

# The Transition from Silver Halide to Digital Printing and Its Effect on Print Quality

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Over the past 150 years, the nature of photography has changed greatly. Photography began and in fact derives from the Greek words for “writing with light.” With digital imaging, the production of photographs is not dependent on light. Photographs may now be produced by many techniques, including electrophotography and ink jet. Is the resulting image still a photograph?

**Photograph, n**

1. A picture or image obtained by photography; (originally) a picture made using a camera in which an image is focused on to sensitive material and then made visible and permanent by chemical treatment; (later also) a picture made by focusing an image and then storing it digitally.

Oxford English Dictionary, 2011




**Photograph**

Ancient Greek		Meaning
φωτος	Photos	light
γραφειν	Graphein	write

I succeeded in producing a photograph on glass.

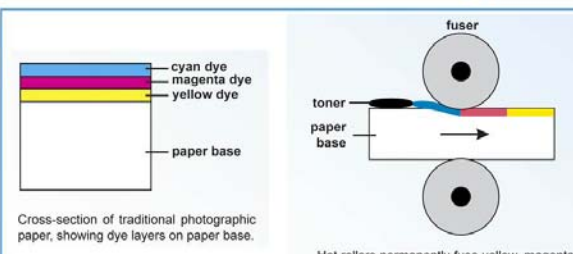
Sir John Frederick William Herschel, 1839



The Oxford English Dictionary explicitly recognizes the change that has taken place and has removed the requirement for exposure of a light sensitive material followed by chemically processing. This updated definition is consistent with typical consumer views.

Most consumers do not care how their photographs are produced, and in fact the technology can be quite different. Light-sensitive silver halide salts are used to form three dyes in traditional photographic processes. Electrophotographic printers, on the other hand, require fusing at least four toners, yellow, magenta, cyan, and black, to paper to produce the final image.


**Photographic Technology**



Cross-section of traditional photographic paper, showing dye layers on paper base.

Hot rollers permanently fuse yellow, magenta, cyan, and black toners into the paper base.

- Traditional silver halide prints are different from electrophotographic prints.



## Creative Memories Page Print

- Photos and artwork
- Digital replacement for a conventional scrapbook page.
- StoryBook Creator for the PC
- sbcStudio for the Macintosh
- Online Creation
- 12x12-inch and 8x8-inch
- Matte and glossy



**Case Study – Creative Memories changed Page Prints from silver halide to electrophotography in July 2009.**

Creative Memories changed one of its Page Prints from traditional silver halide to electrophotography. This change, which was made as part of bringing printing in-house provides the perfect opportunity to understand the requirements for photographic prints.

The Page Print typically contains photos and artwork. It is intended as digital replacement for the conventional scrapbook. Page Prints can be created with StoryBook Creator on the PC, sbcStudio on the Macintosh, and online.

Page Prints are available in 12x12 and 8x8, although 12x12 represents 90% of sales. The 12x12-inch is a popular scrapbook size and cannot be produced with most home printers. The Nexpress textured clear coat and glosser allow us to offer matte and glossy options. In this case, sales are more evenly divided, with matte Page Prints representing 60% of sales.

## Creative Memories Page Print

- 12x12-inch represents 90% of sales.
- Popular scrapbook size.
- Most home printers are unable to print 12x12.
- Matte and glossy options
  - NexGlosser for glossy Page Prints.
  - Textured clear coat for matte Page Prints.
- Matte represents 60% of sales.



## Digital Image Quality

### Silver Halide versus Electrophotography

- Does the quality meet the expectations?
- Are customers pleased with the results?
- “Non-photographic appearance” of digital prints
  - Image structure from half-tone, versus true continuous tone
  - Gloss differential from different gloss in light and dark areas.




The change in technology from silver halide to electrophotography changes product appearance and is obvious to customers. When we changed the Page Print we clearly communicated the change to our customers and had to answer a number of questions. Specifically, does the quality meet expectations and are customers pleased with the results? After all, sample prints are not necessarily the same as customer orders.

In this project, we addressed “non-photographic appearance” of digital prints. After all, customers had become quite accustomed to the appearance of photographic prints over the last 150 years. “Non-photographic appearance” has two main causes: the image structure from the half-tone process that is used in many digital printing processes and the gloss differential that results from the presence of different amounts of toner in different areas of the image.

The difference in image structure is illustrated by this comparison. The halftone dot structure affects image quality even though it is not generally perceptible at normal viewing distances. Differences are particularly apparent in human faces and may translate into dissatisfaction with overall print quality.

### Image Structure


Electrophotography requires half-tone dots.



- Relates to the appearance of an image, particularly the perception of human faces.
- Halftone dot structure is not readily perceptible at normal viewing distances.
- May translate into dissatisfaction with the “photographic” quality of the resulting print.

### Image Structure

Electrophotography produces sharp edges.



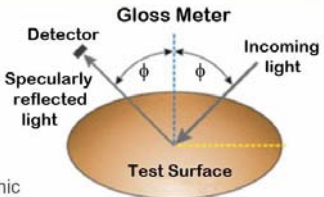
- Increased sharpness of text and lines
  - Edge blur decreases from 0.183 to 0.100 mm.
  - Line blur decreases from 0.137 to 0.084 mm.
- Better resolution of closely spaced lines.
- Improved appearance for journaling, text, and artwork.

Page Prints also contain text and artwork. Here the improved edge sharpness that results with electrophotographic printing is an advantage. Edge blur and line blur show significant improvements compared to traditional photographic prints. This improvement translates into significantly clearer journaling text and artwork.

Gloss also influences photographic quality. In this case, the absolute gloss value, which can vary significantly from matte to glossy prints, is less important than gloss differential. Gloss differential results when different areas of the print that have different amounts of toner have different levels of gloss. In a traditional photographic print, all areas of the print, including snow, green trees, blue sky, and text have essentially the same gloss. Consumers have the same expectation for digital prints.

### Gloss

Digital Prints May Not Have Uniform Gloss



- Gloss differential is more important than the absolute value of gloss for photographic quality.
- Matte and glossy photo paper show significant differences in gloss; yet both appear photographic.
- Within a single photograph, customers expect white snow, green trees, blue skies, and black text to have the same gloss.

### Gloss Differential

60° Gloss	Gm	Dg	Sg
Photographic Paper Glossy	82.7	24.8	2.19
Page Print Glossy	84.9	14.6	0.73
Photographic Paper Matte	37.5	5.6	3.80
Page Print Matte	24.9	11.1	9.53

- Glossy Page Prints have a lower gloss differential, Dg, and are “more photographic” than traditional silver halide prints
- Matte Page Prints have a higher Dg than traditional photographic prints; however, the absolute value of 9.6 for Sg was within acceptable limits, as defined by our target market.

Gloss differential is measured following the procedure given in ISO 19799, which involves comparing the gloss of 40 color patches. For glossy prints, the Nexpress actually shows lower gloss differential than traditional photographic prints. In this respect, the prints are actually more photographic than traditional photographic prints. For matte prints, the Nexpress does have a higher gloss differential than traditional photographic prints, but this difference was acceptable for our market.


Image stability is the final concern. After all, we cannot control how customers will display or use their prints. Prints may not be properly stored in albums or otherwise protected from light and atmospheric pollutants. Instead, prints may be placed on a refrigerator or otherwise displayed. Photos may fade or the colors change. Fortunately, in tests with high-intensity xenon arc light, electrophotographic prints were more stable than traditional silver halide prints, even with new reduced particle size toners designed to improve image quality.

### Image Stability

Sample Description	Hours	Display Lifetime (Years)	Failure
Page Print Glossy	420	34	0.5 Green
Page Print Matte	1200	90	1.5 Yellow
Fuji Silver Halide Gloss	240	19	0.5 various
Fuji Silver Halide Matte	160	13	0.5 red

- Page Prints have greater display lifetime than traditional silver halide photographic prints.
- Colorant stability is lower with the new reduced particle size toners but still meets market needs (160 -> 34-90 years.)
- Prints in albums are not typically exposed to light and environmental gases.

### Market

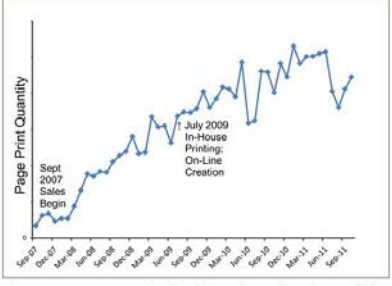


- On July 1, 2009, we replaced traditional photographic prints with a electrophotographic prints from the Kodak Nexpress, as part of bringing printing in-house.
- Features
  - Improved sharpness
  - Improved image stability
  - Better color match to photo books
  - Lower cost

The final judge of product performance is the consumer. On July 1, 2009, we changed the production of Page Prints from traditional photographic printing to electrophotography. We highlighted improved sharpness, improved image stability test, and a better color match.

As this chart of monthly sales illustrates, sales of Page Prints were unaffected by the transition. This data does not mean that all customers agreed with the change. Some customers preferred traditional photographic prints and clearly communicated their preference. However, the majority of our customers continued to purchase Page Prints from Creative Memories and these prints met their expectations for high-quality prints.

### Sales



- Many customer comments (original evaluation did not use customer images.)
- Transition did not affect product sales.

### Sales

- Online Page Print creation was also added July 1, 2009
- Only 2% of orders!
- Creative Memories' customers want custom Page Prints!



On July 1, 2009 we also made online templates available for Page Prints. These proved unnecessary and contribute to only 2% of product sales. The lesson is very clear. Creative Memories customers want custom Page Prints.

Page Prints highlight the importance of the printed image to the future of digital imaging. Sales of Page Prints continue to grow as customers transition to digital scrapbooking. Page Prints have the benefits of traditional prints in that they are easy to handle, share, and preserve. They make it easy to include the stories behind the photo that will be lost if photos remain on hard drives, memory cards and camera phones.

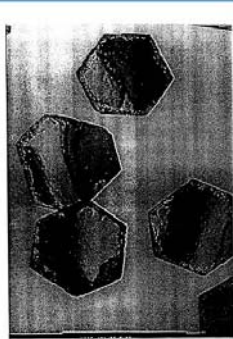
In an interesting twist, recent studies have also highlighted the environmental benefits of printing. After all, once a print is produced, it is permanent and no further effort is required to preserve it. In fact, images that are printed are the ones likely to be preserved for the future.

## Photographic Printing

- Page Prints highlight the importance of the printed image.
  - Sales grow as existing customers transition to and new customers begin digital scrapbooking.
- Added text provides context for Page Prints.
- Consumers prefer prints
  - Tangible, hard copies, easier to look/flip/show.
  - No eye fatigue.
- Prints may, in fact, be more environmentally friendly than on-screen display.
  - Once a print is made, it is permanent and no additional energy is required.

## Conclusions

- Traditional silver halide prints are different from electrophotographic prints, not better or worse.
- For some products the transition time is here.
  - Page Print economics, convenience, quality.
- For other products, the time will come.
  - Creative Memories 4x8 photo cards are silver halide prints



Traditional photographic prints are different from electrophotographic prints. It is not that one technology is necessarily better or worse. Each technology has advantages and disadvantages. For Page Prints the transition time was here. For other products that time will come.