4	77.7	2.2	0.8	4.5	5.2
C3	Midtone L* = 60	87.1	2.4	66.4	68.0	2.4	0.9	5.2	5.9
D3	Midtone L* = 47	88.5	2.2	54.7	56.2	2.3	0.9	5.0	5.8
E3	Midtone L* = 35	90.8	2.0	43.7	45.2	2.2	1.0	4.5	5.1
F3	Shadow L* = 25	92.5	1.7	36.1	37.3	1.8	0.7	3.5	4.0
A4	Midtone L* = 69	87.9	2.1	74.3	75.6	2.3	0.8	4.7	5.5
B4	Midtone L* = 57	87.3	2.3	63.4	65.0	2.4	0.9	5.1	5.9
C4	Midtone L* = 45	88.9	2.2	52.5	54.0	2.3	1.0	5.0	5.7
D4	Midtone L* = 32	91.0	1.9	41.6	42.9	2.1	0.9	4.2	4.9
E4	Shadow L* = 20	94.2	1.6	32.3	33.5	1.6	0.6	2.9	3.3
F4	Shadow L* = 10	92.7	2.5	23.6	25.8	1.1	0.7	1.6	2.7
A5	Midtone L* = 55	87.9	2.2	61.8	63.3	2.4	1.0	5.1	5.9
B5	Midtone L* = 41	89.6	2.1	49.2	50.7	2.3	1.0	4.9	5.6
C5	Shadow L* = 29	91.9	1.7	39.4	40.5	1.9	0.8	3.9	4.5
D5	Shadow L* = 15	95.9	1.3	28.0	28.9	1.4	0.5	2.2	2.5
E5	Shadow L* = 5	80.3	4.2	19.2	22.7	0.9	0.9	1.2	3.5
F5	Max Black	82.9	3.4	14.1	16.8	0.7	1.1	0.5	2.6

Summary Results	I*Color	I*tone	ΔE
Average Score for all patches	89.8	95.4	2.1
Average Score for the Worst 10% (3 lowest scoring patches)	83.4	88.4	3.4

89.4color/95.4tone



Original Print Colors
(measured before light exposure)



Colors after 100 Megalux-hours
light exposure

Epson Stylus Pro 9800, Cone Piezotone™ (split tone Sepia/Selenium with Portfolio Black) ink, Hahnemühle Photo Rag 308 gsm paper

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	Media White	95.7	1.1	96.6	97.2	0.9	0.4	0.2	0.9
B1	Highlight L* = 96	94.8	1.2	94.1	94.8	1.2	0.5	0.9	1.7
C1	Highlight L* = 89	92.8	1.5	88.8	89.8	1.5	0.5	2.3	3.0
D1	Highlight L* = 78	89.5	1.9	81.0	82.2	2.0	0.7	3.8	4.6
E1	Midtone L* = 66	87.1	2.5	71.6	73.3	2.3	0.8	4.9	5.7
F1	Midtone L* = 52	87.0	2.3	59.2	60.7	2.4	0.8	5.1	5.9
A2	Highlight L* = 92	93.3	1.5	90.9	91.8	1.4	0.5	1.8	2.5
B2	Highlight L* = 85	91.4	1.7	85.9	86.9	1.7	0.6	2.9	3.7
C2	Highlight L* = 75	88.5	2.0	78.7	79.9	2.1	0.7	4.2	4.9
D2	Midtone L* = 63	86.7	2.4	68.7	70.4	2.4	0.8	5.0	5.9
E2	Midtone L* = 50	87.2	2.3	57.4	59.0	2.4	0.9	5.1	5.9
F2	Midtone L* = 38	89.4	2.2	45.7	47.3	2.2	0.9	4.7	5.5
A3	Highlight L* = 82	90.2	1.9	83.7	84.9	1.9	0.7	3.4	4.2
B3	Midtone L* = 72	88.2	2.1	76.4	77.8	2.2	0.8	4.5	5.3
C3	Midtone L* = 60	86.7	2.4	66.4	68.0	2.4	0.9	5.2	6.0
D3	Midtone L* = 47	87.9	2.2	54.7	56.2	2.3	0.9	5.0	5.8
E3	Midtone L* = 35	89.8	2.0	43.7	45.1	2.2	0.9	4.5	5.2
F3	Shadow L* = 25	91.8	1.8	36.1	37.3	1.8	0.6	3.5	4.1
A4	Midtone L* = 69	87.6	2.2	74.3	75.7	2.3	0.8	4.7	5.6
B4	Midtone L* = 57	87.1	2.3	63.4	65.0	2.4	0.9	5.1	6.0
C4	Midtone L* = 45	88.3	2.2	52.5	54.0	2.3	1.0	5.0	5.8
D4	Midtone L* = 32	90.2	1.9	41.6	42.9	2.1	0.8	4.2	4.9
E4	Shadow L* = 20	92.9	1.7	32.3	33.5	1.6	0.6	2.9	3.5
F4	Shadow L* = 10	92.2	2.3	23.6	25.5	1.1	0.6	1.6	2.8
A5	Midtone L* = 55	87.5	2.2	61.8	63.3	2.4	0.9	5.1	6.0
B5	Midtone L* = 41	88.9	2.2	49.2	50.7	2.3	0.9	4.9	5.7
C5	Shadow L* = 29	91.0	1.8	39.4	40.5	1.9	0.8	3.9	4.6
D5	Shadow L* = 15	95.0	1.3	28.0	28.8	1.4	0.5	2.2	2.6
E5	Shadow L* = 5	81.5	4.0	19.2	22.5	0.9	0.9	1.2	3.4
F5	Max Black	82.2	3.2	14.1	16.5	0.7	1.0	0.5	2.7

Summary Results	I*Color	I*tone	ΔE
Average Score for all patches	89.4	95.4	2.1
Average Score for the Worst 10% (3 lowest scoring patches)	83.5	88.8	3.2



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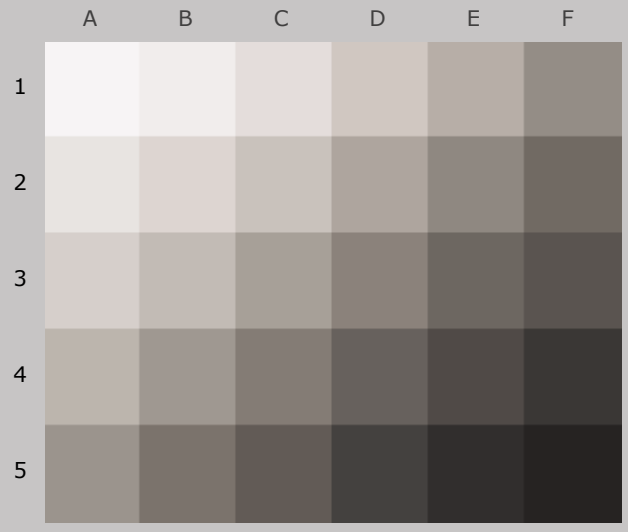
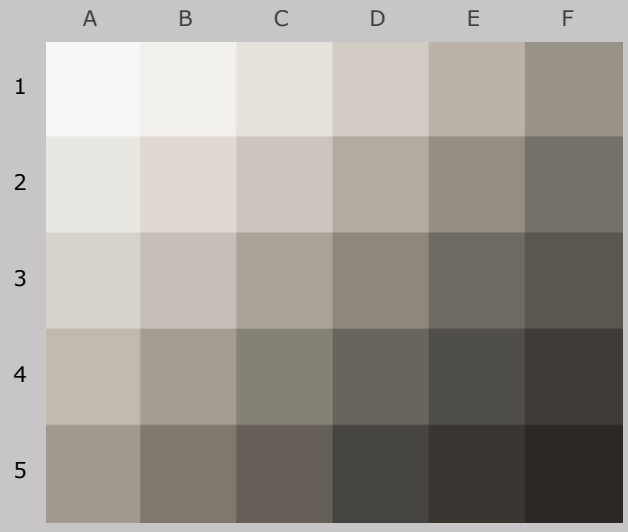
88.7 color / 95.4 tone



Original Print Colors
(measured before light exposure)



Colors after 120 Megalux-hours
light exposure

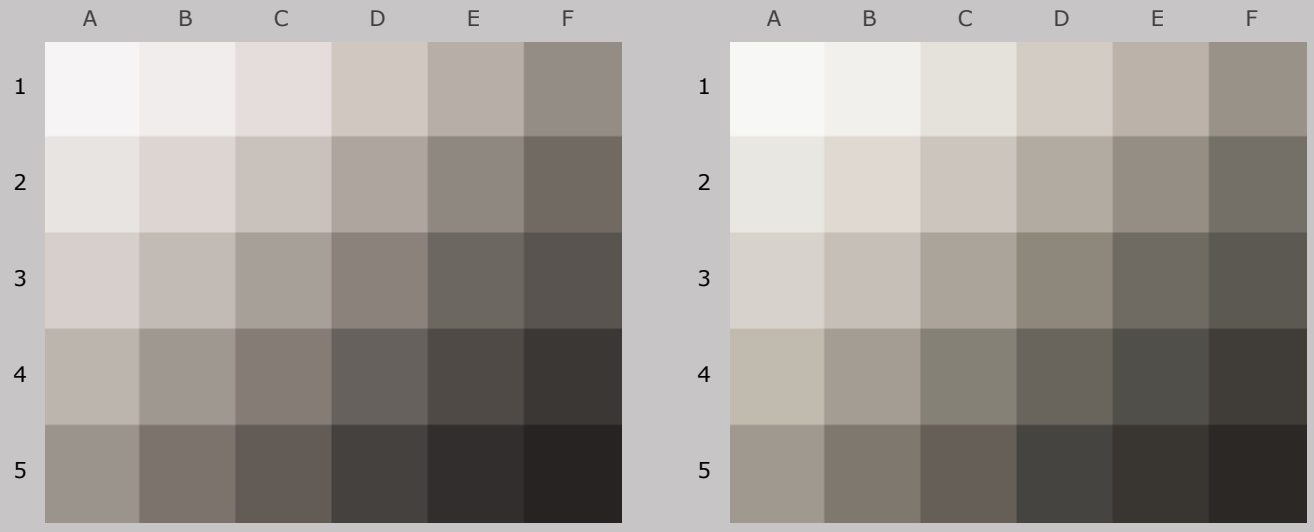
Epson Stylus Pro 9800, Cone Piezotone™ (split tone Sepia/Selenium with Portfolio Black) ink, Hahnemühle Photo Rag 308 gsm paper

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	Media White	94.9	1.1	96.6	97.2	0.9	0.4	0.2	0.9
B1	Highlight L* = 96	93.9	1.3	94.1	94.8	1.2	0.4	0.9	1.7
C1	Highlight L* = 89	91.9	1.6	88.8	89.8	1.5	0.5	2.3	3.1
D1	Highlight L* = 78	88.7	2.0	81.0	82.2	2.0	0.6	3.8	4.6
E1	Midtone L* = 66	86.4	2.5	71.6	73.3	2.3	0.7	4.9	5.7
F1	Midtone L* = 52	86.1	2.4	59.2	60.7	2.4	0.8	5.1	5.9
A2	Highlight L* = 92	92.7	1.5	90.9	91.8	1.4	0.5	1.8	2.6
B2	Highlight L* = 85	90.6	1.8	85.9	86.9	1.7	0.6	2.9	3.7
C2	Highlight L* = 75	88.0	2.1	78.7	80.0	2.1	0.7	4.2	5.0
D2	Midtone L* = 63	86.0	2.4	68.7	70.3	2.4	0.8	5.0	5.9
E2	Midtone L* = 50	86.4	2.4	57.4	59.1	2.4	0.8	5.1	5.9
F2	Midtone L* = 38	88.2	2.3	45.7	47.3	2.2	0.8	4.7	5.5
A3	Highlight L* = 82	89.8	1.9	83.7	84.9	1.9	0.6	3.4	4.2
B3	Midtone L* = 72	87.7	2.1	76.4	77.8	2.2	0.7	4.5	5.3
C3	Midtone L* = 60	86.1	2.4	66.4	68.0	2.4	0.8	5.2	6.0
D3	Midtone L* = 47	86.8	2.4	54.7	56.3	2.3	0.8	5.0	5.8
E3	Midtone L* = 35	88.7	2.2	43.7	45.2	2.2	0.8	4.5	5.2
F3	Shadow L* = 25	90.6	1.9	36.1	37.4	1.8	0.5	3.5	4.0
A4	Midtone L* = 69	87.0	2.2	74.3	75.6	2.3	0.8	4.7	5.6
B4	Midtone L* = 57	86.3	2.4	63.4	65.0	2.4	0.9	5.1	6.0
C4	Midtone L* = 45	87.3	2.3	52.5	54.1	2.3	0.8	5.0	5.8
D4	Midtone L* = 32	88.7	2.1	41.6	43.0	2.1	0.7	4.2	5.0
E4	Shadow L* = 20	91.8	1.8	32.3	33.5	1.6	0.4	2.9	3.4
F4	Shadow L* = 10	92.6	2.4	23.6	25.7	1.1	0.5	1.6	2.7
A5	Midtone L* = 55	86.8	2.3	61.8	63.4	2.4	0.9	5.1	6.0
B5	Midtone L* = 41	88.0	2.3	49.2	50.7	2.3	0.8	4.9	5.7
C5	Shadow L* = 29	89.8	1.9	39.4	40.6	1.9	0.6	3.9	4.6
D5	Shadow L* = 15	94.1	1.4	28.0	28.9	1.4	0.4	2.2	2.5
E5	Shadow L* = 5	81.4	4.2	19.2	22.7	0.9	0.8	1.2	3.4
F5	Max Black	83.3	3.3	14.1	16.6	0.7	1.0	0.5	2.6

Summary Results	I*Color	I*tone	ΔE
Average Score for all patches	88.7	95.4	2.2
Average Score for the Worst 10% (3 lowest scoring patches)	83.5	88.6	3.3

88.1 color / 95.5 tone



Original Print Colors
(measured before light exposure)

Colors after 140 Megalux-hours
light exposure

Epson Stylus Pro 9800, Cone Piezotone™ (split tone Sepia/Selenium with Portfolio Black) ink, Hahnemühle Photo Rag 308 gsm paper

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	Media White	94.3	1.2	96.6	97.2	0.9	0.3	0.2	1.0
B1	Highlight L* = 96	93.4	1.4	94.1	94.8	1.2	0.4	0.9	1.8
C1	Highlight L* = 89	91.5	1.6	88.8	89.8	1.5	0.5	2.3	3.1
D1	Highlight L* = 78	88.3	2.0	81.0	82.2	2.0	0.6	3.8	4.6
E1	Midtone L* = 66	86.0	2.5	71.6	73.3	2.3	0.7	4.9	5.7
F1	Midtone L* = 52	85.8	2.4	59.2	60.7	2.4	0.7	5.1	5.9
A2	Highlight L* = 92	92.1	1.5	90.9	91.7	1.4	0.4	1.8	2.6
B2	Highlight L* = 85	90.1	1.8	85.9	87.0	1.7	0.5	2.9	3.8
C2	Highlight L* = 75	87.5	2.2	78.7	80.0	2.1	0.6	4.2	5.0
D2	Midtone L* = 63	85.5	2.4	68.7	70.3	2.4	0.7	5.0	5.9
E2	Midtone L* = 50	85.9	2.5	57.4	59.1	2.4	0.7	5.1	5.9
F2	Midtone L* = 38	87.5	2.3	45.7	47.2	2.2	0.7	4.7	5.5
A3	Highlight L* = 82	89.1	1.9	83.7	84.9	1.9	0.6	3.4	4.2
B3	Midtone L* = 72	86.9	2.2	76.4	77.8	2.2	0.7	4.5	5.3
C3	Midtone L* = 60	85.4	2.4	66.4	67.9	2.4	0.8	5.2	6.0
D3	Midtone L* = 47	86.3	2.4	54.7	56.3	2.3	0.8	5.0	5.9
E3	Midtone L* = 35	87.7	2.2	43.7	45.2	2.2	0.7	4.5	5.3
F3	Shadow L* = 25	89.4	2.1	36.1	37.5	1.8	0.4	3.5	4.1
A4	Midtone L* = 69	86.5	2.3	74.3	75.7	2.3	0.7	4.7	5.6
B4	Midtone L* = 57	85.8	2.4	63.4	65.0	2.4	0.8	5.1	6.0
C4	Midtone L* = 45	86.6	2.4	52.5	54.1	2.3	0.8	5.0	5.8
D4	Midtone L* = 32	88.0	2.2	41.6	43.0	2.1	0.6	4.2	4.9
E4	Shadow L* = 20	90.9	1.9	32.3	33.5	1.6	0.3	2.9	3.4
F4	Shadow L* = 10	92.2	2.5	23.6	25.7	1.1	0.4	1.6	2.7
A5	Midtone L* = 55	86.1	2.4	61.8	63.4	2.4	0.8	5.1	6.1
B5	Midtone L* = 41	87.2	2.3	49.2	50.7	2.3	0.8	4.9	5.7
C5	Shadow L* = 29	88.6	2.1	39.4	40.7	1.9	0.5	3.9	4.6
D5	Shadow L* = 15	92.8	1.6	28.0	29.0	1.4	0.3	2.2	2.6
E5	Shadow L* = 5	81.7	4.2	19.2	22.7	0.9	0.7	1.2	3.4
F5	Max Black	82.7	3.3	14.1	16.6	0.7	1.0	0.5	2.6

Summary Results	I*Color	I*tone	ΔE
Average Score for all patches	88.1	95.5	2.2
Average Score for the Worst 10% (3 lowest scoring patches)	83.3	88.6	3.3



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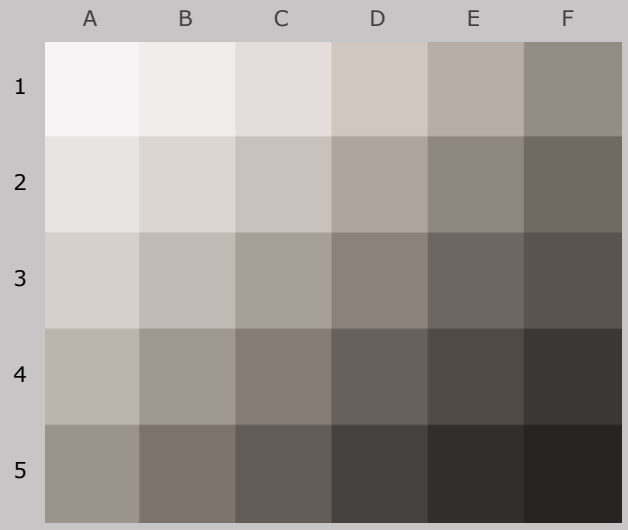
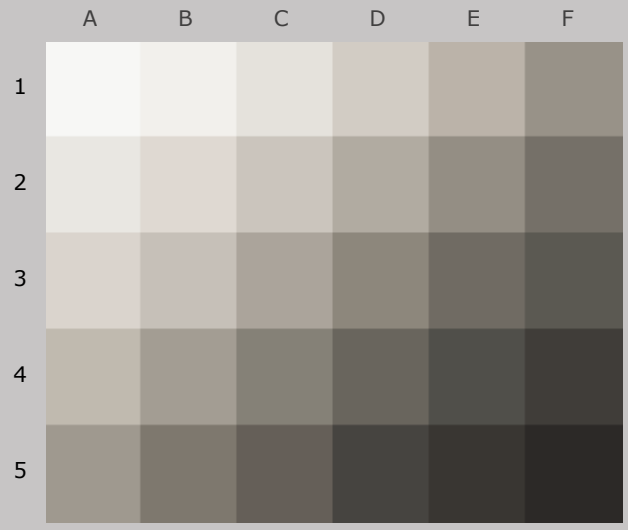
88.4color/95.5tone



Original Print Colors
(measured before light exposure)



Colors after 160 Megalux-hours
light exposure

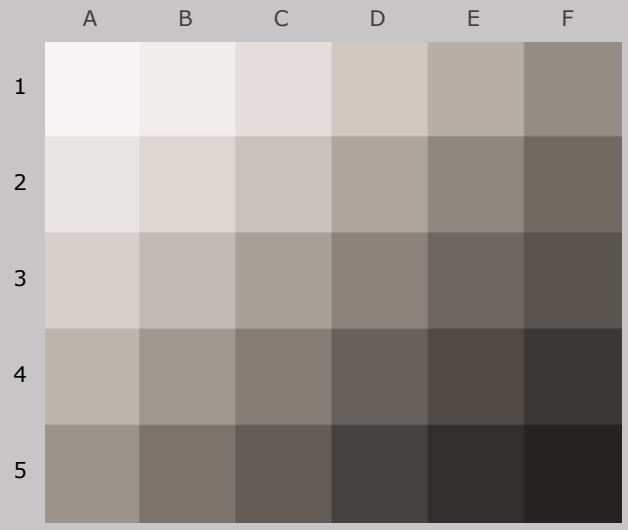
Epson Stylus Pro 9800, Cone Piezotone™ (split tone Sepia/Selenium with Portfolio Black) ink, Hahnemühle Photo Rag 308 gsm paper

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

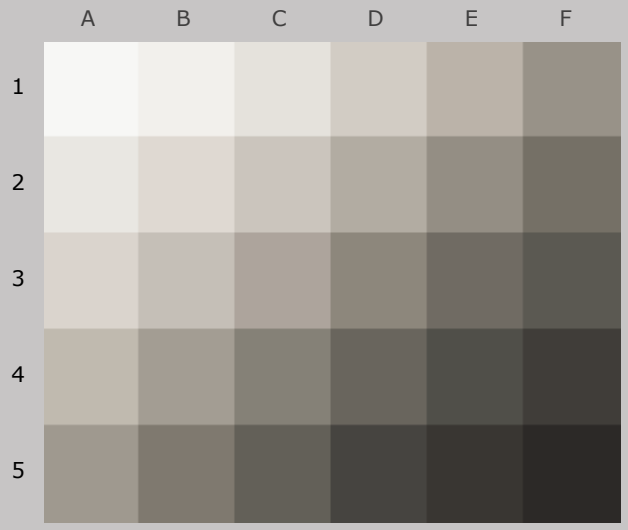
				L*		a*		b*	
Column/row	Color Patch	I*Color	ΔE	Before	After	Before	After	Before	After
A1	Media White	95.3	1.1	96.6	97.2	0.9	0.3	0.2	0.9
B1	Highlight L* = 96	94.1	1.3	94.1	94.8	1.2	0.4	0.9	1.7
C1	Highlight L* = 89	92.2	1.6	88.8	89.8	1.5	0.5	2.3	3.0
D1	Highlight L* = 78	89.0	2.0	81.0	82.3	2.0	0.6	3.8	4.6
E1	Midtone L* = 66	86.3	2.5	71.6	73.3	2.3	0.7	4.9	5.7
F1	Midtone L* = 52	85.8	2.5	59.2	60.8	2.4	0.7	5.1	5.9
A2	Highlight L* = 92	92.7	1.5	90.9	91.7	1.4	0.4	1.8	2.5
B2	Highlight L* = 85	90.7	1.8	85.9	87.0	1.7	0.5	2.9	3.7
C2	Highlight L* = 75	88.0	2.2	78.7	80.1	2.1	0.6	4.2	4.9
D2	Midtone L* = 63	85.8	2.5	68.7	70.4	2.4	0.7	5.0	5.9
E2	Midtone L* = 50	85.8	2.5	57.4	59.2	2.4	0.7	5.1	5.9
F2	Midtone L* = 38	87.1	2.4	45.7	47.3	2.2	0.7	4.7	5.4
A3	Highlight L* = 82	89.9	1.9	83.7	84.9	1.9	0.6	3.4	4.2
B3	Midtone L* = 72	87.4	2.2	76.4	77.9	2.2	0.7	4.5	5.3
C3	Midtone L* = 60	85.7	2.5	66.4	68.0	2.4	0.8	5.2	6.0
D3	Midtone L* = 47	86.2	2.5	54.7	56.4	2.3	0.7	5.0	5.9
E3	Midtone L* = 35	87.4	2.3	43.7	45.3	2.2	0.7	4.5	5.3
F3	Shadow L* = 25	88.9	2.1	36.1	37.6	1.8	0.4	3.5	4.1
A4	Midtone L* = 69	86.9	2.3	74.3	75.7	2.3	0.7	4.7	5.5
B4	Midtone L* = 57	86.0	2.5	63.4	65.1	2.4	0.8	5.1	5.9
C4	Midtone L* = 45	86.6	2.4	52.5	54.1	2.3	0.8	5.0	5.8
D4	Midtone L* = 32	87.7	2.3	41.6	43.2	2.1	0.6	4.2	5.0
E4	Shadow L* = 20	90.2	2.0	32.3	33.7	1.6	0.3	2.9	3.4
F4	Shadow L* = 10	92.5	2.5	23.6	25.8	1.1	0.4	1.6	2.6
A5	Midtone L* = 55	86.3	2.4	61.8	63.5	2.4	0.8	5.1	6.0
B5	Midtone L* = 41	87.0	2.4	49.2	50.8	2.3	0.8	4.9	5.7
C5	Shadow L* = 29	88.2	2.2	39.4	40.9	1.9	0.5	3.9	4.6
D5	Shadow L* = 15	92.2	1.7	28.0	29.1	1.4	0.2	2.2	2.6
E5	Shadow L* = 5	85.4	4.2	19.2	22.9	0.9	0.7	1.2	3.0
F5	Max Black	84.3	3.3	14.1	16.7	0.7	1.0	0.5	2.5

Summary Results	I*Color	I*tone	ΔE
Average Score for all patches	88.4	95.5	2.2
Average Score for the Worst 10% (3 lowest scoring patches)	85.1	88.2	3.3

87.5color/95.3tone



Original Print Colors
(measured before light exposure)



Colors after 180 Megalux-hours
light exposure

Epson Stylus Pro 9800, Cone Piezotone™ (split tone Sepia/Selenium with Portfolio Black) ink, Hahnemühle Photo Rag 308 gsm paper

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	Media White	93.2	1.3	96.6	97.2	0.9	0.3	0.2	1.1
B1	Highlight L* = 96	92.5	1.4	94.1	94.8	1.2	0.4	0.9	1.9
C1	Highlight L* = 89	90.8	1.7	88.8	89.9	1.5	0.5	2.3	3.2
D1	Highlight L* = 78	87.9	2.1	81.0	82.3	2.0	0.6	3.8	4.7
E1	Midtone L* = 66	85.6	2.6	71.6	73.4	2.3	0.7	4.9	5.8
F1	Midtone L* = 52	85.1	2.5	59.2	60.8	2.4	0.7	5.1	6.0
A2	Highlight L* = 92	91.3	1.6	90.9	91.8	1.4	0.4	1.8	2.7
B2	Highlight L* = 85	89.7	1.9	85.9	87.0	1.7	0.5	2.9	3.9
C2	Highlight L* = 75	87.1	2.2	78.7	80.1	2.1	0.6	4.2	5.1
D2	Midtone L* = 63	85.3	2.5	68.7	70.4	2.4	0.7	5.0	6.0
E2	Midtone L* = 50	85.0	2.6	57.4	59.2	2.4	0.7	5.1	6.0
F2	Midtone L* = 38	86.4	2.5	45.7	47.5	2.2	0.7	4.7	5.5
A3	Highlight L* = 82	88.6	2.0	83.7	84.9	1.9	0.6	3.4	4.3
B3	Midtone L* = 72	86.7	2.2	76.4	77.8	2.2	0.7	4.5	5.4
C3	Midtone L* = 60	85.3	2.5	66.4	68.1	2.4	0.8	5.2	6.1
D3	Midtone L* = 47	85.6	2.5	54.7	56.4	2.3	0.7	5.0	5.9
E3	Midtone L* = 35	86.5	2.4	43.7	45.4	2.2	0.6	4.5	5.3
F3	Shadow L* = 25	87.8	2.3	36.1	37.6	1.8	0.3	3.5	4.2
A4	Midtone L* = 69	86.0	2.4	74.3	75.7	2.3	0.7	4.7	5.7
B4	Midtone L* = 57	85.4	2.5	63.4	65.1	2.4	0.8	5.1	6.1
C4	Midtone L* = 45	85.8	2.5	52.5	54.2	2.3	0.7	5.0	5.9
D4	Midtone L* = 32	86.7	2.4	41.6	43.2	2.1	0.5	4.2	5.0
E4	Shadow L* = 20	88.8	2.2	32.3	33.8	1.6	0.2	2.9	3.5
F4	Shadow L* = 10	92.0	2.7	23.6	26.0	1.1	0.3	1.6	2.6
A5	Midtone L* = 55	85.6	2.5	61.8	63.4	2.4	0.8	5.1	6.1
B5	Midtone L* = 41	86.1	2.5	49.2	50.9	2.3	0.7	4.9	5.8
C5	Shadow L* = 29	87.5	2.3	39.4	40.9	1.9	0.4	3.9	4.7
D5	Shadow L* = 15	91.0	1.8	28.0	29.2	1.4	0.1	2.2	2.7
E5	Shadow L* = 5	86.6	4.1	19.2	22.9	0.9	0.6	1.2	2.9
F5	Max Black	84.3	3.3	14.1	16.7	0.7	0.9	0.5	2.5

Summary Results	I*Color	I*tone	ΔE
Average Score for all patches	87.5	95.3	2.3
Average Score for the Worst 10% (3 lowest scoring patches)	84.8	88.5	3.4



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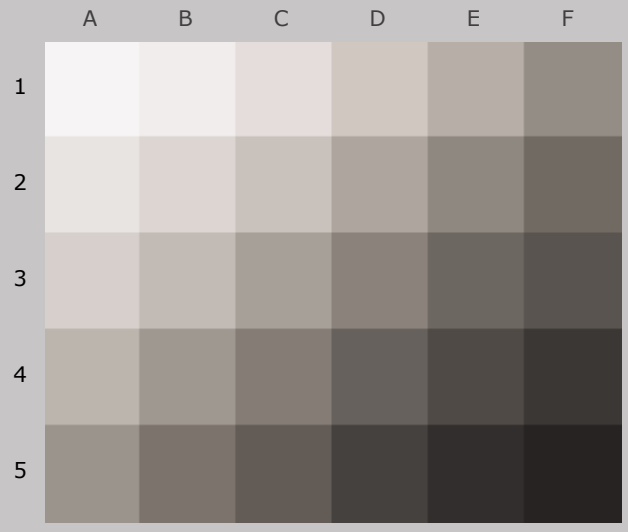
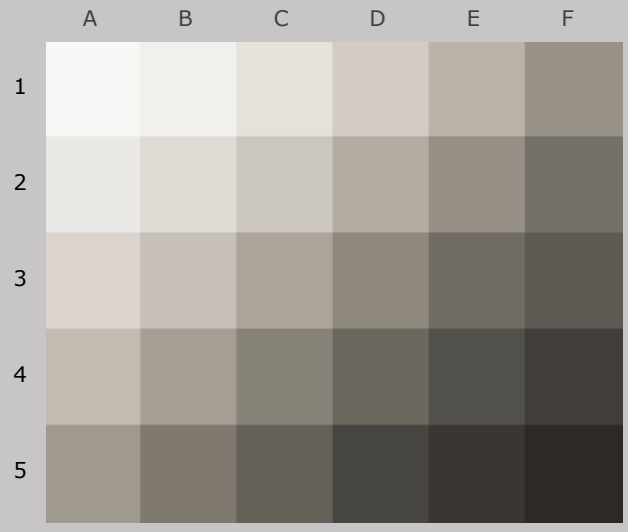
88.0$_{color}$/94.8$_{tone}$



Original Print Colors
(measured before light exposure)



Colors after 200 Megalux-hours
light exposure

Epson Stylus Pro 9800, Cone Piezotone™ (split tone Sepia/Selenium with Portfolio Black) ink, Hahnemühle Photo Rag 308 gsm paper

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	Media White	95.1	1.1	96.6	97.1	0.9	0.3	0.2	0.9
B1	Highlight L* = 96	94.1	1.3	94.1	94.8	1.2	0.4	0.9	1.7
C1	Highlight L* = 89	92.1	1.7	88.8	89.9	1.5	0.5	2.3	3.0
D1	Highlight L* = 78	88.7	2.1	81.0	82.4	2.0	0.6	3.8	4.5
E1	Midtone L* = 66	86.1	2.6	71.6	73.4	2.3	0.7	4.9	5.7
F1	Midtone L* = 52	85.5	2.6	59.2	61.0	2.4	0.7	5.1	5.9
A2	Highlight L* = 92	92.7	1.7	90.9	92.1	1.4	0.4	1.8	2.5
B2	Highlight L* = 85	90.7	2.0	85.9	87.3	1.7	0.5	2.9	3.6
C2	Highlight L* = 75	87.8	2.4	78.7	80.4	2.1	0.6	4.2	4.9
D2	Midtone L* = 63	85.6	2.7	68.7	70.7	2.4	0.7	5.0	5.9
E2	Midtone L* = 50	85.3	2.8	57.4	59.5	2.4	0.7	5.1	5.9
F2	Midtone L* = 38	86.4	2.6	45.7	47.6	2.2	0.6	4.7	5.5
A3	Highlight L* = 82	89.6	2.1	83.7	85.2	1.9	0.6	3.4	4.1
B3	Midtone L* = 72	87.2	2.4	76.4	78.1	2.2	0.7	4.5	5.2
C3	Midtone L* = 60	85.4	2.7	66.4	68.3	2.4	0.7	5.2	6.0
D3	Midtone L* = 47	85.7	2.7	54.7	56.7	2.3	0.7	5.0	5.8
E3	Midtone L* = 35	86.5	2.5	43.7	45.5	2.2	0.6	4.5	5.3
F3	Shadow L* = 25	87.6	2.4	36.1	37.9	1.8	0.3	3.5	4.1
A4	Midtone L* = 69	86.6	2.5	74.3	76.0	2.3	0.7	4.7	5.5
B4	Midtone L* = 57	85.6	2.7	63.4	65.3	2.4	0.7	5.1	5.9
C4	Midtone L* = 45	85.8	2.7	52.5	54.4	2.3	0.7	5.0	5.8
D4	Midtone L* = 32	86.4	2.5	41.6	43.4	2.1	0.5	4.2	5.0
E4	Shadow L* = 20	88.7	2.3	32.3	34.0	1.6	0.1	2.9	3.5
F4	Shadow L* = 10	92.3	2.8	23.6	26.1	1.1	0.3	1.6	2.5
A5	Midtone L* = 55	85.8	2.6	61.8	63.7	2.4	0.8	5.1	6.0
B5	Midtone L* = 41	86.1	2.6	49.2	51.1	2.3	0.7	4.9	5.7
C5	Shadow L* = 29	86.9	2.5	39.4	41.2	1.9	0.4	3.9	4.7
D5	Shadow L* = 15	90.8	1.9	28.0	29.4	1.4	0.1	2.2	2.6
E5	Shadow L* = 5	87.8	4.2	19.2	23.1	0.9	0.6	1.2	2.8
F5	Max Black	85.0	3.4	14.1	16.9	0.7	0.9	0.5	2.4

Summary Results	I*Color	I*tone	ΔE
Average Score for all patches	88.0	94.8	2.4
Average Score for the Worst 10% (3 lowest scoring patches)	85.2	88.3	3.5



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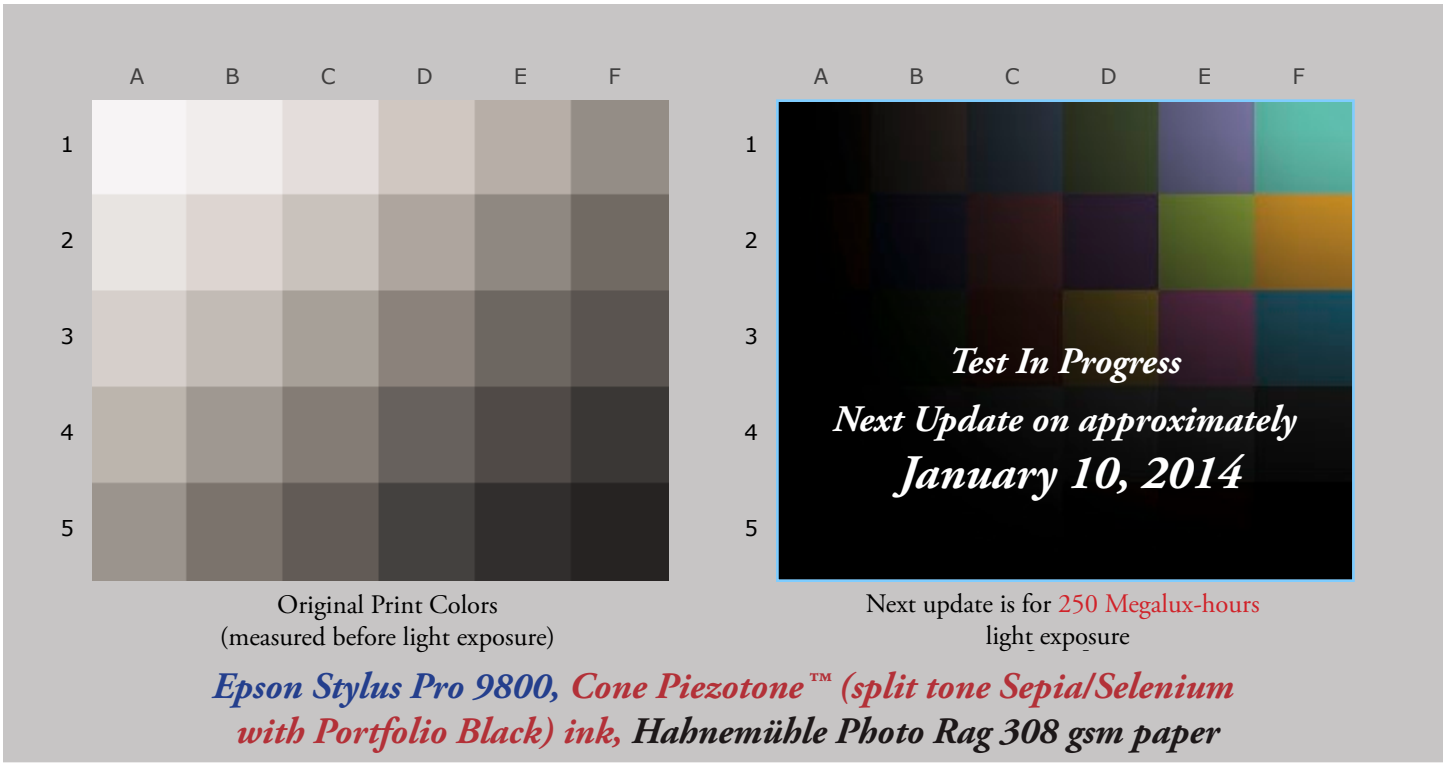

Original Print Colors
(measured before light exposure)

Next update is for 250 Megalux-hours
light exposure

Epson Stylus Pro 9800, Cone Piezotone™ (split tone Sepia/Selenium with Portfolio Black) ink, Hahnemühle Photo Rag 308 gsm paper

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