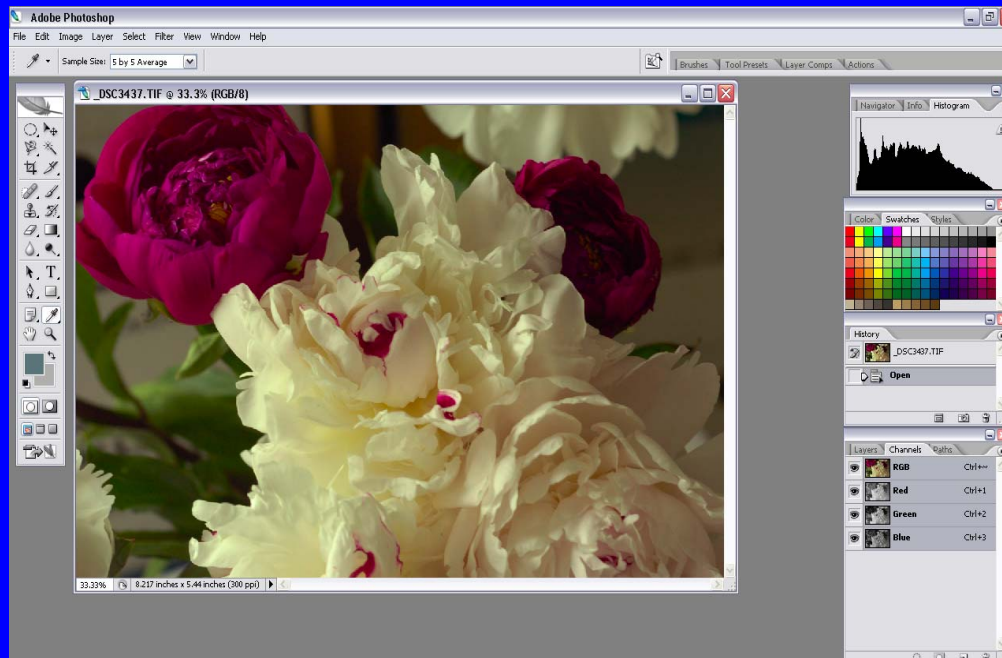


# Born Digital Photographs: Acquisition and Preservation Strategies

AABC Conference 2006



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# Policy and PROCEDURE

Policy is easy

Procedure is hard

# Policy and PROCEDURE

Library of Congress

Sustainability of Digital Formats

Planning for LC Collections Still Image

Preferences

[www.digitalpreservation.gov/formats/content/still\\_preferences.shtml](http://www.digitalpreservation.gov/formats/content/still_preferences.shtml)

# Acquisition and Preservation Strategies

## 1. Preservation policy for e-records

⇒ accept only certain file formats and certain storage formats?

⇒ triage “at risk” media on appraisal?  
(migrate to accepted file format or storage device before arrangement and description)

⇒ policy and procedures

# Camera Choice – What Matters

1. Mega pixel (MP)
2. Sensor size
3. File formats

Focus shifts between acquired ‘born digital’  
and an institution which creates ‘born  
digital’ records

# Mega Pixel

MP		300 dpi
2	1600 x 1200	4 x 6
3		5 x 7
6		8 x 10
14		11 x 14
23		13 x 20

# Sensor Arrays - CCD

- Charged-coupled device
- Capture light on the small photosites
- Charges on the first row are transferred to a **read out register**. Signals are then fed to an amplifier and then on to an analog-to-digital converter. The charges on each row are "coupled" to those on the row above so when one moves down, the next moves down to fill its old space. In this way, each row can be read—one row at a time.

# CMOS Sensor

- **Complementary Metal Oxide Semiconductor**  
(CMOS refers to how a sensor is manufactured, and not to a specific sensor technology)
- Faster, individual processing of pixels, less expensive to produce

# Sensor Size











- 1/8 size = 5.5 x 4.1 mm
- 2/3 size = 23.7 x 15.5 mm

As sensor size decreases  
photosites get smaller  
resulting in less light capture

- Poor signal/noise ratio
- Image more grainy,  
artifacts

## Digital Cameras Side-by-Side, 2 cameras



Format	SLR	SLR
Price (street)	US\$1656	US\$3089
Also known as		
Camera body		
Release Status	Unreleased	
Max resolution	 3872 x 2592	4368 x 2912
Low resolution	 2896 x 1944, 1936 x 1296	3168 x 2112, 2496 x 1664
Image ratio w:h	 3:2	3:2
Effective pixels	 10.0 million	12.7 million
Sensor photo detectors	 10.9 million	13.3 million
Sensor size	 23.6 x 15.8 mm	36 x 24 mm
Sensor type	 CCD	CMOS
Colour filter array	 RGB	RGB
Sensor manufacturer	 Sony	Canon
ISO rating	 100 - 1600 in 1, 1/2 or 1/3 EV steps (up to 3200 as boost)	100 - 1600 in 1/3 stops, plus 50, 3200 as option
Zoom wide (W)	 n/a	n/a

# Noise

- Relates to rate of light capture
- Higher ISO = shorter amount of time to capture light = higher signal/noise ratio  
noise = unwanted 'artifacts' in image area
- So image capture at low ISO is better

# File Formats

- JPEG
- TIFF
- JPEG 2000
- RAW
- DNG

# Compression

- Lossy Compression
- Lossless Compression
  
- Lossless/Non-compressed - preferred

# Compression

Data (pixels) that are duplicated are deleted or saved in a shorter form ie. Blue skies

aaaaaabbbbbccccc or 6a4b5c

Pro = smaller file

Con = data loss

# Lossy Compression

- When a ‘lossy compressed image is decompressed, it is different from the original image because some of the information was eliminated as part of the compression format’.

Besser, Howard. 2000 *Digital Longevity*. Handbook for Digital Projects: A Management Tool for Preservation and Access. NEDCC. Pg.158

[www.nedcc.org](http://www.nedcc.org)

# Lossless Compression

- When a lossless compressed image is decompressed, it is identical to the image before it was decompressed.

(TIFF - LZW lossless compression)

Besser, Howard. 2000 *Digital Longevity*. Handbook for Digital Projects: A Management Tool for Preservation and Access. NEDCC. Pg.158  
[www.nedcc.org](http://www.nedcc.org)

# JPEG

- Joint Photographic Experts Group
- **NOT AN ACCEPTED PRESERVATION FORMAT**
- Algorithm – lossy and compressed
- Converts image data from 12 or 14 bit format to 8 bit format
  
- JPEG starts compression at 8 bit level
- 20:1 10:1 4:1 compression ratios

[www.shortcourses.com/choosing/files/08.htm](http://www.shortcourses.com/choosing/files/08.htm)

Smallest compression ratio

Highest compression ratio

# JPEG

- Each opening and resaving of a JPEG results in cumulative losses
- Image changes and quality decreases each time a JPEG is saved

# TIFF

- Tagged Image File Format
- Currently accepted **PRESERVATION** format
- TIFF = file wrapper = holds data in original order and format

# TIFF

- Lossless and **choose non-compressed**
- TIFF – lossless LZW compression option
  - ↓ files size 3 – 30%
- Retains RGB values for each pixel
- High bit depth
- Metadata can be attached
- ICC profiles can be attached

# TIFF and software

- TIFF is open but –
- Some cameras and imaging s/w create TIFF type files that can't be opened by other software – add proprietary s/w
- Adobe PhotoDeluxe Home Edition 4.0

# JPEG 2000

- JPEG 2000 very different from current JPEG
- Uses wavelet compression to give a higher compression (20% better) and better image quality with fewer artifacts (image flaws).
- Wavelet technology also allows an image to be "streamed." A low resolution image appears quickly and then is gradually "filled in" with more detail.  
**Ideal for web use but not preservation**
- From [shortcourses.com](http://shortcourses.com)

# Raw Files

- RAW stores image data from sensor without processing in camera
- RAW records all camera settings
- RAW becomes the ‘negative’ or ‘original’
- Files approximately 60% smaller than uncompressed TIFF files
- Image processing ‘developing’ done in computer with software

Fraser, Bruce. 2005.  
Camera Raw with Adobe  
Photoshop CS2. Peachpit  
Press, Berkeley, California.

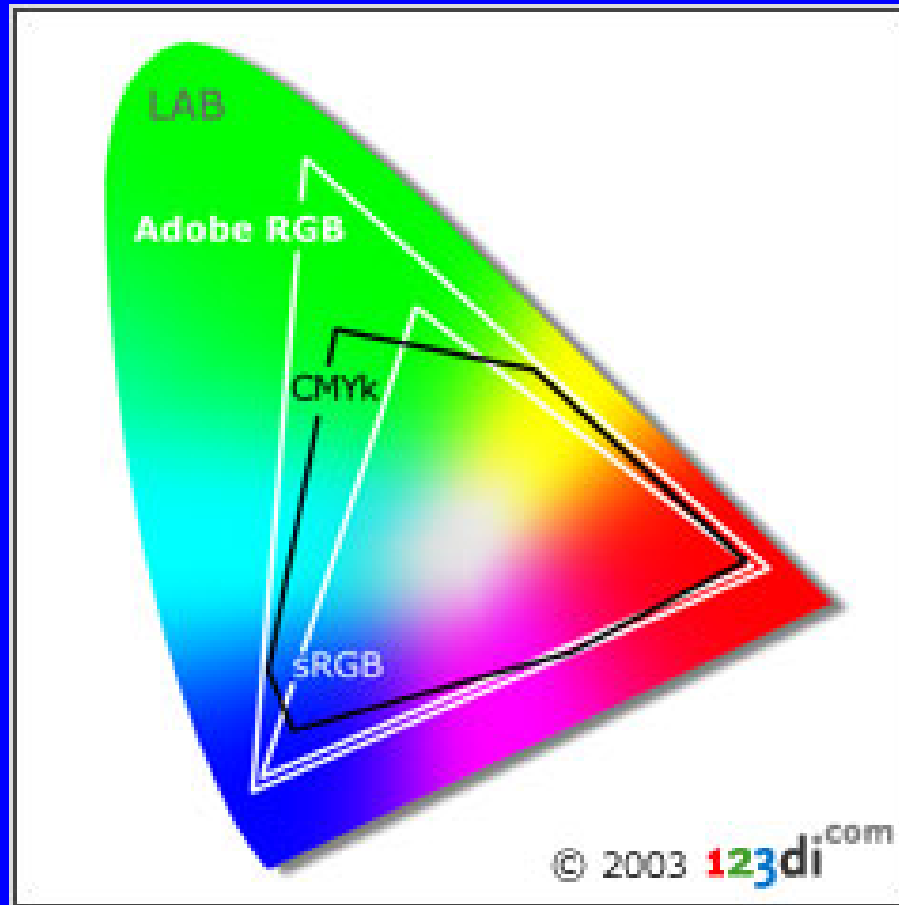
# .DNG Adobe digital negative

- DNG metadata publicly documented
  - broader platform
  - if used will allow access to file formats no longer supported by camera manufacturer
- Extension of TIFF 6.0 – compatible with TIFF-EP

# DNG

- Extensis, Canto, Apple, and iView support DNG
- Photoshop CS2
- [www.adobe.com/products/dng/main.html](http://www.adobe.com/products/dng/main.html)

# sRGB and Adobe RGB (98)



# Documentation Calibration Target

- Allows for white point correction
- GretagMacBeth colour checker – neutral grey scale – known values
- Colour squares useful for adjusting reds, oranges and yellows

# GretagMacBeth Color Checker

- Mini  
3 x 4"
- Full  
8.5 x 11"



# HELP!

Out of Gamut: Calibrating Camera RAW in Photoshop CS  
Fraser, Bruce. 2004.

[www.creativepro.com/printerfriendly/story/21351.html](http://www.creativepro.com/printerfriendly/story/21351.html)

<http://fors.net/chromoholics/>

# Metadata

Data about data

Technical

- Relating to the file format e.g. TIFF
- Relating to camera settings

Descriptive

- Terms to describe the image

# Metadata

NISO 39.87

Technical Metadata for Digital Still Images

- in review process - [ballot](#) July 18-  
August 26, 2005 - still in development

[www.niso.org](http://www.niso.org)

# Descriptive Metadata

RAD Compliant

# Digital Asset Management (DAMs)

- Windows
- ACDSee
- iView
- iPhoto – Mac
- Portfolio
- Photoshop CS2 – File Browser
- Aperture

# File Storage

- Optical media
- Hard drives
- Server

# File Storage

- CD Rs – Gold – preservation standard
- Mitsui - Mam-e
- [www.mitsuidr.com/products/gold/archive.html](http://www.mitsuidr.com/products/gold/archive.html)
- Burn at a slow speed 4 – 8X
- LE – 5 – 20 years?

Iraci, Joe. "The Relative Stabilities of Optical Disc Formats" Restaurator Vol. 26, No. 2 (2005).

<http://aic.stanford.edu/sg/emg/library/pdf/iraci/relativeStabilitiesOpticalDiscs.pdf>

# Gold Cd – Preservation Standard

## 1. Gold CD Only choice

**Phthalocyanine**, a light-green compound that is very stable in the presence of heat and light

Dye Type	Color appearance (Viewing the laser reading side of the disc)		
	Actual Color	On Gold Metal	On Silver Metal
Phthalocyanine (thalo-sy-a-neen)	clear or very light green	gold or greenish gold	silver
Cyanine (sy-a-neen)	blue	green	blue
Azo (ay-zo)	dark blue or deep blue	dark green	dark blue or deep blue

*Table 2: Dye type and color appearance—CD-R discs (recordable discs)*

Byers, Fred. 2003. **Care and Handling of CDs and DVDs.** CLIR: Washington DC. pg.8.

# Storage

- CD-R ~670 MB
  - Actual 650 MB
  - TIFF file i.e. 10 - 20 MB per image
  - 30 – 60 images per CD
- 
- Nikon D2H 4MP = ~12MB

# Labeling Gold CDs

- Mark clear inner hub
- Use only solvent-free, water-based, fine-tip markers, such as the Dixon Redisharp Plus.
- Do not use adhesive labels

# Gold CD Suppliers

Precision Sound

3117 Norland Avenue

Burnaby, BC V5B 3A9

Phone: (604) 299-4141 Fax: (604) 299-4146

Skana Imaging Solutions Inc.

Vancouver BC

Tel (604) 540-9121

[www.skanaimaging.com/contact.php](http://www.skanaimaging.com/contact.php)

# DVDs

- No preservation standard
- Not recommended for permanent or semi-permanent storage

# Hard Drives

- 80 – 100 GB external HDD storage  
~ \$180-190 for 100 GB (London Drugs)

# Digital Output

- Printer ink
- Printer paper
- [www.wilhelm-imaging.com](http://www.wilhelm-imaging.com)
- [www.inkjetart.com](http://www.inkjetart.com)
- [www.imagepermanenceninstitute.org](http://www.imagepermanenceninstitute.org)
- Espon/Canon/HP etc.

# www.wilhelm-imaging.com

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**The Highest Standard of Care: Sub-Zero Cold Storage For Small Personal Collections to Large Institutional Archives**

**"High-Security, Sub-Zero Cold Storage for the PERMANENT Preservation of the Corbis-Bettmann Archive Photography Collection"**

By Henry Wilhelm with Ann C. Hartman, Kenneth Johnston, Els Rijper, and Thomas Benjamin



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Posted May 17, 2004

**WIR Technical Articles About Image Permanence Test Methods and the Permanence of Digitally-Printed Photographs**

**JUST PUBLISHED!**

Article from "Japan Hardcopy 2005" Conference in Tokyo  
June 8-10, 2005

**"New Test Methods for Evaluating the Humidity-Fastness of Inkjet Prints"**

By Mark McCormick-Goodhart

and Henry Wilhelm



[View 5-page Article](#)

**General Interest Articles About Image Permanence and Preservation from Newspapers, Magazines, Books, and Websites**

**NEW WIR Press Release**

Canon U.S.A., Inc. Endorses the Independent WIR Certified Image Permanence Testing Program and Seal, Joining Epson, Hewlett-Packard, and Lexmark in Providing Consumers with Standardized Print Longevity Ratings



[Go To Press Release](#)  
Posted April 8, 2005

**WIR Print Permanence Ratings for Desktop Printers, 4x6-inch Dedicated Photo Printers, and Silver-Halide Digital Minilabs**

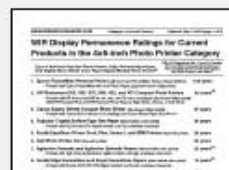
**NEW UPDATE!**

**Display Permanence Ratings for Current Products in the 4x6-inch Printer Category**

Includes WIR Data for the NEWEST 4x6-inch Printers from Dell, Lexmark, Canon, Hewlett-Packard, and Epson

Also Includes WIR Display Permanence Ratings for the Latest Digital Minilab Silver-Halide Color Papers:

**WIR/DPR Ratings (Years)**  
**(40) Fujicolor Crystal Archive**  
**(22) Agfacolor Sensatis**  
**(19) Kodak Edge Generations**  
**(17) Konica Minolta Impresa**



**WIR Print Permanence Ratings for Medium-Format Tabletop Inkjet Printers and for Large-Format Inkjet Printers**

**Print Permanence Ratings for Epson Stylus Pro 9800 Printer and UltraChrome K3 Inks**

[Epson Stylus Pro 9800 Full-Screen Page View](#)  
Updated July 1, 2005

[Epson Stylus Pro 9800 Download 8-Page PDF](#)

**Print Permanence Ratings for Epson Stylus Pro 4800 Printer and UltraChrome K3 Inks**

# WIR

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Posted July 31, 2003

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October 2001



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"All the major aspects of output affect the enjoyment of digital photography. It's important to consider printer speed as well as longevity and color gamut."

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Posted May 28, 2005

**Article From**  
From [PHOTO Techniques Magazine](#)  
Jan/Feb 2005

**"An Interview with Henry Wilhelm of Wilhelm Imaging Research"**

"The noted image-permanence researcher details the history of the field and considers the future of photography."

By Paul Schranz



By Henry Wilhelm with contributing author Carol Brower

Originally Published in 1993

**High-Resolution Adobe Acrobat PDF files for the entire 758-page book or for any or all of the 20 individual chapters may be downloaded for FREE!**

**Guidebook from [Canadian Council of Archives](#)**

**"Cold Storage of Photographs at the [City of Vancouver Archives](#)"**

By Sue Bigelow, Conservator



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Posted May 17, 2004

**"The Influence of Relative Humidity on Short-Term Color Drift in Inkjet Prints"**

By Mark McCormick-Goodhart and Henry Wilhelm



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October 2001

**"Humidity-Induced Color Changes and Ink Migration Effects in Inkjet Photographs in Real-World Environmental Conditions"**

By Mark McCormick-Goodhart and Henry Wilhelm



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# Ink Jet Printers

Printers vary widely

- Type of inks they use
- Type of paper that is recommended
- Can have a profound effect on the stability of the printed image.

# Ink Types

1. Dye based inks
2. Pigment based inks
  - Pigment based inks  
are considered the better choice –  
light fastness and stability
  - Dyes – brighter colours – more saturation  
on glossy papers

# No-Name Inks

"Cheap Ink Probed" September 2003  
PC World Magazine –  
News & Trends section.

[www.wilhelm-research.com/pdf/PCWorld\\_  
Cheap\\_Inks\\_2003\\_10.pdf](http://www.wilhelm-research.com/pdf/PCWorld_Cheap_Inks_2003_10.pdf)

# Ink Jet Papers

- Images can be printed on coated or uncoated papers

# Coated Papers

- Two common types
- ‘swellable’ paper
- ‘porous’ paper

# Swellable Paper

- Swells with moisture from water based inks – allows the ink to penetrate the top layers of the paper

# Swellable Paper

Protective polymer layer – locks ink in place

Absorbent layer – soaks up excess ink

Polyethylene layer

Paper

Polyethylene layer

Anti-curl and anti-static layer

# Swellable Paper

- Generally higher gloss than porous paper
- Longer ink drying times
- Paper feels smooth
- “Rub test” drop of water on paper will cause swellable paper to “melt” the surface – a slippery film is formed

# Porous Papers

- Surface coated with small, inert ceramic particles – create tiny cavities in which the ink is deposited
- Particles prevent ink spread – porous paper tends to be more resistant to RH changes – paper can be handled immediately after printing – preferred when pigmented inks used.

# Porous Papers

- Generally more matte in appearance
- Shorter ink drying time
- Can feel sticky compared to smooth swellable papers

# What Effects Stability?

- RH and Temperature
- Pigment-based ink jet prints less sensitive than traditional colour prints because they use pigments rather than dyes
- At high RH images made with dye inks on swellable paper can blur due to ink movement

# Light

- Light stability studies vary
- Pigment based inks generally recommended

**Table 1. "Standard" Home Display Illumination Levels Used by Printer, Ink, and Photo Paper Manufacturers**

120 lux/12 hrs/day	450 lux or 500 lux/10 hrs/day or 12 hrs/day
Kodak	Fuji
	Hewlett-Packard
	Epson
	Canon
	Lexmark
	Ilford
	Konica Minolta
	Agfa-Gevaert
	DuPont
	Ferrania
	InteliCoat
	Somerset
	Arches
	LexJet
	Lyson
Luminos	
Hahnemühle	
Premier Imaging Products	
American Inkjet	
MediaStreet	

or color balance failure point after the equivalent of 100 years of display are given a rating of "more than 100 years" until such time as meaningful dark stability data are available (see discussion in No. 6 below).

Eastman Kodak bases its home display-life calculations on 120 lux/12 hours per day, rather than 450 lux/12 hours per day. Some of Kodak's display-life predictions for Kodak Ultima Picture Paper are almost 15X longer than the predic-

# Gaseous Pollutants

- Little or no effect on traditional colour prints
- Ozone can effect dye images on porous paper
- More research needs to be done

# Porous Papers

- No polymer protective layer
  - Ozone, SO<sub>2</sub>, NO<sub>x</sub>







# Water

- Dye based ink jet prints – can blur, stick together, handling when wet can cause much surface damage
- Pigment based inks generally water resistant – even on plain printer paper

# Longevity – Paper Choice Matters

Printer	Paper	Display Years
Epson 2200	Espon W/C	90
	Hammermill Jet Print	~30
Epson 820,825..	Epson Colorlite Semigloss	27
	CompUSA High Gloss	5
Traditional Photo Processing	Fujicolor Crystal Archive	60
	Kodak Ektacolor Edge 8	22

## What are the key differences among the Epson Ink Solutions?

Key Differences	4-Color Dye Inks	Photo Inks™	DURABrite® Inks	UltraChrome™ Inks	UltraChrome Hi-Gloss Inks	Archival Inks
<b>Target Application</b>	<p>General purpose printing and home photo</p> 	<p>Advanced amateur photographers and home photo</p> 	<p>Home general purpose and photo—dedicated productivity with the flexibility to print photos</p> 	<p>Commercial, fine art, and advanced amateur photography; pre-press proofing, posters, and signage</p> 	<p>Photography, including commercial, fine art, and advanced amateur</p> 	<p>Indoor/outdoor signage, fine art reproduction, fine art photography, and Print for Pay</p> 
<b>Current Supported Epson Printers</b>	<p>Epson Stylus C44UX, Epson Stylus Color 1520</p>	<p>Epson Stylus Photo R300 / R300M / 1280 / RX500</p>	<p>Epson Stylus C64 / C84 / CX5400 / CX6400</p>	<p>Epson Stylus Photo 2200, Epson Stylus Pro 4000/7600/9600/10600</p>	<p>Epson Stylus Photo R800</p>	<p>Epson Stylus Pro 10600</p>
<b>Ink Characteristics</b>	<ul style="list-style-type: none"> <li>• 4-color dye-based ink—Cyan, Magenta, Yellow, and Black (CMYK)</li> <li>• Quick-Drying formula results in vibrant output without bleeding or smudging</li> <li>• Wide color gamut as well as the largest</li> </ul>	<ul style="list-style-type: none"> <li>• 6-color dye-based ink—CMYK plus light cyan and light magenta inks (CMYKcm) which smooth the tonal gradations critical for photography</li> <li>• Quick-Drying formula has</li> </ul>	<ul style="list-style-type: none"> <li>• 4-color pigment-based ink (CMYK) delivers exceptional text and image quality on plain and matte papers; also produces good output on glossy papers (optimized for the Epson</li> </ul>	<ul style="list-style-type: none"> <li>• 7-channel print head and 8 cartridges: Pigment-based CMYKcm (including Photo Black and Matte Black )plus Light Black to improve the neutral appearance for B&amp;W prints</li> <li>• Color gamut</li> </ul>	<ul style="list-style-type: none"> <li>• 8-channel print head and 8 cartridges: Uses Hi-Fi ink set of Cyan, Magenta, Yellow, Matte Black, Photo Black, Red, Blue, and Gloss Optimizer</li> <li>• First pigment-based ink set to deliver archival</li> </ul>	<ul style="list-style-type: none"> <li>• 6-color pigment-based ink—CMYKcm</li> <li>• This pigment-based ink has a good color gamut and a wide range of media flexibility, with incredible lightfast ratings ideal for archival applications and</li> </ul>

# Canon Chromalife Inks

## **ChromaLife 100 System**

ChromaLife 100 inks and paper are designed to withstand common, real world conditions that can cause a photo to fade.



## **100 Years in an Album\***

Genuine Canon inks and paper that provide up to 100 years album life.



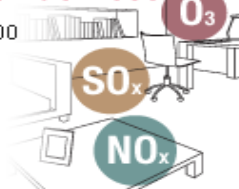
## **30 Years Lightfastness\***

New Canon dye inks and Canon photo papers that resist fading for 30 years.



## **10 Years Gas Fastness\***

The ChromaLife 100 system has been tested to resist fading from mixed gases.



## **Improved resistance to heat and humidity**

ChromaLife 100 inks and Canon Photo Paper are designed to resist real world conditions that cause photos to fade.



## **Improved Contrast**

### **Introduction and Purpose**

As an aid to consumers, Canon Inc. has pre-performed simulated, accelerated image permanence testing to predict estimated longevity of photos printed with the Canon ChromaLife 100 System. Canon Inc. has pre-performed simulated, accelerated image permanence testing to predict estimated longevity of photos printed with the Canon ChromaLife 100 System.

# Digital Preservation Policy

Erpa Guidance Digital Preservation Policy Tool

[www.erpanet.org/guidance/docs/ERPANETPolicyTool.pdf](http://www.erpanet.org/guidance/docs/ERPANETPolicyTool.pdf)

A Framework of Guidance for Building Good Digital Collections (2<sup>nd</sup> Edition – 2004)

[www.niso.org/framework/Framework2.html](http://www.niso.org/framework/Framework2.html)

The NINCH Guide to Good Practice in the Digital Representation and Management of Cultural Heritage Materials

[www.nyu.edu/its/humanities/ninchguide/](http://www.nyu.edu/its/humanities/ninchguide/)

Cornell University Digital Preservation Policy

<http://commondepository.library.cornell.edu/cul-dp-framework.pdf>

# Digital Preservation Policy

Digital Preservation for Museums

[www.chin.gc.ca/English/Digital\\_Content/Preservation\\_Recommendations/index.html](http://www.chin.gc.ca/English/Digital_Content/Preservation_Recommendations/index.html)

Calimera Guidelines

[www.calimera.org/Lists/Guidelines/Digital\\_preservation.htm](http://www.calimera.org/Lists/Guidelines/Digital_preservation.htm)

PADI – National Library of Australia

[www.nla.gov.au/padi/index.html](http://www.nla.gov.au/padi/index.html)

# E – Project AABC List Serve

Using the AABC list serve as a discussion forum we could jointly create a digital preservation policy for still images for small to medium sized archives

Good idea?

Bad idea?